Video Summary

Giant Brains: The Machine That Changed the World

Preface
- In the beginning, the computer size was tremendous but power was limited
- IBM assumed that only six would be sufficient for the United States
- Computers have changed the world of politics and business
- Millions of computers have been manufactured…no one could ignore them

Discover the Strange Machine
- In the past, writing has been the cornerstone of intellectual and commercial lives. Today, we are witnessing the emergence of a new medium. Its influence may rival that of writing.
- Inside a computer are patterns of voltage that represent thoughts, concepts, sounds, and pictures
- Computers are "general purpose" machines that do many kinds of activities such as engineering drawings, mathematics, word processing, and sorting routines.
- Today, computers control the way the world works; they manipulate ideas, conjure up artificial universes, and design walk-through events.
- Computers perform tasks for which human requires intelligence such as playing chess or playing the organ.
- The Computer was invented for doing one thing only which humans did slowly and inaccurately: Arithmetic.
- A modern computer can calculate π (Pi) to thousands and millions of places.

Some Pioneers

William Shanks, Nineteenth Century School Teacher
- Spent 28 years to calculate π to 707 places. Due to error in the 528th place, it was tragically flawed, making his efforts in the last 2 years in vain.
- In his era, the term "computer" referred to a "person who calculated".
- The few aids available to the "computer" (such as the slide rule) were not accurate. He mainly relied on books that were full of ready-worked multiplications, ready-made tables of squares and cubes, and shortcut logarithm tables.
- Inevitably, errors were made very easily.

Charles Babbage, Victorian Mathematician
- "*Finding many discordances, I expressed to my friend the wish that we could calculate by steam for which he assented 'As within the bounds of possibility'.*"
- He was obsessed with errors.
- Sponsored two independent human computers to create a new table for the Astronomic Society in England.
- In comparing, flaws were found.
- If machines can be made to do physical tasks, then why can't they do mental tasks?
- He designed a calculating machine and built just a small section to produce a sequence of squares. He called it the Difference Engine.
- Recognizing the importance of accurate national tables, the government put up the money to pay for development.
- Babbage never completed the engine partly because he was a poor manager, but mainly because he had a better idea.
- He wanted a machine, which was able to do many different things. With that single thought, he hit upon the fundamental concept of computers over 150 years ago.
- That machine separated the storage from the central unit. It happened to be programmable and it used punched cards.
- With different sequences of punched holes, he wants to do a limitless number of computations with his Analytical Engine.
- Babbage was proposing a machine whose purpose was up to the user. The separation of "software" from hardware was born.

Ada Byron, Countess of Lovelace
- Lord Byron's daughter
- She was an enthusiastic supporter and interpreter for Babbage
- Because of their publication of notes on the Analytical Engine, she was considered the 1st programmer

Technological Developments
- By the end of a hundred years, technical development had transformed the classical single-purpose machine.
- Computing is still a tedious task.
- General purpose machines make no progress at all
- From 1935 to 1945, the definition of a computer shifts from a person to a machine (or several devices performing rapid calculations)

Konrad Zuse, Berlin
- *"He came into my workshop and said 'you ought to use vacuum tubes' and I thought he was joking at first. But we thought about it…the idea that you could be able to calculate a thousand times faster was magic'".*
- Self-confessed "bored and lazy" civil engineer.
- Invented his own computer to serve his own needs.
- Implemented new engineering design concepts.
- Computers needed to be adaptable.
- Simplified operation by selecting binary over decimal to work effectively with relays.
- Succeeded where Babbage failed, but the relay and switch method was slow.
- By 1939, he was the leading German computer designer. But, it was all interrupted by the war (at least for six months till he was reassigned due to his skills for the war effort).
- Helmut Schrier (a contemporary) stated *"The future of computers is Electronics"*
- His last proposal for a two-year project to develop the next advancement in computer design was rebuffed by Hitler, deluded by the fact that he would end the war in less than 2 years

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Kay Mauchly Antonelli, Mathematician, University of Pennsylvania
- *"To do just one trajectory, at one particular angle, usually took up between 30 to 40 hours of calculation on this desk calculator"*
- During the war, a shortage of field gun trajectory tables had an impact on the war effort.
- Tables exceeded 1800 entries.
- Required trajectory tables took up to four years to make.

Herman Goldstine, Captain, US Army
- *"It becomes too clear that we have to do something to break the bottleneck…I'm very much on the lookout for a mechanical solution that can resolve this problem"*

J. Mauchley and J. P. Eckert, Visionaries, Moore School of Engineering
- "*Because we wanted this thing to work. If we built this huge thing and it didn't work, it would just set back progress, instead of setting it forward"*
- Built the ENIAC -- **E**lectronic **N**umerical **I**ntegrator **A**nd **C**omputer.
- Capable of 5000 additions per second.
- Comprised of 18,000 tubes and 10's of thousands of other electronic components.
- Over 500,000 soldered connections.
- Despite the well known fact that vacuum tubes tend to burn out (estimated at 1 every 5 seconds), the Army was so desperate, they agreed to fund the project.
- Takes up lots of space; area equal 50' x 30'
- Modularized design allowed section removal.
- Worst design allows for components to drift from their specification and still function effectively.

- Most of the illumination effects were strictly for show as laid out by Arthur Burkes.
- Successful impact as the U.S. Army sees peace dividend from the ENIAC.
- Drawbacks included lack of storage, reprogramming ENIAC required resetting all switched and repatching cables for new instruction codes, and idle time was non-productive.
- Lack of Army endorsement over modifications.
- Collaboration with John von Neumann effected how all computers would henceforth be developed.
- Departure of Mauchly and Eckert from the Moore School at the University of Pennsylvania to the private sector.
- Conflict over copyrights and licensing ensued between them and the University.
- They started their own "computer company".

Freddie Williams, British Radar Engineer
- Designed the first working computer with a stored program in 1948
- Skeptical public about it's general usefulness in spite of its speed.

Maurice Wilkes, Cambridge University
- *"If computers were made as friendly as possible, scientists would become interested"*
- The machine he built was called the EDSAC.
- As scientists became familiar with the machine, they discovered that computers opened up undreamed possibilities.
- New sciences, like Radio Astronomy, developed like they never could without computers to handle the massive data.
- The direct descendants of the ENIAC, they crunch numbers at enormous speeds, helping scientists understand everything from meteorology to chemistry.
- Few could have predicted that most computers are used by ordinary people for things having nothing to do with numbers.

Alan Turing, British Mathematician
- *"To use computers like this one just for Arithmetic was a terrible waste"*
- Indicated computers had limitless potential.
- 1936 – Computing machines can do any logical tasks according to rules
- Code breaker – decrypted German Enigma box and Lorenz continuity shifting
- Built Colossus to decrypt codes; far more advanced than the ENIAC.
- This computer was capable of playing chess.
- Colossus was not just a big calculator; it read instructions and executed them.
- He never saw the computer industry flourish.
- He never saw which vision of computer intelligence succeed
- In 1964, he committed suicide in the wake of homosexual charges.