CMPSC 311 Exam 1

February 13, 2015

**Closed book, closed neighbor, no electronic tools or additional papers.
You may not share or discuss exam questions with anyone.**

1 Short Questions (36pts total, 3pts each, be brief)

1. What should a C function do to indicate to the caller that it has failed?

2. What mechanism is used by the operating system to execute privileged operations on behalf of user code?

3. Why do `struct` types in C sometimes contain padding?

4. Write a prototype (declaration) for a function called `hat_trick` that returns three `int`s using output parameters.

5. In the Bash shell, what is the difference between redirecting output and piping output?

6. After successfully executing the following shell commands:

   ```
   $ cd /etc/apache2/sites
   $ mv web.conf ../../backup/foo/../web.conf
   ```

   what is the full path (starting with `/`) of the file `web.conf`?

7. What is the term for an interface that hides the details of the underlying implementation?

8. What is the `PATH` environment variable used for?

9. When adapting Unix to a new hardware architecture, only the lowest layers need to be reimplemented. What is this property called?

10. Write a `tar` command which takes the directory `assign2` and archives it to a tarball called `my-assign2.tar.gz`.

11. Write a single shell command that prints the text `*"$X'#` literally.

12. Write a single C statement that changes the second character of the string `str` to the letter X. (You may assume that the string is already at least two characters long.)

2   Medium Questions (36pts total, 6pts each)

13. Fill in the parameters and implementation of the `oddify` function, which should add 1 to each of the even values in an `int` array that has been passed as a parameter.

```
void oddify(                                        ) {




}
```

2

14. How does the operating system use virtual memory to prevent processes from interfering with each other when they try to access the same address?

15. What are the two main modes in Vim, and what is each used for?

16. The following code does not work. Rewrite the function and the function call to use pass-by-reference so that it does work.

```
void inc_and_dec(int x, int y)
{
  x += 5;
  y -= 5;
}

// function call
inc_and_dec(i, j);
```

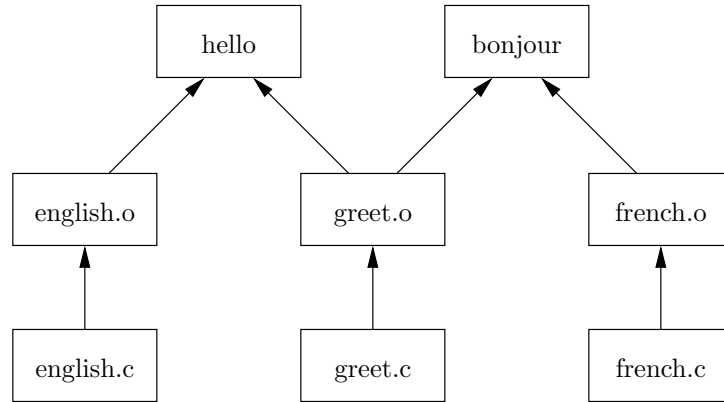17. What are the differences between a library and a header, in terms of

    (a) what they contain?

    (b) what stage(s) in the build process they are needed for?

18. Explain the difference between static and dynamic typing.

3 Long Questions (28pts total)

19. (10pts) Write a Makefile for the following dependency graph, including a pattern rule for the compile step:

```
        hello              bonjour
       ↗     ↖            ↗      ↖
  english.o   greet.o        french.o
     ↑           ↑              ↑
  english.c   greet.c       french.c
```

20. (10pts) In the memory hierarchy:

Explain why good temporal locality leads to more cache hits.

What do memory caches do to improve performance based on spatial locality?

21. (8pts) You have just opened the following text file in Vim:

```
one two
three four
```

and the cursor is at the beginning of the first line. What would the new text be after each of the following sets of keystrokes?

(For simplicity, assume that you are starting with the *original text* in each part.)

(a) `xx`

(b) `rx`

(c) `jdd`

(d) `ABC`