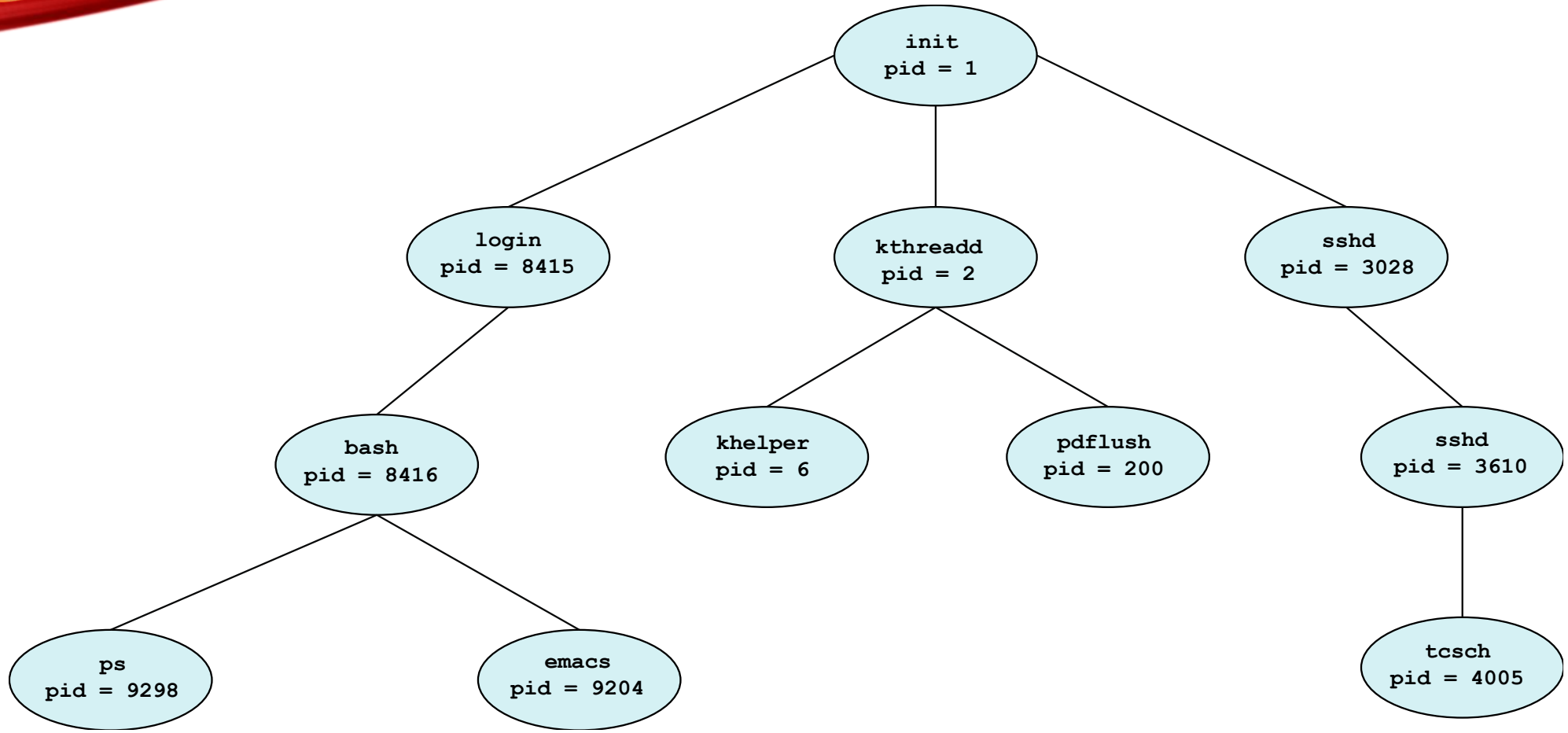
Operations on Processes

- System must provide mechanisms for:
  - process creation,
  - process termination,
  - and so on as detailed next

Process Creation

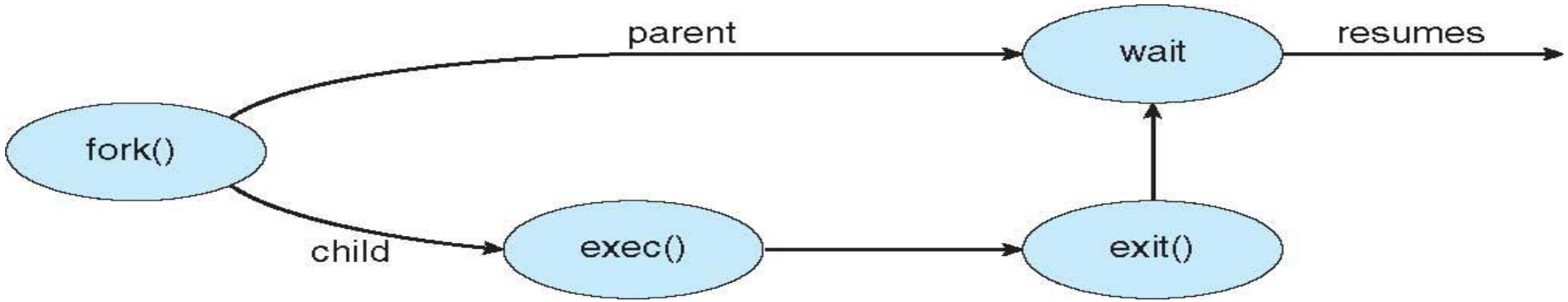
- **Parent** process create **children** processes, which, in turn create other processes, forming a **tree** of processes
- Generally, process identified and managed via a **process identifier** (**pid**)
- **Resource sharing options**
  - Parent and children share all resources
  - Children share subset of parent's resources
  - Parent and child share no resources
- **Execution options**
  - Parent and children execute concurrently
  - Parent waits until children terminate

A Tree of Processes in Linux



Process Creation (Cont.)

- Address space
  - Child duplicate of parent
  - Child has a program loaded into it
- UNIX examples
  - **fork()** system call creates new process
  - **exec()** system call used after a **fork()** to replace the process' memory space with a new program



C Program
Forking Separate Process

```
#include <sys/types.h>
#include <stdio.h>
#include <unistd.h>

int main()
{
pid_t pid;

    /* fork a child process */
    pid = fork();

    if (pid < 0) { /* error occurred */
       fprintf(stderr, "Fork Failed");
       return 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");
    }

    return 0;
}
```

Process Termination

- Process executes last statement and then asks the operating system to delete it using the **exit()** system call.
  - Returns status data from child to parent (via **wait()**)
  - Process' resources are deallocated by operating system
- Parent may terminate the execution of children processes using the **abort()** system call. Some reasons for doing so:
  - Child has exceeded allocated resources
  - Task assigned to child is no longer required
  - The parent is exiting and the operating systems does not allow a child to continue if its parent terminates

Process Termination

- Some operating systems do not allow child to exists if its parent has terminated.

  If a process terminates, then all its children must also be terminated.

  - **cascading termination.** All children, grandchildren, etc. are terminated.
  - The termination is initiated by the operating system.

- The parent process may wait for termination of a child process by using the **`wait()`** system call. The call returns status information and the pid of the terminated process

```
pid = wait(&status);
```

- If no parent waiting (did not invoke **`wait()`**) process is a **zombie**
- If parent terminated without invoking **`wait`**, process is an **orphan**

TEXT BOOK

1. Abraham Silberschatz, Peter B. Galvin, “Operating System Concepts”, 10th Edition, John Wiley & Sons, Inc., 2018.

2. Jane W. and S. Liu. “Real-Time Systems”. Prentice Hall of India 2018.

3. Andrew S Tanenbaum, Herbert Bos, Modern Operating Pearson , 2015.

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1. William Stallings, “Operating Systems: Internals and Design Principles”,9th Edition, Prentice Hall of India., 2018.

2. D.M.Dhamdhere, “Operating Systems: A Concept based Approach”, 3rdEdition, Tata McGraw hill 2016.

3. P.C.Bhatt, “An Introduction to Operating Systems–Concepts and Practice",4th Edition, Prentice Hall of India., 2013.

THANK YOU