File Systems

- File system
  - Designed for storing and managing files on disk media
  - Build logical system on top of physical disk organization
- Tasks
  - Partition and format disks to store and retrieve information
  - Establish file naming conventions
  - Provide utilities for functions such as file compression and disk fragmentation
  - Provide for file and data integrity
  - Provide storage media management functions
- File
  - Set of data that is grouped in some logical manner, assigned a name, and stored on disk
- Directory
  - Connects names to the files that are stored on disk
  - Tracks
    - File locations
    - Attributes
      - Date/time created
      - Date/time modified
      - Owner
      - RWX privileges
      - Size in bytes
- Block allocation
  - Logical blocks
    - Mapped to sector, head, track
- Disk structure
  - Tracks
    - Concentric circles
  - Cylinders
    - Tracks a t same relative position
  - Sectors
    - Tracks subdivided
  - Data regarding disk allocation stored on disk
    - Two methods
      - File allocation table(FAT)
        - Windows and DOS
        - Fixed portion of disk used to store block allocation
      - Various locations on disk to store a special file used for directory and file allocation information
        - NT(NTFS) and UNIX
  - Partitions

        - Divide disk into logical partitions
            - Partition table – DOS and windows
            - Disk label – UNIX
            - Where information about partition stored
- DOS/Windows 3.1 File System
    - FAT – File Allocation Table
        - Stores information on
            - About files
                - Name
                - File attributes
                - File location
            - Searched sequentially
        - Prior to DOS 4.0 limit to 32MB called FAT 12
        - After DOS 6.0 - 2GB called FAT16
        - 8.3 name
            - eight character file name
            - 3 character extension
    - partitioning
        - two partition per hard drive supported
            - primary
            - secondary
                - can be divided into maximum of three logical drives
        - assigned a letter A-Z
        - FDISK
            - Dos Program to modify partition information
            - BIOS uses Active partition to start operating system
            - Volume Label
                - Contains name of partition
            - Can be used to add and delete partitions
    - Formatting
        - Format command
            - Writes all the file structure information to the disk
            - Floppy
                - Uses first sector
                    - Information about disk
                        - Number of tracks
                        - Number of sectors per track
                    - /S option
                    -
                        - makes floppy bootable
                - next comes root directory
                    - file information – ATTRIB command used to modify
                        - name

                - start cluster
                - file size
                - file modification date and time
                - file attributes
                    - read only
                    - hidden
                    - archive
            - two copies of FAT
                - 12 bit entry corresponding to a cluster address on disk
        - when file written FAT entry of first cluster filled with number of second cluster
        - last cluster has FAT entry set all 1's
        - unusable clusters marked as bad and will not be allocated
    - CHKDSK
        - Verifies correctness of file system
    - DEFRAG
        - Defragment disk
            - Rewrites files so they are contiguous
- Windows 95/98 File system
    - FAT16 –similar to DOS
        - Master boot record followed by two FAT tables and root directory
        - Has support for long file names
            - 255 characters
            - not case sensitive
            - can include spaces and several characters that 8.3 could not
                - " / \ [];;=,
            - first directory entry looks like a DOS entry
                - first six characters adding a tilde and a letter behind it
                - LFN stored by using a series of additional directory entries
                    - Each entry can hold 13 characters
    - FAT32
        - Started with Windows 95(OSR2)
            - Partitions up to 8 GB
            - Blocks as small as 8 KB
- Windows NT
    - Two systems
        - FAT16 extended
            - Multiple OS per disk
        - NTFS
            - features
                - Built in security

                - Set per file
                - File has owner
                - Read,write, execute
            - Ability to use large files and disks
            - Ability to compress file and directory contents on fly
            - Better recoverability and stability
            - Less disk fragmentation
        - Master File Table
            - Allocated at beginning of partition
            - Boot sector before MFT
            - Just a file on the system as are other system files
            - Information on a file
                - Filename
                - Size
                - Dates and time stamp
                - Security setting and permission
- UNIX
    - Many different types
    - Example UFS
        - information node - inode
            - stores information on a file
                - owner of file
                - group in which file is placed
                - size of the file
                - date file was created
                - date last modified
                - date last read
                - the number of links to this inode
                - location of the blocks in the file system in which the file is stored
                    - blocks 4096 or 8192
            - inode zero(0) is the root
            - indoe 1 contains allocation of all bad sectors on disk
            - indoe 2 link to root directory
        - superblock
            - contains information about layout of blocks, sectors and cylinders
        - filename
            - stored in directory not in inode
                - directory contains
                    - filename
                    - inode
    - path starts with / which indicates root
    - mount command

        - maps a root node of another file system to a directory on the current file system
    - file names
        - contain any ASCII character
        - case sensitive
        - directory special file
    - symbolic links
        - special file with a flag in the inode
        - contents of file is a path to the file that it points to
- Macintosh
    - Hierarchical File System (HFS)
        - Divides disk into at most 65536 (2^16) units
        - Reports in logical blocks not bytes like other file systems
    - Disk
        - First two sectors are boot blocks
            - Identify file system being used
            - Names of important system files
        - Volume information block
            - Location of system files
            - Catalog
                - Catalog b-tree
                - List of all files on volume
                - Filename
                - Logical location in the folder structure
                - Physical location on disk surface
                - Location and size of the file's data fork and resource forks
                - Data fork
                - Contains changing information
                - i.e. word processing data
                - resource fork
                - fixed data
                - menu resources, splash screens, font faces, color, font size
            - Extent tress
    - Can read and write disks from other operating systems
    - File names up to 31 characters
    - Files have
        - Type codes and Creator codes
            - Example file could be of type text and creator code of ttxt
            - The creator code tells the OS what application to use to open the file if the user clicks on the file name

- Facilitate Mac’s use of Icons
    - Icons come form creating application, not stored with file