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# Building and Maintaining Computers

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Everyman IT

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January 15, 2011

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## Introduction

### Safety

Always unplug computers before working on them

Always remove laptop batteries before working on them

After you have unplugged the computer, and removed the battery press in the power button to discharge any electricity held in the capacitors. Capacitors store electricity and even a small one can cause enough damage to you to send you to the hospital

***NEVER SHORT THE TWO CONNECTORS OF A CAPACITOR!!!***

***Never OPEN a power supply. The capacitors in a power supply carry enough power to kill you!***

ESD – Electro Static Discharge is “Static Electricity”

You feel a shock from Static Electricity at 3000 volts... 100 volts is enough to destroy sensitive electronics...

You “should” wear an anti-static arm band and work on an anti-static work mat. (I don’t... and no one I know does... but you should...)

“Common Practice” to discharge Static Electricity is to touch the unpainted metal of a desktop computer case.

ESD is not as big a problem now because parts are built better, and they are cheaper if they break...

### What is a Computer

A computer system is made up of hardware, operating systems, software and device drivers.

- Motherboard
- CPU
- CPU Heat Sink
- RAM

- Power Supply
- Drives
- Case

## Computer Hardware

### Motherboard

All parts must be compatible with the Motherboard

Don't assume the motherboard will have onboard parts

FSB(Front Side Bus) is how fast the Motherboard can move data between components

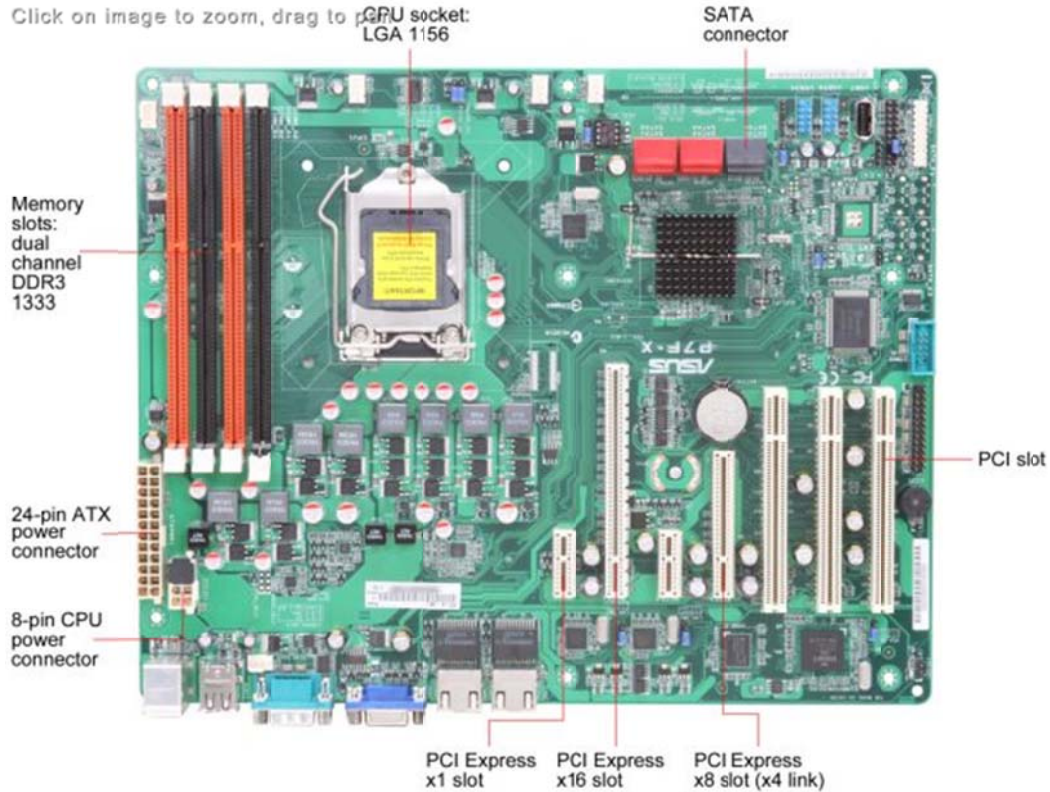
Form Factor- Size of Motherboard

- ATX
- MiniATX
- MicroATX
- ITX
- BTX (Don't buy)

Smaller Motherboards can fit in Larger Cases

Slots

- PCI – Low end add on cards
- PCI Express – Used for Higher End add on cards (RAID, Video)
- PCI Express 16 – Used for very fast add on cards (High Performance RAID, Gaming Video Cards)
- PCI X – Used on very high end servers. Ridiculously expensive! (\$450 for a network card)



### *I Recommend*

- Antec
- Intel
- Gigabyte

### **CPU**

Central Processing Units are what processes data

CPU types have different Sockets

### **Manufacturers**

- Intel
  - Atom – Embedded Systems
  - Celeron – Cheap Processors
  - Pentium – Average Desktop Processor
  - Core – High End Desktop Processor
  - Xeon – Server Processor
- AMD
  - Sempron – Cheap Desktop Processor
  - Athlon – Average Desktop Processor
  - Phenom – High End Desktop Processor
  - Opteron – Server Processor

- ARM
- VIA

***Don't use Xeon/Opteron for Desktop machines!***

Intel vs. AMD – Same, Same but Different. AMD is usually cheaper, but Intel is Easier to Sell to Clients

**Speed** – How fast the processor can process data

**FSB (Front Side Bus)** – How fast the CPU can move data

**Cores** – Multiple CPU's build onto one chip

**L1 and L2 Cache** are memory that is located on the CPU. The higher the L1 and L2 the better.

## RAM

All programs and files are loaded into RAM. If Windows uses 512MB of RAM, and Photoshop uses 512B of RAM, AND you open a 1 GB Picture file you would need 2 GB of RAM in the Computer.

Page Files are designated storage on the Hard Drive where RAM stores data it is using if it is full.

## Type

- SDRAM
- DDR, DDR2, DDR3
- Rambus - Paired RAM

ECC = Error Checking RAM. Does self-test to itself. This is the best type of RAM, but is very expensive.

## Size

Sticks of RAM

## Speed

RAM Works at different speeds

SPEED is many time more important than SIZE for RAM

**Don't Mix RAM Speeds!**

***Before upgrading to more RAM verify that empty RAM slots work. Many times they are bad!***

## Hard Drives

Hard Drive Media Types

- Platter
- Solid State

Hard Drive Types

- IDE – 2 Drives per Cable. Master/ Slave Jumper Configuration. 133 Mbps
- PATA/ SATA – 1 Drive Per Cable. 1.5Gbps
- SATA 2 – 1 Drive Per Cable. 3Gbps
- SATA 3 - 1 Drive Per Cable. 6Gbps
- SCSI – 8 Drives Per Cable. Various Speeds
- SAS – 65,355 Drives, 3-6Gbps

RPM is the speed the hard drive spins at

- 5400 is the slowest usually used in laptops, and “energy efficient” drives
- 7200 is normal
- 10,000 is high speed used in Western Digital Raptor Drives
- 15,000 is found only on SCSI, SAS, drives

### ***RAID – Redundant Array of Inexpensive Disks***

Used for Fault Tolerance and Speed

Software RAID and Hardware RAID – Hardware allows the OS to be on the RAID. Software RAID means the OS will not be protected by the RAID.

RAID Types:

- 0 – Disk Striping
- 1 – Disk Mirroring
- 5 – Disk Striping with Parity
- 6 – Disk Striping with Parity and Redundancy
- 10 – Mirrored Disk Striping with Parity

***RAID is usually not worth the trouble now...***

### **Optical Drives**

Blue Ray isn't worth it

### **Media Card Readers**

Generally plug into the motherboard using the motherboards USB connector

### **USB and Firewire**

- USB 1.0 – 12Mbps, and up to 17 connected devices
- USB 2.0 – 480 Mbps
- USB 3.0 -4.8 Gbps
- Firewire – 400-800 Mbps

Wireless USB is coming...

USB is Asynchronous transfer – One way transfer is faster

Firewire is Isochronous – Same time give to up and down

Firewire was very important for video camera connections to computers. Now it is rarely seen.

## Network Cards

### Video Cards

GPU – Graphics Processing Unit – Used for Creating Graphics, Important for Gaming Systems and any system involved with Graphics.

Onboard RAM – RAM that is onboard the graphics card allows the graphics card to run faster.

Chipsets

- ATI
- NVIDIA

Types

- PCI
- AGP
- PCI Express

***Try to buy video cards without fans! Many graphics cards have extra-large heat sinks vs. fans. Fans have a nasty tendency to get gunked up and die.***

## Cases

Good Cases are important! Cheap cases are hard to work with, and many times don't fit together properly. (You can get a nasty cut from sheet metal that has not been rounded)

Form Factors are the size of the case. The Motherboard and Power Supply must be the right size to fit in the case.

- ATX
- Mini-ATX
- Micro-ATX
- ITX
- BTX – Obsolete. Not compatible with ANY ATX motherboard

### *I Recommend*

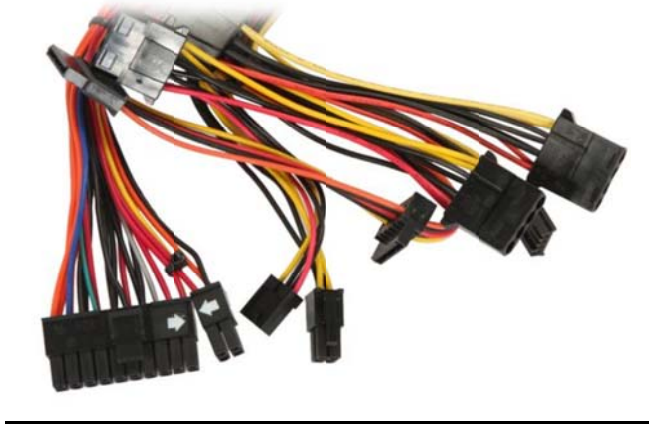
- ANTEC
- Cooler Master

## Power Supplies

When in doubt buy a 600 Watt one from Best Buy for \$70

### Power Supply Plugs

- Main connector (20+4Pin)
- 12V(P4)
- Peripheral (Molex)
- SATA
- Floppy
- PCI-E



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***Video Cards and Motherboards require the most power. Buy a Power Supply above the power requirement for your Video Car and Video Card.***

Buy ANTEC Power Supplies

***A Cheap Power supply will not only fail, but it can destroy your Motherboard, Video Cards and Hard Drive when it dies.***

***Do Not Skimp on Your Power Supply!!!***

## Computer Operating Systems

### 64 bit vs. 32 bit

States How Many Bits are Processed in Parallel

32 Bit Operating Systems will generally run on a 64 bit processor

64 bit Operating Systems REQUIRE a 64 bit processor.

***64 bit is not always faster than 32 bit!***

### Types of Licenses:

- OEM (Original Equipment Manufacturer) – You cannot install the Operating System onto another computer. Requires Activation Once Installed
- Retail – You Own the Operating System. You Can Install it Onto Different Computers, but Only One at a Time. Requires Activation Once Installed
- Volume License – You Can Install Onto as Many Computers as You Have Licenses for

### Windows Versions:

- Home Premium – Basic Windows Functionality
- Business – Allows You to Join Domains, Has BitLocker Encryption, Allows SysPrep.
- Ultimate – Has Everything

<http://www.microsoft.com/windows/windows-7/compare/default.aspx>

### Software

Generally you can run 32 bit software on a 64 bit Operating System.

Previously (as with XP 64bit) you could not run 32 bit software on a 64 bit machine.

You cannot run 64 bit software on a 32 bit Operating System.

### Drivers

Device drivers must be installed in the operating systems for hardware to work.

***Even with Windows 7 all devices may not have device drivers installed automatically.***

Sometimes manufacturers do not make device drivers for all Windows Operating Systems! Many times manufacturers will not create new drivers for new operating systems. This was a big problem when we went from 98 to XP, and from XP to Vista.

Finding device drivers can be a bit of detective work. GOOD hardware will be clearly marked so that you know who made it and what it is. CHEAP hardware many times won't even have the name of the manufacturer printed on it.

## Building a Computer

### Spec'ing Out a New Computer

Everything has to work with the motherboard

Decide what parts you need, then find a good motherboard, then find the rest of the parts.

NewEgg.com is the best for parts

***Don't use EBay!!!***

***Don't use used parts for Clients!!!***

By Cannibalizing Old Computers You Can Save a lot of Money

- Save \$50 by reusing the case
- Save \$40 by reusing the Optical Drive
- Save \$100 if you can reuse your Hard Drive
- Etc...

Fudge Factor... It's easy to buy the wrong parts, and shipping costs mean that it's usually not worth it to return them. While you're new expect to make mistakes and factor in extra cost for mispurchased parts.

## Common Desktop Troubleshooting

### Overheated CPU

**Symptoms:**

- The Computer Seems Possessed
- Computer Freezes
- Computer Shuts Down Randomly

**Likely Suspects:**

- CPU Heat Sink is Clogged, or has Film of Crud on it
- Case Air Intakes are Clogged
- CPU Fan has Failed
- Case Fans Have Failed
- Forgot to Use Thermal Paste
- CPU Fan is Too Small
- Environment is Too Hot (Computer is Closed Inside a Desk Cabinet. Server is in a Closet with No Ventilation)

**In the Real World...**

I had one computer where the clients smoked in the house. The Computer would not get through booting before it would shut off. They smoked so much that the tar had entirely incased the CPU Heat Sink Fan. It looked clean (Free of Obvious Dirt and Hair), but when I used Dawn and washed it off in the sink the tar melted off.

One client had a computer that would freeze up, and the mouse would jump around. I took it to the shop, opened the case and cleaned it out. I then did a full tune up. The system worked flawlessly and so I called the client and scheduled a drop off time. After the call I put the cover back on the case and within 2 minutes it had frozen up again. I took the cover off and looked around to see if a cable had gotten caught in the CPU fan, and it worked fine. I put the cover

back on and it froze. The answer was that they had a cat and the front air intake, underneath the front plate had become clogged with hair. I cleaned out the massive hair ball and it worked fine...

## Video Cards

### Symptoms and Suspects:

- Turn on Computer and You Get a BIOS Screen and Then a Blinking Cursor = Hard Drive Failed or Operating System is Corrupt
- Turn on Computer and Do Not Get BIOS Screen = Monitor is Bad, or Video Card is Bad, or Motherboard is Bad
- Turn on Computer and Icons are Really BIG, Resolution is Poor, and the Colors Look Weird = Video Card Driver is Not Installed, or Incorrect

### Troubleshooting No Video

- Plug in a Known Good Monitor
- Look at Video Card. Many Times the Heat Sink Fan Will Not Spin, or Will Have Fallen Off
- Verify that the Video Card Auxiliary Power is Plugged in.
- Swap Video Card with Known Good
- Use a PCI Video Card. Sometimes the PCI Express/AGP slot will be bad. PCI Video Cards will Allow the Computer to Remain Usable.
- IF PCI Video Card Does not Work then the Motherboard is Bad

## Power

### Symptoms

- Computer Will Not Power On

### Likely Suspects

- Main Power Supply Switch is Off
- Voltage Switch is on Wrong Setting (Should be on 110)
- Power Switch is Not Properly Plugged into Motherboard
- Power Button Broke
- Motherboard is bad
- Power Supply is Bad
- Power Supply is too Small
- CPU Fan no Plugged in
- Bad Power Cable

### Troubleshooting

- Checks Connections and Switch Settings
- Try Different Power Cable
- Verify Video Card and Motherboard Power Requirements
- Use Known Good Power Supply

## Hard Drives

If the hard drives makes a lot of noise just replace it.

Defragmenting can reduce Hard Drive noise.

For IDE Hard Drives Verify Master/ Slave Jumper is set properly

If the hard drive is dead then replace with new one and install operating system.

*Data Recovery covered in our Data Recovery Class*

## USB

If the insulator in a USB plug gets ripped out, and the metal contacts touch your machine could start having problems.

If it is a front USB Port unplug the port from the motherboard.

If it is a Motherboard USB port do what you can...

## Laptop Hardware Repair

Keep Track of All the Screws! Tape Screws to a Piece of Paper Placing them Approximately Where they are from on the Laptop.

Be careful with the stickers that cover the screws! No one wants an ugly computer! (100% Right, 100% Fired)

***Stay Away from MacBook's!! (Repairing a MacBook is not the same as repairing a Laptop.)***

## Hard Drives

Generally you can remove a screw to allow the hard drives enclosure to slide out.

## Optical Drive

Generally you can remove one holding screw, and the drive will slide out.

## RAM

Generally under a panel that can be removed from the bottom of the case.

## CPU FAN

Can be cleaned of replaced. Generally found by removing the entire bottom cover.

## LCD Screen

Generally remove the faceplate from the monitor area and then unscrew the Screen. Screws are hidden under stickers, or rubber bumpers.

## LCD Inverter

LCD Inverter is under the monitor faceplate.

## Keyboard

Generally remove panel above keyboard to access screws. Sometimes the entire motherboard has to be removed.

## Motherboard

Don't... New Laptop Motherboards cost \$300+ and the labor involved makes it non economical to fix.

## Power Plug Resolder

Disassemble the entire bottom of the laptop. Many times the power jack can be purchased and replaced.

## Common Laptop Troubleshooting

### Video

If the screen is very dim, but you can see an image on it then usually the LCD Inverter is Bad

If you cannot see any image on the screen plug a monitor into the monitor port. If the monitor does not show an image then your Motherboard is bad (Make sure to use the Function Keys to turn on the external monitor). If the external Monitor shows an image then it could be your Screen, Inverter, or the cable from the Screen to the Motherboard.

### Shutdown or Freeze Up

The CPU Heat sink intake fans are usually on the bottom of the laptop. If you put the laptop on a blanket, or pillow the fans will be blocked and the CPU will over heat. Try putting the laptop on a hard surface (table or counter).

### Broken Hinges

Screen Hinges can be replaced. Make sure whether you can buy the hinges alone, or if you have to buy a whole new LCD frame!

### Misc.

**Reseating parts sometimes fixes Laptop Computers. This means removing the RAM, Hard Drive, wireless card and Optical Drive, and putting them back in.**

***For laptop Parts I recommend SmartMicroUSA.com***

## BIOS

Tells the computer how to deal with hardware

Usually you will be told what key to hit to enter BIOS setup, if not “play the piano” on the keys

BIOS tells you quickly what hardware is DETECTED on the computer (CPU, RAM, Hard Drives). ***If BIOS does not detect the hardware you have a problem!***

### ***Main uses for BIOS***

- Change Boot Order
- Change what happens after power outage (Computer stays off, or comes back on)
- Set BIOS password

BIOS Passwords can generally be reset on Desktop Computers by removing the CMOS battery, or connecting a jumper.

***BIOS Passwords on Laptop Computers generally cannot be reset! If you lose the BIOS Password on a Laptop and you should expect to buy a new motherboard!***

## Install an Operating System

### Creating Recovery Disks

Most manufacturers no longer give you recovery disks when you buy a PC. You must create your own using whatever utility they give you.

System Recovery using Recovery disks is not the same as a Clean Installation of an Operating System

### Steps to Install an Operating System

- Change BIOS to Boot off of CD/ROM
- Hit NEXT Until Done....

## Windows Maintenance

### Modes

Press F8 while computer is booting

#### ***Safe Mode***

Safe Mode uses a minimum amount of drivers and services when starting. This is good for changing configurations. Generally you cannot install, uninstall software or run virus/ malware scans.

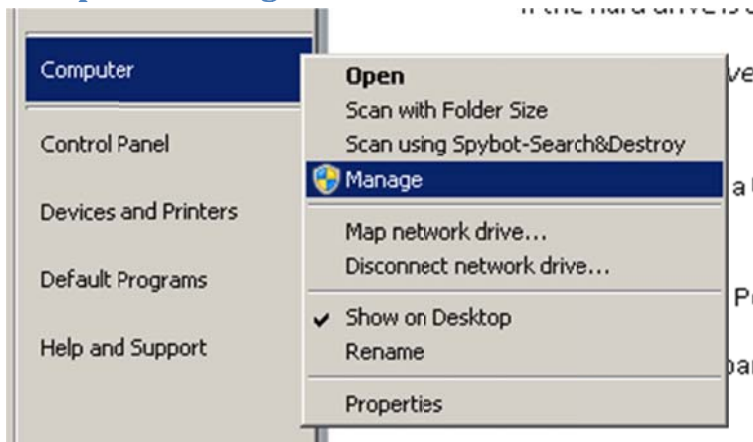
### Last Known Good Configuration

This is the hardware settings that were loaded the last time a person logged in. If you think you made a mistake DON'T Login! Last Known Good will revert to the drivers and hardware settings that were used with the last login.

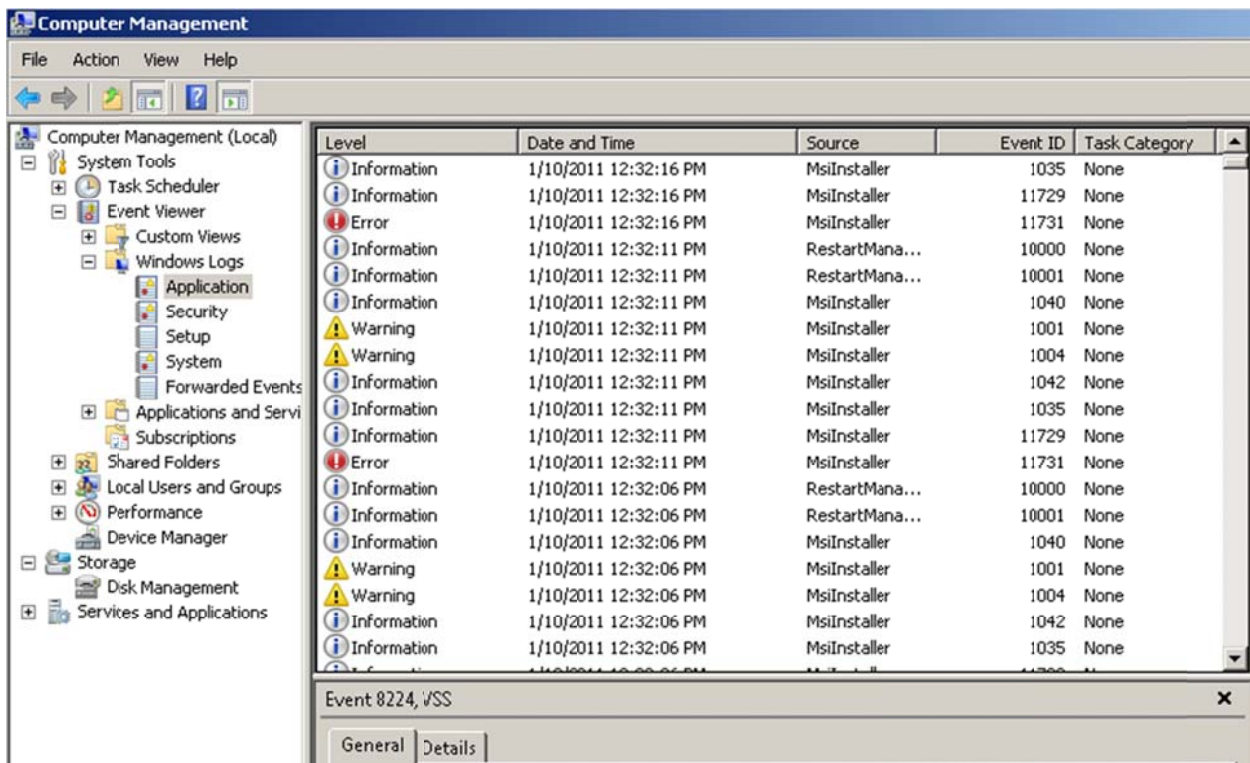
### VGA

Uses the base graphics drivers. This is used if you make a mistake configuring your video adapter.

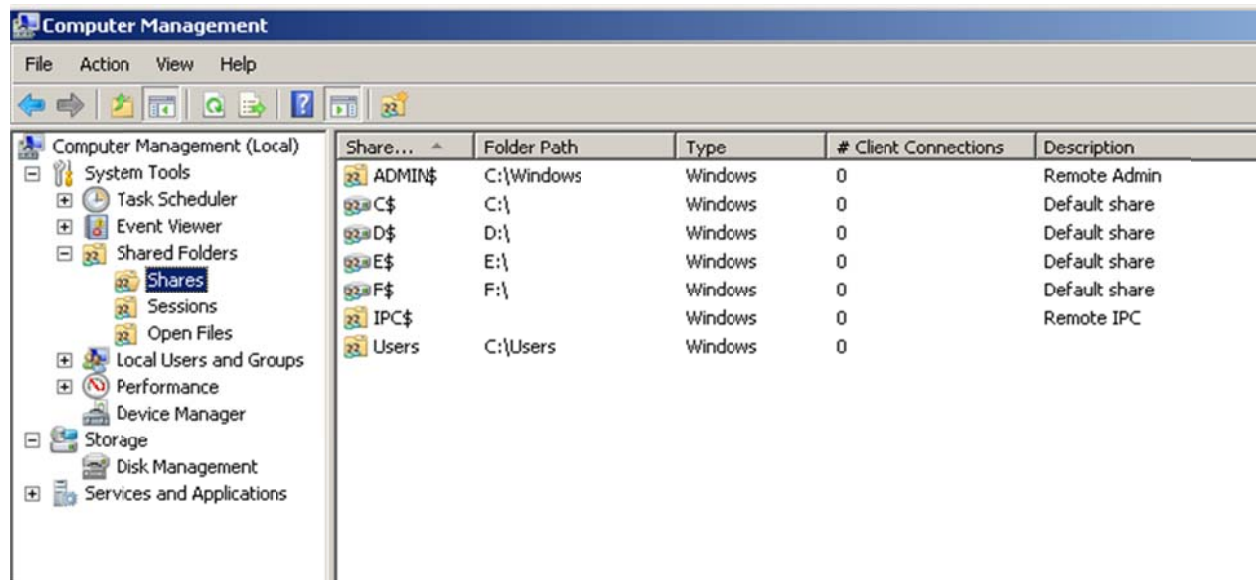
## Computer Management



## Event Viewer

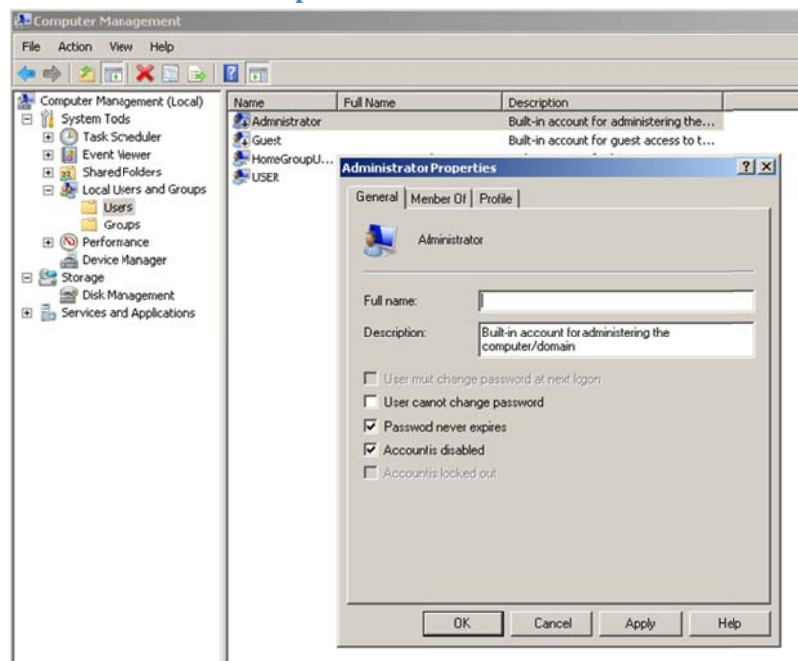


## Shared Folders

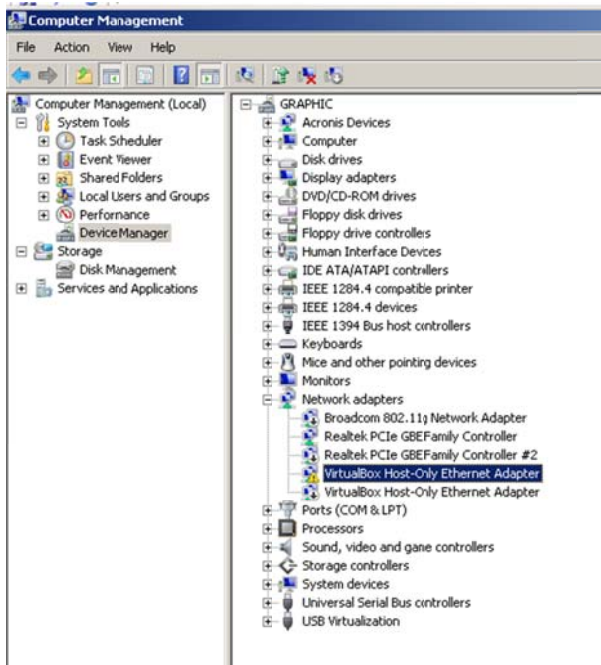


- Shares – Shows Shared Folders on Computer
- Sessions – Show Sessions that are currently open
- Open Files – Shows Shared Files that are Open

## Local Users and Groups

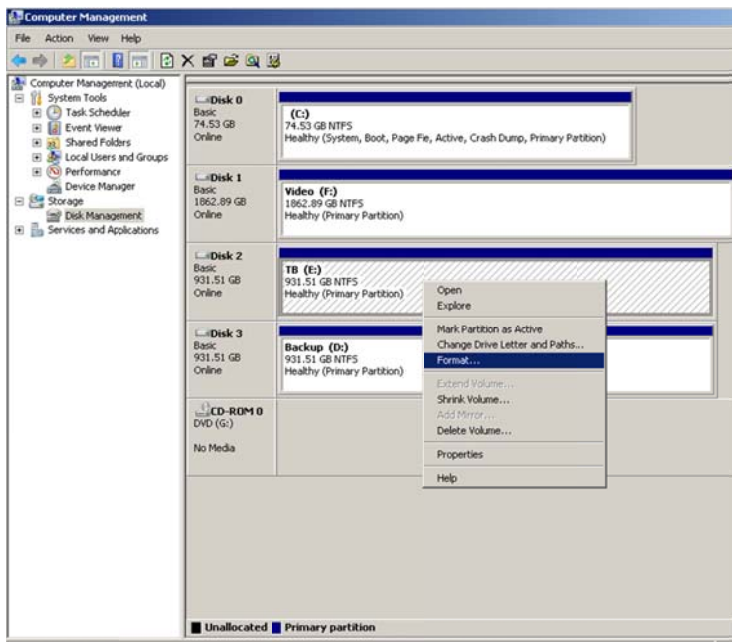


## Device Manager



## Disk Management

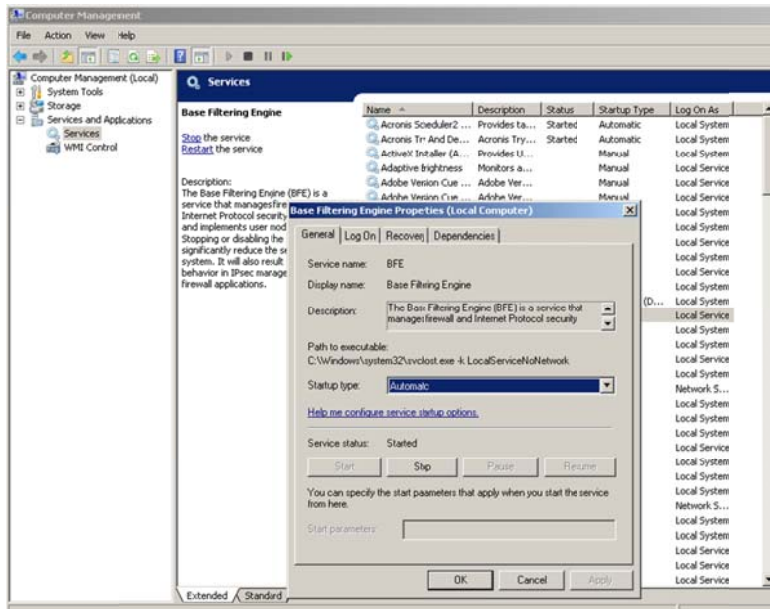
Disk Management is used to manage your internal hard drives



## Services

Services shows you what services are running and how they are started. You can change how Services starts to Manual, Automatic or Disabled.

Services also shows you what individual Services are dependent on.



## Windows Update

Update Critical Updates

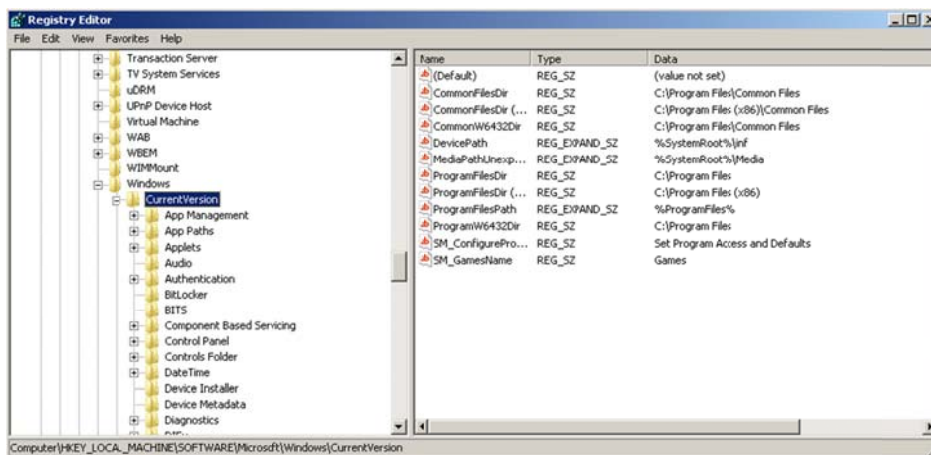
Setup to Install Updates Every Night

**NEVER Update Drivers from Windows Update!!!** (I don't know why, but too many times it causes the computer to crash)

## RegEdit

RegEdit allows you to edit the Registry. The Registry is the main database that holds most configurations for the Windows Operating System.

1. Click "Start" Button
2. In Run Bar type **regedit** and then Click "OK"



Many Applications Auto Start when the Computer Boots from Keys in these:

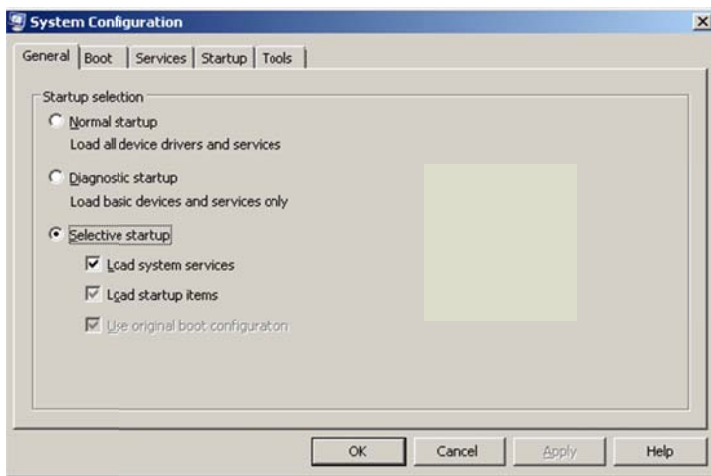
- HKEY\_LOCAL\_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run
- HKEY\_CURRENT\_USER\Software\Microsoft\Windows\CurrentVersion\Run

## MsConfig

- Click “Start” Button
- Type **msconfig** in Run bar and Click “OK”

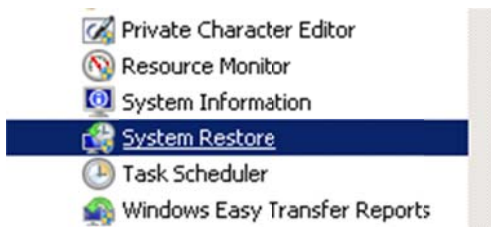
Msconfig allows you to specify what Programs and Services will load when the Computer Boots. This is generally better than Safe Mode because you can run Virus Scans and Install/ Uninstall Programs.

Generally Select “Selective Startup” and Uncheck “Load Startup Items” Checkbox.

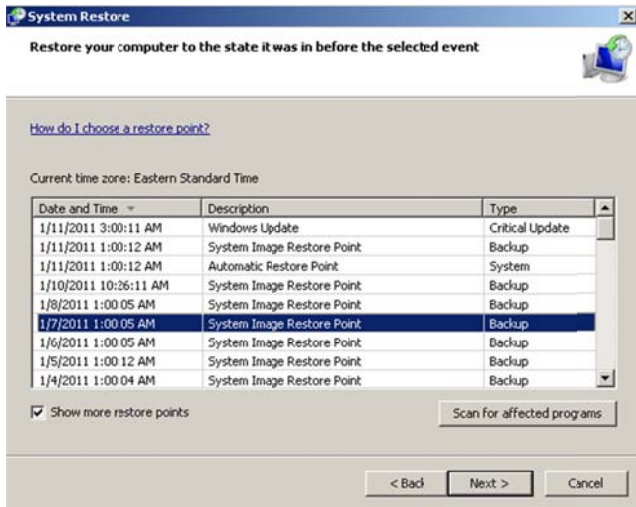


## System Restore

System Restores Applications and Operating System settings to previous condition. System Restore does not affect documents and pictures.



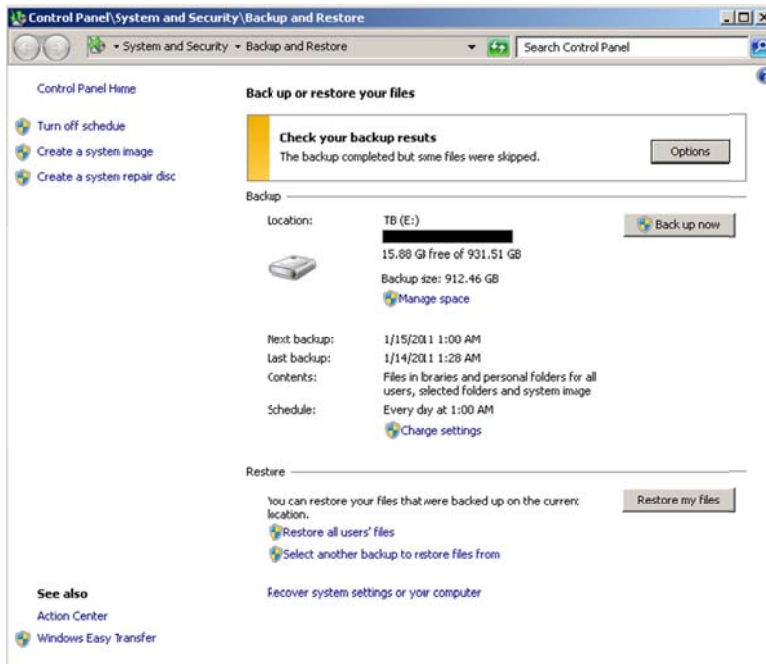
1. Select Start Button
2. Select “All Programs”
3. Select “Accessories”
4. Select “System Tools”
5. Select “System Recovery”



- Select Previous Time and Date to Restore to and Click “Next”

## Windows Backup

### Backup and Restore



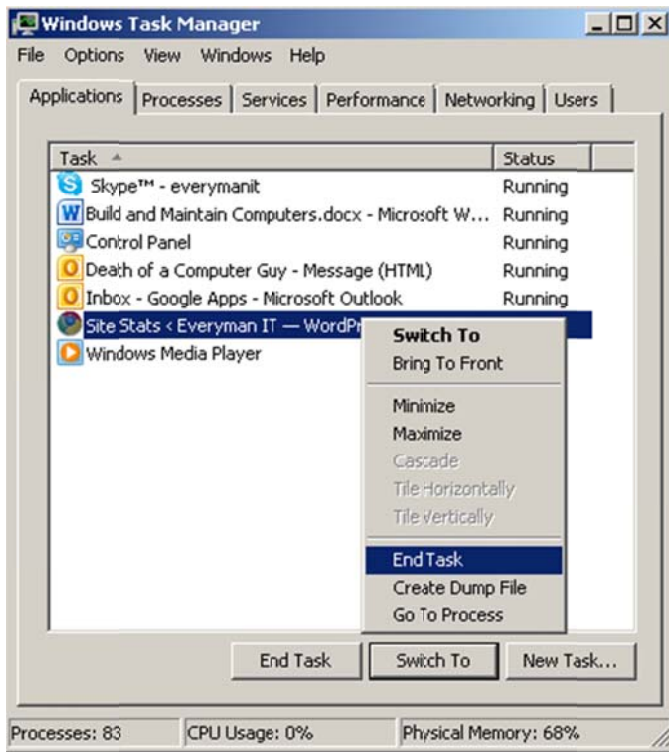
### **Backup to a different disk!**

You can use your Windows OS Disk to recover a computer from a Backup File

## Task Manager

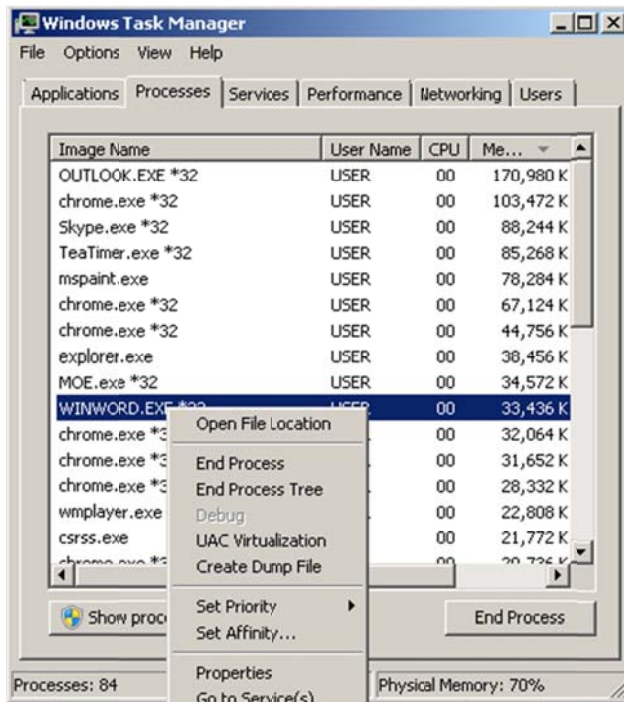
1. Right Click Taskbar

2. Click “Start Task Manager”



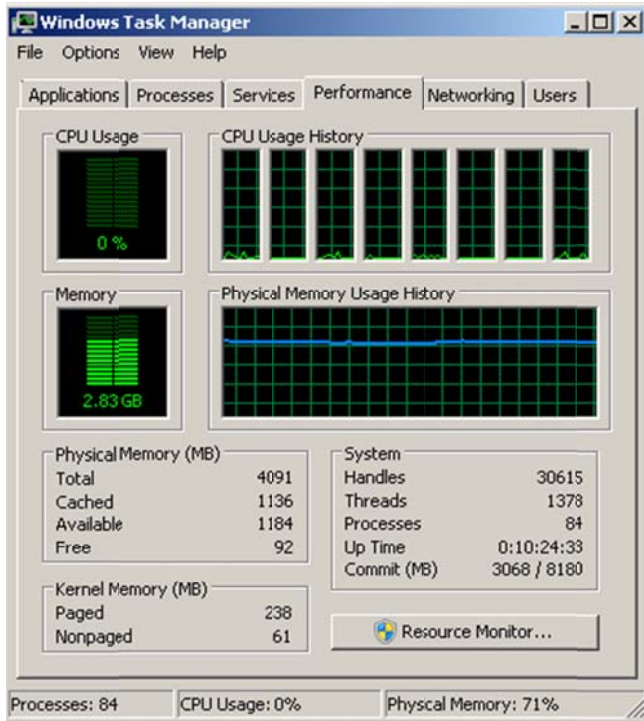
Application Tab:

- To Kill an Application – Right Click Application and then Select “End Task”



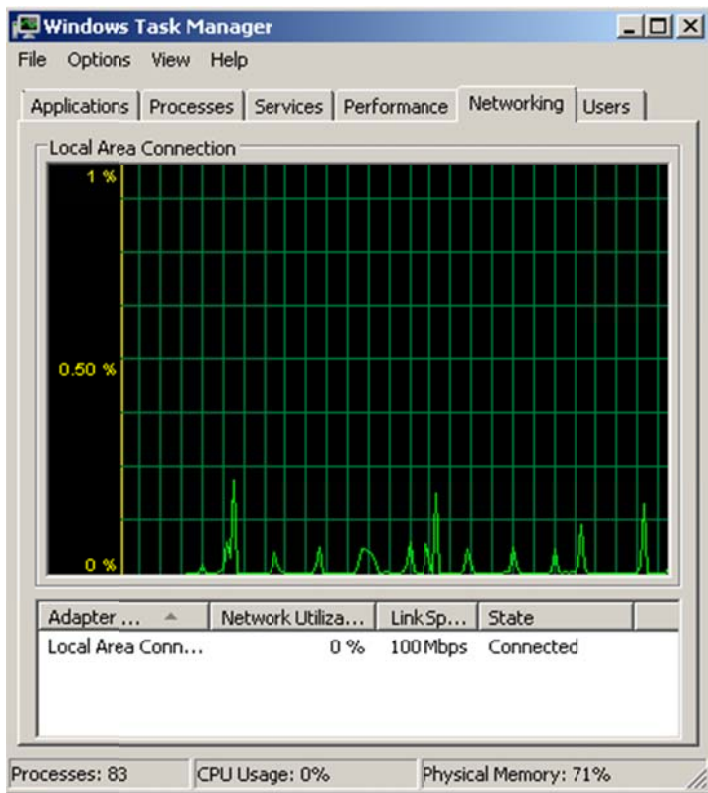
## Processes Tab:

- You can see what Process are Using Your Resources by Sorting by CPU, or Memory
- To Kill a Process – Right Click Process and Select “End Process”



## Performance Tab:

- CPU Usage should be below 50%. If CPU is 90-100% you have too many programs running, or need a better processor.
- Memory shows you how much RAM you are using. Memory should be less than your total amount of RAM

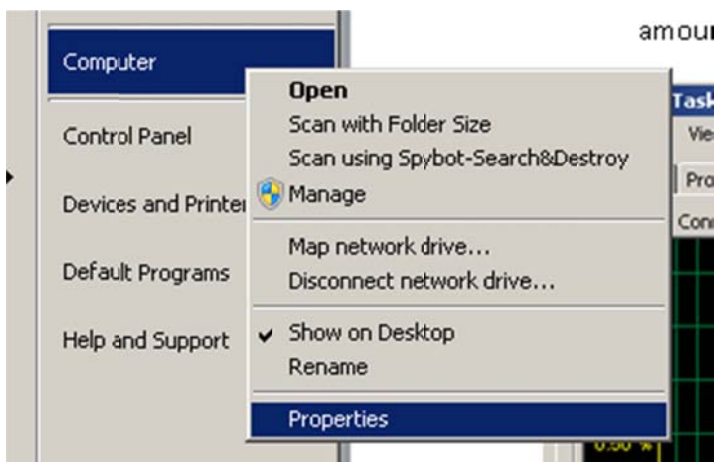


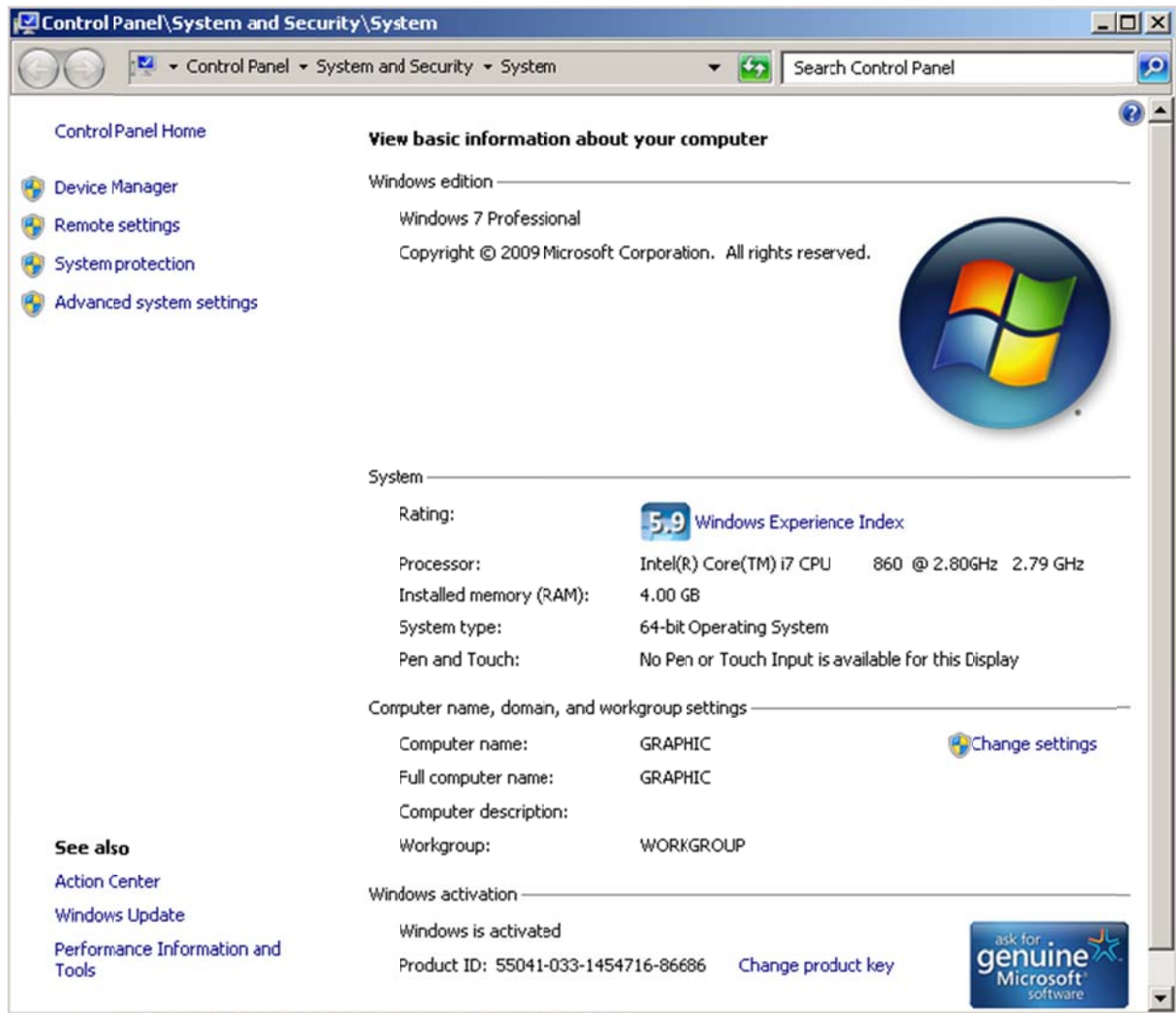
Networking Tab:

- Shows how much network traffic your computer is using.

## Computer Properties

- Start Button
- Right Click "Computer" of "My Computer"
- Select "Properties"





## Hard Drive Space

Should Have 10% Free

***MUST Have At Least 1 GB Free or Computer will Freeze Up and Have Problems!***

**Defragmenting is overrated!**

Use Defraggler instead of Windows Defragmenter for Defragmenting Hard Drives. (It's Free. [www.Defraggler.com](http://www.Defraggler.com))

## Uninstall Programs

1. Control Panel
2. Uninstall a Program

Uninstall All Unnecessary "Protection" Software

## **CCleaner**

Download at [www.CCleaner.com](http://www.CCleaner.com)

Good for cleaning out temporary files

Good for defragmenting registry

Easily Enable or Disable Startup Programs

# Home Work

---

- Find a Computer that Needs Fixing and Fix it
- Schedule Time to Come In for Practical Exercises
- You should complete at least 10 actual repairs, or practical exercises by next class