TCSS 343 - Week 4

Jake McKenzie

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Homework 2

3.5 When a process creates a new process using the fork() operation, which of the following states is shared between the parent process and the child process?

ANSWER:
c. Shared memory segments. Processes can only share read-only memory or create shared-memory regions of safe memory(I was confused by the latter but you mentioned this in class. The book was unclear on this point). It would make no sense for the processes to share a stack or heap.

3.9 Describe the actions taken by a kernel to context-switch between processes.

ANSWER:
Say we have two processes P_1 and P_2. Their process control blocks reside in memory and the values of the CPU will change depending on which process is currently executing. A context is the mechanism used for switching the CPU from the context of one process to the context of another. When the operating system switches from the execution of $P_1 \rightarrow P_2$ and again when the operating system switches from the execution of $P_2 \rightarrow P_1$. This operation can be expensive. There are both direct and indirect costs. The direct cost includes cycling for loading and storing of instructions. The indirect costs from cold cache(cache misses).

In modern CPUs there exists a cache hierarchy. Accessing this cache is many orders of magnitude faster than accessing memory. Using our P_1, P_2 process from before. Say the data for P_1 is in the cache, we would say in this case that the cache is hot but say we context switch $P_1 \rightarrow P_2$ and we need to access the data for P_2 which is not in the cache. In this case we would say the cache is cold. Not only do we need to retrieve the data for P_2 and put it into the cache but we need to replace the data for P_1 in the cache with that of P_2.

Long story short, having a cold cache sucks. The hotter your cache, the smoother your OS operates so limiting the number of context switching is optimal.

3.10 Construct a process tree similar to Figure 3.8. To obtain process information for the UNIX or Linux system, use the command ps -ael.

```c
#include <sys/types.h>
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>// The book forgot to include
#include <sys/wait.h>// these libraries? *tsk tsk*
int main() {
    pid_t pid, pid1;
    /* fork a child process */
    pid = fork();
    if (pid < 0) { /* error occurred */
        fprintf(stderr, "Fork Failed");
        return 1;
    } else if (pid == 0) { /* child process */
        pid1 = getpid();
        printf("child: pid = %d",pid); /* A */
        printf("child: pid1 = %d",pid1); /* B */
    } else { /* parent process */
        pid1 = getpid();
        printf("parent: pid = %d",pid); /* C */
        printf("parent: pid1 = %d",pid1); /* D */
        wait(NULL);
    }
    return 0;
}
```

Use the command man ps to get more information about the ps command. The task manager on Windows systems does not provide the parent process ID, but the process monitor tool, available from technet. microsoft.com, provides a process-tree tool.

ANSWER:

I apologize if it's tiny but we can clearly see that my program generated a child from a parent. The parent has a PID of 21519 whie the child has a PPID of that is the same.

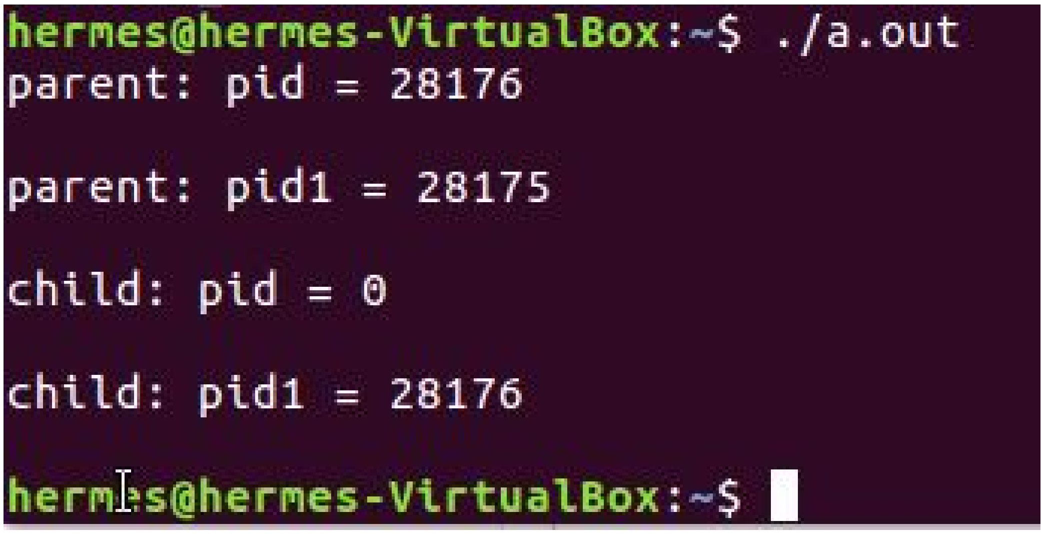
3.12 Including the initial parent process, how many processes are created by the program shown in Figure 3.32?

ANSWER:
So at each interation of the loop we fork() we fork once. This will make 4 parents. This process creates a binary tree which gives us the following equation for the problem: $\sum_{i=0}^{3} 2^i = 2^4 - 1 = 15$.

3.13 Explain the circumstances under which the line of code marked printf("LINE J") in Figure 3.33 will be reached.

ANSWER:
If the process generated from fork() is a child then this line will have been reached.

3.14 Using the program in Figure 3.34, identify the values of pid at lines A, B, C, and D. (Assume that the actual pids of the parent and child are 2600 and 2603, respectively.)



3.17 Using the program shown in Figure 3.35, explain what the output will be at lines X and Y.

ANSWER:

Whenever a child is produced it generates $0*(-0)$ then $1*(-1)$ then $2*(-2)$ then $3*(-3)$ then $4*(-4)$ producing:
$X = \{0, -1, -4, -9, -16\}$

Whenever a parent is produced it generates the following list:
$Y = \{0, 1, 2, 3, 4\}$