

CS Basics - Exercises

Concurrency in C

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1 Implement a simple shell

You are to implement a simple shell. Your shell should show a command-line prompt (“\$”), allow the user to enter a command with arguments, and then launch the command using `fork()` and `execv()`. Wait for the command to complete using `waitpid()`.

Handle all applicable errors with proper error reporting. When the user enters an empty line, do nothing. Terminate your shell when `stdin` is closed or when the user enters “exit”.

2 Implement launching commands in the background

When the last non-whitespace character of the command is “&”, run the program in the background. Keep a linked list of all processes that have been backgrounded (with `pid_t` and the program’s binary name).

Use `sigaction()` to install a signal handler for `SIGCHLD` to be notified when the background process terminates. In the signal handler, set a global flag.

Whenever the user presses “ENTER”, and before launching any commands, check if the global flag is set. Then collect all zombies using `waitpid()` and output their termination status in the form “PROGRAM NAME terminated with STATUS” to `stdout`.

Test your shell with `valgrind` for memory leaks.

3 Bonus: File redirection

Study the `dup2()` and `open()` system calls. Add minimal support for redirecting `stdin` (“< FILE”), `stdout` (“> FILE”) and `stderr` (“2> FILE”) to your shell.

4 Command line arguments

Write a program reading its command line arguments. The program is `logarithm` and takes as input one number. It writes the logarithm of this number, and also the factorial

of this logarithm.

Example

```
bie1@mymachine $/ ./logarithm 1024
Log of 1024 is 10
10! is 3628800
```

5 Read a file

Write a program in C, that reads the content of a file given as an argument and writes it in upercase.

```
bie1@mymachine $/ ./touppercase myfile.txt
HELLO WORLD
```

6 Threads

Write a C program, that starts two threads. One thread is computing the factorial of a given number, and the other one is computing its exponential.