

CSE 333 – Autumn 2016 Final Exam

Name: _____

A question involving what could be either C or C++ is about C++, unless it explicitly states that it is about C. We assume `std=c11` or `std=c++11` when compiling.

We will grade this exam using the tool used to grade the midterm. Please print the exam and fill it out, as if you were taking it in class. Then scan the result and submit to gradescope as a PDF file.

- *DO NOT omit or add any pages when you scan the result. Your submission MUST have the same number of pages as this pdf file. The pages MUST be in the same order as this pdf file.*
- *DO NOT write on the back of any page. We are unlikely to ever read anything written on the backs of pages. DO NOT scan the backs of any pages.*
- *Please produce a readable pdf file. Do not try to submit jpegs. Please do not submit a pdf file composed of a set of images taken with a camera. CSE has scanners you can use if you don't have one.*
- *If you are unable to read the scan of your exam, that means we won't be able to read it either. Please try to write with enough contrast on that the scan will be legible. Please write at a size that can be read.*

Because we have asked you not to write on the backs of pages, we have left more space for question answers than we feel should be necessary. Don't take the amount of space as an indication of the expected answer length.

There is a single programming problem (the last question on this exam) that you should implement and submit using the course drop box. Nothing else is submitted to the course drop box.

You should begin by fetching the tar file at

<https://courses.cs.washington.edu/courses/cse333/16au/final/code-distribution.tar.gz>

When you untar that file you will find code that is referenced by many of the questions. Except for the final (programming) question, your answers to all questions are written on your paper copy of this exam. You do not alter and submit any of the code we distribute.

1. *[15 points]*

Look at the C++ code distributed in directory q1. Translate the code from C++ to C. Your answer should reflect a very simpler translator, one that translates line by line, to the extent that's possible. You should NOT make any global optimizations. For instance, don't produce a C file that simply prints the same thing as the original C++ code. Your translation should demonstrate that you know how to express the C++ features used in this program as C features, beyond this specific example.

Write your C code here.

2. [5 points]

(This question uses the code from question 1, but is about C++ only.)

Imagine I add this line just before the return in q1-main.cc.

```
cout << first << endl;
```

The line of code doesn't compile. My intention is that it would print the C string referred to by instance variable `str_`.

Write here modifications that you could make to file `q1.h` ONLY so that the new line compiled and produced the desired result.

Your modifications should be "correct" in the sense that you put in the `.h` file only the kinds of things that go in a `.h` file. It isn't enough for it to work for this very restricted example code; it should be a reasonable thing to do even for more complicated examples.

3. [5 points]

Imagine that I have an application that has only two source files, q3-a.c and q3-b.c. If I compile both those files with gcc (and then link with gcc) everything works fine. If I compile both with g++ (and then link with g++), again everything works fine. But if I compile one with gcc and one with g++ (and then link with g++), the application doesn't build.

Briefly explain why the program doesn't build when I compile the two source files, one with gcc and one with g++.

4. [5 points]

The C++ container classes include an `emplace()` method that constructs an object directly into the list. Briefly describe a situation in which you would **have to** use `emplace()`. Don't tell me why `emplace` is useful, or better than `push` (or equivalent operations). Describe a situation in which `push` wouldn't work at all, but `emplace` would.

5. [8 points]

Suppose Q5 is a class with no user defined constructors. Describe **two** distinct situations in which the implicitly defined default constructor will not succeed for this declaration:

```
Q5 failedDefaultConstructor;
```

6. [8 points]

Suppose Foo is a class. A subroutine is declared as follows:

```
shared_ptr<Foo> sub(shared_ptr<Foo> arg);
```

For this calling code:

```
shared_ptr<Foo> pFoo = make_shared<Foo>();
```

```
shared_ptr<Foo> pOther = sub(pFoo);
```

think about how large the reference count of pFoo might become. Call that the maximum reference count of pFoo.

(a) What is the largest plausible maximum reference count pFoo might have at any point during the execution of that code, assuming no shared_ptr's are created in the body of sub? Briefly explain.

(b) What is the minimum maximum reference count pFoo might have at any point during the execution of that code, assuming that no shared_ptr's are created in the body of sub? Briefly explain.

7. [16 points]

- | | | |
|------|-------|--|
| True | False | If you supply the definition of a method inside the declaration of a class in a .h file, the C++ compiler will inline every invocation of that file method. |
| True | False | If an object of class A has an object of class B as an instance variable, and both A and B define constructors but neither A nor B define default constructors, then the code won't be able to pass an A object as a by-value argument. |
| True | False | C++ references are nothing more than "syntactic sugar" for pointers. |
| True | False | If your code doesn't link, in some cases you can fix it by adding a #include to one of your source files. |
| True | False | A constructor's member initializer list is just shorthand for assignment to instance variables that could be done in the constructor body. |
| True | False | If A is an object of some class and has been allocated on the stack of the currently executing procedure, then the statement "return A;" has undefined result. |
| True | False | A const procedure isn't allowed to change the values of any global variables. |
| True | False | You have working code that includes a number of classes that all have class A as an ancestor. The method foo() is not currently virtual in any of them, and isn't declared in A at all. You add a declaration for foo() in class A. The code is guaranteed to still run correctly. |
| True | False | If class A has no user-defined constructors, (Question deleted) |
| True | False | It is impossible for one thread to alter the values of variables that have been stack allocated by another thread. |
| True | False | If process A sends 1024 bytes in a single write operations on a TCP connection to process B and B performs a read with a buffer of 512 bytes, the second 512 bytes that A sent will be lost. |
| True | False | If process A has a TCP connection to process B, B is sent a notification if A crashes. |
| True | False | If both processes A and B have opened the same file and are writing to it, it's possible that some of the writes will never appear in the file. |
| True | False | Suppose we used the same interface to GTK+ as we did in HW 3, but we wrote our code in C++ instead of C. C++'s std::bind would make registering GTK+ callbacks a lot simpler than it was in C. |
| True | False | If A is a variable of type int, A = 0; could mean almost anything in a C++ program. |
| True | False | If A and B are instances of class Foo, A = B; could mean almost anything in a C++ program. |

8. [8 points]

Foo is a class. Consider this C++ code:

```
vector<Foo> vec = {0,3,21,-2,8,10,4,4,10,0};  
auto p = std::find(vec.begin(), vec.end(), 8);  
vec.erase(p);
```

Assuming this code compiles just fine, briefly describe everything you can deduce about class Foo. Be specific.

9. [5+3 = 8 points]

(A) The program q9.cc has a bug. Describe here how to fix that bug.

(B) Briefly explain why the line marked in the code is preferable to the alternative:
if (value1 > value2) return 1;

10. [6 points]

I'd like the following C code to compile and do the expected thing:

```
int ***p = createArray(10,10,10);  
p[1][2][3] = 0;
```

Write the C function createArray() here.

11. [5 points]

In this question we assume we're compiling using "g++ -std=c++14 ...".

The code in file ~~q10.cc~~ q11.cc doesn't compile. Fix it, so that it both compiles and runs correctly, **by changing only a single character in the file**. Briefly explain what you changed.

12. [35 points]

Implement and submit to the course dropbox the application described here.

You are to write an application that allows clients to connect to it via tcp. You write only the server, but to explain its functioning we also describe the clients. The clients read keyboard input. Anything typed is sent to your server. Your server receives the text sent by a client and sends it to all connected clients, including the one who sent it originally. It is important that all clients receive all transmission from the server in the same order. The clients print what they receive from the server. They should all print exactly the same thing.

We will use the Linux utility nc to connect to your server. Many nc sessions may be connected at once.

The files you submit should allow us to build your application by saying "make". We should then be able to run your program by saying something like "./q12 33300" - the argument is the port number your server should use to listen for connections from clients.

You may reuse any code you wrote or distributed to you this quarter as part of cse333. You must implement in C++.

We provide a sample solution executable so you can check behavior if this specification isn't clear.