

Week 4 Day 7 - Beginnings of computation and cybernetics in the 20th-c

1830s: Babbage, Lovelace Difference Engine no. 1, Analytic Engine, Difference Engine no. 2

- Analytic Engine
- In 1834 Babbage develops the Analytic Engine. It was with this model (never built) when Ada Lovelace conceived of the engine as being "fully programmable." This is the first time that software and hardware are conceived of as separate.
 - Ada Lovelace conceives of this machine as being able to be used for other things besides calculations, like for music and the arts. This is known as the "Lovelace Leap."
- Programmable via punched cards - a concept drawn from the textile industry
- Had a "Store" and a "Mill"
 - store was where numbers could be temporarily held, and the mill was where the numbers were getting processed.
 - store and mill can be equated to storage and CPU of modern day computers
- could perform direct multiplication and division. It was also capable of functions for which we have modern names: conditional branching, looping (iteration)
- outputs including hardcopy printout, punched cards, graph plotting and the automatic production of molds

1931 differential analyzer, Vannevar Bush

1936 Claude Shannon with Vannevar Bush at MIT

- Shannon works on Boolean Logic and electronic circuits

1940 Norbert Wiener: automated anti-aircraft using servo mechanisms

- system with inputs and outputs where there is a transformation, or goal
- comes to understand feedback,
- feedback happens with output becomes input about state change
- positive feedback when output to input accelerates transformation in same direction as it was prior/cumulative effects
 - fire, microphone and speaker
 - population explosion, inflation, capitalism, cancer
 - catastrophe before the angel of history
 - leads to self destruction
 - negative loops required
 - control a finalized action (complete a goal), circulation of information (feedback)
 - must form a closed loop and receive negative feedback
- negative feedback stabilizes
 - negative feedback loop required to correct actions
 - required for goal seeking behavior
 - system oscillates around an ideal equilibrium that it never attains.
 - A thermostat or a water tank equipped with a float are simple examples of regulation by negative feedback
 - physical homeostasis of the body (contestable)
- Wiener coins term cybernetics and from the beginning at MIT, in dialogue with neurophysiology
- from the beginning these concepts were generalized and human behavior was generalized to match one another

Early 40s

- Shannon Bell labs & cryptography, Alan Turing, mostly England (Manchester) but at Bell Labs one summer, Turing Machine, Turing Test, morphogenesis, Wiener at MIT automated anti-aircraft
- 10 seminars by Josiah Macy Foundation (start in '44-'53) "Macy Conferences" — cybernetics central theme
 - cross disciplinary
 - mathematicians, physiologists, and mechanical and electrical engineers, ecologists,
- psychoanalysts, anthropologists like Margaret Mead, Warren McCulloch, Norbert Wiener, Claude Shannon, Gregory Bateson, Gordon Pask, Humberto Maturana, Francisco Varela, Alfred Kubie, Jay Forrester, Heinz von Foerster, John von Neumann, Warren Weaver, Oliver Selfridge

- dominant figures control conversation/ narrative. Warren McCulloch central.
 - parallels are drawn betw neurophysiology and the computer
- orientation/ bias towards idea of homeostasis
- regulated system where conditions are stable/ consistent
- Vannevar Bush writes *As We May Think*

40s and 50s a new cemented perspective on cybernetics, "organized complexity" and the computer.

- 1941, Bombe - Electromechanical mechanical means of decrypting Nazi ENIGMA-based military communications during World War II,
 - conceived of by computer pioneer Alan Turing (film Imitation Game)
 - allowed the Allies to decrypt German messages.
- Colossus, 1944 at Bletchley Park - break the Nazi code known as Lorenz ciphers
- ENIAC (Electronic Numerical Integrator And Computer, 1946) and
- EDVAC or EDSAC (Electronic Discrete Variable Automatic Computer, 1947). - first stored program computer. Binary. This is the computer Chun writes about.
- UNIVAC (UNIVersal Automatic Computer, 1951)
- One of the fastest was Whirlwind 11, constructed at MIT in 1951.
 - It used--for the first time--a superfast magnetic memory invented by young engineer from the servomechanisms laboratory, Jay W. Forrester.

1943 Shannon has numerous conversations with alan turing (also a cryptographer)

- cryptographer in war
- known as "the father of information theory"
- worked on boolean logic and electronic circuits
- masters thesis
- worked out how electronic circuits could do binary math/ if/ then statements
- essentially make decisions
- worked for vannevar bush & "differential analyzer"
- doctorate, then bell labs

1948 Shannon, Theory of Information // Considered founder of Information Theory

- worked on general theory of information
- information source, transmitter, a channel, a receiver, a destination
- technical, semantic, effective
- information can be quantifiable
- argues all comm technologies the same, all can be represented by digital data
- speed effects accuracy above a certain threshold, info get lost
- this means we have control over our errors math.
 - error correction, compression
- critique: assumes single person, no analysis of power relations, interpreting meaning
- The technical problem: how accurately can the message be transmitted?
- yes vs yes i will marry you
- slippage between communication & transmission
- as an engineer, shannon concerned with accuracy of transmission
- What are the most efficient ways to encode information for transmission in
- the inevitable presence of noise?
- The semantic problem: how precisely is the meaning 'conveyed'?
- The effectiveness problem: how effectively does the received meaning affect behavior?
- natural language processing and computational linguistics joined
- text, telephone signals, radio waves, pictures, film and every other mode of communication could be encoded in the
- universal language of binary digits, or bits-a term that his article was the first to use in print

1948

- Norbert Wiener's Cybernetics, or Control and Communication in the Animal and the Machine,
- The Mathematical Theory of Communication by Claude Shannon and Warren Weaver. The latter work founded information theory.
- cybernetics was considered to encompass learning, regulation, adaptation, self-organization, perception, memory.

Can we make connections between turn of the century technology (trains, electricity, telegraph, telephone) and how information comes to be understood?