Administrivia

- (None.)

Slide 1

Why Review History?

- To understand roots/development of current operating systems.

- As a way of getting many perspectives on "what do we want an o/s to do, and how do we make it do that?"

- Because history is intrinsically interesting? Try to imagine what using some of those early machines might have been like.

- (To allow the instructor to relive the days of his/her youth?)

Slide 2

The Early Days (1940s)

- Programming done by making physical connections on a plugboard (!).

- Better than no computer at all, but tedious and inefficient!

- Example: the ENIAC (picture here).

Slide 3

The Early Days (1940s – 1950s)

- Key improvements: stored-program concept, punch cards.

- Programming done by encoding machine language into cards.

- Program included code to start up computer, read rest of program into memory, do all input and output, etc. (no operating system).

Slide 4

- One program at a time, machine operated by programmer.

- Better, but still tedious and inefficient!

The Early Days (1950s)

Slide 5

- Key improvements: assemblers and compilers, libraries of commonly-used code, specialists to run machine (operators).

- Programming done in assembly language (or early high-level language), punched into cards.

- Separate steps to translate to machine language, execute.

- One program at a time, but machine operated by specialist.

- Less tedious, less inefficient.

- Still cumbersome for programmers, CPU idle between steps.

Batch Systems (1950s)

Slide 6

- Key improvement: "batch" idea — automate transitions between steps (translate program, execute, translate next program, etc.).

- How to make this work? separate input by "control cards", write primitive operating system to interpret them, manage transitions.

- Less inefficient, but I/O devices slow, so CPU idle a lot — still one program at a time.

- Still cumbersome for programmers — punch program into cards, give to operator, wait for output.

Slide 7

Control Cards — Example

```
//jobname  JOB  acctno,name, ....
//stepname EXEC PGM=compiler_name,PARM=(options)
//STEPLIB  DD   DSNAME=path_for_compiler
//SYSUT1   DD   UNIT=SYSDA,SPACE=(subparms)
//SYSPRINT DD   SYSOUT=A
//SYSLIN   DD   DSNAME=object_code,UNIT=SYSDA,
//              DISP=(MOD,PASS),SPACE=(subparms)
//SYSIN    DD   *
source code
/*
//stepname EXEC PGM=load-and-go
....
.... input data for program ....
```

Slide 8

Multiprogramming Systems (1960s – ?)

- Key improvement: "multiprogramming" — more than one program in memory, so when one has to wait another can run.

- How to make this work? requires much more complex operating system — must share memory and I/O devices among programs, switch between them, etc.

- Efficient use of hardware.

- Still cumbersome for programmers — no real changes here.

- Example: IBM mainframe (picture here, 1964); keypunch machine (picture here); line printer (picture here).

Timesharing Systems (1960s – ?)

- Key improvements: "interactive" users (using text terminals), utility programs to support them (shells, text editors, etc.).

- How to make this work? like multiprogramming, but now programs sharing memory are interactive users wanting fast response.

- Efficient use of hardware.

- Much less cumbersome for program development!

- Example: IBM terminals (picture here, late 1970s).

Slide 9

Personal Computers (1980s – ?)

- Similar evolution of operating systems — initially very simple, gradually becoming more complex/capable.

- Features from mainframes adopted as hardware permitted.

- A key difference — emphasis on user convenience rather than efficient use of hardware.

Slide 10

Evolution of Operating Systems, Recap

- Increasing hardware capability.

- Increasing o/s functionality and complexity — from simple program loader to complex multitasking system.

- Parallels between evolution of mainframe o/s and PC o/s.

Slide 11

Minute Essay

- What's the most primitive and/or cumbersome system you've personally used to write programs?

Slide 12