Module 2

Spawning New Tasks

Overview

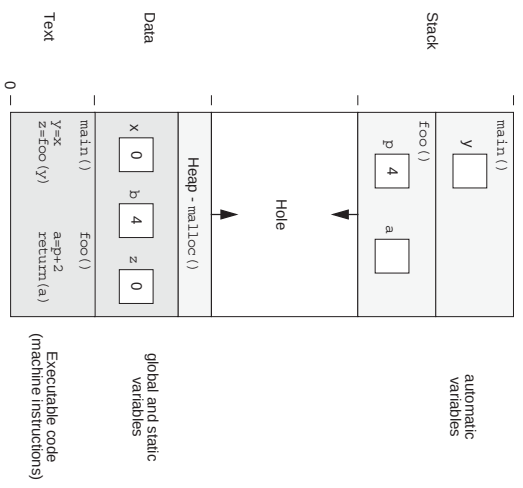
- Objectives
- Relevance

Defining a Program

`pgm.c`

```
1   int x;
2   static int b = 4;
3
4   main() {
5     int y;
6     static int z;
7
8     y = b;
9     z = foo(y);
10  }
11
12  foo( int p ) {
13    int a;
14    a = p + 2;
15    return(a);
16  }
```


Processes as Compared to Procedure Calls



Creating a Process

mysystem.c

```
1   #include <stdio.h>
2   #include <stdlib.h>
3
4   main()   {
5
6     int rv;
7
8     /* Sometimes useful for troubleshooting, */
9     /* E.g., do "ps" command inside program and save output */
10    rv = system("ps -le | grep mysystem > /tmp/junk");
11
12    if ( rv != 0 ) {
13      fprintf(stderr, "Something went wrong!\n");
14    }
15  }
```


myfork.c

```
1   #include <sys/types.h>
2   #include <unistd.h>
3   #include <stdio.h>
4
5   main() {
6
7     pid_t pid;
8
9     pid = fork();
10
11    switch(pid) {
12
13    /* fork failed! */
14    case -1:
15      perror("fork");
16      exit(1);
17
18    /* in new child process */
19    case 0:
20      printf("In Child, my pid is: %d\n", getpid());
```



```
21      do_child_stuff();
22      exit(0);
23
24    /* in parent, pid is PID of child */
25    default:
26      break;
27    }
28
29    /* Rest of parent program code */
30    printf("In parent, my child is %d\n", pid);
31  }
32
33  int do_child_stuff() {
34    printf("\t Child activity here \n");
35  }
```


Running a New Program

	Give Absolute Path	Use PATH Variable	New Environment
argv as list	execl()	execlp()	execle()
argv as vector	execv()	execvp()	execve()

Running a New Program

```
1   #include <stdio.h>
2   #include <sys/types.h>
3   #include <unistd.h>
4   #include <sys/wait.h>
5
6   main() {
7
8     pid_t  pid;
9
10    pid = fork();
11
12    switch(pid) {
13
14    /* fork failed! */
15    case -1:
16      perror("fork");
17      exit(1);
18  /* in new child process */
19    case 0:
```



```
20      execlp("ls", "ls", "-F", (char *)0);
21      /* why no test? */
22      perror("execlp");
23      exit(1);
24
25    /* in parent, pid is PID of child */
26    default:
27      break;
28    }
29
30    /* Rest of parent program code */
31    wait(NULL);
32    printf("In parent, my child is %d\n", pid);
33  }
```


Terminating a Process

- `exit()`— Flushes buffers and calls `_exit()` to terminate process
- `_exit()`— Closes files and terminates process
- `atexit()`— Stores function for future execution before terminating a process
- `abort()`— Closes files, terminates the process, and produces a core dump for debugging

Terminating a Process

```
1   #include <stdlib.h>
2   #include <unistd.h>
3
4   void cleanup() {
5
6     char *message = "cleanup invoked\n";
7
8     write(STDOUT_FILENO, message, strlen(message));
9   }
10
11  main() {
12
13    /* Register cleanup() as atexit function */
14    atexit(cleanup);
15
16    /* Other things in program done here */
17
18    exit(0);
19  }
```

Cleaning Up Terminated Processes

- `wait()` – Blocks the process until one of its children is ready to have its status reaped.
- `waitpid()` – Allows you to specify which process to wait for and whether to block.

Cleaning Up Terminated Processes

```
1   #include <sys/types.h>
2   #include <sys/wait.h>
3   #include <stdio.h>
4   #include <unistd.h>
5   #include <stdlib.h>
6
7   main() {
8
9     pid_t  pid;
10    int    status;
11
12    /* fork() a child */
13    switch(pid = fork()) {
14
15    case -1:
16      perror("fork");
17      exit(1);
18
19  /* in child */
```



```
20    case 0:
21      execlp("ls","ls","-F",(char *)NULL);
22      perror("execlp");
23      exit(1);
24
25    /* parent */
26    default:
27      break;
28    }
29
30    if (waitpid(pid, &status, 0) == -1) {
31      perror("waitpid");
32      exit(1);
33    }
34
35  /* See wstat(5) for macros used with status
36     from wait(2) */
37    if (WIFSIGNALED(status)) {
38      printf("ls terminated by signal %d.\n",
39          WTERMSIG(status));
40    } else if (WIFEXITED(status)) {
41      printf("ls exited with status %d.\n",
```



```
42          WEXITSTATUS(status));
43    } else if (WIFSTOPPED(status)) {
44      printf("ls stopped by signal %d.\n",
45          WSTOPSIG(status));
46    }
47    return 0;
48  }
```

Exercise: Spawning New Tasks

- Objectives
- Tasks
- Discussion
- Solutions