The University of Western Ontario
London Canada
Department of Computer Science

CS026a – Computer Science Fundamentals I
Final Examination December 2004 (3 hours)

Complete the following (please print):

Last Name (Surname):_____

First Name(s): _____ **Student Number:**_____

Signature:_____

Please circle your lab:

005 Mon 9-11	010 Tues 9-11	016 Wed 1-3	020 Thurs 9-11	026 Fri 1-3
006 Mon 1-3	011 Tues 11-1		021 Thurs 11-1	
007 Mon 3-5	012 Tues 1-3		023 Thurs 1-3	
008 Mon 5-7	013 Tues 5-7			

Please carefully read the following:

The exam is composed of 165 marks in two parts. Part I has 70 multiple choice questions (worth one mark each), and Part II has questions that require written answers, which you will complete in the provided exam booklet (worth a total of 95 marks). There are 19 pages in the exam. Please ensure you have all pages.

- **CIRCLE** your answers for the multiple choice questions on this question paper **AND** mark your answers on the Scantron form.
- Write your answers to the written answer questions in the exam booklet.
- You **must** complete the Scantron form using a pencil and **completely** fill in the selected bubbles which represent your choices.
- Write your name, signature, and the course number in the spaces provided at the top of the Scantron form.
- Encode your student number with any leading zeros in the area indicated "Student Number".
- The approximate number of marks for each question is indicated. It is recommended that you work at approximately a one mark per minute pace.
- **NO REFERENCE MATERIALS ALLOWED. NO ELECTRONIC DEVICES ALLOWED.**

NO EXTRA TIME WILL BE GIVEN FOR COMPLETING THE SCANTRON FORM; IT MUST BE COMPLETED DURING THE 3-HOUR EXAM TIME.
SUBMIT the Scantron form, the entire exam question paper, and your booklet.

Question	Possible Marks	Achieved
I	70	
II.1	15	
II.2	20	
II.3	25	
II.4	15	
II.5	20	
TOTAL	165	

For your reference, the following from the Java String API is supplied:

indexOf

```
public int indexOf(String str)
```

Returns the index within this string of the first occurrence of the specified substring. The integer returned is the smallest value *k* such that:

```
this.startsWith(str, k) is true.
```

Parameters:

`str` - any string.

Returns:

if the string argument occurs as a substring within this object, then the index of the first character of the first such substring is returned; if it does not occur as a substring, `-1` is returned.

indexOf

```
public int indexOf(String str,
                   int fromIndex)
```

Returns the index within this string of the first occurrence of the specified substring, starting at the specified index. The integer returned is the smallest value *k* such that:

```
this.startsWith(str, k) && (k >= fromIndex) is true.
```

Parameters:

`str` - the substring to search for.

`fromIndex` - the index to start the search from.

Returns:

If the string argument occurs as a substring within this object at a starting index no smaller than `fromIndex`, then the index of the first character of the first such substring is returned. If it does not occur as a substring starting at `fromIndex` or beyond, `-1` is returned.

substring

```
public String substring(int beginIndex)
```

Returns a new string that is a substring of this string. The substring begins with the character at the specified index and extends to the end of this string.

substring

```
public String substring(int beginIndex,
                        int endIndex)
```

Returns a new string that is a substring of this string. The substring begins at the specified `beginIndex` and extends to the character at index `endIndex - 1`. Thus the length of the substring is `endIndex-beginIndex`.

PART I – MULTIPLE CHOICE

Select the best answer from the choices given. Select only ONE answer. Each question is worth 1 mark. Incorrect answers will not be penalized.

1. Java is
   a. a high level programming language
   b. an assembly programming language
   c. a machine programming language
   d. all of the above
   e. none of the above

2. The CPU
   a. is an IO device
   b. executes instructions
   c. provides persistent storage
   d. communicates information from the user to the computer
   e. none of the above

3. Which of the following is an operating system?
   a. Emacs
   b. Xemacs
   c. Windows XP
   d. Word Pad
   e. none of the above

4. Machine language is stored in
   a. pseudo code
   b. a high level language
   c. binary
   d. assembly language
   e. none of the above

5. Assembly language is machine independent because it
   a. is a representation of machine language
   b. is available on many machines
   c. can be stored in main memory
   d. can be written in pseudo code
   e. Assembly language is not machine independent.

6. A compiler
    a. translates high-level code into machine language code
    b. translates pseudo code into machine language code
    c. translates high-level code into assembly code
    d. translates executable code into machine language code
    e. none of the above

7. A file of Java bytecode contains
    a. machine code for IBM computers
    b. machine code for Apple computers
    c. source code
    d. pseudo code
    e. none of the above

8. Which of the following is ***not*** a Java keyword?
    a. import
    b. static
    c. public
    d. void
    e. none of the above, all are Java keywords

9. A file containing Java code has the header:
```
public class Question
```
The file in which the source code must be stored is
    a. Question.class
    b. Question.java
    c. Program.java
    d. classQuestion.java
    e. none of the above

10. A Java program contains the following:
```
/* Input */
```
This is
    a. an Input-Output statement
    b. an Input statement
    c. a method invocation
    d. a comment
    e. none of the above

11. The Java statement terminator is
    a. the end of line
    b. } (the "curly" bracket)
    c. . (the period or dot)
    d. ; (the semi-colon)
    e. none of the above

12. The body of a post-tested loop
    a. is executed at least once
    b. is executed at most once
    c. is executed zero or more times
    d. is never executed
    e. does not exist in programming

13. The body of a mid-tested loop
    a. is executed at least once
    b. is executed at most once
    c. is executed zero or more times
    d. is never executed
    e. does not exist in programming

14. The Java compiler determines syntax errors.
    a. true
    b. false

15. The Java arithmetic expression 21 % 5 + 3 evaluates to
    a. "21 % 5 + 3"
    b. 4
    c. 5
    d. 7.2
    e. none of the above

16. The Java arithmetic expression 99 % (3 + 2) evaluates to
    a. 19
    b. 19.8
    c. 5
    d. 4
    e. none of the above

17. Which of the following is ***not*** a Java primitive type:
    a. int
    b. float
    c. double
    d. long
    e. all of the above are primitive types

18. The Java arithmetic expression 99.0 / (3 + 2) evaluates to
    a. 19
    b. 19.8
    c. 5
    d. 4
    e. none of the above

19. What does the following Java statement output?

```
System.out.println(32+2+"is_the_answer");
```

(Note that a space is represented by _.)

a. 322is_the_answer
b. 34is_the_answer
c. 32+2+"is_the_answer"
d. 34+"is_the_answer"
e. none of the above

20. What does the following Java statement output?

```
System.out.println("The_answer_is"+32+2);
```

(Note that a space is represented by _.)

a. The_answer_ is322
b. The_answer_is_34
c. "The_answer_is"+32+2
d. "The_answer_is"+34
e. none of the above

21. The following Java statement:

```
final int ABC = 123;
```

a. declares an integer variable
b. defines an integer constant
c. is invalid syntax
d. does not follow Java conventions
e. none of the above

22. Java conventions should be followed

a. to make software errors (aka bugs) easier to find
b. to make code easier to correct
c. to make code easier to read
d. all of the above
e. none of the above

23. Given the following code segment, which type is the expression a/b?

```
int a = 7;
double b = 12.2;
```

a. int
b. double
c. boolean
d. a reference variable
e. none of the above

24. What is the value of the expression
```
(int) 41.3 / 2
```

a. 20.65
b. 20.5
c. 20
d. 21
e. none of the above

25. The following Java statement contains a syntax error
```
int courses = 5.5;
```

a. true
b. false

26. The following Java code segment contains a syntax error:

```
int height=0;
double weight=0;
height = weight + 2;
```

a. true
b. false

27. In Java, the boolean type is a reference type.
a. true
b. false

28. A for loop is
a. pre-tested and deterministic
b. post-tested and non-deterministic
c. pre-tested and non-deterministic
d. post-tested and deterministic
e. none of the above

29. A do-while loop is
a. pre-tested and deterministic
b. post-tested and non-deterministic
c. pre-tested and non-deterministic
d. post-tested and deterministic
e. none of the above

30. The keyword `static`, when used within a method definition, indicates that the method
a. requires an object to be invoked
b. cannot be invoked
c. does not require an object to be invoked
d. is not valid
e. none of the above

31. Top-down design
    a. can only be used with object-oriented design
    b. is a way to identify the required variables
    c. cannot be used with object-oriented design
    d. is used to decompose a problem into smaller sub -problems
    e. none of the above

32. Formal parameters are found in the
    a. method invocation
    b. method prototype
    c. method deconstructor
    d. method constructor
    e. none of the above

33. The Java statement
```
flowers++;
```
is equivalent to the Java statement
    a. `+flowers+;`
    b. `flowers = flowers + 1;`
    c. `flowers = flowers + 1 + 1;`
    d. there is a syntax error
    e. none of the above

34. If a method is overloaded, it means that the method
    a. is syntactically too complicated
    b. is logically too complicated
    c. has different versions depending on the number and type of the parameters
    d. requires an object to be invoked
    e. none of the above

35. A method prototype
    a. gives information about the method, including the parameters, name, and return type
    b. gives details regarding the implementation of the method
    c. must include a reference to an object
    d. all of the above
    e. none of the above

36. In object-oriented design, an object is composed of
    a. methods
    b. variables
    c. attributes and behaviours
    d. variables and constants
    e. none of the above

37. A Java object is
    a. an instance of a class
    b. a set
    c. a primitive variable
    d. all of the above
    e. none of the above

38. To invoke an instance method from a class other than the one in which it is defined, one must specify
    a. formal parameters
    b. local variables
    c. a reference to an object
    d. a constant
    e. none of the above

39. The instance variables of an object should be initialized by the
    a. constructor
    b. creator
    c. initializer
    d. declarer
    e. none of the above

40. An accessor method
    a. is a static method
    b. changes the value of an instance variable
    c. must invoke the constructor
    d. any of the above
    e. none of the above

41. The String method `toUpperCase()` is a
    a. mutator method
    b. static method
    c. programmer defined method
    d. all of the above
    e. none of the above

42. What exists after the following Java statements?

```
Date a;
Date b;
```

    a. two primitive variables
    b. two reference variables
    c. two objects
    d. b. and c.
    e. none of the above

43. What exists after the following Java statements?

```
Date now = new Date();
Date later = new Date();
```

a. two primitive variables
b. two reference variables
c. two objects
d. b. and c.
e. none of the above

44. How many objects are referenced after the following Java statements?

```
Date past = new Date();
Date present = new Date();
past = present;
present = new Date();
```

a. 0
b. 1
c. 2
d. 3
e. none of the above

45. How many objects are referenced after the following Java statements?

```
Rectangle field = new Rectangle(0,1,2,3);
Rectangle rink = new Rectangle(3,2,1,0);
Rectangle pitch = field;
```

a. 0
b. 1
c. 2
d. 3
e. none of the above

46. Two objects have state equivalence if the
a. attributes (characteristics) of the objects are the same
b. behaviours (methods) of the objects are the same
c. attributes (characteristics) of the objects are different
d. attributes (characteristics) are the same, but the behaviours (methods) of the objects are different
e. none of the above

47. Identity equivalence of objects implies state equivalence; that is, when one has identity equivalence, one also has state equivalence.
    a. true
    b. false
    c. only true for integers
    d. only false for integers
    e. none of the above

Consider the following Java switch statement to answer the next 4 questions:

```
switch(number) {
        case 99 : System.out.println(number + 99);
                  break;
        case -1 : System.out.println(number - 1);
                  break;
        default : System.out.println("here");
}
```

Assume that the variable number has been declared to be of type int .

48. If the variable number has the value 99, what output is produced by the switch statement?
    a. 99
    b. 198
    c. -1
    d. here
    e. none of the above

49. If the variable number has the value 50, what output is produced by the switch statement?
    a. 99
    b. 198
    c. -1
    d. here
    e. none of the above

50. If the variable number has the value -1, what output is produced by the switch statement?
    a. 99
    b. 198
    c. -1
    d. here
    e. none of the above

51. Suppose the two break statements are omitted.
What is the complete output if the variable number has the value 99?
    a. 99
    b. 198
    c. -1
    d. here
    e. none of the above

52. One wishes to output the contents of an integer variable if it has a value between 30 and 40, inclusive. Which of the following if conditions would test this?
    a. `if ( (number >= 30) && (number <= 40) )`
    b. `if ( (number >= 30) || (number <= 40) )`
    c. `if ( (number <= 30) && (number >= 40) )`
    d. `if ( (number <= 30) || (number <= 40) )`
    e. none of the above

53. Consider the string declaration:
```
String priceString = "$12.75";
```
To convert the dollar value to a double, the following code could be used:
    a. `double price = Double.parseDouble(priceString);`
    b. `double price = Integer.parseInt(priceString);`
    c. `double price = Double.parseDouble(priceString.substring(1));`
    d. `double price = priceString.toDouble();`
    e. none of the above

54. What is the output of the following code segment?
```
int number = 50, value = 0;
final int LIMIT = 100;

if (number > LIMIT)
if (number <= 2*LIMIT)
value = LIMIT;
else
value = LIMIT*2;

System.out.println(value);
```
    a. 0
    b. 50
    c. 100
    d. 200
    e. there is a syntax error

55. Which of the following values **cannot** be assigned to a Java boolean variable?
    a. true
    b. false
    c. 0
    d. all of the above
    e. none of the above

56. Which of the following is a Java statement that declares a variable of a primitive type?
    a. `Rectangle house;`
    b. `Rectangle house = new Rectangle();`
    c. `double weight;`
    d. `primitive height;`
    e. none of the above

57. What does the Java statement:
    `rental = new Car();`
    most likely do?
    a. declares a reference variable of type `Car` called `rental`
    b. creates a `Car` object and initializes it using the constructor that takes no parameters
    c. nothing. The statement is syntactically incorrect.
    d. declares a reference variable of type `rental` called `Car`
    e. none of the above

For the following 4 questions, consider modeling statistics for first year at UWO in an object oriented fashion.

58. Which of the following most likely would **not** be an appropriate attribute for an object of type Student?
    a. student's name
    b. name of the faculty in which the student is enrolled
    c. number of courses in which the student is enrolled
    d. the student drops a course
    e. none of the above

59. Which of the following most likely would be an appropriate behaviour of an object of type Student?
    a. student's name
    b. name of the faculty in which the student is enrolled
    c. number of courses in which the student is enrolled
    d. the student drops a course
    e. none of the above

60. Which of the following most likely would be another type of object, in addition to the Student type, when modeling statistics for first year at UWO?
    a. Instructor
    b. Course
    c. Faculty
    d. all of the above
    e. none of the above

61. Which of the following most likely would **not** be an appropriate behaviour of an object of type Student?
    a. student drops a course
    b. change the student's faculty
    c. change the student's name
    d. student adds a course
    e. none of the above

62. A method that returns a value must contain the following keyword:
    a. void
    b. return
    c. break
    d. public
    e. none of the above

63. To return two integers from a method, one could:
    a. return an object containing two integers
    b. use two parameters
    c. use two local variables
    d. any of the above
    e. none of the above

64. Which for statement header can be used to loop over the decades of the 20th century (i.e. 1900, 1910, ..., 1990)?
    a. for (int year = 1900; year <= 1990; year++)
    b. for (int year = 1900; year < 2000; year++)
    c. for (int year = 1900; year <= 1990; year=year + 10)
    d. for (int year = 1900; year <= 1990; year+10)
    e. none of the above

65. How many stars will this loop display?

```
for (int star = 9; star < 0; star++) {
        System.out.println("*");
}
```

    a. 8
    b. 9
    c. 10
    d. 0
    e. none of the above

66. What happens when a switch statement with no default case is entered with a value for which there is no case statement?
    a. there will be a syntax error
    b. there will be a runtime error
    c. the last case statement will be executed
    d. no case statement is executed and the program proceeds
    e. none of the above

Use the following statements for the next 4 questions:

```
Graph.display(x, y);
there.getLanguage();
```

67. Assuming that Java conventions are followed, what is `Graph`?
    a. a reference variable
    b. the name of a static method
    c. the name of a class
    d. a primitive variable
    e. the name of an instance method

68. Assuming that Java conventions are followed, what is `display`?
    a. a reference variable
    b. the name of a static method
    c. the name of a class
    d. a primitive variable
    e. the name of an instance method

69. Assuming that Java conventions are followed, what is `there`?
    a. a reference variable
    b. the name of a static method
    c. the name of a class
    d. a primitive variable
    e. the name of an instance method

70. Assuming that Java conventions are followed, what is `getLanguage`?
    a. a reference variable
    b. the name of a static method
    c. the name of a class
    d. a primitive variable
    e. the name of an instance method

PART II
PROVIDE WRITTEN ANSWERS TO THE FOLLOWING QUESTIONS IN THE BOOKLET PROVIDED

Comments are not required for any of the following code segments. However, you should follow Java naming conventions, and use the most appropriate programming structures (i.e. for loop vs. while loop). There are method prototypes for some String methods given on page 2 of this exam.

1. (15 marks) Design and write a Java static method for a class named PhysicsPhun (you may assume that the class is already defined) to calculate the speed of an object according to the following specifications:

    i. The *speed* of an object after *time* seconds of *acceleration* from an initial *velocity* can be calculated using the formula:
    `speed = velocity + (acceleration * time)`
    ii. the method must not perform any keyboard input, screen output or file I/O (input/output); that is, any required values must be passed as parameters
    iii. a real value, the speed, must be returned
    iv. time must be an integer value
    v. acceleration and initial velocity must be real values
    vi. it must be possible to invoke this method from outside of the PhysicsPhun class

2. (20 marks) Write a Java code segment that gets 10 integer values from the user, and reports the maximum value entered and the sum of all values. Your code should satisfy the following requirements:

    i. Prompt the user with a message.
    ii. The code segment should be part of the given main method. You may assume the existence of the code below. (You need not copy the given code into the booklet.)
    iii. Avoid repeated code by using appropriate programming structures.

```
import java.io.*;

public static void main(String[] args)
                                        throws Exception {

  BufferedReader keyboard = new BufferedReader(
          new InputStreamReader(System.in),1);
```

3. (25 marks) Write a Java method that satisfies the following specifications:

   i. it is a static method
   ii. its public visibility is explicitly declared
   iii. it has an appropriate name
   iv. it has one formal parameter, named appropriately, of type String
   v. it returns a reference to a String object that has the same state as the formal parameter except that all lower case vowels are deleted. (The set of vowels is defined as: {a, e, i, o, u, y})
   vi. Be sure to adhere to Java conventions.
   vii. Be sure to use a modular design. If necessary, write additional methods in order to implement a top down design.

   For example:

formal parameter	method returns
Western	Wstrn
Lord of The Rings	Lrd f Th Rngs
$88.99	$88.99

   Hint: See the String method prototypes given on page 2 of this exam.

For the next 2 questions, consider the following Java class Count.

```
public class Count {
    private int counter;

    public Count() {
        counter = 0;
    }

    public Count(int n) {
        counter = n;
    }

    public int getCounter() {
        return counter;
    }

    public void setCounter(int value) {
        counter = value;
    }

    public void display() {
        System.out.println(getCounter());
    }
    public void increment() {
        counter++;
    }

    public void decrement() {
        counter--;
    }

    public void increment(int howMuch) {
        counter = counter + howMuch;
    }

    public void decrement(int howMuch) {
        counter = counter - howMuch;
    }
}
```

4. (15 marks) Provide a trace (desk check) for the following code segment. Be sure to show all your work and the output of the code segment.

```
public class CountApp {

   public static void main(String[] args) {

      final int NUM_TIMES = 2;

      Count i = new Count();

      i.decrement();
      i.display();

      Count j = new Count(NUM_TIMES);

      j.decrement();
      j.display();
      i.decrement();

      j.increment();

      i.decrement(NUM_TIMES);

      i = j;

      i.display();
      j.display();
   }
}
```

5.

a) (10 marks) Write an instance method for the Count class in the previous question called stateEquals. The method must have, as its parameter, a reference to an object of type Count. The method will return true if the object invoking the method has the same state as the parameter object.

b) (10 marks) Write a static method for the Count class in the previous question called identityEquals. The method must have two parameters which are references to objects of type Count. The method will return true if the parameters refer to the same object.

Happy Holidays!!