

McGill University School of Computer Science COMP-202A Introduction to Computing 1

Midterm Exam

Thursday, October 26, 2006, 18:00-20:00 (6:00 – 8:00 PM)
Instructors: Mathieu Petitpas, Shah Asaduzzaman, Sherif Shaker

Student Name: _____

Student ID: _____

Your Section: Mathieu Petitpas (Sect 1) Shah Asaduzzaman (Sect 2) Sherif Shaker (Sect 3)

Instructions

- This is a 2-hour midterm
- No notebooks, calculators or textbooks permitted in this exam.
- Language translation dictionaries are permitted.
- You are permitted to write your answers in either English or French.
- Attempt all questions.
- Parts marks are given for all questions. Show your work and do not leave a question empty.
- Write all answers in the exam booklet provided.

Grading

| Section | Grade | Your Mark |
|---------|-------|-----------|
|---------|-------|-----------|

| | | |
|----------------------------|----|--|
| Section 1: Multiple Choice | 20 | |
|----------------------------|----|--|

| Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
|----|----|----|----|----|----|----|----|----|-----|
| | | | | | | | | | |

| | | |
|---------------------|----|--|
| Section 2: Problems | 45 | |
|---------------------|----|--|

| | | |
|------------------------|----|--|
| Section 3: Programming | 35 | |
|------------------------|----|--|

| | | |
|--------------|----------------|-------|
| Total | ----- 100 % | ----- |
|--------------|----------------|-------|

Section 1: Multiple Choice Questions (2 points each; 20 points total)

Please circle your answer on this page AND write it in the box provided on the cover page of this questionnaire.

1. Which of the following is TRUE about fetch and execute cycle?

In a fetch and execute cycle...

- a) One byte of data is read from the main memory and stored into the hard-disk
- b) One byte of program code is loaded in the CPU's arithmetic logic unit, and the code is executed
- c) One machine instruction is read from main memory into the CPU and the instruction is executed
- d) One arithmetic operation is executed
- e) None of the above

2. Computers can only understand numbers. How is an English word represented in computer memory?

- a) Each word is represented by a number equal to the number of letters in it
- b) Each letter in the alphabet is given a standard numeric code. Codes for each letter in the word are stored one after the other
- c) Each word in the dictionary is given a serial number based on its position in the dictionary
- d) Each letter has position number in the alphabet (A=1, C=3, Z=26). The sum of position numbers for all the letters represent the word in memory
- e) None of the above

3. Which of the following is FALSE about Java syntax?

- a) A Java program is a collection of classes
- b) For an integer variable a, `3 == a` is a valid Java expression
- c) A method can have more than one parameter but only one return value
- d) A variable can be declared outside a method in a Java program
- e) None of the above

4. What is the value of `x` after executing the following code fragment?

```
int a = 5, b = 6, c = 1;  
int x = (a > b ? a : (a < b ? b : c));
```

- a) 0
- b) 5
- c) 6
- d) 1
- e) None of the above

5. Which of the following assignment statements will cause a compilation error?

- a) `int i = 4 / 5;`
- b) `double d = 4 / 5;`
- c) `int i = 4 / 5.0;`
- d) `double d = 4 / 5.0;`
- e) `char c = (char)('A' + 3);`

6. Consider the following expression:

```
a = b && c + d * e <= f || g;
```

Which of the following expressions is equivalent to the one above:

- a) `a = ((b && ((c + d) * e) <= f) || g);`
- b) `a = ((b && (c + (d * e)) <= f) || g);`
- c) `a = (b && (((c + d) * e) <= f) || g);`
- d) `a = (b && ((c + (d * e)) <= f) || g);`
- e) `a = ((b && (c + d)) * (e <= (f || g)));`

7. Which of the following statements about control flow are FALSE:

- 1) A `while` loop always executes its body at least once.
- 2) If one of the cases inside a `switch` statement does not end with a `break` statement, control does not transfer at the end of the `switch` statement but instead transfers in the next case.
- 3) The initialization, condition, and increment part of a `for` loop are optional.
- 4) To put more than one statement inside the `else` clause of an `if-else` statement, one must use a block statement.
- 5) Control flow constructs (`if`, `if-else`, `while`, ...) cannot be nested.

- a) 1, 3
- b) 1, 5
- c) 2, 3
- d) 2, 4
- e) 3, 4

8. Which of the following statements about classes and methods are FALSE?

- 1) One of the purposes of a Java class is to serve as a model or blueprint for creating objects.
- 2) Methods can be defined outside of classes in Java.
- 3) Methods must declare a return type (either `void` or some other type).
- 4) Methods can optionally take parameters.
- 5) Constructors must declare a return type (either `void` or some other type).

- a) 1, 3
- b) 1, 5
- c) 2, 4
- d) 2, 5
- e) 3, 4

9. What is the minimum number of bits required to represent 70 unique items?

- a) 5 bits
- b) 6 bits
- c) 7 bits
- d) 8 bits
- e) None of the above

10. The following expression involves what kind of data conversion?

```
double d = (int) 3.0/4 + 6;
```

- a) Arithmetic promotion and casting
- b) Casting and assignment conversion
- c) Assignment conversion and arithmetic promotion
- d) Casting, arithmetic promotion and assignment conversion
- e) None of the above

Section 2: Problems (total 45 points)

1. (15 points) Consider the following program:

```
public class Confuse {
    public static void main(String[] args) {
        int n;
        double d;

1         n = 3;
2         while (n < 50) {
3             n = n * n;
            }

4         d = n / 2;
5         System.out.println("Result: " + n + d);

6         n = 24;
7         d = 0;
8         while (n > 0) {
9             if (n % 4 == 0) {
10                d += 6;
11                n--;
            } else {
12                d += d - 5;
13                n = n - 5;
            }
        }
14        System.out.println(d + n + " == result");
    }
}
```

Trace this program by writing down the list of the statements that will execute, in the order that they will be executed. Each statement must be included on your list exactly as many times as it is executed. Use the statement numbers to the left of each statement to indicate which statement is executed.

If a statement changes the value of a variable, you must indicate which variable it changes as well as the new value of the variable. If a statement is a control flow construct (`if` or `while`), indicate the boolean value (`true` or `false`) to which the boolean expression evaluates. Finally, if the statement is a call to the `println()` method, indicate what will be displayed on the screen.

To do this correctly, write your answer using a 2-column format. For each row, the first column will contain the line number of the statement being executed, and the second column will contain the following information, according to the type of the statement:

- If the statement is an assignment statement: the variable whose value is being changed, and its new value.
- If the statement is a control flow construct: the value to which the boolean expression controlling it

evaluates.

- If the statement is a call to the `println()` method: what is displayed on the screen.

2. (15 points) For each of the following conditions, write a boolean expression that evaluates to `true` if and only if the condition is true. You are not allowed to use any methods from the Java Platform API (that is, the Java standard library) to answer this question.

- a) The absolute value of variable `a` (of type `int`) is greater than 100.
- b) The values of variables `a`, `b`, and `c` are all different.
- c) The character stored in either variable `c1`, or variable `c2` (both of type `char`), or both, is a digit.
- d) The value stored in exactly one of the two variables `a` and `b` (both of type `int`) is equal to 0.
- e) The character stored in both variable `c1` and variable `c2` (both of type `char`) is a letter.

3. (15 points) Rewrite the program below and fix all the errors that are in it (compilation, logic and scope). If something compiles and is not a logical error, then do not fix it. Also indicate what the program outputs at the end once it has been fixed. Keep in mind that the output result depends on scoping rules.

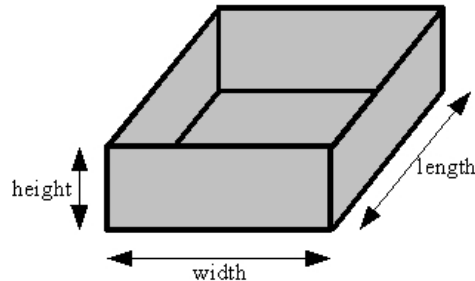
```
public class TaxCalculator {
    double tax;

    public double calculateTax (float salary) {
        if (salary <= 40000)
            double tax = salary * 0.3F;
        else
            if ((salary > 40000) && (salary <= 60000))
                tax = salary * 0.45;
            else {
                double tax = salary * 0.5;
                return tax;
            }
    }

    public static main(String args[ ]) {
        System.out.print ("Enter a number: ");
        double salary = Keyboard.readDouble();
        float tax = calcuateTax(salary);
        System.out.println ("Calculated tax : " + tax);
    }
}
```

Section 3: Programming (35 points)

A program needs to manipulate some cardboard boxes. Each box has 3 dimensions – height (h), width (w) and length (l), as depicted on the diagram below:



The program checks if one box can be contained in another box. Note that the tops of the boxes are open, so we cannot turn a box upside down, tilt it, or put it on its side. However, we can rotate a box, clockwise or counter-clockwise, on its bottom. Thus, a box with (w=10, h=4, l=6) fits in a box with (w=6, h=5, l=12). But a box with (w=5, h=10, l=6) does not fit inside a box with (w=10, h=5, l=6). Note that we ignore the thickness of the cardboard, so one box can be fitted inside another box of the same dimension.

(A) (20 points)

Write a class `Box` to represent box objects. This class should allow the initialization of each box using its three dimensions by a constructor. It should also allow construction of boxes without any parameters, in which case each of the dimensions will be set to 1.

The class should implement two other methods:

```
boolean canContain(Box otherBox)
```

This should check whether the `otherBox` can be fit into this box, according to the rules mentioned above and return `true` or `false` based on the answer.

```
int compareVolume(Box otherBox)
```

This method should compare the volume of this box with that of the `otherBox`. It should return a positive integer, 0 or negative integer, if the `otherBox` is smaller, equal or bigger in volume, respectively.

(B) (15 points)

Write another class called `BoxTester` that contains a `main()` method that will ask the user to create two boxes, A and B. The program will then test if A can be put into B and if B can be put into A. The program will display a message indicating which could and could not fit into each other. The program will then ask the user if they want to do this again. If the user answers Y, y, YES, yes, Yes (or any other case combination of these 1 or 3 letters) the program will repeat the test, otherwise the program will terminate.