# Lecture 2 – Operating Systems, File Systems, Printers

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# Objectives

- To discuss operating systems
  - Why have them?
  - What is available?
  - What metaphors do they use?
- To understand file systems
  - “Native” format of file systems
  - “Export” format of file systems
- To understand printers
  - How does the image get to the paper?

# Operating Systems

- In the old days….
  - "We just had '1's and '0's, and sometimes we didn't even have '1's… I wrote a whole database package once just using '0's"
- A basic set of services
  - Manage files
  - Manage programs
  - Interact with peripherals
  - Provide an application programming interface

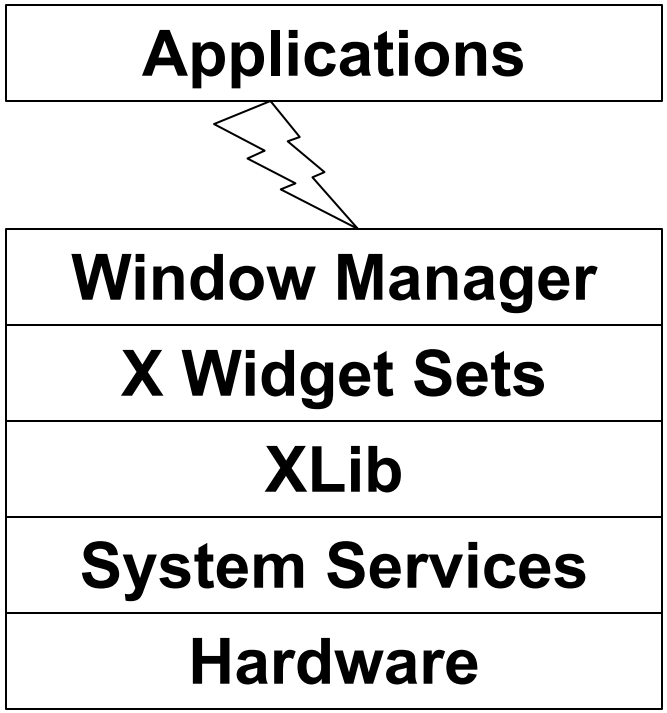
# Available Operating Systems

- For PC Hardware
  - Windows Family, Linux, (BEOS)…
- For Sun & other mid-range systems
  - Unix, VMS, Linux…
- For MAC
  - MAC OS, System 10, Linux…
- For handhelds, PDAs, phones
  - Windows CE, RISC OS, Linux…
- For embedded / real time systems
  - RTOS, Linux variants, many other proprietary…
- For mainframes
  - VM, MVS, VME…(and Linux)

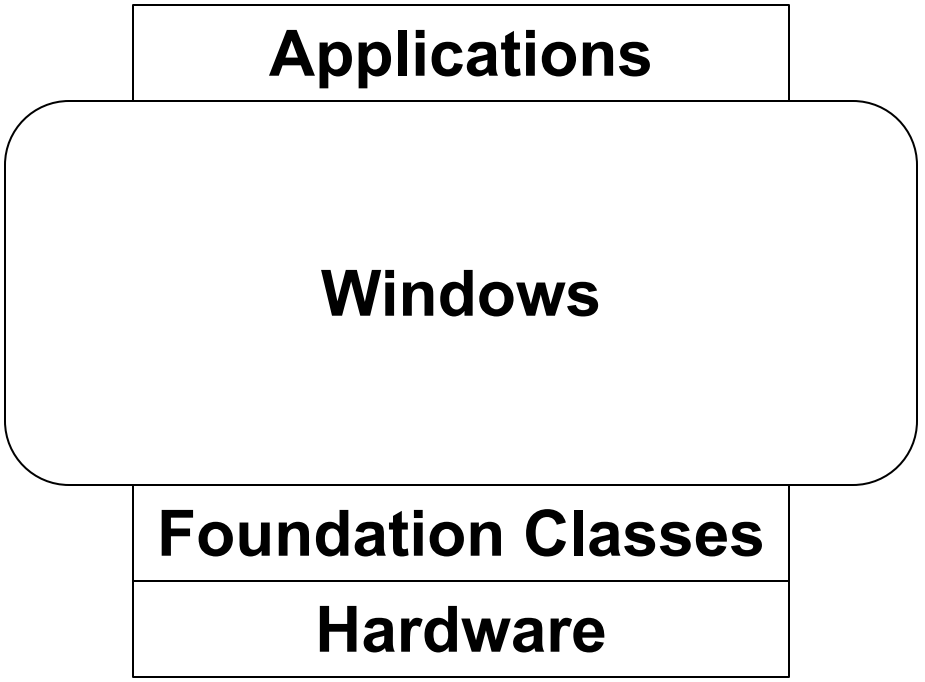
# The OS and the User Interface

**Do not confuse the operating system with the user interface!**

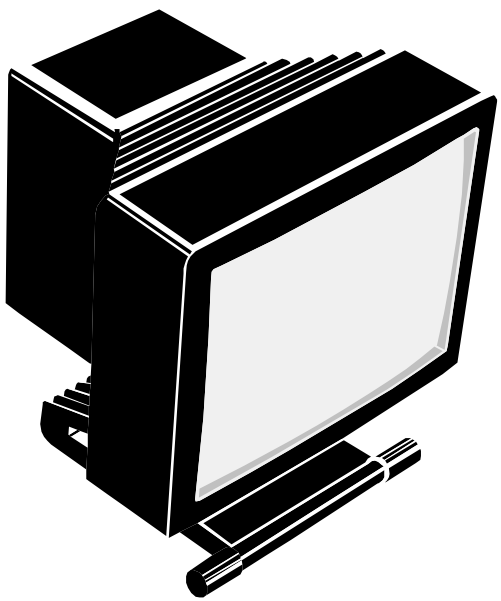
Unix

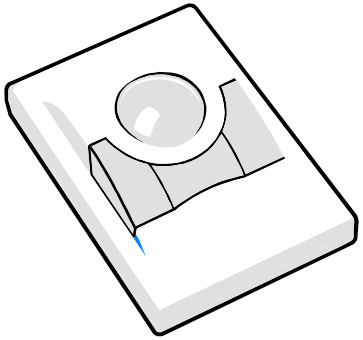


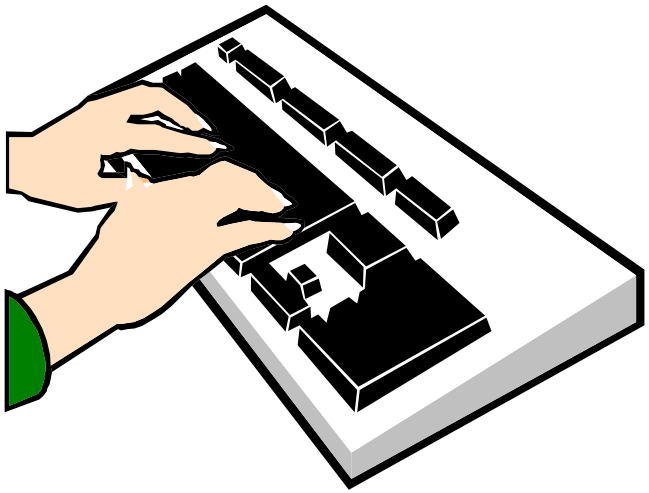

Windows



# User Interface Components







Given these common user interface components, how should the user interact with the computer?

# User Interaction

- The most common forms of interaction are based on WIMPs:
  - Windows
  - Icons
  - Menus
  - Pointers
- Developed from work at Xerox Parc
- First seen commercially in Apple Lisa
- These elements are combined into the now ubiquitous “desktop” metaphor

# User Interface Metaphors

- The Desktop is not the only possible metaphor
- Windows
  - Do windows always have to be rectangular?
  - Can windows have holes in them?
- Icons
  - Can they represent things other than OS objects?
- Menus
  - Not the only way to issue commands (`vi` editor)
- Pointers
  - Are “clicks” always indivisible, binary events?

# Why only 2 dimensions?

- The desktop metaphor is 2 dimensional
  - Except for simple "layering" of windows
- The desktop metaphor does not "work" for more than one user
  - How should a common, shared user environment be represented ( what *metaphor* should we use?)
- Most PCs have 3D capable graphics cards
  - Quake may have more influence on future user interfaces than Windows…?
- See any good cyberpunk fiction for examples
  - William Gibson, Bruce Sterling,
    but especially Neal Stephenson ("*Snow Crash*")

# Back to Earth – File Systems

- A File system has a "native" format
  - How files are organised on the physical device
  - File & directory naming rules (length, characters etc.)
  - File attribute sets (ownership, read only, executable…)
  - Sometimes include "special" files (usually *devices*)
  - May include journalling, mirroring, quotas etc.
    - May also be implemented transparently in hardware
- Examples
  - FAT, FAT32, NTFS
  - ISO9660, Rock Ridge
  - ext2/3, resierfs, sysv

# File System External Interfaces

- Allow a file system to be “mounted” remotely (over a network)
- Usually a subset of the native facilities
- Two most common formats are:
  - SMBFS (Simple Message Block File System)
  - NFS (Network File System)
- There is no restriction on the external interface presented by a particular native format
  - Depends on program / driver availability

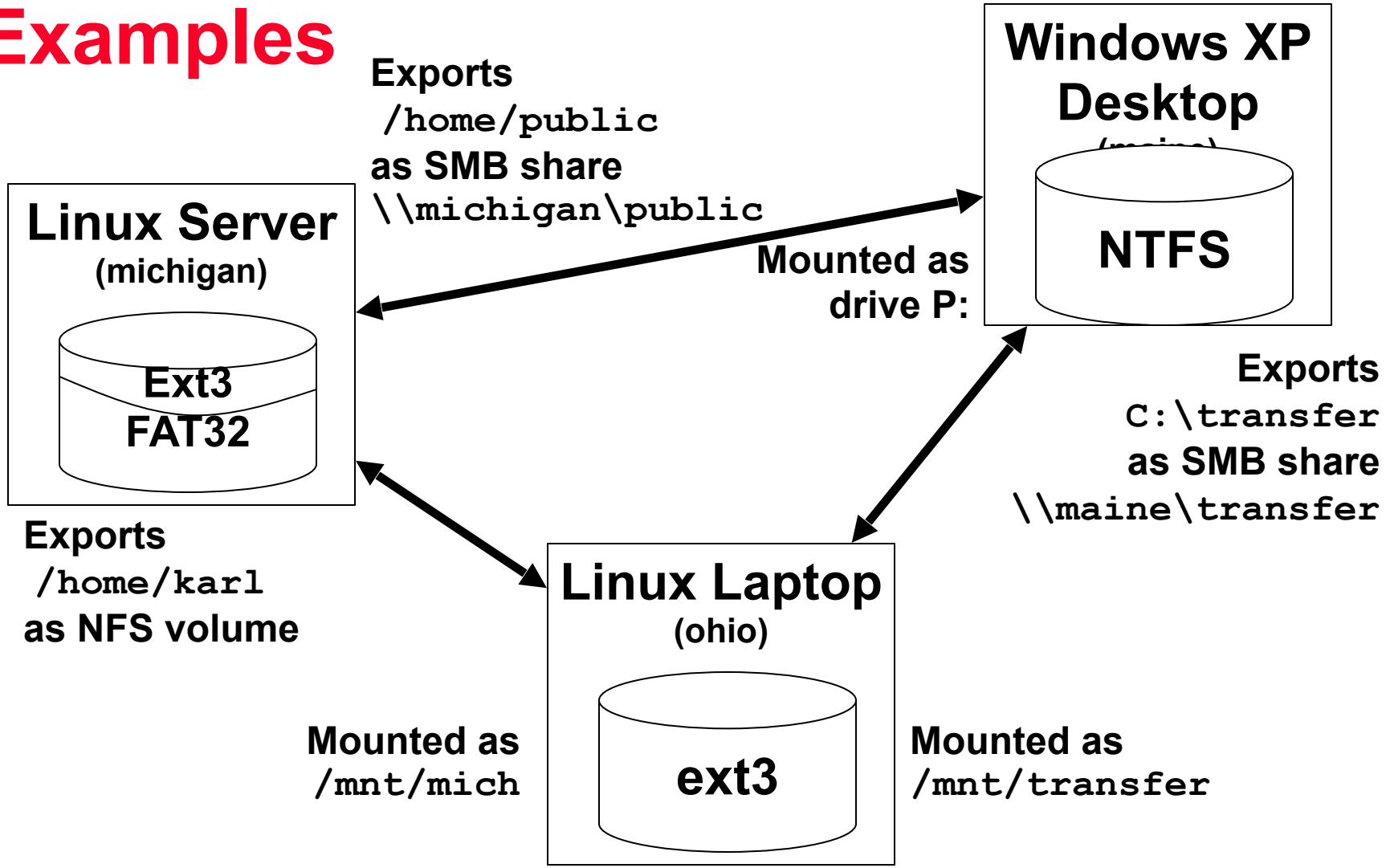
# Example External Formats

- SMBFS
  - Typically Exported by Windows NT servers
  - Limited permissions & security
  - Long, mixed case filenames
- NFS
  - Typically exported by Unix systems
  - Same permissions as Unix (user, group, world)
  - Can limit executables & special files

# Mounting External File Systems

- Windows
  - "Connect Network Drive" on Windows Explorer
  - Can only mount as a "lettered" drive
  - Need 3rd party product to mount NFS drives
- Unix
  - Use "**`mount`**" command
  - Can mount anywhere in file system
  - **`smbmount`** to attach SMB "shares"

# Examples


Windows XP Desktop
(maine)
NTFS
Exports
/home/public
as SMB share
\\michigan\public
Linux Server
(michigan)
Ext3
FAT32
Mounted as
drive P:
Exports
C:\transfer
as SMB share
\\maine\transfer
Exports
/home/karl
as NFS volume
Linux Laptop
(ohio)
ext3
Mounted as
/mnt/mich
Mounted as
/mnt/transfer

# Printers

- Printers use different control languages
- Two most common;
  - PDL (Page Description Language - HP Laserjet Family)
  - Postscript (Apple Laser writer + many others)
- Less common
  - HPGL (Hewlett Packard Graphics Language – plotters)
  - Epson (Character based, dot matrix printers)
  - Other proprietary formats

# Printer Drivers

- To simplify printer driver management:
  - Unix systems tend to use Postscript only
    - Convert to other formats (if required)
  - Windows defines a “notional” printer – GDI
    - Converts to other formats
- “GDI Printers” work directly from Windows
  - Reduces hardware requirements in printer
  - Moves workload onto PC
  - Not very efficient network usage

# Network Printers

- Printers can be shared over a network
  - SMB printers (like SMB filesystems)
  - Unix printing system (lpd – line printer daemon)
- Can use PCs as dedicated printer servers
  - Local storage of files while printing
  - Load sharing & redundancy
- Some printers have network interfaces
  - HP jetdirect protocol, IRDA, Bluetooth, WiFi
- Still need to know type & capabilities of printers
  - Control language, memory size etc.
  - May be able to download drivers from printer server

# Font Management

- A lot of printing content is text
- Three main approaches to handling fonts:
  - Convert all data (including characters) to bitmaps
    - Generates large files / network traffic
  - Include a complete, scalable font description with the print data
    - Medium addition to files / network traffic
  - Map fonts in the original to built-in fonts on the printer
    - No filesize or network overhead
    - Character widths may not match
    - Character sets may not match

# Summary

- "Desktop" Graphical User Interface currently ubiquitous, but:
  - Do not underestimate the command line
  - Expect future shared interfaces to be 3 dimensional
- Operating Systems can often support many types of file system
  - providing a common file management interface
- File systems can be shared remotely
  - Need to understand the capabilities available
- Printers can be shared remotely
  - Need to understand the capabilities available

# Today's Practical

- Looking at basic facilities of the Windows OS
  - Should not be too challenging!
- The advanced exercises explore some of the issues we raised about
  - Native vs. exported file systems
  - Printer & font management

# Next Week

- The Internet & World Wide Web
  - What are they?
  - How do they work?