This study guide is intended to be used with the Exam 1 study guide. I have not repeated topics from the first study guide here. Please reference the other guide for those topics.

This guide contains a list of topics that may be tested on the exam, general conceptual questions for each topic, and some more concrete questions. I recommend looking through the topics and, for any topic you’re not fully comfortable with, checking your understanding with conceptual questions. I also recommend that you complete a variety of the specific questions.

**Topic Outline:**

- **String methods**
  - `length` method
  - `substring` method
  - `charAt` method

- **`continue` and `break`**
  - `break`’s and `continue`’s behavior in for and for each loops

- **Writing methods**
  - Method headers, signatures
  - Access modifiers
  - Return types and `void`
  - Parameter lists
  - Method overloading
  - Ordering of methods in a program
  - Methods and scope of variables

- **Calling Methods**
  - Parameters and pass-by-value, esp. primitive types vs. arrays
  - How parameters are passed and values returned to the caller.

- **Arrays**
  - Declaring arrays
  - Initializing arrays
  - Default values for various types (do not need to memorize char)
  - Assigning values to elements in an array
  - `.length`
  - Zero-indexing
  - Array elements in RAM, and how indexing works
  - Printing arrays
  - Copying behavior using `System.arraycopy` versus the assignment operator =
  - Arrays as parameters to methods
  - Iterating through arrays
• For Each Loops
  – Syntax
  – Usage
  – Scoping with the identifier chosen for the elements accessed
  – Inability to modify array elements using for each loops

• Algorithms
  – Selection sort
  – Insertion sort
  – Binary search
  – Linear search

General Conceptual Questions:
• String Methods and Escape Characters
  1. How do you find the last character in a String? The first?
  2. Given String someString, how do you find its length, or which character is in a certain position?
  3. For a string of a given (non-zero) length, what indexes will cause charAt() to give an error when the program runs?

• continue and break
  1. What happens if there is a break statement directly in a for or for each loop? Within an if/else block in a for/for each loop? In a doubly-nested for/for each loop?

• Writing methods
  1. What is a method header?
  2. What is a method signature?
  3. What are two access modifiers? Can you leave the access modifier off of a method header?
  4. What does a return type indicate? What does it mean when the return type is void?
  5. Can you create void type variables?
  6. Is there a minimum number of parameters you must include in a method? A maximum you’re allowed to include?
  7. What two pieces of information are needed for each parameter in a method header?
  8. What is method overloading?
  9. What constitutes valid method overloading versus invalid method overloading?
10. How does the right method get picked for execution when a method is overloaded?
11. Do you have to write a method above its first use in a program?
12. What scope do parameter variables have? Local variables?
13. Do methods have access to variables declared in methods that call them?

• Calling Methods
  1. What does “parameters are passed by value” mean?
  2. What happens if a primitive typed variable is passed in to a method, and the method modifies the value internally? (Answer for what happens in the method to which the parameter is passed and the calling method.)
  3. What happens when arrays are passed in to methods? Can the value of elements in the array be modified? How about its length?
  4. Is it more work, the same amount of work, or less work for the computer to perform a method call than to do the same procedure without using a method?
  5. What extra work happens during a method call as opposed to general statements?

• Arrays
  1. How do you declare an array of a given type?
  2. How can you initialize an array with an array literal? What restrictions are there?
  3. How can you initialize an array so that it has a given size, but not explicitly specify the elements?
  4. Can you combine the two methods above?
  5. What are the default values for an array of types int, double, and boolean?
  6. When are default values given to array elements?
  7. How do you access a particular element in an array?
  8. How do you assign value to a particular element in an array?
  9. How do you determine the number of elements in an array?
10. What is the index of the first element in an array? The last element?
11. What happens if you try to print an array of integers using System.out.println? How about an array of characters? Booleans?
12. How can you print each element of an array manually?
13. What happens if you assign an array variable to another array using the assignment operator =, then change a value in the original array?
14. How can you create a completely separate copy of an already-existing array?
15. If an array is passed to a method, what changes can be made to it?
16. Can you have elements of various types in an array?
• For Each Loops
  1. What is the general syntax of a for each loop?
  2. How do you use a for each loop, and in what situations would you use a for each as opposed to a normal for loop?
  3. What is the scope of the element you are given access to in each iteration?
  4. What happens if you change the value of the element you’re iterating over in a for each loop? Does the change persist in the array?

• Algorithms
  For each algorithm listed below, answer the following questions:
  1. What is the algorithm used for?
  2. Are there any sub-routines necessary to complete the algorithm?
  3. What is the general procedure of the algorithm?
  4. Are there any restrictions on when the algorithm can be used?
  5. What are the inputs to the algorithm, and what are the outputs?
  6. Is there a reason this algorithm would be preferred to another algorithm?

  Algorithms:
  – Selection sort
  – Insertion sort
  – Binary search
  – Linear search

Specific Practice Questions:

These questions are intended to be worked out on paper, but I would also recommend checking your answer by writing, compiling, and running Java code. In addition to these questions, I **highly** recommend trying out some practice problems on [http://codingbat.com/java](http://codingbat.com/java) (the logic, array, and String questions would be useful).

1. Perform insertion and selection sort on the following arrays, writing down the intermediate array after each iteration in the sort.
   
   {0, 3, -1, 2, 4}
   
   {1, 2, -3, 4, -5}
   
   {-4, -3, -2, -1}
   
   {1, 0, 3, 0, 2}
2. Perform linear search and binary search on the following arrays with the given keys, if possible. Note down the index inspected at each step, and what the result of the search is. If it's not possible, explain why.

{0, 3, 5, 10, 15, 20, 22} key: 10

{-4, -3, -2, -1} key: -1

{0, 3, 5, 10, 15, 20, 22} key: 17

{2, 4, 7, 10, 13, 15} key: 13

{-4, -3, 1, 2, 7, 9} key: -4

3. For the following method, identify the method header, signature, return type, identifier, access modifier, and parameters are:

```java
public static double calculateTax(double price, boolean isGrocery){
    final double groceryTaxRate = 0.02;
    final double normalTaxRate = 0.07;
    if(isGrocery){
        return groceryTaxRate*price;
    } else {
        return price*normalTaxRate;
    }
}
```

4. Write a method that takes an integer number and returns a boolean indicating whether or not the number is a power of 2 (so, of the form $2^m$. You cannot use the Math library.

5. What is the output of the following code snippet?

```java
int index;
int[] applesPicked = {0, 1, 3, 4, 7, 4, 2};
for(index = 0; index < applesPicked.length; index++){
    if(index%3 == applesPicked[index]%3){
        System.out.println("Picked " + applesPicked[index] + " apples!");
    }
}
System.out.println(index);
```
6. What does the following code fragment print? (Assume \texttt{Arrays} has been imported.)

```java
double[] oldValues = new double[3];
double[] newValues = oldValues;
double[] printedValues = Arrays.copyOf(oldValues, 5);

oldValues[0] = 1;
newValues[0] = 2;
newValues[2] = -1;

printedValues[3] = 4;
printedValues[0] = 1;

for(double value : printedValues){
    System.out.println(value);
}

System.out.println(Arrays.toString(oldValues));
```

7. Identify four errors in the following code. Indicate whether they are compile-time errors (that will cause the program to not compile) or run-time errors (that will cause the program to crash). Indicate how these errors could be fixed.

```java
int[] values;
int finalValue = 6;
values = {0, 1, 2, finalValue};
for(int i = 0; i <= values.length; i++){
    if(i%2 = 0){
        System.out.println(values[i]);
    }
}

System.out.println("Final index: " + i);
```
8. Given the following methods, what are the final values in the array values when the main method is run?

```java
public static int setSize(int x){
    if(x<0){
        x = -x;
    }
    if(x%2 == 0){
        x = x*3 + 1;
    } else {
        x = x*2;
    }
    return x;
}

public static void setValue(int y, int val){
    y = val;
}

public static void doubleValues(int[] array){
    for(int index = 0; index < array.length; index++){
        array[index] *= 2;
    }
}

public static void main(String[] args){
    int x = 5;
    setSize(x);
    int[] values = new int[x];
    for(int i = 0; i < values.length; i++){
        setValue(values[i], i);
    }
    doubleValues(values);
    values[0] += 2;
}
```
9. **New!** Write a method that takes as parameters a string and an integer number, $N$. The method should return a string consisting of the first character of the parameter string and the last $N$ characters of the string. If this is not possible because the string is too short, return the empty string instead.

You can see the class code for Friday March 27, `Review2.java`, for one possible solution to this.