Thanks for your feedback! Following your main concern… let’s stop doing interviews.

- PSA6 will be the last.
- No more interviews from PSA7 on.

Today: REVIEW!

- If you feel very comfortable with the material so far, you may leave earlier today!
- If you’d like a bit more practice, stick around…
### Hiding information in images

<table>
<thead>
<tr>
<th></th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pixel in context image</td>
<td>00100111, 00111000, 01100101</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<thead>
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<th></th>
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<th>Green</th>
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</thead>
<tbody>
<tr>
<td>Pixel in secret message (at same x, y position)</td>
<td>01100100, 11111001, 00001111</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SLIGHTLY DIFFERENT ALGORITHM FROM THE VIDEO
Hiding information in images

Pixel in context image (00100111, 00111000, 01100101)

Pixel in secret message (at same x, y position) (01100100, 11111001, 00001111)

Turn the 8-bit secret message color into a 2-bit color by preserving the two most significant bits. (How? Why?)

Context image

Secret message
Hiding information in images

Pixel in context image

\[(00100111, 00111000, 01100101)\]

Pixel in secret message (at same x, y position)

\[(01, 11, 00)\]

Overwrite the two least significant digits in the context image with the 2-bit color of the secret message. (How?)
Hiding information in images

Pixel in context image
(00100101, 00111011, 01100100)

Pixel in secret message
(01, 11, 00)

The secret message is now hidden in the context image! (Make a copy first!)
Recovering information from images

Pixel in context with secret message
(001001\textcolor{red}{01}, 0011\textcolor{green}{11}, 011001\textcolor{blue}{00})

Pixel in recovered message (at same x, y position)
(\textcolor{red}{01}, \textcolor{green}{11}, \textcolor{blue}{00})

Find the two least significant digits from the image with the secret message (How?)
Recovering information from images

Red

Green

Blue

Pixel in context with secret message

( 00100101, 00111011, 01100100 )

Pixel in recovered message (at same x, y position)

( 01000000, 11000000, 00000000 )

Shift the bits in the recovered message to the left. You’ve recovered the message!
Debugging

The Beginner’s Guide to Debugging
https://sites.google.com/a/eng.ucsd.edu/cse-8a-fall-2013/Debugging.pdf
And now for one of the hardest things we’ve seen so far…

REVIEW: VARIABLES, ASSIGNMENT AND REFERENCES
What is printed? (DRAW BOXES!)

```java
int x = 42;
int y = x + 1;
x = y + 1;
System.out.println( x + "\," + y );
```

A. 43, 43  
B. 43, 44  
C. 44, 43  
D. 42, 43  
E. Something else
public void silly( int a, int b ) {
    a = b + 1;
    b = a/2;
    System.out.println( a + "", " + b );
}

// in main
int a = 67;
int b = 13;
silly( b, a );

A. 67, 13  
B. 68, 34  
C. 14, 7  
D. 8, 7  
E. Something else
public void silly(int a, int b) {
    a = b + 1;
    b = a/2;
}

// in main
int a = 67;
int b = 13;
silly(b, a);
System.out.println(a + " , " + b);

A. 67, 13
B. 68, 34
C. 14, 7
D. 8, 7
E. Something else

Different a’s and b’s! Reassignment within the function has NO EFFECT on the variables in the interaction pane.
Pictures in Java

A file on your computer

On your computer’s hard drive

Java’s representation

In your computer’s memory

```java
Picture pic = new Picture ('flower.jpg');
```
Pictures in Java

A file on your computer
On your computer’s hard drive

Java’s representation
In your computer’s memory

2 variables. 2 picture objects!

```java
Picture pic =
new Picture ('flower.jpg');

Picture pic2 =
new Picture ('flower.jpg');
```
Pictures in Java

What do the red arrows really mean??

```
Picture pic = new Picture ('flower.jpg');
```

2 variables. 2 picture objects!

```
Picture pic2 = new Picture ('flower.jpg');
```

Java's representation
In your computer's memory

On your computer's hard drive

flower.jpg
A file on your computer

pic

pic2

2 variables. 2 picture objects!
The value of an object variable in Java (i.e., the red arrow in the diagram) is an integer that encodes the location of that object in your computer’s memory. The variable stores a reference to the object in memory.
Objects in Java (review)

The value of an object variable in Java (i.e., the red arrow in the diagram) is an integer that encodes the location of that object in your computer’s memory. The variable stores a reference to the object in memory.
Pictures in Java

What do the red arrows really mean??

Pic

Picture pic =
new Picture ('flower.jpg');

2 variables. 2 picture objects!

Picture pic2 =
new Picture ('flower.jpg');

flower.jpg
A file on your computer

On your computer’s hard drive

Java’s representation
In your computer’s memory
Pictures in Java

What do the red arrows really mean?

```java
Picture pic = new Picture ("flower.jpg");

2 variables. 2 picture objects!

Picture pic2 = pic;
```

flower.jpg
A file on your computer

On your computer’s hard drive

Java’s representation
In your computer’s memory
public void doStuff() {
    Picture pic = new Picture( this.getWidth(), this.getHeight() );
    for ( int x=0; x < pic.getWidth(); x++ ) {
        for (int y=0; y < pic.getHeight(); y++ ) {
            Pixel p = pic.getPixel( x, y );
            p.setColor( new Color( 100, 100, 100 ) );
        }
    }
}

// in main
Picture myP = new Picture( FileChooser.pickAFile() );
myP.doStuff( );
myP.show();

Assume that the user chose a butterfly picture when the dialog box came up.
What picture will be displayed?
A. A butterfly
B. A picture that is all gray
C. A gray-colored butterfly
D. Something else
public void doStuff() {
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            Pixel p = pic.getPixel( x, y );
            p.setColor( new Color( 100, 100, 100 ) );
        }
    }
}

// in main
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            p.setColor( new Color( 100, 100, 100 ) );
        }
    }
    return pic;
}
// in main
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TODO

- Reading for Tuesday: Chapter 8
- Work on PSA7