

The Origins of Interactive Computing

I202, Fall 2003
Session 3, Sept 07

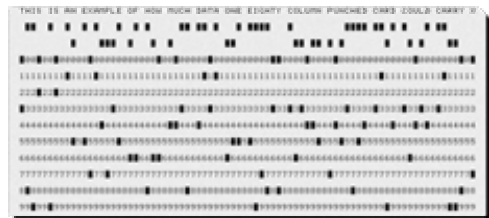
Structure of this Session

- Review of last session
- Origins of Interactive Computing
- The Mainframe Matures
- The Minicomputer
- The Context for “Hackers” reading

Early Computer “Generations”

- Experimental, one-off machines
 - 1946 – early 1950s. E.g. ENIAC. A few dozen made
- First Generation of commercial systems
 - 1952 (UNIVAC I) to 1960
 - A few thousand sold (mostly small ones using punched cards for storage)
 - Large models (using magnetic tape drives) sell a few dozen each, eg. UNIVAC
- Second Generation
 - 1960 to 1965
 - Transistorized for performance, reliability, miniaturization
 - A few tens of thousands sold
 - Tape drives common, some disk drives for data storage

A Punched Card



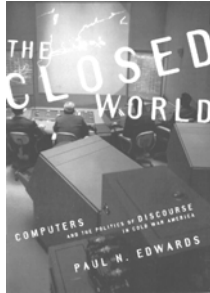
1: Early Interactive Systems

Definition of Interactivity

- Immediate response to input
 - User sees feedback, this guides next action
 - eg: any menu based or graphical system
 - Opposite of “batch,” where all data and instructions fed into computer together, it processes them
- Related concepts
 - “Real time” – response is fast enough to mirror (and respond to) actions in the world as they occur

A "Semi-Automated Ground Environment"!

- SAGE was an anti-bomber air defense network in 1950s & 1960s
- Highly automated system
 - Collects data from huge network at central command posts
 - Decisions made very rapidly
- Enormously expensive
 - Most important single project in history of computing



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Key Technologies from MIT

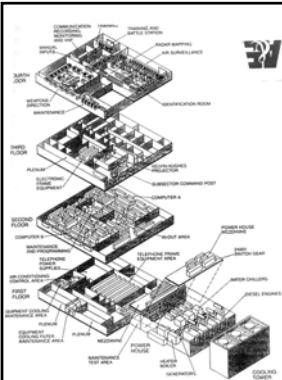
- "Whirlwind" project of 1950s
 - Funded by Air Force
 - Originally to produce a flight trainer!
 - Commercialized as AN/FSQ-7 by IBM for SAGE
- Makes MIT a leading center of computer research
 - Huge amount of Cold War funding
 - Best researchers and hardware access in the world

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A SAGE Installation

- Each one included two duplicate computers, weighed 250 tons
- Network involved 23 networked installations
- Finished in 1963



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Technologies from SAGE/Whirlwind

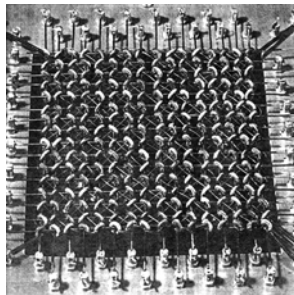
- For Real Time Systems
 - First "high level" programming language
 - First real-time operating system (specialized)
 - First large group of experienced programmers
- First use of
 - "core memory"
 - computer networking
 - computer graphics
 - graphical input device (light pen)

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Ceramic Memory Cores (16x16)

- Random Access Memory
 - Stores programs and data as computer is running
 - Hand-woven matrix
 - Used until 1970s
 - SAGE had massive 256 kilobytes (0.25MB)



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SAGE



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On-Line Applications

- Spread slowly during 1960s
- SAGE approach “pushing the envelope”
 - Enormously expensive project
 - Not practical for many civilian applications

SABRE

- First big civilian on-line system
 - Airline reservations for American Airlines
 - First version finished in 1964
 - Newer versions still used today
- Original system expensive and limited
 - Custom operating system
 - Custom “handset units” (terminals)
- Why this application?

2: The Mainframe Matures

New Capabilities of 1960s

- Third Generation Computers
- Hardware
 - Disk Drives (rather than just tape)
 - “Large memories” (16 to 256KB)
- Software
 - Operating systems
 - Efficient high level languages (COBOL, FORTRAN)
 - First commercial software packages (late 1960s)
 - Almost all application programs still custom written!

The IBM Series /360

- First large compatible family
 - Not 1 machine – whole range
- Powerful operating system
- Some on-line capabilities



A Full Circle: Business & Science



Backward Compatibility

- Once an "installed base" exists, very unwise to introduce similar product not compatible with old one
 - Not just computers (electrical power, CDs, etc)
- New product must either incorporate (in hardware) or emulate (in software) the interfaces of the old product
 - E.g. Windows XP runs DOS programs (emulation)
 - Gillette Sensor takes Sensor Excel blades

In Mainframes

- Backward compatibility retained since 1960s
 - Crucial role of installed base
 - System /370, 390, z900, etc.
- Mainframes still in use today
 - Until 1990s only choice for large administrative applications
 - Very high throughput and reliability in batch applications

By late 1970s

- Video terminals starting to become widespread
- Database packages entering use
- Interactive applications becoming more common
 - Software packages (esp. IBM's CICS) & better OS support are making

Big Systems Change Slowly

- Personal computer created mid-1970s
 - But remains isolated from big systems until 1990s
- Interactive capabilities added to batch-mode applications
 - Batch mode remains common today
 - E.g. Insite system at IU

3: The Minicomputer & Timesharing

The Minicomputer

- Smaller, cheaper computer
- Grows out of laboratory equipment
 - Used to control equipment
 - Also for calculations
- Cheaper, so well equipped lab can
 - Have researchers use directly
 - Afford to buy one for its own use

Digital Equipment Corporation

- Leading supplier of minicomputers
 - Founded 1957 to make lab controllers
 - First computer, PDP 1, 1960
 - Used in "Hackers"
 - Strong ties to MIT, including SAGE research
 - PDP range leads field.
 - VAX range dominate in late 70s and 1980s

digital
EQUIPMENT
CORPORATION
MAYNARD, MASSACHUSETTS

pdp8

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The PDP 8

- Huge hit (30-40,000 sold)
 - Some consider first 'true' minicomputer
 - Launched 1965
 - Small
 - Very expandable
- This model had
 - 4K of memory (core)
 - Used transistors but not chips
- Cost less than \$25,000



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Timesharing

- One computer shared between several users
 - Each uses a terminal to work interactively
 - Can stop & start programs, enter data, etc.
 - An alternative to batch mode operation
- Requires
 - Reasonably large memory
 - Complex operating system
 - Hardware support for multitasking
 - Originally used to make batch more efficient

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Early Timesharing Experimental

- MIT is a leader
 - CTSS (Compatible Timesharing System) mentioned in Hackers
 - Then Project MAC to build huge system called Multics
- Dartmouth College makes early system
 - Develops BASIC programming language for non-specialists
- Also SDC, producer of the SAGE software
 - Tries to commercialize its technology, mixed results

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The "Computer Utility"

- Original use expected for timesharing
- Huge central computers
 - Each with thousands of terminals via phone line
 - Like centralized power plant
- First technology predicted to bring computing to the masses
- Flops by early 1970s
 - Timesharing services are niche business
 - Massive numbers of users hard to support

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Timesharing on Minicomputer

- Makes minicomputer more viable
 - Buy, but share between a dozen users
 - Basis of many early word processing, office automation systems in 1970s
- UNIX operating system
 - Developed on PDP-7 from 1969 at Bell Laboratories
 - Small, clean, user-extensible
 - Free for education use, becomes standard in computer science departments internationally

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Context for Hackers

- They're somewhat ahead of other places
 - Only with personal computer can public experiment with programming
 - MIT has unique access to technology
 - TX-0 computer basically lying around in 1959
 - Paid for with taxpayers money
 - Unique local experience in real time/timesharing
- Distinctive MIT mindset
 - Look at the personalities, and toy trains!
 - Arrogant yet insecure
- First computer hobbyists?