

## Homework #2:

### Create Two Different Processes and Implement IPC Communication

Implement a communication protocol between two processes using IPC. Follow these steps:

#### Parent Process:

- Create a program that takes an integer argument.
- Create two FIFOs (named pipes).
- Send an array of random numbers to the first FIFO and the second FIFO. Send a command to the second FIFO (requesting a multiplication operation).
- Use the `fork()` system call to create two child processes and assign each to a FIFO.
- All child processes sleep for 10 seconds, execute their tasks, and then exit.
- Set a signal handler for `SIGCHLD` in the parent process to handle child process termination.
- Enter a loop, printing a message containing "proceeding" every two seconds.
- The signal handler should call `waitpid()` to reap the terminated child process, print out the process ID of the exited child, and increment a counter.
- When the counter reaches the number of children originally spawned, the program exits.

#### Child Process 1:

- Open the first FIFO and read random numbers to perform a summation operation.
- Write the result to the second FIFO.

#### Child Process 2:

- Open the second FIFO and read the command to perform the multiplication operation. (It should receive the "multiply" command from the parent process and use a string compare method. Finally, it should perform the operation)
- Print the sum of the results of all child processes on the screen.

Handle program errors and provide a message indicating whether the program has completed successfully or not using any method.

#### Bonus Section:

1. *Implement a zombie protection method to earn 15 points.*
2. *Print the exit statuses of all processes for an additional 15 points.*

This assignment challenges you to use FIFOs for data communication between child processes and implement a complex IPC scenario.

### **Test Scenario:**

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### **Expected Results(In one scenario):**

- FIFOs were created successfully, and data/command transmission occurred without errors.
- The array was initialized with ten elements: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9].
- These values were read by the FIFOs.
- In the first FIFO, the sum of all elements was calculated as 45.
- This result value was written to the second FIFO.
- In the second FIFO, the multiplication of all elements was calculated as 0.
- The printed value of the screen should be "45".
- Child processes completed their tasks successfully and exited without errors.
- The parent process correctly managed the counter value and printed exit statuses for each child process.

### **Error Scenarios:**

- If FIFOs cannot be created or if there are errors in data/command transmission, appropriate error messages should be displayed.
  - If child processes fail to complete their tasks successfully or encounter unexpected errors, error messages indicating the failure should be displayed.
  - If the counter value is not managed correctly or if exit statuses are not printed for each child process, error messages should be displayed indicating the issue.
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### **Grading Criteria:**

- 1) No compilation: -100 points
- 2) Missing Makefile or Makefile without "make clean": -30 points
- 3) Each memory leak that we encounter: -20 points
- 4) No report was submitted: -100 points (You must test and demonstrate every step.)
- 5) Failure in one of the tasks: -10 points
- 6) No error control block was used or failure in throwing a message: -10 points
- 7) Creating processes without using the fork() system call: -20 points
- 8) If one of the FIFOs does not exist: -20 points

**Late submissions will not be accepted.**

**Good Luck!**