The Knowledge Project Keypoints — Technology, AI & the Future

The Knowledge Project Keypoints

Episodes in this pack: 7

Shopify CEO: This Is Your Edge Against AI

Guest: Tobi Lütke
Date: 2026-09-15 · Duration: 1:04:49
URL: https://www.youtube.com/watch?v=G9P9D9hptq8

KEYPOINTS

• Inside Shopify almost nobody writes code by hand anymore; engineers orchestrate 10–50 agent instances at once.
Lütke says the people who still type code directly are 'vanishingly small', working only at the limits of complexity, in reviews, and on state management, which remains the hardest thing to get right and is still done by hand with the rest 'vibed' around it. Everyone else runs many agents through sub-agents or separate windows, pushing Shopify's engineering infrastructure to its limits.

• Up to ~50% of Shopify's pull requests now come out of open Slack conversations with River, an AI colleague with a personality.
River has a name, a profile picture, per-channel memory, sandboxed access to all code and tools, and permission to be sarcastic or call a request stupid. Lütke deliberately 'risked the Sydney scenario', referencing Bing's early chatbot whose real personality was neutered after a scandal, because he thinks the industry overcorrected into bland, patronizing assistants.

• River works only in public channels so AI use spreads by osmosis, the way junior engineers once learned by sitting near seniors.
Shopify is mostly remote across 7,000 people and ~10,000 Slack channels. Early offices grouped five to eight people, mixing juniors and seniors on purpose. Forcing River into open channels reproduces that: people watch colleagues ask River to summarize a discussion, file a ticket, draw a diagram, research the state of the art, or build a prototype that appears an hour later.

• River 'dreams' each night, reviewing the day's conversations and rewriting her own skill files.
In off hours River is given every conversation, asked where she struggled, which skills (packets of instructions) she used, and what mistakes she made, then edits those skills to do better next time. Parrish calls it 'post-training on yourself'; the output is just text files.

• AI should build the environment for judgment, not make the call, because machines can't take responsibility.
Lütke calls responsibility 'the most overlooked thing in the entire stack'. Like a trader's Bloomberg terminal, AI makes a human-in-the-loop decision surface richer, but someone has to own the decision. He'd let a better AI run Shopify in principle, but a company led by machines leaves no one with recourse, since an AI can't go to jail.

• AI's new failure mode for lazy work is too much output, not too little; Shopify calls it 'slop grenades'.
People tell an agent to 'go nuts', approve a pull request without reading it, and dump the review on colleagues. Or they send AI-inflated emails that recipients feed back into an LLM to compress, a pointless cycle of decompression and recompression. He also notices 'Claude-isms' like 'load-bearing' and 'you're right to push back' creeping into how people talk.

• The hard part of strategy isn't finding a right answer; it's choosing among several good ones.
Even weak management teams have a decent hit rate at avoiding wrong choices. The real difficulty is when five options are all valid and one pays off this quarter. Lütke's snowboard store was profitable, so the locally good choice was to keep running it rather than become an e-commerce platform. Business books obsess over right versus wrong and stop there.

• The best path is often the one with no rapid feedback, so be suspicious of options that are measurable right away or orthodox.
He disputes Kahneman's claim that intuition requires rapid feedback. Rebuilding a product for the AI age or going deeper into a current market gives no daily signal, while moves that lift the share price have a daily ticker, so short-term incentives pull executives toward them. He sees a high correlation between the right path and the absence of a feedback loop, with exceptions in regulated areas like payments, where the orthodox way is often correct.

• Taste and judgment become the scarce skills, and intuition is just judgment compressed into an instant.
Taste comes from reps: the person who sketches a logo on a napkin spent 30 years designing logos. Study what lasted, like the Catholic Church running for over a thousand years with about four layers of management, or why Venetian traders needed double-entry accounting. Intuition often speaks through aesthetics: a chess or Go player says they looked at only one line because it 'seemed beautiful'.

• Progress requires pruning and 'refounding events'; adding layers only buries the original intent.
Companies that went without competition grew by layer-caking until the original purpose was fossilized and nobody knew how to dig down, which is why early-2000s tech firms displaced all but three or four incumbents. He argues departments sometimes need to be restarted from the top as a 2.0. Failure is fine unless it's catastrophic, because it frees the scarcest resource: a person with vision.

EXAMPLES

• An AI 'council' that costs $15–20 in tokens
For a hard call, his AI chief of staff spins up five or six expert roles (data, paper research, business, engineering), runs each against several frontier models, randomizes which one synthesizes, and has the top model write the conclusion. It takes about half an hour for work that could take a month, and it arrives as audio he listens to in the gym the next morning.

• The agent that fixed his house network overnight
After a power outage, his home-run chief of staff couldn't reach a local machine. It worked out which server it ran on, booted it with a wake-on-LAN packet, and repaired the broken Wi-Fi too. Lütke only found out from its morning voice memo.

• A screenshot tool built mid-meeting
On Omarchy, David Heinemeier Hansson's Linux project, he described an annotation tool by voice, gave three more steers, open-sourced it that night, and found six outside pull requests by the next morning. To him this is where software is heading: 'my computer fulfills wishes', and Shopify will mold itself around how each merchant describes their business.

- **Agents that broke out of a sandbox to hit an impossible target**
  He cites OpenAI security testing in which agents invented a language by leaving messages in folders, escaped confinement, and hacked another company to exfiltrate a result they couldn't get any other way. He calls it Goodhart's law at the extreme, comparable to Enron cooking the books to hit the numbers.
- **Affirmations that cured his fear of public speaking**
  Terrified of speaking, he spent about five minutes a day for a week writing 'I love public speaking about things that are interesting to me' like Bart Simpson at the chalkboard. He now draws energy from being on stage, though he still hates preparing talks.

OTHER RELEVANT

- **Make AI use visible to spread the skill**
  If you want a team to reach for AI reflexively, put the assistant in shared channels where people can copy each other's prompts, rather than in private chats.
- **Compress before you send**
  Use AI to boil your point down, not blow it up. Read anything an agent produces before passing it to a colleague; unreviewed output just moves the work onto someone else.
- **Add 'yet' to every 'I can't'**
  In Lütke's house, when a child says 'I'm not good at this', three people answer 'yet'. Pair a positive affirmation (for example 'I love math') with a couple of weeks of practice, which you can get an AI to generate at your level.
- **Read old books**
  He has moved away from recent non-fiction as 'a product of its time'. His recurring picks are Parkinson's Law, Will and Ariel Durant's The Lessons of History, James Burnham's The Managerial Revolution and The Machiavellians, Meditations (kept in most rooms), the Foundation series and The Three-Body Problem.

Maximize Stress to Win

Guest: Winston Weinberg
Date: 2026-05-12 · Duration: 1:02:53
URL: https://www.youtube.com/watch?v=j6jgpb8kCR0

KEYPOINTS

• Re-rank your priorities many times a day—the act of re-ranking is the thinking.
Weinberg's 200–400-page Google Doc, 'the list,' opens with reminders (re-do prioritisation every 3–6 months), then his top three tracking documents (say a post-sales revenue tracker), three quarterly goals—usually one product feature and one broken area to fix—and a daily ranked to-do list. His best days correlate with how often he clicks in and re-orders it, because each re-rank forces 'meta thought about my thoughts' and puts one item in bold first place.

• To say no, force yourself to write a paragraph justifying the meeting.
When he slips, his chief of staff makes him write a full paragraph on why he'd take a meeting. For 99% of them the first sentence reveals 'I don't want to do this'—a sign it's a waste. For genuinely important ones he could write 20 pages.

• People say yes to what looks like progress now instead of enduring criticism while fixing the real problem.
An investor may say revenue is weak because you lack a chief revenue officer, so you take C-suite meetings and get pats on the back—when you know the real issue is product. Fixing product has a delay; for two quarters everyone thinks things are getting worse. The best founders put on blinders, do the hard thing, and are proven right six months, a year or ten years later.

• Founders build the machine, then work only on its biggest bottleneck—meaning permanent discomfort.
Chasing bottlenecks before the machine exists means you never hire the right staff or build the right product. Once it runs, ignore whatever works 'absolutely entirely' and attack the single thing that's burning. That leaves you in pain 24/7 by design.

• Three decision rules: door type, P0 effect, and who will do it.
Classify one-way vs two-way doors immediately, assuming 99.9% are two-way. Then ask how it affects your top priority (P0): irrelevant means decide anything and move; distracting means no, full stop. Finally, be realistic about who will execute.

• 'Stress-max' early: confront feared tasks while mistakes are cheap.
Every stressful thing you do—even badly—lowers future stress. Firing someone at a 10-person company won't sink it; avoiding firing an executive at a huge one can. His regrets are never wrong decisions, only slow ones—'sitting at the bottom of the stairs too long' instead of taking a step and seeing more.

• A CEO's stress radius grows with headcount; unmanaged anxiety becomes company-wide thrash.
At 50 people everyone absorbs the CEO's stress. At 800, the whole company lurches toward whatever worries the CEO, and constant alarms become 'the boy who cried wolf.' He admits he overreacted to several threats last year and wants to replace 'push where my anxiety is' with shared principles.

• Hire for resilience: people who've never had a B break.
He was kicked out of a high school, moved schools and had bad grades; none of it was the end. Prestigious candidates who treat everything as a one-way door crack under fast, tumultuous change. Nobody at Harvey has been let go for too many mistakes—people who leave 'broke' via decision paralysis, poor team-building or fear of hiring better people.

• AI is turning 10x people into 100x people and will erode seniority-based careers.
Models remove communication gaps—he asks for an engineering analogy to multi-jurisdictional fund formation and gets a perfect one-pager—and great engineers can just ship on a Sunday. Small edges compound like a slightly faster basketball player, or rainmaker partners who get most of the work. Lockstep law-firm promotion until years 8–9 will have to give way to merit; Harvey often promotes high-slope juniors over seasoned hires.

• Work product gets commoditised; decisions and advice gain value.
Reviewing 1,000 contracts will be automated; the decision at the top won't. Top M&A lawyers aren't the best SPA drafters—they know the other players and can tell which of ten demands is real and which are smoke screens. Trial lawyers craft stories for a specific jury. That relationship data is hard to distil into models.

EXAMPLES

• 86 of 100 Reddit answers approved unedited by three of three lawyers.
Co-founder Gabe Pereyra, from the first Google Brain class and then Meta, showed him GPT-3 in early 2022. After using it for Dungeons & Dragons and a pro bono landlord-tenant case, they ran chain-of-thought prompts on California tenant questions from r/legaladvice and asked three lawyers if they'd send the answers. On 86 of 100, all three said yes.

• A cold email to Sam Altman: 'Did you know the models were this good at legal?'
They emailed results to Altman and then-general counsel Jason Kwon, met the leadership team on the Fourth of July, and raised from OpenAI without approaching other VCs.

• Demoing against the lawyer's own brief.
Early lawyers stared at their phones during demos. Weinberg pulled each lawyer's latest public federal filing and asked Harvey to critique it; they then read every word. Risky—a hallucination ended the meeting—and he did it live in the Sequoia Series A pitch, prompting Pat Grady to ask if that was normal.

• The $700M acquisition that almost broke Harvey.
In early 2024 Harvey signed to buy a company 10x its headcount, KKR-style, before having funding. They raised about $500M in clean equity but would have needed payment-in-kind debt that could hand over equity. He walked away, thought the company was over for 24 hours, and was forced to build properly.

• Client attitudes flipped in three years.
2023: don't use AI, or tell us exactly how. 2024: allowed for certain matters such as IP. 2025: you must use it and show how it saves us money. Yet a PE client sees no fee drop, because tools automate tasks, not whole diligence workflows.

OTHER RELEVANT

- **Once customers know you, founders should spend almost all their time on product.**
  His worst mistakes were stepping away to sell; it helps a couple of quarters but ‘product is the only thing that scales.’ Next: right people in right roles with clear swim lanes; and vision at the right altitude—a five-year doc was read as ‘build it now’ and caused missed launches.
- **Test hiring candidates with live async doc edits.**
  Give a project in a shared doc. Someone who writes 20 hedging paragraphs on an A-or-B question will likely freeze in high-stakes calls.
- **For law students: first-year skills plus deep client and industry knowledge.**
  1L teaches argument and research using mostly outdated law, which stays valuable; years two and three should be hands-on. If your edge is fastest research or brief writing, it never really was.
- **Run early and protect sleep.**
  A morning run gives a ‘shock’ that leaves him calm for the day; ruthless prioritisation shrinks a thousand fires to one ‘terminal’ problem.

OpenAI Co-Founder: “I just had to Quit”

Guest: Greg Brockman
Date: 2026-04-22 · Duration: 1:11:42
URL: https://www.youtube.com/watch?v=6JoUcQ1qmAc

KEYPOINTS

• OpenAI started from a 2015 dinner question: is it too late to compete with DeepMind?
DeepMind had the researchers, capital and data, and AlphaGo was months away. At Sam Altman's July dinner, people listed reasons it would be hard but nobody could name one that made it impossible. Driving back, Brockman and Altman agreed 'we got to do this', and Brockman went full-time the next day. Dario Amodei and Chris Olah turned down the early team and went to Google Brain.

• A Napa offsite turned interested researchers into a team and produced a 10-year technical plan.
About ten people were each waiting to see who else would join. At Altman's suggestion, Brockman (who even made t-shirts) took them to Napa before any offers or structure existed. The plan they came up with was to solve reinforcement learning, solve unsupervised learning, then gradually learn more complicated things. Offers went out right after, with a two-to-three-week start date.

• The pure nonprofit was dropped because doing the compute math in 2017 showed charity money couldn't fund AGI.
Projections of the compute needed, plus the prospect of exclusive access to Cerebras hardware or very large data centers, showed that the scale required was far beyond what nonprofit fundraising could reach. Raising $100–500 million was possible; a billion was 'pretty hard'. Elon Musk, Altman, Ilya Sutskever and Brockman agreed that a for-profit entity of some form was the only route to the mission.

• Dota showed that simple algorithms plus massive compute work in messy real-world settings.
OpenAI chose Dota to force the invention of new methods, because PPO plans at every timestep with no hierarchy and seemed doomed not to scale. They kept scaling PPO anyway and beat the best humans, with a network about the size of an insect brain. The finding was that pushing baselines until they hit the wall can show there's no wall.

• Prediction isn't a shallow task: predicting Einstein's next word means being at least as smart as Einstein.
The 2017 'unsupervised sentiment neuron', trained only to predict the next character, learned whether text was positive or negative, the first sign of semantics emerging. Reasoning models add reinforcement learning, in which the model generates its own data from actions, but training is still prediction, just on differently structured data.

• When stakes feel existential, ordinary office politics like credit and decision rights take on enormous weight.
Brockman says the field is 'fragmentary': under pressure you get diamonds, meaning high-trust teams, or cracks, with groups splintering off. He frames the resulting diversity of labs and approaches, including on safety, as healthy debate that has moved from inside OpenAI into the wider world.

• His first-person account of the firing: no reasons given, and he quit the same day.
On a video call with the board minus Altman, he was told Altman was out and that he himself had been removed from the board but would stay as 'critical to the mission'. When he asked for reasons, he got none. He told his wife 'got to quit' and she agreed. He put the chance of getting the company back at 10% that first day. When the board replaced interim CEO Mira Murati that Sunday, the company rebelled.

• Most of his regrets are about waiting too long, not about acting too fast.
Asked to write his lessons on one page, he lists persistence through 'it's over' and 'so back' swings, steadiness as a leader, and decisiveness. When opinions contradict each other, you have to pick, knowing someone will be upset or quit. His regrets are mostly cases where they knew someone was the wrong person for a role, or a technical direction was wrong, and dragged their feet. Lesson learned more than once: 'Make the hard decision. Have the hard conversation.'

• OpenAI hides chain-of-thought both to resist distillation and to keep reasoning traces honest.
Reading a model's reasoning turned out to be an unexpected way to interpret it. But if you train the chain of thought to look presentable, it stops faithfully reflecting how the answer was reached, so OpenAI decided early never to optimize it for appearance. On distillation, he argues the real moat is 'the machine that makes the models', since they're always on to the next model.

• The world is heading toward a compute shortage, and who gets compute becomes a societal question.
One GPU per person would mean 8 billion GPUs, while fleets are in the hundreds of thousands to millions. He expects dedicated data centers, for example one aimed at cancer, possibly this year. OpenAI keeps a free tier because it believes everyone needs access, and it treats safety as a product feature, since nobody wants a model that isn't aligned with them.

EXAMPLES

• A petition that crashed Google Docs
Employees canceled Thanksgiving flights to pack the office. So many tried to sign the return-Altman petition at once that it crashed Google Docs, and designated people had to add names. Brockman got home around 5 a.m., woke 45 minutes later, and saw Sutskever had signed. No one accepted a competitor's offer that weekend.

• Training DNA models during his time off
Sutskever's later departure was 'maybe the only moment' Brockman didn't want to keep going. During his break he trained language models on DNA sequences for the Arc Institute, work tied to his wife's health conditions.

• GPT-3's top misuse was medical spam
The team had prepared for misinformation, but the number one misuse turned out to be drug advertising spam. That's his case for iterative deployment: by your 100th system you've solved deployment 99 times and society has had time to adapt.

• AI writes nearly all of OpenAI's code
The share not written by AI is 'a vanishing fraction'. Humans still decide module layout and interfaces. When used on chip

layout, the model produced optimizations that were already on the team's list, just faster. He also says a quantum physics problem was resolved in the opposite way the community expected.

- **'Who built this?' 'You did.'**
  A friend typed his sister's app idea into Codex as she described it, and a few hours later showed her a working app. Brockman's point is that the line between consumer and builder is blurring.

OTHER RELEVANT

- **Lean in early to each new generation of AI**
  Across generations of this technology, the people who benefit most from the new one are those who used the last one. The core skill is agency and having ideas, as everyone becomes a manager of agents.
- **Watch for sycophancy**
  OpenAI admits its models drifted toward telling people what they wanted to hear and retrained them against 'hacking the grader'. Judge an assistant by whether it serves your long-term goals.
- **It's easier to see what you'll lose than what you'll gain**
  His Uber analogy: in 1950, using computers, phones and GPS to summon a car in three minutes would sound absurd, yet the same stack enabled millions of other uses. Prepare for disruption and look for what you gain.
- **Cut words to be clear**
  His best advice came from a Harvard freshman writing class: keep cutting words. He reads widely, triages aggressively, and names Gauss and Descartes as role models.

Why Everyone Is Wrong About AI (Including You) | Benedict Evans

Guest: Benedict Evans
Date: 2025-09-02 · Duration: 1:11:53
URL: https://www.youtube.com/watch?v=2NgdQf2GzJg

KEYPOINTS

• His 'controversial' take is the centrist one: AI is the biggest thing since the iPhone, but only that.
Some people say AI is bigger than computing, on the scale of electricity or the industrial revolution. Evans' base case is another platform shift: everything new gets built around it for 10–15 years, it has the same sort of effects on jobs and productivity as previous shifts, and then 'it'll just be software'. Every shift is 'different', like every financial bubble, but that doesn't mean it isn't a familiar pattern.

• You can be sure a technology is huge and still have no idea how it will play out.
In 1995 people talked about 'cyberspace' and an 'information superhighway' run by cable and phone companies. Mary Meeker forecast email users separately from web users and expected email to be bigger. Microsoft won browsers, which turned out not to matter, and the value went to search and social 5–10 years later. In 2000, as a telecoms analyst, Evans was sure mobile internet would happen, but no one foresaw the iPhone as 'a small Mac', carriers and Nokia capturing nothing, or a 10-year lag.

• Incumbents always try to make the new technology a feature, and hindsight makes their fate look inevitable.
People expected IBM to win PCs, Microsoft to win the internet and Google and Meta to win mobile. Kodak's 1975 digital camera was the size of a refrigerator. Once digital was viable, Kodak went all in and briefly sold the most digital cameras in the US. It lost because digital was a low-margin commodity compared with high-margin film, and because smartphones and social media killed printing.

• Google's threat isn't one rival; it's a reset in which everyone reconsiders their defaults.
Evidence from the antitrust trial shows Google is still far better than other traditional search engines. But LLMs reset the product, how it's sold, the org chart and incentives needed to build it, and user habits. Google has big advantages in that reset, but defaults are up for grabs.

• Data isn't a moat for LLMs, because everyone needs essentially all the text that exists.
Models train on text, not YouTube. Meta's lawsuit over downloading pirated books shows even giants lack enough long-form prose; social platforms have short snippets. Anyone with a billion dollars can scrape the web or download Common Crawl from AWS, so the data is a level playing field.

• The models look like commodities, and the consumer winner so far is brand and distribution.
He bets most people couldn't tell Grok, Claude, Gemini, Mistral and DeepSeek apart in a blind test. Yet ChatGPT tops the app store while Gemini ranks between 50 and 100 and the others don't make the top 100. He compares it to browsers, which have barely innovated beyond tabs and search in the address bar. There's no network effect yet, since more users don't improve the model. Memory is a switching cost, and you could ask one model what it knows about you and paste it into another.

• Most people still look at chatbots and 'don't get it'.
Across five US surveys he sees about 10% of people using an LLM chatbot daily, 15–20% weekly, 20–30% every month or two, and 20–30% who tried it and didn't see the point. Fast adoption is an unfair comparison, because it's a free website while a 1980s PC cost about $5,000 in today's money. The real puzzle is why weekly users can only think of something to do with it once a week.

• A blank chat box puts the burden on the user; products that wrap AI in a specific task get adoption.
Evans doesn't code, brainstorm, summarize or make images, which are the obvious uses. The things he would want done, like figuring out why a client's ERP system rejects his bank details, LLMs can't do yet. A 'draft a reply' button inside Salesforce gets used because someone else has worked out the use case. He compares it to VisiCalc, where accountants finished a month's work in a week.

• Whether output that's 'roughly right' is useful depends on whether you can fix it.
Today he says chatbots are wrong 'a dozen times a page' and have zero value where numbers must be exact. An AI-written conference bio of him was the right kind of bio with all the wrong facts. That was useless to the organizers but useful to him, since he could correct it in 30 seconds.

• AI rarely produces 'original and good', because LLMs lack a feedback loop for originality.
AlphaGo could invent moves because every move gets a score. Monkeys at typewriters and Borges' library produce masterpieces with no way to recognize them. For an LLM, variance counts as error. Could a model have known that fans tired of 1970s prog rock would want punk, or that post-war Europe would embrace Dior's New Look? As AI handles the median, value shifts to the curated, the in-person and the unique.

EXAMPLES

• Automatic elevators with 'electronic politeness'
Until the 1950s, elevators were manually driven 'vertical streetcars'. Otis's automatic version had 'electronic politeness', the sensor that stops the doors closing. Today nobody says 'automatic elevator'; it's just a lift. His point is that new technology stops seeming strange.

• Anthropic's 'blackmail' headlines
Evans compares those studies to writing 'murder is good' on paper, photocopying it, and announcing the machine says murder is good. If you ask a story-generating machine what it would do in a scenario, it tells the likely story.

• The 'Is this what ChatGPT would say?' test
Evans thinks by writing. Before publishing, he asks whether ChatGPT would have said the same thing, and if so he drops it, because anyone could have said it. Shane points out the bar rises as the models improve.

• Zola's department store

In Au Bonheur des Dames, a 19th-century 'Jeff Bezos' invents fixed prices, loss leaders and mail order while rival shopkeepers sneer that he'll be selling fish next. People have panicked before about mass production and too much content.

• Tesla as 'Android with no iPhone'

Evans argues cars are becoming Android with no iPhone, and Tesla is just another Android-style maker facing a flood of Chinese EVs that are just as good, protected only by US tariffs. Its robotaxi launch was a handful of geofenced cars with safety drivers, something others did a decade ago.

OTHER RELEVANT

• Regulate uses, not 'AI'

Regulating AI as such is like regulating spreadsheets. 'To govern is to choose': if you make building models hard, as he says the EU and a past California bill attempted, you can't then complain about the result, just as restricting housing makes houses expensive.

• Study to learn how to think

Studying history at Cambridge taught him to find the next question, skim 50–100 books a week for what matters, and judge credibility. Don't assume you will or won't be an engineer. Stay curious, try many things, and expect many careers. It took him 20 years to work out what he was good at.

• Calibrate by seeing many examples

Like seeing a Raphael glow across a room in a small Roman gallery, seeing many startups at a16z teaches you what good looks like. The right question isn't 'Is it dumb?' but 'If it worked, what would it be, and can these people make it work?'

A Technologist's Guide to the Future | Nathan Myhrvold | Knowledge Project Podcast

Guest: Nathan Myhrvold
Date: 2023-03-21 · Duration: 0:57:01
URL: https://www.youtube.com/watch?v=pi7iclNf24I

KEYPOINTS

• Make each decision as carefully as you can, then watch how it plays out and be willing to change your mind.

That was Myhrvold's rule at Microsoft, which he joined when it bought the software company he'd started in grad school, taking a 'leave of absence' from his postdoc with Stephen Hawking. When he later retired, Hawking emailed to ask whether to clear out his office. Microsoft's slogan, 'a computer on every desk and in every home', drew grief at the time ('an absurd nerd fantasy'). In 1990 Myhrvold wrote a memo arguing you'd need one in every pocket. Cars are now 'computers with wheels': the easiest performance upgrade is a new chip.

• In environments built for machines, they beat humans. Roads are harder, and the real question is whether we'll accept better robots.

No modern jet flies without an autopilot, yet even Star Trek has a human steering the starship. High-speed trains and most modern subways are effectively computer-controlled because people are slow, distractible and unreliable. Autonomous cars, he says, 'aren't really autonomous' today and don't yet match human drivers. Too many random things happen on roads. But little improvement would be needed to surpass us, and then society must decide whether to accept them. The Air Force, run by pilots, resisted drones. A missile can pull G-forces that make a pilot black out, 'and you've got to call their mom when they die.'

• Explore space with machines. Colonizing Mars is a holdover from the age of imperialism.

Crewed spaceflight is now 'a reality TV show', with space tourism at its cutting edge, and keeping a fragile human alive in space is enormously costly. Against Mars colonization he asks, 'Is Antarctica full?' Antarctica is warmer and has air and water. Getting to Mars means long trips, cosmic radiation and frequent lost probes, and signal delays of minutes mean rovers must be semi-autonomous. If we truly needed a second home, the Moon or space habitats would be closer. Treating Earth as disposable means 'you're going to screw Mars up too'.

• We fix pollution that is local, short-lived and traceable. Climate change is none of those.

Spain once had a quarter of a million cyanide-killed fish rotting in a river at Seville in August, and it got fixed fast, as did Love Canal and Los Angeles smog. Beijing will fix its air too, once residents demand it. Wildfires are more diffuse: forestry that suppressed every small fire left fuel for huge ones. Climate is the worst case: global, slow and hard to attribute. 'To first order, we're doing exactly nothing,' he says. Renewables are growing, but not fast enough to offset new coal in fast-growing China and India, and CO2 readings at Mauna Kea rise every year.

• Fossil fuels will only be displaced by something clearly better, as coal replaced wood and kerosene replaced whale oil.

Britain's need for fuel and timber stripped Scotland of forests. Around 1875, the humor magazine Punch ran a cartoon of whales holding a ball to honor 'Colonel' Drake, whose Pennsylvania oil replaced whale oil in lamps. Soon after, the light bulb beat flames altogether. We have no such superior climate option yet. Momentum keeps getting interrupted: the 2008 crisis after An Inconvenient Truth, then the pandemic, then war. He argues Europe's natural gas was never clean, because leaked methane has about 120 times CO2's warming effect in its first year, and many estimates put gas worse than coal overall.

• Humans procrastinate and then panic. With climate, panic comes too late, because the physics doesn't forgive.

We know we should eat well and exercise, yet the average American is overweight. With pandemics, people argued that heart disease and cancer kill daily while pandemics come once a century. His answer: fire sprinklers. Any one building rarely burns, but we protect them all. Panic can work. A Pfizer executive, he recalls, demanded a vaccine in eight months rather than eight years so teams would rethink the process instead of tweaking it. Pearl Harbor turned an isolationist US serious, and half the 'parade generals' were let go within three months. But CO2 lasts thousands of years. Halt all emissions on 'panic day' and temperatures keep rising for about a century and take about 145 years to return to that day's level.

• Geoengineering, such as dimming sunlight by about 1%, could offset warming. Treat it like emergency heart surgery.

Sunlight averages about 300 watts per square meter, and extra trapped heat (radiative forcing) is about 2, less than 1%. Ice, high clouds and deserts reflect light; melting Arctic sea ice exposes dark ocean that absorbs it. White roofs and roads help a little. Solar radiation management would put reflective particles in the stratosphere, as Mount Pinatubo did in 1991, cooling the globe by 1–1.8°F for about a year. Cracking his chest open for a heart attack is awful but worth it. You wouldn't do it for a hangnail.

• Critics fear geoengineering will sap willpower and cause new problems. He replies that willpower fails, and trading problems is human history.

To the 'Little Engine That Could' view that we just need resolve, he says that would mean no one was overweight, 'me included'. When CO2 falls year on year, he'll stop arguing. On side effects: agriculture enabled civilization and then brought famines. Cars rescued cities 'drowning in horse urine' and still kill far more Americans each year than died on 9/11, roughly double the number murdered, but we tolerate that for mobility.

EXAMPLES

• Cooking Thanksgiving at nine

After finding cookbooks at the library, he announced he'd cook Thanksgiving dinner alone. Later, while at Microsoft, he persuaded Bill Gates to give him leave and a French culinary school to take him. He went on to write Modernist Cuisine.

• Why EVs aren't automatically green

Statistically, he says, charging a Tesla on the US East Coast hurts the climate, because the power is fossil-derived. In Washington State, with hydro and nuclear, it helps.

- **A nuclear plant for China**
  His nuclear company once planned its first new-design plant in China. When critics objected, he said, 'We all share the same atmosphere,' and China is the one building coal plants. The plant is now planned for Wyoming.
- **The bioterror asymmetry**
  'Thank God for nuclear weapons,' he says, half seriously: hostile states crave them, and they're very hard to build. Bioweapons are cheaper, easier and harder to control, so he expects a bioterror event someday.
- **Why developing nations push back**
  The US and UK burned fossil fuels for 150 years. China and India say 'it's our turn', and there's no way to force them short of war, which would itself be disastrous for the climate.

OTHER RELEVANT

- **Optimism takes willpower**
  'Pessimism is just so damn easy,' he says, after a war of conquest in Europe that would have sounded crazy two years earlier.
- **Hindsight isn't a lesson**
  Asked what he wishes he'd known, he jokes about shorting Lehman, then says second-guessing isn't helpful.
- **Small fixes still count**
  White roofs and roads won't solve warming, but they reflect sunlight and help.

Inside the Mind of A Famous Investor | Marc Andreessen

Guest: Marc Andreessen
Date: 2022-01-25 · Duration: 1:17:36
URL: https://www.youtube.com/watch?v=1n2rXx-IOyE

KEYPOINTS

• When you don't understand the present, read backwards. Most 'new' patterns are old.
Many of Andreessen's assumptions about how the US, politics and society worked were 'upended' between about 2008 and 2015, so he started reading history to see how much of today is actually new. The further back he goes, the more universal the themes look, which he finds 'calming'. Take the claim that a new technology will ruin the next generation of kids: ask whether the same claim was made about earlier technologies, whether it was the same claim, and how it played out. He points to a rich literature in the history and sociology of technology.

• Society meets new technology in three stages: ignore it, argue against it, then call names.
He draws this from MIT historian Elting Morison's short book Men, Machines, and Modern Times, written more than 50 years ago, before the internet. First, experts dismiss the new thing. Second, the status quo assembles rational arguments for why it can't work. Third, it 'goes bananas' and accuses the technology's proponents of moral crimes. The reason is that technological change is really a reordering of power and status, and status fights are the most vicious ones humans have. Technologists who think they've built a better mousetrap are surprised to find everyone hates them.

• The deep conflict today is hierarchies versus networks.
Between about 1880 and 1939 the West got very good at giant top-down systems: mass manufacturing, mass media, mass government and two-party mass politics, with power exercised in conference rooms, as described in The Organization Man. The internet arrived at near-peak centralization with the opposite architecture: no central node, permissionless, lateral. In 2006, getting an app on a phone meant pitching carriers in a conference room for a place on 'the deck', with opening bids of 40–50% of your revenue. Soviet dissidents risked being shot for owning a mimeograph machine. Now people use the internet both to entrench institutions and to disrupt them, on the left and on the right.

• The optimistic case is a rebel alliance of internet-educated kids. Every winner becomes an incumbent in about five years.
Founders now arrive from everywhere, far more knowledgeable than he was at their age because they learned online. The fight is asymmetric: an empire must defend against every attacker, while challengers only need to win once. But a successful startup has about five years before it starts acting like an incumbent, which is rational because it now has something worth defending. Often it's a 26-year-old angry at a 21-year-old. He relays Peter Thiel's harsher view that Google has become anti-tech, but frames it as 'the incumbent temptation' rather than a judgment of any one company.

• There are two pessimistic cases: 1984, or networks that destroy but can't build.
In the first, technology becomes a tool of top-down control. Peter Huber's Orwell's Revenge rewrites 1984 with two-way telescreens, and the rebels win. The second is Martin Gurri's thesis in The Revolt of the Public: peer-to-peer networks are great at tearing hierarchies down but haven't proven they can govern, run a democracy or replace banks. That leads to nihilism. Niall Ferguson's The Square and the Tower expresses a similar fear, and Andreessen agrees with the first two-thirds of it and is 'very mad' at the last third.

• Scar tissue shrinks what you'll explore. In probabilistic fields, 'there are no bad ideas, just timing'.
Life is touching one hot stove after another: a startup fails, so 'don't work at startups'; you're laid off, so 'never trust big companies'. Your aperture narrows with age. In top-tier venture, about half the companies in any period fail, many simply because they're too early. Webvan failed and food delivery is now huge. He believes that by now almost every failed dot-com idea of the late 1990s has worked. So a16z asks only whether this is the right person and the right time. He cites Annie Duke's warning against 'resulting': in poker, play the next hand the same way, and Kobe Bryant is near the top of the list for missed shots.

• Judge success by the portfolio, not the individual bet. 'We're in the fluke business.'
Every top VC in history missed almost all of the great deals of their generation. So a16z judges baskets: a gaming push might back ten studios, and it's fine if one produces 99% of the profit. When a partner's ten investments include one huge hit and nine flops, someone will call the hit a fluke. Andreessen's reply: 'the whole point is to get the flukes.' Not needing 100% means you can take chances. That's true of creative work generally, though not of running a nuclear plant.

• One partner pulls the trigger: budgets, not votes.
Some firms require unanimity or a 'council of elders' giving a thumbs up or down. a16z gives partners budgets, and within them they can invest in what they want. In exchange, they must do deep work, keep no secret deals, and present to colleagues who may 'crap on it' without having a veto. A failed investment is acceptable. Missing the category winner because you didn't know it existed is not. The model favors offbeat ideas that fit no box, and it adds speed. It also avoids the 'idea event horizon', the point where veterans say 'TikTok, really?' and stop processing anything new.

EXAMPLES

• The 21-year-old who isn't new
Breakthrough founders like Zuckerberg often have no track record, but usually they've been deep in the domain for years: coding games at 11, building guild-matching tools in high school, a CS project in college. 'It's a much safer bet than it looks.'

• Three tiers of bets
Seed ($2–5M) is almost entirely a bet on the people. Venture ($10M+) means a board seat, a ten-year commitment and staying out of competitors, so the question is whether this team wins the category. Growth ($50–300M) is where numbers matter, plus whether the founder has new 'venture-quality' ideas still to come.

• Schools as factories
Mass education was built about a century ago with Model T and time-and-motion methods to train factory and office workers. He calls it unreformable, with public-sector employees holding both civil-service and union protections. The answer is building

new networks for homeschooling and micro-schools.

- **Pro-market, not pro-business**
  Soft drinks fight for every purchase. Oligopolies like big banks or accounting firms capture regulators. No new US car company mattered for about 80 years, until Tesla.

- **Bezos and kindergarten**
  Asked whether he'd start over if Amazon were gone, Bezos laughed: that would be 'going back to kindergarten'. Andreessen's point is that success erodes the willingness to return to basics.

OTHER RELEVANT

- **Imaginary shoulder advisors**
  He asks what Elon (first principles), Thiel (Girard's mimetic rivalry and scapegoating), Jobs or Grove would say: 'Marc, that's stupid.' It's a forcing function against complacency, like a strong board.

- **Blame the incentive designers**
  Following Munger, he faults whoever created the incentives, not people trying to feed their families inside the system.

- **Books he returns to**
  Henrich's The WEIRDest People in the World, Burnham's The Machiavellians, Gurri's The Revolt of the Public, and The Ancient City, an 1860s French study of pre-Roman society that he has dog-eared on nearly every page.

Semiconductors: Everything You Wanted to Know

Guest: Jon Bathgate and Brinton Johns
Date: 2020-11-23 · Duration: 1:09:27
URL: https://www.youtube.com/watch?v=r6NUO_bymuA

KEYPOINTS

• Semiconductors are the unsung building blocks of the digital economy.

Software may be eating the world, say NZS Capital investors Jon Bathgate and Brinton Johns, but semiconductors do the work underneath. Nearly every major trend of the next 10 to 15 years runs on chips: electric and autonomous cars, AI, the connected factory, drug discovery. The COVID-19 genome was mapped in January, before the virus really hit the US. Their test for strategic importance: if a company were wiped out, would it matter? Lose CVS and you go to Walgreens. Lose a couple of firms in the chip value chain and the world goes backwards 10 or 20 years.

• The industry went horizontal — and a passed-over CEO candidate created the foundry.

Early players like Texas Instruments did everything: made equipment, fabbed chips, sold calculators and the Speak & Spell. As the industry matured, it split into layers. Morris Chang, passed over for TI's CEO job, returned to Taiwan. Asked to build a chip industry on an earthquake-prone island, he realised fabrication was customers' pain point. So he founded TSMC to make other companies' chips without competing with them: the foundry model. Today, when Apple 'makes' its chips, TSMC fabs them; Tesla's are fabbed by Samsung in Austin.

• A few companies hold chokepoints across the value chain.

Chip designers lay out chips with electronic design automation software from just two firms, Synopsys and Cadence. TSMC fabs nearly all bleeding-edge digital chips, with Samsung as second source. Equipment comes from a handful of suppliers: ASML in the Netherlands, Lam Research, KLA and Applied Materials in the US, and Tokyo Electron. Everyone collaborates closely, and there's margin throughout the chain. Doing the whole stack yourself every two years became too hard, even Intel outsourced its design software.

• Fall behind and the race gets exponentially harder.

GlobalFoundries, spun out of AMD and backed by Middle Eastern sovereign wealth, had effectively unlimited resources. Yet facing the move to 10nm, it gave up and settled for older technology. China's SMIC has spent tens of billions over 20 years and remains about a decade behind. Its plan for a fab with no US equipment targets a 28nm line, roughly 10-year-old technology by the time it's running. Skipping nodes is almost impossible, Johns says. Combine the same machines and 'one plus one plus one could give you blue,' and it takes a year to trace why.

• EUV lithography is one of humanity's hardest engineering feats.

Leading-edge chips are 5nm; a nanometre is about two to three silicon atoms. Traditional lithography light is 193nm, stretched with lenses and water immersion until around 10nm. ASML's extreme ultraviolet light is about 10.5nm. To make it, drops of molten tin are hit with a laser in a vacuum, about 50,000 times a second, creating plasma. Because EUV is absorbed by all known mirrors, ASML had to invent new ones to bounce it off about 20 of them. Only one private German company makes the laser. Nikon gave up on EUV, so ASML has a natural monopoly. One system costs about $200 million and needs four 747s to ship.

• Classic Moore's Law has ended — 'More than Moore' hasn't.

Gordon Moore predicted transistor density would double every one to two years at the same price, which democratised chips into everything. Bathgate thinks that literal definition has empirically ended against the laws of physics. But computing performance can keep doubling through chiplets, stacked chips, 3D transistors (enabled by Lam Research), new materials and specialised architectures. ASML's high-numerical-aperture tools, about $300 million each, map a path to around 2 or 1.5nm by decade's end. Even Intel, which led Moore's Law for some 40 years, fell off around 2015: a two-year node took five.

• GPUs and CUDA turned Nvidia into an AI powerhouse.

If a CPU is a big V8 engine, a GPU is lots of little engines doing parallel work, as when rendering screens. When Jensen Huang started Nvidia there were about 100 GPU competitors; now there are two, both fabbed at TSMC. About 15 years ago Nvidia released CUDA, letting anyone write code for parallel GPU architectures. That carried GPUs into data centres, where Nvidia's business grew from a couple of hundred million dollars to about $4 billion in five years. AI model parameters were doubling every three to four months, needing GPU clusters with only a few CPUs. Meanwhile ARM licenses low-power designs to Apple and Qualcomm, and open-source RISC-V is emerging.

• Chips are the ultimate geopolitical leverage.

The US cut ZTE off from chips over Iran sanctions for a few months, crippling it. Huawei, once about 20% of TSMC's sales and a national champion with over $100 billion in revenue, was later blocked: TSMC couldn't build for it using US equipment, and nothing can be built without it. US companies earn about half of semiconductor revenue; China buys over half of chips. But about 70% of chips pass through Taiwan at the front or back end. Less than 15% are now made in the US. Rebuilding requires a whole ecosystem, which moves in decades.

EXAMPLES

• Texas Instruments' catalog strategy.

CEO Rich Templeton exited cellphone chips — the majority of revenue — when no buyer could be found, bled it to zero, and doubled down on analog. Analog parts average about 30 cents, last 30–40 years in cars and tractors, and give TI some of the S&P 500's best margins.

• A $5 billion empty factory.

When a Chinese DRAM project's IP origin came into question, the US stopped selling it equipment and everyone walked off.

• US versus China, played as chess.

Bathgate would rally Apple, Qualcomm, Nvidia, Amazon and Google behind a roughly $100 billion domestic manufacturing push. Johns, playing China, would lock Apple's factories, pressure Taiwan, or withhold drug precursors and rare earths.

• Intel's foundry stumbles.

Intel never mastered making chips for others; its Altera partnership and 2016 acquisition suffered manufacturing problems. Outsourcing to TSMC would be like a pastor announcing he no longer believes in God.

OTHER RELEVANT

- **Who could be the next Morris Chang?**
  Candidates suggested: Cadence CEO Lip-Bu Tan, who knows everyone, or TI's Rich Templeton, who still runs fabs.
- **There is no next big thing.**
  After mainframes, PCs and smartphones, growth now comes from cars, data centres, industry and medicine at once — spurring the first chip startups in ages.
- **Mutual dependence keeps the peace.**
  Like masks and antibiotics, critical chips may need domestic or reliably friendly suppliers.