The University of Western Ontario
Department of Computer Science

Computer Science 026a Midterm Exam - SOLUTIONS
October 27, 2007
2 hours

Print your name: _____

Student number: _____

Instructions:

- **Fill in your name and student number above immediately.**
- **On the Scantron form, fill in your name and signature in the spaces provided at the top. Encode your student number in the area indicated by STUDENT NUMBER.**
- You have 2 hours to complete the exam. **There will be NO extra time given to fill in the Scantron form at the end of the exam.**
- The exam is out of a possible 110 marks (Part 1 is out of 60, Part 2 is out of 50).
- **Part 1** of the exam consists of Multiple Choice questions. Circle your answers on this exam paper and fill in your answers on the provided Scantron form.
- **Part 2** consists of questions for which you will provide written answers: Write your answers in the spaces provided in this exam paper.
- The marks for each individual question are given. Allow approximately 1 minute per mark on average.
- There is a page for rough work at the very back of the exam. You may detach it if you wish, but hand it in with the rest of the exam paper.

Documentation concerning the methods you may need for the classes World, Turtle, Picture, Pixel, FileChooser and Color is provided at the back of the exam.

DO NOT TURN THIS PAGE UNTIL DIRECTED TO DO SO.

Part 2 Marks

1	
2	
3	
4	
5	
6	
7	
Total	

Part 1: Multiple Choice

Choose the best answer from the choices given. Choose only ONE answer. Each question is worth 1 mark unless otherwise indicated.

You may assume that there are no syntax errors intended in any of the code provided in the questions of Part 1.

1. A compiler will
   - **(a) find syntax errors**
   - (b) fix syntax errors
   - (c) find logic errors
   - (d) more than one of the above
   - (e) none of the above answers

2. An algorithm should be written
   - (a) in Java
   - (b) in machine language
   - (c) without syntax errors
   - **(d) in a natural language such as English**
   - (e) none of the above answers

3. In order to run a Java program,
   - (a) it must be compiled
   - (b) it must have a main method
   - (c) it must have at least one other method
   - **(d) exactly two of (a), (b), (c)**
   - (e) all of (a), (b), (c)

4. What will be displayed on the screen by the following code segment?

```
String word = "Hello";
System.out.println(word);
```

   - (a) word
   - **(b) Hello**
   - (c) "Hello"
   - (d) "Hello";
   - (e) none of the above

5. In the previous question, `println` is the name of a
   - (a) variable
   - **(b) method**
   - (c) class
   - (d) object
   - (e) none of the above

6. What will be output by the following Java statement?

```
System.out.println((double)(12/5));
```

(a) 2.4
(b) 2.0
(c) 2
(d) 2.5
(e) none of the above

7. What will be output by the following Java statement?

```
System.out.println((double)12/5);
```

(a) 2.4
(b) 2.0
(c) 2
(d) 2.5
(e) none of the above

8. What will be output by the following Java statement?

```
System.out.println((int)(12.0/5));
```

(a) 2.4
(b) 2.0
(c) 2
(d) 2.5
(e) none of the above

9. What will be output by the following Java statement?

```
System.out.println((int)12.0/5);
```

(a) 2.4
(b) 2.0
(c) 2
(d) 2.5
(e) none of the above

10. (2 marks) Suppose we have defined

```
int m = 18, n = 4;
```

The value of the expression `m / n + m % n` is

(a) 6.5
(b) 6
(c) 6.0
(d) 100
(e) none of the above

11. (2 marks) Suppose we have defined

```
int n = 4;
double x = 2.5;
```

The value of the expression `5 * x – n / 5` is

(a) 12.5
(b) 11.7
(c) 1.7
(d) 11.5
(e) none of the above

12. Suppose we have defined

```
int num1 = 50, num2 = 50;
```

The value of the expression `(num1 == num2)` is

(a) true
(b) false
(c) 50
(d) 0
(e) none of the above

13. What will be printed by the following statement?

```
System.out.println("x\\y");
```

(a) x\\y
(b) x\y
(c) xy
(d) this statement will not compile
(e) none of the above answers

14. (2 marks) What will be the value of x after the following code segment is executed?

```
int x = 3;
x = x + x;
x = x + x;
```

(a) 3
(b) 6
(c) 9
(d) 12
(e) none of the above

15. (2 marks) What will be the value of y after the following code segment is executed?

```
int x = 3,  y = 5;
x = y;
y = x;
```

(a) 3
(b) 5
(c) 6
(d) 10
(e) none of the above

Consider the following Java program for the next 9 questions (you may assume it compiles):

```
public class Midterm {
    public static void main (String [] args) {
      final int SIZE = 10;
      int num = 75;
      World w1 = new World();
      Turtle t1 = new Turtle(w1);
      t1.forward(num);
      t1.drawSquare(SIZE);
    }
 }
```

16. The identifier `Midterm` in the above code is the name of
    (a) a method
    (b) an object
    (c) a class
    (d) a file
    (e) none of the above

17. The Java keyword `void` in the above code means that
    (a) the method `main` has no parameters
    (b) the method `main` returns the integer 0
    (c) the method `main` returns the keyword `null`
    (d) the method `main` returns nothing
    (e) none of the above

18. Which of the following statements is/are true about the method `main` in the above code?
    (a) It is a class method.
    (b) It is an object method.
    (c) It is executed by using the statement `Midterm.main();`
    (d) Exactly two of (a), (b), (c)
    (e) None of the above answers

19. The identifier `num` in the above code is a
    (a) reference variable
    (b) variable of primitive type
    (c) constant
    (d) name of a method
    (e) none of the above

20. The identifier `SIZE` in the above code is a
    (a) reference variable
    (b) variable of primitive type
    (c) constant
    (d) name of a method
    (e) none of the above

21. The identifier `w1` in the above code is a
    - **(a) reference variable**
    - (b) variable of primitive type
    - (c) constant
    - (d) name of a method
    - (e) none of the above

22. Which of the following statements is/are true about the keyword **`new`** in the above code?
    - (a) It refers to the current object.
    - (b) It is the name of a method.
    - (c) It is the name of a variable.
    - **(d) It creates a new object.**
    - (e) More than one of the above statements are true.

23. Which of the following in the above code is/are parameters to methods?
    - (a) num
    - (b) w1
    - (c) t1
    - **(d) exactly two of (a), (b), and (c)**
    - (e) all of (a), (b), and (c)

24. Which of the following in the above code is/are object methods?
    - (a) World
    - (b) Turtle
    - **(c) forward**
    - (d) exactly two of (a), (b), and (c)
    - (e) all of (a), (b), and (c)

25. Suppose we have an array declared by
    ```
    int [] intArr = {2,4,6,8,10};
    ```
    What value is stored in `intArr[1]` ?
    - (a) 1
    - (b) 2
    - **(c) 4**
    - (d) 0
    - (e) none of the above

26. How can we refer to the last element in the array of the previous question?
    - (a) intArr[10]
    - (b) intArr[intArr.length]
    - **(c) intArr[intArr.length – 1]**
    - (d) intArr[0]
    - (e) none of the above

27. (2 marks) Suppose we want to store the value 100 in each of the elements of the array `intArr2` declared by:

```
int [] intArr2 = new int[12];
```

Which of the following `for` loops would do this correctly?

(a)
```
for (int k = 1; k <= 12; k++)
    intArr2[k] = 100;
```

(b)
```
for (int k = 0; k <= 12; k++)
    intArr2[k] = 100;
```

(c)
```
for (int k = 1; k <= 11; k++)
    intArr2[k] = 100;
```

(d)
```
for (int k = 0; k <= 11; k++)
    intArr2[k] = 100;
```

(e) none of the above

28. In the previous question, `intArr2` is a
    (a) reference variable
    (b) variable of primitive type
    (c) constant
    (d) name of a method
    (e) none of the above

Consider the following code segment. Use it to answer the next 4 questions.

```
int n1, n2 = 0;
double x = 12.34;
String test;
World w1 = new World();
Turtle t1 = new Turtle(w1);
Turtle t2 = t1;
```

29. How many variables are declared in this code segment?
    (a) 0
    (b) 5
    (c) 6
    (d) 7
    (e) none of the above
30. How many objects are created in this code segment?
    (a) 0
    (b) 1
    (c) 2
    (d) 3
    (e) none of the above

31. The variables `t1` and `t2` in the above code segment refer to different objects of the Turtle class.
    (a) True

(b) False

32. Which if the following is/are true about the variable `test` in the above code?
    (a) It is of a primitive data type.
    (b) It is initialized to zero (0).
    (c) It is initialized to null.
    (d) More than one of the above
    (e) None of the above answers

Use the following Java code segment for the next 4 questions.

```
Picture picture = new Picture(getMediaPath("caterpillar.jpg"));
Pixel [] pixelArray = picture.getPixels();
int value = 0;
int count = 0;
while (count < pixelArray.length)
{
    pixelArray[count].setRed(value);
    pixelArray[count].setBlue(value);
    pixelArray[count].setGreen(value);
    count = count + 1;
}
picture.show();
```

33. (2 marks) Which of the following statements most correctly describes what the above code does to the Picture object referenced by `picture`?
    (a) It makes all the pixels be white.
    (b) It makes all the pixels be gray.
    (c) It makes all the pixels be black.
    (d) It does not change the color of any of the pixels.
    (e) None of the above

34. The variable `pixelArray` in the above code refers to
    (a) a Picture object
    (b) a Pixel object
    (c) a one-dimensional array
    (d) a two-dimensional array
    (e) none of the above

35. The number of pixels in the Picture object referenced by `picture` in the above code is the value
    (a) pixelArray.length()
    (b) pixelArray.length
    (c) pixelArray[length]
    (d) pixelArray[length – 1]
    (e) none of the above

36. The above code segment changes the image stored in the file *caterpillar.jpg.*
    (a) True
    (b) False

37. (3 marks) What will be output by the following code segment?

```
int sum = 0;
int count = 1;
while (count < 5)
{   sum = sum + count;
   count = count + 2;
}
System.out.println(sum);
```

    (a) 10
    (b) 15
    (c) 4
    (d) 9
    (e) none of the above

38. (3 marks) What will be output by the following code segment?

```
int sum = 0;
int count = 5;
while (count >1)
{
    sum = sum + count;
    count = count + 2;
}
System.out.println(sum);
```

    (a) 10
    (b) 15
    (c) 4
    (d) 9
    (e) none of the above

39. (2 marks) What will be output by the following code segment?

```
Picture pic1 = new Picture(100,100);
Picture pic2 = new Picture(200,200);
pic2 = pic1;
System.out.println(pic2.getHeight());
```

    (a) 100
    (b) 200
    (c) 300
    (d) 400
    (e) none of the above

40. (3 marks) Suppose we have the following method defined in the Turtle class:

```
public void someMove(int length)
{
    this.forward(length);
    this.turnRight();
}
```

Suppose we have the following sequence of statements executed in the Interactions pane:

```
World w1 = new World();
Turtle t1 = new Turtle(100,100,w1);
t1.someMove(25);
System.out.println(t1.getXPos() + " " + t1.getYPos());
```

What will be output when the above code sequence is executed?

(a) 100 25
(b) 100 75
(c) 25 100
(d) 75 100
(e) none of the above

41. (2 marks) Consider the following code segment:

```
Picture picture = new Picture(getMediaPath("caterpillar.jpg"));
int x = 0;
int y = picture.getHeight() – 1;
Pixel pixel = picture.getPixel(x,y);
```

The location of the pixel referenced by the variable `pixel` is:

(a) at the top left of the picture
(b) at the top right of the picture
(c) at the bottom left of the picture
(d) at the bottom right of the picture
(e) none of the above

42. The statement that would change the color of the pixel of the previous question to black is

(a) Pixel.setColor(java.awt.Color.BLACK);
(b) pixel.setColor(java.awt.Color.BLACK);
(c) pixel.color = java.awt.Color.BLACK;
(d) picture.setColor(x,y, java.awt.Color.BLACK);
(e) none of the above

43. Consider the following code segment, assuming that the method with the header `public void copyPictureTo(Picture sourcePicture, int xstart, int ystart)` has been added to the Picture class:

```
Picture pic1 = new Picture(900,900);
Picture pic2 = new Picture(FileChooser.pickAFile());
pic1.copyPictureTo(pic2,100,100);
```

When this code segment is executed, the picture referenced by `pic1` will be copied onto the picture referenced by `pic2`, with the top left corner of the picture of `pic1` at (100,100) of the picture of `pic2`.

(a) True
(b) False

44. (3 marks) What will be output by the following code segment?

```
for (int row = 1; row <= 3; row ++)
{
    for (int count = 1; count <= (4 – row); count ++)
    {
      System.out.print(“*”);
     }
   System.out.println();
}
```

(a)
```
*
**
***
```

(b)
```
***
**
*
```

(c)
```
***
***
***
```

(d)
```
*
*
*
```

(e) none of the above

Part 2: Write your answers in the spaces provided below each question.

1. (7 marks) Consider the following Java code segment:

```
String item = new String("Book");
double price = 100.0;
double taxRate = 0.10;
System.out.println(taxRate);
double finalPrice = price + price*taxRate;
System.out.println("Book price before tax: " + price);
System.out.println("Book price after tax: " + finalPrice);
System.out.print("Tax paid: ");
System.out.println(price*taxRate);
```

What does this code segment print to the screen?

0.1 // 1 mark
Book price before tax: 100.0 // 2 marks
Book price after tax: 110.0 // 1 mark
Tax paid: 10.0 // 3 marks

2. (5 marks) The following Java code segment makes use of a `while` loop to compute the sum of all numbers between 1 and 100 that are divisible by 3. In the space provided, you should change it to do the same thing but use a `for` loop.

```
int sum = 0;
int i = 3;
while (i < 100)
{
   sum = sum + i;
   i = i + 3;
 }
```

```
int sum = 0;
for (int i = 3; i < 100; i = i + 3)
   sum = sum + i;
```

3. (10 marks) Recall the Turtle World examples from class, labs and Assignment 1. Provide a sequence of Java statements that will create a new world and a new turtle within that world, and will then instruct the turtle to create a block character of the letter U, for which the left hand and right hand sides are each 50 units high and the bottom line is 30 units wide. You only need to provide the statements required to do this in the Interactions pane of DrJava; you do not need to contain these statements within methods or a program. *The turtle should start and end at the same point, facing in the same direction as it started.*

World w = new World(); // 2 marks for first 2 statements
Turtle t = new Turtle(w);
t.turn (180); // 5 marks to draw letter U
t.forward(50);
t.turnLeft();
t.forward(30);
t.turnLeft();
t.forward(50);
t.turnLeft();
t.penUp(); // 3 marks to get turtle back to original position
t.forward(30);
t.turnRight();

Note: There are many other possible solutions to this question.

4. (5 marks) Suppose that the method drawSquare() has been implemented in the Turtle class as follows:

```
public void drawSquare(int sideLength)
{
  this.penDown();
  for (int k = 1; k <= 4; k++ )
  {
    this.turnLeft();
    this.forward(sideLength);
  }
}
```

Provide a sequence of Java statements that will create a new world and a new turtle within that world, and will then instruct the turtle to draw a square with sides of length 50, move forward by 20 units, and draw another square with sides of length 20.

World w = new World(); **//** 1 mark for first 2 statements
Turtle t = new Turtle(w);
t.drawSquare(50); // 2 marks
t.forward(20); // 1 mark
t.drawSquare(20); // 1 mark

5. (8 marks) The following Java method added to the Picture class is intended to change the green in the picture by the amount passed in as the parameter. It has several logic errors. (The code compiles correctly, but does not behave as expected when it is run.) Correct each error; there is at most one error in a line. In the space below the method, write the *line number* for each line with an error, and then *rewrite the line with the correction made*. (Line numbers are to the left of each line of code.)

```
1     public void changeGreen(double amount)
2     {
3           Pixel[] pixelArray = this.getPixels();
4           Pixel pixel = null;
5           int value = 0;
6
7           //loop through all the pixels
8           for (int i = 0; i <= pixelArray.length; i++)
9           {
10                // get the current pixel
11                pixel = pixelArray[value];
12
13                //get its green value
14                value = pixel.getGreen();
15
16                //change the green value
17                value = (int) (value * amount);
18
19                //set the new green value
20                pixel.setGreen(i);
21
22                i = i + 1;
23          }
24    }
```

Error in Line number **Correction**

8 **for (int i = 0; i < pixelArray.length; i++)**

11 **pixel = pixelArray[i];**

20 **pixel.setGreen(value);**

22 **nothing (leave it out)**

(2 marks each)

6. (4 marks) The following Java method added to the Picture class changes a picture to grayscale. This is done in *row order* i.e., the rows are done one by one. How would you change the code to use *column order*, i.e. so that the columns are done one by one? You do not need to rewrite the whole method; in the space provided below, write the *line number* for each line that needs to be changed, and then *rewrite the line with the changes made*. (Line numbers are to the left of each line of code.)

```
1     public void grayscale()
2     {
3        int intensity = 0;
4        Color color = null;
5        Pixel pixel = null;
6
7        for (int y = 0; y < this.getHeight(); y++)
8        {
9           for (int x = 0; x < this.getWidth(); x++)
10          {
11           //get the current pixel
12           pixel = this.getPixel(x,y);
13
14           //get the current color
15           color = pixel.getColor();
16           //convert to grayscale
17           intensity = (int) ((pixel.getRed()+
18                       pixel.getGreen()+ pixel.getBlue())/3);
19           pixel.setColor(new Color(intensity,intensity,intensity));
20
21          }
22       }
23    }
```

Line number	**Changed Line**
7	**`for (int x = 0; x < this.getWidth(); x++)`**
9	**`for (int y = 0; y < this.getHeight(); y++)`**

(2 marks each)

7. (11 marks) The following Java method added to the Picture class changes a picture to its negation. Suppose that we want to modify the method so that it takes four integer parameters `startX, startY, endX,` and `endY,` where `startX`, `startY` are the coordinates of the position that the negation should start with, and `endX`, `endY` are the coordinates of the position where negation ends. This means that only a part of the picture will be negated by this method. You should modify the provided method to support this. There are **exactly three** lines that need to be changed. In the space provided below, write the *line number* for each line that needs to be changed, and then *rewrite the line with the changes made*. (Line numbers are to the left of each line of code.)

```
1  public void negate()
2    {
3    Color color = null;
4    Pixel pixelObj = null;
5
6    //loop through the rows
7    for (int y = 0; y < this.getHeight(); y++)
8    {
9         // loop through the columns
10        for (int x = 0; x < this.getWidth(); x++)
11        {
12          pixelObj = this.getPixel(x,y);
13
14          int redValue = pixelObj.getRed();
15          int greenValue = pixelObj.getGreen();
16          int blueValue = pixelObj.getBlue();
17
18          pixelObj.setColor(new Color( 255-redValue,
19                                       255-greenValue,
20                                       255-blueValue));
21
22        }
23    }
24  }
```

Line number: __1___ (5 marks)

public void negate(int startX, int startY, int endX, int endY)

Line number: __7___ (3 marks)

for (int y = startY; y <= endY; y++) **//** or **y < endY**

better solution**: for (int y = startY; y <= endY && y < this.getHeight(); y++)**

Line number: __10__ (3 marks)

for (int x = startX; x < = endX; x++) **//** or **x < endX**

better solution**: for (int x = startX; x < = endX && x < this.getWidth(); x++)**