Summary of Key Concepts: CPSC 1213/1223 – Introduction to Computer Science

Chapter One:

- A computer system consists of hardware and software that work in concert to help us solve problems.
- The CPU reads the program instructions from main memory, executing them one at a time until the program ends.
- The operating system provides a user interface and manages computer resources.
- As far as the user is concerned, the interface *is* the program.
- Digital computers store information by breaking it into pieces and representing each piece as a number.
- Binary is used to store and move information in a computer because the devices that store and manipulate binary data are inexpensive and reliable.
- There are exactly 2^N permutations of N bits. Therefore, N bits can represent up to 2^N unique items.
- The core of a computer is made up of main memory, which stores programs and data, and the CPU, which executes program instructions one at a time.
- An address is a unique number associated with a memory location.
- Main memory is volatile, meaning the stored information is maintained only as long as electric power is supplied.
- The surface of a CD has both smooth areas and small pits. A pit represents a binary 1 and a smooth area represents a binary 0.
- The fetch-decode-execute cycle forms the foundation of computer processing.
- A network consists of two or more computers connected together so that they can exchange information.
- Sharing a communication line creates delays, but it is cost effective and simplifies adding new computers to the network.
- A local-area network (LAN) is an effective way to share information and resources throughout an organization.
- The Internet is a wide-area network (WAN) that spans the globe.
- Every computer connected to the Internet has an IP address that uniquely identifies it.
- The World Wide Web is software that makes sharing information across a network each for humans.
- A URL uniquely specifies documents and other information found on the Web for a browser to obtain and display.
- This book focuses on the principles of object-oriented programming.
- Comments do not affect a program's processing; instead, they serve to facilitate human comprehension.
- Inline documentation should provide insight into your code. It should not be ambiguous or belabor the obvious.
- Java is case sensitive. The uppercase and lowercase versions of a letter are distinct.
- Identifier names should be descriptive and readable.
- Appropriate use of white space makes a program easier to read and understand.

- You should adhere to a set of guidelines that establish the way you format and document your programs.
- All programs must be translated to a particular CPU's machine language in order to be executed.
- High-level languages allow a programmer to ignore the underlying details of machine language.
- A Java compiler translates Java source code into Java bytecode, a low-level \, architecture-neutral representation of the program.
- Many different development environments exist to help you create and modify Java programs.
- Syntax rules dictate the form of a program. Semantics dictate the meaning of the program statements.
- The programmer is responsible for the accuracy and reliability of a program.
- A Java program must be syntactically correct or the compiler will not produce bytecode.
- Object-oriented programming helps us solve problems, which is the purpose of writing a program.
- Program design involves breaking a solution down into manageable pieces.
- Each object has a state, defined by its attributes, and a set of behaviors, defined by its methods.
- A class is a blueprint of an object. Multiple objects can be created from one class definition.

Chapter Two:

- The *print* and *println* methods represent two services provided by the *System.out* object.
- An escape sequence can be used to represent a character that would otherwise cause compilation problems.
- A variable is a name for a memory location used to hold a value of a particular data type.
- Accessing data leaves it intact in memory, but an assignment statement overwrites the old data.
- We cannot assign a value of one type to a variable of an incompatible type.
- Constants hold a particular value for the duration of their existence.
- Java has two kinds of numeric values: integer and floating point. There are four integer data types and two floating point data types.
- Java uses the 16-bit Unicode character set to represent character data.
- Expressions are combinations of operators and operands used to perform a calculation.
- Java follows a well-defined set of precedence rules that governs the order in which operators will be evaluated in an expression.
- Narrowing conversions should be avoided because they can lose information.
- The *Scanner* class provides methods for reading input of various types from various sources.

Chapter Three:

- The *new* operator returns a reference to a newly created object.

- Multiple reference variables can refer to the same object.
- Usually, a method is executed on a particular object, which affects the results.
- The Java standard class library is organized into packages.
- All classes of the *java.lang* package are automatically imported for every program.
- A pseudorandom number generator performs a complex calculation to create the illusion of randomness.
- All methods of the *Math* class are static, meaning they are invoked through the class name.
- The *printf* method was added to Java to support the migration of legacy systems.
- Enumerated types are type-safe, ensuring that invalid values will not be used.
- A wrapper class allows a primitive value to be managed as an object.
- Autoboxing provides automatic conversions between primitive values and corresponding wrapper objects.
- JavaFX is now the preferred approach for developing Java programs that use graphics and GUIs.
- JavaFX uses a theatre metaphor to present a scene on a stage.
- The origin in Java's coordinate system is in the upper-left corner. All visible coordinates are positive.
- Shapes are drawn in the order in which they are added to a group, making one appear in front of another.
- Shapes and groups can be shifted and rotated as needed.
- Java represents colors using RGB values.

Chapter Four:

- The heart of object-oriented programming is defining classes that represent objects with well-defined state and behavior.
- The scope of a variable, which determines where it can be referenced, depends on where it is declared.
- A UML class diagram helps us visualize the contents of and relationships among the classes of a program.
- An object should be encapsulated, guarding its data from inappropriate access.
- Instance variables should be declared with private visibility to promote encapsulation.
- Most objects contain accessor and mutator methods to allow the client to manage data in a controlled manner.
- The value returned from a method must be consistent with the return type specified in the method header.
- When a method is called, the actual parameters are copied into the formal parameters.
- A variable declared in a method is local to that method and cannot be used outside of it.
- A constructor cannot have any return type, even *void*.
- An arc is defined as a portion of an ellipse.
- Positive start angles and lengths are measured counterclockwise. Negative values are measured clockwise.
- An image is represented by an *Image* object but is displayed using an *ImageView* object.

- A layout pane is a JavaFX container that manages the visual arrangement of the nodes in a particular way.
- A GUI is made up of controls, events that represent user actions, and handlers that process those events.

Chapter Five:

- Conditionals and loops allow us to control the flow of execution through a method.
- An *if* statement allows a program to choose whether to execute a particular statement.
- A loop allows a program to execute a statement multiple times.
- Logical operators are often used to construct sophisticated conditions.
- Proper indentation is important for human readability; it shows the relationship between one statement and another.
- An *if-else* statement allows a program to do one thing if a condition is true and another thing if the condition is false.
- In a nested *if* statement, an *else* clause is matched to the closest unmatched *if*.
- The relative order of characters in Java is defined by the Unicode character set.
- The *compareTo* method can be used to determine the relative order of strings.
- A *while* statement executes the same statement until its condition becomes false.
- We must design our programs carefully to avoid infinite loops.
- An iterator is an object that helps you process a group of related items.
- The delimiters used to separate tokens in a *Scanner* object can be explicitly set as needed.
- An *ArrayList* object stores a list of objects and lets you access them using an integer index.
- When an *ArrayList* object is created, you specify the type of element that will be stored in the list.
- A single event handler can be used to process events generated by multiple controls.
- A character font applied to a *Text*, *Label*, or *Button* object is represented by the *Font* class.
- The *HBox* and *VBox* layout panes arrange their nodes in a single row or column, respectively.
- A group of radio buttons provide a set of mutually exclusive options.

Chapter Six:

- A *switch* statement matches a character or integer value to one of several possible cases.
- A *break* statement is usually used at the end of each case alternative of a *switch* statement.
- The conditional operator evaluates to one of two possible values based on a Boolean condition.
- A *do* statement executes its loop body at least once.
- A *for* statement is usually used when a loop will be executed a set number of times.
- The for-each version of a *for* loop simplifies the processing of all elements in an *Iterable* object.

- The loop statements are functionally equivalent. Which one you use should depend on the situation.
- A transformation changes the visual presentation of a node.
- Use the same scaling factor on both axes to keep a node in proportion to the original.
- A transformation applied to a group or pane is applied automatically to all nodes in the container.

Chapter Seven:

- The effort put into design is both crucial and cost effective.
- The nouns in a problem description may indicate some of the classes and objects needed in a program.
- A static variable is shared among all instances of a class.
- An aggregate object is composed of other objects, forming a has-a relationship.
- An interface is a collection of abstract methods and therefore cannot be instantiated.
- The values of an enumerated type are static variables of that type.
- We can add attributes and methods to the definition of an enumerated type.
- A complex service provided by an object can be decomposed to make use of private support methods.
- When an object is passed to a method, the actual and formal parameters become aliases.
- The versions of an overloaded method are distinguished by the number, type, and order of their parameters.
- Testing a program can never guarantee the absence of errors.
- A good test is one that uncovers an error.
- It is not feasible to exhaustively test a program for all possible input and user actions.
- The design of any GUI should adhere to basic guidelines regarding consistency and usability.
- Moving the mouse and clicking the mouse button generate events to which a program can respond.
- Rubberbanding is the graphical effect caused when a shape seems to resize as the mouse is dragged.
- Key events allow a program to respond immediately to the user pressing keyboard keys.

Chapter Eight:

- An array of size N is indexed from 0 to N - 1.
- In Java, an array is an object that must be instantiated.
- Bounds checking ensures that an index used to refer to an array element is in range.
- An initializer list can be used to instantiate an array object instead of using the *new* operator.
- An entire array can be passed as a parameter, making the formal parameter an alias of the original.
- Instantiating an array of objects reserves room to store references only. The objects that are stored in each element must be instantiated separately.

- Command-line arguments are stored in an array of *String* objects and are passed to the *main* method.
- A Java method can be defined to accept a varying number of parameters.
- Using an array with more than two dimensions is rare in an object-oriented system.
- A polyline is similar to a polygon except that a polyline is not a closed shape.
- The remainder operator can be used to wrap a sequence of values back to zero.
- A choice box provides a drop down menu of options to the user.

Chapter Nine:

- Inheritance is the process of deriving a new class from an existing one.
- One purpose of inheritance is the reuse existing software.
- Inheritance creates an is-a relationship between the parent and child classes.
- Protected visibility provides the best possible encapsulation that permits inheritance.
- A parent's constructor can be invoked using the *super* reference.
- A child class can override (redefine) the parent's definition of an inherited method.
- The child of one class can be the parent of one or more other classes, creating a class hierarchy.
- Common features should be located as high in a class hierarchy as is reasonably possible.
- All Java classes are derived, directly or indirectly, from the *Object* class.
- The *toString* and *equals* methods are inherited by every class in every Java program.
- An abstract class cannot be instantiated. It represents a concept on which other classes can build their definitions.
- A class derived from an abstract parent must override all of its parent's abstract methods, or the derived class will also be considered abstract.
- Inheritance can be applied to interfaces so that one interface can be derived from another.
- Private members are inherited by the child class, but cannot be referenced directly by name. they may be used indirectly, however.
- Software design must carefully and specifically address inheritance.
- The *final* modifier can be used to restrict inheritance.
- The classes that define the nodes of a JavaFX scene are organized into a class hierarchy.
- Color and date pickers are controls that allow the user to specify a color or calendar data, respectively.
- A dialog box is a pop-up window that allows brief, specific user interaction.
- The look and feel of a file chooser is based on the underlying platform.

Chapter Ten:

- A polymorphic reference can refer to different types of objects over time.
- The binding of a method invocation to its definition is performed at run time for a polymorphic reference.
- A reference variable can refer to any object created from any class related to it by inheritance.
- The type of object, not the type of the reference, is used to determine which version of a method to invoke.

- An interface name can be used to declare an object reference variable.
- An interface reference can refer to any object of any class that implements that interface.
- A parameter to a method can be polymorphic, giving the method flexible control of its arguments.
- Implementing a sort algorithm polymorphically allows it to sort any comparable set of objects.
- Polymorphism allows us to apply a consistent approach to inconsistent behaviors.
- We should hone our design senses to identify situations that lend themselves to polymorphic solutions.
- Many values in JavaFX classes are managed as properties, which can be bound to other properties.
- Property bindings are used specifically to keep data in sync. They are not a replacement for event handlers in general.
- A slider allows the user to specify a numeric value within a bounded range.
- A spinner lets the user select a value from a list of predefined options using arrow buttons.

Chapter Eleven:

- Errors and exceptions are objects that represent unusual or invalid processing.
- The messages printed when an exception is thrown provide a method call stack trace.
- Each *catch* clause handles a particular kind of exception that may be thrown within the *try* block.
- The *finally* clause is executed whether the *try* block is exited normally or because of a thrown exception.
- If an exception is not caught and handled where it occurs, it is propagated to the calling method.
- A programmer must carefully consider how and where exceptions should be handled, if at all.
- A new exception is defined by deriving a new class from the *Exception* class or one of its descendants.
- The *throws* clause on a method header must be included for checked exceptions that are not caught and handled in the method.
- A stream is a sequential sequence of bytes; it can be used as a source of input or a destination for output.
- Three public reference variables in the *System* class represent the standard I/O streams.
- Output file streams should be explicitly closed or they may not correctly retain the data written to them.
- The Java class library contains many classes for defining I/O streams with various characteristics.
- A tool tip provides a hint to the user about the purpose of a control.
- Controls should be disabled when their use is inappropriate.
- A scroll pane is useful for viewing large images or large amounts of data.
- A split pane displays two nodes side by side or one on top of the other.
- A list view displays a scrollable list of selectable options.

Chapter Twelve:

- Recursion is a programming technique in which a method calls itself. A key to being able to program recursively is to be able to think recursively.
- Any recursive definition must have a non-recursive part, called the base case, which permits the recursion to eventually end.
- Mathematical problems and formulas are often expressed recursively.
- Each recursive call to a method creates new local variables and parameters.
- A careful trace of recursive processing can provide insight into the way it is used to solve a problem.
- Recursion is the most elegant and appropriate way to solve some problems, but for others it is less intuitive than an iterative solution.
- The Towers of Hanoi solution has exponential complexity, which is very inefficient. Yet the implementation of the solution is incredibly short and elegant.
- A fractal is a geometric shape with repeated patterns that can be described recursively.
- A Koch snowflake has a finite area but an infinite perimeter.

Chapter Thirteen:

- An object, with its well-defined interface, is a perfect mechanism for implementing a collection.
- The size of a dynamic data structure grows and shrinks as needed.
- A dynamically linked list is managed by storing and updating references to objects.
- Insert and delete operations can be implemented by carefully manipulating object references.
- Many variations on the implementation of dynamically linked lists can be defined.
- A queue is a linear collection that manages data in a first-in, first-out manner.
- A stack is a linear collection that manages data in a last-in, first-out manner.
- A tree is a non-linear data structure that organizes data into a hierarchy.
- A graph is a non-linear data structure that connects nodes using generic edges.
- The Java Collections API defines several collection classes implemented in various ways.
- The classes of the Java Collections API are implemented as generic types.
- Generic classes ensure type compatibility among the objects stored by the collection.