А.И. Матяшевская, Е.В. Тиден

THE POWER OF ALGORITHMS:

part 5

Учебное пособие

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

Саратов

2019

Составители - А.И. Матяшевская, Е.В. Тиден

The power of algorithms: part 5: Учебное пособие по иностранному языку для студентов /Сост. А.И. Матяшевская, Е.В. Тиден. — Саратов, 2019. — 83 с.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Рецензент:

Кандидат философских наук Шилова С.А.

Table of Contents

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

PREFACE

Настоящее учебное пособие включает актуальные тексты (2018-2019гг.) учебно-познавательной тематики для студентов механико-математического факультета (направления 02.03.01 «Математика и компьютерные науки», 01.03.02 «Прикладная математика и информатика», 38.03.05 «Бизнес-информатика»). Целью данного пособия является формирование навыка чтения и перевода научно-популярных текстов, а также развитие устной речи студентов (умение выразигь свою точку зрения, дать оценку обсуждаемой проблеме).

Пособие состоит из 5 разделов, рассматривающих значение информационных технологий в современном мире. Каждый из них содержит аутентичные материалы (источники: *Aeon, Quanta Magazine, Logic Magazine, Wired magazine, The Guardian*) и упражнения к ним.

Раздел “Supplementary reading“ служит материалом для расширения словарного запаса и дальнейшего закрепления навыков работы с текстами по специальности. Пособие может успешно использоваться как для аудиторных занятий, так и для внеаудиторной практики.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

1. Gold among the dross

Exercise I.

Say what Russian words help to guess the meaning of the following words: academic, organization, productivity, contrast, standard, structure, bureaucratic, manipulating, faculty, permanent

Exercise II.

Make sure you know the following words and word combinations.

aspiration, mediocrity, sustaining, daunting, novice, flywheel, to compile, formulaic, substantive, emergent

Gold among the dross

Academic research in the US is unplanned and driven by a lust for glory. The result is the envy of the world

The higher education system is a unique type of organisation with its own way of motivating productivity in its scholarly workforce. It doesn't need to compel professors to produce scholarship because they choose to do it on their own. This is in contrast to the standard structure for motivating employees in bureaucratic organisations, which relies on manipulating two incentives: fear and greed. Fear works by holding the threat of firing over the heads of workers in order to ensure that they stay in line: Do it my way or you're out of here. Greed works by holding the prospect of pay increases and promotions in front of workers in order to encourage them to exhibit the work behaviours that will bring these rewards: Do it my way and you'll get what's yours. Yes, in the United States contingent faculty can be fired at any time, and permanent faculty can be fired at the point of tenure. But, once tenured, there's little other

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

than criminal conduct or gross negligence that can threaten your job. And yes, most colleges do have merit pay systems that reward more productive faculty with higher salaries. But the differences are small – between the standard 3 per cent raise and a 4 per cent merit increase. Even though gaining consistent above-average raises can compound annually into substantial differences over time, the immediate rewards are pretty underwhelming. Deans can ask you to do something, but they really can't make you do it. This situation is the norm for systems of higher education in most liberal democracies around the world.

If the usual extrinsic incentives of fear and greed don't apply to academics, then what does motivate them to be productive scholars? One factor, of course, is that this population is highly self-selected. People don't become professors in order to gain power and money. They enter the role because of a deep passion for a particular field of study. They find that scholarship is a mode of work that is intrinsically satisfying. It's more a vocation than a job. And these elements tend to be pervasive in most of the world's universities. But I want to focus on an additional powerful motivation that drives academics, one that we don't talk about very much. Once launched into an academic career, faculty members find their scholarly efforts spurred on by more than a love of the work. We in academia are motivated by a lust for glory. We want to be recognised for our academic accomplishments by earning our own little pieces of fame. So we work assiduously to accumulate a set of merit badges over the course of our careers, which we then proudly display on our CVs. This situation is particularly pervasive in the US system of higher education, which is organised more by the market than by the state. Market systems

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

are especially prone to the accumulation of distinctions that define your position in the hierarchy. But European and other scholars are also engaged in a race to pick up honours and add lines to their CVs. It's the universal obsession of the scholarly profession. At the very pinnacle of the structure of merit badges is, of course, the Nobel Prize. A nice thought, but what are the odds? Fortunately, other academic honours are a lot more attainable. And attain them we do. This being the case, the academic profession requires a wide array of other forms of recognition that are more easily attainable and that you can accumulate the way you can collect Fabergé eggs. And they're about as useful. Let us count the kinds of merit badges that are within the reach of faculty: publication in high-impact journals; membership on editorial boards of journals; a large number of awards of all kinds – for teaching, advising, public service, professional service, and so on: the possibilities are endless. Each of these honours tells the academic world that you are the member of an exclusive club. Academics are unlike the employees of most organisations in that they fight over symbolic rather than material objects of aspiration, but they are like other workers in that they too are motivated by fear and greed. Instead of competing over power and money, they compete over respect. So far I've been focusing on professors' greedy pursuit of various kinds of honours. But, if anything, fear of dishonour is an even more powerful motive for professorial behaviour. I aspire to gain the esteem of my peers but I'm terrified of earning their scorn. Lurking in the halls of every academic department are a few furtive figures of scholarly disrepute. They're the professors who are no longer publishing in academic journals,

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

who have stopped attending academic conferences, and who teach classes that draw on the literature of yesteryear. Colleagues quietly warn students to avoid these academic ghosts, and administrators try to assign them courses where they will do the least harm. As an academic, I might be eager to pursue tokens of merit, but I am also desperate to avoid being lumped together with the department's walking dead. Better to be an academic mediocrity, publishing occasionally in second-rate journals, than to be your colleagues' archetype of academic failure. The result of all this pursuit of honour and retreat from dishonour is a self-generating machine for scholarly production. No administrator needs to tell us to do it, and no one needs to dangle incentives in front of our noses as motivation. The pressure to publish and demonstrate academic accomplishment comes from within. College faculties become self-sustaining engines of academic production, in which we drive ourselves to demonstrate scholarly achievement without the administration needing to lift a finger or spend a dollar. What could possibly go wrong with such a system?

One problem is that faculty research productivity varies significantly according to what tier of the highly stratified structure of higher education professors find themselves in. Compared with systems of higher education in other countries, the US system is organised into a hierarchy of institutions that are strikingly different from each other. The top tier is occupied by the 115 universities that the Carnegie Classification labels as having the highest research activity, which represents only 2.5 per cent of the 4,700 institutions that grant college degrees. The next tier is doctoral universities with less of a research orientation, which account for 4.7 per cent of institutions. The third is an array of master's level institutions often

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

referred to as comprehensive universities, which account for 16 per cent. The fourth is baccalaureate institutions (liberal arts colleges), which account for 21 per cent. The fifth is two-year colleges, which account for 24 per cent. (The remaining 32 per cent are small specialised institutions that enrol only 5 per cent of all students.) The number of publications by faculty members declines sharply as you move down the tiers of the system. One study shows how this works for professors in economics. The total number of refereed journal articles published per faculty member over the course of a career was 18.4 at research universities; 8.1 at comprehensive universities; 4.9 at liberal arts colleges; and 3.1 at all others. As a result, it seems that the incentive system for spurring faculty research productivity operates primarily at the very top levels of the institutional hierarchy. So why am I making such a big deal about US professors as self-motivated scholars?

The most illuminating way to understand the faculty incentive to publish is to look at the system from the point of view of the newly graduating PhD who is seeking to find a faculty position. These prospective scholars face some daunting mathematics. As we have seen, the 115 high-research universities produce the majority of research doctorates, but 80 per cent of the jobs are at lower-level institutions. The prospect of a dramatic drop in academic status and the possibility of failing to find any academic job do a lot to concentrate the mind of the recent doctoral graduate. Fear of falling compounded by fear of total failure works wonders in motivating novice scholars to become flywheels of productivity. From their experience in grad school, they know that life at

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

the highest level of the system is very good for faculty, but the good times fade fast as you move to lower levels. At every step down the academic ladder, the pay is less, the teaching loads are higher, research support is less, and student skills are lower. In a faculty system where academic status matters more than material benefits, the strongest signal of the status you have as a professor is the institution where you work. And in light of the kind of institution where most new professors find themselves, they start hearing a loud, clear voice saying: 'I deserve better.' So the mandate is clear. As a grad student, you need to write your way to an academic job. And when you get a job at an institution far down the hierarchy, you need to write your way to a better job. You experience a powerful incentive to claw your way back up the academic ladder to an institution as close as possible to the one that recently graduated you. The incentive to publish is baked in from the very beginning. One result of this Darwinian struggle to regain one's rightful place at the top of the hierarchy is that a large number of faculty fall by the wayside without attaining their goal. This can leave a lot of bitter people occupying the middle and lower tiers of the system, and it can saddle students with professors who would really rather be somewhere else. That's a high cost for the process that supports the productivity of scholars at the system's pinnacle. Another potential problem with my argument about the self-generating incentive for professors to publish is that the work produced by scholars is often distinguished more by its quantity rather than its quality. Put another way, a lot of the work that appears in print doesn't seem worth the effort required to read it, much less to produce it. Under these circumstances, the

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

value of the incentive structure seems lacking. Consider some of the ways in which contemporary academic production promotes quantity over quality. One familiar technique is known as ‘salami slicing’. The idea here is simple. Take one study and divide it up into pieces that can each be published separately, so it leads to multiple entries in your CV. The result is an accumulation of trivial bits of a study instead of a solid contribution to the literature. Another approach is to inflate co-authorship. Multiple authors make sense in some ways, large projects often involve a large number of scholars. Fine, as long as everyone in the list made a significant contribution to research. But often co-authorship comes for reasons of power rather than scholarly contribution. It has become normal for anyone who compiled a dataset to demand co-authorship for any papers that draw on the data, even if the data-owner added nothing to the analysis in the paper. Likewise, the principal investigator of a project might insist on being included in the author list for any publications that come from this project. More lines on the CV. Yet another way to increase the number of publications is to increase the number of journals. The members of a particular sub-area of a sub-field set up a journal where members of the club engage in a practice that political scientists call log-rolling. I review your paper and you review mine, so everyone gets published. A lot of journal articles are also written in a highly formulaic fashion, which makes it easy to produce lots of papers without breaking an intellectual sweat. The standard model for this kind of writing is known as IMRaD. It represents the four canonical sections for every paper: introduction (what’s it about and what’s the literature behind it?); methods (how did I do it?);

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

research (what are my findings?); and discussion (what does it mean?). All you have to do as a writer is to write the same paper over and over, introducing bits of new content into the tried and true formula. The result of all this is that the number of scholarly publications is enormous and growing daily. One estimate shows that, since the first science papers were published in the 1600s, the total number of papers in science alone passed the 50 million mark in 2009; 2.5 million new science papers are published each year. How many of them do you think are worth reading? How many make a substantive contribution to the field?

OK, so I agree. A lot of scholarly publications – maybe most such publications – are less than stellar. Does this matter? In one sense, yes. It's sad to see academic scholarship fall into a state where the accumulation of lines on a CV matters more than producing quality work. And think of all the time wasted reviewing papers that should never have been written, and think of how this clutters and trivialises the literature with contributions that don't contribute. But I suggest that the incentive system for faculty publication still provides net benefits for both academy and society. I base this hope on my own analysis of the nature of the US academic system itself. Keep in mind that US higher education is a system without a plan. No one designed it and no one oversees its operation. It's an emergent structure that arose in the 19th century under unique conditions in the US – when the market was strong, the state was weak, and the church was divided. Under these circumstances, colleges emerged as private not-for-profit enterprises that had a state charter but little or no state funding. And, for the most part, they arose for reasons that had less to do with higher

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

learning than with the extrinsic benefits a college could bring. As a result, the system grew from the bottom up. By the time state governments started putting up their own institutions, and the federal government started funding colleges, this market-based system was already firmly in place. Colleges were relatively autonomous enterprises that had found a way to survive without steady support from either church or state. They had to attract and retain students in order to bring in tuition dollars, and they had to make themselves useful both to these students and to elites in the local community, both of whom would then make donations to continue the colleges in operation. This autonomy was an accident, not a plan, but by the 20th century it became a major source of strength. It promoted a system that was adaptive, able to take advantage of possibilities in the environment. The point is this: compared with planned organisational structures, emergent structures are inefficient at producing socially useful results. They're messy by nature, and they pursue their own interests rather than following directions from above according to a plan. But as we have seen with market-based economies compared with state-planned economies, the messy approach can be quite beneficial. The result is a system that is the envy of the world, a world where higher education is normally framed as a pure state function under the direct control of the state education ministry. Professors need to publish in order to win honours for themselves and to avoid dishonour. As a result, they end up publishing a lot of work that is more useful to their own advancement (lines on a CV) than to the larger society. Also, following from the analysis of the first problem I introduced, an additional cost of this system

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

is the large number of faculty who fall by the wayside in the effort to write their way into a better job. The success of the system of scholarly production at the top is based on the failed dreams of most of the participants.But maybe it's worth tolerating a high level of dross in the effort to produce scholarly gold – even if this is at the expense of many of the scholars themselves. At its best, the university is a place that gives maximum freedom for faculty to pursue their interests and passions in the justified hope that they will frequently come up with something interesting and possibly useful, even if this value is not immediately apparent. They're institutions that provide answers to problems that haven't yet developed, storing up both the dross and the gold until such time as we can determine which is which.

Adapted from Aeon

Exercise III.

Fill in the gaps.

1) Life in any ad agency consists of creating messages that _____ consumers to buy.

2) In addition to the large media _____, spectators are filling the courtroom.

3) I am sorry to disapoint you but that is _____ and extreme carelessness.

4) Someone who looks very qualified can turn out to be an _____ performer.

5) He is an _____ A student, terrified of being drafted should he fall behind.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

6) There is pleasure and pain, gain and loss, praise and blame, fame and _____.

7) Thus you _____ clear opposites, obfuscating the reality of the issue.

8) He was popular in his day, but he is now widely seen as an avatar of _____.

9) Respondents categorized themselves as _____, average, advanced, or expert users.

10) They are doing ongoing research to predict, prevent or curtail _____ events.

Exercise IV.

Make up sentences of your own with the following word combinations:

to lump together, to compel, in contrast, to rely on, to stay in line, to tend to be, to focus on, to fight over, to compete over respect, to draw on

Exercise V.

Match the words to the definitions in the column on the right:

greed	last year or the recent past, esp. as nostalgically recalled
contingent	showing great care and perseverance
tenure	(esp. of an unwelcome influence or physical effect) Spreading widely throughout an area or a group of people
merit	the state of being held in low esteem by the public
underwhelming	a high, pointed piece of rock
assiduous	fail to impress or make a positive impact on (someone);

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

	disappoint
pervasive	the conditions under which land or buildings are held or occupied
pinnacle	a gathering of persons representative of some larger group
yesteryear	intense and selfish desire for something, esp. wealth, power, or food
disrepute	the quality of being particularly good or worthy, esp. so as to deserve praise or reward

Exercise VI.

Identify the part of speech the words belong to: academic, system, unique, organization, productivity, workforce, professors, produce, structure, bureaucratic

Exercise VII.

Match the words to make word combinations:

Fabergé	badges
editorial	passion
comprehensive	organisations
gross	workforce
merit	education
deep	university
bureaucratic	eggs

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

unique	negligence
higher	boards
scholarly:	type

Exercise VIII.

Summarize the article “Gold among the dross”.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

2. Virtues of uncertainty

Exercise I.

Say what Russian words help to guess the meaning of the following words: character, standards, methods, moral, system, national, rhetoric, mysterious, class, spectrum.

Exercise II.

Make sure you know the following words and word combinations.

Overtly, covertly, abiding, penetrating, testbed, yoke, painstaking, knack

Virtues of uncertainty. A life of tests is no preparation for the tests of life

Schools are in the business of forming character – so what kind of people will thrive in the 21st century?

Education pretends that the only serious questions it faces are technical ones, such as how are we going to raise standards? Or what are the most appropriate methods for testing students, and when, and how much? But education is essentially a moral enterprise. Whether overtly or covertly, every aspect of a school system is riddled with value judgements about what is worth knowing, and what kinds of young people we are trying to turn out. Words such as ‘standards’ and ‘appropriate’ have only the appearance of neutrality, for we only need ask ‘standards of what?’ or ‘appropriate to what end?’ for their value-laden nature to be hauled to the surface. Only if we assume that standards refer to performance on national tests do the moral questions seem to disappear. Despite occasional bursts of rhetoric about developing that mysterious beast ‘the world class workforce’, the goal of most education ministers turns out to be beating

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

Singapore or Finland in the tables of PISA, the Program for International Student Assessment: in other words, to keep racking up the test scores, without stopping to think what those scores are meant to indicate. Examination results are proxies for our underlying values and intentions, not ends in themselves. Most of what kids learn in school they forget within weeks of having taken the test. As Einstein said, 'Education is what remains after you have forgotten everything you learnt in school.' So what are the valuable residues which we want for all our young people after those 12 long years in school? On this question, there is, from many current governments, a deafening silence or, at best, a feeble voice saying 'a place at your chosen university', as if this were something to which all students should aspire (despite there being places for only just over half of them in the UK).The fact is, education has always been about more than knowledge and test scores. It is also, inevitably, about the formation of character. Schools are cultures that are saturated with values: who to admire; what to respect; what is worth knowing; who has a right to question what; where is the line between imagination and silliness; and so on. To be a school student is to undergo a protracted social apprenticeship. Through the electronic media, children are daily bombarded with conflicting models of what to value and how to live. It is also increasingly obvious that young people (especially in the UK, according to recent reports) are not coping well with this freedom and diversity. Classic symptoms of stress — anxiety, depression, self-doubt — are high across the whole social spectrum. If stress reflects a widening gap between the demands of one's life and the resources one has to cope, many young

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

people are clearly feeling badly under-resourced. As the core function of education is precisely to develop the mental and emotional resources that young people need to cope well with the real demands of their real lives, it is clearly not doing its job. Those resources are psychological as much as they are material or social. This is surely the heart of the question of what schools are for.

In my book What's the Point of School? I had a stab at describing the virtues that make people good at coping with uncertainty and complexity. I think it is important that the virtues of uncertainty are broad enough to take beyond the school gates: that, surely, is the point of learning how to learn. Dealing with the real uncertainties of modern life, and developing one's own passionate interests and avocations, are usually not at all like school. An apprenticeship in passing exams leaves even the most successful with a skill for which there is little call once they have left university. Few job adverts specify that applicants 'must be able to sit still, copy down notes, and regurgitate disembedded chunks of information under pressure.' So what are the learning virtues that I think are most important? There are eight: **1. Curiosity** is the starting point. If you are not interested in things that are difficult or puzzling, you won't engage. Curious people have an abiding sense of inquisitiveness. They wonder how things come to be, how they work, whether they might be otherwise. They live in a wonder-full world, not a world of dead certainties and cut-and-dried rules. They know how to ask good, pertinent, penetrating questions. They have a healthy scepticism about what they are told. **2.** Young people surely need **courage**; not necessarily physical valour but the capacity to be up for a challenge, to be willing to take a risk and see what happens, not always playing it safe

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

and sticking to things they know they can do. Courageous learners have the determination to stick with things that are hard, (although it is also a virtue to know when to quit, not because you are feeling stupid but because it really isn't worth it). They bounce back from frustration; they don't stay floored for long. **3. Exploration** is the active counterpart of curiosity. Inquisitive people enjoy the process of finding things out, of researching (whether it be footballers' lives or particle physics). They like reading, but they also enjoy just looking at things, letting details and patterns emerge. They can let themselves get immersed in a book or a game; absorption in learning is often a pleasure. They can concentrate. They like sifting and evaluating 'evidence', not just reading or surfing the net uncritically, and their exploration usually breeds more questions. Explorers are also good at finding, making or capitalising on resources (tools, sources of information, people) that will support their investigations. **4. Experimentation** is the virtue of the practical inventor, actively trying things out to see if they work. Experimenters don't have to have a foolproof scheme before they try something out; they are at home with trial and error. They spend a good deal of time just playing with materials — paint or computer graphics — to see what they will do, uncovering new 'affordances.' They are happy practising, they enjoy drafting and redrafting, looking at what they've produced — an essay, a melody — and thinking about how they could build on and improve their own products and performances. **5. Imagination** is the virtue of fantasy, of using the inner world as a test-bed for ideas and as a theatre of possibilities. Good imaginers have the virtue of dreaminess: they know

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

when and how to make use of reverie, how to let ideas come to them. They have a mixture of healthy respect and sceptical appraisal toward their own hunches and intuitions. They use mental rehearsal to develop their skills and readiness for tricky situations. They like finding links and making connections inside their own minds. **6.** The creativity of imagination needs to be yoked to the virtue of **discipline**; of being able to think carefully, rigorously and methodically, as well as to take an imaginative leap. Reason isn't the be-all and end-all of learning by any means, but the ability to follow a rigorous train of thought, and to spot the holes in someone else's argument, as well as your own, is invaluable. Disciplined learners can create plans and forms of organisation which support the painstaking 'crafting' of things that usually needs to follow the 'brainwave.' **7.** The virtue of **sociability**, and of judiciously balancing sociability with solitariness, also seems essential. Effective learners know who to talk to, and when to talk (and when to keep silent) about their own learning. And they are good members of groups: they know how to listen, how to take turns, what kinds of contribution are helpful. They have the knack of being able to give their views and hold their own in debate, and at the same time stay open-minded to and respectful of others' views: of giving feedback and suggestions skilfully and receiving them graciously. They are generous in sharing information, ideas and useful ways of thinking and exploring; and they are keen to pick up useful perspectives and strategies from others. **8**. Finally there is the virtue of **mindfulness**, in the sense of being disposed to reflection and contemplation, taking time to mull things over, take stock and consider alternative strategies. Reflective

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

learners can take a step back every so often and question their own priorities and assumptions. Mindfulness means giving yourself the time to go deeper, to see what conclusions you may have leapt to, and let a bigger picture emerge.

No doubt the list can be improved, but as Samuel Beckett said, 'Try again. Fail again. Fail better.' The big question is: how do we put these kinds of virtues in action? What does it take for schools to become systematic incubators of learning virtues, so that their students graduate, whatever their grades, with deep-seated habits of curiosity, courage and the rest? How do we make schools into a kind of 'virtue gym' where students get to practise their mental fitness, not just talk about it? To answer this question, we need first to weed out what doesn't work. First, merely talking about 'character', desirable though that vocabulary is, does not cultivate the sought-after characteristics. Being able to discuss, defend and even agree with the importance of a particular virtue is no guarantee that one will manifest it in practice. Troubled teenagers might be perfectly able to 'tell right from wrong'; they just don't choose the 'right' option in the heat of the moment. Knowledge and belief get trumped by habit and impulse all the time. We are all, as one of my students put it so eloquently, 'knowledgeable about things we are crap at.' The thing is, virtues are not just skills, they are also habits or dispositions. Possessing the virtue of curiosity does not simply mean that you have the ability to ask good questions when someone prompts you. It means having a questioning frame of mind. The goal of character education cannot be merely to train skills. A virtuous school has to be more than a 'training' institution; it has to be an incubator that develops and strengthens the desired qualities of

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

mind through everything it does. So, how do teachers strengthen youngsters' curiosity? Asking what puzzles them is a good start. Greet them on a Monday morning by saying, 'Who found a really good question over the weekend?' Have a 'wonder wall' full of sticky notes that capture the children's questions. Ask your science class to generate new hypotheses, and new questions, based on the experimental results they have just collected. What about courage and determination? Encourage students to think of difficulty as a challenge rather than a threat. Don't let them think that finding something difficult is a sign of stupidity. (Darwin and Einstein were both notoriously slow learners. When faced with something genuinely tricky, slow can be the most intelligent approach!). How do we build the habits and capabilities of the explorer? If we give children more resource-based projects, they have to learn how to do their own research and find their own resources. We can encourage them to question the knowledge claims they meet and gradually build the habit of respectful, intelligent scepticism about what they read on Wikipedia or in the newspaper. Experimentation? Give students the opportunity to think about how to evaluate and improve work for themselves, both individually and collaboratively. Talk to them about the trials, conflicts and uncertainties that lay behind the discoveries of Galileo and Newton, and the hard work and many drafts that ended in the waste-paper basket on the way to the discovery. Science students who are told about these struggles have been shown to remember information better and use it more effectively to solve problems. Imagination too can be taught. Schools have been based on bad psychology, where they have presumed that

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

imagination and visualisation are childish or immature ways of knowing. Students can be given the chance, as one little girl put it to me, ‘to let our brains cool down so they will bubble up with new ideas.’ Naturally we need to help students develop the discipline of being able to plan, think things through carefully, anticipate consequences, and apply the skills of crafting that lead to a satisfying essay, proof or painting. How do we teach sociability? One teacher I know has a class that regularly changes the size and constitution of the groups they are working in because ‘when we are grown up, we will have to get on with all sorts of people, not just our friends, so we want learn how to do that now.’ Finally, how do we teach mindfulness and reflection? Through gentle reminders, a teacher can get her students into the habit of regularly standing back and thinking about what they are doing. Learning to learn, in these classrooms, becomes a kind of underlay to the more explicitly patterned subject-matter. In spite of what the traditionalists think, there isn’t a trade off between content and learning virtues: the two depend on each other. When students are helped to become more confident and articulate about the process of learning itself, they do better, not worse, on the tests. When we articulate the virtues of uncertainty in clear terms, we find we can teach in a way that prepares young people both for a life of tests and the tests of life.

Adapted from Aeon

Exercise III.

Fill in the gaps.

1) Clearly, looking good is important in all jobs, even if it's not _____ stated.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

2) We are each other's best friend, and I believe we can make it for the long _____.

3) That new way of thinking is helping the company_____ some impressive numbers.

4) His materials exude a conceptual _____ taken from an object's original purpose.

5) At 18, he began an _____ as a plumber, and he enjoys blue-collar work.

6) The reason that negotiations in Brussels are currently so _____ is twofold.

7) Users also can _____ their own channel of favorite shows on their Facebook page.

8) Making the switch from paper to digital records is not easy, cheap or _____.

9) Why do we have such ego that we think we are the _____ on this planet.

10) The concept of _____ is one thing, the actual experience of it is another.

Exercise IV.

Make up sentences of your own with the following word combinations:

to rack up, be-all and end-all, to take stock, to haul, to saturate, to regurgitate, to embed, cut-and-dried, subject-matter, to articulate

Exercise V.

Match the words to the definitions in the column on the right:

riddle	a state of being pleasantly lost in one's thoughts; a daydream

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

proxy	cause (someone) to lose the power of hearing permanently or temporarily
residue	prolong
feeble	incapable of going wrong or being misused
apprenticeship	great courage in the face of danger, esp. in battle
protracted	the position of an apprentice
deafening	lacking physical strength, esp. as a result of age or illness
valor	the authority to represent someone else, esp. in voting
foolproof	a question or statement intentionally phrased so as to require ingenuity in ascertaining its answer or meaning, typically presented as a game
reverie	a small amount of something that remains after the main part has gone or been taken or used

Exercise VI.

Identify the part of speech the words belong to. judiciously, solitariness, disposition, virtuous, absorption, graciously, mindfulness, contemplation, eloquently, pertinent

Exercise VII.

Match the words to make word combinations:

classic	university
feeble	results

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

chosen	scores
electronic	symptoms
examination	voice
national	enterprise
school	ministers
test	media
moral	system
education	tests

Exercise VIII.

Summarize the article “Virtues of uncertainty. A life of tests is no preparation for the tests of life”.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

3. Foundations Built for a General Theory of Neural Networks

Exercise I.

Say what Russian words help to guess the meaning of the following words: effectively, diagnose, crime, situation, rocket, guarantee, construct, manner, combine, abstractions.

Exercise II.

Make sure you know the following words and word combinations.

convolutional neural network, recurrent neural network, natural number exponent, to tinker, higher-dimensional

Foundations Built for a General Theory of Neural Networks

Neural networks can be as unpredictable as they are powerful. Now researchers are beginning to reveal how a neural network's form will influence its function.

When we design a skyscraper we expect it will perform to specification: that the tower will support so much weight and be able to withstand an earthquake of a certain strength. But with one of the most important technologies of the modern world, we're effectively building blind. We play with different designs, tinker with different setups, but until we take it out for a test run, we don't really know what it can do or where it will fail. This technology is the neural network, which underpins today's most advanced artificial intelligence systems. Increasingly, neural networks are moving into the core areas of society: They determine what we learn of the world through our social media feeds, they help doctors diagnose illnesses, and they even influence whether a person convicted of

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

a crime will spend time in jail. Yet the best approximation to what we know is that we know almost nothing about how neural networks actually work and what a really insightful theory would be.

Boris Hanin, a scientist at Facebook AI Research, likens the situation to the development of another revolutionary technology: the steam engine. At first, steam engines weren't good for much more than pumping water. Then they powered trains, which is maybe the level of sophistication neural networks have reached. Then scientists and mathematicians developed a theory of thermodynamics, which let them understand exactly what was going on inside engines of any kind. Eventually, that knowledge took us to the moon. "First you had great engineering, and you had some great trains, then you needed some theoretical understanding to go to rocket ships," Hanin said.

Within the sprawling community of neural network development, there is a small group of mathematically minded researchers who are trying to build a theory of neural networks — one that would explain how they work and guarantee that if you construct a neural network in a prescribed manner, it will be able to perform certain tasks. This work is still in its very early stages, but in the last year researchers have produced several papers which elaborate the relationship between form and function in neural networks. The work takes neural networks all the way down to their foundations. It shows that long before you can certify that neural networks can drive cars, you need to prove that they can multiply. Neural networks aim to mimic the human brain — and one way to think about the brain is that it works by accreting smaller abstractions into larger ones. Complexity of thought, in this view, is then measured by the range of

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИНИ Н.Г.ЧЕРНЫШЕВСКОГО

smaller abstractions you can draw on, and the number of times you can combine lower-level abstractions into higher-level abstractions — like the way we learn to distinguish dogs from birds.

"For a human, if you're learning how to recognize a dog you'd learn to recognize four legs, fluffy," said Maithra Raghu, a doctoral student in computer science at Cornell University and a member of Google Brain. "Ideally we'd like our neural networks to do the same kinds of things."Abstraction comes naturally to the human brain. Neural networks have to work for it. As with the brain, neural networks are made of building blocks called "neurons" that are connected in various ways. (The neurons in a neural network are inspired by neurons in the brain but do not imitate them directly.) Each neuron might represent an attribute, or a combination of attributes, that the network considers at each level of abstraction. When joining these neurons together, engineers have many choices to make. They have to decide how many layers of neurons the network should have (or how "deep" it should be). Consider, for example, a neural network with the task of recognizing objects in images. The image enters the system at the first layer. At the next layer, the network might have neurons that simply detect edges in the image. The next layer combines lines to identify curves in the image. Then the next layer combines curves into shapes and textures, and the final layer processes shapes and textures to reach a conclusion about what it's looking at: woolly mammoth! "The idea is that each layer combines several aspects of the previous layer. A circle is curves in many different places, a curve is lines in many different places," said David Rolnick, a mathematician at the University of Pennsylvania. Engineers also have to decide the "width" of

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

each layer, which corresponds to the number of different features the network is considering at each level of abstraction. In the case of image recognition, the width of the layers would be the number of types of lines, curves or shapes it considers at each level. Beyond the depth and width of a network, there are also choices about how to connect neurons within layers and between layers, and how much weight to give each connection.

So if you have a specific task in mind, how do you know which neural network architecture will accomplish it best? There are some broad rules of thumb. For image-related tasks, engineers typically use “convolutional” neural networks, which feature the same pattern of connections between layers repeated over and over. For natural language processing — like speech recognition, or language generation — engineers have found that “recurrent” neural networks seem to work best. In these, neurons can be connected to non-adjacent layers. Beyond those general guidelines, however, engineers largely have to rely on experimental evidence: They run 1,000 different neural networks and simply observe which one gets the job done.“These choices are often made by trial and error in practice,” Hanin said. “That’s sort of a tough way to do it because there are infinitely many choices and one really doesn’t know what’s the best.”A better approach would involve a little less trial and error and a little more upfront understanding of what a given neural network architecture gets you. A few papers published recently have moved the field in that direction.“This work tries to develop, as it were, a cookbook for designing the right neural network. If you know what it is that you want to achieve out of the network, then here is the recipe for that network,” Rolnick said.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

One of the earliest important theoretical guarantees about neural network architecture came three decades ago. In 1989, computer scientists proved that if a neural network has only a single computational layer, but you allow that one layer to have an unlimited number of neurons, with unlimited connections between them, the network will be capable of performing any task you might ask of it. It was a sweeping statement that turned out to be fairly intuitive and not so useful. It's like saying that if you can identify an unlimited number of lines in an image, you can distinguish between all objects using just one layer. That may be true in principle, but good luck implementing it in practice. Researchers today describe such wide, flat networks as "expressive," meaning that they're capable in theory of capturing a richer set of connections between possible inputs (such as an image) and outputs (such as descriptions of the image). Yet these networks are extremely difficult to train, meaning it's almost impossible to teach them how to actually produce those outputs. They're also more computationally intensive than any computer can handle.

More recently, researchers have been trying to understand how far they can push neural networks in the other direction — by making them narrower (with fewer neurons per layer) and deeper (with more layers overall). So maybe you only need to pick out 100 different lines, but with connections for turning those 100 lines into 50 curves, which you can combine into 10 different shapes, which give you all the building blocks you need to recognize most objects. In a paper completed last year, Rolnick and Max Tegmark of the Massachusetts Institute of Technology proved that by increasing depth and decreasing width, you can perform the same functions with exponentially fewer neurons. They showed that if the

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

situation you're modeling has 100 input variables, you can get the same reliability using either 2100 neurons in one layer or just 210 neurons spread over two layers. They found that there is power in taking small pieces and combining them at greater levels of abstraction instead of attempting to capture all levels of abstraction at once. "The notion of depth in a neural network is linked to the idea that you can express something complicated by doing many simple things in sequence," Rolnick said. "It's like an assembly line."

Rolnick and Tegmark proved the utility of depth by asking neural networks to perform a simple task: multiplying polynomial functions. (These are just equations that feature variables raised to natural-number exponents, for example y = x3 + 1.) They trained the networks by showing them examples of equations and their products. Then they asked the networks to compute the products of equations they hadn't seen before. Deeper neural networks learned the task with far fewer neurons than shallower ones. And while multiplication isn't a task that's going to set the world on fire, Rolnick says the paper made an important point: "If a shallow network can't even do multiplication then we shouldn't trust it with anything else."

Other researchers have been probing the minimum amount of width needed. At the end of September, Jesse Johnson, a mathematician at Oklahoma State University, proved that at a certain point, no amount of depth can compensate for a lack of width. To get a sense of his result, imagine sheep in a field, except these are punk-rock sheep: Their wool has been dyed one of several colors. The task for your neural network is to draw a border around all sheep of the same color. In spirit, this task is

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

similar to image classification: The network has a collection of images (which it represents as points in higher-dimensional space), and it needs to group together similar ones. Johnson proved that a neural network will fail at this task when the width of the layers is less than or equal to the number of inputs. So for our sheep, each can be described with two inputs: an x and a ycoordinate to specify its position in the field. The neural network then labels each sheep with a color and draws a border around sheep of the same color. In this case, you will need three or more neurons per layer to solve the problem. More specifically, Johnson showed that if the width-to-variable ratio is off, the neural network won't be able to draw closed loops — the kind of loops the network would need to draw if, say, all the red sheep were clustered together in the middle of the pasture. "If none of the layers are thicker than the number of input dimensions, there are certain shapes the function will never be able to create, no matter how many layers you add," Johnson said.

Papers like Johnson's are beginning to build the rudiments of a theory of neural networks. At the moment, researchers can make only very basic claims about the relationship between architecture and function — and those claims are in small proportion to the number of tasks neural networks are taking on. So while the theory of neural networks isn't going to change the way systems are built anytime soon, the blueprints are being drafted for a new theory of how computers learn — one that's poised to take humanity on a ride with even greater repercussions than a trip to the moon.

Adapted from Quanta Magazine

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Exercise III.

Fill in the gaps.

1) This interface is electrically and physically compatible with MMC _____.

2) Anyone who has visited the _____ park knows that it's a daunting experience.

3) I think people want their politicians to be_____, honest and straightforward.

4) I'd be most interested to see what evidence you have to back up this rather _____.

5) When their gas bill exceeded $1,000 18 months ago, the _____ cut off them off.

6) It requires the use of the _____ and the imaginary number.

7) Shopping is considered an ultimate _____ activity and women the masters of it.

8) _____ knots are n-dimensional spheres in m-dimensional Euclidean space.

9) A late fee isn't the only _____ for a missed credit card payment.

10) To forgive maybe an_____ of God but man was created after the image of God.

Exercise IV.

Make up sentences of your own with the following word combinations:

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

to convict of a crime, to take on, to get a sense of, in spirit, to group together, to fail at, to labels with a color, per layer, to solve the problem, to be off

Exercise V.

Match the words to the definitions in the column on the right:

specification	an echo or reverberation
elaborate	of little depth
to attribute	a large extinct elephant of the Pleistocene epoch, typically hairy with a sloping back and long curved tusks
texture	the state of being useful, profitable, or beneficial
mammoth	bold, honest, and frank
sprawling	the tactile quality of the surface of a work of art
upfront	regard something as being caused by (someone or something)
utility	work out in detail
shallow	an act of describing or identifying something precisely or of stating a precise requirement
repercussion	spread in a rambling or irregular way

Exercise VI.

Identify the part of speech the words belong to. neural, function, proportion, humanity, repercussions, depth, exponents, examples, equations, products.

Exercise VII.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Match the words to make word combinations:

minimum	understanding
small	engine
computational	technology
sweeping	ships
steam	layer
rocket	network
theoretical	number
revolutionary	statement
neural	amount
general	theory

Exercise VIII.

Summarize the article “Foundations Built for a General Theory of Neural Networks”

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

4. Did laughter make the mind?

Exercise I.

Say what Russian words help to guess the meaning of the following words: psychological, despotism, collective, central, anthropologists, interest, paradox, banana, cliché, comic

Exercise II.

Make sure you know the following words and word combinations.
profound, forebear, incremental, upheaval, affluent, trickster, antics, incongruity, foible, to constitute

Did laughter make the mind?

A psychological relief valve and a guard against despotism, laughter is a uniquely human – and collective – activity

The central question that anthropologists ask can be stated simply: 'What does it mean to be human?' In search of answers, we learn from people around the world – from city-dwellers to those who live by hunting and gathering. Something that sets us apart from our ancestors and primate relatives, and should be of special interest to anthropology, is our unique propensity to laugh. Laughter is a paradox. We all know it's good for us; we experience it as one of life's pleasures and a form of emotional release. Yet to be able to laugh, we must somehow cut ourselves off from feelings of love, hate, fear or any other powerful emotion. The fall of a fool slipping on a banana skin is the cliché of comic routines; we laugh at his misfortune because we don't really care. A helpful way to get a handle on laughter is to place it in evolutionary context. Other animals play, and their

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

playful antics can prompt vocal sounds. But human laughter remains unique. For one, it is contagious. When a group of us get the giggles, we soon become unmanageable. The evolutionary psychologist Steven Pinker notes that this might be what allowed laughter to be pressed into the service of humour. In How the Mind Works, he writes: *No government has the might to control an entire population. When scattered titters swell into a chorus of hilarity like a nuclear chain reaction, people are acknowledging that they have all noticed the same infirmity in an exalted target. A lone insulter would have risked the reprisals of the target, but a mob of them, unambiguously in cahoots in recognising the target's foibles, is safe.* Besides contagion, laughter also leaves us peculiarly helpless and vulnerable. We can be doubled up with laughter, or laugh until we weep. Physiologically, it can come close to crying. Nearly every aspect of the body – voice, eyes, skin, heart, breathing, digestion – can be powerfully affected. What we find funny might vary by culture, but people across the world make essentially the same sounds.

When we apply Darwinian theory to laughter, it's tempting to look for a plausible precursor among our ape-like ancestors. The primatologist Jane Goodall, for example, points out that young chimpanzees often engage in tickling games, making huffing and puffing noises all the while. Maybe, then, human laughter is best viewed as an evolutionary extension of certain playful vocalisations already found among apes. The objection to this theory is that ape tickle-play vocalisations don't sound like human laughter at all – they are more like heavy breathing, with inhalations and exhalations equally audible. Another problem is that the apes' sounds are

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

not socially contagious, and don't bond the group together in quite the same way. No chimpanzee will laugh just because others are doing so – each animal must itself be tickled. By contrast, when humans meet up on social occasions, the most frequent sounds you're likely to hear are not grunts and screams but ripples of laughter. Those sounds convey a certain level of relaxed happiness in the company of others. Although monkeys and apes can be friendly, their face-to-face social dynamics are typically competitive and despotic in ways that humans tend to find intolerable. Everyday encounters between nonhuman great apes oscillate between dominance and submission, with facial expressions and instinctive vocalisations to match. There is nothing egalitarian about their encounters. Building on these insights, scores of theorists have attempted to explain why humans evolved to be the species that laughs. One classic idea is the Superiority Theory, according to which the loudest laughs were originally cries of triumph made at the expense of the enemy. Another is the Relief Theory, in which laughter is thought to have evolved long before words or grammar, as an instinctive way of signalling that danger had passed and everyone could relax. Finally, the Ambivalence Theory holds that laughter erupts as a means of escape from contradictory emotions or perceptions. What these ideas have in common is their focus on individual psychology. In each case, the thinking is that tension is released with the sudden realisation that there is nothing to fear. For supporters of the Superiority Theory, the initial threat comes from other people who are suddenly exposed as harmless. The Relief Theory agrees that we laugh upon

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

realising we are safe. The Ambivalence theory also proposes that laughter arises when a mental or physical challenge or paradox suddenly dissolves.

The shared insight can be expressed in a single word: reversal. The evolution of the human smile neatly illustrates the idea. When we smile, we stretch out the corners of our mouth and show our teeth. If other animals were to bare their teeth in this way it would be threatening. In the case of nonhuman primates, baring the teeth can be more ambivalent – as in the chimpanzee 'fear grin', which simultaneously shows resistance and submission to a more dominant animal. Although humans, too, sometimes behave in this way, we can all spot the difference between a nervous grin and a genuinely warm smile. So it seems likely that the happy smile is probably a fear-grin that has adapted to relaxed social conditions, its significance reversed because there is no longer anything to worry about. Against existing theories, however, I view laughter as a more profound social and collective endeavour – though still tied to reversal. Smiling, after all, can easily become laughter, so it's worth exploring whether reversal might explain this behaviour too. When animals collectively mob an enemy, they sometimes bare their teeth and make threatening sounds. Typically, there is something rhythmic, contagious and emotionally bonding about those intimidating screams and cries. Mobbing, then, might be the behavioural precursor to laughter. Taking a step further, it might even help to account for the broader architecture of the human mind. Over evolutionary time, our psychology has been shaped by the demands of face-to-face relationships based on mutual respect; we have adapted to reflect a much more egalitarian socio-political order than anything known among apes. The break is so sharp that there must have been some kind of

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИН. Г. ЧЕРНЫШЕВСКОГО

radical regime-change – a human revolution, as I and some of my colleagues call it – to accomplish the transition from ape-like politics to hunter-gatherer-style egalitarianism. The anthropologist Christopher Boehm has proposed an influential theory about the emergence of human society that he terms Reverse Dominance. According to Boehm, great-ape society is like a pyramid, with one despotic leader – the alpha male – at the apex and the rank-and-file underneath. By contrast, Boehm notes that our hunter-gatherer forebears were profoundly egalitarian. He argues that this was established not simply via incremental change, but in the final stages, through an upheaval so profound that political relationships went into reverse. By this he means that certain rebel coalitions, formed to resist the dominant males, eventually became all-embracing and powerful enough to overthrow the former regime. In its place, a political system was established that still prevails among many hunter-gatherers to this day: Reverse Dominance or community-wide rule from below. What Boehm terms Reverse Dominance is an upturned pyramid, with the rank-and-file dominant over any would-be alpha male. While Boehm himself doesn't mention laughter, it seems likely that such a profound political revolution would trigger a great sense of relief. When the threat posed by the fear-inducing alpha-male was defied, we can imagine the rejoicing and laughter that must have accompanied such a reversal of fortune. For our evolving species, perhaps laughter is a marker of our irrevocable departure from the psychology of apes. From then on, society was decisively egalitarian, with power – now socially accountable – in the hands of the community as a whole. One consequence was that no-one could simply follow their

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

instincts or pursue their own selfish agenda. You needed to take into account what everyone else thought, on pain of being laughed out of town. Collective laughter, then, might have served as a social levelling device helping to keep everyone in line. The outcome was not only a social and political reversal but also a cognitive one: a transition that every child re-enacts as it develops into a self-aware, smiling, laughing, fully human being.As a consequence of the human revolution, whenever we engage with one another informally, we find it natural to put one another at ease, and to establish at least the appearance of equality. This has become so habitual that our instinctive social signals, inherited from our primate ancestors, have been largely repurposed: the tense primate fear-grin has given way to the relaxed human smile, while the angry mobbing cry has transformed into uproarious laughter. The emotional significance of the signal might be reversed, but remnants of its original form and meaning have been preserved.

For most of the time since the emergence of our species some 300,000 years ago, we have been hunter-gatherers. To answer the anthropologist's question about what it means to be human, then, modern hunter-gather societies remain particularly important. Every aspect of our minds and bodies has evolved in response to this long-lasting and immensely stable way of life. It's true that as a species we have evolved to be flexible – but when we find adapting to power inequalities stressful, as many of us do today, it damages both our physical and our mental health. Our need for companionship, for relaxed playfulness, for opportunities to sing and laugh together – all these things have their roots in the hunter-gatherer way of life. It was once imagined that people in these societies

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

must have always struggled to survive, teetering on the edge of starvation, their relentless quest for food leaving them with no time for leisure or play. It's hard to know where this strange idea came from, because it is utterly wrong. The prejudice was refuted by the anthropologist Marshall Sahlins in Stone Age Economics, which describes 'the original affluent society'. Today's hunting and gathering peoples, Sahlins explained, have a far more healthy and varied diet than people who farm or live in cities. Theirs is an economy of abundance, even super-abundance. Hunter-gatherers typically enjoy hours of leisure time for creative activities such as art, dancing and singing. A striking feature of these societies is their profound egalitarianism. As an anthropologist, I can report that in any hunter-gatherer camp, equality is maintained by almost nonstop laughter aimed at anyone who is getting above themselves. Everywhere you look, there is a palpable atmosphere of playfulness and fun. It's no coincidence that the gods of hunter-gatherers are not solemn guardians of morality, but mischievous tricksters whose antics provoke helpless mirth in listener and storyteller alike. Today, it's a settled consensus that Africa is where our species evolved. More than city-dwellers or farmers, these people can inform us about how to use laughter as a way of maintaining egalitarianism. Grandmothers and other senior females demonstrate how, by derisively laughing at those who throw their weight around or put on airs and graces, people can be persuaded to respect egalitarian norms.

Nothing in those psychologically individualistic theories about mocking, or about experiencing relief from fear or tension, implies anything specific about the social conditions required for laughter to flourish. But social anthropologists all agree that, among hunter-gatherers,

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

laughter functions as a levelling device, bringing people down to size. The major figure here is Jerome Lewis at University College London, who has been studying the people in the Republic of Congo for many years. They are sometimes referred to as 'Pygmy people', because of their short stature. Among them, Lewis is able to pin-point exactly how laughter maintains egalitarianism in practice. He explains that it would be risky for a young person to make fun of an older one, no matter how foolish the elder's behaviour. But senior women exercise a special privilege, seeing it as their enjoyable role to bring down anyone who seems to be getting above themselves. By way of example, Lewis relates how a woman who is upset with her husband's behaviour – he might be chasing another woman, or not providing enough to eat – will go to sit with other women in a prominent place. In loud, exaggerated tones, she talks about her problems with her husband, while her listeners enthusiastically take up her gestures as she mimes his actions and expressions. This is a terrible situation for the hapless husband as he hears the women, children and other men laughing boisterously at his expense. A senior woman might start the ball rolling by silently imitating some characteristic mannerism of her target. One or two others immediately grasp whom she means. They begin to laugh and, because laughter is so contagious, soon everyone is laughing. After a while, the only person still not laughing is the man himself. But the laughter goes on until, at last, even he gets the joke. The chorus subsides only as he finally joins in, laughing at his own expense. He now sees the funny side of things, at last viewing himself as others see him. Hunter-gatherer women adopt a collective perspective on badly behaved males,

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

and will do everything possible to bring each culprit back into line. Although it can seem cruel, the truth is that women's laughter is generous and inclusive. Despite its hurtfulness, the target is invited to save face by joining in, thus calming the atmosphere by allowing everyone to laugh and forget their anger.

Looking at laughter from the perspective of an anthropologist, it's possible to claim that all humour is essentially political. Down to the smallest details of our lives, our relationships and encounters involve exercises and exchanges of power. In the face of these dynamics, laughter is an equalising gesture, a restoration of a rightful order in the face of an unjust hierarchy. Similarly, when we find something funny, it's often because of some incongruity between mind and body, the ideal and the real. That division is political to the core. Laughing, then, appears to be intimately tied to our ability to reflect back on ourselves. When we chuckle at our own foibles, we show that we are no longer trapped inside our individual egos, but can see ourselves through one another's eyes. Likewise, when speaking, we separate ourselves from those around us by using words such as 'I' or 'me', drawing attention to ourselves as one person among others, as if from outside. Language would be impossible without the ability to adopt such a reverse-egocentric standpoint. Humans are instinctive egalitarians, who work best with one another when no one has absolute authority, when teasing is good-natured, when there is sufficient affection and trust for shared tasks to constitute their own reward. When moved to laugh by those around us, we reveal ourselves to be truly human.

Adapted from Aeon

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Exercise III.

Fill in the gaps.

1) Friendly Russian tycoons and banks were said to have been _____.

2) This is not because he couldn't communicate better, but because he chose to speak _____.

3) An alternative reading is that Wikileaks is _____ with US intelligence.

4) Researchers can't say for sure why some people tend towards greater _____.

5) Any research which will help improve survival rates will have a _____ effect.

6) His empire was the largest the world has seen, a product of _____ conquest.

7) _____ Russians use cell phones, own laptops, and tool around in foreign cars.

8) Absolutely no _____ at all and he was happy to answer fan questions.

9) Maybe one phone call or meeting is all you need to _____.

10) Enter Siemens AG, the German technology giant with a _____ medical division.

Exercise IV.

Make up sentences of your own with the following word combinations: to be pressed into service, in cahoots, to laugh out of, to throw one's weight

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

around, airs and graces, to bring down to size, to get above yourself, at someone's expense, to start the ball rolling, rank-and-file

Exercise V.

Match the words to the definitions in the column on the right:

valve	(of an animal, esp. a pig) Make a low, short guttural sound
propensity	lightly touch or prod (a person or a part of the body) in a way that causes itching and often laughter
scattered	a person or thing that comes before another of the same kind; a forerunner
exalted	equivocally
reprisal	a device for controlling the passage of fluid through a pipe or duct, esp. an automatic device allowing movement in one direction only
ambiguously	an act of retaliation
precursor	a haphazard distribution in all directions
to tickle	an inclination or natural tendency to behave in a particular way
grunt	exhilarate: fill with sublime emotion

Exercise VI.

Identify the part of speech the words belong to: superiority, ambivalence, accountable, relentless, palpable, mischievous, irrevocable, hapless, boisterously, prominent

Exercise VII.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Match the words to make word combinations:

emotional	sounds
banana	emotion
comic	laughter
socially	routines
vocal	skin
human	uproarious
chain	release
central	interest
powerful	reaction
special	question

Exercise VIII .

Summarize the article “Did laughter make the mind?”

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

SUPPLEMENTARY READING

The Data Is Ours!

Anxiety is a feeling that tends to come in waves—big data anxiety is no different. One minute, you're grateful for the personalized precision of Netflix's recommendations. The next, you're nauseated by the personalized precision of a Facebook ad.

Big data has been around for awhile, but our discomfort with it is relatively recent. We've always had dissenters sounding the alarm about Silicon Valley's surveillance-based business model. It's only since 2016, however, that their message has gone mainstream. The election of Donald Trump punctured many powerful fictions, among them the belief in the beneficence of the tech industry. The media, long captive to the tales that Silicon Valley tells about itself, has turned a sharper eye on tech. Among other things, this has meant greater public awareness of how a handful of large companies use technology to monitor and manipulate us.

This awareness is a wonderful thing. But if we want to harvest the political opportunity it presents, and channel the bad feelings swirling around tech into something more enduring and transformative, we need to radicalize the conversation. The techno-skeptical turn is fragile, incomplete—it needs to be consolidated, intensified. It's good that more people see a problem where they didn't before. The next step is showing them that the problem is much larger than they think.

The problem is not personal. Yes, our private lives are being pillaged on an unprecedented scale. Information as trivial or as intimate as our favorite sandwich or our weirdest fantasy is being hoarded in data centers and strip-mined for profit.

But big data is bigger than that. It is not merely the mechanism whereby Google learns you're pregnant. It is not confined to the cluster of companies that we know, somewhat imprecisely, as the tech industry.

Rather, big data describes a particular way of acquiring and organizing information that is increasingly indispensable to the economy as a whole. When you think about big data, you shouldn't just think about Google and Facebook; you should think about manufacturing and retail and logistics and healthcare. You should think about pretty much everything.

Understanding big data, then, is crucial for understanding what capitalism currently is and what it is becoming—and how we might transform it.

What Makes Data Big?

As long as capitalism has existed, data has helped it grow. The boss watches how workers work, and rearranges them to be more efficient—this is a good example of how surveillance generates information that's used to improve productivity. In the early twentieth century, Frederick Winslow Taylor made systematic surveillance of the productive process a key part of "scientific management," a set of widely influential ideas about how to increase industrial efficiency.

Data is useful for capitalism. That's not new. What's new is the scale and significance of data, thanks to breakthroughs in information technology. Take scale. Digitization makes data infinitely more abundant, because it becomes much easier to

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

create, store, and transmit. You can slap a sensor on almost anything and stream data from it—an assembly line, a gas turbine, a shipping container. Our ability to extract information from the productive process in order to optimize it has reached a level of sophistication far beyond anything Taylor could've ever imagined.

But observing the productive process isn't the only way we create data. More broadly, we create data whenever we do anything that is mediated or monitored by a computer—which, at this point, is almost everything. Information technology has been woven into the entire fabric of the economy. Just because you're not directly using a computer doesn't mean you're not making information for someone somewhere. Your credit score, your healthcare history—simply by virtue of being alive in an advanced capitalist country, you are constantly hemorrhaging data.

No single technology contributes more powerfully to our perpetual data hemorrhage than the internet, of course. The internet both facilitates the flow of data and constantly creates more of it. It goes without saying that everything we do online leaves a trace. And companies are working hard to ensure that we leave more traces, by putting more of our life online.

This is broadly known as the "Internet of Things": by placing connected devices everywhere, businesses hope to make corporate surveillance as deeply embedded in our physical environment as it is in our virtual one. Imagine a brick-and-mortar store that watches you as closely as Facebook, or a car that tracks you as thoroughly as Google. This kind of data capture will only grow in coming years, as the already porous boundary between online and off disappears.

Eating Reality

At one level, then, big data is about literal bigness: the datasets are larger and more diverse because they are drawn from so many different sources. But big data also means that data can be made more meaningful—it can yield valuable lessons about how people or processes behave, and how they're likely to behave in the future. This is true for a few reasons. It's partly because we have more data, partly because we have faster computers, and partly because developments in fields like machine learning have given us better tools for analysis. But the bottom line is that big data is driving the digitization of everything because any scrap of information, when combined with many other scraps and interpreted en masse, may reveal actionable knowledge about the world. It might teach a manufacturer how to make a factory more efficient, or an advertiser what kind of stuff you might buy, or a self-driving car how to drive.

If information can come from anywhere, then it can hold lucrative lessons for any industry. That's why digitization is becoming as important to capitalism as financialization became during and after the 1970s. Digitization, as scholars like Shoshana Zuboff and Nick Srnicek have shown, offers a new engine of capital accumulation. It gives capitalism a new way to grow.

Rosa Luxemburg once observed that capitalism grows by consuming anything that isn't capitalist. It eats the world, to adapt Marc Andreessen's famous phrase. Historically, this has often involved literal imperialism: a developed country uses

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

force against an undeveloped one in order to extract raw materials, exploit cheap labor, and create markets. With digitization, however, capitalism starts to eat reality itself. It becomes an imperialism of everyday life—it begins to consume moments.

Because any moment may be valuable, every moment must be made into data. This is the logical conclusion of our current trajectory: the total enclosure of reality by capital. In the classic science-fiction film The Blob, a meteorite lands in a small town carrying an alien amoeba. The amoeba starts expanding, swallowing up people and structures, threatening to envelop the whole town, until the Air Force swoops in and air-lifts it to the Arctic.

Big data will eventually become so big that it devours everything. One way to respond is to try to kill it—to rip out the Blob and dump it in the Arctic. That seems to be what a certain school of technology critics want. Writers like Franklin Foer denounce digitization as a threat to our essential humanity, while tech industry "refuseniks" warn us about the damaging psychological effects of the technologies they helped create.

This is the path of retreat from the digital, towards the "authentically human"—an idea that's constantly invoked by the new techno-moralists but rarely defined, although it's generally associated with reading more books and having more face-to-face conversations. The other route is to build a better Blob.

Building a Better Blob

Data is the new oil, says everyone. The analogy has become something of a cliche, widely deployed in media coverage of the digital economy.

But there's a reason it keeps coming back. It's a useful comparison—more useful, in fact, than many of the people using it realize. Thinking of data as a resource like oil helps illuminate not only how it functions, but how we might organize it differently.

Big data is extractive. It involves extracting data from various "mines"—Facebook, say, or a connected piece of industrial equipment. This raw material must then be "refined" into potentially valuable knowledge by combining it with other data and analyzing it.

Extractive industries need to be closely regulated because they generate all sorts of externalities—costs that aren't borne by the company, but are instead passed on to society as a whole. There are certain kinds of resources that we shouldn't be extracting at all, because those costs are far too high, like fossil fuels. There are others that we should only be extracting under very specific conditions, with adequate protections for workers, the environment, and the broader public. And democratic participation is crucial: you shouldn't build a mine in a community that doesn't want it.

These principles offer a framework for governing big data. There are certain kinds of data we shouldn't be extracting. There are certain places where we shouldn't build data mines. And the incredibly complex and opaque process whereby raw data is refined into knowledge needs to be cracked wide open, so we can figure out what further rules are required.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

Like any extractive endeavor, big data produces externalities. The extractors reap profits, while the rest of us are left with the personal, social, and environmental consequences. These range from the annihilation of privacy to algorithmic racism to a rapidly warming climate—the world's data centers, for instance, put about as much carbon into the atmosphere as air travel. Society, not industry, should decide how and where resources are extracted and refined. Big data is no different.

Giving People Stuff

Regulating big data is a good start, but it's far from revolutionary. In fact, it's already begun: the General Data Protection Regulation (GDPR) that takes effect in the European Union in 2018 embodies aspects of this approach, imposing new obligations on companies that collect personal data. Congress isn't anywhere close to passing something similar, but it's not impossible to imagine some basic protections around data privacy and algorithmic transparency emerging within the next decade.

More public oversight is welcome, but insufficient. Regulating how data is extracted and refined is necessary. To democratize big data, however, we need to change who benefitsfrom its use.

Under the current model, data is owned largely by big companies and used for profit. Under a more democratic model, what would it look like instead?

Again, the oil metaphor is useful. Developing countries have often embraced "resource nationalism": the idea that a state should control the resources found within its borders, not foreign corporations. A famous example is Mexico: in 1938, President Lázaro Cárdenas nationalized the country's oil reserves and expropriated the equipment of foreign-owned oil companies. "The oil is ours!" Mexicans cheered.

Resource nationalism isn't necessarily democratic. Revenues from nationalized resources can flow to dictators, cronies, and militaries. But they can also fund social welfare initiatives that empower working people to lead freer, more self-directed lives. The left-wing governments of Latin America's "pink tide," for instance, plowed resource revenues into education, healthcare, and a raft of anti-poverty programs.

In a democracy, everyone should have the power to participate in the decisions that affect their lives. But that's impossible if they don't have access to the things they need to survive—and, further, to fulfill their full potential. Human potential is infinite. "You can be anything when you grow up," parents tell their kids, a phrase we've heard so often it's become a cliche—but which, when taken literally, is a genuinely radical thing to say. It's a statement that would've been considered laughable for most of human history, and remains quite obviously untrue for the vast majority of the human race today.

How could we make it true? In part, by giving people stuff. And this stuff can be financed out of the wealth that society holds and creates in common, including the natural wealth that Thomas Paine once called "the common property of the human race."

Nationalize It

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Data isn't natural, but it's no less a form of common property than oil or soil or copper. Resources that come from a planet we all happened to be born onto belong to everyone—they're our "natural inheritance," said Paine. Data is similar. Data is made collectively, and made valuable collectively.

We all make data: as users, workers, consumers, borrowers, drivers. More broadly, we all make the reality that is recorded as data—we supply the something or someone to be recorded. Perhaps most importantly, we all make data meaningful together, because the whole point of big data is that interesting patterns emerge from collecting and analyzing large quantities of information.

This is where the excessive emphasis on personal data is misleading. Personal data represents only one portion of the overall data pool. And even our personal data isn't especially personal to the companies that acquire it: our information may have enormous significance for us, but it's not particularly significant until it's combined with lots of other people's information.

There's a contradiction here, the most fundamental contradiction in capitalism: wealth is made collectively, but owned privately. We make data together, and make it meaningful together, but its value is captured by the companies that own it, and the investors who own those companies. We find ourselves in the position of a colonized country, our resources extracted to fill faraway pockets. Wealth that belongs to the many—wealth that could help feed, educate, house, and heal people—is used to enrich the few.

The solution is to take up the template of resource nationalism, and nationalize our data reserves. This isn't as abstract as it sounds. It would begin with the recognition, enshrined in law, that all of the data extracted within a country is the common property of everyone who lives in that country.

Such a move wouldn't necessarily require seizing the extractive apparatus itself. You don't have to nationalize the data centers to nationalize the data. Companies could continue to extract and refine data—under democratically determined rules—but with the crucial distinction that they are doing so on our behalf, and for our benefit.

In the oil industry, companies often sign "production sharing agreements" (PSAs) with governments. The government hires the company as a contractor to explore, develop, and produce the oil, but retains ownership of the oil itself. The company bears the cost and risk of the venture, and in exchange receives a portion of the revenue. The rest goes to the government.

Production sharing agreements are particularly useful for governments that don't have the machinery or expertise to exploit a resource themselves. This is certainly true in the case of big data: there is no government in the world that can match the capacity of the private sector. But governments have something the private sector doesn't: the power to make and enforce laws. And they can use that power to ensure that data extractors pay for the privilege of making a profit from common property.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Bringing data revenues into public coffers is only the first step. To avoid the bad forms of resource nationalism, we would also need to distribute those revenues as widely as possible.

In 1976, Alaska established a sovereign wealth fund with a share of the rents and royalties collected from oil companies drilling on state lands. Since 1982, the fund has paid out an annual dividend to every Alaskan citizen. The exact amount fluctuates with the fund's performance, but in the last few years, it's generally ranged from $1000 to $2000.

We could do the same with data. In exchange for permission to extract and refine our data, companies would be required to pay a certain percentage of their data revenue into a sovereign wealth fund, either in cash or stock. The fund could use that capital to acquire other income-producing assets, as the Alaskan fund has, and pay out an annual dividend to all citizens. If it were generous enough, this dividend could even function as a universal basic income, along the lines of what Matt Bruenig has proposed.

A data fund that distributes a data dividend would help democratize big data. It would enable us to collectively benefit from a resource we collectively create. It would transform data from a private asset stockpiled by corporations to make a small number of people rich into a form of social property held in common by everyone who helps create it.

If we're going to require companies to pay a chunk of their data revenue into a fund, however, we first have to measure that revenue. This isn't always easy. A company like Facebook, by virtue of its business model, is wholly dependent on data extraction—all its revenue is data revenue. But most companies don't fall into that category.

Boeing, for instance, uses big data to help manufacture and maintain its planes. A 787 can produce more than half a terabyte of data per flight, thanks to sensors attached to various components like the engines and the landing gear. This information is then analyzed for insights into how to better preserve existing planes and build new ones. So, how much of Boeing's total revenue is derived from data?

Further, how much of a company's data revenue can be attributed to one country? Big data is global, after all. If an interaction between an American and a Brazilian generates data for Facebook, where was that data extracted? And if Facebook then refines that data by combining it with information sourced from dozens of other countries, how much of the value that's subsequently created should be considered taxable for our data fund?

Measuring data's value can be tricky. Fortunately, scholars are developing tools for it. And politics can help: in the past, political necessity has motivated the creation of new economic measurements. In the 1930s, the economist Simon Kuznets laid the basis for modern GDP because FDR needed to measure how badly the Great Depression had hurt the economy in order to justify the New Deal.

Economic measurement doesn't happen in a vacuum. Political power helps determine which parts of the economy are worth measuring, and how those

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

measurements are understood. If we can build enough power to make our data ours, we can build enough power to measure what it's worth.

Every analogy breaks down eventually. Thinking about data as the new oil takes us a fair distance towards understanding how it works, how to regulate it, and how to socialize it.

But data is also very different than oil, or any other resource. That's because it has genuinely radical potential. It's not just a source of profit—it's also, possibly, a mechanism for moving beyond profit as the organizing principle of our economic life.

Maybe the most intriguing idea from the Marxist tradition is that capitalism creates the conditions for its overcoming—that the building blocks for making a better world are already present in our own. Information technology is almost certainly one of those building blocks. Data gives capitalism a new way to grow, yes, but it also might give us a way to turn capitalism into something else.

One of capitalism's sustaining myths is that it's unplanned. Markets impartially, impersonally allocate wealth; Detroit goes bankrupt, Jeff Bezos makes another billion dollars, all because of something called the market. In truth, however, capitalism is planned. The planners are banks and other large financial institutions, as the economist J.W. Mason has pointed out—they make the decisions about how to allocate wealth, and their decisions are anything but impartial or impersonal.

What if those decisions were democratic? What if everyone had the power to help make them? Such an economy would still be planned, of course. But planning would have to become more explicit and more participatory. This would also presumably change what an economy is for: if everyone had a say over how society organizes its wealth, the economy would no longer be run solely for the purpose of profit-making. It would become a machine for fulfilling human needs.

Fulfilling human needs is a daunting task. After all, people's needs vary. We all share some big ones, like the need for food, shelter, healthcare, and a habitable planet. But beyond the basics, needs can get pretty varied.

For that reason, democratic planning is likely to be more complex than the capitalist variety. Drug addicts often talk about the clarity of addiction, how it simplifies one's life by structuring it around a single goal: scoring the next dose. The clarity of capitalism is similar: it structures the economy around profit-making. In a society without this compulsion, the economy becomes less simple. Planning no longer serves a single goal, but many.

This is where data comes in. Information technology has the potential to be planning's killer app. It offers tools for meeting the complexity of the task, by enlarging our capacities for economic coordination.

The idea of using computers to plan an economy isn't new. The Soviets briefly experimented with it in the 1960s, Salvador Allende's Chile explored it in the 1970s, and Western leftists have been particularly interested in it since the 1990s. In 1993, W. Paul Cockshott and Allin Cottrell published Towards a New Socialism, which proposed that advances in computing made a more efficient, flexible, and liberating

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

form of planning possible—a theme picked up by more recent "accelerationist" works like Inventing the Future by Nick Srnicek and Alex Williams.

The dream of a digitally run economy is an old one, then. But it's rapidly becoming more workable, as vast new quantities of information become available.

The problem of planning is primarily a problem of information. Friedrich Hayek famously said that planning couldn't work because markets have more information than the planners. Markets give us prices, and prices determine what to produce, how to allocate assets, and so on. Without markets, you don't have the price mechanism, and thus you lose a critical source of information. In Hayek's view, this explained the inefficiencies of Soviet-style command economies, and their failure to meet people's material demands.

As more of our economy is encoded as data, however, Hayek's critique no longer holds. The Soviet planner couldn't possibly see the entire economy. But the planner of the near future might. Data is like the dye that doctors inject into a patient's veins for an MRI—it illuminates the entire organism. The information delivered by prices looks crude by comparison. Who needs prices when you know everything?

Greater transparency enables greater coordination. Imagine a continuous stream of data that describes all economic activity in granular detail. This data could be analyzed to obtain a clearer picture of people's needs, and to figure out how to fulfill those needs in the most efficient and sustainable way.

Even better, much of this process could be automated. Economic democracy has the potential to be terribly time-consuming. Everyone should have the opportunity to participate in the decisions that most affect them, but nobody wants to make everydecision. Nick Srnicek and Alex Williams offer one possible solution: rather than subject every last detail of the economy to democratic deliberation, we could come up with our preferred outcomes—"energy input, carbon output, level of inequality, level of research investment and so on"—and let the algorithms worry about how to get there.

This is an excellent future, and an entirely feasible one. But it's far from guaranteed. Transparency, coordination, automation—if these have democratic possibilities, they have authoritarian ones as well.

China is likely to be the innovator in this respect. The government is developing a "Social Credit System" that uses big data to rate citizens' "trustworthiness." China also happens to be investing heavily in big data and artificial intelligence, which suggests that more sophisticated forms of surveillance and control will soon emerge.

Technology helps set the parameters of possibility. It frames our range of potential futures, but it doesn't select one for us. The potential futures framed by big data have a particularly wide range: they run from the somewhat annoying to the very miserable, from the reasonably humane to the delightfully utopian. Where we land in this grid will come down to who owns the machines, and how they're used—a matter for power, and politics, to decide.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Adapted from Logic Magazine

The Untold Story of NotPetya, the Most Devastating Cyberattack in History

Crippled ports. Paralyzed corporations. Frozen government agencies. How a single piece of code crashed the world.

It was a perfect sunny summer afternoon in Copenhagen when the world's largest shipping conglomerate began to lose its mind. The headquarters of A.P. Møller-Maersk sits beside the breezy, cobblestoned esplanade of Copenhagen's harbor. A ship's mast carrying the Danish flag is planted by the building's northeastern corner, and six stories of blue-tinted windows look out over the water, facing a dock where the Danish royal family parks its yacht. In the building's basement, employees can browse a corporate gift shop, stocked with Maersk-branded bags and ties, and even a rare Lego model of the company's gargantuan Triple-E container ship, a vessel roughly as large as the Empire State Building laid on its side, capable of carrying another Empire State Building–sized load of cargo stacked on top of it.

That gift shop also houses a technology help center, a single desk manned by IT troubleshooters next to the shop's cashier. And on the afternoon of June 27, 2017, confused Maersk staffers began to gather at that help desk in twos and threes, almost all of them carrying laptops. On the machines' screens were messages in red and black lettering. Some read "repairing file system on C:" with a stark warning not to turn off the computer. Others, more surreally, read "oops, your important files are encrypted" and demanded a payment of $300 worth of bitcoin to decrypt them.

It was a perfect sunny summer afternoon in Copenhagen when the world's largest shipping conglomerate began to lose its mind.

The headquarters of A.P. Møller-Maersk sits beside the breezy, cobblestoned esplanade of Copenhagen's harbor. A ship's mast carrying the Danish flag is planted by the building's northeastern corner, and six stories of blue-tinted windows look out over the water, facing a dock where the Danish royal family parks its yacht. In the building's basement, employees can browse a corporate gift shop, stocked with Maersk-branded bags and ties, and even a rare Lego model of the company's gargantuan Triple-E container ship, a vessel roughly as large as the Empire State Building laid on its side, capable of carrying another Empire State Building–sized load of cargo stacked on top of it.

That gift shop also houses a technology help center, a single desk manned by IT troubleshooters next to the shop's cashier. And on the afternoon of June 27, 2017, confused Maersk staffers began to gather at that help desk in twos and threes, almost all of them carrying laptops. On the machines' screens were messages in red and black lettering. Some read "repairing file system on C:" with a stark warning not to turn off the computer. Others, more surreally, read "oops, your important files are encrypted" and demanded a payment of $300 worth of bitcoin to decrypt them.

All across Maersk headquarters, the full scale of the crisis was starting to become clear. Within half an hour, Maersk employees were running down hallways,

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

yelling to their colleagues to turn off computers or disconnect them from Maersk's network before the malicious software could infect them, as it dawned on them that every minute could mean dozens or hundreds more corrupted PCs. Tech workers ran into conference rooms and unplugged machines in the middle of meetings. Soon staffers were hurdling over locked key-card gates, which had been paralyzed by the still-mysterious malware, to spread the warning to other sections of the building.

Disconnecting Maersk's entire global network took the company's IT staff more than two panicky hours. By the end of that process, every employee had been ordered to turn off their computer and leave it at their desk. The digital phones at every cubicle, too, had been rendered useless in the emergency network shutdown.

Around 3 pm, a Maersk executive walked into the room where Jensen and a dozen or so of his colleagues were anxiously awaiting news and told them to go home. Maersk's network was so deeply corrupted that even IT staffers were helpless. A few of the company's more old-school managers told their teams to remain at the office. But many employees—rendered entirely idle without computers, servers, routers, or desk phones—simply left.

Jensen walked out of the building and into the warm air of a late June afternoon. Like the vast majority of Maersk staffers, he had no idea when he might return to work. The maritime giant that employed him, responsible for 76 ports on all sides of the earth and nearly 800 seafaring vessels, including container ships carrying tens of millions of tons of cargo, representing close to a fifth of the entire world's shipping capacity, was dead in the water. On the edge of the trendy Podil neighborhood in the Ukrainian capital of Kiev, coffee shops and parks abruptly evaporate, replaced by a grim industrial landscape. Under a highway overpass, across some trash-strewn railroad tracks, and through a concrete gate stands the four-story headquarters of Linkos Group, a small, family-run Ukrainian software business.

Up three flights of stairs in that building is a server room, where a rack of-pizza-box-sized computers is connected by a tangle of wires and marked with handwritten, numbered labels. On a normal day, these servers push out routine updates—bug fixes, security patches, new features—to a piece of accounting software called M.E.Doc, which is more or less Ukraine's equivalent of TurboTax or Quicken. It's used by nearly anyone who files taxes or does business in the country. But for a moment in 2017, those machines served as ground zero for the most devastating cyberattack since the invention of the internet—an attack that began, at least, as an assault on one nation by another.

For the past four and a half years, Ukraine has been locked in a grinding, undeclared war with Russia that has killed more than 10,000 Ukrainians and displaced millions more. The conflict has also seen Ukraine become a scorched-earth testing ground for Russian cyberwar tactics. In 2015 and 2016, while the Kremlin-linked hackers known as Fancy Bear were busy breaking into the US Democratic National Committee's servers, another group of agents known as Sandworm was hacking into dozens of Ukrainian governmental organizations and companies. They penetrated the networks of victims ranging from media outlets to railway firms,

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

detonating logic bombs that destroyed terabytes of data. The attacks followed a sadistic seasonal cadence. In the winters of both years, the saboteurs capped off their destructive sprees by causing widespread power outages—the first confirmed blackouts induced by hackers.

But those attacks still weren't Sandworm's grand finale. In the spring of 2017, unbeknownst to anyone at Linkos Group, Russian military hackers hijacked the company's update servers to allow them a hidden back door into the thousands of PCs around the country and the world that have M.E.Doc installed. Then, in June 2017, the saboteurs used that back door to release a piece of malware called NotPetya, their most vicious cyberweapon yet.

The code that the hackers pushed out was honed to spread automatically, rapidly, and indiscriminately. "To date, it was simply the fastest-propagating piece of malware we've ever seen," says Craig Williams, director of outreach at Cisco's Talos division, one of the first security companies to reverse engineer and analyze Not-Petya. "By the second you saw it, your data center was already gone." NotPetya was propelled by two powerful hacker exploits working in tandem: One was a penetration tool known as EternalBlue, created by the US National Security Agency but leaked in a disastrous breach of the agency's ultrasecret files earlier in 2017. EternalBlue takes advantage of a vulnerability in a particular Windows protocol, allowing hackers free rein to remotely run their own code on any unpatched machine.

NotPetya's architects combined that digital skeleton key with an older invention known as Mimikatz, created as a proof of concept by French security researcher Benjamin Delpy in 2011. Delpy had originally released Mimikatz to demonstrate that Windows left users' passwords lingering in computers' memory. Once hackers gained initial access to a computer, Mimikatz could pull those passwords out of RAM and use them to hack into other machines accessible with the same credentials. On networks with multiuser computers, it could even allow an automated attack to hopscotch from one machine to the next.

Before NotPetya's launch, Microsoft had released a patch for its EternalBlue vulnerability. But EternalBlue and Mimikatz together nonetheless made a virulent combination. "You can infect computers that aren't patched, and then you can grab the passwords from those computers to infect other computers that are patched," Delpy says.

NotPetya took its name from its resemblance to the ransomware Petya, a piece of criminal code that surfaced in early 2016 and extorted victims to pay for a key to unlock their files. But NotPetya's ransom messages were only a ruse: The malware's goal was purely destructive. It irreversibly encrypted computers' master boot records, the deep-seated part of a machine that tells it where to find its own operating system. Any ransom payment that victims tried to make was futile. No key even existed to reorder the scrambled noise of their computer's contents.

The release of NotPetya was an act of cyberwar by almost any definition—one that was likely more explosive than even its creators intended. Within hours of its first appearance, the worm raced beyond Ukraine and out to countless machines

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

around the world, from hospitals in Pennsylvania to a chocolate factory in Tasmania. It crippled multinational companies including Maersk, pharmaceutical giant Merck, FedEx's European subsidiary TNT Express, French construction company Saint-Gobain, food producer Mondelēz, and manufacturer Reckitt Benckiser. In each case, it inflicted nine-figure costs. It even spread back to Russia, striking the state oil company Rosneft.

The result was more than $10 billion in total damages, according to a White House assessment confirmed to WIRED by former Homeland Security adviser Tom Bossert, who at the time of the attack was President Trump's most senior cybersecurity-focused official. Bossert and US intelligence agencies also confirmed in February that Russia's military—the prime suspect in any cyberwar attack targeting Ukraine—was responsible for launching the malicious code. (The Russian foreign ministry declined to answer repeated requests for comment.)

To get a sense of the scale of NotPetya's damage, consider the nightmarish but more typical ransomware attack that paralyzed the city government of Atlanta this past March: It cost up to $10 million, a tenth of a percent of NotPetya's price. Even WannaCry, the more notorious worm that spread a month before NotPetya in May 2017, is estimated to have cost between $4 billion and $8 billion. Nothing since has come close. "While there was no loss of life, it was the equivalent of using a nuclear bomb to achieve a small tactical victory," Bossert says. "That's a degree of recklessness we can't tolerate on the world stage."

In the year since NotPetya shook the world, WIRED has delved into the experience of one corporate goliath brought to its knees by Russia's worm: Maersk, whose malware fiasco uniquely demonstrates the danger that cyberwar now poses to the infrastructure of the modern world. The executives of the shipping behemoth, like every other non-Ukrainian victim WIRED approached to speak about NotPetya, declined to comment in any official capacity for this story. WIRED's account is instead assembled from current and former Maersk sources, many of whom chose to remain anonymous.

But the story of NotPetya isn't truly about Maersk, or even about Ukraine. It's the story of a nation-state's weapon of war released in a medium where national borders have no meaning, and where collateral damage travels via a cruel and unexpected logic: Where an attack aimed at Ukraine strikes Maersk, and an attack on Maersk strikes everywhere at once.

Oleksii Yasinsky expected a calm Tuesday at the office. It was the day before Ukraine's Constitution Day, a national holiday, and most of his coworkers were either planning their vacations or already taking them. But not Yasinsky. For the past year he'd been the head of the cyber lab at Information Systems Security Partners, a company that was quickly becoming the go-to firm for victims of Ukraine's cyberwar. That job description didn't lend itself to downtime. Since the first blows of Russia's cyberattacks hit in late 2015, in fact, he'd allowed himself a grand total of one week off.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

So Yasinsky was unperturbed when he received a call that morning from ISSP's director telling him that Oschadbank, the second-largest bank in Ukraine, was under attack. The bank had told ISSP that it was facing a ransomware infection, an increasingly common crisis for companies around the world targeted by profit-focused cybercriminals. But when Yasinsky walked into Oschadbank's IT department at its central Kiev office half an hour later, he could tell this was something new. "The staff were lost, confused, in a state of shock," Yasinsky says. Around 90 percent of the bank's thousands of computers were locked, showing NotPetya's "repairing disk" messages and ransom screens.

After a quick examination of the bank's surviving logs, Yasinsky could see that the attack was an automated worm that had somehow obtained an administrator's credentials. That had allowed it to rampage through the bank's network like a prison inmate who has stolen the warden's keys.

As he analyzed the bank's breach back in ISSP's office, Yasinsky started receiving calls and messages from people around Ukraine, telling him of similar instances in other companies and government agencies. One told him that another victim had attempted to pay the ransom. As Yasinsky suspected, the payment had no effect. This was no ordinary ransomware. "There was no silver bullet for this, no antidote," he says.

A thousand miles to the south, ISSP CEO Roman Sologub was attempting to take a Constitution Day vacation on the southern coast of Turkey, preparing to head to the beach with his family. His phone, too, began to explode with calls from ISSP clients who were either watching NotPetya tear across their networks or reading news of the attack and frantically seeking advice.

Sologub retreated to his hotel, where he'd spend the rest of the day fielding more than 50 calls from customers reporting, one after another after another, that their networks had been infected. ISSP's security operations center, which monitored the networks of clients in real time, warned Sologub that NotPetya was saturating victims' systems with terrifying speed: It took 45 seconds to bring down the network of a large Ukrainian bank. A portion of one major Ukrainian transit hub, where ISSP had installed its equipment as a demonstration, was fully infected in 16 seconds. Ukrenergo, the energy company whose network ISSP had been helping to rebuild after the 2016 blackout cyberattack, had also been struck yet again. "Do you remember we were about to implement new security controls?" Sologub recalls a frustrated Ukrenergo IT director asking him on the phone. "Well, too late."

By noon, ISSP's founder, a serial entrepreneur named Oleh Derevianko, had sidelined his vacation too. Derevianko was driving north to meet his family at his village house for the holiday when the NotPetya calls began. Soon he had pulled off the highway and was working from a roadside restaurant. By the early afternoon, he was warning every executive who called to unplug their networks without hesitation, even if it meant shutting down their entire company. In many cases, they'd already waited too long. "By the time you reached them, the infrastructure was already lost," Derevianko says.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

On a national scale, NotPetya was eating Ukraine's computers alive. It would hit at least four hospitals in Kiev alone, six power companies, two airports, more than 22 Ukrainian banks, ATMs and card payment systems in retailers and transport, and practically every federal agency. "The government was dead," summarizes Ukrainian minister of infrastructure Volodymyr Omelyan. According to ISSP, at least 300 companies were hit, and one senior Ukrainian government official estimated that 10 percent of all computers in the country were wiped. The attack even shut down the computers used by scientists at the Chernobyl cleanup site, 60 miles north of Kiev. "It was a massive bombing of all our systems," Omelyan says.

When Derevianko emerged from the restaurant in the early evening, he stopped to refuel his car and found that the gas station's credit card payment system had been taken out by NotPetya too. With no cash in his pockets, he eyed his gas gauge, wondering if he had enough fuel to reach his village. Across the country, Ukrainians were asking themselves similar questions: whether they had enough money for groceries and gas to last through the blitz, whether they would receive their paychecks and pensions, whether their prescriptions would be filled. By that night, as the outside world was still debating whether NotPetya was criminal ransomware or a weapon of state-sponsored cyberwar, ISSP's staff had already started referring to it as a new kind of phenomenon: a "massive, coordinated cyber invasion."

Amid that epidemic, one single infection would become particularly fateful for Maersk: In an office in Odessa, a port city on Ukraine's Black Sea coast, a finance executive for Maersk's Ukraine operation had asked IT administrators to install the accounting software M.E.Doc on a single computer. That gave NotPetya the only foothold it needed.

The shipping terminal in Elizabeth, New Jersey—one of the 76 that make up the port-operations division of Maersk known as APM Terminals—sprawls out into Newark Bay on a man-made peninsula covering a full square mile. Tens of thousands of stacked, perfectly modular shipping containers cover its vast asphalt landscape, and 200-foot-high blue cranes loom over the bay. From the top floors of lower Manhattan's skyscrapers, five miles away, they look like brachiosaurs gathered at a Jurassic-era watering hole.

On a good day, about 3,000 trucks arrive at the terminal, each assigned to pick up or drop off tens of thousands of pounds of everything from diapers to avocados to tractor parts. They start that process, much like airline passengers, by checking in at the terminal's gate, where scanners automatically read their container's barcodes and a Maersk gate clerk talks to the truck driver via a speaker system. The driver receives a printed pass that tells them where to park so that a massive yard crane can haul their container from the truck's chassis to a stack in the cargo yard, where it's loaded onto a container ship and floated across an ocean—or that entire process in reverse order.

On the morning of June 27, Pablo Fernández was expecting dozens of trucks' worth of cargo to be shipped out from Elizabeth to a port in the Middle East. Fernández is a so-called freight forwarder—a middleman whom cargo owners pay to make sure their

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

property arrives safely at a destination halfway around the world. (Fernández is not his real name.)

At around 9 am New Jersey time, Fernández's phone started buzzing with a succession of screaming calls from angry cargo owners. All of them had just heard from truck drivers that their vehicles were stuck outside Maersk's Elizabeth terminal. "People were jumping up and down," Fernández says. "They couldn't get their containers in and out of the gate."

That gate, a choke point to Maersk's entire New Jersey terminal operation, was dead. The gate clerks had gone silent. Soon, hundreds of 18-wheelers were backed up in a line that stretched for miles outside the terminal. One employee at another company's nearby terminal at the same New Jersey port watched the trucks collect, bumper to bumper, farther than he could see. He'd seen gate systems go down for stretches of 15 minutes or half an hour before. But after a few hours, still with no word from Maersk, the Port Authority put out an alert that the company's Elizabeth terminal would be closed for the rest of the day. "That's when we started to realize," the nearby terminal's staffer remembers, "this was an attack." Police began to approach drivers in their cabs, telling them to turn their massive loads around and clear out.

Fernández and countless other frantic Maersk customers faced a set of bleak options: They could try to get their precious cargo onto other ships at premium, last-minute rates, often traveling the equivalent of standby. Or, if their cargo was part of a tight supply chain, like components for a factory, Maersk's outage could mean shelling out for exorbitant air freight delivery or risk stalling manufacturing processes, where a single day of downtime costs hundreds of thousands of dollars. Many of the containers, known as reefers, were electrified and full of perishable goods that required refrigeration. They'd have to be plugged in somewhere or their contents would rot.

Fernández had to scramble to find a New Jersey warehouse where he could stash his customers' cargo while he waited for word from Maersk. During the entire first day, he says, he received only one official email, which read like "gibberish," from a frazzled Maersk staffer's Gmail account, offering no real explanation of the mounting crisis. The company's central booking website, Maerskline.com, was down, and no one at the company was picking up their phones. Some of the containers he'd sent on Maersk's ships that day would remain lost in cargo yards and ports around the world for the next three months. "Maersk was like a black hole," Fernández remembers with a sigh. "It was just a clusterfuck."

In fact, it was a clusterfuck of clusterfucks. The same scene was playing out at 17 of Maersk's 76 terminals, from Los Angeles to Algeciras, Spain, to Rotterdam in the Netherlands, to Mumbai. Gates were down. Cranes were frozen. Tens of thousands of trucks would be turned away from comatose terminals across the globe. No new bookings could be made, essentially cutting off Maersk's core source of shipping revenue. The computers on Maersk's ships weren't infected. But the terminals' software, designed to receive the Electronic Data Interchange files from

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

those ships, which tell terminal operators the exact contents of their massive cargo holds, had been entirely wiped away. That left Maersk's ports with no guide to perform the colossal Jenga game of loading and unloading their towering piles of containers.

For days to come, one of the world's most complex and interconnected distributed machines, underpinning the circulatory system of the global economy itself, would remain broken. "It was clear this problem was of a magnitude never seen before in global transport," one Maersk customer remembers. "In the history of shipping IT, no one has ever gone through such a monumental crisis."

Several days after his screen had gone dark in a corner of Maersk's office, Henrik Jensen was at home in his Copenhagen apartment, enjoying a brunch of poached eggs, toast, and marmalade. Since he'd walked out of the office the Tuesday before, he hadn't heard a word from any of his superiors. Then his phone rang.

When he answered, he found himself on a conference call with three Maersk staffers. He was needed, they said, at Maersk's office in Maidenhead, England, a town west of London where the conglomerate's IT overlords, Maersk Group Infrastructure Services, were based. They told him to drop everything and go there. Immediately.

Two hours later, Jensen was on a plane to London, then in a car to an eight-story glass-and-brick building in central Maidenhead. When he arrived, he found that the fourth and fifth floors of the building had been converted into a 24/7 emergency operations center. Its singular purpose: to rebuild Maersk's global network in the wake of its NotPetya meltdown.

Some Maersk staffers, Jensen learned, had been in the recovery center since Tuesday, when NotPetya first struck. Some had been sleeping in the office, under their desks or in corners of conference rooms. Others seemed to be arriving every minute from other parts of the world, luggage in hand. Maersk had booked practically every hotel room within tens of miles, every bed-and-breakfast, every spare room above a pub. Staffers were subsisting on snacks that someone had piled up in the office kitchen after a trip to a nearby Sainsbury's grocery store.

The Maidenhead recovery center was being managed by the consultancy Deloitte. Maersk had essentially given the UK firm a blank check to make its NotPetya problem go away, and at any given time as many as 200 Deloitte staffers were stationed in the Maidenhead office, alongside up to 400 Maersk personnel. All computer equipment used by Maersk from before NotPetya's outbreak had been confiscated, for fear that it might infect new systems, and signs were posted threatening disciplinary action against anyone who used it. Instead, staffers had gone into every available electronics store in Maidenhead and bought up piles of new laptops and prepaid Wi-Fi hot spots. Jensen, like hundreds of other Maersk IT staffers, was given one of those fresh laptops and told to do his job. "It was very much just 'Find your corner, get to work, do whatever needs to be done,' " he says.

Early in the operation, the IT staffers rebuilding Maersk's network came to a sickening realization. They had located backups of almost all of Maersk's individual

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

servers, dating from between three and seven days prior to NotPetya's onset. But no one could find a backup for one crucial layer of the company's network: its domain controllers, the servers that function as a detailed map of Maersk's network and set the basic rules that determine which users are allowed access to which systems.

Maersk's 150 or so domain controllers were programmed to sync their data with one another, so that, in theory, any of them could function as a backup for all the others. But that decentralized backup strategy hadn't accounted for one scenario: where every domain controller is wiped simultaneously. "If we can't recover our domain controllers," a Maersk IT staffer remembers thinking, "we can't recover anything."

After a frantic search that entailed calling hundreds of IT admins in data centers around the world, Maersk's desperate administrators finally found one lone surviving domain controller in a remote office—in Ghana. At some point before NotPetya struck, a blackout had knocked the Ghanaian machine offline, and the computer remained disconnected from the network. It thus contained the singular known copy of the company's domain controller data left untouched by the malware—all thanks to a power outage. "There were a lot of joyous whoops in the office when we found it," a Maersk administrator says.

When the tense engineers in Maidenhead set up a connection to the Ghana office, however, they found its bandwidth was so thin that it would take days to transmit the several-hundred-gigabyte domain controller backup to the UK. Their next idea: put a Ghanaian staffer on the next plane to London. But none of the West African office's employees had a British visa.

So the Maidenhead operation arranged for a kind of relay race: One staffer from the Ghana office flew to Nigeria to meet another Maersk employee in the airport to hand off the very precious hard drive. That staffer then boarded the six-and-a-half-hour flight to Heathrow, carrying the keystone of Maersk's entire recovery process.

With that rescue operation completed, the Maidenhead office could begin bringing Maersk's core services back online. After the first days, Maersk's port operations had regained the ability to read the ships' inventory files, so operators were no longer blind to the contents of the hulking, 18,000-container vessels arriving in their harbors. But several days would pass after the initial outage before Maersk started taking orders through Maerskline.com for new shipments, and it would be more than a week before terminals around the world started functioning with any degree of normalcy.

In the meantime, Maersk staffers worked with whatever tools were still available to them. They taped paper documents to shipping containers at APM ports and took orders via personal Gmail accounts, WhatsApp, and Excel spreadsheets. "I can tell you it's a fairly bizarre experience to find yourself booking 500 shipping containers via WhatsApp, but that's what we did," one Maersk customer says.

About two weeks after the attack, Maersk's network had finally reached a point where the company could begin reissuing personal computers to the majority of staff.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Back at the Copenhagen headquarters, a cafeteria in the basement of the building was turned into a reinstallation assembly line. Computers were lined up 20 at a time on dining tables as help desk staff walked down the rows, inserting USB drives they'd copied by the dozens, clicking through prompts for hours.

A few days after his return from Maidenhead, Henrik Jensen found his laptop in an alphabetized pile of hundreds, its hard drive wiped, a clean image of Windows installed. Everything that he and every other Maersk employee had stored locally on their machines, from notes to contacts to family photos, was gone.

Five months after Maersk had recovered from its NotPetya attack, Maersk chair Jim Hagemann Snabe sat onstage at the World Economic Forum meeting in Davos, Switzerland, and lauded the "heroic effort" that went into the company's IT rescue operation. From June 27, when he was first awakened by a 4 am phone call in California, ahead of a planned appearance at a Stanford conference, he said, it took just 10 days for the company to rebuild its entire network of 4,000 servers and 45,000 PCs. (Full recovery had taken far longer: Some staffers at the Maidenhead operation continued to work day and night for close to two months to rebuild Maersk's software setup.) "We overcame the problem with human resilience," Snabe told the crowd.

Since then, Snabe went on, Maersk has worked not only to improve its cybersecurity but also to make it a "competitive advantage." Indeed, in the wake of NotPetya, IT staffers say that practically every security feature they've asked for has been almost immediately approved. Multifactor authentication has been rolled out across the company, along with a long-delayed upgrade to Windows 10.

Snabe, however, didn't say much about the company's security posture pre-NotPetya. Maersk security staffers tell WIRED that some of the corporation's servers were, up until the attack, still running Windows 2000—an operating system so old Microsoft no longer supported it. In 2016, one group of IT executives had pushed for a preemptive security redesign of Maersk's entire global network. They called attention to Maersk's less-than-perfect software patching, outdated operating systems, and above all insufficient network segmentation. That last vulnerability in particular, they warned, could allow malware with access to one part of the network to spread wildly beyond its initial foothold, exactly as NotPetya would the next year. The security revamp was green-lit and budgeted. But its success was never made a so-called key performance indicator for Maersk's most senior IT overseers, so implementing it wouldn't contribute to their bonuses. They never carried the security makeover forward.

Few firms have paid more dearly for dragging their feet on security. In his Davos talk, Snabe claimed that the company suffered only a 20 percent reduction in total shipping volume during its NotPetya outage, thanks to its quick efforts and manual workarounds. But aside from the company's lost business and downtime, as well as the cost of rebuilding an entire network, Maersk also reimbursed many of its customers for the expense of rerouting or storing their marooned cargo. One Maersk customer described receiving a seven-figure check from the company to cover the

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

cost of sending his cargo via last-minute chartered jet. “They paid me a cool million with no more than a two-minute discussion,” he says.

All told, Snabe estimated in his Davos comments, NotPetya cost Maersk between $250 million and $300 million. Most of the staffers WIRED spoke with privately suspected the company’s accountants had low-balled the figure.

Regardless, those numbers only start to describe the magnitude of the damage. Logistics companies whose livelihoods depend on Maersk-owned terminals weren’t all treated as well during the outage as Maersk’s customers, for instance. Jeffrey Bader, president of a Port Newark–based trucking group, the Association of Bi-State Motor Carriers, estimates that the unreimbursed cost for trucking companies and truckers alone is in the tens of millions. “It was a nightmare,” Bader says. “We lost a lot of money, and we’re angry.”

The wider cost of Maersk’s disruption to the global supply chain as a whole—which depends on just-in-time delivery of products and manufacturing components—is far harder to measure. And, of course, Maersk was only one victim. Merck, whose ability to manufacture some drugs was temporarily shut down by NotPetya, told shareholders it lost a staggering $870 million due to the malware. FedEx, whose European subsidiary TNT Express was crippled in the attack and required months to recover some data, took a $400 million blow. French construction giant Saint-Gobain lost around the same amount. Reckitt Benckiser, the British manufacturer of Durex condoms, lost $129 million, and Mondelēz, the owner of chocolate-maker Cadbury, took a $188 million hit. Untold numbers of victims without public shareholders counted their losses in secret.

Only when you start to multiply Maersk’s story—imagining the same paralysis, the same serial crises, the same grueling recovery—playing out across dozens of other NotPetya victims and countless other industries does the true scale of Russia’s cyberwar crime begin to come into focus.

“This was a very significant wake-up call,” Snabe said at his Davos panel. Then he added, with a Scandinavian touch of understatement, “You could say, a very expensive one.”

One week after NotPetya’s outbreak, Ukrainian police dressed in full SWAT camo gear and armed with assault rifles poured out of vans and into the modest headquarters of Linkos Group, running up the stairs like SEAL Team Six invading the bin Laden compound.

They pointed rifles at perplexed employees and lined them up in the hallway, according to the company’s founder, Olesya Linnyk. On the second floor, next to her office, the armored cops even smashed open the door to one room with a metal baton, in spite of Linnyk’s offer of a key to unlock it. “It was an absurd situation,” Linnyk says after a deep breath of exasperation.

The militarized police squad finally found what it was looking for: the rack of servers that had played the role of patient zero in the NotPetya plague. They confiscated the offending machines and put them in plastic bags.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Even now, more than a year after the attack's calamitous spread, cybersecurity experts still argue over the mysteries of NotPetya. What were the hackers' true intentions? The Kiev staff of security firm ISSP, including Oleh Derevianko and Oleksii Yasinsky, maintain that the attack was intended not merely for destruction but as a cleanup effort. After all, the hackers who launched it first had months of unfettered access to victims' networks. On top of the panic and disruption it caused, NotPetya may have also wiped away evidence of espionage or even reconnaissance for future sabotage. Just in May, the US Justice Department and Ukrainian security services announced that they'd disrupted a Russian operation that had infected half a million internet routers—mostly in Ukraine—with a new form of destructive malware.

While many in the security community still see NotPetya's international victims as collateral damage, Cisco's Craig Williams argues that Russia knew full well the extent of the pain the worm would inflict internationally. That fallout, he argues, was meant to explicitly punish anyone who would dare even to maintain an office inside the borders of Russia's enemy. "Anyone who thinks this was accidental is engaged in wishful thinking," Williams says. "This was a piece of malware designed to send a political message: If you do business in Ukraine, bad things are going to happen to you."

Almost everyone who has studied NotPetya, however, agrees on one point: that it could happen again or even reoccur on a larger scale. Global corporations are simply too interconnected, information security too complex, attack surfaces too broad to protect against state-trained hackers bent on releasing the next world-shaking worm. Russia, meanwhile, hardly seems to have been chastened by the US government's sanctions for NotPetya, which arrived a full eight months after the worm hit and whose punishments were muddled with other messages chastising Russia for everything from 2016 election disinformation to hacker probes of the US power grid. "The lack of a proper response has been almost an invitation to escalate more," says Thomas Rid, a political science professor at Johns Hopkins' School of Advanced International Studies.

But the most enduring object lesson of NotPetya may simply be the strange, extradimensional landscape of cyberwar's battlefield. This is the confounding geography of cyberwarfare: In ways that still defy human intuition, phantoms inside M.E.Doc's server room in a gritty corner of Kiev spread chaos into the gilded conference rooms of the capital's federal agencies, into ports dotting the globe, into the stately headquarters of Maersk on the Copenhagen harbor, and across the global economy. "Somehow the vulnerability of this Ukrainian accounting software affects the US national security supply of vaccines and global shipping?" asks Joshua Corman, a cybersecurity fellow at the Atlantic Council, as if still puzzling out the shape of the wormhole that made that cause-and-effect possible. "The physics of cyberspace are wholly different from every other war domain."

In those physics, NotPetya reminds us, distance is no defense. Every barbarian is already at every gate. And the network of entanglements in that ether, which have

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

unified and elevated the world for the past 25 years, can, over a few hours on a summer day, bring it to a crashing halt.
Adapted fom Wired magazine

Dr. Robot
New software is industrializing medicine by turning doctors into data entry clerks—and making them suicidally depressed in the process.

An article in JAMA: The Journal of the American Medical Association suggests that almost a third of medical school graduates become clinically depressed upon beginning their residency training. That rate increases to almost half by the end of their first year.

Between 300 and 400 medical residents commit suicide annually, one of the highest rates of any profession, the equivalent of two average-sized medical school classes. Survey the programs of almost any medical conference and you'll find sessions dedicated to contending with physician depression, burnout, higher-than-average divorce rates, bankruptcy, and substance abuse.

At the risk of sounding unsympathetic, medicine should be difficult. No other profession requires such rigorous and lengthy training, such onerous and ongoing scrutiny, and the continuous self-interrogation that accompanies saving or failing to save lives.

But today's crisis of physician burnout is the outcome of more than just a job that's exceptionally difficult. Medicine is undergoing an agonizing transformation that's both fundamental and unprecedented in its 2500-year history. What's at stake is nothing less than the terms of the contract between the profession and society.

An electronic medical record, or EMR, is not all that different from any other piece of record-keeping software. A health care provider uses an EMR to collect information about their patient, to describe their treatment, and to communicate with other providers. At times, the EMR might automatically alert the provider to a potential problem, such as a complex drug interaction. In its purest form, the EMR is a digital and interconnected version of the paper charts you see lining the shelves of doctors' offices.

And if that's all there were to it, a doctor using an EMR would be no more worrisome than an accountant switching out her paper ledger for Microsoft Excel. But underlying EMRs is an approach to organizing knowledge that is deeply antithetical to how doctors are trained to practice and to see themselves. When an EMR implementation team walks into a clinical environment, the result is roughly that of two alien races attempting to communicate across a cultural and linguistic divide.

When building a tool, a natural starting point for software developers is to identify the scope, parameters, and flow of information among its potential users. What kind of conversation will the software facilitate? What sort of work will be carried out?

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

This approach tends to standardize individual behavior. Software may enable the exchange of information, but it can only do so within the scope of predetermined words and actions. To accommodate the greatest number of people, software defines the range of possible choices and organizes them into decision trees.

Yet medicine is uniquely allergic to software's push towards standards. Healthcare terminology standards, such as the Systematized Nomenclature of Medicine (SNOMED), have been around since 1965. But the professional consensus required to determine how those terms should be used has been elusive.

This is partly because not all clinical concepts lend themselves to being measured objectively. For example, a patient's pulse can be counted, but "pain" cannot. Qualitative descriptions can be useful for their flexibility, but this same flexibility prevents individual decisions from being captured by even the best designed EMRs.

More acutely, medicine avoids settling on a shared language because of the degree to which it privileges intuition and autonomy as the best answer to navigating immense complexity. One estimate finds that a primary care doctor juggles 550 independent thoughts related to clinical decision-making on a given day. Though there are vast libraries of guidelines and research to draw on, medical education and regulations resist the urge to dictate behavior for fear of the many exceptions to the rule.

Over the last several years, governments, insurance companies, health plans, and patient groups have begun to push for greater transparency and accountability in healthcare. They see EMRs as the best way to track a doctor's decision-making and control for quality. But the EMR and the physician are so at odds that rather than increase efficiency—typically the appeal of digital tools—the EMR often decreases it, introducing reams of new administrative tasks and crowding out care. The result is a bureaucracy that puts controlling costs above quality and undervalues the clinical intuition around which medicine's professional identity has been constructed.

Inputting information in the EMR can take up as much as two-thirds of a physician's workday. Physicians have a term for this: "work after clinic," referring to the countless hours they spend entering data into their EMR after seeing patients. The term is illuminating not only because it implies an increased workload, but also because it suggests that seeing patients doesn't feel like work in the way that data entry feels like work.

The EMR causes an excruciating disconnect: from other physicians, from patients, from one's clinical intuition, and possibly even from one's ability to adhere faithfully to the Hippocratic oath. And, if the link between using a computer and physician suicide seems like a stretch, consider a recent paper by the American Medical Association and the RAND Corporation, which places the blame for declining physician health squarely at the feet of the EMR.

Drop-down menus and checkboxes not only turn doctors into well-paid data entry clerks. They also offend medical sensibility to its core by making the doctor aware of her place in an industrialized arrangement.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Physicians were once trained through an informal system of apprenticeship. They were overwhelmingly white and male, and there was little in the way of regulatory oversight or public accountability. It was a physician's privilege to determine who received treatment, and how, and at what cost.

Supernatural justifications for treatment techniques eventually ceded to pseudoscientific ones; prayer was replaced by bloodletting and cocaine (and more prayer). Wilhelm Fliess engaged in surgical trial-and-error on his collaborator Emma Eckstein. His friend Sigmund Freud institutionalized female hysteria. Franz Joseph Gall performed backbends to legitimize racism via phrenology.

Then, in 1910, the Flexner Report caused a paradigmatic shift in medical education. Abraham Flexner was not a doctor, but a secondary school principal from Louisville, Kentucky, who later joined the Carnegie Foundation for the Advancement of Teaching. It was there that he wrote "Medical Education in the United States and Canada," and transformed the lives of millions of people.

The Flexner Report recommended that medical education develop an evidence-based curriculum. Under its influence, medicine was subjected to the rigors of peer review and the scientific method for the first time. Residency programs were established, uniting the university and the hospital, and placing apprenticeship within the academy. Medical teachers were expected to be proponents of the latest and most credible research. State licensure was tied to education, introducing some semblance of standards.

The recommendations in the Flexner Report also formed the basis of what we today understand as the social contract between the medical profession and the people whom it serves. Patients are entitled to competence, altruism, morality, integrity, accountability, transparency, objectivity, and promotion of the public good. In return, physicians are entitled to trust, autonomy, self-regulation, a funded healthcare system, inclusion in public policy, monopoly, and prestige.

In the intervening years, the tenets of physician prestige and self-regulation have remained intact. But the introduction of computerization has begun to rewrite the social contract between doctors and society, as EMRs lay the groundwork for the industrialization of medicine.

Industrialization is the premise that people working together in a coordinated fashion will work more efficiently than one person doing everything themselves. To achieve this coordination requires standardization (the wheel goes on the car the same way every time); a technological innovation that makes work as simple as possible (an assembly line with power tools); and cheap labor (poor people).

An expert dressmaker may have once been responsible for every aspect of their craft: designing the dress, procuring the fabric, cutting and stitching, marketing and selling. Some dressmakers might be particularly good at one or more of those things. A few might even be good at all of them. But even in the best-case scenario, the quality of the dresses and the rate of their production will vary wildly.

Dressmaking is the kind of thing that's easy to industrialize. The pieces of the process can be categorized, standardized, and delegated. The language we use to refer

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

to the parts of the dress, and the tasks associated with the job, are clear. Reducing the qualifications for participation in dressmaking renders individuals interchangeable and disposable.

Industrialization has been applied to almost every field in which something is produced and sold. Now, EMRs are applying it to medicine. In the industrialized conception of medicine, as in the industrialized conception of all professions, more tasks become routine, and routine tasks are delegated downward. It's no surprise that in the health policy world the introduction of EMRs often accompanies a discussion about hiring less educated professionals, like nurses and pharmacists. Meanwhile, fewer and fewer spaces are designated as safe for creativity and intuition, because these are considered unpredictable and unreliable.

One wonders if it's possible to carve out a third way between the purely intuitive and the mechanically standardized. Atul Gawande has written extensively about this possibility, depicting a meeting of minds between autonomous doctors and health systems designers—and he manages to do so without making it seem terrifying or fantastical. In this world, technologies might seek to complement and enhance, rather than replace, the physician's ability to incorporate research into practice.

Natural language processing and dictation will allow physicians to use any words they like while recording notes into an EMR, as opposed to drop-down menus and pick-lists. Artificial intelligences like IBM's Watson will comb through research on behalf of the physician and aid in clinical decision-making. The doctor's lounge, an increasingly rare phenomenon, is a basic form of technology that allows physicians to connect and share information. Not all innovations need to be bleeding edge.

But reform is big business. The "eHealth" industry, which produces the infrastructure with which the square peg of medicine will be crammed into the round hole of scalable technology, is estimated to reach $308 billion by 2022, and is a key driver of America's $3 trillion national healthcare expenditure. The Healthcare Information and Management Systems Society (HIMSS) Annual Conference & Exhibition—the biggest eHealth conference in the world—was attended by just over 43,000 people. The allure of a disruptive solution that will tidily rationalize medicine has too many short-term winners to question—even if those winners are neither physicians nor patients.

Adapted from Logic magazine

How to get rich quick in Silicon Valley

Corey Pein took his half-baked startup idea to America's hottest billionaire factory – and found a wasteland of techie hustlers and con men

The most desirable career of the 21st century, with numerous advantages over other fast-growing occupations such as hospice carer and rickshaw driver, is being a billionaire. Prior to the incorporation of US Steel in 1901, the world didn't have a single billion-dollar company, much less a billion-dollar individual. Today, more people than ever are becoming billionaires – 2,000 and counting have made the great

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

leap upward, according to the "global wealth team" at Forbes. And the US's hottest billionaire factory is located in the most hyped yet least understood swath of suburban sprawl in the world: Silicon Valley.

Despite what you may have heard, hard work in your chosen trade is absolutely the stupidest way to join the billionaires club. In Silicon Valley, the world's most brilliant MBAs and IT professionals discovered a shortcut to fabulous riches. Ambitious Ivy Leaguers who once flocked to Wall Street are now packing up and heading west. The Valley's startup founders, investors, equity-holding executives and fee-taking middlemen have thrived above all. Inspired by their success, my idea was to move to Silicon Valley, pitch a startup and become obscenely rich. I left home with some homemade business cards showing my new email address, futurebillionaire@aol.com, and a bunch of half-baked ideas.

The first thing I needed was a place to stay. The best deal I could find on short notice was a place I called Hacker Condo. Like most Bay Area newcomers, I was relying on the short-term apartment rental app Airbnb. At $85 (£59) per night, the place cost less than the market average, but was still more than I could afford. On the upside, it was in what the real estate hucksters called SoMa – a trendy San Francisco neighbourhood well suited to my journalistic and entrepreneurial purposes. Once a low-rent manufacturing district, the south of Market Street area had become the go-to place for startups seeking industrial-chic open-plan offices, although the poor and homeless had not yet been fully purged.

The ad for Hacker Condo stated an express preference for techies: "We would like to welcome motivated and serious entrepreneurs who are looking to expand their network," it said. Perfect. The best part: "No bunk beds." I told the hosts that I was an "embryo-stage" startup founder and author. The hosts didn't own the place. I looked it up: the mortgage was held by some European guy who seemed to spend most of his time surfing at a resort and dabbled in the tech business as a hobby. The legal status of this rental arrangement was, let's say, unclear.

I rang the buzzer for a unit labelled TENANT. A man answered right away. He had been waiting. After a moment, the door opened, and I met my new roommate, a gangly Kiwi. We took the elevator three floors up and entered a silent, beige-carpeted hallway. Our unit was No 16. The first thing I noticed inside was a small mountain of men's shoes. Hacker Condo was modern and more spacious than seemed possible from the outside. The unit was spread over three floors. The furniture consisted of a picnic bench and a sectional sofa spanning the width of the living room. I counted five other short-term tenants. The Kiwi told me that soon, some Norwegian guys – a whole startup team – would be moving in. We calculated that Hacker Condo would soon have three more guests than it had beds.

"What's the key situation?" I asked.

"There's one key," the Kiwi said.

"One key?" I said. "For everybody?"

There were more tricks to learn, as a consequence of the possibly illicit nature of this type of rental arrangement and the evident stinginess of our Airbnb hosts. The

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

Condo Hackers never came in through the front door. It was too conspicuous. I followed the Kiwi down to the ground-floor garage, then outside to the rear of the building. He showed me how to slide my hand along a grate to locate the tiny combination safe that contained the exterior door key. It was best to do this when no one was looking.

I knew not to spend too much time getting to know my flatmates, for we were all rootless high-tech transients, our relationships temporary, our status revocable. The room I had booked was available for only two weeks. As soon as I connected to the wifi network, I would need to start looking for another place. “My” room had five beds in it. I thought I had paid for a private space. I double-checked. The listing clearly stated “no bunk beds”, but down in the fine print I finally found the words “shared room”.

Two weeks was not enough time to find an apartment in San Francisco. Not on my budget. Rents were higher than in New York or London. One-beds were running at about $3,000 per month; studios, about $2,500; shares, $1,500; and illegal crap shares, $1,000. It was the same deal across the bay to the east in Oakland and Berkeley, as well as to the south in the Silicon suburbs of Redwood City, Palo Alto and Mountain View. Whatever I might save in rent by living on the periphery I would lose in transportation costs and time.

These “hacker houses” were the products of disruptive innovation in the urban property market. The city was once riddled with small apartments and single-family homes that sheltered trifling handfuls of obsolete labourers and their unproductive children, often for decades at a stretch. But the tech boom let such so-called family homes reach their full potential as investment properties. Some hacker houses were attached to startup investment incubators or shared workspaces. Others amounted to little more than flimsy bunks in a windowless room. A number of trend-savvy investors purchased or leased dozens of residential properties around the Bay Area to rent out in this fashion.

Although I envied them from my dark and squalid quarters, the San Francisco long-timers who lived in rent-controlled apartments were in situations nearly as precarious as my own. I met a musician who lived in a $600 rent-controlled apartment in the Mission. When I met her, she was terrified that her landlord would evict her and sell the building so that it could be rented out at six times the price to white techie colonisers such as myself.

With landlords eager to cash in, formal evictions had increased 55% in five years. More often, though, landlords simply bullied their tenants into packing up. “Tenants are getting evicted for having cups in their cupboards. The landlords say it’s clutter. They’ll say anything. Eventually the tenants just give up,” a lawyer for a tenants’ rights organisation told me. His employer, the Eviction Defense Collaborative, was itself getting evicted from its offices so that the landlord could rent the space to a tech startup. My earnings potential had plummeted when I stopped writing software and started writing for newspapers. I now looked with envy at the techies, the winners, the pioneers. They had ideas. They had momentum. Most

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

important, they had money. Why not me? I wasn't just changing careers and jumping on the "learn to code" bandwagon. I was being steadily indoctrinated in a specious ideology. As proud as I was of having learned new skills, I didn't understand that the only way to turn those skills into a livelihood was to embrace the economy of the digital world, where giant corporations wrote the rules.

My idea was to pitch a tech startup and get obscenely rich while writing a book about how to pitch a tech startup and get obscenely rich – the Silicon Valley way. To save money, I took to cooking my own meals most of the time. This was when I discovered that it was much easier to launch a tech startup if you could afford to always have food delivered and never had to deal with mundane chores such as doing laundry, washing dishes or buying groceries. As one Twitter wag observed, San Francisco's "tech culture is focused on solving one problem: what is my mother no longer doing for me?"

I never felt older nor crankier than when watching these "digital natives" stumble through the daily rituals of adulthood. One of the kids, an overachieving Ivy Leaguer whose Google internship demanded an advanced understanding of high-level mathematics, was completely baffled when it came to using a simple rice cooker. I explained the process: put in rice, add water, press the button labelled "cook". He grew increasingly flustered, and I suspected he wanted me to make the rice for him. He managed to sauté a boneless, skinless chicken breast, but only by following the instructions on the package to the letter.

"How did it turn out?" I asked.

"It's terrible. Bland," he said. "I'm full, that's all that matters. I don't care how it tastes."

When I first heard about Soylent, the startup selling a gooey "meal replacement beverage" powder with a determinedly "neutral" flavour, I wondered what sort of miserable insensates would choose to subsist on such glop. Now I knew.

It may have been better for everyone when the overpaid nerds stayed home. "They're importing children to destroy the culture," one bar owner told me.

Indeed, to overhear the baby-faced billionaire wannabes exchanging boastful inanities in public could be enraging. Their inevitable first question was: "What's your space?" Not "How's it going?" Not "Where are you from?" But: "What's your space?"

This was perhaps the most insufferable bit of tech jargon I heard. "What's your space?" meant "What does your company do?" This was not quite the same as asking: "What do you do for a living?" because one's company may well produce no living at all. A "space" had an aspirational quality a day job never would. If you were a writer, you would never say "I'm a writer". You would say "I'm in the content space", or, if you were more ambitious, "I'm in the media space". But if you were really ambitious you would know that "media" was out and "platforms" were in, and that the measure – excuse me, the "metric" – that investors used to judge platform companies was attention, because this ephemeral thing, attention, could be sold to advertisers for cash. So if someone asked "What's your space?" and you had a deeply

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

unfashionable job like, say, writer, it behooved you to say “I deliver eyeballs like a fucking ninja”.

In my former life I would have sooner gouged out my own eyeballs than describe myself in such a way, but in post-recession, post-boom, post-work, post-shame San Francisco, we all did what we had to do to survive. I was beginning to become acquainted with the infinite solipsism of my new milieu. We were grown men who lived like captive gerbils, pressing one lever to make food appear and another for some fleeting entertainment – everything on demand. Airbnb and Foodpanda served the flesh, Netflix and Lifehacker nourished the soul.

I relied on sites such as EventBrite and Meetup to keep my social calendar full and my expenses down. I went to a party at the Yelp office – like most of the freebies around town, it was advertised online. The venue was a forbidding art deco tower – the old PacBell building, constructed for the California branch of the national telephone monopoly in its heyday. Now the tower’s largest tenant was a website that allows anonymous semi-literates to post critiques of local establishments. Most of the crowd seemed to work at Yelp, and felt obliged to stick around for the event. But there was something else keeping these people here – an overriding anxiety about unfamiliar spaces.

Life outside the startup bubble was frightening and unpredictable. Inside, it was safe. “Fun” was mandatory in the Bay Area tech world, and inebriation strongly encouraged. The bar at Yelp, for instance, featured three kegs of high-end craft beer and an array of wines and spirits. This was not a temporary selection for the benefit of us honoured guests, but a permanent fixture of the commissary. Normally open only to employees, the Yelp Cafe had a perfect five-star rating ... on Yelp. “Well, looks like I’m never leaving my office compound!” one reviewer wrote. A corporate recruiter explained to me the forces driving the “perks war”, an escalating tit-for-tat of such freebies as steak dinners delivered to employees’ desks, free laundry service, free bikes and bike repair, free concierge service and, of course, free drinks.

“They might get a $20 steak, but with the extra time they’ve stayed at work, they’ve provided an extra $200 in value to their employer,” the recruiter said. Thus the seemingly lavish enticements were a way to attract profit-producing programmers, who were in exceedingly high demand, without offering higher salaries. The perks also provided effective cover for the companies’ slave-driving work schedules.

My flatmates seemed happy with the arrangement, at least at first. “Everything they say about Google is true,” one intern told me after his orientation at the Googleplex. “There are 20 cafeterias, a gym – everything.” Early each weekday morning, he and the other Googlers in his neighbourhood swiped their ID cards to board a chartered bus parked near the Bart station, then rode 35 miles to Mountain View. They started working onboard the bus, which was equipped with wifi, and didn’t leave the campus until about 8pm, when another bus ferried them home after they ate at the company cafeteria. This was a pretty standard deal at the big Silicon Valley companies. Even rinky-dink startups in SoMa warehouses offered free

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

catering. “The perks, man!” another roommate, a non-Googler, raved after arriving home at 10pm from his first day on the job. “I worked until 9pm because dinner is free if you work that late ... And they’ll pay for your cab home,” he went on. That became his routine, and he never questioned it. Come to think of it, like a lot of his contemporaries, he never questioned anything.

In this milieu, a certain tolerance for phoniness was prerequisite. It was not enough to have the right skills, put in your time and get the job done – you had to be fucking pumped about your job. Certain specialities were in more demand than others. Any chump with a humanities degree could talk his or her way into a marketing job, but programmers were harder to come by. One sunny day, I followed the waterfront to the event center at Pier 27 and signed in to the DeveloperWeek conference. DevWeek, as everyone called it, was basically a week-long recruitment fair sprinkled with slideshows and panel talks. It was jarring to see employers desperate to hire, not the other way around. In 2010s America, the only place that was always hiring, apart from Silicon Valley, was the local US army recruiting centre. Hundreds upon hundreds of people had flocked here to look for a better job and still there were not enough applicants to fill all the openings for “Java Legends, Python Badasses, Hadoop Heroes”, and other gratingly childish classifications describing various programming specialities. Techies would call themselves just about anything to avoid the stigmatising label of “worker”. They could only face themselves in the mirror if their business card proved that they were rock stars or ninjas or something romantic and brave and individualistic – anything but the truth, anything but a drone.

I had an important realisation at DevWeek: I wasn’t the only one bluffing my way through the tech scene. Everyone was doing it, even the much-sought-after engineering talent. I was struck by how many developers were, like myself, not really programmers, but rather this, that and the other. A great number of tech ninjas were not exactly black belts when it came to the actual onerous work of computer programming. So many of the complex, discrete tasks involved in the creation of a website or an app had been automated that it was no longer necessary to possess knowledge of software mechanics. The coder’s work was rarely a craft. The apps ran on an assembly line, built with “open-source”, off-the-shelf components. The most important computer commands for the ninja to master were copy and paste.

Barack Obama’s White House had endorsed Silicon Valley’s “learn to code” campaign – it was an official government job-creation programme. With the traditional US job market still a smouldering charcoal pit after the 2008 crash, computer programming skills were promoted as one sure way to attain the sort of prosperity and stability Americans had over many decades come to expect.

And yet, many programmers who had “made it” in Silicon Valley were scrambling to promote themselves from coder to “founder”. There wasn’t necessarily more money to be had running a startup, and the increase in status was marginal unless one’s startup attracted major investment and the right kind of press coverage. It’s because the programmers knew that their own ladder to prosperity was on fire

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

and disintegrating fast. They knew that well-paid programming jobs would also soon turn to smoke and ash, as the proliferation of learn-to-code courses around the world lowered the market value of their skills, and as advances in artificial intelligence allowed for computers to take over more of the mundane work of producing software. The programmers also knew that the fastest way to win that promotion to founder was to find some new domain that hadn't yet been automated. Every tech industry campaign designed to spur investment in the Next Big Thing – at that time, it was the "sharing economy" – concealed a larger programme for the transformation of society, always in a direction that favoured the investor and executive classes.

In the first seven years after the 2008 crash, 16 million people left the US labour force. And in that same period, thanks to Silicon Valley's timely opportunism, the country gained an endless bounty of gigs. Tech startups, backed by Wall Street, swept in to offer displaced workers countless push-button moneymaking schemes – what Bloomberg News called "entrepreneurialism-in-a-box". Need fast cash? Take out a "peer-to-peer" loan, or start a crowdfunding campaign. Need a career? Take on odd jobs as a TaskRabbit or pitch corporate swag as a YouTube "vlogger". Nine-to-five jobs with benefits and overtime may be in the process of getting disrupted out of existence, but in their place we have the internet, with endless gigs and freelance opportunities, where survival becomes something like a video game – a matter of pressing the right buttons to attain instant gratification and meagre rewards.

More than a third of American workers now qualify as "freelancers" or "contingent workers" – that is, their livelihoods are contingent upon the whims of their managers. That's because the choice to become entrepreneurs has been made for them. The destruction of social welfare, public education and organised labour has created what might be called the 50 Cent economy, a system structured to offer only two options: "Get rich or die trying." George W Bush called it the "ownership society". Obama, smitten with his Silicon Valley donors, gave us "Startup America". And Donald Trump, history's luckiest winner, reigned over a nation of "losers". Under the latest iteration of the American Dream, if you aren't a billionaire yet, you haven't tried hard enough.

The contemporary equivalent of an entry-level job in the corporate mailroom was a work-from-home service called Mechanical Turk, operated by Amazon, the $136bn online retailer controlled by Jeff Bezos. The idea with Mechanical Turk was to create a digitised assembly line featuring thousands of separate "human intelligence tasks", designed to be completed within seconds and paying pennies. Academic surveys found that many Turkers worked more than 30 hours per week foraverage wages of under $2 per hour. Yet these workers were considered self-employed small business owners. Their work was commissioned by social scientists seeking to cut costs on large-sample surveys, but also by profit-minded companies that hired hundreds of Turkers as needed, instead of a full- or part-time employee. Another sharing economy upstart called Fiverr was a catalogue of freelance "gigs", from illustration to translation, all sold at a fixed cost of $5. Launched in 2010 by two Israelis, Fiverr raised more than $50m in investment within five years, on annual

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

revenue of $15m. Silicon Valley investors praised the founders' "incredible vision" and swooned over the "liquidity, velocity and engagement" the company brought to the global marketplace.

It was remarkable what people were willing to do for $5, or more like $3.92 after service fees. A lot of ads promised custom website development. Others offered quick-and-dirty logos, proofreading, or résumé writing. I hoped to forge my place in the strange niche of bargain basement flat-fee consulting. Thousands of people were paying $5 to strangers for direction on matters they found too difficult, too stressful or too trivial to face alone. Fiverr's terms of service forbade "nonsense" and "uncool stuff" but the service seemed to tolerate ads like one for an Amazon "Kindle ghostwriting machine"; or another for tools designed "to cheat likes on social networks"; and still another for "a profitable forex cheating strategy" – an obvious scam that Fiverr marked for a while as "recommended". I had entered a murky ethical realm. I scanned gigs methodically. I learned that it paid to over-promise. No matter was too momentous:

"I will teach you to make Life and Death Decisions for $5."

This gig was listed by a Fiverr-certified "top-rated seller" who claimed experience as a broker of precious metals.

"I will help you Survive the Fatal Ebola Virus Epidemic for $5."

As far as I knew, there was no cure for Ebola. But who was I to argue with a five-star-rated seller? Could 2,679 customers be wrong? On the site's discussion boards, sellers swapped stories of unfair competition from scammers, insufficient payments from Fiverr, capricious rules, meagre sales and endless hours. Some sounded genuinely desperate. Fiverr even sent its workers emails about increasing productivity by avoiding depression. Full-time Fiverring took a physical toll, as well, with many slavish gig-peddlers reporting rapid weight gain. "I know what you mean! I bought some jeggings this weekend," one woman wrote. Another commenter saw opportunity. "If anyone is interested," he wrote, "I'm putting together a Fiverr gig where I will be offering online fitness coaching."

Fiverr offered a glimpse at the new model worker: a fat, depressed con artist forever scheming against his comrades, egged on by the distant architects of the virtual marketplace– the only real winners. The company eventually embraced this image and celebrated it with a subway ad campaign featuring a fatigued-looking model with frizzy hair and circles under her eyes. "You eat a coffee for lunch. You follow through on your follow through. Sleep deprivation is your drug of choice," the ad said. "You might be a doer," it concluded. When busy-ness became a status symbol, the glamorisation of exhaustion was inevitable. I found Corey Ferreira through his website, makefiverrmoney.com, which was a marketing vehicle for his ebook, Fiverr Success: $4,000 a Month. 8 Hours of Work a Week. Having made a decent amount on Fiverr, Ferreira had found rates of pay had halved. Faced with slowing business, he had adopted a new approach: he could "sell the method". He got the idea from a book called The Laptop Millionaire, which describes "a guy's journey from being basically homeless to making money online. One of the things he talks

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО

about is making ‘information products’.” Hence Fiverr Success by Corey Ferreira was born, selling “hundreds” of copies at $17.

The book marked a transition for Ferreira, as he spent less time doing labour-intensive web design and more time searching for the cold fusion of internet marketing: “passive income.” “I remember when eBay started,” he told me. “I was kinda young. Everybody was talking about how to make money on eBay. I remember somebody telling me, ‘During a gold rush, you should sell shovels’.”

I felt he had let me in on some oracular wisdom. Don’t dig for gold: sell shovels to all the suckers who think they’ll get rich digging for gold. To post an ad on Fiverr was to announce one’s status as an easy mark. To hawk get-rich-quick manuals to all those eager Fiverrers, however, was to join the exalted ranks of the shovel merchants.

My Airbnb landlord, I realised, was a shovel merchant. As was the company that rented me server space for website hosting. As were the “startup community organisers” selling tickets to conferences and networking parties. As were the startup awards shows and Hacker News and the whole Silicon Valley economic apparatus promoting the ideal of individual achievement. We startup wannabes were not entrepreneurs. We were suckers for the shovel merchants, who were much cleverer than the thick-skulled “innovators” who did all the work while trading away the rewards.

For a business incompetent such as myself, this concept of selling a method, rather than a straightforward product or service, was revelatory. I understood this lesson as an extension of that old saying about teaching a man to fish instead of just giving him a fish. Now the idea was: you made him pay for fishing lessons, offering student loans if necessary, and failed to mention that you had already depleted the pool. In a late capitalist society with dwindling opportunities for cash-poor workers and few checks on entrepreneurial conduct, what could be better to sell than false hope? This was a smart business.

Unfortunately, the techie hustlers can be a little too clever for their own good – and ours. With decades of unwavering support from the military-industrial complex, Congress and Wall Street, the pallid princelings of Silicon Valley rewrote the rules of the global economy in their favour. The public, fooled as it was by the tech industry’s slick marketing and lulled by the novelty and convenience of its gadgetry, might be forgiven for missing some early warning signs. (Remember when the Google guys used to rhapsodise about beaming the internet – with the attendant targeted advertising – directly into people’s brains? It doesn’t sound so far-fetched and quirky now, does it?)

If we are feeling generous, the same retrospective clemency could even be shown to politicians who mistook Silicon Valley for just another well-heeled lobby looking for favours, and to the reporters who were suckered by the rapid rise of “revolutionary” companies such as Theranos and Uber. But the builders of our digital dystopia – the tech titans themselves, and their armies of engineers – have no such excuses. They will talk about the mistakes they have made. They will express regret for their oversights and make a show of contrition. Don’t be fooled.

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н.Г. ЧЕРНЫШЕВСКОГО

The dark side of Big Tech, which many consumers are only beginning to come to grips with, is not some byproduct of California-style "conscious capitalism" – an unfortunate misstep in an otherwise heroic effort to "change the world". Profit-hunger, philistinism and misanthropy are and always have been at the core of the enterprise. The new breed of Silicon Valley billionaires knew exactly what they were doing. The plan was to take all the money and run – to Mars, if necessary.

Adapted from The Guardian

САРАТОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ Н. Г. ЧЕРНЫШЕВСКОГО