

CMPUT 201 — Winter 1990-2000 — Section B1

Practical Programming Methodology

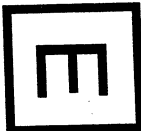
Final Exam

Thursday, April 27, 2000 P. Rudnicki

Name:
Id:

Instructions

- Write your name and student id number in the box above.
- This is an **OPEN BOOK** exam. Time allowed: 120 minutes.
- Place all answers in the spaces provided on the question pages. **JUSTIFY** each answer appropriately.
- This exam counts 32% toward your final grade in this course. This exam is worth 57 points. The weight of each question is indicated in square brackets by the question number.
- This exam is not impossible, but the questions do not necessarily have obvious answers. Think about each question for couple of minutes before answering it.
- There should be 10 questions and 11 pages in this exam booklet. You are responsible for checking that your exam booklet is complete.



04721
CMPUT 201 (B1)
RUDNICKI, P.
APR 00 FINAL
PAGES: 11

Question	Mark	Out Of
1		6
2		6
3		7
4		3
5		4
6		6
7		8
8		8
9		4
10		5
TOTAL		57

Question 1 [6 marks]: John's four troubles.

Part 1 a [2 marks]: John needs to list only the names of C files in the current directory. None of the commands below does the trick. Why? Which command should John use?

```
gsb078:~/John>ls | grep c
```

```
gsb078:~/John>ls | grep .c
```

```
gsb078:~/John>ls | grep \.c
```

Part 1 b [1 mark]: John is in despair. He tries to compile his C program named a.c and here is what he gets:

```
gsb078:~/John>gcc  
You have been fooled!
```

What would explain this unexpected output?

Part 1 c [2 marks]: Unable to sort out his previous mishap, John logged into another machine and instead of using gcc he used a different C compiler and produced his executable named a. Now, back at the same machine where he started, he gets

```
gsb078:~/John>./a  
bash: ./a: cannot execute binary file
```

How would you explain this?

Part 1 d [1 mark]: In an attempt to understand the previous trouble, John issued the following command:

```
gsb078:~/John>cat a
```

What kind of output would you expect?

Question 3 [7 marks]: Consider the following definitions:

```
#define N 10000

typedef enum {R, G, B} Color;
typedef struct {
    int x, y;
    Color color;
} Point;

Point C[N];
```

Part 3 a [3 marks]: Write a comparison function called `point_comp` that can be used with `qsort` to sort the array `C` of points into the non-decreasing order by the horizontal coordinate `x`. The points with the same horizontal coordinate should be sorted into the non-decreasing order by the vertical coordinate `y`.

Part 3 b [2 marks]: Write a call to `qsort` to sort the array `C` using the comparison function from Part a.

Part 3 c [2 marks]: Assume that `C` is sorted by `qsort` from Part b. Change the color of the point with coordinates (2, 3) to R if a point with this coordinates is in array `C`. Use `bsearch`. (Assume that no two points in `C` have the same coordinates.)

Question 4 [3 marks]: Write the definition of the C function declared as follows:

```
void resize(int **arr, int oldsize, int *newsize);
```

Function `resize` resizes the array whose beginning is stored in `*arr` to hold the number of elements in the integer pointed to by `newsize`, making it bigger or smaller and preserving the appropriate contents of the old array. The pointer to the new array is returned in `*arr`. If it is not possible to resize the array to the new size, the original array should be left unmodified and the old size should be then stored in `*newsize`.

Question 5 [4 marks]: Consider the following definitions:

```
unsigned char Mem[32767];
```

```
short x, y;
```

Write the code with proper casting to store `x` into `Mem` starting at index 120 and to assign a short from `Mem` starting at index 200 to `y`.

Question 6 [6 marks]: Here is a set of C files from our implementation of `sasm` and `svm` (for assignment 3) with their include statements shown:

```
svm.c:
    #include <svm.h>
    #include <opcodes.h>
sasm.c:
    #include <sasm.h>
    #include <opcodes.h>
svm_mem.c:
    #include <svm.h>
symtab.c:
    #include <sasm.h>
```

We have written a Makefile to build an executable named `sasm` out of sources `sasm.c` and `symtab.c`, and an executable named `svm` out of sources `svm.c` and `svm_mem.c`. Our Makefile uses `gcc` and minimizes the amount of re-compilation when anything changes. We do not show you our Makefile but nonetheless we ask you to answer the following questions. Assume we do not have any `.o` in the current directory.

Part 6 a [2 marks]: Which calls to `gcc` will be executed when we call `make sasm`?

Part 6 b [2 marks]: Which calls to `gcc` will be executed when we call `make svm`?

Part 6 c [2 marks]: After executing the previous two steps we now change the file `opcodes.h` and call `make all`. What will be recompiled?

Question 7 [8 marks]: Consider the following program:

```
#include <iostream.h>

template <class L, class R>
class Pair {
    L left_data;
    R right_data;
public:
    Pair() { }
    L& left() { return left_data; }
    R& right() { return right_data; }
};

void main () {
    Pair<int, double> a;
    a.left() = 1;
    a.right() = 2.7;
    cout << a.left() << " " << a.right() << endl;
}
```

This program when compiled and run outputs: 1 2.7

Part 7 a [2 marks]: Why do the methods `left` and `right` return references?

Part 7 b [2 marks]: Declare `b` to be a pair whose left component is a `char` and whose right component is a pair of `int` and `double`.

Part 7 c [2 marks]: Assign values to `b` such that it contains ('a', (4, 5.7)).

Part 7 d [2 marks]: The above defined template class `Pair` contains private data. Would it make any difference if the data were public? Why?

Question 8 [8 points]: This question is about C and C++. Consider the following C program.

```
#include <stdio.h>

enum Shape_kind {circle, square, triangle};

typedef struct {
    enum Shape_kind kind;
    double size;
} Shape;

void I_am (Shape *s) {
    printf ("I am a");
    switch (s->kind) {
        case circle:
            printf (" circle with radius %g.\n", s->size); break;
        case square:
            printf (" square with side %g.\n", s->size); break;
        case triangle:
            printf ("\n equilateral triangle with side %g.\n", s->size); break;
        default:
            fprintf(stderr, "Wrong shape kind\n");
            exit(1);
    }
}

void main () {
    Shape *p;
    Shape sa[3] = { {circle, 7}, {square, 11}, {triangle, 13} };
    for (p = &sa[0]; p < sa+3; p++)
        I_am(p);
}
```

This program produces the following output:

```
I am a circle with radius 7.
I am a square with side 11.
I am an equilateral triangle with side 13.
```

Rewrite this program into a C++ program that uses an abstract base class and appropriate classes derived from the base class such that the following main program produces the same output as the above C program.

```
void main () {
    Circle c(7);
    Square s(11);
    Triangle t(13);
    Shape *sa[3] = {&c, &s, &t};
    for (int i = 0; i < 3; i++)
        sa[i]->I_am();
}
```


Question 8 continued:

Question 9 [4 marks]: What is the output of the following program?

```
#include <iostream.h>

class A {
public:
    A (int i = 0)          { id = i; cout << "C " << id << endl; }
    ~A ()                 { cout << "D " << -id << endl; }
    A (const A& a)        { id = a.id+1; cout << "CC " << id << endl;}
    A& operator=(const A& a) { id = a.id*2; return *this; }
    int id;
};

A f(A x) {
    x.id += 2;
    return x;
}

A& g(A& x) {
    x.id += 3;
    return x;
}

int main () {
    A a(5), b(4), c(b), d(a);
    cout << "After construction\n";
    d = f(a);
    cout << "Just returned from f\n";
    c = g(b);
    cout << "Just returned from g\n";
}
```

Question 10 [5 marks]: How would you solve the following programming problem:

In a larger program, we have a file named `DataSource` open for reading. To the best of our knowledge, the size of the file can be large (megabytes). Many times in the program there is a need to test whether a pair of characters occurs on two neighboring bytes in the file.

You are not expected to write any actual code. Try to explain your solution in English.