Full Name: _____

CSCI 340, Fall 2015

Practice Midterm Exam

Instructions:

- Make sure that your exam is not missing any sheets, then write your full name on the front. Put your name or student ID on each page.
- Write your answers in the space provided below the problem. If you make a mess, clearly indicate your final answer.
- You may **not** use your text, notes, or any other reference material.
- No electronic devices (music, phone, calculator, etc).
- **Do not turn this page until instructed to do so.**

Advice:

- The amount of space after a question does not always indicate how long the answer should be. Sometimes I add space so questions fit well on pages.
- Some questions have multiple parts such as Explain your answer. Make sure you answer all the parts of each question.
- If you can't answer a question easily, move on and come back to it later.
- If you have time left over, use it to review your answers. Students who turn tests in early often make trivial mistakes that they would catch if they went back over their answers.
- If you think a question has a mistake make sure to ask me during the test. It is too late to have a clarification or fix the problem after the exam.

Problem	Page	Possible	Score
1	1	20	
2	2	25	
3	4	20	
Total		65	

1. **[20 Points]** This problem tests your understanding of process creation and event ordering

```
void end(void)
{
   printf("2");
}

int main()
{
  if ( fork() == 0 ) {
     atexit(end);
  }
  if ( fork() == 0) {
     printf("0");
  } else {
     printf("1");
  }
  exit(0);
}
```

The `atexit()` routine takes a pointer to a function adds that function to a list of functions (initially empty) to be called when the `exit()` function is called.

What outputs are possible? Circle the possible outputs in the list below.

(a) 112002

(b) 211020

(c) 122001

(d) 100212

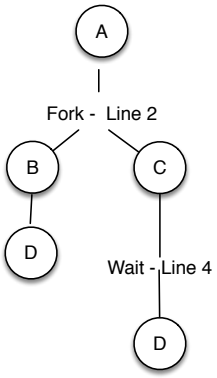
2. **[25 Points]** This problem tests your understanding of process creation and event ordering

```
void P(char *s) { fprintf(stderr,"%s ", s); }

main()
{
  int status;

  P("B");
  if (fork() ) {
    P("L");
    if ( fork() == 0 ) {
      P("G");
    } else {
      P("S");
      wait(&status);
    }
  } else {
    P("X");
    if ( fork() ) {
      P("W");
      wait(&status)
      P("Z");
    } else {
      P("T");
      if (fork()) {
         P("H");
      } else {
         P("M");
      }
      exit(0);
    }
  }
  P("R");
}
```

(a) **[10 Points]**

Draw a "process tree" diagram. Each `fork()` in the program should cause a fork in the tree labeled with the line number of the `fork()`. The output of print statements should be shown linearly beneath the tree in the order they would be output. `wait()` statements should also be included in the tree.

Model your diagram after the diagram on the right, which shows a program that prints "A", forks a child using an —verb—if(fork())—, has the child output "B" and the parent output "C" and then waits for the child; following the if-then-else is a statement to print "D".



(b) **[4 Points]** Line 14 contains a `wait` call. Other lines (8, 10, 18, 24) contain fork() statements that spawn child precesses. What are the line numbers of the corresponding `fork()` calls that create processes that might be successfully harvested by the `wait()` statement on line 14?

(c) **[4 Points]** Repeat part the previous problem for the `wait()` on line 20?

(d) **[4 Points]** If the program is executed, can W ever appear before H?

(e) **[4 Points]** Can Z ever appear before W?

(f) **[4 Points]** Can R ever appear before L?

3. **[20 Points]** Consider the following C program. (For space reasons, we are not checking error return codes, so assume that all functions return normally.)

```
pid_t pid;

void bar(int sig) {
  printf("wabbit");
  kill(pid, SIGUSR1);
}

void baz(int sig) {
  printf("tweribble");
}

void foo(int sig) {
  printf("waskly");
  kill(pid, SIGUSR1);
  exit(0);
}

main() {
  signal(SIGUSR1, baz);
  signal(SIGCHLD, bar);
  pid = fork();
  if (pid == 0) {
    signal(SIGUSR1, foo);
    kill(getpid(), SIGUSR1);
    for(;;);
  }
  else {
    pid_t p; int status;
    if ((p = wait(&status)) > 0) {
      printf("that");
    }
  }
}
```

What is the output string that this program prints?