15-292 History of Computing

IBM Domination
in the 1960s and 1970s

IBM

- 1962 – first year that computers revenue exceeded that of punched-card machines
- By end of ’60s, no more punched-card machines
- ’60s – growth of 15-20% per year
  - 1960 - $1.8 billion in sales, 104,000 employees
  - 1970 - $7.2 billion in sales, 259,000 employees
  - sustained 70% share of computers market throughout the decade
- The next great success: IBM’s 1401

IBM 1401

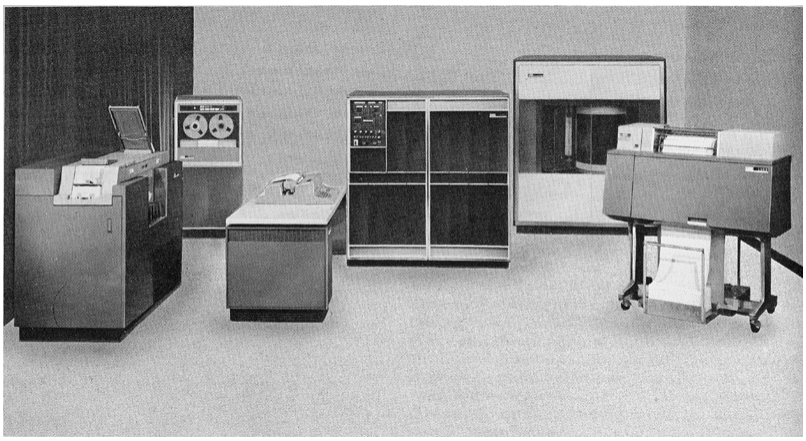
IBM 1401

- A stored-program transistor-logic computer *system*
  - follow-up to 650
    - aimed to be cheaper, faster, & more reliable
    - transistors for vacuum tubes, core memory for magnetic drum
    - high-speed printer (600 lines/minute)
      - helped lure customers using punched-card machines
  - $2500 per month minimally configured in 1960
  - It was the first computer to deploy 10,000 units
  - IBM concentrated on computer systems rather than just individual machines & architectures
    - customer driven

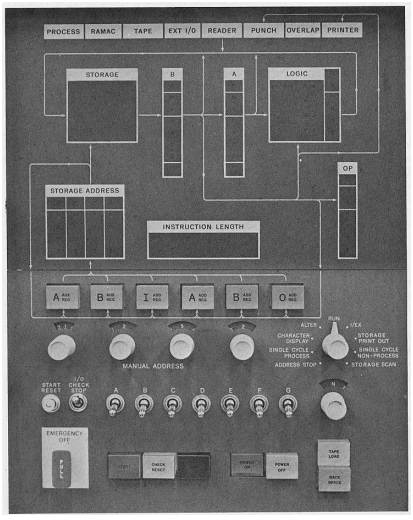
Other 1401 Specs

- The 1401 was a decimal (not binary) computer intended primarily for business applications
- Originally programmed only in Autocoder (assembler)
  - proved difficult for many people
- Soon used one of the earliest high-level business-oriented programming languages, RPG
  - Report Program Generator
  - increased its usability and popularity

IBM 1401



IBM 1401



IBM 1401 Reconstructed

IBM 1401 reconstruction at the Computer History Museum

IBM Competition

- IBM and the Seven Dwarves – late 1950's
  - Sperry Rand (UNIVAC division)
  - Control Data Corp. (CDC)
  - RCA
  - Honeywell
  - GE
  - Burroughs
  - NCR

- IBM enters into a consent decree with the U.S. Government in 1956 agreeing to *sell* as well as lease its computers
  - Leads to many leasing companies
  - Provide parts to other companies to maintain IBM machines
  - http://www.cptech.org/at/ibm/ibm1956cd.html
  - Consent decree remains in effect until 1996

IBM Competition

- Companies like Honeywell, GE, & RCA started to produce IBM-compatible machines
  - to target IBM customers
  - Honeywell's 200 was an improvement over IBM 1401
    - 400 orders in first week (more for Honeywell than in previous 8 years)
- Additional IBM competition: itself
  - too many different machines (7 lines) not fully compatible
    - a particular problem with software
    - not one of IBMs models could run the software of another

SPREAD Task Group

- SPREAD: Systems, Programming, Review, Engineering And Development
- Established by Vincent Learson in October 1961

  - Consisted of IBM's 13 most senior engineering, software and marketing managers.
  - "Banished" to Sheraton New Englander in Cos Cob, Connecticut to come up with a new product line of *compatible* computers
    - Proposed a range of compatible computers that would replace all of IBM's existing computers – System/360
      - enormous, secret undertaking
    - Software development estimate: $125 million?!?!?!?
    - Project nicknamed "You bet your company" by IBM engineers
    - Resulting direct research costs: $500 million
    - Resulting development costs: $5 billion
      - Second in '60s only to Apollo project

IBM System/360

- "the computer that IBM made that made IBM"
- Called 360 because of its "betokening all points of the compass"
  - Suggesting universal applicability of the machines
- An entire line of computers
  - small to large
  - low to high performance
  - all (with but one exception) running the same command set

- Announced with much drama on April 7, 1964
  - Watson Jr, "the most important product announcement in computer history"
- An immediate success, IBM could not fulfill all the orders it got
- Some models (e.g., the 360/30) even offered the option of microcode emulation of the customer's previous computer
  - old programs could still be run on the new machine

IBM System/360

IBM System/360

- The most expensive CPU project in history.
  - Fortune magazine: "$5 Billion gamble"
- The System/360 introduced a number of industry standards to the marketplace, such as:
  - the 8-bit byte (against financial pressure during development to reduce the byte to 4 or 6 bits)
  - byte-addressable memory (as opposed to word-addressable memory)
  - 32-bit words
  - segmented and paged memory
  - commercial use of microcoded CPUs
  - could be configured for networked applications

IBM System/360

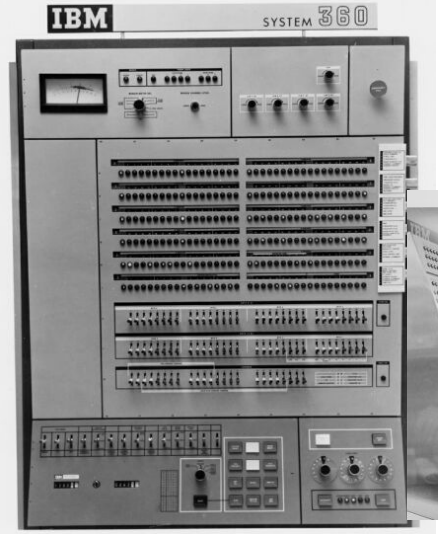
- The S/360 family initially consisted of six computers and forty common peripherals
  - There were thirteen models in all.
  - The cheapest model was the 360/20
    - 24K of memory
    - half the registers of other models
    - the instruction set was not binary-compatible with the rest of the range
  - The most significant model was the 360/67
    - first shipped in August 1966
    - the first to offer virtual machine computing to its users through its CP-67 operating system

IBM System/360

IBM 360 Model 75 - 1965
(IBM Archives)

IBM 360 Model 25 - 1968
(IBM Archives)

IBM System/360



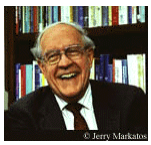
IBM 360 Model 65 console - 1965
(IBM Archives)

IBM 360 Model 91 - 1968
(IBM Archives)

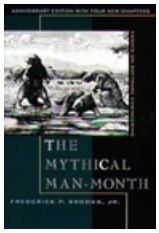
IBM System/360

- Some would say the implementation was "pedestrian"
  - Ex: did not support time-sharing
    - where multiple parties/programs may share use of a machine
  - IBM Audit said "IBM engineering was mediocre"
  - Some would say the marketing was far stronger than the implementation
- RCA would immediately make 360-compatible clones

OS/360 & Fred Brooks



- A batch processing operating system developed by IBM for the System/360
- Versions:
  - PCP – Primary Control Program
  - MFT – Multiprogramming w/ Fixed Number of Tasks
  - MVT – Multiprogramming w/ Variable Number of Tasks
- Delayed for over a year due to organizational disarray and inexperience in developing large-scale software systems
- Frederick P. Brooks publishes The Mythical Man-Month in 1975 describing the *second-system effect*



Brooks Interview

Brooks' Law

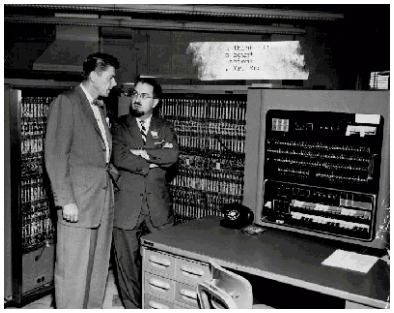
Programming work performed increases with direct proportion to the number of programmers (N), but the complexity of a project increases by the square of the number of programmers (N^2). Therefore, it should follow that thousands of programmers working on a single project should become mired in a nightmare of human communication and version control.

Steve Jobs references
The Mythical Man-Month

Herbert Grosch

- In 1945, he was drafted into the new IBM Watson Lab at Columbia by Los Alamos to provide backup for bomb calculations.
- Grosch's Law (1965): Computer performance increases as the square of the cost.
  - You have a computer that costs $100,000
  - Another computer that costs $500,000 will be 25X as powerful.
  - It is cheaper to buy one $500K computer for 25 people than 25 $100K computers.
- His law didn't apply in the 1970s as the cost of computer power shrank by a factor of 100 due to integrated circuits.

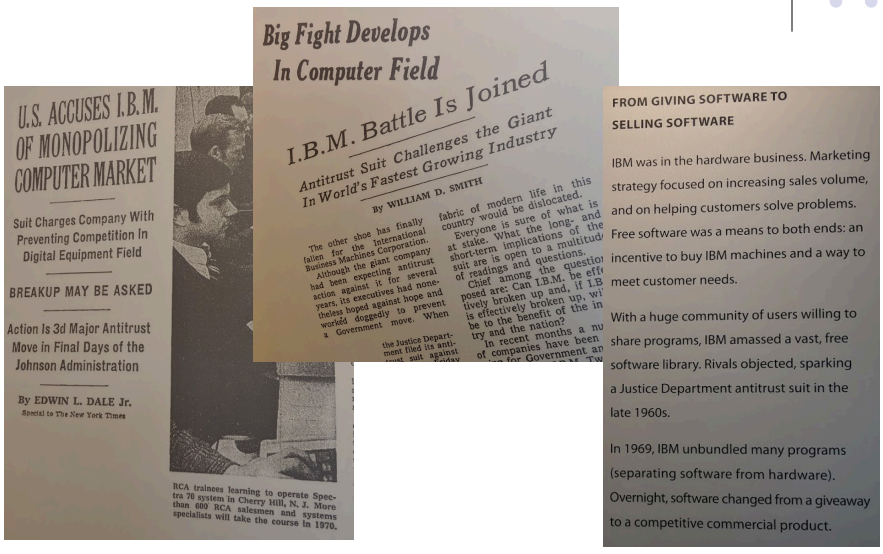
Herbert Grosch and a future U.S. President



Ronald Reagan and Herb Grosch at an IBM 701 in 1954.

Ronald Reagan becomes spokesperson for General Electric and their new computer ERMA:
Electronic Recording Machine – Accounting
Meant to speed up banking transactions

Pressure on IBM (late 1960s)



U.S. ACCUSES I.B.M. OF MONOPOLIZING COMPUTER MARKET

Suit Charges Company With Preventing Competition In Digital Equipment Field

BREAKUP MAY BE ASKED

Action Is 3d Major Antitrust Move in Final Days of the Johnson Administration

By EDWIN L. DALE Jr.
Special to The New York Times

RCA trainees learning to operate Spectra 70 system in Cherry Hill, N. J. More than 600 RCA salesmen and systems specialists will take the course in 1970.

Big Fight Develops In Computer Field

I.B.M. Battle Is Joined

Antitrust Suit Challenges the Giant In World's Fastest Growing Industry

By WILLIAM D. SMITH

The other shoe has finally fallen for the International Business Machines Corporation. Although the giant company had been expecting antitrust action against it for several years, its executives had nonetheless hoped against hope and world doggedly to prevent a Government move. When the Justice Department filed its anti-ment suit against

fabric of modern life in this country would be dislocated. Everyone is sure of what is at stake. What the long- and short-term implications of the suit are is open to a multitude of readings and questions. Chief among the questio posed are: Can I.B.M. be effe tively broken up and, if I.B is effectively broken up, wi be to the benefit of the in try and the nation? In recent months a nu of companies have been

FROM GIVING SOFTWARE TO SELLING SOFTWARE

IBM was in the hardware business. Marketing strategy focused on increasing sales volume, and on helping customers solve problems. Free software was a means to both ends: an incentive to buy IBM machines and a way to meet customer needs.

With a huge community of users willing to share programs, IBM amassed a vast, free software library. Rivals objected, sparking a Justice Department antitrust suit in the late 1960s.

In 1969, IBM unbundled many programs (separating software from hardware). Overnight, software changed from a giveaway to a competitive commercial product.

IBM System/370

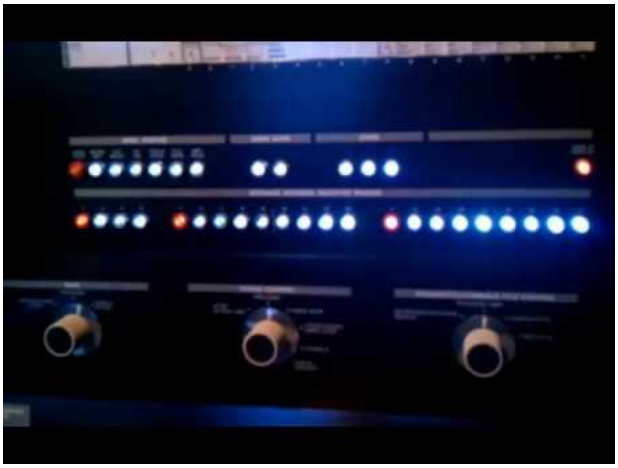
- A line of IBM mainframes to be the successor to the System/360 family (announced 1970)
- Cheaper & better technology than 360
  - used true integrated circuits (ICs)
  - semiconductor RAM rather than core memory
  - enhanced address space
  - virtual memory
    - Developed first at Manchester University
  - "As always, IBM's publicity machine was stronger than its technology." – Campbell-Kelly, Aspray

IBM System/370

IBM System 370 Model 135 console (IBM Archives)

IBM System 370 Model 125 console (IBM Archives)

IBM System/370



IBM Future Series (FS)

- Launched in the 1970s to make another major leap to create a platform that would have reduced software costs.
- Planned for late ’70s release
  - In 1975, IBM stopped the project after many delays.
  - Reasons for failure:
    - Vague objectives?
    - Objectives too far ahead of available technologies?
    - Poor management after Watson Jr. retired (1971)?
    - Specter of existing software investment
    - $100 million for nothing, “the most expensive development-effort failure in IBM’s history”
- The 370/ESA was eventually rebranded as the System/390, and later still as the zSeries.

IBM System/390 & zSeries

IBM System 390
(IBM Archives)

IBM zSeries z990
(IBM Archives)

The Decline of the IBM Empire

- Anti-trust suit
- More of a broadening of the market than a collapse of IBM
  - Still one of the most profitable companies in the world
    - Though it lost $5 billion in 1992, more than any U.S. company had ever lost in a single year
  - Still the industry leader in mainframe computers
- Emergence of mini & then micro computers
- Low-cost ICs allowed new companies to enter what was once an exclusive club
- As software advanced, companies needed less of IBM's service, which was their greatest asset
- Percent of global market: 1976: 50% 1985: 25%