**Statics:**

* Static fields and static methods do not belong to a single instance of a class
* Common explanation is that statics belong to the entire class, not just one instance
* Main is static because the class needs to access that
  + Main is also global, and apparently globals are bad
* Static fields and methods are properties of a class
  + Static methods are good for utility i.e. it will be used from multiple classes, multiple instances
* Non-static fields and methods are properties of an instance
  + Non-static or instance is the same thing
  + Every time new is used, it’s a new instance of a method i.e. new int[4];
* Example, every math method is static because it makes much more sense to have a static method available to every class than to force a new instance of math class every single time there needs to be a math call. Math.sqrt(25.0); instead of Math myMath = new Math(); myMath.sqrt(25.0);
* You can access statics anywhere, and since global is bad, don’t have static unless its for utilitarian stuff
* Primitive static fields are initialized to 0 if no initialization is performed
* All instances of class shares the same static fields
  + I feel like that would explain some bad behavior in some of my code
* Ask yourself, does it make sense to call this method without constructing an Object?
* Static can’t access instance fields
  + Reason why I add static to everything but apparently that’s bad
* Reasons why statics are bad:
  + Static is global, and the memory exists the entire runtime of the program
  + No thread safety
  + Not good security
* Static methods can’t be overridden because method overriding only occurs in thecontext of runtime

**Objects:**

* Objects passed to methods as arguments
* Java passes arguments by value
* When an object is passed as an argument, the value of the reference is passed
* Basically any type that isn’t the primitive 8 types are just passed as a pointer to the object
* In the example, r is just a pointer to globalRect
  + public Rectangle globalRect;
  + public void displayRectangle(Rectangle r){ System.out.println(r.getLength()); }
* Methods can return any object type, not just primatives

**Strings:**

* Good programming practive for each class is to have a **toString()** method in each class, which will return the “state” of an object created in a class
  + In RobotTorso.java, RobotHead.java, etc, there is a toString function that returns how many arms or color of eye, etc.
    - If you try and System.out.println() a class object, it will look for **toString()**, else it will print the name and address of the object
* Strings are immutable
  + Changing String dog = “Rex”; 🡪 dog = “fido”; doesn’t actually change the string stored at location dog, it points dog to a brand new address that has a brand new address. STRINGS ARE IMMUTABLE. PERIOD
  + Brand new address every time a string is changed, pointed to a new location
* StringBuilder can change specific characters, insert, delete, etc, without creating new object and address
  + Create StringBuilder by StringBuilder(), StringBuilder(int length), StringBuilder(String str)
* StringTokenizer doesn’t exist anymore, **split** instead
  + split(String regex, int limit); //doesn’t need limit
    - regex = regular expression
  + returns an array of strings
  + throws PatternSyntaxException if the regular expression syntax isn’t valid
  + “geekss@for@geekss”.split(“@”,2) 🡪 “geekss” & “for@geekss”

**Regex:**

* . matches any character
* ^regex finds regex that matches at the beginning of the line
* Regex$ finds regex that matches at the end of the line
* [abc] can match the letter a or b or c
* [abc][vz] can match a or b or c followed by either v or z
* [^abc] negates the pattern. Patter matches any character except a or b or c
* \d is digit
* \D non digit
* \s is any whitespace
* \S non-whitespace char
* \w a word character
* \W a non-word
* Many many many more

**Inheritance:**

* Every single Java class inherits from Object, which provides toString() and equals()
* Every plane has wings, every plane has engine, every \_\_\_ has something, use inheritance!
* Get rid of duplication by having similar functions in the large class, and have smaller classes inherit from large class
* public class F18Hornet extends Airplane 🡪 F18Hornet inherits all fields
* classes that inherit from superclasses will not inherit private fields, but often classes can access superclass private fields through getters and setters
* Auto is superclass, SportsCar is subclass
* Subclasses don’t inherit every field in superclass. Kind of….
  + In the memory of the computer, subclasses have an address for every field in the superclass, but subclasses can’t access private fields without public getters or setters
  + Technically, subclasses only inherit the public fields, but all fields are initialized in memory so superclass can still use its own fields
* In order to create SportsCar, you need to create a new Auto class and have SportsCar inherit from Auto
* When subclass is instantiated, the superclass default constructor is execuded first
  + You have to have a parent before you can have a baby
* SportsCar mclaren = new SportsCar() 🡪 calls Auto() first then it will call SportsCar() constructor
* public SportsCar(){ super(); hasLeatherSeats = false; } = public SportsCar() { hasLeatherSeats = false;} because SportsCar extends Auto, so Auto superclass constructor will be called first
  + Calling super(); is just a way of calling the super constructor method
    - super() can take arguments if superclass constructor calls for it
      * If super() requires arguments, you need to actually call it in subclass constructor

**Overloading/Overriding:**

* Overloading is methods with the same name, different arguments
  + Works with inheritance
    - Animal has eat(), Dog has eat(String)
      * Can call eat() and eat(String) from Dog
* Overriding is a superclass and subclass with the same name
  + Auto has getGasMileage() and SportsCar has getGasMileage()
    - If Auto getGasMileage() is private, SportsCar getGasMileage() is ***NOT*** overriding, just creating a new class
  + Subclasses will look within themselves for method before going to check in superclass
    - Subclass overrides superclass method
  + Can call super method from subclass by super.getGasMileage()

**Protected:**

* Private is most restrictive and most hidden, public is most open, protected is somewhere between
* In UML diagram, # represents protected
* Protected methods can be accessed by children objects, but private to the rest of the world
* Protected works for fields and methods

**Copies:**

* The best way to copy is by making a copy constructor
  + Don’t just make a new object with the same arguments
* Make a method that returns type of class
  + For example,
    - public Car copy(){
      * Car copyCar = new Car(color, engine, name, doors, ….”);
      * return copyCar;
    - }

**Aggregation:**

* An object made up of other objects
  + House has door, window, room, etc
* In a UML diagram, an object that contains some other class will be represented by a diamond
  + Left box contains right box

**This:**

* Why would we ever need this?
  + You can live without ‘this’, but it makes some code clearer
* In constructor, when you set a class variable equal to a constructor argument, using this.myVar = myVar; will set the class var equal to the constructor argument myVar
* ‘this’ references itself inside its own class
  + Basically, MY variable = argument variable

**Primatives:**

* byte, short, int, long, float, double, boolean, char

**Enums:**

* enum typeName { (one or more enum constants}
  + enum Day {SUNDAY, MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY, SATURDAY}
    - Day dayOfWeek = Day.WEDNESDAY;

**Autoboxing (boxing), Unboxing:**

* Autoboxing (boxing)
  + Converting a primitive valye into an object of the corresponding wrapper class is called autoboxing. For example, converting int to Integer class
    - Passed as a parameter to a method that expects an object of the corresponding wrapper class
* Unboxing
  + Converting from wrapper class to primitive
* Types
  + char, Character
  + byte, Byte
  + short, Short
  + int, Integer
  + long, Long
  + float, Float
  + double, Double
  + boolean, Boolean
* Only reason to use class wrapper instead of primitive is to use a lot of prebuilt methods
  + Integer.parseInt(double a); is an example

**Polymorphism:**

* Something is multiple things
* If subclasses extend the same superclass, each subclass type could be the superclass type
  + Example, public class Car{} 🡪 public class SportsCar extends Car{} && public class Truck extends Car{} 🡪 Car myCar = new SportsCar(); Car abbiCar = new Truck();
    - myCar and abbiCar are both different types, but since they both extend Car, they can both be type Car

**Abstract:**

* If class is abstract, you cant make an instance of class
  + You can have a class inherit from abstract class
* Abstract methods have no body
  + If superclass has abstract method, subclass has to have that method and define it with some function
* Public class Car{ public abstract hasDoors(); } 🡪 public class SportsCar extends Car{ public hasDoors(){}}
  + hasDoors in SportsCar NEEDS to exist
* Abstract objects are *italic* in UML diagrams

**Exceptions:**

* Unhandled exceptions will crash the program
  + Use try/catch blocks
    - Or don’t write bad code
* Throwable has error and exception
  + Errors are caused by unhandleable things with java
    - Out of memory is one error
  + Exception has two different types
    - IOException and RuntimeException
* Exceptions will go through all methods above where the error occurs until the error gets to main. If the error still isn’t caught, Java will print out the red error messages
  + main() calls method1() which calls method2() which calls method3()
    - if there is an error in method3, it will look for a try/catch in method3
      * if there isn’t, it will go to method2, etc until main, then if main still doesn’t handle it, it’ll crash
* throws FileNotFoundException lets JVM handle an exception, try/catch blocks allow us to handle exceptions
* we can create our own exceptions
  + throw new ExceptionType(MessageString);
* method **THROWS** exception, we **THROW** exception
  + throws defines what exceptions methods can throw
    - throws IOException
  + throw is a command to call exception
    - throw is basically what happens when something crashed
    - throw new IOException(“Connection failed”);

**Interfaces:**

* Very similar to abstract class that has ALL abstract methods
* It cannot be instantiated
* **All of the methods listed in an interface must be overridden**
* Interaaces specify behavior of a class
* All interface methods are **public** and have **no bodies**
* All fields are **final**, **static**, and **MUST** be initialized
* An interface looks similar to a class, except the keyword
* public interface InterfaceName{}
  + Define fields by <type> <name> = <value>;
    - Automatically makes everything public and static
  + Define methods by <return value> <name>(<arguments>);
    - No body in methods
* public class Supercar extends Car implements RelateTwoCars
* class can implement multiple interfaces, but can only extend one superclass
* In UML diagram, interface is a - - - > line
* Interface is a contract/protocol/common understanding of what the class can do. When a class implements an interface, it promises to provide implementation to all the abstract methods declared in theinterface
* Java does **NOT** support multiple inheritance. However, Java permits you to mplement more than one interface (can only *extend* one, but can *implement* many)
* Abstract classes should be used primarily for objects that are closely related
  + Supercar extends Car, Truck extends Car
* Interfaces are best suited for providing common functionality to unrelated classes
  + CargoPlane implements PlaneFunctions{}, Jet implements PlaneFunctions{}, interface PlaneFunctions{double calcGasMileage();}
    - CargoPlane and Jet needs to have a double calcGasMileage() function

**Recursion:**

* A lot of people think they get it, but they do it wrong
  + People call a method recursively with a loop inside method
    - That is not recursion
* When a method calls itself, it is recursion
  + Calling methods by calling method on stack, instead of looping and calling the same function over and over
* Methods need to have a basecase
  + if(i==0) return 1; is the basecase in sumTwoNums
* public class OutputSum{  
   public static void main(String[] args){  
   int i=4,j=4;  
   int calcResult = sumTwoNums(i,j);  
   System.out.println(calcResult);  
   }  
     
   public static int sumTwoNums(int i, int j){  
   if(i==0)return 1;  
   else return 1+sumTwoNums(i-1,j+1);  
   }  
  }
  + every time the sumTwoNums function is called, i is one less. Once i gets to 0, it will return 1. Since it will take five iterations to get i==0, there are five method calls
    - stack five will return 1
    - stack four will return 1+1
    - stack three will return 1+2
    - stack two will return 1+3
    - stack one will return 1+4
* Recursion does not equal looping. Recursion has no looping whatsoever
* Any problem that can be solved with recursion, you can also solve with a loop
* In many cased, recursive algorithms are less efficient than algorithms
  + Every time a method calls itself, it creates a new method on the stack
* Recursive calls move the problem closer and closer to the basecase

**GUI Layout**

* FlowLayout
  + Arranges components in rows
  + FlowLayout is default layout
  + panel.setLayout(new Layout(FlowLayout.LEFT); to set layout of objects on the left
    - new Layout(FlowLayout.RIGHT, 50, 80); Vertical gap and Horizontal gap
* BorderLayout
  + Arranges components by north, east, south, west, center
  + panel.setLayout(new BorderLayout());
    - panel.add(button1, BorderLayout.EAST);
* GridLayout
  + Arranges componest in grids (columns and rows)

**Binary Search:**