Review: Introduction to Systems Programming

Systems software versus Application software

Classify the following: *wordprocessor, spreadsheet, video game, C compiler, Java compiler, Python interpreter, bash shell, Standard C library, GPU device driver, database software*.

- Operating systems are the quintessential systems programs.
- Systems programming often uses features specific to hardware devices.
- Systems programming often uses features and APIs specific to a given operating system.
- Systems programming deals with objects and concepts that are typically low-level.
- However concepts from systems programming are used in application programming and vice-versa.

Topics

- Simple systems programming.
- Using the file interface: POSIX, MS Windows Files.
- Creating and managing processes:
  - Creating multiple processes with Linux/UNIX system calls.
  - Creating multiple processes with MS Windows API calls.
- Creating and managing threads:
  - POSIX threads (Pthreads) multi-threading library.
  - Multi-threaded programming in Java
  - MS Windows API for threads

Using the Operating System

- A *file* is the fundamental unit of information storage.
- A *process* is the fundamental unit of computation.

A process uses resources. Examples of resources: CPU(s), GPU(s), memory, files, disk drives, tape drives, keyboards, display units, pipes, sockets etc.

The operating system maintains descriptors for processes and resources.

What is a process?

- A program in execution.
- A process is a working structure, a (potentially) huge information refinery buzzing and blazing with activity as masses of information move around inside.
- A process is an information machine, merely enacted, temporarily embodied by an irrelevant hunk of metal, plastic and silicon called a computer. (From the book *Mirror Worlds...* by David Gelernter)
- A process is an abstraction (illusion?) maintained by the operating system.

What is a file?

- Files can be viewed as either:
  - a sequence of bytes with no structure imposed by the operating system.
  - or a structured collection of information with some structure imposed by the operating system.
- Unix, Linux, Windows, Mac OS X all treat files as a sequence of bytes. This model is the most flexible, leaving the structure of the file up to the application programs.