

Your Name: _____

CSE 374 Assessment 4

C++ Programming & Miscellany

Instructions

This assessment is designed to be completed within our 110 minute final exam period. It is my expectation that it will take closer to one hour for completion. You may leave early if you complete the assessment early. Turn-in your assessment by handing it to a staff member; you must also show your Husky card for verification.

This assessment is designed to measure your knowledge of the skills taught in the last third of the quarter. It covers Makefiles and C++ programming. You may refer to one double-sided 8.5x11" sheet of information that you have prepared yourself.

Please write your answers in the answer boxes provided. If you must write an answer outside of that space, please note that in or near the answer box.

This assessment is worth a total of 25 points. Partial credit is available.

Your information

Your Name:	
Your UnetID:	

Set-up

We will refer to the following source code for future questions. Assume that you have cloned a git repository, placing it in a folder called `debug-demo`. Within `debug-demo` you have the following directory tree:

```
├── data_files
│   ├── pap.txt
│   ├── scramble.txt
│   └── simple.txt
├── dict
│   ├── dict0
│   └── dict1
├── interview-1 (buggy code)
│   ├── count_typos.c
│   └── SpellChecker.c
├── interview-2 (buggy code)
│   ├── count_typos.c
│   └── SpellChecker.c
├── README.md
├── SpellChecker.h
├── Utils.c
└── Utils.h
```

After you copy `count_typos.c` and `SpellChecker.c` from your interview file into `debug-demo`, you run the command `gcc -MM count_typos.c` and get the following output: `count_typos.o: count_typos.c Utils.h SpellChecker.h`

Makefiles (5 points)

You are creating a Makefile to use with the code in `debug_demo`. You have gotten to the point where all the code is compiling correctly. Make is not quite working yet, but what you have so far is in the box below. To finish up, answer the following short answer questions in the boxes provided:

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```
CC = gcc
CFLAGS = -Wall -std=c11
TARGET = count_typos

debug: CFLAGS += -g
debug: clean $(TARGET)

all: $(TARGET)

$(TARGET): count_typos.o SpellChecker.o Utils.o
    $(CC) $(CFLAGS) -o count_typos $^

# Individual source files
count_typos.o: _____
    $(CC) $(CFLAGS) -c count_typos.c

SpellChecker.o: SpellChecker.c SpellChecker.h
    $(CC) $(CFLAGS) -c SpellChecker.c

Utils.o: Utils.c
    $(CC) $(CFLAGS) -c Utils.c

clean:
    rm -f *.o $(TARGET) *~
```

1. What should you name the file when you save your work, assuming you don't want to specify a file name every time you use it?

2. You have a blank line next to the `count_typos.o` target. What should you put there?

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3. If you type `make` at the command prompt, what commands get executed? (*Hint: there are five distinct commands. You should be able to write them precisely.*)

4. Now you execute `$rm count_typos`. What single command gets executed if you then type `make all` at the command prompt? (*Hint: there is only one, and you should be able to write it precisely.*)

5. You realize you'd like to use the newer `c17` standard to compile. You can update just one line to make this happen. Please write the *entire line with the change* below.

C++ Syntax (6 points)

You have the following header file - **Point.h**, and the accompanying **usePoint.cc**

```
#ifndef POINT_H_
#define POINT_H_

namespace cse374 {

// Class that represents a 2D integral coordinate plane
class Point {
public:
    Point() = default;    // synthesized
    Point(int x, int y) : x_(x), y_(y) {};
    Point(const Point &copyme) : x_(copyme.x_), y_(copyme.y_) {};
    explicit Point(const int vect[2]) : x_(vect[0]), y_(vect[1]) {};
    ~Point() {};

    int get_x() const { return x_; }
    int get_y() const { return y_; }

private:
    int x_;
    int y_;
}; // class Point
}

#endif // POINT_H_
```

```
#include "Point.h"
#include <iostream>
#include <cstdlib>

using std::cout;
using std::endl;

int main(int argc, char** argv) {
    Point p1;
    Point p2(4, 6);
    Point p2copy = p2;
    int vector[2] = {5,7};
    Point pvec = vector;

    cout << "p1: (" << p1.get_x() << ", " << p1.get_y() << ")" << endl;

    return EXIT_SUCCESS;
}
```

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When you go to use your new class, things don't quite work yet. Answer the following questions to debug your code:

1. The first time you try to compile you get an error message:

`usePoint.cc:11:3: error: 'Point' was not declared in this scope; What line of code can you add before main to fix this problem?`

2. After you fix that, there is another compile error: `usePoint.cc: error: conversion from 'int [2]' to non-scalar type 'cse374::Point' requested. How can you change the line of code with your copy constructor in the header file to fix this error?`

3. Now your code compiles, but the output includes:

`p1 is: (1611138176, 32766)`

You think it makes more sense for a default point to be at (0,0). Write a new default constructor to make this happen. Use initializer syntax.

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4. You're adding to your code, and you create an array of points on the heap using `Point *heappoints = new Point [3];`. You want to be sure you don't have any memory leaks, so what must you add at the end of your program?

5. Your copy constructor has the following signature: `Point(const Point ©me)`. Why did you include the keyword `const`?

6. Considering the same constructor, what is the meaning of the `&` before `copyme`? Why would we pass a variable in this manner?

C++ Inheritance (5 points)

You have the following file containing inherited classes. It compiles and executes. What does it print out?

```
#include <iostream>
using namespace std;

class Bird {
public:
    virtual void noise() { cout << "squeak" << endl; }
    void move() { noise(); cout << "fly" << endl; }
};

class Canary: public Bird {
public:
    void noise() { cout << "chirp" << endl; }
    void move() { Bird::noise(); cout << "flap" << endl; }
};

class Tweety: public Canary {
public:
    void noise() { cout << "tweet" << endl; }
    void move() { cout << "run" << endl; }
};

int main() {
    Canary *yellow = new Tweety();
    yellow->noise();
    yellow->move();

    Bird *big = new Canary();
    big->noise();
    big->move();
    return 0;
}
```

C++ Templates (4 points)

You have the following code which uses templates.

```
#include <iostream>
#include <vector>
#include <algorithm>
#include <memory>
using namespace std;

template <typename T> void PrintOut(const T &p) {
    cout << p << endl;
}

int main(int argc, char **argv) {
    vector<char> vec;
    vec.reserve(4);
    vec.push_back('e');
    vec.push_back('t');
    vec.push_back('s');
    vec.push_back('b');

    sort(vec.begin(), vec.end());
    cout << "done sort!" << endl;
    for_each(vec.begin(), vec.end(), &PrintOut<char>);

    unique_ptr<int[]> x(new int[5]);
    x[0] = 1;
    x[4] = 3;

    return 0;
}
```

1. What does this code print when it is run?

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2. If you wanted to use a vector of `floats` instead of a vector of `chars`, what would you have to change in the code?

3. You run this code with `valgrind` and there are no memory leaks. When was the memory deleted?

4. Your boss suggests you write some code using a `map` to store some data. Will you write your own `map` code? Why or why not?

Miscellaneous (5 points)

1. Refer back to the '**Setup**' section. Assume your current working directory is `debug-demo`. What single command do you use to copy both the files from `interview-2` to your current directory?

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2. Imagine that you have some multi-threaded software that is updating student tuition accounts. Many scholarships make deposits at 8 am on the first of the month. Sometimes these deposits are not accounted for. What is one technique we discussed in class that you could use to address this issue?

3. You have a number stored using twos-complement in which every digit is a 1. (For example, 1111). What is this number's decimal representation?

4. Suppose you have the following definition of a `free_node`.

```
struct free_node {           // node on free list:
    uintptr_t size;          // number of bytes in this block,
                             // not including this header
    free_node *next;         // next block on free list
};
```

Assume that you are working with a single node, in which `next != NULL`. You want to see if you can merge this node with the one that comes after it, using `if (COND) merge();` What statement do you use in place of `COND`?

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5. What does *encapsulation* mean?

Extra (1 points)

Please use this space to provide any notes you have on this assessment – do you have outstanding questions or concerns about this assessment?

Have one free point and a great summer!