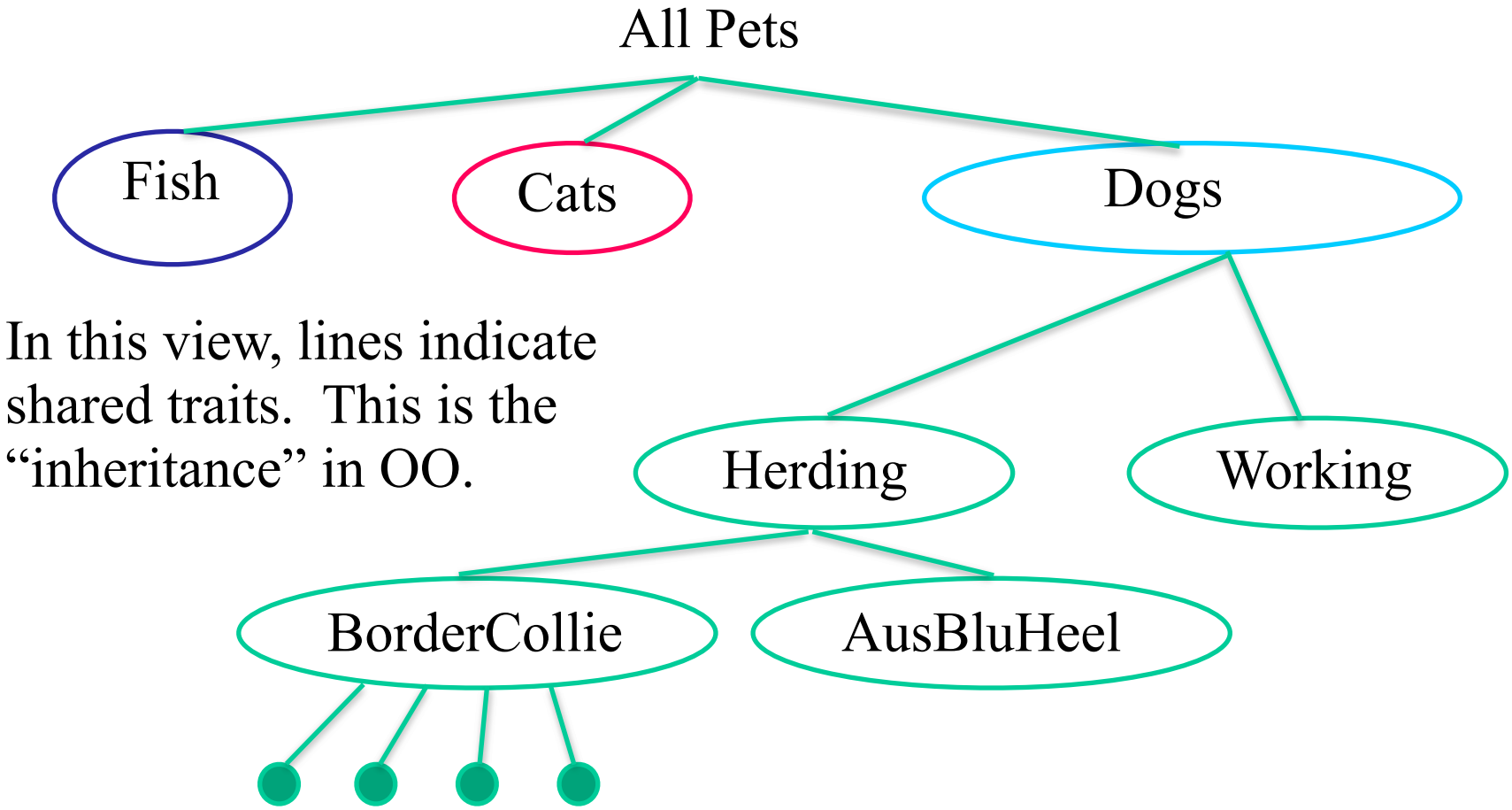
CS206

I/O Methods

Files/Exceptions

Inheritance

Classes and Inheritance



In this view, lines indicate shared traits. This is the "inheritance" in OO.

Pet Class

```
public class Petv1 extends Object {
    private String iD;
    private String name;
    public String sound() {
        return "silence";
    }
    public String getId() {
        return iD;
    }
    public String getName() {
        return name;
    }
}
```

```
public class Pet {
    protected String iD;
    protected String name;
    public String sound() {
        return "silence";
    }
    public String getId() {
        return iD;
    }
    public String getName() {
        return name;
    }
    public boolean equals(Pet p)
        return iD.equals(p.getId(
    }
}
```

Cat class

What happens when name is private in Pet

```
public class Cat extends Pet {
    private String breed;
    private double hairLength;
    public Cat(String name, String id, String breed) {
        this.name = name;
        this.iD = id;
        this.breed = breed;
    }
    @Override
    public String sound() {
        return "meow";
    }
    @Override
    public String toString() {
        return "My name is " + name + " breed " + breed + " and I say
" + sound();
    }
    public static void main(String[] args) {
        System.out.println(new Cat("calypso", "112234", "siberian"));
    }}
```

Dog Classes

```
public class Dog extends Pet{
    protected String group;
    protected double hairLength;
    protected boolean doubleCoat;
    @Override
    public String sound() {
        return "arf";
    }
    @Override
    public String toString() {
        return sound();
    }
    public static void
main(String[] args) {
        System.out.println(new
Dog());
    }
}
```

```
public class WorkingDog extends Dog
{
    protected String breed;
    protected String task;
    @Override
    public String toString() {
        return super.toString() + "
work " + task;
        }
    @Override
    public String sound() {
        return "woof";
    }
}
```

Casting, Classes and Inheritance

- Suppose: SPCA pet shelter
- Desire: A program that tracks all animals at shelter
- Approach
  - Use single array to hold all Pets
  - But deal with dogs cats separately later

```
public class Shelter {
    Pet[] animals = new Pet[100];
    int animalCount=0;
    public void addAnimal(Pet anima ) {
        animals[animalCount++]=ani al;
    }
    public Pet getAnimal(int locat on) {
        return animals[location];
    }
   public static void main(String[ args) {
        Shelter shelter = new Shelter();
        shelter.addAnimal(new Dog());
        shelter.addAnimal(new Cat());
        Pet aa = shelter.getAnimal(1);
        System.out.println(aa);
        if (aa instanceof Cat) {
            Cat c = (Cat)aa;
            System.out.println(c.toString());
        }
```

casting of class "up" to Pet

Unlike base types, objects remember what they were

cast "down" to Cat

Class Organization and main

- Generally, main should not do the work.
  - It should be short!
  - Do not put a significant function of a class into main.
- Main can be large, if its only purpose is examples of use of class.
- Parameterize whenever possible

```
public class Fibonacci {
    public void doIt(int limit) {
        int n_2=1;
        int n_1=1;
        for (int i=1; i<limit; i++) {
            int nI = n_2 + n_1;
            System.out.println(n_1 + " "
+ n_2 + " " + nI + " " + ((double)nI /
n_2));
            n_1 = n_2;
            n_2 = nI;
        }
    }
    public static void main(String[]
args) {
        new Fibonacci().doIt(20);
    }
}
```

Exceptions

- Unexpected events during execution
  - unavailable resource
  - unexpected input
  - logical error
- In Java, exceptions are objects
- 2 options with an Exception
  - "Throw" it
    - this says that the exception must be handled elsewhere
  - "Catch" it.
    - handle the problem here and now

Catching Exceptions

- Exception handling
- `try-catch`
- An exception is caught by having control transfer to the matching `catch` block
- If no exception occurs, all `catch` blocks are ignored

```
try {
    guardedBody
} catch (exceptionType1 variable1) {
    remedyBody1
} catch (exceptionType2 variable2) {
    remedyBody2
} ...
    ...
```

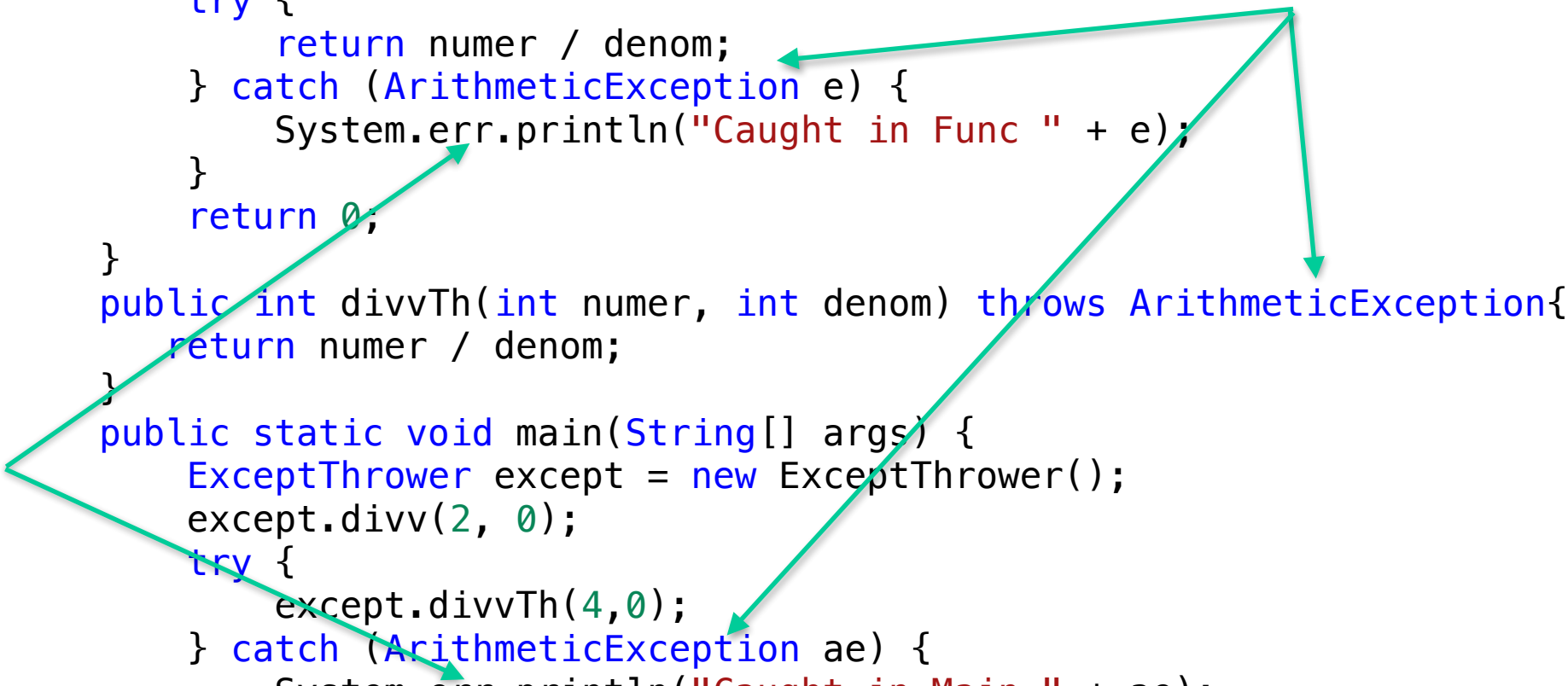
Throwing Exceptions

- An exception is thrown
  - implicitly by the JVM because of errors
  - explicitly by code
- If your code throws an exception it **must** catch that exception somewhere else
- Method signature – `throws`

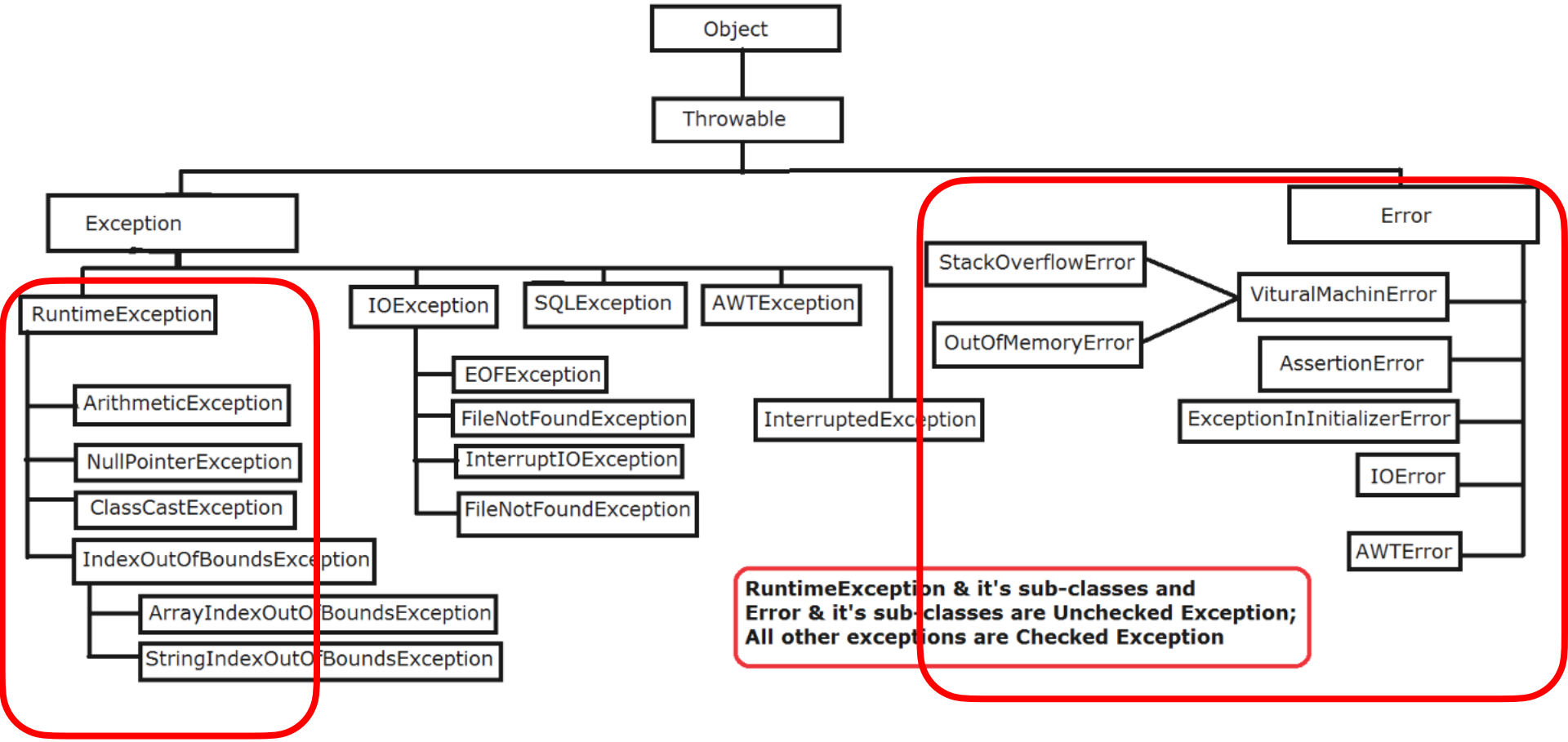
```
public static int parseInt(String s)
throws NumberFormatException
```

Exceptions Example

```
public class ExceptThrower {
    public int divv(int numer, int denom) {
        try {
            return numer / denom;
        } catch (ArithmeticException e) {
            System.err.println("Caught in Func " + e);
        }
        return 0;
    }
    public int divvTh(int numer, int denom) throws ArithmeticException{
       return numer / denom;
    }
    public static void main(String[] args) {
        ExceptThrower except = new ExceptThrower();
        except.divv(2, 0);
        try {
            except.divvTh(4,0);
        } catch (ArithmeticException ae) {
            System.err.println("Caught in Main " + ae);
        }}}
```



Java's Exception Hierarchy



Reading the Keyboard

- `System.in` is, by default, set to receive keyboard input
- Use Scanner to read from keyboard
  - Do NOT use scanner otherwise

```
import java.util.InputMismatchException;
import java.util.Scanner;
public class CatKeyboard {
    public static void main(String[] args) {
        try (Scanner scanner = new Scanner(System.in);) {
            System.out.print("Enter name: ");
            String name = scanner.next();
            System.out.print("Enter Id:");
            int iid = scanner.nextInt();
            System.out.print("Enter breed: ");
            String breed = scanner.next();
            Cat ccat = new Cat(name, (""+iid), breed);
            System.out.println(ccat);
        } catch (InputMismatchException ime) {
            System.out.println(ime);
        } finally {}}}
```

Handling Exceptions — alternate cat try-catch

```
public Cat() throws InputMismatchException {
    Scanner scanner = new Scanner(System.in);
    System.out.print("Enter name: ");
    name = scanner.next();
    System.out.print("Enter Id:");
    iD = "" + scanner.nextInt();
    System.out.print("Enter breed: ");
    breed = scanner.next();
}

public Cat getCat() {
    try {
        Cat c = new Cat();
        return c;
    } catch (InputMismatchException ime) {
        System.err.println(ime);
    }
    return null;
}
```

Exceptions should be handled as soon as possible.

try-catch should enclose as little code as possible

Reading from Files

```
public void readOneLineTC()
 {
     BufferedReader br;
     try {
         br = new BufferedReader(
               new FileReader(fileName));
         br.readLine();
     } catch (FileNotFoundException fnf) {
         System.err.println("No file " + e);
     }  catch (IOException e) {
         System.err.println("Reading " + e);
     } finally {
         if (br!=null) {
             try {
                 br.close();
             } catch (IOException ioe) {
                 System.err.println("Close" + ioe);
             }
         }
     }
 }
```

```
public void readOneLineTCR(
    {
        try (BufferedReader br = new BufferedReader(
                        new FileReader(fileName));) {
            br.readLine();
            // close unnecessary in this formulation
        } catch (FileNotFoundException e) {
            System.err.println("Open " + e);
        } catch (IOException e) {
            System.err.println("Reading " + e);
        }
    }
```

finally == code that WILL be executed. Optional part of try-catch

Close can throw an exception so it too must be caught. Sigh

if time, write program to demo try/catch/fianlly

Software Design Goals

- Robustness
  - software capable of error handling and recovery
  - programs should never crash
    - ending abruptly is not crashing
- Adaptability
  - software able to evolve over time and changing conditions (without huge rewrites)
- Reusability
  - same code is usable as component of different systems in various applications
  - The story of Mel — https://www.cs.utah.edu/~elb/folklore/mel.html

OOP Design Principles

- Modularity
  - programs should be composed of "modules" each of which do their own thing
    - each module is separately testable
  - Large programs are built by assembling modules
  - Objects (Classes) are modules
- Abstraction
  - Get to the core — non-removable essence of a thing
  - Most pencils are yellow, but yellowness does not required
- Encapsulation
  - Nothing outside a class should know about how the class works.
    - For instance, does the Object class have any instance variables. (Of what type?)
  - Allows programmer to totally change internals without external effect

OOP Design

- Responsibilities/Independence: divide the work into different classes, each with a different responsibility and are as independent as possible
- Behaviors: define the behaviors for each class carefully and precisely, so that the consequences of each action performed by a class will be well understood by other classes that interact with it.

Class Definition

- Primary means for abstraction in OOP
- Class determines
  - the way state information is stored – via instance variables
  - a set of behaviors – via methods
- Classes encapsulate
  - `private` instance variables
  - `public` accessor methods (getters)

Constructors

- Constructors are never inherited
- A class may invoke the constructor of the class it extends via a call to `super` with the appropriate parameters
  - e.g. `super()`
  - `super` must be in the first line of constructor
  - If no explicit call to `super`, then an implicit call to the zero-parameter `super` will be made
- A class make invoke other constructors of their own class using `this()`
  - `this` must be first
  - Cannot explicitly use both `super` and `this` **in single constructor**
  - See FileOpen.java for example

Lab

Do Feb 16 lab from the class website.

You will use most of this in HW 1 which just adds comments and submits using the homework submission system.