

Recitation 10: Tshlab + VM

Instructor: TAs

Outline

- Labs
- Signals
- IO
- Virtual Memory

TshLab and MallocLab

- **TshLab due Tuesday**
- **MallocLab is released immediately after**
 - Students overwhelmingly say, “Start early!”
 - For many, checkpoint will take half of the time
 - Expect a “bootcamp” and recitation next week
 - Working for several hours will improve their value significantly

Signals

- **Parent process sends SIGINT to a child process.
What is the behavior of the child?**
- **What is the default?**
- **What else could the child do?**

More Signals

- **Parent process sends SIGKILL to a child process.
What is the behavior of the child?**
- **What is the default?**
- **What else could the child do?**

Sending Signals

- Parent sends SIGKILL to a child process.

...

```
pid_t pid = ...; // child pid
kill(pid, SIGKILL);
// At this point, what has happened
// to the child process?
```

Signals

- How many times is Hi printed?

```
int main(int argc, char** argv)
{
    pid_t ppid = getpid(), cpid, tpid;
    cpid = fork();
    if (cpid == 0) tpid = ppid;
    else tpid = cpid;
    kill(tpid, SIGINT);
    write(STDOUT_FILENO, "Hi", strlen("Hi"));
    return 0;
}
```

Blocking Signals

- The shell is currently running its handler for SIGCHLD.
- What signals can it receive?
- What signals can it not receive (i.e., blocked)?

IO

- File descriptor management can be tricky.
- How many file descriptors are open in the parent process at the indicated point?
- How many does each child have open at the call to `execve`?

```
int main(int argc, char** argv)
{
    int i;
    for (i = 0; i < 4; i++)
    {
        int fd = open("foo", O_RDONLY);
        pid_t pid = fork();
        if (pid == 0)
        {
            int ofd = open("bar", O_RDONLY);
            execve(...);
        }
    }
    // How many file descriptors are open in the parent?
```

Redirecting IO

- File descriptors can be directed to identify different open files.

```
int main(int argc, char** argv)
{
    int i;
    for (i = 0; i < 4; i++)
    {
        int fd = open("foo", O_RDONLY);
        pid_t pid = fork();
        if (pid == 0)
        {
            int ofd = open("bar", O_WRONLY);
            dup2(fd, STDIN_FILENO);
            dup2(ofd, STDOUT_FILENO);
            execve(...);
        }
    }
    // How many file descriptors are open in the parent?
```

Redirecting IO

- At the two points (A and B) in main, how many file descriptors are open?

```
int main(int argc, char** argv)
{
    int i, fd;
    fd = open("foo", O_WRONLY);
    dup2(fd, STDOUT_FILENO);
    // Point A
    close(fd);
    // Point B
    ...
}
```

Memory Access

- **The processor tries to write to a memory address.**
- **List different steps that are required to complete this operation.**

Memory Access

- The processor tries to write to a memory address.
- List different steps that are required to complete this operation. (non exhaustive list)
- Virtual to physical address conversion (TLB lookup)
- TLB miss
- Page fault, page loaded from disk
- TLB updated, check permissions
- L1 Cache miss (and L2 ... and)
- Request sent to memory
- Memory sends data to processor
- Cache updated

Address Translation with TLB

- Translate 0x15213, given the contents of the TLB and the first 32 entries of the page table below.
- 1MB Virtual Memory**
256KB Physical Memory
4KB page size

2-way
set
associative

Index	Tag	PPN	Valid
0	05	13	1
	3F	15	1
1	10	0F	1
	0F	1E	0
2	1F	01	1
	11	1F	0
3	03	2B	1
	1D	23	0

VPN	PPN	Valid	VPN	PPN	Valid
00	17	1	10	26	0
01	28	1	11	17	0
02	14	1	12	0E	1
03	0B	0	13	10	1
04	26	0	14	13	1
05	13	0	15	18	1
06	0F	1	16	31	1
07	10	1	17	12	0
08	1C	0	18	23	1
09	25	1	19	04	0
0A	31	0	1A	0C	1
0B	16	1	1B	2B	0
0C	01	0	1C	1E	0
0D	15	0	1D	3E	1
0E	0C	0	1E	27	1
0F	2B	1	1F	15	1

If you get stuck on TshLab

- **Read the writeup!**
- **Do manual unit testing before** `runtrace` **and** `sdriver`!

- **Read the writeup!**
- **Post private questions on piazza!**

- **Read the man pages on the syscalls.**
 - Especially the error conditions
 - What errors should terminate the shell?
 - What errors should be reported?