OBJECT-ORIENTED PROGRAM DESIGN

Program Design (10 requirements)
- ☐ Are you able to create a class that extends another class?
- ☐ Can you identify a subclass and superclass when given a class definition?
- ☐ Do you know how to invoke a superclass constructor from a subclass constructor method?
- ☐ Are you able to identify which methods are accessible by a given subclass?
- ☐ From a subclass, how should you call a superclass method that has the same name as a method in the subclass?
- ☐ Do you know how to interpret is-A and has-A terminology?
- ☐ What are the considerations for designing a program?
- ☐ Are you able to define and use an abstract class?
- ☐ What are abstract methods and how are they used?
- ☐ What are the file extensions for java source files, compiled code, and libraries?

Class Design (22 requirements)
- ☐ What is the difference between a class and an object?
- ☐ Do you know the overall structure of a typical class?
- ☐ What are instance variable and how should they be defined in a class?
- ☐ What is unique about a class that is used to test other classes?
- ☐ Do you know how to instantiate (construct) a new object based on a user-defined class?
- ☐ What is an interface and how is it used in a program design?
- ☐ What is procedural abstraction?
- ☐ Can you interpret the signature of a method and be able to code the method accordingly?
- ☐ Do you know how to identify and code a constructor method?
- ☐ Do you know how to use parameters passed to a method?
- ☐ Are you able to return the proper value from a user-defined method?
- ☐ Are you able to code a modifier (setter) method?
- ☐ Are you able to code an accessor (getter) method?
- ☐ What is the difference between a static and a non-static method?
- ☐ When should a static method be used?
- ☐ Do you know how to use the equals() method and toString() method?
- ☐ What is method overloading and when is it useful?
- ☐ Are you able to create a boolean method and use it in conditional logic?
- ☐ Do you know when a variable is in or out of scope for a method?
- ☐ What is a static variable and when is it appropriate?
- ☐ What does the keyword "this" refer to and what is its common usage?
- ☐ What does the keyword "null" refer to?

PROGRAM IMPLEMENTATION

Implementation Techniques (5 requirements)
- [ ] What is encapsulation?
- [ ] When is it best to use procedural abstraction?
- [ ] What are the three types of java comments and how are they used?
- [ ] Are you able to use top-down design when implementing a program?
- [ ] What is bottom-up program design and when is it appropriate?

Programming Constructs – Objects and Declarations (12 requirements)
- [ ] Do you know how to declare and initialize variables that represent the following data types (int, double, boolean, Strings, and user-defined classes)?
- [ ] Which data types are passed "by value" as parameters to methods and what does this mean?
- [ ] Which data types are passed "by reference" as parameters to methods and what does this mean?
- [ ] Are you able to declare and use a variable defined as an int data type?
- [ ] What is the approximately range of valid numbers for an int data type?
- [ ] Are you able to declare and use a variable defined as a double data type?
- [ ] Are you able to declare and use a variable defined as a boolean data type?
- [ ] What is a String and how is it declared?
- [ ] What is a constant and how is it declared?
- [ ] How do you declare a method that returns a value?
- [ ] How do you declare a method that has a parameter passed to it?
- [ ] How do you declare and initialize multiple variables in one statement?

Programming Constructs – Outputs and Controls (43 requirements)
- [ ] Can you follow the logic of multiple method calls?
- [ ] Can you follow the logic when the result of a method call is the parameter passed to another method?
- [ ] How do you print information to the console on a single line?
- [ ] How do you print information to the console on multiple lines?
- [ ] How can you print an object to the console?
- [ ] What is the escape sequence for moving the cursor to the next line?
- [ ] What is the escape sequence for a double quote character?
- [ ] What is the escape sequence for a backslash character?
- [ ] Do you know how to use an if statement?
- [ ] Do you know how to use an if/else statement?
- [ ] Are you able to use nested if statements within the then and else clauses of an if statement?
- [ ] Are you able to compare numbers, compare Strings, and compare objects?
- [ ] Do you know the different relational operators used in conditional logic?
- [ ] Do you know how to use boolean operators (&&, ||, !)?
- [ ] Do you know how to simplify if/else statements (bottom factoring, top factoring)?
- [ ] Do you know how to use DeMorgan's Law to negate a condition?
- [ ] What is the logical operator to determine if two conditions are both true?

- What is the logical operator to determine if either of two conditions is true?
- What is the logical operator for negating a condition?
- Are you able to construct a conditional statement using these logical operators?
- Do you know the arithmetic operators and their precedence?
- Do you know the results of using division with integers, floating point numbers, or a mixture of the two?
- What is modulus (%) arithmetic?
- How can you determine if a number is even or odd?
- How can you force a mathematical operation to occur outside of the normal precedence rules?
- Do you know how to use casting to convert an integer to a double or a double to a integer?
- Do you know how to use extended assignment operators (+=, -=, etc.)?
- How do you increment and decrement variables?
- Are you able to write a java arithmetic statement based on a formula?
- Do you know the general structure of a while loop?
- When is a while loop preferable vs. using a for loop?
- Do you know how to use and when to use while loops?
- What is the structure of a for statement?
- What is a loop control variable and how is it used?
- Do you know how and when to use for loops?
- What would cause the execution of a for loop to throw an "out of bounds" error?
- What is a "for each" loop and when can it be used and when can it not be used?
- Are you able to identify an infinite loop?
- Do you know how to break out of a loop?
- Are you able to follow the logic of a recursive method that calls itself at the bottom of the method?
- Are you able to follow the logic of a recursive method with statements after the recursive call?
- What is a stack and how is it used in recursion?
- Are you able to identify the stop condition (base case) in a recursive loop?

Java Library Classes (20 requirements)
- What is the Object class and why is it important?
- What is the purpose of the toString() method in the Object class?
- Do you know how and when to use Integer.MIN_VALUE and Integer.MAX_VALUE when declaring variables?
- What happens when adding 1 to a variable that is initialized as Integer.MAX_VALUE?
- What happens when subtracting 1 from a variable that is initialized as Integer.MIN_VALUE?
- Do you know how to concatenate Strings?
- Do you know how to find the number of characters in a String?
- Do you know how to select part of a string (from one index position to another)?
- Do you know how to select part of a string (from an index position to the end of the String)?
- Do you know how to find the position of one String found in a String?

- ☐ Do you know how to compare Strings to determine if they are identical?
- ☐ Do you know how to compare two Strings to determine how they are related alphabetically?
- ☐ Are you able to recognize the sort sequence for sorting Strings?
- ☐ How can an integer value be converted to a string?
- ☐ Do you know how to find the absolute value of a number?
- ☐ Do you know how to raise a number to a power?
- ☐ Do you know how to take the square root of a number?
- ☐ Do you know how to generate a random number?
- ☐ What is the relationship between the List interface and the ArrayList class?
- ☐ Which methods are in the List interface must be defined in classes that implement List?

PROGRAM ANALYSIS

Testing (3 requirements)
- ☐ Why is testing important in computer programming?
- ☐ What is unit testing?
- ☐ What is integration testing?
- ☐ Are you able to create test scenarios to test a method and create the data necessary to conduct the test?

Debugging and Error Handling (8 requirements)
- ☐ Are you able to identify and classify errors (lexical, syntax, execution, intent)?
- ☐ Are you able to identify and resolve a NullPointerException?
- ☐ What is an ArrayIndexOutOfBoundsException and how do you correct it?
- ☐ What is an IllegalArgumentException?
- ☐ What is an example of an ArithmeticException?
- ☐ Are you able to resolve a ClassCastException?
- ☐ Are you able to debug a loop that traverses an array (either one-dimensional or two-dimensional)?
- ☐ What type of errors might you encounter when using an enhanced for loop?

Inheritance, Conditions, and Assertions (4 requirements)
- ☐ How is inheritance useful in java programming?
- ☐ Are you able to interpret preconditions stated for a given method?
- ☐ Are you able to interpret post conditions stated for a given method?
- ☐ What is assertion and how is it used in programming?

Analysis of Algorithms (3 requirements)
- ☐ Are you able to identify and resolve optimization issues with algorithms?
- ☐ Are you able to identify irrelevant code?
- ☐ Are you able to count the number of statements in a loop that are executed?

Numerical Representations and Limits (8 requirements)
☐ What are the approximate bounds for a variable defined as an int data type?
☐ Why are floating point numbers not stored in exact precision?
☐ How can you convert a decimal number to a binary number?
☐ How can you convert a binary number to a decimal number?
☐ How can you convert a decimal number to a hexadecimal number?
☐ How can you convert a hexadecimal number to a decimal number?
☐ How can you convert a hexadecimal number to a decimal number?
☐ How can you convert a hexadecimal number to a binary number?

DATA STRUCTURES

Simple Data Types (7 requirements)
☐ What are the primitive data types?
☐ When should these primitive data types be used?
☐ How do you pass (data that is defined as a primitive data type) as a parameter to a method?
☐ What is the result of performing integer arithmetic?
☐ How can you cast an integer to a floating point number?
☐ How can you cast a floating point number to an integer?
☐ Are you able to use boolean logic in a conditional statement or within iteration?

Classes (13 requirements)
☐ Are you able to create the correct constructor method when given a specification?
☐ Can you code the necessary accessor methods when given a specification?
☐ Can you code the necessary modifier methods when given a specification?
☐ Are you able to create a class correctly when given a specification?
☐ Can you use other user-defined classes correctly within the class you are creating?
☐ Can you construct objects from a user-defined class?
☐ Are you able to define a String?
☐ Are you able to compare Strings?
☐ How do you compare sections of a String?
☐ Can you determine the position where a specified set of characters is defined in a String?
☐ Do you know how to use static methods from the Math class?
☐ Are you able to combine multiple methods from the Math class in a complicated formula?
☐ Can you evaluate a java statement which performs mathematics?

Lists (15 requirements)
☐ How is an ArrayList different from an array?
☐ Do you know how to declare and instantiate an ArrayList?
☐ What are the advantages of using an ArrayList versus an array?
☐ Are you able to determine the number of elements in an ArrayList?
☐ Do you know how to declare an ArrayList that can contains different data types?
☐ Do you know how to refer to an ArrayList element?

- ☐ Do you know how to modify an ArrayList element?
- ☐ Do you know how to add an element to the end of an ArrayList?
- ☐ Do you know how to insert an element into an ArrayList at a specific position?
- ☐ Are you able to remove an element at a certain position from an ArrayList?
- ☐ Are you able to remove the first element with a certain value from an ArrayList?
- ☐ How can an ArrayList be cleared of all elements?
- ☐ Do you know how to use ArrayLists with user classes?
- ☐ Do you know how to sort an ArrayList in ascending order ?
- ☐ Do you know how to reverse the order of elements in an ArrayList?

Arrays (19 requirements)
- ☐ What is an array and what are its characteristics?
- ☐ What is a position/index/subscript used for?
- ☐ What is an element in an array?
- ☐ Do you know how to instantiate and initialize an array?
- ☐ What are the elements' default values (for each of the possible data types) when instantiating a new array?
- ☐ Do you know how to refer to an array element?
- ☐ How do you determine the length of an array?
- ☐ What is an ArrayIndexOutOfBoundsException?
- ☐ Do you know how to use a regular for loop and an enhanced for loop with arrays?
- ☐ Are you able to use an array initializer list?
- ☐ Are you able to use objects in arrays?
- ☐ Do you know how to instantiate and initialize a 2-dimensional array?
- ☐ Do you know how to refer to a 2-dimensional array element?
- ☐ How do you determine the number of rows in a 2-dimensional array?
- ☐ How do you determine the number of columns in a 2-dimensional array?
- ☐ Do you know how to refer to an element in a 2-dimensional array?
- ☐ Do you know how to modify an element in a 2-dimensional array?
- ☐ Do you know how to define a regular for loop (without going out of bounds) and an enhanced for loop when using a 2-dimensional array?
- ☐ Are you able to navigate through a 2-dimensional array in either row-major order or column-major order?

STANDARD ALGORITHMS

Operations on Data Structures (23 requirements)
- ☐ How can you delete an element from an ArrayList?
- ☐ What happens when you delete an element from an ArrayList?
- ☐ How can you remove an element from an array?
- ☐ How can you delete a character or string of characters from a String?
- ☐ How can you add an element to the end of an ArrayList?
- ☐ How can you insert an element into an ArrayList?
- ☐ Do you know how to modify an ArrayList element?
- ☐ Can you add a new element to an array that is not fully populated?
- ☐ How do you modify an array element?

□ Are you able to traverse an ArrayList or array from the beginning to the end?
□ Are you able to traverse an ArrayList or array from the end to the beginning (in reverse order)?
□ Are you able to traverse an array and examine all elements without going out of bounds?
□ Are you able to loop through an array or ArrayList of numbers and sum the values?
□ Are you able to loop through an array or ArrayList of numbers and count the number of elements with a specified criteria?
□ Are you able to loop through an array or ArrayList of numbers and calculate an average?
□ Are you able to loop through an array or ArrayList of numbers and determine the minimum and maximum values?
□ Are you able to access objects from an array or ArrayList and execute methods from their classes?
□ Are you able to compare an element to a previous or next element?
□ Are you able to compare an element in a two-dimensional array to the element in the previous or next column?
□ Are you able to compare a character to the previous or next character?
□ Are you able to loop through the characters in a String in forward and backwards sequence?
□ Are you able to compare one string to another string?
□ Are you able to correctly refer to the first and last characters in a String?

Searching (9 requirements)
□ Are you able to search sequentially through an array for a specific value?
□ Are you able to search sequentially through a two-dimensional array for a specific value?
□ Are you able to search sequentially through an ArrayList for a specific value?
□ Are you able to search sequentially through the characters in a String?
□ What is a binary search and what is the prerequisite to use it?
□ Are you able to identify and explain the differences between a sequential search and a binary search algorithms?
□ What is the general behavior and relative speed of the sequential and binary searching algorithms?
□ Can you decide which searching algorithm is best when given a certain criteria?
□ How can you search for an object that has a certain property?

Sorting (13 requirements)
□ Can you identify the algorithm for a selection sort?
□ What are the advantages and disadvantages of using a selection sort?
□ Given a set of data values, can you simulate the order of the data each pass through the algorithm?
□ Can you identify the algorithm for an insertion sort?
□ What are the advantages and disadvantages of using an insertion sort?
□ Given a set of data values, can you simulate the order of the data each pass through the algorithm?

- ☐ Can you identify the algorithm for a merge sort?
- ☐ What are the advantages and disadvantages of using a merge sort?
- ☐ Given a set of data values, can you simulate the order of the data each pass through the algorithm?
- ☐ Are you able to compare the relative speeds of the selection sort, insertion sort and merge sort algorithms
- ☐ Are you able to select the best sort algorithm when given a specific problem?
- ☐ Do you know how to override the compareTo method in a user-defined class to control the sorting of objects?
- ☐ Are you able to sort the characters in a String?

COMPUTING IN CONTEXT

System Reliability, Privacy, Legal Issues, IP (4 requirements)
- ☐ Are you aware of the legal issues related to computing?
- ☐ What are examples of computer ethics?
- ☐ What are some of the social issues related to computing?
- ☐ What does IP stand for and how does it relate to computing?