

**CIS 110 — Introduction to Computer Programming
Summer 2016 — Midterm**

Name: _____

Recitation # (e.g., 201): _____

Pennkey (e.g., paulmcb): _____

My signature below certifies that I have complied with the University of Pennsylvania's Code of Academic Integrity in completing this examination.

Signature

Date

Instructions:

- **Do not open this exam until told by the proctor.**
You will have exactly 60 minutes to finish it.
- **Make sure your phone is turned OFF (not to vibrate!) before the exam starts.**
- Food, gum, and drink are strictly forbidden.
- **You may not use your phone or open your bag for any reason**, including to retrieve or put away pens or pencils, until you have left the exam room.
- This exam is *closed-book, closed-notes, and closed-computational devices*.
- If you get stuck on a problem, it may be to your benefit to move on to another question and come back later.
- All code must be written out in proper java format, including all curly braces and semicolons.
- Do not separate the pages. If a page becomes loose, - re attach it with the provided staplers.
- Staple all scratch paper to your exam. Do not take any sheets of paper with you.
- If you require extra paper, please use the backs of the exam pages or the extra pages provided at the end of the exam. **Clearly indicate on the question page where the graders can find the remainder of your work (e.g., "back of page" or "on extra sheet").**
- Use a pencil, or blue or black pen to complete the exam.
- If you have any questions, raise your hand and a proctor will come to answer them.
- When you turn in your exam, you may be required to show ID. **If you forgot to bring your ID, talk to an exam proctor immediately.**
- We wish you the best of luck.

Scores: [For instructor use only]

Question 1		9 pts
Question 2		12 pts
Question 3		10 pts
Question 4		9 pts
Question 5		15 pts
Total:		55 pts

1.) MISCELLANEOUS (9 pts total)**1.1) (1 point)** The Easy One:

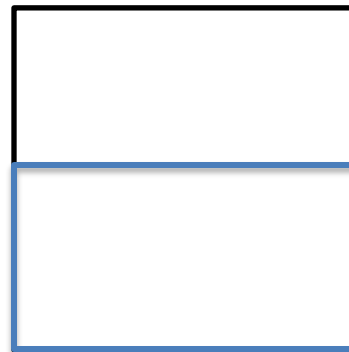
- Check that your exam has all **10** pages (excluding the cover sheet).
- Write your name, recitation number, and PennKey (username) on the front of the exam.
- Sign the certification that you comply with the Penn Academic Integrity Code.

1.2) (2 points) In the space provided, draw what the result of running the following code fragment in PennDraw would be:

```
PennDraw.drawRectangle(.5, .25, .5, .25);  
PennDraw.drawLine(1.5, .5, 1.0, 1.0);
```

Note: color doesn't matter. Use any writing utensil

Only the rectangle was in the frame. The line is out of frame and therefore not drawn (no points were lost if you the line outside the frame)

**1.3) (2 points)** How many times would this code fragment print the text “Hello World”?

```
for (int i = 11/2; i >= 0; i -= 5;) {  
    System.out.println("Hello World");  
}
```

- A. Zero (0)
- B. One (1)
- C. Two (2)

D. None, this is invalid Java code

Note: you received 1 point if you selected 2. However, the semicolon after the statement highlighted in red is an error.

1.5) (2 points) `int x = 3+(int)(3.99)*2;`

What does x equal after this statement?

- A. Nine (9)**
- B. Eleven (11)
- C. Twelve (12)
- D. Fourteen (14)

1.4) (2 points) The result of evaluating

$$4 / 3 + 5 * 2 / 3 = \underline{4}$$

2.) OPERATORS AND EXPRESSIONS (12 points total)

For each code fragment, (a) fill in the most appropriate data type in the 1st column and (b) give the value that z contains after the code has been executed in the 2nd column.

If the code would result in an error, write “ERROR” in the 1st column and give the reason for the error in the 2nd column (you do not need to write the exact error message, just a general explanation). The first two problems have been completed for you.

<pre> _____ z = 11; z++; </pre>	int	12
<pre> int x = "Hello World"; _____ z = x.length; </pre>	ERROR	Int X cannot be set to a string
<pre> int x = 5; int y = 3; _____ z = x / y * 2.0; </pre>	double	2.0
<pre> char a = 97; _____ z = a++; </pre>	char (int was accepted)	98, or 'b' (97 as a char equals 'a'. Either answer was acceptable)
<pre> int[] x = { 2, 1, 3, 0 }; _____ z = x; x[x[0]++]++; </pre>	int[]	{3,1,4,0} - This question was thrown out because this relied on understanding the order ++ is executed in relative to other operations. We didn't cover that in class, so for fairness, no one lost points here.

<pre> _____ z = 5.5; z %= 4.0; </pre>	double	1.5
<pre> _____ z == true; </pre>	ERROR	There is nothing you can put in the blank (certainly not boolean) that will make this statement work.
<pre> String str = "Midterm"; _____ z = str + 5; </pre>	String	"Midterm5"

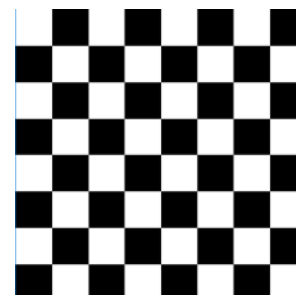
3.) CONDITIONALS AND LOOPS (10 points total)

The code fragment below contains four blanks, labeled A, B, C, D, and E. Fill in the blanks to make the chessboard image shown on the right. Note that it must match the image as much as possible. Pay special attention to the corner tiles:

```

for( _____ A _____ {
    for( _____ B _____ {
        if ((i+j)%2 _____ C _____ 0){
            PennDraw.setPenColor(PennDraw.BLACK);
        }
        else{
            PennDraw.setPenColor(PennDraw.WHITE);
        }
        double xCenter = _____ D _____ ;
        double yCenter = _____ E _____ ;
        PennDraw.filledRectangle(xCenter, yCenter, 0.5/8, 0.5/8);
    }
}

```



Note that there were multiple acceptable answers here. This is only 1 such answer.

Blank A: (int i=0; i<8; i++)

Blank B: (int j=0; j<8; j++)

Blank C: ==

Blank D: (i+0.5)/8.0

Blank E: (i+0.5)/8.0

4) Tracing a Loop (9 points)

Consider the follow code fragment that contains a nested loop. Use this code fragment to answer the following questions. The next page is blank and may be used for notes.

```
int[] x = {0,0,0,0,0,0,0,0};
for (int i=1; i<x.length; i*=2){ //outer loop
    for (int j=i; j<x.length; j++){ //inner loop
        x[i]++;
        x[j]++;
    }

    //Print array
    for(int j=0; j<x.length; j++){
        System.out.print(x[j]+",");
    }
    System.out.println();
}
System.out.println("exit");
```

How many times will the outer loop execute? _____

Write what will be printed line by line from this code fragment. Remember that “System.out.println();” prints a line break, meaning the next piece of text will appear on the next line.

[line1] 0,8,1,1,1,1,1,1,

[line2] 0,8,8,2,2,2,2,2,

[line3] 0,8,8,2,7,3,3,3,

[line4] exit

[line5]

[line6]

[line7]

5.) 2D Arrays + Testing (15 points)

You are tasked with writing a function using test driven development that transposes a matrix, represented as a 2D integer array. An example of transposing a matrix is below:

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix} \quad A^T = \begin{pmatrix} 1 & 3 & 5 \\ 2 & 4 & 6 \end{pmatrix}$$

Your function should return a new 2D integer array, without doing anything that changes the values of the original input array. Your function should check the following:

- 1) That the input array isn't empty.
- 2) That every row in the input array has the same number of columns

If either of these conditions fail, then you should print an error and return an empty array.

5.1) Method declaration (2 points)

Write the method declaration here. Circle the parts of the method declaration that make up the *method signature*:

(note: underlined sections are part of the signature)

```
public static int[][] transpose ( int[][] inputArray)
```

5.2) Tests (3 points)

Write simple tests with the goal of testing both a normal execution, and abnormal execution below. Do not just copy the example above. Your goal is to have coverage as discussed in class. You may write your input and output matrices as they are in the picture above. **You do not have to write them as they would appear in Java.**

If you need more space, use the blank page AFTER 6.3 (page 8)

Tests in this case were evaluated on two things: example input and expected output.

For example, an empty input matrix should generate expected output of an empty matrix.

An example of proper execution can be shown above in the picture given for this assignment.

For coverage, we were looking for 1 input of ideal execution, 1 input of an empty input matrix, and 1 input of an unequal rows array, as well as the correct expected output for those inputs.

5.3) (10 points) Write the code of the function on this page. You may use the next blank page as needed.

DO NOT PRINT the new array. Rather your function should return the array.

```
public static int[][] transposeMatrix(int[][] matrix){

    if ((matrix.length > 0) && (matrix[0].length > 0)){ //matrix isn't empty
        int firstRowLength = matrix[0].length; //get first row length
        //this is to ensure rows are all equal length
        int[][] transpose = new int[matrix[0].length][matrix.length];
        //create return matrix

        for(int i=0; i<matrix.length; i++){ //loop throw columns
            if(matrix[i].length != firstRowLength){
                //row isn't the same size as expected
                System.out.println("Unequal row lengths");
                return new int[0][0]; //return empty matrix

            } //row is equal length

            for(int j=0; j<matrix[0].length; j++){
                transpose[j][i] = matrix[i][j];
                //transpose values into return matrix
            }
        }

        return transpose;

    }

    else{//matrix is empty
        System.out.println("Matrix is empty");
        return new int[0][0]; //return empty matrix
    }
}
```