dsh: A Devil Shell

COMPSCI210 Recitation

14 Sep 2012

Vamsi Thummala

Comments on heap manager

- Q's on pointer manipulation
- Infinite loop
- Space utilization (success rate)
- segfault issues

The fact

Debugging segfaults is hard!

gdb can help

Code walk through is often faster (for this lab)

Shell

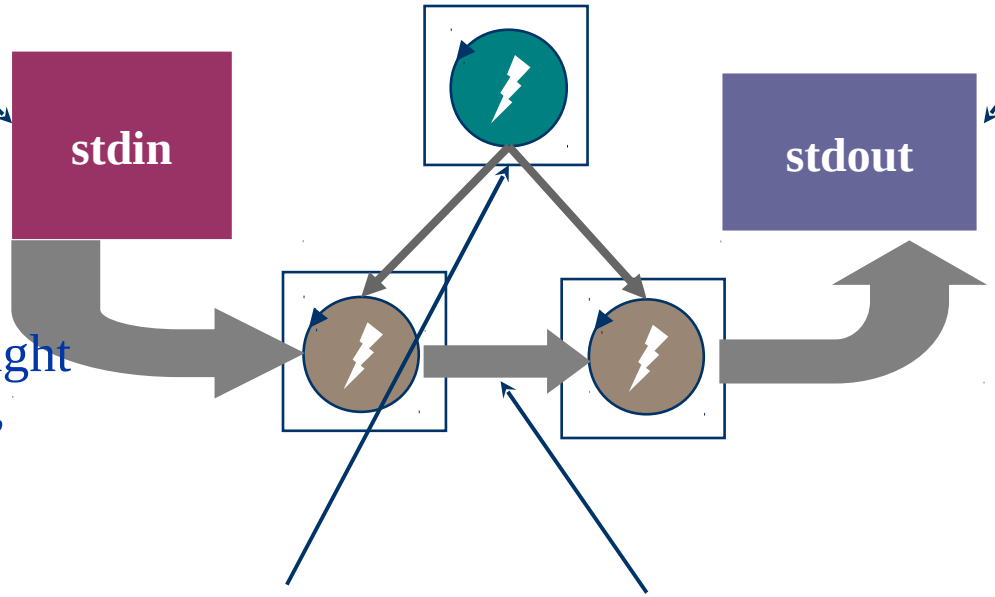
- Interactive command interpreter
- A high level language (scripting)
- Interface to the OS
- Provides support for key OS ideas
  - Isolation
  - Concurrency
  - Communication
  - Synchronization

Demo

Unix programming environment

Standard unix programs read a byte stream from standard input (fd==0).

They write their output to standard output (fd==1).



Stdin or stdout might be bound to a file, pipe, device, or network socket.

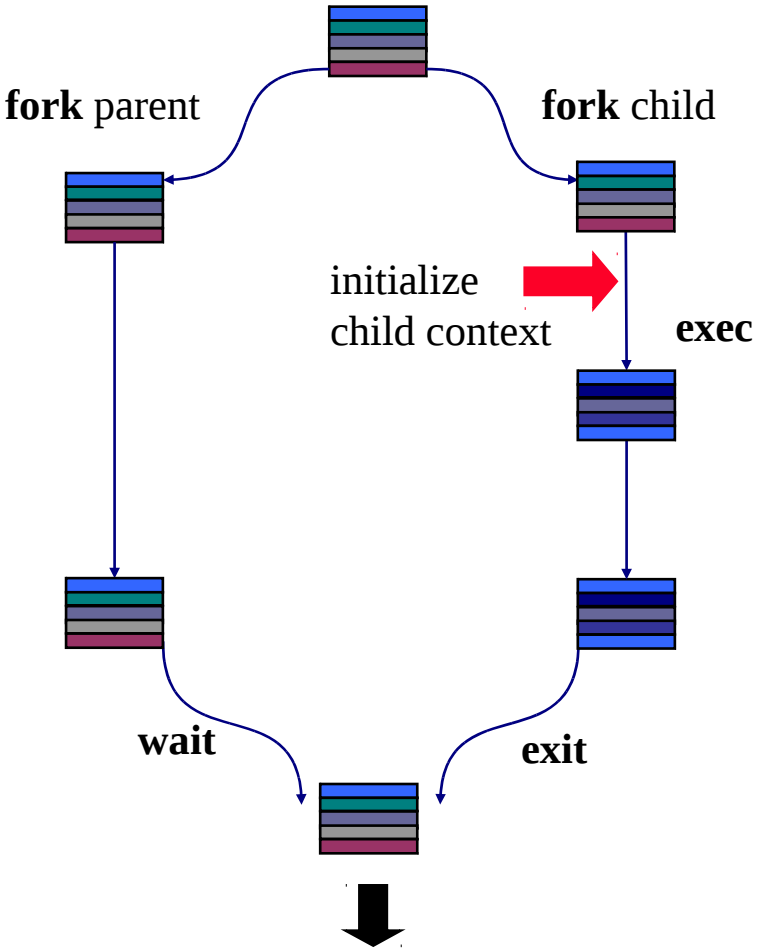
If the parent sets it up, the program doesn't even have to know.

That style makes it easy to combine simple programs using pipes or files.

Shell Concepts

- Process creation
- Execution
- Input/Output redirection
- Pipelines
- Job control
  - Process groups
  - Sessions
  - Foreground/background jobs
    - Given that many processes can be executed concurrently, which processes should have accesses to the keyboard/screen (I/O)?
  - Signals
    - SIGSEGV (segfault), SIGINT, SIGCONT

Unix fork/exec/exit/wait syscalls



int pid = fork();
Create a new process that is a clone of its parent.

exec*("program" [, argvp, envp]);
Overlay the calling process with a new program, and transfer control to it.

exit(status);
Exit with status, destroying the process. Note: this is not the only way for a process to exit!

int pid = wait*(&status);
Wait for exit (or other status change) of a child, and "reap" its exit status. Note: child may have exited before parent calls wait!

Process creation and execution

```
while (1) {
   printf("$");
   command = readnparse(args);
   switch (pid = fork()) {    // new process; concurrency
        case -1:
            perror("Failed to fork\n");
        case 0:                    // child when pid = 0
          exec (command, args, 0);  // run command
        default:                        // parent pid > 0
           waitpid(pid, NULL, 0); // wait until child is done
   }
```

Input/Output (I/O)

- I/O through file descriptors
  - File descriptor may be for a file, terminal, …
- Example calls
  - read(fd, buf, sizeof(buf));
  - write(fd, buf, sizeof(buf));
- Convention:
  - 0: input
  - 1: output
  - 2: error
- Child inherits open file descriptors from parents

I/O redirection (< >)

- Example: “ls > tmpFile”
- Modify *dsh* to insert before exec:

```
close(1);                              // release fd 1
fd = create(“tmpFile”, 0666);      // fd will be 1
```

- No modifications to “ls”!
- “ls” could be writing to file, terminal, etc., but programmer of “ls” doesn’t need to know

Pipeline: Chaining processes

- One-way communication channel
- Symbol: |

```
int fdarray[2]; char buffer[100];
pipe(fdarray);
write(fdarray[1], “hello world”, 11);
read(fdarray[0], buffer, sizeof(buffer));
```

Pipe between parent/child

```
int fdarray[2];
char buffer[100];
pipe(fdarray);
 switch (pid = fork()) {
        case -1: perror("fork failed");
        case 0:  write(fdarray[1], "hello world", 5);
        default: n = read(fdarray[0], buffer, sizeof(buffer)); //block until data is
available
 }
```

How does the pipes in shell, i.e, "ls | wc"?

dup2(newfd, oldfd); // duplicates fd; closes and copies at one shot

Process groups

- A process group is a collection of (related) processes. Each group has a process group ID.
- Each group has a group leader who pid = pgid
- To get the group ID of a process:

  pid_t getpgrp(void)
- A process may join an existing group, create a new group.

  int setpgid(pid_t, pid, pid_t, pgid)
- A signal can be sent to the whole group of processes.

```
pid_t spawn_job(bool fg, pid_t pgrp) {

    int ctty = -1;
    pid_t pid;

    switch (pid = fork()) {
                case -1: /* fork failure */
                        return pid;
                case 0: /* child */
                        /* establish a new process group, and put the child in
                         * foreground if requested
                         * Q: what if setpgid fails?
                         */
                        if (pgrp < 0)
                                pgrp = getpid();

                        if (setpgid(0,pgrp) == 0 && fg) // If success and fg is set
                                tcsetpgrp(ctty, pgrp); // assign the terminal

                        return 0;
                default: /* parent */
                        /* establish child process group here too. */
                        if (pgrp < 0)
                    pgrp = pid;
                        setpgid(pid, pgrp);

                        return pid;
    }
}
```