

## Introduction To Computers

**You will learn about the fundamental parts of a computer and how this information can be applied.**

James Tam

## Types Of Computers

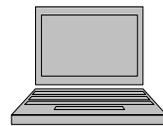
- Desktop:

- Fits on or near the desktop
- General purpose computer: schoolwork, office, entertainment, Internet



- Laptop/notebook

- *Almost* as much power as a desktop computer but provides portability



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## Types Of Computers (2)

### •Netbook

- Originally intended as a smaller and inexpensive laptop for: going on the Internet, composing email and it was meant only for light office tasks.



Notebook



Netbook

- Features that support portability:

- Small and light
- A built-in high speed wireless connection
- Can accept input from many types of devices that would likely be employed when outside of the office/home (e.g., digital camera memory)
- Some may have features to make them more durable

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## Types Of Computers (3)

- Drawbacks of netbooks:

- A typical netbook is 3 – 5 times slower than a typical notebook
  - It's graphics are more limited
  - Missing a built in CD/DVD drive
  - Smaller keyboard
- 
- One further note is that some of these limitations mean that a typical netbook is significantly less expensive than a typical notebook.
  - (While you pay a premium for portability when choosing a notebook over a desktop, you are receiving a discount when buying a netbook vs. a notebook).

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## Types Of Computers (4)



- **Workstation**

- It looks very similar to a desktop computer.
- Inside it's more powerful and used for specialized applications (drawing detailed graphics, running complex simulations etc.).
- Much like a desktop computer it's typically meant to be used by one person at a time.

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## Types Of Computers (5)

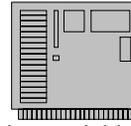


- **Main frame**

- Similar to workstations they're used for specialized situations.
- Often many users will be simultaneously using the mainframe.
- Needed when reliability is important (e.g., a company that handles many online purchases, for institutional users).
- It may not be much more powerful than a desktop computer but the increased reliability substantially increases the cost.

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## Types Of Computers (6)



- Super computer

- An extremely powerful computer that can perform calculations quickly.
- Very expensive.

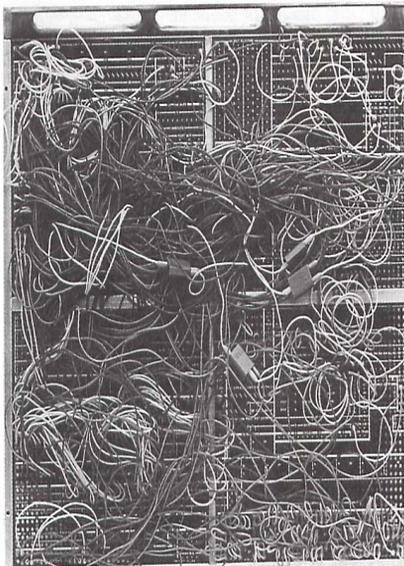


- PDA (personal digital assistant)

- A handheld computing device.
- They provide some of the power of a full computer but are only slightly larger than a mobile phone.

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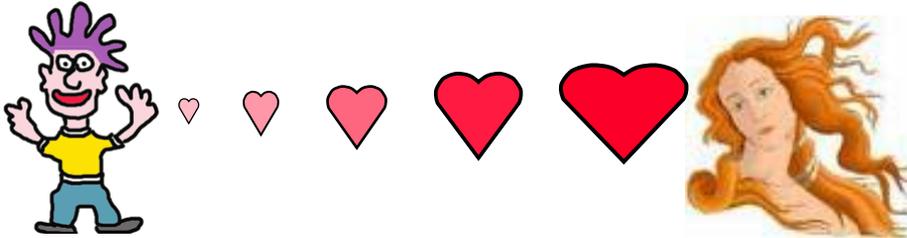
## Are Computers Really So Confusing?



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## How Does A Person Work?

- In many shades of grey (subtleties and ambiguities can exist)...



- ...i.e., people are complex with many possible states (some of which may be conflicting).

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## How Does A Computer Work?

- Simple: something is either in one state or another.

On / off

Pitted / smooth

- All parts of modern computers work this way.
- This two state approach is referred to as binary (bi = two for 2 states).

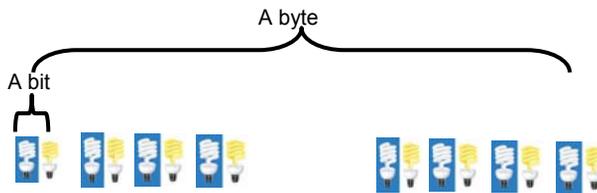


Off / on

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## Beyond The Bit

- By itself a bit is useless (it can't store a useful amount of information = only 2 possible states)
- Bits must be combined together before information can be stored
  - Q: How many states can be represented with 2 bits? 3 bits? 4 bits?
- The next unit of storage is a byte = 8 bits (256 possibilities)



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## Related Side Note

- In case you wondered what was *really* happening inside the computer when it isn't doing what you want it to do (e.g., print a document, save a file, run a program etc. etc. etc.)



From [www.oring89.wordpress.com/](http://www.oring89.wordpress.com/)

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## Large Units Of Measurement

- The amount of information that can be stored and transferred is typically measured in bytes.
- Kilobyte (KB) ~ a thousand bytes ( $1,024 = 2^{10}$ )

 X 1,000

- Megabyte (MB) ~ a million bytes ( $1,048,576 = 2^{20}$ )

 X 1,000,000

A typical image may range from ~20,000 bytes/20 KB to over 1 million bytes (1 MB)

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## Large Units Of Measurement (2)

- Gigabyte (GB) ~ a billion bytes ( $1,073,741,824 = 2^{30}$ )

 X 1,000,000,000

~ 30 minutes of video (~1/4 of the information stored on a typical DVD)

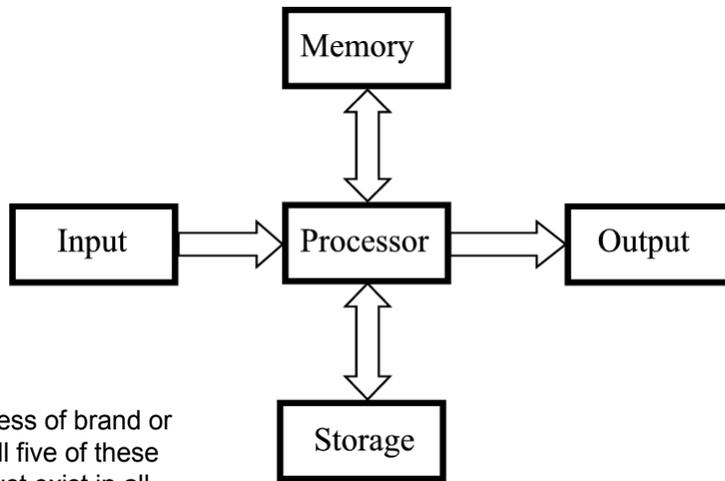
- Terabyte (TB) ~ a trillion bytes ( $1,099,511,627,776 = 2^{40}$ )

 X 1,000,000,000,000

~ 200 DVD's of information

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## High Level View Of A Computer

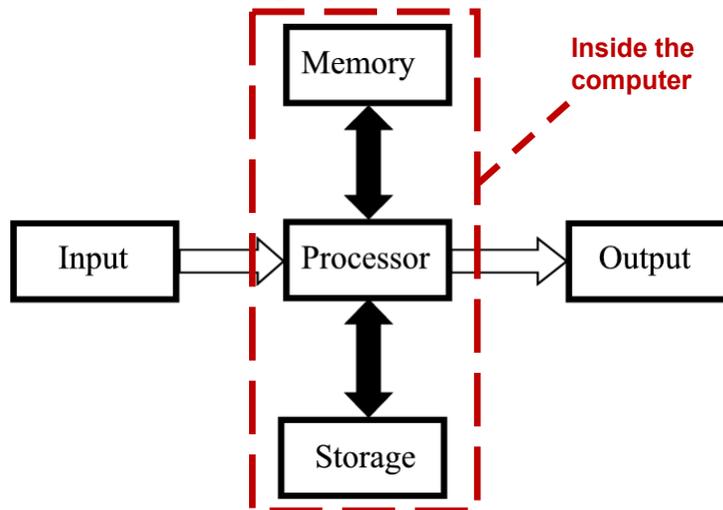


Regardless of brand or model all five of these parts must exist in all complete computer systems

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## Computer Buses

- Connect the internal parts of the computer

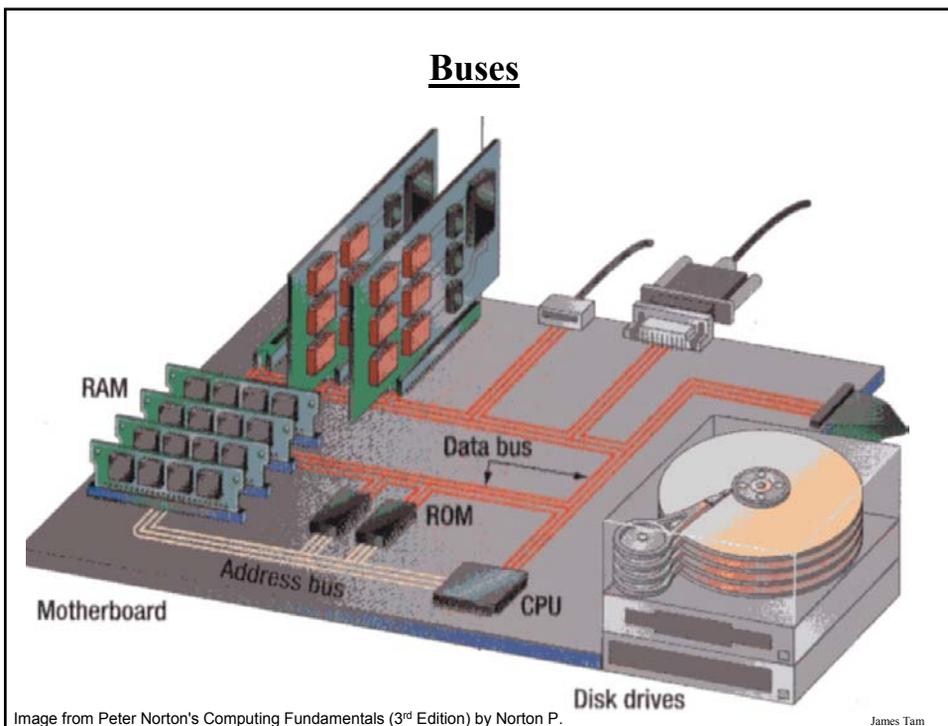


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## Types Of Buses

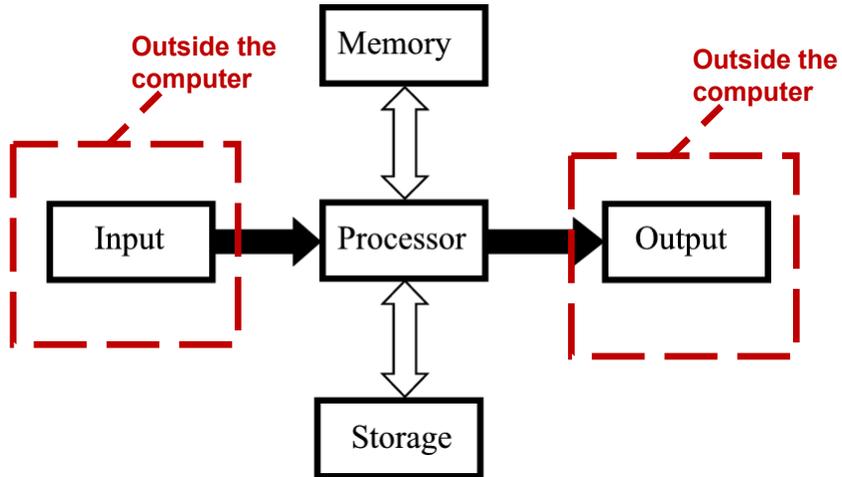
- Data buses
  - Are used to transmit information to the different parts of the computer.
- Address buses
  - Indicate where the information is supposed go.

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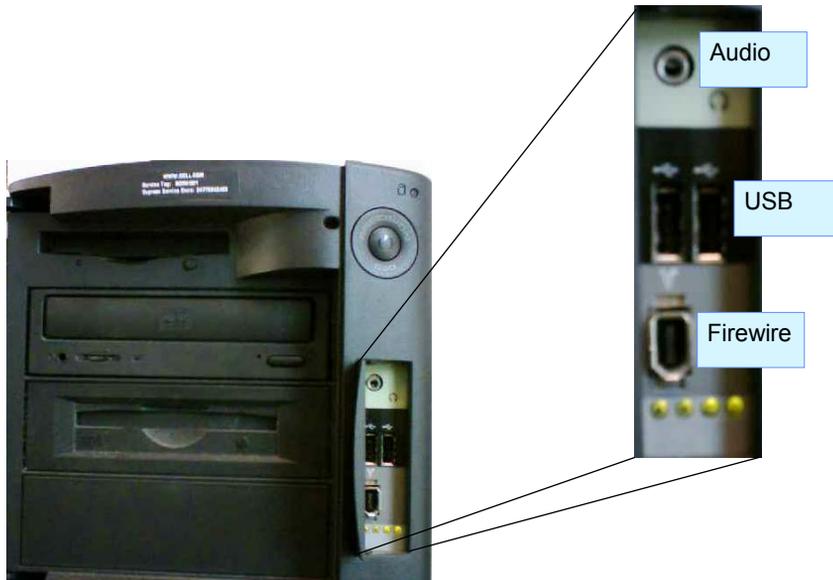
## Ports

- Connects the computer to the outside.



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## Ports



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## Ports On Modern Computers

- USB v2.0

- Speed: 480 Mbps
- Typical devices that use this port: mouse, keyboard, printers, scanners, game controllers, digital cameras and camcorders, storage devices.



USB port



USB cable

- FireWire

- Speed: 400 Mbps
- Typical devices that use this port: digital cameras and camcorders, storage devices.



FireWire port



FireWire cable

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## Ports On Modern Computers (2)

- FireWire 800

- Speed: 800 Mbps
- Typical devices that use this port: digital cameras and camcorders, storage devices.



FireWire 800 port



FireWire 800 cable

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## Ports On Modern Computers (3)

- Ethernet/Network
  - Speed: 100 Mbps
  - Typical devices that use this port: cable modems, network connections.
- Gigabit Ethernet
  - Speed: 1000 Mbps
  - Typical devices that use this port: cable modems, network connections.



Ethernet port



Ethernet cable

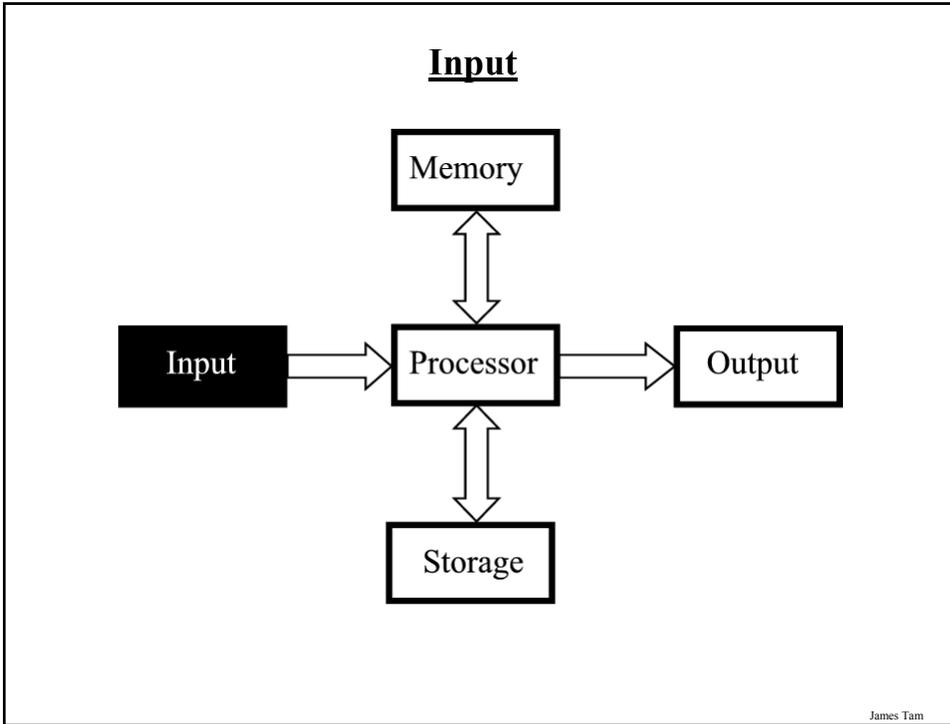
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## Ports On Computers (4)

- Wireless Ports
  - IrDA (Infrared):
    - Maximum speed of 4 Mbps.
    - Requires a direct line-of-sight (the standard guarantees 3 feet).
  - Bluetooth:
    - Maximum speed of 3 Mbps.
    - Doesn't require a line of sight (max ~30 feet).
    - Used in place of wired (cable) connections between devices (laptops, PDA's, printers).
  - Wi-Fi (Wireless fidelity):
    - Maximum speed is over 10 times that of Bluetooth.
    - Doesn't require a line of sight and may allow for longer ranges than Bluetooth (300 feet).
    - Typically used to provide a Internet connection or to connect a large network.



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### Input Devices

- Used by a person to communicate to a computer.

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## Example Input Devices

- Keyboard



- Mouse



- Stylus



- Touch screen



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## Keyboards

- Wired

- Least expensive
- Requires a physical connection

- Wireless

- Costlier
- Reduces the number of wires (no direct physical connection between the keyboard and the computer)
- Can introduce additional issues: battery use, security
- Types
  - Infrared
    - Similar to a TV remote control
    - Unidirectional / line-of-sight
  - Radio frequency (RF)
    - Omni directional

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## Mice

- Similar to keyboards they can be wired or wireless.
- Method of input:
  - Roller ball
  - Optical
  - Laser

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## Mice: Method Of Input

- Roller ball
  - Employs physical moving parts.
  - Cheap but dirt and other debris can interfere with input.
- Optical
  - Uses an LED and a reflective surface.
  - A little more costly to make but they have become the standard.
- Laser
  - Employs a laser instead of an LED.
  - Allows for more precise work.



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## Example Input Devices For Users With A Disability

- Headsets:

- Used with speech recognition



- Breath and head mounted devices:

- The jouse



From <http://www.jouse.com/>

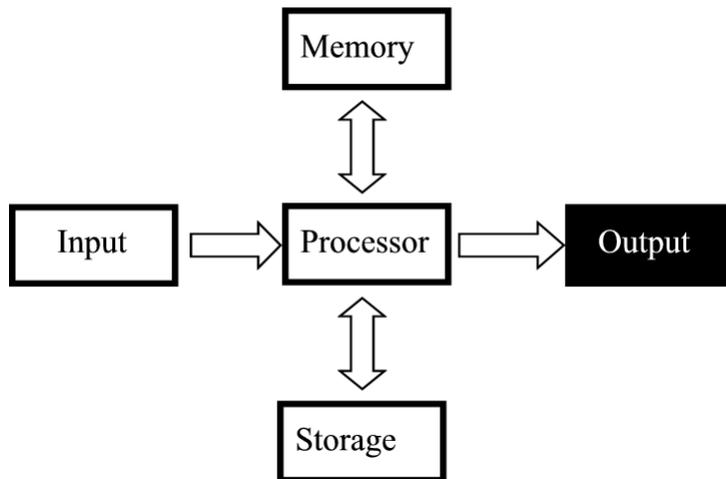
- Direct input

- Reading brainwaves



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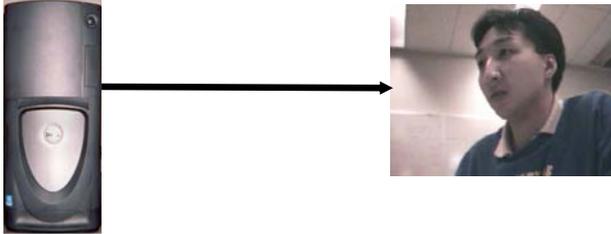
## Output



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## Output Devices

- Communicating information from the computer.



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## The Most Common Output Device: The Monitor



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## How Information Is Created On Monitors

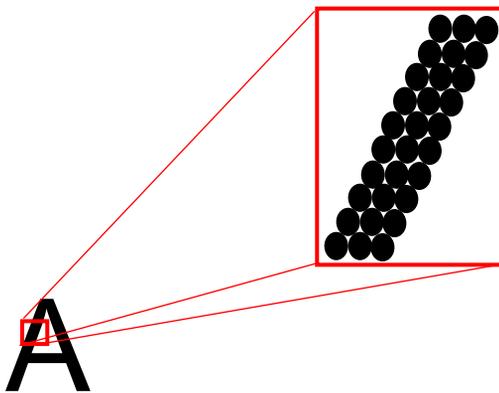
- Images and text are drawn with tiny dots (Pixels: Picture elements).

A

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## How Information Is Created On Monitors

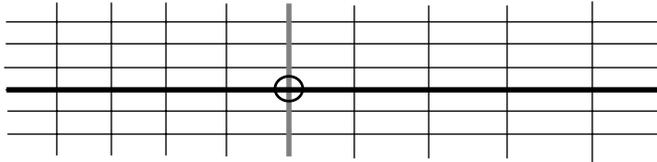
- Images and text are drawn with tiny dots (Pixels: Picture elements)



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## LCD Monitors

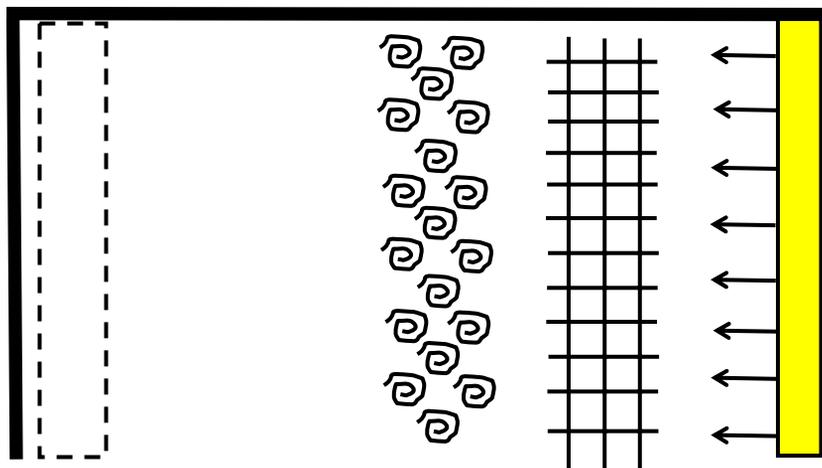
- Employ a conductive grid for each row and column.
- A layer of liquid crystals is used to block or let through light.
- The meeting of a row and column allows light to be emitted (a pixel can be seen in various degrees of brightness).



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## LCD Monitors (2)

- The creation of images and text requires several layers to produce the necessary pixels.



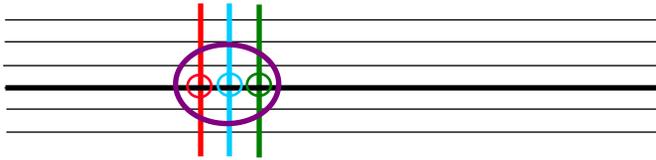
Front

Back

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## Colour LCD Monitors

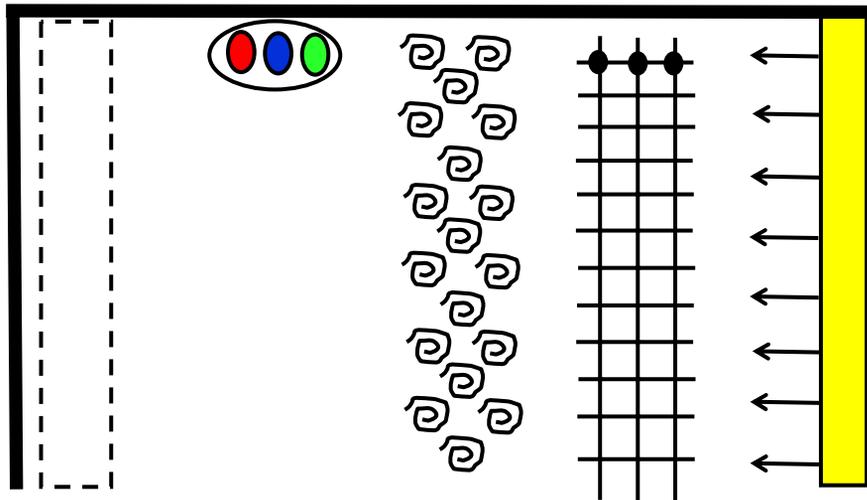
- Use three sub pixels:
  - One wire for each row
  - One wire for each sub-pixel
  - One colour filter for each colour (red, blue, green)



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## Colour LCD Monitors (2)

- An extra layer is needed to produce the color pixels



Front

Back

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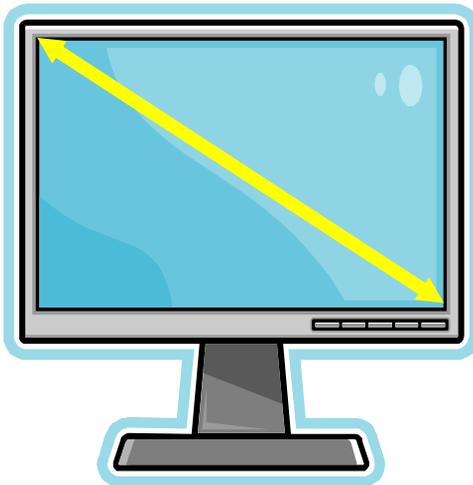
## Common Characteristics Of Monitors

- Size
- Resolution
- Dot pitch
- Response time
- Contrast

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## Computer Monitors: Size

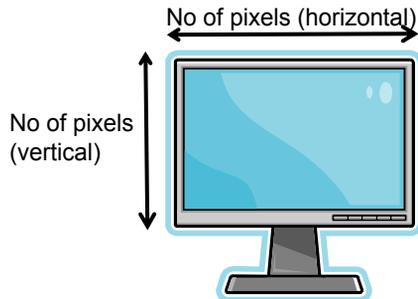
- Measured diagonally



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## Computer Monitors: Resolution

- It's determined by the number of horizontal pixels X the number of vertical pixels.



- For a given monitor size, the higher the resolution the sharper the image.
- Common resolutions:
  - 800 x 600, 1280 x 1024...1600x1200.

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## Monitor Resolution: Tradeoff

- Keep in mind that a higher resolution may result in a sharper display but objects will be smaller.

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My Desktop: 800x600



James Tam

My Desktop: 1600x1200



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## Computer Resolution: LCD Monitors

- Native resolution: is the best (only) resolution for displaying information. (Other resolutions may be possible by simulating the resolution with graphical effects).

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## A Game Running At The Native Resolution: Sharp



Icewind Dale © Black Isle (from [www.gamespot.com](http://www.gamespot.com))

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## A Game Not Running At The Monitor's Native Resolution: Reduced Quality



Original image



Image at non-native resolution

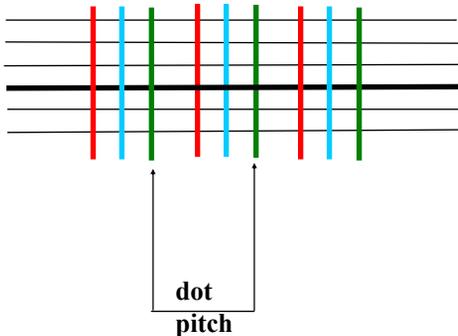


Thumbnail image at non-native resolution

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## Computer Monitors: Dot Pitch

- Dot pitch is the distance between picture elements e.g., the “colored” wire (mm).



- Common values for monitors today ~0.29 mm to 0.25 mm.

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## **Computer Monitors: Response Time**

- Refers to how quickly pixels can change colors as measured in a thousandth of a second (millisecond).
- Typical response times ~2 – 8 milliseconds.
- Slower response time (larger numbers) may have noticeable detrimental effects when parts of the screen must be quickly redrawn.

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## **Slow Response Time: Ghosting During Fast Movement**



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## **Slow Response Time May Even Result In Blurriness For Less Dynamic Displays**



From [www.d-silence.com](http://www.d-silence.com)

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## **Computer Monitors: Contrast**

- Contrast is difference in light intensity between the brightest white and the deepest black.
- It's typically expressed as a ratio (all things being equal the larger the number the greater the contrast and the better the image quality will be).
- Typical listed contrast ratios: ~600:1 to 8000:1, many averaging 2000:1.

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## Computer Monitors: Summary

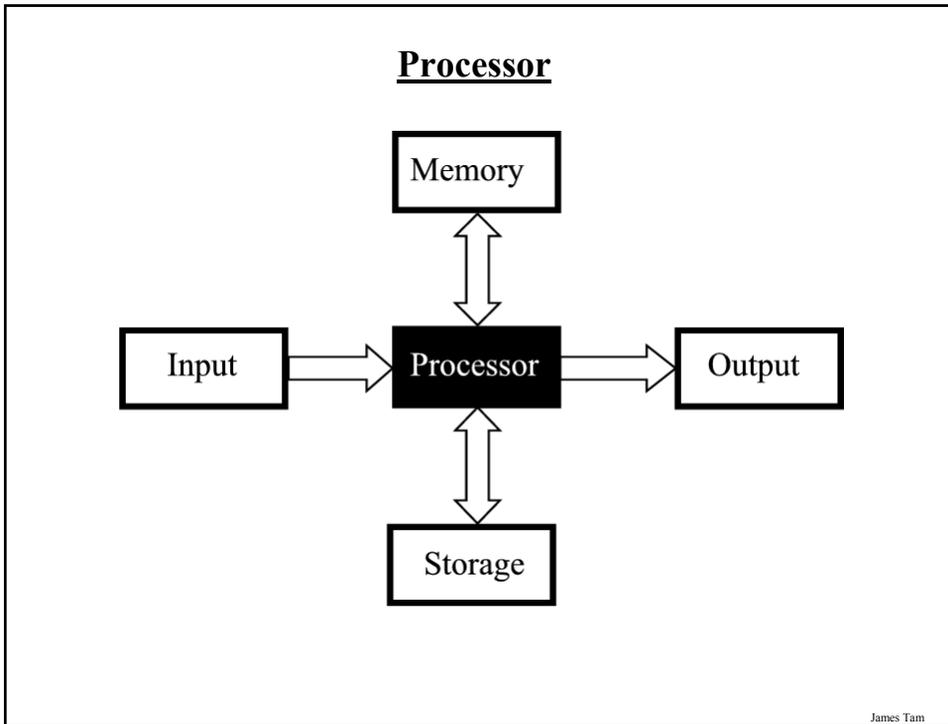
Characteristic	Common values	What's better: Smaller or larger numbers?
Size	19 to 27+ inches	Larger
Resolution	800x600 to 1600x1200	Larger
Dot pitch	0.25 – 0.29 millimeters	Smaller
Response time	2 – 8 milliseconds	Smaller
Contrast	600:1 to 8000:1	Larger

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## Counting: Small Units Of Measurement

- Milli: one thousandth ( $1 / 1,000$ )
- Micro: one millionth ( $1 / 1,000,000$ )
- Nano: one billionth ( $1 / 1,000,000,000$ )

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- Processor Speed**
- In a new computer many factors can effect processor speed (to be discussed later).
  - Traditionally there were two main factors:
    - Processor model e.g., Intel processors: Celeron vs. Pentium
    - Clock speed:
      - Generally the higher the number, the faster the processor
      - However GHz (Giga Hertz) is faster than MHz (Mega Hertz)
- James Tam

## Processor Models

- The two main CPU manufacturers are AMD and Intel, the following models are the ones manufactured by Intel listed from the slowest to the fastest:
- Celeron**
  - Produced at the same time as the Pentium processors (below) they were developed as a less expensive, slower alternative.
  - If everything else is the same a Pentium will be faster than a Celeron.
- Pentium 4:**
  - Similar base architecture to the Celeron processor but additional features make the Pentium 4 faster (all things being equal).
- Core family of processors**
  - They're newer than the Pentium 4 and generally faster.
  - In addition, many come with additional features not found in the Pentium processors that may also speed up processing time (more on this later).

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## Processor Models (2)

- Laptop processors:**
  - Some of the processors used in desktop computers are also used in laptops
  - Centrino technology: the computer may use desktop processors but incorporates other technology that is useful for a laptop user:
    - Uses less power (extends laptop battery life)
    - Faster high definition video playback
    - Built in hardware for fast wireless connections

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## **Processor Clock Speed**

- The second traditional measure of the computational speed of a computer.
- For each clock ‘cycle’ an instruction is executed (pulsed) by the computer.
  - 1 Hz = 1 pulse is sent out each second (1 second passes between each pulse)
  - 10 Hz = 10 pulses are sent out each second (0.1 seconds passes between each pulse)
  - :
  - 25 MHz = 25 million pulses sent out each second (0.000 000 04 seconds between each pulse, or 40 ns between pulses)
  - 3.8 GHz = 3.8 billion pulses sent out each second (0.26 ns between pulses)

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## **How Is Having A Faster Processor Beneficial?**

- Calculations are performed faster (e.g., large spreadsheet)
- Programs are loaded faster (includes the time to start up your computer)
- Viewing videos and copying music to your computer may be faster and more free of ‘glitches’

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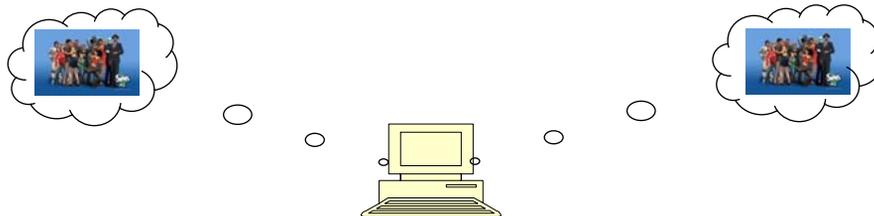
## Common Processor Clock Speeds

- Budget processors
  - Laptop: 1.06 – 2.6 GHz
  - Desktop: 1.8 – 3 GHz
- Higher end processors
  - 2.33 – 3+ GHz

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## Multi-Core Technology

- One of the newer determinants of processor speed.
- A core is the part of the processor that's capable of executing instructions and has some memory to store information.
- The processor is split into multiple (dual = two, quad = four) cores.
- Each core is capable of executing its own set of instructions.



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## **Do You Need Multiple Processing Cores?**

- Going from a single core to a multi-core system *will not* automatically result in an increase in speed.
- Two situations where speed will increase:
  1. You simultaneously run two or more programs that are processor intensive.
  2. You run a single program that is processor intensive and it is written specifically for a multi-core processor.
- When having multiple cores won't increase speed:
  - Opposite of the above:
    - You don't run multiple processor intensive programs at the same time. (You only run a single calculation-heavy program at a time).
    - The single processor intensive program that you do run is not optimized to run on a multi-core processor.

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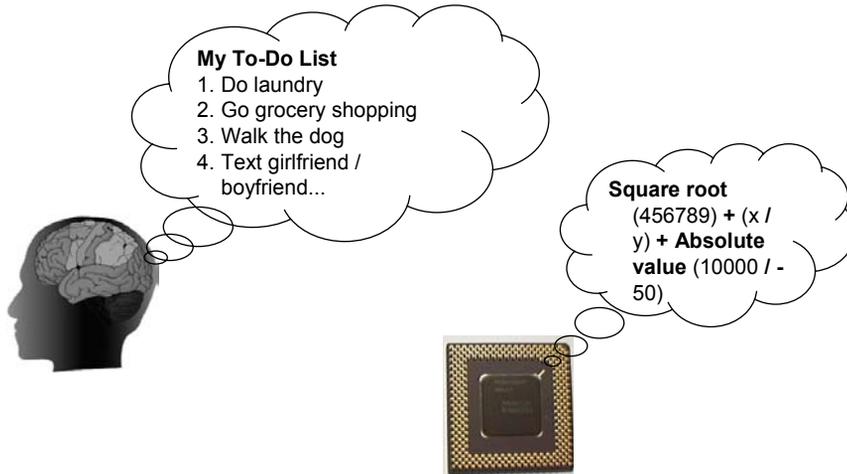
## **Do You Need Multiple Processing Cores? (2)**

- Examples of processor intensive tasks:
  - Video editing (saving).
  - Playing videos.
  - Ripping CD's / DVD's
  - Running security software (e.g., anti-virus scan).
  - Many of the newer computer games are processor intensive (at least to a degree).

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## Storage Of Information: Processors

- The processor has a small amount of memory that is fast but very low in storage capacity (analogous to short-term memory)

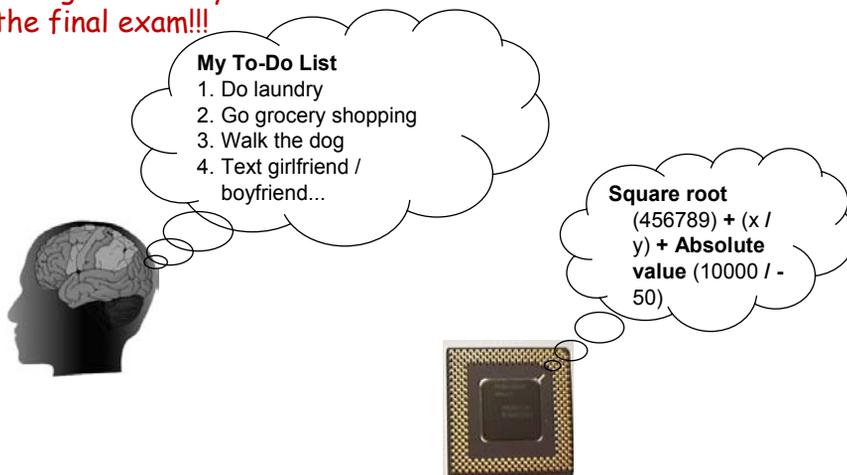


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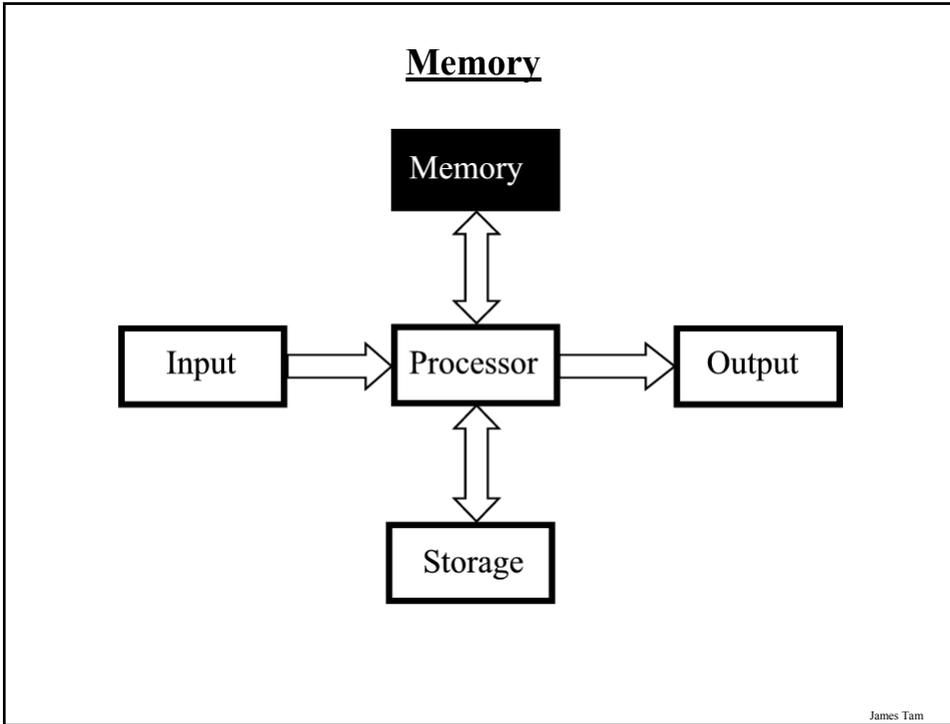
## Storage Of Information: Processors (2)

- Very often this limited storage space is insufficient.

Oops forgot to study  
for the final exam!!!



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### Memory

- It is used as temporary storage for the computer (analogous to scrap paper)

**Processor:**  
'brains' that performs the calculations

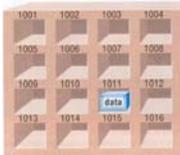
**Memory:**  
stores information needed by the processor

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## Memory (2)



- Main memory is used to store information that is currently needed by the computer (e.g., a program running now) but won't fit into the processor's memory.
- A common type of computer memory is RAM (Random Access Memory)
- RAM is volatile (information is stored so long as there is power).
- Memory is organized into numbered 'slots' with each slot storing a byte of information.



Picture from Computers in your future by Pfaffenberger B

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## How Much RAM?

- Rules of thumb:
  - Generally larger numbers are better (stores more)
  - Giga is better than Mega
- Systems vary widely depending on price but the typical starting values range from 1 GB – 6 GB
- The maximum RAM that can be installed on a home desktop computer is around 4 GB – 24 GB

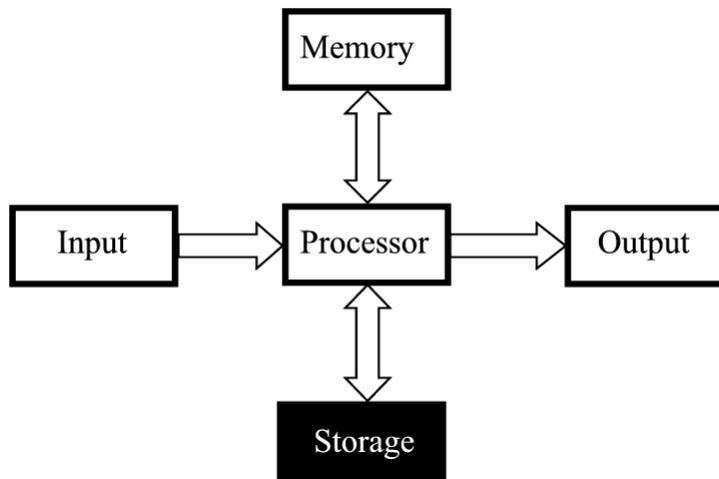
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## Limitations Of Memory

- It can store more information than the processor's memory but it's still finite in size.
- Also recall that RAM is volatile and information stored there will be lost after the computer is shut off (something else is needed)

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## Storage



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## Storage Vs. Memory



### **Storage (e.g., hard drive)**

- Information is not needed immediately but will eventually be needed.

### **Memory (RAM)**

- Information is required now.

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## Storage Vs. Memory (2)



### **Storage (e.g., hard drive)**

- The information is retained longer (e.g., a saved document).

### **Memory (RAM)**

- The information stored here is volatile (e.g., a document you've worked on but not saved is gone when the computer is shut off).

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### Storage Vs. Memory (3)



#### **Storage (e.g., hard drive)**

- Accessing the information is slower (~1,000,000 times) but much more information can be stored x10 to x1000+ times more than RAM

#### **Memory (RAM)**

- Access to the information is fast but far less can be stored here

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### Storage Vs. Memory (4)



#### **Storage (e.g., hard drive)**

- Storing information is less expensive ~100 times less

#### **Memory (RAM)**

- Storing information is more expensive

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## Common Forms Of Storage

1. Magnetic
  - Hard drives
  - Floppy and zip drives
2. Optical
  - CD
  - DVD
3. Solid State
  - Flash drives

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### 1. Magnetic Storage Devices

- Include floppy disks, zip disks, hard drives
- All use magnetism to store information:



- Like other storage devices it's non-volatile but is care must be taken to avoid magnetic fields, dusty or smoky environments, or physical jolts (the latter especially when reading or writing information)

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## 2. Optical Storage Devices

- Use lasers to store and retrieve information (CD's and DVD's).
- The storage capacity difference is approximately 1:8 (CD:DVD).
- Categories:
  - Can only read information off the disc (CD-ROM, DVD-ROM).
  - Can read and also record information to the disk (CD-R, DVD-R, DVD+R).
  - Can read, record and also re-write information multiple times (CD-RW, DVD-RW, DVD+RW).
- Optical storage devices aren't as susceptible to as many problems as magnetic devices but care must be taken not to scratch or leave residue on the surface of the disc.

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## 3. Solid State Storage Devices: Flash Memory

- Portables can store a large amount of information (~1/8 DVD – 16 DVD's of information)



- Solid state devices are fairly sturdy (come in a protective case) but reasonable care must still be taken e.g., don't remove the device when information is being written to it, keep the cap on when it's not in use).

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## Buying Storage For Your Computer

- Rules of thumb:
  - As is the case with memory larger numbers are generally better (stores more)
  - Tera is largest unit, which is better than Giga, which in turn is larger than Mega
- Common storage capacities:
  - Hard drives: 40 GB to 2+ TB
  - CD's ~600 MB
  - DVD's ~4 GB to 50 GB
  - USB keys and USB drives ~1 GB to 64 GB

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## Hardware Requirements For Some Programs

Operating system	Min RAM	Min processor speed	Hard drive space
Windows XP	64 MB	233 MHz	1.5 GB
Windows Vista (Home basic)	512 MB (32 MB graphics memory)	800 MHz	20 GB (install) + 15 GB (needed while running)
Windows Vista (Home premium, business versions)	1 GB (128 MB graphics memory)	1 GHz	40 GB + 15 GB (needed while running)

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## Hardware Requirements For Some Programs (2)

Software	Min RAM	Min processor speed	Hard drive space
Office 2003	128 MB (8 MB for each Office program running at the same time)	233 MHz	~400 MB
Office 2007	256 MB	500 MHz	1.5 GB
Halo 2 (game)	1 GB (also there's hardware requirements on the graphics card)	2 GHz	7 GB
Crysis (game)	1 GB (256 MB graphics memory)	2.8 GHz (Core 2 Duo is recommended)	12 GB

James Tam

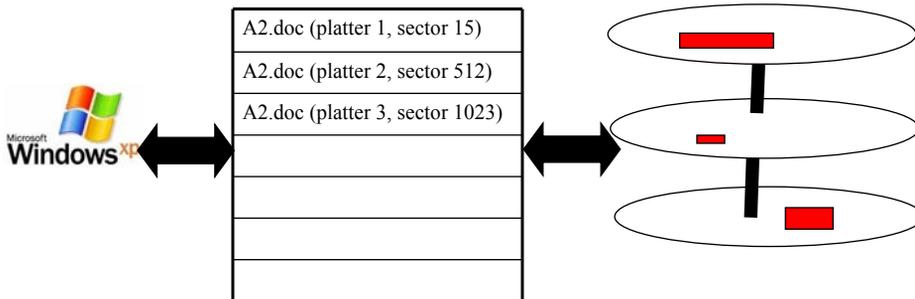
## Inkjet Vs. Laser Printers

- Printing photographic style pictures:
  - Inkjet is better
- Speed:
  - Laser is faster
- Cost of the printer:
  - Inkjet printers cost less initially
- Cost per page printed:
  - Inkjet printers tend to cost more over time

James Tam

## Indexing Hard Drives

- To speed up the retrieval of information from storage, information is 'indexed'.



- When the operating system searches the hard drive it actually searches the index to the drive rather than the drive itself.

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## Indexing Files And Security

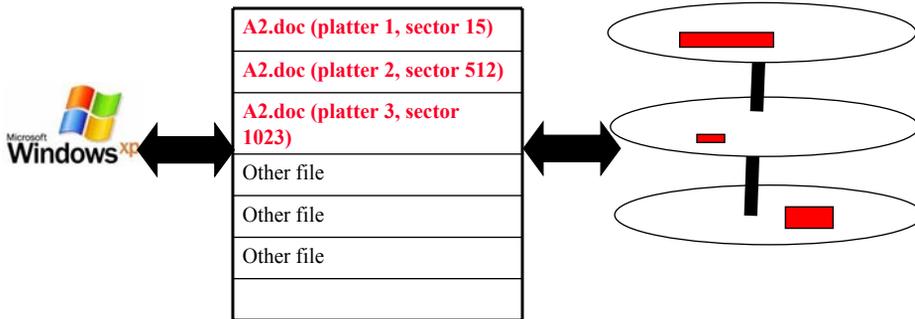
- While indexing files may speed up access it may lead to potential issues related to security.
- When is your file truly gone?
  - When it's in the recycle bin?
  - When the recycle bin has been emptied?
  - Other?

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## File Recovery Programs

- May allow accidentally deleted files to be “undeleted” or files on a bad disk to be recovered.
- They are NOT meant to replace your regular backup of files.

**Recall: files are indexed to increased access time**

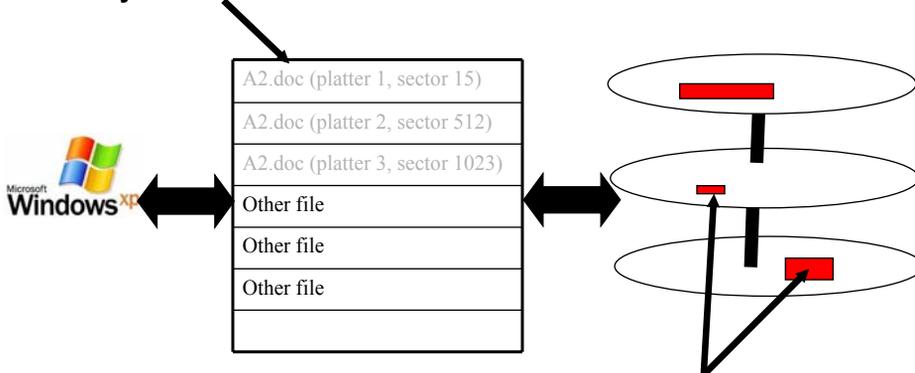


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## File Recovery Programs (2)

- Deleted files are often not truly deleted!

**Only the file index is deleted**

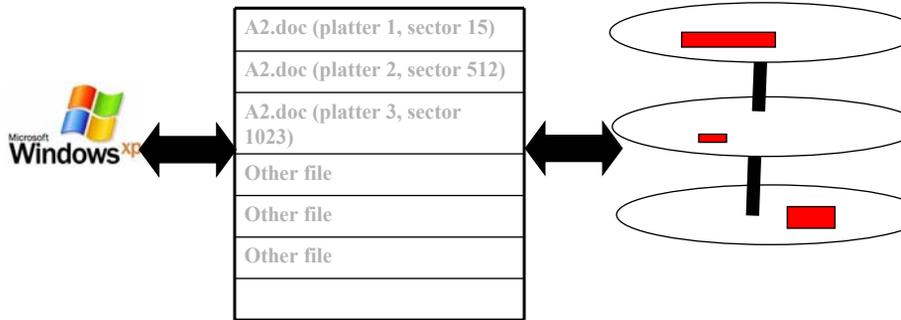


**The file \*MAY\* still remain on disk where a program may reverse the deletion process by re-creating the index**

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## File Recovery Programs (3)

- **\*SOMETIMES\*** when the contents of the disk is no longer accessible, the data is undamaged and it's only the disk index that has been corrupted.



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## Some Example Computer Programs To Recover Files

- Recover deleted files
  - Undelete
  - Pandora recovery
- Recover information from a bad drive
  - R-Studio
  - Spotmau PowerSuite
- Programs that can do both
  - Virtuallab data recovery
  - File scavenger data recovery

James Tam

## Backup Programs

- Most operating systems include a backup utility as part of the operating system.
- The software to backup files may also come packaged with storage devices.
- Rules of thumb:
  - Backup important files as often as possible (monthly, weekly or even more often).
  - Backups *should not* be made on the same disk where the data is stored.
  - Use an external hard drive or flash drive that is only connected when the backup is taking place (to mitigate system failures or virus attacks). Disconnect it otherwise.

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## Backup Programs (2)

- Rules of thumb (continued)
  - For truly crucial data consider a second backup that is stored at another location separate from the computer (file attachments via email, CD/DVD's, USB key etc.). *Of course you may want to avoid putting private information in your email.*
  - After completing the backup check that the backup was successful – backups do periodically fail (reverse the backup process to check that it worked).

James Tam

## **You Should Now Know**

- What are the different types of computers from PDA to super computer
- What are the common units of measurement for computers (large and small)
- How a computer works on the two state model and how these two states are combined to form larger units
- What are the 5 parts of the high-level computer
- How buses connects the inner parts of the computer and the ports connects the computer to the outside
- Approximate and relative port speeds
- What are some common (and not so common) input devices
- How wired and wireless input devices work as well as some of the issues associated with each

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## **You Should Now Know (2)**

- What are the three methods of control used for mice
- How do LCD monitors work
- What are the common characteristics of monitors
- The role that the processor plays in the computer, characteristics that determine processor speed, benefits of faster processing speed
- How do multi-core processors work and under what conditions are they faster and when they make no difference
- The purpose of memory (RAM) in the computer, how does it work
- What are different types of computer storage and how does each one work

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### **You Should Now Know (3)**

- What is the difference between storage and memory
- Common hardware metrics for speed and storage capacities
- The differences between inkjet and laser printers
- What are the security and other issues associated with the indexing of files
- Approaches for backing up your computer and why is it important