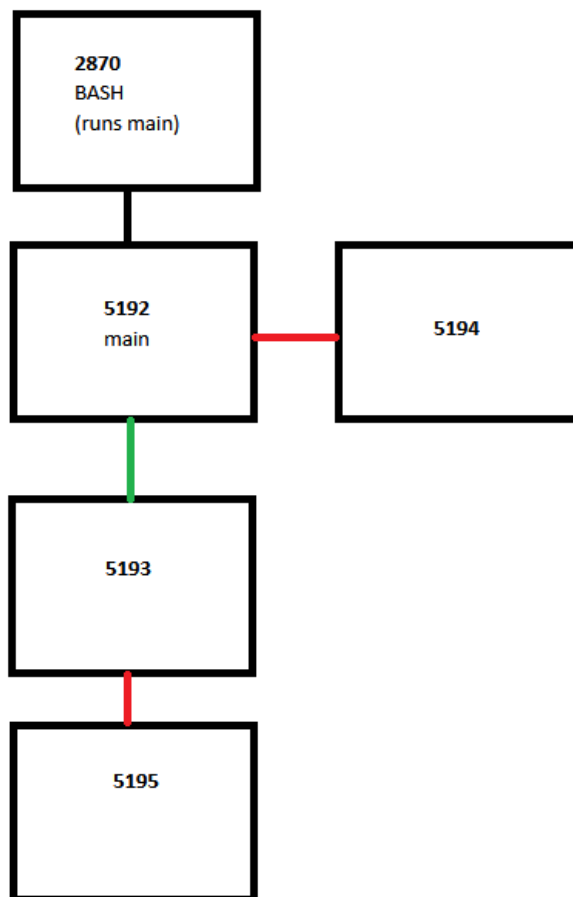


## erikvs lab5

### Exercise 1

The output of fork\_ex1.c:

```
Process 5192's parent process ID is 2870
Process 5194's parent process ID is 5192
Process 5193's parent process ID is 5192
Process 5195's parent process ID is 5193
```



The process 2870 is created when I open my terminal. Process 5192 is created when I run fork\_ex1.c. The first call of fork() forks 5192 creating the child 5193 (marked green path). The second call of fork() forks both 5192 again, creating the child 5194, and forks 5193 creating the child 5195 (marked red path).

Sleep() pauses the program for x number of seconds. When I run the program with sleep(2), the program will pause for 2 seconds after printing to the terminal before ending and thus showing the command line again. When I remove sleep the program ends immediately after printing the terminal instantly showing the command line again.

The output of fork\_ex1.c without sleep(2):

```
Process 16211's parent process ID is 12763
Process 16213's parent process ID is 16211
Process 16212's parent process ID is 16211
Process 16214's parent process ID is 16212
```

## Exercise 2

The concatenated output of the three files:

```
I am the parent!
Child 7514 is done, status is 0
I am the child!
I am the child!
I am the parent!
Child 7366 is done, status is 42
I am the child!
I am the parent!
Child 7538 is done, status is 42
```

The program no\_wait.c functions as follows:

A child is created, but the parent will continue its run through the loop first and the else if print is completed, returning 0 as status. The child will then run the loop and in if it will print and end.

The program wait.c functions as follows:

A child is created. The parent continues through the loop but in the else if it will wait for a child to finish (the trigger being a change in the variable status). The child will then be allowed to start its run through the loop and will print in the if and return a value to status. The status value variable changes and child finishing triggers the parent allowing it to complete its run and printing in the else if.

The program waitpid.c functions as follows:

A child is created. The parent continues through the loop but in the else if it will wait, but this time it is waiting for its child to finish and thus return status. The child will then be allowed to start its run through the loop and will print in the if and return a value to status. The status value variable changes and child finishing triggers the parent allowing it to complete its run and printing in the else if.

The **difference between the three** is that the parent will wait for the child to finish its run in the two latter programs. The effect of waitpid() is not readily apparent in the situation with only one parent and child, but if the program were to have multiple parents with each of their child, a given parent would await its child to finish as opposed to every parent fighting to finish as soon as a child would finish its run.

### Exercise 3

I expect the child to count to 10 seconds minus the number of microseconds it takes from the parent to start counting until the child starts counting. I expect this because within a 10 second window the child is killed. Child starts counting after parent but starts closely after parent does. I assume that the number the child can reach would vary based on how big the workload of the processor is and on hardware.

The loop stops because the process running the loop is terminated. Parent is running in else and has nothing to do with the while loop.

Child did reach what I expected, but I had no indication of HOW many microseconds it would take between parent starting to count and child to start counting.

#### **Output of kill.c:**

Child is counting at 1  
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Child is counting at 977

Child is counting at 978

Child is counting at 979

Child is counting at 980

Child is counting at 981

Child is counting at 982

Child is counting at 983

Child is counting at 984  
Child is counting at 985  
Child is counting at 986  
Child is counting at 987  
Child is Parent sleeping  
Child has been killed!!!!!!!!!!  
Parent done!

#### Exercise 4

A zombie process is a process which is neither dead (doesn't exist) nor alive (is running).

My program exercise4.c prints the PIDs of the parent and child created. While the parent is waiting, the child exits. To be able to truly finish, the child must tell the parent but the parent is waiting and cannot receive from the child. The program ends when the parent wakes up, but since the child has not been able to tell the parent it remains in the process table of the parent.

```
Parent ID 15153  
Child ID 15154
```

This can be proven by running the command **ps -l** to view all processes running in the terminal. In my case I can find that the child (PID 15154) is denoted as <defunct> which is another way of saying it is a zombie. The status of this process is Z, for zombie.

```
1 Z 1000 15154 15153 0 80 0 - 0 - pts/0 00:00:00 exercise4 <defunct>
```