

I.Ch 8 Secondary Storage

A. *Competencies page 210*

- 1. Distinguish between primary and secondary storage.**
- 2. Describe the traditional floppy disk and compare it to high capacity floppy disks.**
- 3. Compare internal hard disks, hard-disk cartridges, and hard-disk packs.**
- 4. Describe ways to improve hard-disk operations, including disk caching, redundant arrays of inexpensive disks, and data compression and decompression.**
- 5. Describe the different types of optical disks.**
- 6. Describe solid state storage, Internet drives, and magnetic tape.**

B. *Introduction page 211*

- Secondary storage devices are used to save, to back up, and even to transport files consisting of data or programs from one location or computer to another.
- The need for storage continues to grow due to higher demands of users to store more digital media such as videos, music, and images.
- Data is stored on secondary storage in digital or machine code, so it doesn't need to be translated from the 1s & 0s when it is sent to the CPU for processing.

C. *Storage page 212*

- RAM (Random Access Memory) is called primary storage since it is used directly by the CPU for processing data and program instructions.
- RAM is volatile or temporary storage (once the power is turned off, the contents are lost).
- Secondary storage provides permanent or non-volatile storage.
- Secondary storage devices read and write the data onto the storage medium.
- Reading is the process of retrieving/accessing the data.
- Writing is the process of storing/saving the data.
- Important characteristics of secondary storage include:
 - Media or medium: the physical material that holds the data

- Capacity: measures how much the media can store, typically measured in MB, GB, and TB
- Storage devices: hardware that reads (and often writes) to storage media
- Access speed (aka access time): measures the amount of time to read and/or write to the storage medium

D.Floppy Disks

- Floppy disks (aka floppies, diskettes, disks or flexible disks) are portable, removable storage media.
- The use flat circular pieces of Mylar plastic coated with a magnetic material to store data.
- Floppy Disk Drives (FDD) store/retrieve data by magnetizing spots according to an encoding scheme such as ASCII, EBCDIC, or Unicode.

1.Traditional Floppy Disk page 213

- Traditional disk is the 1.44 MB 3 ½" disk, introduced in the 1980's
- 2HD disks are "two sided, high density"
- Density refers to how tightly the bits can be packed on the medium
- A Shutter slides to provide access to the plastic medium
- Labels can be applied to the external surface of the disk to identify the contents
- A Write-Protection Notch can be moved to protect the disk from accidentally writing over it.
- Floppies store the data in a series of Tracks and Sectors – each sector can store up to 512 bytes or characters.

2.High Capacity Floppy Disks page 214

- High Capacity Floppy Disks (aka floppy-disk cartridges) have capacities of much higher than traditional floppies. Three leading types include:
- Zip Disks (sold by Iomega) have 100, 250, or 750 MB capacities and connect to the PC via USB cable. The disks are slightly thicker than traditional floppies, so they require special disk drives.
- HiFD disks (from Sony Corporation) have 200 MB or 720 MB capacities. The main advantage is the drives can also read traditional 1.44 MB floppies.
- SuperDisks (from Imation) have a 120 MB or 240 MB capacity, and the drives can also read traditional 1.44 MB floppies.

E.Hard Disks page 215

- Hard disks save files by altering magnetic charges of the disk's surface
- Hard disks use a thicker, rigid metallic platter for the base medium

- Read/Write heads ride a 0.000001 (one 1 millionth) inch cushion of air above the disk.
- A “head crash” occurs if the R/W head scratches the surface of the disk, but these don’t occur as frequently as they did on early storage systems.

1.Internal Hard Disk

- Also known as a fixed disk
- Located inside the system unit or chassis
- Typically mapped as the “C.” drive
- Advantages are speed and capacity: a 100 GB HD can hold as much as 70,000 traditional 1.44 MB floppies = $(100 * 2^{30}) / 1,440,000$
- Access speeds are measured in milliseconds (ms) e.g. 10 ms
- Disk rotation speeds are measured in RPM (rotations per minute) e.g. 5,400 RPM
- You should perform routine maintenance on your hard drive using programs such as Microsoft’s Disk utility programs.

2.Hard-Disk Cartridges page 216

- Also known as removable hard disks
- Limited only by the number of cartridges you use
- Cartridges typically hold 10-40 GB of storage
- See Iomega’s older Peerless system or the Rev system
- PC Card Hard disks are credit card sized hard-disk cartridges
- Examples include IBM’s Microdrive and Toshiba’s MK5002 drives which hold around 5 GB and are typically used on laptops

3.Hard-Disk Packs

- Hard disk packs are removable storage devices used to store massive amounts of information without duplicating the drive mechanism.
- They may have up to 11 large disks with 20 recording surfaces.
- Typical use is in large mainframe shops like banks and insurance companies.

4.Performance Enhancements page 217

- Disk Caching: frequently used data is read into memory chips, which improves the transfer rate to the CPU by up to 30%.
- Redundant Array of Inexpensive Disks (RAID): improves performance by expanding external storage, improving access speed, and providing backup. While it costs more to have a RAID system, it improves storage reliability. RAID systems are typically used for network servers.
- File Compression and File Decompression: increase the amount of storage available on the disks by removing repeating patterns of

data. Popular programs for compressing files include WinZip and PKZip. The smaller size comes at a price, since it takes a little longer to uncompress the data.

F.Optical Disks page 219

- Optical disks can hold close to 17 GB of data – enough to store over several million typewritten pages or a medium sized library on a single disk.
- Optical disks use reflected light rather than magnetized spots.
- Binary 1s and 0s are represented by flat areas called “lands” and bumpy areas called “pits”
- Unlike hard disks that have concentric tracks, optical disks have a single spiral track that is divided into equally sized sectors for storing data.
- The most common sized optical disk is 4 ½ inches, and typically stored in a plastic “jewel box”

1.Compact Disc (CD)

- One of the most widely used optical formats
- Typically store 650 MB to 1 GB (1,000 MB) on one side of a CD
- Rotational speed determines how fast data can be transferred to the CPU
- 24X (24 speed) CD can transfer data at 3.6 MB per second
- 48X (48 speed) CD can transfer data at 7.2 MB per second

a)Read Only - CD-ROM

- Compact Disc – Read Only Memory is similar to a commercial music CD
- RO means it can not be written over by the user
- Typically used to deliver large databases, references, or software applications

b)Write once - CD-R

- Compact Disc – Recordable: write once, read many
- CD burners typically use these to archive data or record music

c)Rewriteable - CD-RW

- Compact Disc – ReWritable: write many, read many
- Used to create and edit multimedia presentations
- Typically cost a little more than CD-R

d)Photo CD (aka Picture CD)

- A special format developed by Eastman Kodak for storing digital images

- Disks are typically single session – all images are written once, but may be read many times
- Photo CDs are now multisession – images can be added later

2.Digital Versatile/Video Disc (DVD) page 220

- A newer format that is replacing CD optical disks
- DVDs can store 4.7 GB to 17 GB on a single disk

a)Read only - DVD-ROM

- Written at manufacturing plant, read many
- Typically used for video distribution

b)Write once - DVD-R DVD+R

- Write once, read many
- Tend to cost more than CD writable disks
- Used for archiving data and writing video files

c)Rewriteable - DVD-RW DVD+RW DVD-RAM

- Write many, read many
- Still working on setting a standard format

G.Making IT Work for You – Music from Internet page 222

- This section briefly describes how you can find music on the Internet, and transfer it to a portable player.

1.Finding Music

- Many sites on line – best to look for current sites

2.Creating a Custom CD

- Several different programs can burn a CD for you
- Look at the software that comes with your CD burner, or look for some on line.

3.Uploading to a Portable Player

- Transfer the files to the portable player of your choice
- You may need to find the file formats that work with your player: mp3, wav, au, etc.

H.Other Types of Secondary Storage page 221

1.Solid-state storage

- These devices have no moving parts, so they are fast and reliable

- Tends to have less capacity, and costs more per byte
- Flash memory cards are used in notebook computers and digital cameras
- Key chain hard drives (aka key chain flash memory devices) typically connect through a USB port, and can store up to 1 GB for easy, portable storage

2. Internet Hard Drives page 224

- Special web sites that provide users with storage
- Called i-drives or online storage
- Advantage is it's always available as long as you have an Internet connection
- Disadvantage is speed is often slower, and there is some hesitation about storing sensitive data on these sites.

3. Magnetic Tape page 225

- Tapes only provide sequential access, where disk systems provide either sequential or direct access
- Advantage with tape is virtually unlimited storage (just add another tape), it's reliable, and it's inexpensive per MB stored.
- Disadvantage is it's somewhat slow, and limited to sequential access
- Often used to back up disk storage, especially for networked systems
- Mainframe systems used magnetic tape reels
- Newer tape systems use tape cartridges or magnetic tape streamers for backing up data

I.A Look to the Future page 227

- Blu-Ray Technology Expected to Replace DVD.
- Using a blue laser light rather than the current red light, capacities may be close to 50 GB per disk.
- Additional material can be found at <http://www.blu-ray.com/>

J. Visual Summary at a glance – Secondary Storage page 228

1. Storage

- Key terms:
- RAM – primary storage, volatile
- Secondary storage – nonvolatile
- Writing – saving the information
- Reading – retrieving the information
- Media or medium
- Capacity

- Storage devices
- Access time or Access speed

2.Floppy Disks

a)Traditional Floppy Disk

b)High Capacity Floppy Disks

(1)Zip disks

(2)HiFD disks

(3)SuperDisk disks

3.Hard Disks

a)Internal hard disk

b)Hard-disk Cartridge

4.Hard Disks

a)Hard-disk Pack

b)Performance Enhancements

(1)Disk caching

(2)RAID (Redundant Array of Inexpensive Disks)

(3)File Compression/Decompression

5.Optical Disks

a)Compact Discs

(1)CD-ROM

(2)CD-R

(3)CD-RW

(4)Photo CD

b)Digital Versatile Discs

6.Other Types

a)Solid-State

b)Internet hard drives

c)Magnetic Tape

K.Key Terms page 231

1	1.44 MB 3 1/2-inch disk	traditional sized floppy disk, the standard for portable storage for 20 years
2	2HD	two sided, high density indication found on 3 1/2 inch floppy diskettes
3	access speed	aka access time; time it takes to read data from a storage medium and send it to the processor
4	access time	aka access speed; time it takes to read data from a storage medium and send it to the processor
5	C drive	typical "mapping letter" for a local hard drive on a Windows based PC
6	capacity	amount of data that can be stored, typically measured in bytes
7	CD (compact disk)	optical disk format for storing multimedia data, typically up to 650 MB
8	CD burner	aka CD drive, allows a user to save data on a recordable CD disk
9	CD-R (CD-recordable)	special CD format that can be written once, read many times
	CD-ROM (compact disc)	
10	read only memory)	CD format that is written by a manufacturer, but readable many times by the buyer - often used for music CDs
	CD-RW (compact disc	
11	rewritable)	CD format that can be written and read many times, often used for backup purposes
12	cylinder	set of similar tracks on different disk platters in a hard disk storage system
13	density	the amount of data that can be stored on a medium
14	direct access	ability to find data on storage without having to read through it sequentially
15	disk	aka floppy, a small, portable plastic medium for storing data
16	disk caching	technique to speed up disk access by storing the most recently used data in electronic memory (chips)
17	diskette	aka floppy, a small, portable plastic medium for storing data
18	DVD (digital versatile disc or digital video disc)	optical format used for storing large amounts of multimedia data, up to 17 GB
19	DVD player	driver for reading DVD disks
20	DVD-R or DVD+R (DVD recordable)	re-writable format for DVD, fairly new technology replacing writable CD technology
21	DVD-RAM (DVD-random-access memory)	re-writable format for DVD, fairly new technology replacing writable CD technology
22	DVD-ROM (digital versatile disc-read only memory)	readable DVD format typically used for movies
	DVD-RW or DVD+RW	
23	(DVD rewritable)	re-writable format for DVD, fairly new technology replacing writable CD technology
24	erasable optical disk	generic term for re-writeable optical formats including CD-RW
25	file compression	technique to eliminate redundant data from files to shrink their size for better storage and transport
26	file decompression	opposite of compression, it's restoring of files from a compressed format e.g. unzipping a file
27	fixed disk	aka internal hard disk; metallic platters storing GBs worth of data for fast access
28	flash memory card	solid state storage device often used in digital cameras to store electronic photos
29	flexible disk	aka floppy, a small, portable plastic medium for storing data
30	floppies	aka floppy, a small, portable plastic medium for storing data
31	floppy disk	aka floppy, a small, portable plastic medium for storing data
32	floppy disk drive	the device for reading and writing data on floppy disks
33	floppy-disk cartridge	aka high capacity floppy disks; newer diskette technology to store 100 MB or more
34	hard disk	aka fixed disk; metallic platters storing GBs worth of data for fast access
35	hard-disk cartridge	aka removable hard disks; a portable hard disk
36	hard-disk pack	removable storage for massive amounts of data, often used on mainframe systems
37	head crash	occurs when the R/W heads touch the surface of the hard disk platters, making it inoperable
38	HiFD disk	one type of high capacity floppy disk sold by Sony

Computing Essentials 2006 Chapter 8 Secondary Storage

39	high capacity floppy disk	newer floppy technology storing over 100 MB per disk
40	i-drive	aka Internet hard drive; a hard drive you can access via the Internet for slow, but portable storage
41	internal hard disk	aka fixed disk; metallic platters storing GBs worth of data for fast access
42	Internet hard drive	aka i-drive; a hard drive you can access via the Internet for slow, but portable storage
43	jewel box	plastic case to store optical disks in
44	key chain flash memory devices	aka key chain hard drives; small, solid state storage devices holding close to 1 GB of data
45	key chain hard drives	small, solid state storage devices holding close to 1 GB of data
46	label	sticker placed on diskettes to identify the contents to a human reader
47	land	a "flat area" on an optical disk that contains 0 bits
48	magnetic tape	sequential storage medium frequently used to back up data
49	magnetic tape reel	sequential storage medium frequently used to back up data
50	magnetic tape streamer	sequential storage medium frequently used to back up data
51	media	the physical material used to store data, e.g. plastic film, metallic platter, etc.
52	medium	the physical material used to store data, e.g. plastic film, metallic platter, etc.
53	multiread	optical drives that are able to read both CD-R and CD-RW formats
54	multisession	Photo CDs that allow the user to add more files/photos at a later date
55	nonvolatile storage	storage that is kept even if the power is off
56	online storage	storage that is available over a network, specially the Internet
57	optical disk	generic term for storage technologies such as CD and DVD formats
58	optical disk drive	the device used to read (and write) optical disks
59	PC Card hard disk	small, portable hard drive that fits into a PCMCIA slot on a notebook computer
60	photo CD	special CD format marketed by Eastman Kodak for storing photos
61	picture CD	special CD format marketed by Eastman Kodak for storing photos
62	pit	a small bump on an optical disk representing a 1 bit
63	platter	metallic plates that act as the storage medium on a hard drive
64	primary storage	memory chips, e.g. RAM used by the computer to store temporarily used data and program instructions
65	read only	allows a user only to retrieve data, not modify it
66	reading	receiving data from a storage device
67	redundant arrays of inexpensive disks	RAID group of hard drives to improve the speed and reliability of hard drive storage
68	removable hard disk	aka hard disk cartridge; additional, portable hard disk storage
69	rewriteable	the ability to modify the contents of storage
70	rotational speed	measurement of how fast the hard disk platters spin, typically measured in RPM (Rotations Per Minute)
71	secondary storage	generic term to cover all storage devices such as hard drives, optical drives, tape, etc.
72	secondary storage device	the equipment used to read/write data onto secondary storage media
73	sector	a "pie shaped" area of a disk used to locate and store data
74	sequential access	reading one piece of data after another, the only method available with tape storage
75	shutter	metal door on a floppy disk to protect the plastic disk media underneath
76	single-session	Photo CDs that are written at one time - write once, read many
77	solid-state storage	chip based electronic storage with no moving parts, often used in digital cameras for storing photos
78	storage devices	the equipment used to read/write data onto secondary storage media
79	SuperDisk	one type of high capacity floppy disk sold by Imation
80	tape cartridge	magnetic tape stored in a plastic container, used to automate the backup of data on large systems
81	track	a spiral or concentric circle used when storing data on a disk
82	volatile storage	temporary storage where the contents are lost when the power is turned off
83	write once	ability to store the data one time on medium, but read it many times
84	write-protection notch	hole in a floppy disk when open prevents data from being written on the diskette
85	Writing	placing data on the storage medium
86	Zip disk	one type of high capacity floppy disk sold by Iomega

L. Chapter Review page 232

1. Crossword

a) Across

3	FIXED	Also known as the internal hard drive
8	SECTOR	Invisible wedge-shaped division of a track
9	PITSANDLANDS	Represent 1s and 0s
10	TRACK	Rings of concentric circles without visible grooves
11	RAID	Grouped disk drives treated as one hard disk by the computer system
13	ZIP	Disk with 500 times the storage as a standard floppy
14	FLOPPY	Portable and removable storage device
15	WRITING	The process of saving information to the secondary storage device
16	PLATTER	Rigid metallic part of a hard disk
17	DISKETTE	Storage medium that contains a flexible plastic disk

b) Down

1	DISKCACHING	Improves hard-disk performance by anticipating data needs
2	MULTISESSION	Meaning new images can be added to a CD at any time
4	CYLINDER	Runs through each track of a stack of platters
5	ACCESSTIME	Measures the amount of time required to retrieve data
6	SECTOR	Invisible wedge-shaped section
7	ONLINESTORAGE	Web based storage
12	DENSITY	How tightly the bits can be packed next to each other

2. Multiple Choice page 233

1	A	Nonvolatile storage
2	A	Reading
3	D	Access time
4	E	All of the above
5	*	None of these – DENSITY – see page 213
6	B	Open
7	C	C (drive)
8	B	Fixed disk
9	D	DVD-ROM
1	C	Magnetic tape
0		

3. Matching page 234

TERM	MATCH	NUMBER	HINT
RAM writing	Q T	1 2	A type of storage that is volatile The process of saving a file to a secondary storage device
access speed	A	3	Time required to retrieve data and programs
floppy disk	I	4	Also known as a diskette or disk
track	S	5	Closed concentric ring on a disk on which data is recorded
sector	N	6	Wedge-shaped section of a track
floppy disk cartridge	J	7	Zip disks, SuperDisks, HiFD disks
cylinder	C	8	Runs through each track of a stack of platters
hard disk pack	K	9	Several platters aligned one above the other, allowing greater storage capacity
disk caching	D	10	Hardware and software that anticipates data needs
file compression	F	11	Increases storage capacity by reducing the amount of space required to store data and programs
jewel box	M	12	Used to protect optical disks
CD burner	B	13	CD-R drive
Picture CD	P	14	Special CD format for storing digital pictures
solid-state storage	R	15	Stores data electronically and has no moving parts
flash memory card	H	16	Solid state storage device used in portable computers
i-drive	O	17	Free or low cost storage available at special service web sites
disks	E	18	Provide fast direct access
tapes	L	19	Provide slower sequential access
fixed disk	G	20	Also known as internal hard drive

4. Open-ended

a) Describe the three most likely successors to the 1.44 MB 3 1/2 inch floppy.

- May want to look at the three types of High Capacity Floppy disks: Zip Disks, HiFD disks, and SuperDisks
- May want to argue for optical disks: CD or DVD since they are becoming cheaper
- May also argue for portable solid state storage such as “key chain hard drives”

b) What are the three types of hard disks? What is so disastrous about a head crash?

- Three types include internal hard drives, hard-disk cartridges, and hard-disk packs (may also want to mention external hard drives and RAID systems)
- A head crash occurs when a read/write head touches the disk surface, which can ruin a hard drive.

c) Describe three ways to improve hard disk performance.

- Disk caching: reading a portion of the disk into RAM to improve response time

- RAID: striping data across drives to provide backup and faster access times
- File compression: reduce the amount of space used up for data storage – can also help reduce file transfer time

d)What are the two most common optical disk formats? Describe the basic types for each format.

- CD and DVD formats
- CD-ROM: written by manufacturer, read many
- CD-R: write once, read many
- CD-RW: write many, read many
- Photo CD: specialized image storage medium
- DVD-ROM: video format
- DVD-R, DVD+R: write once, read many
- DVD-RW, DVD+RW, and DVD-RAM: rewritable

e)Explain the concept of Internet storage. What are the advantages and disadvantages of this type of storage?

- An i-drive is a web accessible hard drive
- Advantage is it's always available so long as you have an Internet connection
- Disadvantage is they are slow (limited by the Internet connection) and security may be suspect

M.Using Technology page 235

1.Music from the Internet

- This section refers you to Making IT Work: Music from the Internet
- Have students discuss the advantages and disadvantages of a music website such as Apple's iTunes site (note: look into cost and copying issues)

2.iPod

- Have students review the text's Web site section about Apple's iPod music player.
- Use it as a review of storage media (iPod uses a portable hard drive for storage)
- May want to discuss what the “target market” is for a product such as this.

N. Expanding Your Knowledge page 236

1. How Music is Downloaded from the Internet

- Review the animation “How Music is Downloaded” from the text’s CD and/or Web site
- Discuss different Web based music sites and their advantages and disadvantages
- Discuss ways to play music from the web (may focus on MP3 format and the different types of players available)

2. File Compression

- Study the expansion “File Compression” on the text’s CD and/or Web site.
- Discuss different types of compression (lossy, lossless, etc.) and its use for different applications (text, images, videos, music, etc.).

O. Building Your Portfolio page 237

1. DVD

- Students are asked to write a one page paper titled “DVD Technology” and answer questions discussed in the text, such as a) Define DVD-ROM, DVD-R, etc.
- May recommend that students research these topics on line – look at some electronic retailer sites to learn about the costs and features of some of these items.

2. CD-R and Music Files

- Students are asked to write a one page summary about downloading and copying music files. Reply to questions such as “Is it fair to make a copy of a CD you have purchased on your computer”? – yes, if it’s for backup purposes
- May want to have your students perform some research about federal government sites addressing “fair use” as well as read through the “fine print” on licensing agreements.

II. Concept Checks at a glance

A. Ch 8 page 214

1. Discuss four important characteristics of secondary storage.

- Media or medium: the physical material that holds the data

- Capacity: measures how much the media can store, typically measured in MB, GB, and TB
- Storage devices: hardware that reads (and often writes) to storage media
- Access speed (aka access time): measures the amount of time to read and/or write to the storage medium

2.What is the traditional floppy disk? Why is it likely to be replaced in the future?

- Traditional disk is the 1.44 MB 3 ½" disk, introduced in the 1980's
- 2HD disks are "two sided, high density"
- Density refers to how tightly the bits can be packed on the medium
- A Shutter slides to provide access to the plastic medium
- Labels can be applied to the external surface of the disk to identify the contents
- A Write-Protection Notch can be moved to protect the disk from accidentally writing over it.
- Floppies store the data in a series of Tracks and Sectors – each sector can store up to 512 bytes or characters
- It is likely to be replaced because newer technologies have exceeded its capacity, speed, and portability.

B.Ch 8 page 218

1.Compare floppy and hard drives. What is a head crash?

- Floppy drives are meant to be portable. They are slower than hard drives, but the capacity is limited only by the number of diskettes that are used. Floppies also plastic for the main storage medium
- Hard drives are much faster, but generally not as portable as a floppy, since they are often "built into the machine". Hard drives use a metallic disk for the storage medium.
- A "head crash" can occur when the read/write head of the drive touches the surface of the disk, therefore destroying the data. These once occurred frequently, but newer technology drives have increased the MTBF – Mean Time Between Failures.

2.What are the three types of hard disks? Briefly describe each.

a)Internal Hard Disk

- Also known as a fixed disk
- Located inside the system unit or chassis
- Typically mapped as the "C:" drive
- Advantages are speed and capacity: a 100 GB HD can hold as much as 70,000 traditional 1.44 MB floppies = $(100 * 2^{30}) / 1,440,000$

- Access speeds are measured in milliseconds (ms) e.g. 10 ms
- Disk rotation speeds are measured in RPM (rotations per minute) e.g. 5,400 RPM

b)Hard-Disk Cartridges

- Also known as removable hard disks
- Limited only by the number of cartridges you use
- Cartridges typically hold 10-40 GB of storage
- See Iomega's older Peerless system or the Rev system
- PC Card Hard disks are credit card sized hard-disk cartridges
- Examples include IBM's Microdrive and Toshiba's MK5002 drives which hold around 5 GB and are typically used on laptops

c)Hard-Disk Packs

- Hard disk packs are removable storage devices used to store massive amounts of information without duplicating the drive mechanism.
- They may have up to 11 large disks with 20 recording surfaces.
- Typical use is in large mainframe shops like banks and insurance companies.

3.List and describe three ways to improve the performance of hard disks.

- Disk Caching: frequently used data is read into memory chips, which improves the transfer rate to the CPU by up to 30%.
- Redundant Array of Inexpensive Disks (RAID): improves performance by expanding external storage, improving access speed, and providing backup. While it costs more to have a RAID system, it improves storage reliability. RAID systems are typically used for network servers.
- File Compression and File Decompression: increase the amount of storage available on the disks by removing repeating patterns of data. Popular programs for compressing files include WinZip and PKZip. The smaller size comes at a price, since it takes a little longer to uncompress the data

C.Ch 8 page 220

1.How is data represented on optical disks?

- Data is “burned” onto the medium using light (a laser).
- The flat spots are called “lands” and the bumpy parts are called “pits” representing 0s and 1s respectively.

2.Compare CD and DVD formats. Why are DVDs replacing CDs?

- CDs typically hold up to 650 MB, while DVD formats can hold close to 17 GB (almost 30 x more than CDs).
- CD formats are older and more established, but they are slowly being replaced by DVD formats
- DVDs are replacing CDs because of their higher capacity and the cost of the technology has fallen. As users demand more and more data capacity for applications such as video, they will need higher capacity storage media.

3.What are DVD-RW, DVD+RW and DVD-RAM?

- They are different formats for the DVD format – they differ in terms of how they can be written/rewritten. Once the standards shake out in the marketplace, many drives will need to support a number of these standards.

D.Ch 8 page 225

1.What is solid-state storage? What are key chain hard drives?

- Solid-state storage is electronic storage with “no moving parts” – the data is stored on silicon chips.
- Examples include flash memory cards and key chain hard drives
- Flash memory is solid-state memory often used for storing digital images from digital cameras.
- Key chain hard drives are small storage devices that connect with a computer through a USB port. They can hold close to 1 GB of data, and offer a portable way to store data.

2.What are Internet hard drives? What are they used for?

- Internet hard drives (aka i-drives) are regular hard drives that can be accessed via an Internet connection.
- They are often used for portable storage – so long as you have an Internet connection, you can access the drive.
- The drawbacks include the speed (limited by the speed of your connection) and privacy/security (do you feel safe with your data stored on someone else’s computer).

3.Discuss magnetic tape reels and tape cartridges.

- Tape storage offers only sequential storage.
- Tape reels were an older technology dating from the 1950s used to store large amounts of data for mainframe computers

- Tape cartridges have replaced many of the reel systems, and are used for backing up servers.

III.List of Figures at a glance

- Ch 8 page 212 figure 8-1 Secondary storage media
 - Photo of an optical disk being inserted into a computer
 - Media is the actual physical material that holds the data
- Ch 8 page 213 figure 8-2 How charges on a disk store the number 3
 - Drawing of how the decimal number 3 is stored as a series of bits on a floppy disk
 - This number is shown with the ASCII equivalent for the number 3. The first 4 bits indicate it is a number, the second 4 bits indicate the value $0011 = 0*8 + 0*4 + 1*2 + 1*1$
- Ch 8 page 213 figure 8-3 A 1.44 MB 3 ½ inch floppy disk
 - Photo of the traditional floppy that was the standard for portable storage for close to 20 years
- Ch 8 page 213 figure 8-4 The parts of a 3 ½ inch floppy disk
 - Cut away image of a traditional floppy disk showing
 - Metal shutter: opens to permit access to the media, closes to protect it
 - Data access area: small open “window” to allow the drives R/W heads to access the media
 - Hard plastic jacket: outside covering of diskette
 - Label: allows user to write notes about contents of the disk
 - Write protection notch: when open it prevents writing to the diskette
 - Inside of disk: diagram of tracks and sectors used to store data on the disk
- Ch 8 page 214 figure 8-5 Zip disk and drive
 - Photo of an Iomega zip disk & drive, a higher capacity drive that can store anywhere from 100 – 750 MB on a diskette
- Ch 8 page 214 On the Web Explorations
 - Encourages students to learn more about leaders in high capacity disk storage systems by visiting the text’s CD and/or Web site.
- Ch 8 page 214 figure 8-6 Typical floppy disk capacities
 - Table listing some storage capacities of diskette media
 - 2HD – 1.44 MB
 - Zip – 100/250/750 MB
 - HiFD – 200/720 MB
 - SuperDisk – 120/240 MB
- Ch 8 page 214 TIPS box – rules for handling diskettes
 - Don’t bend
 - Don’t touch

Computing Essentials 2006 Chapter 8 Secondary Storage

- Don't remove
 - Avoid extreme conditions
 - Use storage boxes
- Ch 8 page 215 figure 8-7 Materials that can cause a head crash
 - A head crash occurs when the R/W heads touch the surface of the metallic platters of a hard drive. This image shows the relative size of hair, dust, fingerprints, and smoke in comparison to the thin cushion of air that the R/W heads "float" above the disk.
- Ch 8 page 215 On the Web Explorations
 - Encourages students to learn more about manufacturers of high capacity hard disks by visiting the text's CD and/or Web site.
- Ch 8 page 216 TIPS box
 - Lists a few recommendations for improving your hard drive performance, including using the Disk Defragmenter
 - Start Disk Defragmenter
 - Keep Working
 - Automate
- Ch 8 page 216 figure 8-8 Hard-disk cartridge and card from Iomega
 - Photo of the Iomega Peerless product with a 20GB cartridge
- Ch 8 page 216 figure 8-9 PC card hard disk from Toshiba
 - Photo of a tiny hard drive that fits in the palm of your hand.
 - These can be inserted into the PCMCIA slot of a laptop computer
- Ch 8 page 216 figure 8-10 Hard disk pack enclosed in a plastic cover
 - Photo of older technology that was used for mainframe computer storage
- Ch 8 page 217 figure 8-11 Hard-disk pack
 - Cut away image of a hard-disk pack showing the large number of platters, and R/W access arms used to store and retrieve data
- Ch 8 page 217 figure 8-12 Types of hard disks
 - Table listing some different types of hard drives including:
 - Internal: fast access, fixed
 - Cartridge: complement internal HD, removable
 - Disk pack: massive storage capacity, removable
- Ch 8 page 218 figure 8-13 RAID storage device
 - RAID – Redundant Array of Inexpensive Disks systems are used for ensuring fast, reliable disk storage on servers
- Ch 8 page 218 figure 8-14 Performance enhancement techniques
 - Table listing a few techniques used to enhance storage performance, including:
 - Disk caching
 - RAID
 - File compression
 - File decompression
- Ch 8 page 218 TIPS box – on using compression/decompression utilities
 - Start the WinZip program

Computing Essentials 2006 Chapter 8 Secondary Storage

- Create a file
 - Select
 - Compress
- Ch 8 page 219 figure 8-15 Optical disk
 - Photo showing an optical disk (CD or DVD), a popular storage medium for multimedia data
- Ch 8 page 219 TIPS box
 - Offers tips on protecting your optical disks, including:
 - Don't stack (them)
 - Don't touch
 - Don't remove
 - Avoid extreme conditions
 - Use storage boxes
- Ch 8 page 221 figure 8-16 Types of optical disks
 - Table listing the Format, Capacity, Type, and Description of some optical disks
 - CD-ROM – read only
 - CD-R – write once
 - CD-RW - rewriteable
 - Picture CD – single session
 - Photo CD – multi-session
 - DVD-ROM – read only
 - DVD-R and DVD+R – write once
 - DVD-RW, DVD+RW, DVD-RAM - rewriteable
- Ch 8 page 224 figure 8-17 Flash memory card
 - Photo of a Microtech Smart Media card (holds 128 MB) typically used for holding digital photos in a camera
- Ch 8 page 224 figure 8-18 Key chain flash memory
 - Photo of a small keychain device in a person's hand. These devices can store around 1 GB of data in a small, portable package
- Ch 8 page 224 figure 8-19 An Internet hard drive site
 - Screen shot of <http://www.xdrive.com> site that offered storage via the Internet (in Dec 2004, 5GB for \$10 per month)
- Ch 8 page 225 figure 8-20 Internet hard drive sites
 - Table listing a few Internet hard drive sites including:
 - <http://Itools.mac.com>
 - <http://www.freedrive.com> – same as Xdrive
 - <http://Briefcase.yahoo.com>
 - <http://www.Amerivault.com> (defunct?)
 - <http://www.Connected.com>
 - NOTE: you will probably want to test these sites out, since many of these services are no longer offered
- Ch 8 page 225 figure 8-21 Magnetic tape cartridge

Computing Essentials 2006 Chapter 8 Secondary Storage

- Photo of a Sony DLT tape, with capacities of 20-80 GB per tape
- These are typically used for backup purposes