

Beijing National Day School  
Department of Mathematics

AP Computer Science A  
Semester 1 Exam

English Name: \_\_\_\_\_

Pinyin Name: \_\_\_\_\_

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**Exam Record**

Multiple Choice \_\_\_\_\_ / 40 pts

Free Response \_\_\_\_\_ / 18 pts

Total: \_\_\_\_\_ / 58 pts

Grade: \_\_\_\_\_

**Section I: Multiple Choice** (40 points)

- Number of questions: 40. Percent of total grade: 69%.
- Determine the answer to each of the following questions, using the available space for any necessary scratchwork.
- Decide which is the best of the choices given, and select the correct answer by filling in the corresponding bubble on the separate answer sheet.
- Assume that the classes in the **Java Quick Reference** have been imported where needed.
- Assume that variables and methods are declared within the context of an enclosing class.

**Variables**

- (1<sup>pt</sup>) 1. What does the following code segment print to the display? 1 pt
- `System.out.println(2 % 3);`
- A 2  
 B 0  
 C 3  
 D 1
- (1<sup>pt</sup>) 2. What does the following code segment print to the display? 1 pt
- `System.out.println(19 % 5);`
- A 3  
 B 0  
 C 4  
 D 1
- (1<sup>pt</sup>) 3. What does the following code segment print to the display? 1 pt
- `System.out.println(1 / 3);`
- A 0.3333333333333333  
 B 0  
 C It will give a run-time error.  
 D 0.3
- (1<sup>pt</sup>) 4. Which of the following is the decimal value for the binary number 1001011? 1 pt
- A 75  
 B 67  
 C 150  
 D 43

(1<sup>pt</sup>) 5. What are the values of x, y, and z after the following code executes?

```
int x = 3;
int y = x;
int z = x * y;
x++;
```

1 pt

- A x = 3, y = 3, z = 9  
 B x = 4, y = 3, z = 9  
 C x = 0, y = 3, z = 0  
 D x = 4, y = 4, z = 9

### Strings

(1<sup>pt</sup>) 6. Given the following code segment, what is in the string referenced by s1?

```
String s1 = "xy";
String s2 = s1;
s1 = s1 + s2 + "z";
```

1 pt

- A xyz  
 B xyxyz  
 C xy z  
 D z

(1<sup>pt</sup>) 7. What is the value of pos after the following code segment executes?

```
String s1 = "ac ded ca";
int pos = s1.indexOf("d");
```

1 pt

- A 3  
 B 4  
 C 5  
 D -1

(1<sup>pt</sup>) 8. What is the value of s3 after the following code segment executes?

```
String s = "Georgia Tech";
String s1 = s.substring(0, 7);
String s2 = s1.substring(2);
String s3 = s2.substring(0, 3);
System.out.println(s3);
```

1 pt

- A org  
 B eor  
 C eorg  
 D orgi

(1<sup>pt</sup>) 9. Consider the following method:

```
public static String scramble(String word, int howFar)
{
    return word.substring(howFar+1,word.length()) + word.substring(0,howFar);
}
```

1 pt

What value is returned as a result of the call `scramble("compiler", 3)`?

- A "compiler"
- B "pilercom"
- C "ilercom"
- D "ilercomp" will be thrown.

(1<sup>pt</sup>) 10. Consider the following method:

```
public String mystery(String input)
{
    String output = "";
    for (int k = 1; k < input.length(); k = k+2)
    {
        output += input.substring(k, k+1);
    }
    return output;
}
```

1 pt

What value is returned as a result of the call `mystery("computer")`?

- A "computer"
- B "cmue"
- C "optr"
- D "ompute" is thrown.

### Conditionals

(1<sup>pt</sup>) 11. What does the following code segment print, when x has been set to 187?

```
if (x < 0)
    System.out.println("x is negative");
else if (x == 0)
    System.out.println("x is zero");
else
    System.out.println("x is positive");
```

1 pt

- A x is negative
- B x is zero
- C x is positive
- D x is irrational

(1<sup>pt</sup>) 12. What is the value of `grade` when the following code segment executes, and `score` is 80?

```
if (score >= 90)
    grade = "A";
if (score >= 80)
    grade = "B";
if (score >= 70)
    grade = "C";
if (score >= 60)
    grade = "D";
else
    grade = "E";
```

1 pt

- A A  
 B B  
 C C  
 D D

(1<sup>pt</sup>) 13. What is printed when the following code segment executes, and we have `x = 4` and `y = 3`?

```
if (!(x < 3 || y > 2))
    System.out.println("first case");
else
    System.out.println("second case");
```

1 pt

- A first case  
 B second case  
 C first second case  
 D It will give a run-time error.

(1<sup>pt</sup>) 14. Which of the following choices is equivalent to the code segment below?

```
if (x > 2)
    x = x * 2;
if (x > 4)
    x = 0;
```

1 pt

- A `x = 0;`  
 B `if (x > 2) x *= 2;`  
 C `if (x > 2) x = 0;`  
 D `if (x > 2) x = 0; else x *= 2;`

(1<sup>pt</sup>) 15. Which of the following choices is equivalent to the code segment below?

```
if (x > 0)
    x = -x;
if (x < 0)
    x = 0;
```

1 pt

- A x = 0;  
 B if (x > 0) x = 0;  
 C if (x < 0) x = 0;  
 D if (x > 0) x = -x; else x = 0;

### Loops

(1<sup>pt</sup>) 16. What does the following code segment print to the display?

```
for (int i = 3; i <= 12; i++)
{
    System.out.print(i + " ");
}
```

1 pt

- A 5 6 7 8 9  
 B 4 5 6 7 8 9 10 11 12  
 C 3 5 7 9 11  
 D 3 4 5 6 7 8 9 10 11 12

(1<sup>pt</sup>) 17. What does the following code segment print to the display?

```
int x = 0;
while (x <= 5)
{
    System.out.print(x + " ");
    x++;
}
```

1 pt

- A 1 2 3 4  
 B 1 2 3 4 5  
 C 0 1 2 3 4  
 D 0 1 2 3 4 5

- (1<sup>pt</sup>) 18. How many asterisk characters(\*) are printed to the display, when the following code segment is executed?

1 pt

```
for (int i = 0; i < 5; i++)
{
    for (int j = 0; j < 5; j++)
    {
        System.out.println("*");
    }
}
```

- A 10  
 B 5  
 C 25  
 D 50

- (1<sup>pt</sup>) 19. What does the following code segment print to the display?

1 pt

```
for (int k = 0; k < 20; k += 2)
{
    if (k % 3 == 1)
        System.out.println(k + " ");
}
```

- A 4 16  
 B 4 10 16  
 C 0 6 12 18  
 D 0 1 4 7 10 13 16 19

- (1<sup>pt</sup>) 20. What are the values of var1 and var2 after the following code segment is executed, and the while loop finishes?

1 pt

```
int var1 = 0;
int var2 = 2;

while ((var2 != 0) && ((var1 / var2) >= 0))
{
    var1 = var1 + 1;
    var2 = var2 - 1;
}
```

- A var1 = 1, var2 = 1  
 B var1 = 3, var2 = -1  
 C var1 = 2, var2 = 0  
 D The loop won't finish executing because of a division by zero.

**Arrays**

(1<sup>pt</sup>) **21.** Which of the following declarations will cause a compile time error?

- A** `int[] scores = null;`
- B** `int[] scoreArray = {50, 90, 85};`
- C** `String[] nameArray = new String[10];`
- D** `String[] nameArray = {5, 3, 2};`

1 pt

(1<sup>pt</sup>) **22.** Given the following values of `nums` and the method `doubleLast`, what will the array `nums` contain after you execute `doubleLast()` ?

```
private int[] nums = {-10, -5, 1, 4, 8, 30};

public void doubleLast()
{
    for (int i = nums.length/2; i < nums.length; i++)
    {
        nums[i] = nums[i] * 2;
    }
}
```

1 pt

- A** `{-20, -10, 2, 8, 16, 60}`
- B** `{-20, -10, 2, 4, 8, 30}`
- C** `{-10, -5, 1, 8, 16, 60}`
- D** `{-10, -5, 1, 4, 8, 30}`

(1<sup>pt</sup>) **23.** Consider the following code segment. Which of the following statements best describes the condition when it returns `true`?

```
boolean temp = false;
for (int i = 0; i < nums.length; i++)
{
    temp = (nums[i] == val);
}
return temp;
```

1 pt

- A** Whenever the first element in `nums` is equal to `val`.
- B** Whenever `nums` contains any element which equals `val`.
- C** Whenever the last element in `nums` is equal to `val`.
- D** Whenever more than 1 element in `nums` is equal to `val`.



- (1<sup>pt</sup>) 24. Given the following array `nums` and the method `mystery`, what is the value in `nums[1]` after `mystery(nums)` has been executed?

1 pt

```
private int[] nums = {7, 3, -1};

public int mystery(int[] arr)
{
    arr[1]--;
    return (arr[1] * 2);
}
```

- A 4  
 B 2  
 C 12  
 D 6

- (1<sup>pt</sup>) 25. Assume that `arr1 = {1, 5, 3, -8, 6}` and `arr2 = {-2, -1, -5, 3, -4}`. What will the contents of `arr1` be after `copyArray` finishes executing?

1 pt

```
public static void copyArray(int[] arr1, int[] arr2)
{
    for (int i = arr1.length/2; i < arr1.length; i++)
    {
        arr1[i] = arr2[i];
    }
}
```

- A [-2, -1, -5, 3, -4]  
 B [-2, -1, 3, -8, 6]  
 C [1, 5, -5, 3, -4]  
 D [1, 5, 3, -8, 6]

### ArrayLists

- (1<sup>pt</sup>) 26. Which of the following is the correct way to set the second value in an `ArrayList` called `nums` to 5?

1 pt

- A `nums[1] = 5;`  
 B `nums[2] = 5;`  
 C `nums.set(5, 1);`  
 D `nums.set(1, 5);`

(1<sup>pt</sup>) 27. What does the following code segment print to the display?

```
ArrayList<Integer> nums = new ArrayList<Integer>();  
nums.add(new Integer(1));  
nums.add(new Integer(2));  
nums.add(new Integer(3));  
nums.remove(1);  
System.out.println(nums);
```

1 pt

- A [2, 3]
- B [1, 2, 3]
- C [1, 2]
- D [1, 3]

(1<sup>pt</sup>) 28. What does the following code segment print to the display?

```
ArrayList<Integer> nums = new ArrayList<Integer>();  
nums.add(new Integer(1));  
nums.add(new Integer(2));  
nums.add(new Integer(3));  
nums.set(2, new Integer(4));  
nums.add(2, new Integer(5));  
nums.add(new Integer(6));  
System.out.println(nums);
```

1 pt

- A [1, 2, 3, 4, 5]
- B [1, 2, 4, 5, 6]
- C [1, 2, 5, 4, 6]
- D [1, 5, 2, 4, 6]

(1<sup>pt</sup>) 29. Assume that numList has been initialized with the following Integer objects: [0, 1, 2, 3, 4]. What is the value of numList after mystery(5) executes?

```
private ArrayList<Integer> numList;  
  
public void mystery(int n)  
{  
    for (int i = 0; i < n; i++)  
    {  
        Integer obj = numList.remove(0);  
        numList.add(obj);  
    }  
}
```

1 pt

- A [0, 1, 2, 3, 4]
- B [4, 3, 2, 1, 0]
- C [1, 2, 3, 4, 0]
- D [2, 3, 4, 0, 1]

- (1<sup>pt</sup>) **30.** Assume that `numList` has been initialized with the following `Integer` objects: [5, 7, 8, 12]. Which of the following shows the values in `numList` after a call to `mystery(11)`?

1 pt

```
private ArrayList<Integer> numList;

public void mystery(int value)
{
    int i = 0;
    while (i < numList.size() && numList.get(i) < value)
    {
        i++;
    }
    numList.add(i, value);
}
```

- A [5, 7, 8, 12]  
 B [5, 7, 8, 11, 12]  
 C [11, 5, 7, 8, 12]  
 D [5, 7, 8, 12, 11]

### Two-dimensional Arrays

- (1<sup>pt</sup>) **31.** How many columns does `nums` have, if it is created as follows:

```
int[] [] nums = {{2, 4, 6, 8}, {1, 2, 3, 4}};
```

1 pt

- A 2  
 B 4  
 C 6  
 D 8

- (1<sup>pt</sup>) **32.** Which of the following statements assigns the letter "S" to the third row and first column of a two-dimensional array named `strGrid`(assuming row-major order)?

1 pt

- A `strGrid[0][2] = "S";`  
 B `strGrid[1][3] = "S";`  
 C `strGrid[3][1] = "S";`  
 D `strGrid[2][0] = "S";`

(1<sup>pt</sup>) 33. Given the following code segment, what is the value of `sum` after this code executes?

```
int[] [] matrix = {{1,1,2,2}, {1,2,2,4}, {1,2,3,4}, {1,4,1,2}};

int sum = 0;
int col = matrix[0].length - 2;
for (int row = 0; row < 4; row++)
{
    sum = sum + matrix[row][col];
}
```

1 pt

- A 4
- B 8
- C 9
- D 12

(1<sup>pt</sup>) 34. What are the contents of `mat` after the following code segment has been executed?

```
int[] [] mat = new int[4][3];

for (int row = 0; row < mat.length; row++)
{
    for (int col = 0; col < mat[0].length; col++)
    {
        if (row < col)
            mat[row][col] = 1;
        else if (row == col)
            mat[row][col] = 2;
        else
            mat[row][col] = 3;
    }
}
```

1 pt

- A {{2,3,3}, {1,2,3}, {1,1,2}, {1,1,1}}
- B {{2,1,1}, {3,2,1}, {3,3,2}, {3,3,3}}
- C {{2,1,1,1}, {3,2,1,1}, {3,3,2,1}}
- D {{2,3,3,3}, {1,2,3,3}, {1,1,2,3}}

(1<sup>pt</sup>) **35.** Given the following code segment, what is the value of `sum` after this code executes?

```
int[] [] mat = {{1,1,1,1}, {1,2,3,4}, {2,2,2,2}, {2,4,6,8}};

int sum = 0;
for (int k = 0; k < mat.length; k++)
{
    sum = sum + mat[mat.length-1-k][1];
}
```

1 pt

- A 4
- B 6
- C 9
- D 10

### Object-oriented Concepts

(1<sup>pt</sup>) **36.** What best describes the purpose of a class' constructor?

- A To initialize the instance variables of an object.
- B To name the new object.
- C To determine the amount of memory needed for an object.
- D To set up a test bench for the class.

1 pt

(1<sup>pt</sup>) **37.** Under which of the following conditions is it appropriate to overload a method(that is, the class will contain two methods with the same name)?

- A The methods do different things.
- B The methods have different numbers of parameters.
- C The methods have different post-conditions.
- D Two methods with the same name can never be included in the same class.

1 pt

Questions 38, 39 and 40 refer to the Time class declared below:

```
1 public class Time
2 {
3     private int myHrs;
4     private int myMins;
5     private int mySecs;
6
7     public Time()
8     {
9         /* implementation not shown */
10    }
11
12    public Time(int h, int m, int s)
13    {
14        /* implementation not shown */
15    }
16
17    // Resets time to myHrs = h, myMins = m, mySecs = s.
18    public void resetTime(int h, int m, int s)
19    {
20        /* implementation not shown */
21    }
22
23    // Advances time by one second.
24    public void increment()
25    {
26        /* implementation not shown */
27    }
28
29    // Returns true if this time equals t, false otherwise.
30    public boolean equals(Time t)
31    {
32        /* implementation not shown */
33    }
34
35    // Returns true if this time is earlier than t, false otherwise.
36    public boolean lessThan(Time t)
37    {
38        /* implementation not shown */
39    }
40
41    // Returns time as a String in the form hrs:mins:secs.
42    public String toString()
43    {
44        /* implementation not shown */
45    }
46 }
```

(1<sup>pt</sup>) 38. Which of the following is a **false** statement about the methods?

- A equals, lessThan, and toString are all accessor methods.
- B increment is a mutator method.
- C Time() is the default constructor.
- D The Time class has three constructors.

1 pt

(1<sup>pt</sup>) 39. Which of the following represents correct **implementation code** for the constructor with parameters?

- A myHrs = 0;  
myMins = 0;  
mySecs = 0;
- B myHrs = h;  
myMins = m;  
mySecs = s;
- C resetTime(myHrs, myMins, mySecs);
- D h = myHrs;  
m = myMins;  
s = mySecs;

1 pt

(1<sup>pt</sup>) 40. A **client class** called TimeTest has a display method that writes the time represented by its parameter:

```
// Outputs time t in the form hrs:mins:secs.  
public void display(Time t)  
{  
    /* method body */  
}
```

1 pt

Which of the following are correct replacements for */\* method body \*/*?

- I Time clock = new Time(h, m, s);  
System.out.println(clock);
  - II System.out.println(t.myHrs + ":" + t.myMins + ":" + t.mySecs);
  - III System.out.println(t);
- A I only
  - B II only
  - C III only
  - D II and III only

**Section II: Free Response** (18 points)

- Number of questions: 2. Percent of total grade: 31%.
- **SHOW ALL YOUR WORK. REMEMBER THAT PROGRAM SEGMENTS ARE TO BE WRITTEN IN JAVA.**
- Assume that the classes listed in the **Java Quick Reference** have been imported where appropriate.
- Unless otherwise noted in the question, assume that parameters in method calls are not `null` and that methods are called only when their preconditions are satisfied.
- In writing solutions for each question, you may use any of the accessible methods that are listed in classes defined in that question. Writing significant amounts of code that can be replaced by a call to one of these methods may not receive full credit.

**CookieOrder question(2010 AP Computer Science A Free Response)**

- (9pts) 1. An organization raises money by selling boxes of cookies. A cookie order specifies the variety of cookie and the number of boxes ordered. The declaration of the `CookieOrder` class is shown below.

9 pts

```
1 public class CookieOrder
2 {
3     /** Constructs a new CookieOrder object.
4     */
5     public CookieOrder(String variety, int numBoxes)
6     { /* implementation not shown */ }
7
8     /** @return the variety of cookie being ordered.
9     */
10    public String getVariety()
11    { /* implementation not shown */ }
12
13    /** @return the number of boxes being ordered.
14    */
15    public int getNumBoxes()
16    { /* implementation not shown */ }
17
18    // There may be instance variables, constructors, and methods that are not shown.
19 }
```



The `MasterOrder` class maintains a list of the cookies to be purchased. The declaration of the `MasterOrder` class is shown below.

```
1 public class MasterOrder
2 {
3     /** The list of all cookie orders.
4     */
5     private ArrayList<CookieOrder> orders;
6
7     /** Constructs a new MasterOrder object.
8     */
9     public MasterOrder()
10    { orders = new ArrayList<CookieOrder>(); }
11
12    /** Adds theOrder to the master order.
13    * @param theOrder the cookie order to add to the master order.
14    */
15    public void addOrder(CookieOrder theOrder)
16    { orders.add(theOrder); }
17
18    /** @return the sum of the number of boxes of all of the cookie orders.
19    */
20    public int getTotalBoxes()
21    { /* to be implemented in part (a) */ }
22
23    /** Removes all cookie orders from the master order that have the same variety of
24    * cookie as cookieVar and returns the total number of boxes that were removed.
25    * @param cookieVar the variety of cookies to remove from the master order.
26    * @return the total number of boxes of cookieVar in the cookie orders removed.
27    */
28    public int removeVariety(String cookieVar)
29    { /* to be implemented in part (b) */ }
30
31    // There may be instance variables, constructors, and methods that are not shown.
32 }
```

- (a) (3 pts) The `getTotalBoxes` method computes and returns the sum of the number of boxes of all cookie orders. If there are no cookie orders in the master order, the method returns 0.

Complete method `getTotalBoxes` below.

```
/** @return the sum of the number of boxes of all of the cookie orders.  
*/  
public int getTotalBoxes()
```

(b) The `removeVariety` method updates the master order by removing all of the cookie orders in which the variety of cookie matches the parameter `cookieVar`. The master order may contain zero or more cookie orders with the same variety as `cookieVar`. The method returns the total number of boxes removed from the master order.

For example, consider the following code segment:

```

1 MasterOrder goodies = new MasterOrder();
2 goodies.addOrder(new CookieOrder("Chocolate Chip", 1));
3 goodies.addOrder(new CookieOrder("Shortbread", 5));
4 goodies.addOrder(new CookieOrder("Macaroon", 2));
5 goodies.addOrder(new CookieOrder("Chocolate Chip", 3));

```

After the code segment has executed, the contents of the master order are as shown in the following table.

"Chocolate Chip" 1	"Shortbread" 5	"Macaroon" 2	"Chocolate Chip" 3
-----------------------	-------------------	-----------------	-----------------------

The method call `goodies.removeVariety("Chocolate Chip")` returns 4 because there were two Chocolate Chip cookie orders totalling 4 boxes. The master order is modified as shown below.

"Shortbread" 5	"Macaroon" 2
-------------------	-----------------

The method call `goodies.removeVariety("Brownie")` returns 0 and does **not** change the master order.

**Write your solution on the next page.**

(b) (6 pts) Complete method `removeVariety` below.

```
/** Removes all cookie orders from the master order that have the same variety of  
 * cookie as cookieVar and returns the total number of boxes that were removed.  
 * @param cookieVar the variety of cookies to remove from the master order.  
 * @return the total number of boxes of cookieVar in the cookie orders removed.  
 */  
public int removeVariety(String cookieVar)
```

## GrayImage question(2012 AP Computer Science A Free Response)

- (9pts) 2. A grayscale image is represented by a 2-dimensional rectangular array of pixels (picture elements). A pixel is an integer value that represents a shade of gray. In this question, pixel values can be in the range from 0 through 255, inclusive. A black pixel is represented by 0, and a white pixel is represented by 255.

9 pts

The declaration of the `GrayImage` class is shown below. You will write two unrelated methods of the `GrayImage` class.

```

1 public class GrayImage
2 {
3     public static final int BLACK = 0;
4     public static final int WHITE = 255;
5
6     /** The 2-dimensional representation of this image. Guaranteed not to be null.
7      * All values in the array are within the range [BLACK, WHITE], inclusive.
8      */
9     private int[] [] pixelValues;
10
11    /** @return the total number of white pixels in this image.
12     * Postcondition: this image has not been changed.
13     */
14    public int countWhitePixels()
15    { /* to be implemented in part (a) */ }
16
17    /** Processes this image in row-major order and decreases the value of each pixel at
18     * position(row, col) by the value of the pixel at position(row+2, col+2) if it exists.
19     * Resulting values that would be less than BLACK are replaced by BLACK.
20     * Pixels for which there is no pixel at position(row+2, col+2) are unchanged.
21     */
22    public void processImage()
23    { /* to be implemented in part (b) */ }
24 }

```

(a) Write the method `countWhitePixels` that returns the number of pixels in the image that contain the value `WHITE`. For example, assume that `pixelValues` contains the following image:

	0	1	2	3	4
0	<b>255</b>	184	178	84	129
1	84	<b>255</b>	<b>255</b>	130	84
2	78	<b>255</b>	0	0	78
3	84	130	<b>255</b>	130	84

A call to the `countWhitePixels` method would return 5 because there are 5 entries (shown in boldface) that have the value `WHITE`.

(a) (4 pts) Complete method `countWhitePixels` below.

```
/** @return the total number of white pixels in this image.  
 * Postcondition: this image has not been changed.  
 */  
public int countWhitePixels()
```

(b) Write the method `processImage` that modifies the image by changing the values in the instance variable `pixelValues` according to the following description. The pixels in the image are processed one at a time in **row-major order**.

Row-major order processes the first row in the array from left-to-right, and then processes the second row from left-to-right, continuing until all rows are processed from left-to-right. The first index of `pixelValues` represents the row number, and the second index represents the column number.

The pixel value at position(`row`, `col`) is decreased by the value at position (`row+2`, `col+2`) if such a position exists. If the result of the subtraction is less than the value `BLACK`, the pixel is assigned the value of `BLACK`. The values of the pixels for which there is no pixel at position(`row+2`, `col+2`) remain unchanged. You may assume that all the original values in the array are within the range [`BLACK`, `WHITE`], inclusive.

The following diagram shows the contents of the instance variable `pixelValues` before and after a call to `processImage`. The values shown in boldface represent the pixels that could be modified in a grayscale image with 4 rows and 5 columns.

	<u>Before Call to processImage</u>						<u>After Call to processImage</u>				
	0	1	2	3	4		0	1	2	3	4
0	<b>221</b>	<b>184</b>	<b>178</b>	84	135	0	<b>221</b>	<b>184</b>	<b>100</b>	84	135
1	<b>84</b>	<b>255</b>	<b>255</b>	130	84	1	<b>0</b>	<b>125</b>	<b>171</b>	130	84
2	78	255	0	0	78	2	78	255	0	0	78
3	84	130	255	130	84	3	84	130	255	130	84

Information repeated from the beginning of the question:

```

public class GrayImage

public static final int BLACK = 0
public static final int WHITE = 255
private int [] [] pixelValues
public int countWhitePixels()
public void processImage()

```

Write your solution on the next page.

(b) (5 pts) Complete method `processImage` below.

```
/** Processes this image in row-major order and decreases the value of each pixel at  
* position(row, col) by the value of the pixel at position(row+2, col+2) if it exists.  
* Resulting values that would be less than BLACK are replaced by BLACK.  
* Pixels for which there is no pixel at position(row+2, col+2) are unchanged.  
*/  
public void processImage()
```