

Computers and Society

CSE 351 Autumn 2023

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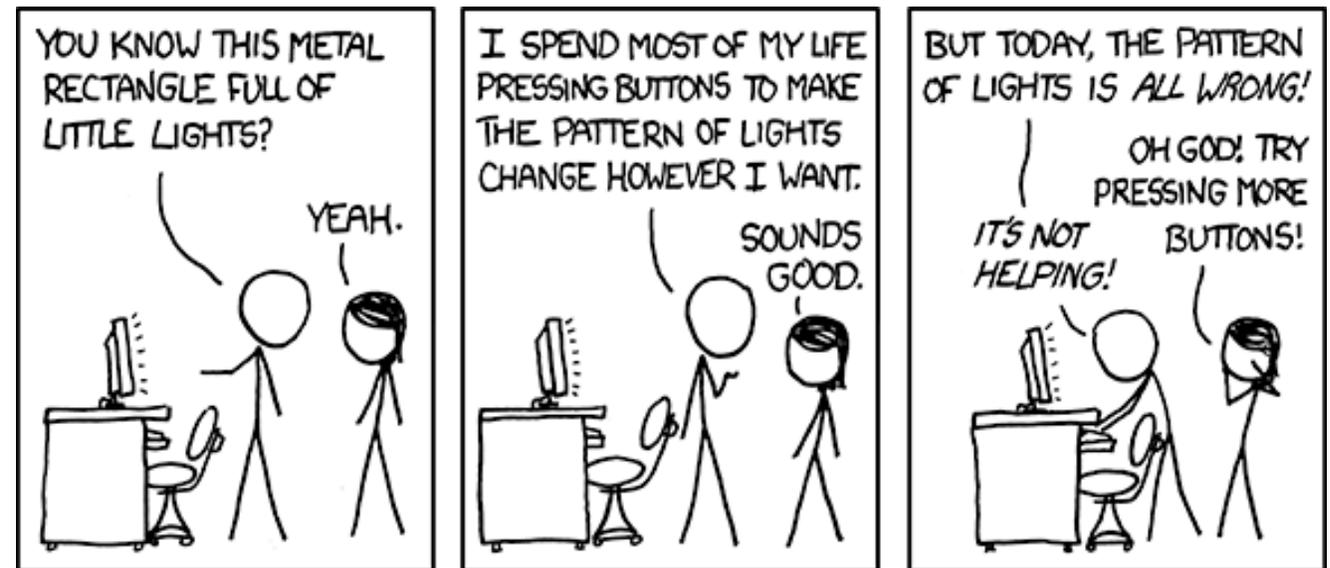
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<http://xkcd.com/722/>

Alt text: "This is how I explain computer problems to my cat.
My cat usually seems happier than me."

Relevant Course Information

- ❖ Lab 5 due Thursday (12/7)

- ❖ Course evaluations open
 - See [Ed post #1132](#) for links (separate for Lecture and Section)

- ❖ **Final Exam:** take-home Dec. 11-13
 - Review Session: Friday, 12/8, 4:30-6:30 pm on Zoom & CSE2 G01
 - Similar structure to Midterm, including Gilligan's Island Rule
 - Final review packet on website now, will see in section

Disclaimers

- ❖ This is a big and nuanced topic
 - Could fill whole courses with this type of content
 - *e.g.*, CSE480: Computer Ethics Seminar
 - Our hope is to expand your viewpoints about computers (and computing), but please think critically about the information and come to your own conclusions

- ❖ This lecture is a work-in-progress
 - There is a lot more I wish I could cram in here
 - It has a narrative that someone (me) designed, therefore it is inevitably imbued with my values and beliefs and experiences

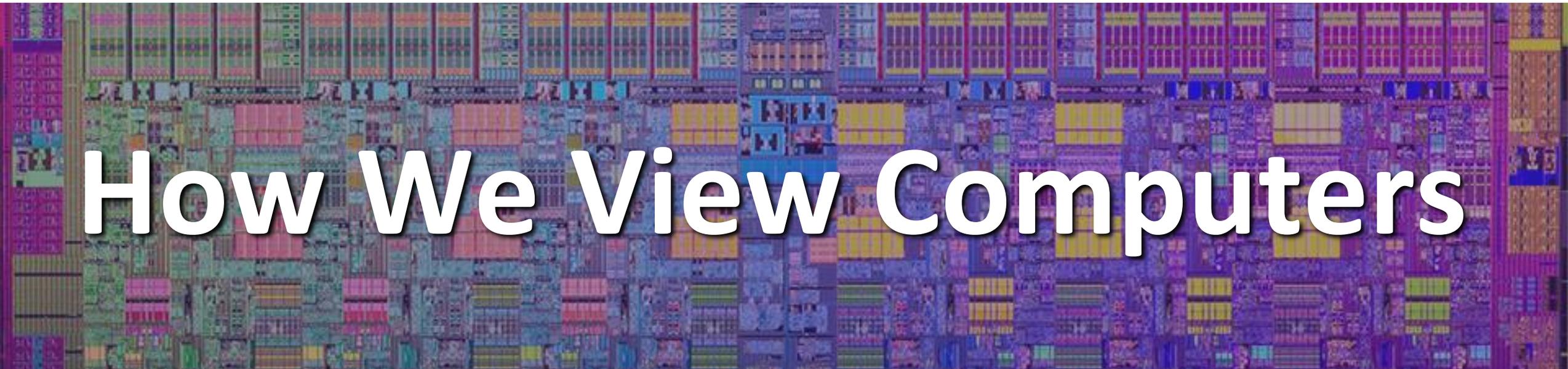
Pre-Quarter Survey Quotes

- ❖ Note that I will be interspersing some quotes from the pre-quarter survey, where one of your prompts was:

What is your current impression of computers?

This is a fake quote!

- These will be included without attribution for privacy
- The point is not to call anyone out or to pass judgment, but to validate some of the points being made today as well as recognize that society shapes our views and values



How We View Computers

How We View Computers

- ❖ Top responses: fascinating/cool, powerful, and complex
 - Based on personal usage, media, and coursework
- ❖ Personal views vary, but many trend towards **utopian/essential, mysterious, and cautious**
 - Easier to see the positives (that's how they're marketed), but increasingly becoming aware of negatives
 - Please remember that y'all are a biased sample of society
 - Also, the following quotes were from the beginning of the quarter

Pre-Quarter Survey Quotes (Utopian/Essential)

As far as I'm concerned, **computers are the key to the next stage in humanity's progress, both in terms of industry and culture.**

I think that **computers are the basis of all major breakthroughs from now on in human history, and will never really stop evolving.** I don't know how much science fiction is realistically going to come to pass, but I have no doubt that in some ways we as a population will blow [past] anything that anyone can imagine.

Computers serve as versatile and indispensable tools across diverse industries. They function as highly adaptable devices, facilitating an array of tasks and projects in areas such as business, scientific research, and entertainment [via] their capacity for data processing, communication, and automation.

I consider the computer as the most fascinating achievement that has been made in human history, as the development of computers has literally shaped the 21st century and how we live today, **making us unable to imagine how we live without computers.**

Pre-Quarter Survey Quotes (Mysterious)

In all honesty, I find them really complicated and **daunting to learn about**. I think there are so many components, from hardware to software that **I get intimidated to even start learning about it**.

Computers are a bunch of math and numbers that somehow managed to create some insane things.
Also video games.

My current impression of computers is that they are incredibly powerful tools. **Many people use websites and everyday apps without knowing what goes on behind the scenes**. The ability for humans to communicate with computers, instruct them on what to do, and essentially design anything they envision is truly fascinating.

Pre-Quarter Survey Quotes (Cautious)

My current impression is that **they are powerful tools that can help humanity achieve their goals but it's also a double edge sword because other humans can use technologies that a majority of the population doesn't understand or know to abuse their power.**

They're impersonal and mechanical. They've caused a lot of people to think in [an]... unfocused way rather than in a sequential, logical way. **I don't like the way they've directed society at least culturally,** but I think they can still accomplish a lot.

My current impression of computers is that they're essentially necessary for our survival. Despite this fact, **there are plenty of negatives related to computers such as the overuse of social media, allowing predators to have greater accessibility, and climate concerns.**

Computers as Tools

- ❖ **“We shape our buildings and afterwards our buildings shape us.”** – Winston Churchill in a 1943 speech
- ❖ **“We shape our tools, and thereafter, our tools shape us.”** – John Culkin in a 1967 article about Marshall McLuhan



A Brief History of Computers

The First Computers

- ❖ **Computer:** a *person* who computes
 - Doing calculations by hand quickly for aeronautics, warfare, science, etc.



The women of
Bletchley Park,
Credit: BBC



Human Computers at NACA, Credit: NASA



Human Computers at JPL, Credit: JPL

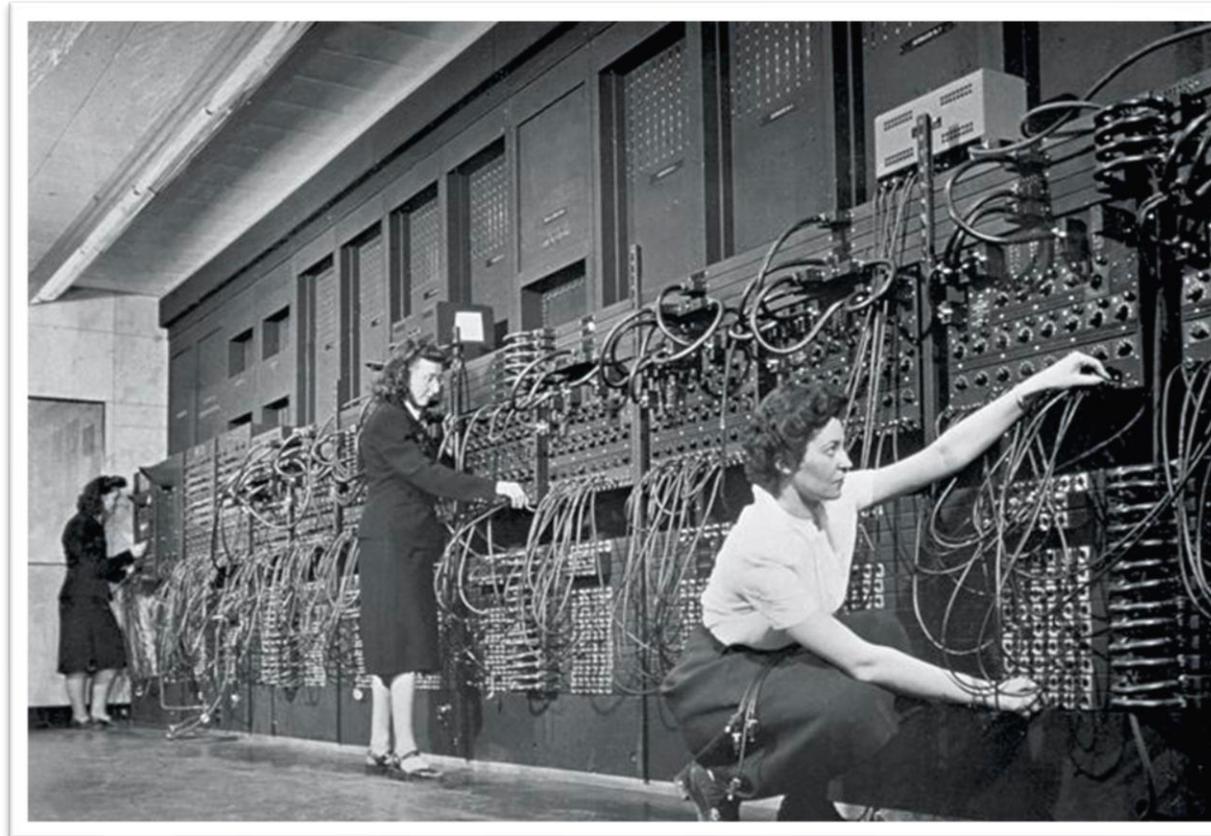
ENIAC

- ❖ 1st programmable, electronic, general-purpose digital computer built at UPenn in 1945
 - Automated ballistics calculations for the US military



Historical Programming (1940's)

- ❖ Manual plugboard wiring to connect arithmetic machines:



Jean Jennings (left), Marlyn Wescoff (center), and Ruth Lichterman program ENIAC at the University of Pennsylvania, circa 1946.

Photo: Corbis <http://fortune.com/2014/09/18/walter-isacson-the-women-of-eniac/>

Historical Programming (1940's-1970's)

- ❖ Programming via punch cards
 - Idea taken from automated looms and data processing



Historical Programming (1940's-1970's)

- ❖ Human computer operators manage program queue
 - Precursor to operating systems!



Historical Programming (1970's)

- ❖ Magnetic tape replaced punch cards, operating systems could run more than one program
 - Programming by typing into a machine now:



<https://s-media-cache-ak0.pinimg.com/564x/91/37/23/91372375e2e6517f8af128aab655e3b4.jpg>

Computing History and Women

- ❖ Early computers and then later computer operators were mostly white cis-women!
 - Allowed to do the “boring, repetitive” work
 - Less common, but also available to some women of color:

HIDDEN FIGURES



Source: <https://netforward.net/what-hidden-figures%E2%80%8B-can-teach-us-about-the-importance-of-diversity-in-tech/>

High Paying Jobs for Women

Source:

<http://thecomputerboys.com/wp-content/uploads/2011/06/cosmopolitan-april-1967-1-large.jpg>

The Computer Girls

BY LOIS MANDEL

A trainee gets \$8,000 a year
...a girl "senior systems analyst"
gets \$20,000—and up!
Maybe it's time to investigate....

Ann Richardson, IBM systems engineer, designs a bridge via computer. Above (left) she checks her facts with fellow systems engineer, Marvin V. Fuchs. Right, she feeds facts into the computer. Below, Ann demonstrates on a viewing screen how her facts designed the bridge, and makes changes with a "light pen."

Twenty years ago, a girl could be a secretary, a school teacher . . . maybe a librarian, a social worker or a nurse. If she was really ambitious, she could go into the professions and compete with men . . . usually working harder and longer to earn less pay for the same job.

Now have come the big, dazzling computers—and a whole new kind of work for women: programming. Telling the miracle machines what to do and how to do it. Anything from predicting the weather to sending out billing notices from the local department store.

And if it doesn't sound like woman's work—well, it just is.

("I had this idea I'd be standing at a big machine and pressing buttons all day long," says a girl who programs for a Los Angeles bank. I couldn't have been further off the track. I figure out how the

computer can solve a problem, and then instruct the machine to do it."

"It's just like planning a dinner," explains Dr. Grace Hopper, now a staff scientist in systems programming for Univac. (She helped develop the first electronic digital computer, the Eniac, in 1946.) "You have to plan ahead and schedule everything so it's ready when you need it. Programming requires patience and the ability to handle detail. Women are 'naturals' at computer programming."

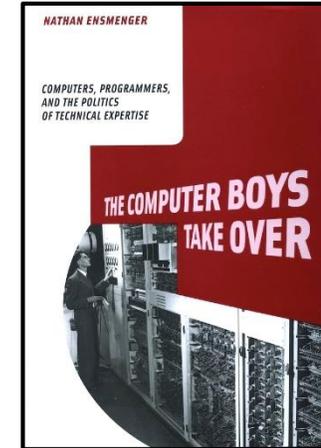
What she's talking about is *aptitude*—the one most important quality a girl needs to become a programmer. She also needs a keen, logical mind. And if that zeroes out the old Billie Burke-Gracie Allen image of femininity, it's about time, because this is the age of the Computer Girls. There are twenty thousand of them in the United (cont. on page 54)



The Computer Boys Take Over

- ❖ Over time, programming transformed!
 - From boring, repetitive work into a creative, intellectual pursuit
 - From “low-status, largely feminized labor” to coveted by those in power

- ❖ Through the ages:
 - Human computers – largely female
 - ENIAC – hardware designed by men, programmed by women
 - Punch cards – programs designed by men, computers operated by women
 - Contemporary programming – boys encouraged, girls discouraged



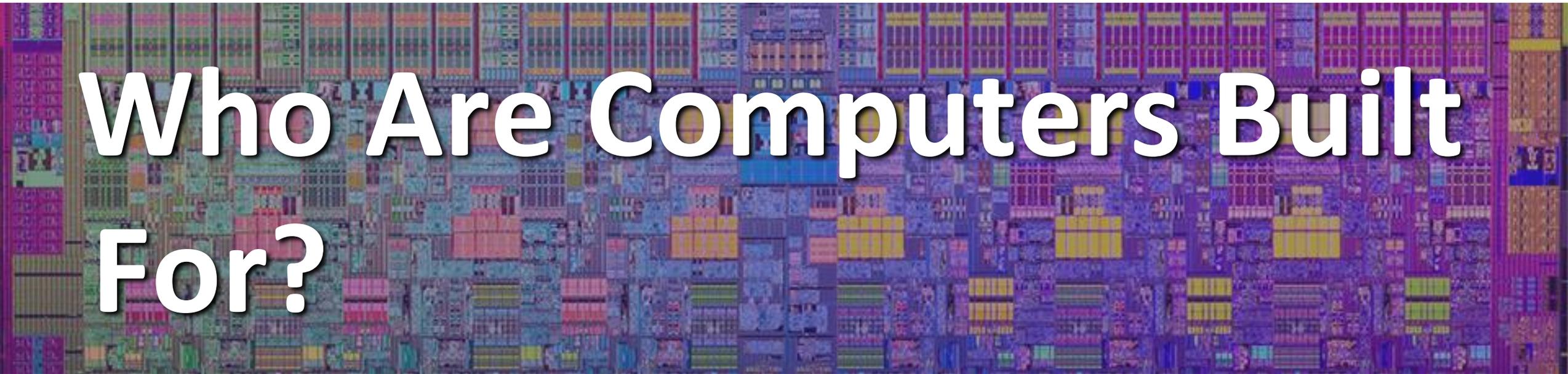
Historical Legacy of Computers

- ❖ Computers **augment** the abilities of humans
 - Makes the labor of boring, repetitive work more widely available
 - Highly valued, but generally *exclusively* available
- ❖ Computers **automate** the boring, repetitive work
 - Culturally, we are conditioned to believe that all of this work *should* be automated
 - Consistently eliminates the jobs of marginalized folks
 - *e.g.*, ENIAC's calculation speed could displace 2,400 human computers
- ❖ Both narratives are simultaneously true, even today!
 - Underlying goal is **efficiency of labor** (for profit)
 - Take CSE478: Autonomous Robotics for more ethics here

Quick Discussion

- ❖ What jobs have you heard about that might be in imminent danger of automation?
 - Who stereotypically holds these jobs?

- ❖ What are some of the consequences if there are no more “low skill” (*i.e.*, boring, repetitive) jobs for humans?



Who Are Computers Built For?

Who Are Computers Built For?

- ❖ New computers come with *de facto* requirements:
 - \$\$\$ – generally quite expensive
 - A regularly-available power supply
 - Access to the internet
 - A trained user
- ❖ Most useful to those with social power and privilege!
 - Have the means to afford new technology
 - Have access to learning opportunities and education

Computer Marketing

- ❖ First digital computers took up whole rooms
 - Housed at prestigious/exclusive universities, accessible to math and engineering students



Computer Marketing

- ❖ First digital computers took up whole rooms
- ❖ With advent of personal computing, marketed to those with leisure time and money

How to talk your parents into parting with \$1300.

There's a new Apple® Personal Computer called the IIc that's so complete and so affordable that getting your parents to buy one should be easier than learning Logo.

If that is, you know what to say. For example, don't tell your parents that the IIc has the first true VLSI motherboard, dual built-in RS-232 ports and a built-in half-height disk drive. Or that it has a switchable 80/40 character display and built-in mousematics so it can use an AppleMouse.

Now know that's incredible in an 8 pound** computer, but all those specs may make your parents uncomfortable. Just tell them that the Apple IIc can run more than 10,000 programs written for the Apple IIe, the most popular computer in education at all levels. And it You might also mention that it's a bargain. It comes with everything you need to start computing in one box—including an RF modulator that lets you hook it up to your TV the moment you can use when you're too busy to show them how.

All for under \$1,300**

Of course, they probably won't want to hear that it runs more games than any other computer in the world except the Apple IIe.

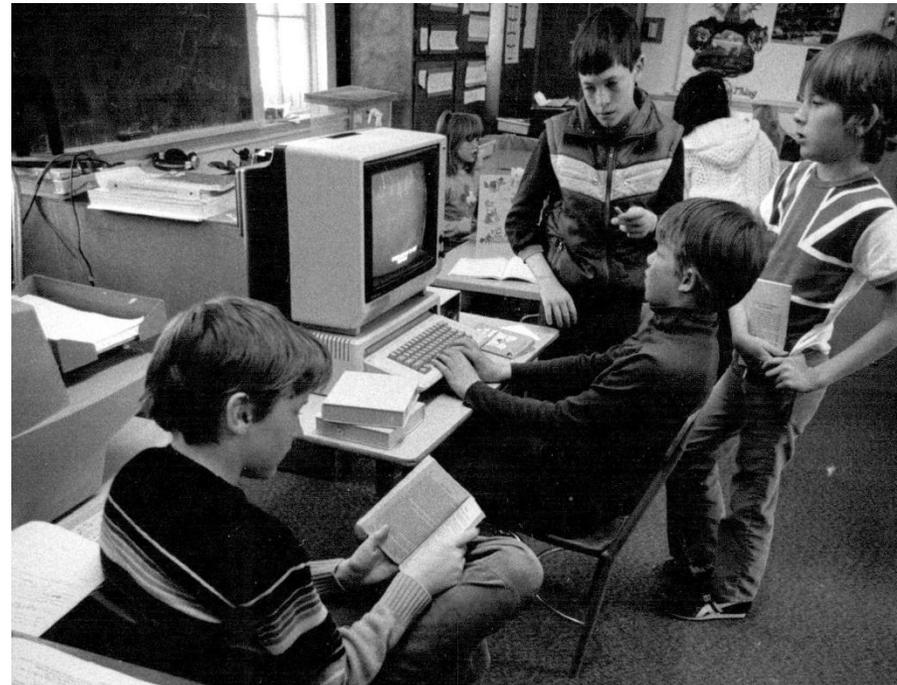
But they might like to know that it also runs advanced business software. Including specialized programs for every profession from doctoring to farming to astronauting. Not to mention personal productivity software to manage their personal finances and taxes. Speaking of which, they can deduct part of an Apple IIc's price from their taxes if they use it for business. Even if they always keep it at home.

Don't confuse them right now with the wide array of Apple IIc accessories: modems. Or the IIc's low cost full-color graphics/text printer, Scribe. But assure them that your IIc can grow just as fast as you do. Now, if all of these carefully reasoned arguments fall on deaf parental ears, don't despair. There is still one thing more you can do. Get a paper route.

*The IIc alone weighs just 7.5 pounds. These packs, modems, printers, modems and mice can make it as heavy as you'd like. **Suggested retail price. © 1984 Apple Computer, Inc. Apple and the Apple logo are trademarks of Apple Computer, Inc. For an authorized Apple dealer nearest you, call (800) 538-9696. In Canada, call (800) 268-7756 or (800) 268-7637.

Computer Marketing

- ❖ First digital computers took up whole rooms
- ❖ With advent of personal computing, marketed to those with leisure time and money
- ❖ Eventually trickled down to general population via K-12 schools
 - Only those that could afford them or close enough to tech to be donated
 - Also needed staff who could use/teach them



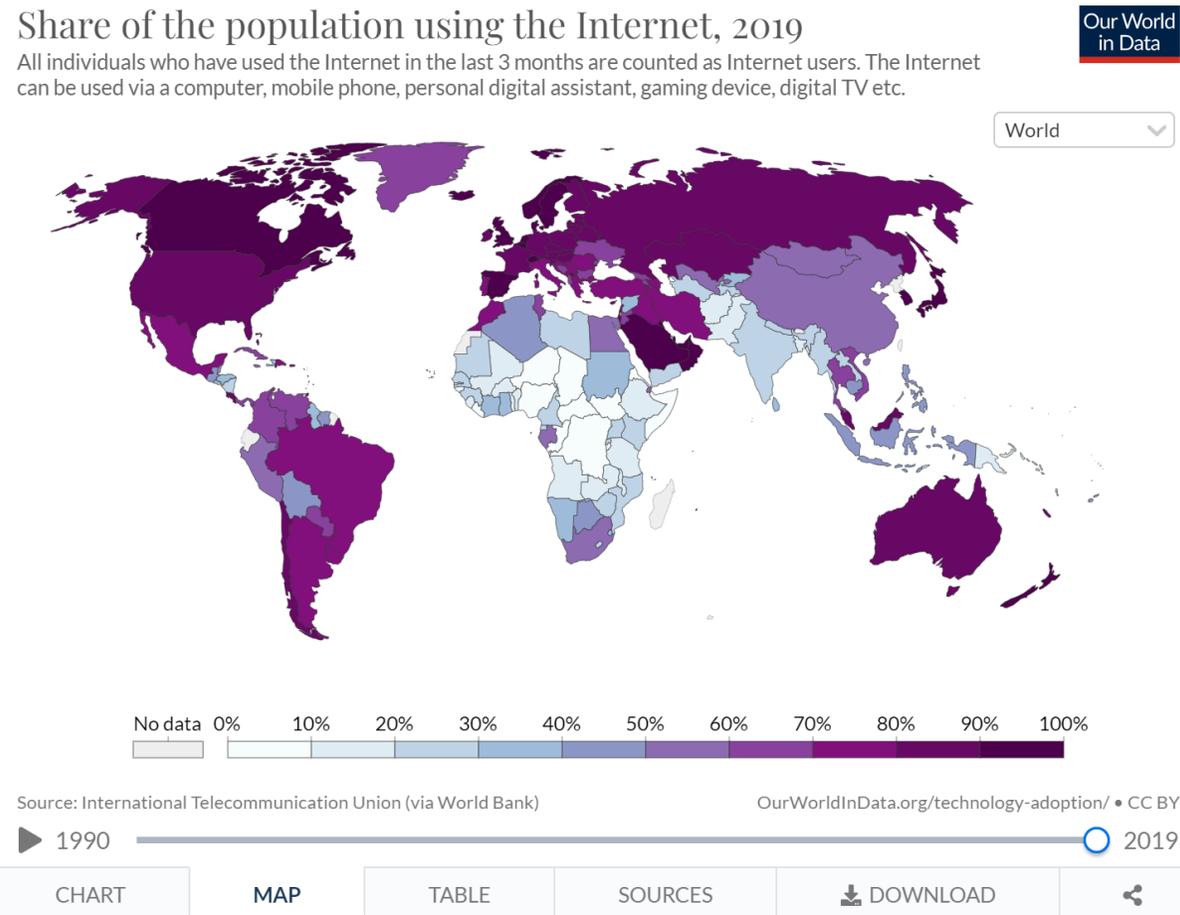
Computer Marketing

- ❖ First digital computers took up whole rooms
- ❖ With advent of personal computing, marketed to those with leisure time and money
- ❖ Eventually trickled down to general population via K-12 schools
- ❖ Smartphones now advertised as productivity tool and social status symbol



Not Everyone Has Internet Access

❖ Who designs computers & tech for them?

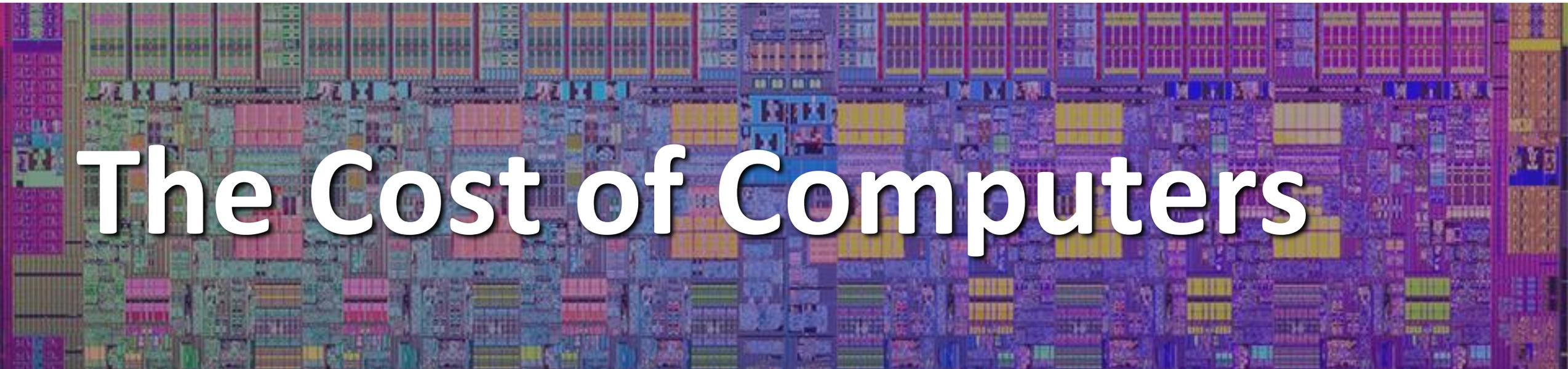


<https://ourworldindata.org/internet>. Accessed Dec. 6, 2021.

ICTD Lab at UW

- ❖ Information & Communication Technology for Development (<http://ictd.cs.washington.edu>)
 - **Goal:** Work *with* communities (international & local) to promote digital literacy & empower everyday people to have agency over technology
 - Example: after-school technology education programs
 - Example: build free Internet infrastructure plus maintenance training ([Seattle Community Network](#) is looking for [volunteers!](#))
 - An *interdisciplinary* field: public health, education, engineering, business, and more!

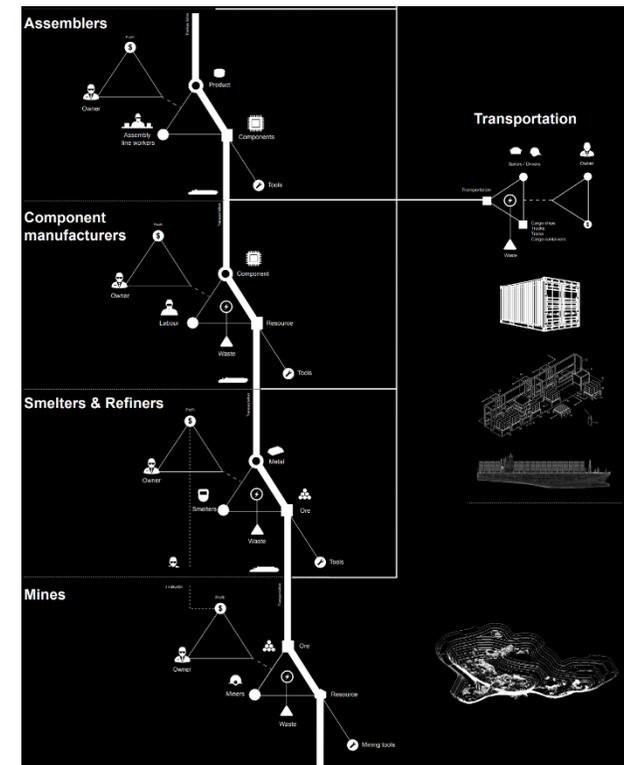




The Cost of Computers

Costs of Production

- ❖ Creating products is a process that involves labor, hazards, and waste:
 - “From a slow process of elemental development, these elements and materials go through an extraordinarily rapid period of excavation, smelting, mixing, and logistical transport – crossing thousands of kilometers in their transformation. Geological processes mark both the beginning and the end of this period, from the mining of ore, to the deposition of material in an electronic waste dump.” – <https://anatomyof.ai>



Costs of Production

❖ Material resources:

■ Silicon (non-renewable)

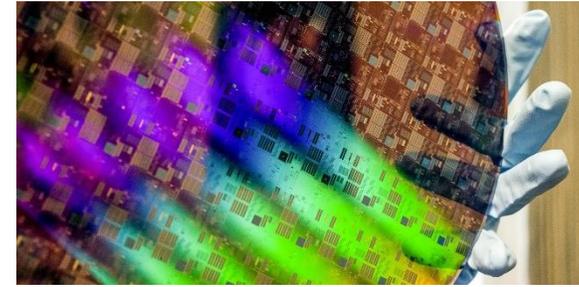
- Silicon dioxide purified from quartz or silica sand
- In 2021, shortage of silicon metal caused 300% price spike – China cut production to reduce power consumption
- Other industries that require silicon, including auto and solar, in trouble because supply being gobbled up by chip manufacturers

■ Lithium (non-renewable)

- Lithium-ion batteries have a limited lifespan
- Classified as non-hazardous waste and often end up in landfills or incinerators
- Could be recycled, but the cost of collecting, sorting, and shipping used batteries to a recycler exceeds the scrap value

■ Plastics

Costs of Production



- ❖ Semiconductor chip manufacturing:
 - Needed for computers, cell phones, “smart” appliances, automobiles, airplanes, health-care equipment, etc.
 - Semiconductor factories
 - Takes 5+ years and billions of dollars to build
 - Lots of expensive machinery & chemicals to process and protect wafers (people just maintain the machines)
 - A silicon wafer takes ~3 months and ~700 steps to process
 - Use of fossil fuels and chemicals can be harmful to the health of those living in proximity to manufacturing facilities
 - Global affair
 - ~75% manufactured in Asia, must be imported
 - Supply chain: raw materials, manufacturing workers, transport

Costs of Production

❖ Use and disposal:

- Strain on electrical grid during use and wasted energy while idling contribute to greenhouse gases and pollution
 - Bitcoin mining is particularly power-intensive: The amount of electricity used to mine bitcoin “has historically been more than [electricity used by] entire countries, like Ireland”
- Millions of tons of electronic waste are discarded into (overseas) landfills each year
 - Heavy metals can pollute the soil and contaminate groundwater

Quick Discussion

- ❖ In reconciling a utopian view of a fully computerized future with the costs of production, what parts of our homes, workplaces, and lives could/should most likely do *without* computerization?

Quick Polls

- ❖ Answer polls on Ed as quickly as possible; no discussion needed
 - About how frequently do you buy a new computer or smartphone?
 - **A:** Once a year or more frequently
 - **B:** Every 1-2 years
 - **C:** Every 3-5 years
 - **D:** Every 5+ years
 - **E:** I don't own or don't buy
 - What is the main reason that you buy a new computer or smartphone?
 - **A:** Old one broke or lost
 - **B:** Old one is too slow
 - **C:** Old one no longer supported
 - **D:** Newer version released
 - **E:** New tech released
 - **F:** Not applicable

The Technology Cycle

- ❖ Computers and technology eventually break down and stop working, but the industry really relies on consumers buying *before* that happens
 - The entire chip industry depends on a brand new laptop/smartphone meaning something!
 - Consumers want speedups, engineers should deliver
 - Self-fulfilling, industry taught consumers to believe “faster is better”
 - **Obsolescence**: when an object, service, or practice is no longer maintained, required, or degraded even though it may still be in good working order.
 - Newer version or new tech released = “**technical** obsolescence”
 - Old one is too slow = “**functional** obsolescence”
 - Old one no longer supported = “**planned** obsolescence”

The Technology Cycle

- ❖ Technology and longevity:
 - Longevity is nearly impossible to design for
 - Nothing is future-proof!
 - We've seen lots of weird historical artifacts in this class
 - Tension around technological change
 - *Companies* and *developers* hate supporting the same tool over a long period of time
 - *Consumers* tend to be resistant to change and hate being “forced” to upgrade
 - Backwards-compatibility can be a decent compromise
 - “Exciting” areas see lots of change, “boring” areas neglected
 - *e.g.*, unemployment systems and ATMs still run on COBOL (1959)

The Technology Cycle

- ❖ Who benefits? Who loses?
 - The consumers?
 - The developers?
 - The Earth?

- ❖ “The Consumer Technology Association notes that the average smartphone lifespan is 4.7 years. This obsolescence cycle fuels the purchase of more devices, drives up profits, and increases incentives for the use of unsustainable extraction practices.”
 - <https://anatomyof.ai>



Where Do We Go From Here?

Where Do We Go From Here?

- ❖ In this class, we have examined some of how computers got to where they are today – but we get a say in where we go from here!
- ❖ You have unprecedented power and access as technologists – be the change that you want to see!
 - What would you like to accomplish?
 - Who/what will you support (explicitly or tacitly)?
- ❖ Remember, computers shape society and society shapes computers
 - Be wary of what you build and how you design it!
 - Make sure you take the messy social context into account