

# Announcements

- Midterm #2 is next Thursday 4/17 in class
- Project #4 deadline is Friday April 11 (5:00pm)

# NTFS Files

- Each file is stored in an entry in the Master File Table (MFT)
  - Each entry 1-4KB
  - Small attributes stored directly in MFT
  - Larger attributes are stored in one or more extents (contiguous clusters on the disk)
- Special Files
  - MFT – file 0
  - Copy of first 16 entries in MFT
  - Log file – log of changes to file system
  - Attribution definition table
  - Root directory
  - Bitmap free list
  - Boot file (must be at a standard disk address)
  - Bad cluster file

# NTFS (cont)

- Each Directory is stored in a B+ Tree
  - Permits fast lookup of information
  - Index root is a cluster with the top of the B+ tree
  - Larger directories contain additional clusters
- Security
  - Each file has an access token (owner info) and an ACL list
  - Permissions not normally checked on directories

# NTFS

- Logs
  - Stores redo and undo info for changes to FS state
    - Only represents data structures of the file system not data
  - Writes a commit record when the update is done
- Multi-partition files
  - Volume set
    - Concat up to 32 partitions into one larger file system
  - Stripe set (basically RAID0)
    - Round robin among partitions on a per LCN basis
  - Stripe set with parity (RAID5)
  - Disk mirroring (RAID1)

# NTFS Plugin Features

- **Change Journal**

- Way for user space processes to learn what files have changed
  - Useful content index services
  - Used by replication services

- **Volume Shadow Copy**

- Provides copy on write of files after the shadow copy
- Permits
  - Backups in a consistent state
  - User file undo operations

# Extent Based Storage

- Try to keep blocks together
- Allocate blocks prior to use
  - Reserves space for file (user can specify size)
  - Ensures clusters are together

# UNIX Shell and Current Directory

- **Current Directory**

- Maintained on a per process basis by kernel
- System Calls: get/set the current directory
- Open system Call
  - File name checked and if it lacks a leading /, pre-pend cwd onto path

- **Shell (file path)**

- Entirely implemented in user space
- PATH Environment variable
  - Lists directories to search
- Hash table of commands and their location (file, or internal)