IClicker Question

Which one of the following colors is a blend?

A. ⬜
B. ☢
C. ♦
D. ⚖
E. None of the above.
What are the $x$ and $y$ coordinates of the shaded pixel?

- A. 0,0
- B. 3,2
- C. 2,2
- D. 3,3
- E. 3,4

To manipulate a picture we need to manipulate the pixels that make it up.
- Change the red, green, or blue values at the pixel
• One way to change a picture is to reduce the amount of red in it
  – What if we want to decrease it by half?
    • If we have a value of 200 what should the new value be?
    • How do we reduce any value by half?

• One way to change a picture is to increase the amount of red in it
  – What if we want to increase it by 25%?
    • If we have a value of 100 what should the new value be?
    • How do we increase any value by 25%?

• So, to change the red in an image, we will need to alter the Red value in all of the pixels.
• How do we go about this?
• First, think about how you would change the value of Red for a single pixel.

• What change do we need to reduce the red in a single pixel?
  – Get the pixel
  – Get the red value of the pixel
  – Change the red value to half the original value (value / 2)
  – Put the new red value in the pixel
CHANGING ALL THE PIXELS IN A PICTURE

• Next we need to figure how to do this for all the pixels in an image.
• There are 329 * 150 = 49,350 pixels in the caterpillar picture
• Do we really want to write the code to change each one of these individually?
• Clearly, this is a job for a loop.

WHILE LOOPS

• In Java one way to repeat a block of statements while an expression is true is to use a while loop.
  – Create a counter and set it to the start value.
  – Check that the counter is less then the stop value.
  – If it is less than the stop value, execute the statements in the loop.
  – Add one to the counter and go back to check that the counter is less than the stop value.

THE PICTURE IS A FLOWCHART THAT SHOWS THE ORDER THE STATEMENTS ARE EXECUTED IN A PROGRAM.

ADDITIONAL TOTAL THE NUMBERS FROM 1 TO 100

• What if you want to add all the numbers from 1 to 100?
  – You will need something to hold the total.
    • What type should it be?
    • What value should it start out with?
  – You will need something that counts from 1 to 100.
    • And adds each value to the total as it's counting.
    • Stop when you get to 100.
    • What type should it be?
    • What value should it start with?
WHILE LOOP SYNTAX

• Adding up the numbers from 1 to 100:

```java
int total = 0;
int counter = 1;
while (counter <= 100)
{
    total = total + counter;
    counter = counter + 1;
} // while
System.out.println(total);
```

ADDING A MAIN METHOD

• We have been typing our statements in the interactions pane in DrJava
  – To try out Java code and to try methods
• Most development environments make you write a `main` method to start execution.
  – DrJava allows this too.
• Having a `main()` method allows you to run your program on its own, without DrJava.
  – Similar to how other programs like Excel, Firefox, etc. run on their own.

ADDING A MAIN METHOD

• Each class can have a main method declared as follows:

```java
public static void main(String[] args)
{
} // main()
```

with the following properties:
• It is public so that it can be called by other classes.
• It is static because no object of the class exists when it is executed.
• It doesn’t return anything so the return type is void.
• You can pass several arguments to the main method and these are put in an array of strings.

MAIN METHOD

• Make our example a free-standing Java program (WhileExample.java).

```java
public class WhileExample
{
    public static void main(String[] args)
    {
        int total = 0;
        int counter = 1;
        while (counter <= 100)
        {
            total = total + counter;
            counter = counter + 1;
        } // while
        System.out.println(total);
    } // main
} // class
```
EXECUTE THE MAIN METHOD

- In DrJava you can run the main method in the class that is displayed in the definitions pane
  - By clicking on Tools then Run Document’s Main Method (or press key F2)
- It will do `java Student` in the interactions pane
  - Which executes the main in the Student class

SUMMING FROM 1 TO \(N\)

- Our free-standing Java program (WhileExample.java).
  ```java
  public class WhileExample
  {
      public static void main(String[] args)
      {
          int total = 0;
          int counter = 1;
          while(counter <= 100)
          {
              total = total + counter;
              counter = counter + 1;
          }
          System.out.println(total);
      } // while
  } // class
  ```
  - By the way, this can be done more efficiently.
  - As we saw the loop sums up to 5050.
  - The sum of the numbers from 1 to 100 is \(\frac{(100)(101)}{2}\).
  - More generally, the sum of integers from 1 to \(n\) is \(\frac{n(n+1)}{2}\).
  - Try it.

DECREASE RED ALGORITHM

- To decrease the red value in a picture by 50%:
  1. Get the array of pixels from the picture.
  2. Set up an index to start at 0.
  3. If the index is less than the length of the array?
     3.1. True: go to step 4 of the loop.
     3.2. False: go to step 9 (i.e. leave the loop)
  4. Get the pixel at the current index from the array of pixels.
  5. Get the red value at the pixel.
  6. Divide the red value by 2.
  7. Set the red value at the pixel to the reduced red value.
  8. Increment the index and go back to step 3.
  9. Done.

WHAT IS AN ALGORITHM?

- An algorithm is a description of the steps needed to do a task.
  - It can be written in English.
  - A recipe is type of algorithm.
- A program is an implementation of an algorithm.
  - In a particular computer language.
    - In our case, Java.
FROM ALGORITHM TO PROGRAM (CODE)

• How do we get the array of pixels from the current picture object?
  – We have used
    ```java
    Pixel[] pixelArray = picture.getPixels();
    ```
  – But we want to get the array of pixels from the current object
    • So we can use the keyword `this`
      ```java
      Pixel[] pixelArray = this.getPixels();
      ```
    – Or we can leave off the `this`
      ```java
      Pixel[] pixelArray = getPixels();
      ```

LOOP ALGORITHM TO CODE

• How to write/code/implement the loop?
  – Use a while loop with a counter for the index starting at 0
    ```java
    int index = 0;
    ```
  – Loop while the index is less than the length of the array
    ```java
    while(index < pixelArray.length)
    ```
  – Get the current pixel from the array of pixels for the current index
    ```java
    Pixel pixel = pixelArray[index];
    ```

LOOP ALGORITHM TO CODE - CONTINUED

– Get the red value at the pixel
  ```java
  int value = pixel.getRed();
  ```
– Divide the red value by 2
  ```java
  value = value / 2;
  ```
– Set the pixel red value
  ```java
  pixel.setRed(value);
  ```
– Add one to **increment** the index
  ```java
  index = index + 1;
  ```

DECREASE RED METHOD

```java
/*
 * Method to decrease the red by half in the current picture
 */
public void decreaseRed() {
    Pixel[] pixelArray = this.getPixels();
    Pixel pixel = null;
    int value = 0;
    int index = 0;
    // loop through all the pixels
    while(index < pixelArray.length) {
        // get the current pixel
        pixel = pixelArray[index];
        // get the red value
        value = pixel.getRed();
        // decrease the red value
        value = value / 2;
        // set the pixel red
        pixel.setRed(value);
        // increment the index
        index = index + 1;
    }
    // end while
} // end decreaseRed()
```
THE PICTURE EXPLORER

- Tool that creates a copy of the current picture and lets you explore it
  - See the color, x, and y values at the cursor
- To use the tool on a picture object:
  - `pictureObj.explore();`
- Use it to see if the colors have changed

MOVE DECLARATIONS OUTSIDE LOOPS

- When you need a variable in a loop it is best to declare it before (outside of) the loop.
  - Otherwise you are declaring a new variable each time through the loop.
    - Which is slower than just changing the value associated with the variable.

DECLARATIONS IN JAVA

- In some languages you must declare all variables at the beginning of a method (function).
- In Java you can declare variables anywhere in a method.
  - So long as you declare them before you use them.
- However, you should place all of your declarations together at the beginning of the method.
- This makes it easier to keep track of them as you are developing and debugging your program.
What will be output by the following code?

A. 0
   int index = 0;
   int count = 0;
B. 1
   while(index < 3)
   {
      count = count + index;
      index = index + 1;
   }
C. 6
D. 2
E. 3
   System.out.println(count);

Answer: C