Lecture Notes 2

Operating Systems Structures

- Operating System Services
  - User Interface – How the user inputs/receives output
  - Program Execution – Ability to load, run, and terminate a program
  - I/O Operations – Move data in from or out to I/O devices
  - File-system Manipulation – Read/Write/Create/Delete files and directories
  - Communication – Exchange information between processes
  - Error Detection – Detect CPU, Memory or other Hardware failures
  - Resource Allocation – Reservation/Scheduling of Resources when multiple users/processes exist
  - Accounting – Keep track of the allocated resources
  - Protection & Security – Controlling access and preventing unauthorized access to resources
- User Interface
  - Command Line Interface (CLI) – Typically in form of shell
  - Batch Interface – Used to submit batches of jobs
  - Graphical User Interface (GUI) – Typically a windowing system with pointing device or touchscreen with gestures
- System Calls
  - Application Programming Interface (API) – Set of functions/structures available to programmer
  - System Call Interface
    - Invocation – Typically invoked through an software interrupt
    - Parameters – Typically passed by register, but may be stack/memory block
  - Process Control
    - Controls program execution, loading, terminating, etc.
    - Controls synchronization, locks, etc.
  - File Management
    - Create/Delete/Read/Write/Reposition files and directories
    - Get/Set file and directory attributes
  - Device Management – Access to I/O devices and possibly memory
  - Information Maintenance
    - Maintain time/date
    - Maintain process statistics (CPU time etc)
  - Communication
    - Shared Memory – Sharing of memory space to share information
    - Message Passing – Messages or packets are explicitly sent between processes
  - Protection – Get/Set permission for other calls

- System Programs (or System Utilities) – Program user can use to call system call
- OS Design and Implementation
  - Design Goals
    - Type of System – Batch, Time Sharing, Single vs. Multi User, Real-Time, etc.
    - User Goals – Properties the user wants of the system
    - System Goals – Properties the developer wants the system to have
  - Mechanisms and Policies
    - Mechanism – How something is accomplished
    - Policy – What will be done
  - Implementation
    - C/C++ Typically
    - Some Assembly
- OS Structure
  - Simple Structure – Single monolithic simple piece of code
  - Layered Approach – Layers builds upon lower layers only
  - Microkernel – Nonessential functionality removed from kernel
    - Provides Message passing between services
  - Modules – Loadable kernel modules
    - Dynamically load additional functionality into kernel
  - Hybrid Systems – Most OSes are mixes of multiple types
- OS Debugging
  - Failure Analysis
    - Log files – Provided on most OS for processes
    - Core Dump – Capture of memory during failure
    - Crash – Kernel failure leaves a Crash Dump
  - Performance Tuning – Tweak system to improve performance
    - Trace Listings – Logging of system behavior
    - Profiling – Periodically sample where instruction pointer is
- OS Generation
  - System Generation (SYSGEN) – Configuring a OS for a specific computer
- System Boot
  - Bootstrap Program (or Bootstrap Loader, or Bootloader) – Small code that loads the kernel
    - Stored in Nonvolatile usually ROM, EEPROM, or Flash memory
    - Considered Firmware in many systems
  - Boot Block – Location on disk that has program that is able to load OS
  - Boot Disk (or System Disk) – Is the disk with the Boot Block