CSc 360
Operating Systems
Process Operations

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Review: process

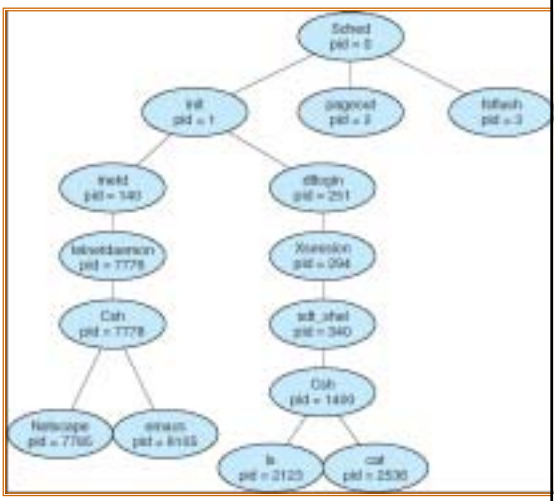
- Process vs program
  - active vs passive entity
- Process control block
  - context switching
- Process scheduling
  - long-term scheduling
  - short-term scheduling
  - medium-term scheduling

Process creation

- Creating processes
  - parent process: create child processes
  - child process: created by its parent process
- Process tree
  - recursive parent-child relationship; why tree?
  - /usr/bin/pstree
- Process ID (PID) and Parent PID (PPID)
  - usually nonnegative integer

Process tree

- sched (0)
  - init (1)
    - all user processes
  - pageout
    - memory
  - fsflush
    - file system

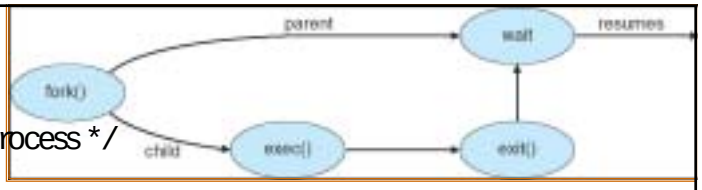


Parent vs child processes

- Process: running program + resources
- Resource sharing
  - all shared
  - some shared (e.g., read-only code)
  - nothing shared
- Process execution
  - parent waits until child finishes
  - parent and child run concurrently

fork(), exec*(), wait()

- Create a child process: fork()
  - return code < 0: error (in “parent” process)
  - return code = 0: you’re in child process
  - return code > 0: you’re in parent process
    - return code = child’s PID
- Child process: load a new program
  - exec*(): front-end for execve(file, arg, environ)
- Parent process: wait() and waitpid()




```
int main()
{
Pid_t pid;
   /* fork another process */
   pid = fork();
   if (pid < 0) { /* error occurred */
        fprintf(stderr, "Fork Failed");
        exit(-1);
   }
   else if (pid == 0) { /* child process */
        execlp("/bin/ls", "ls", NULL);
   }
   else { /* parent process */
        /* parent will wait for the child to complete */
        wait(NULL);
        printf ("Child Complete");
        exit(0);
   }
}
```

Example

Process termination

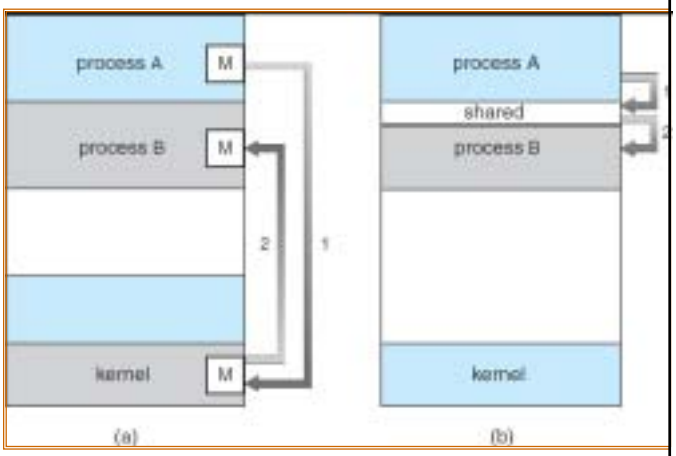
- Terminate itself: exit()
  - report status to parent process
  - release allocated resources
- Terminate child processes: kill(pid, signal)
  - child resource exceeded
  - child process no long needed
  - parent is exiting
    - cascading termination
    - find another parent

Process communication

- Independent process
  - standalone process
- Cooperating process
  - affecting or affected by other processes
    - sharing, parallel, modularity, convenience
- Process communication
  - shared memory
  - message passing

Message passing vs shared memory

- Overhead
- Protection



This lecture

- Process operations
  - process creation
    - process tree
  - process termination
  - the need for inter-process communication
- Explore further
  - /bin/ps, /usr/bin/top, /usr/bin/pstree
  - how does a child process find its parent's PID?

Next lecture

- Inter-process communication
  - read OSC7 Chapter 3 (or OSC6 Chapter 4)