CS 1181 Week Two

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Review

- Behavior Modularity
    - Abstract Classes
    - Interfaces
- Separation of Implementation
    - Definitions
    - Implementations

Review

- How can we use this to solve actual problems?
- Data Modeling
- Let’s do an example!

Interface vs. Abstract Class

- Suppose you are creating a media app that allows users to listen to music but also view artwork
- I want to create a class called Media
- Should this be an interface, abstract class, or concrete class?

Media Example

- Considering some of the media items cannot be listened to, what interfaces might make sense to create?

Interface vs. Abstract Class

- Suppose I am creating a system to manage both autonomous and driveable vehicles

Vehicle Tracking System

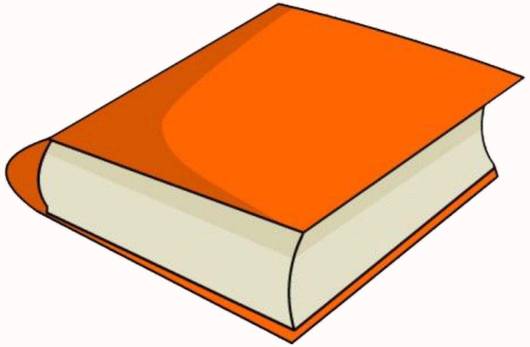
- Should the following be implemented via an interface, abstract, or concrete class?
  - Vehicle
  - Car
  - UAV
  - Driveable

Practice Problem

- Local Library
- Inventory System
- Managing a large amount of books

Practice Problem

- All books have
  - A Dewey Decimal Number
  - A title
  - A number of days left on loan



Practice Problem

- All Books cost money to borrow
  - Except fiction books are free if you are under the age of 12
- Non-fiction books can have their loans renewed

Practice Problem

- Book Types (DD number, title)
    - Fiction (Cost money)
    - Non-Fiction (Cost Money, can be renewed)

Data Modeling

- Good start to solving *any* problem

- Model how you want your data first
- Implement later
- Adjust model
- Repeat

Data Modeling

- Using the tools we have so far

- How should we model this problem?
- Consider what has “default behavior”

Problem Overview

- All books have:
  - A Dewey Decimal Number
  - A title
  - A number of days left on loan
- Fiction books are free under 12
- Non-fiction books can be renewed

Modeling with Interfaces

- “able” interfaces
- Renewable Interface
- Chargeable Interface
- Abstract Book Class

- Let’s do it!

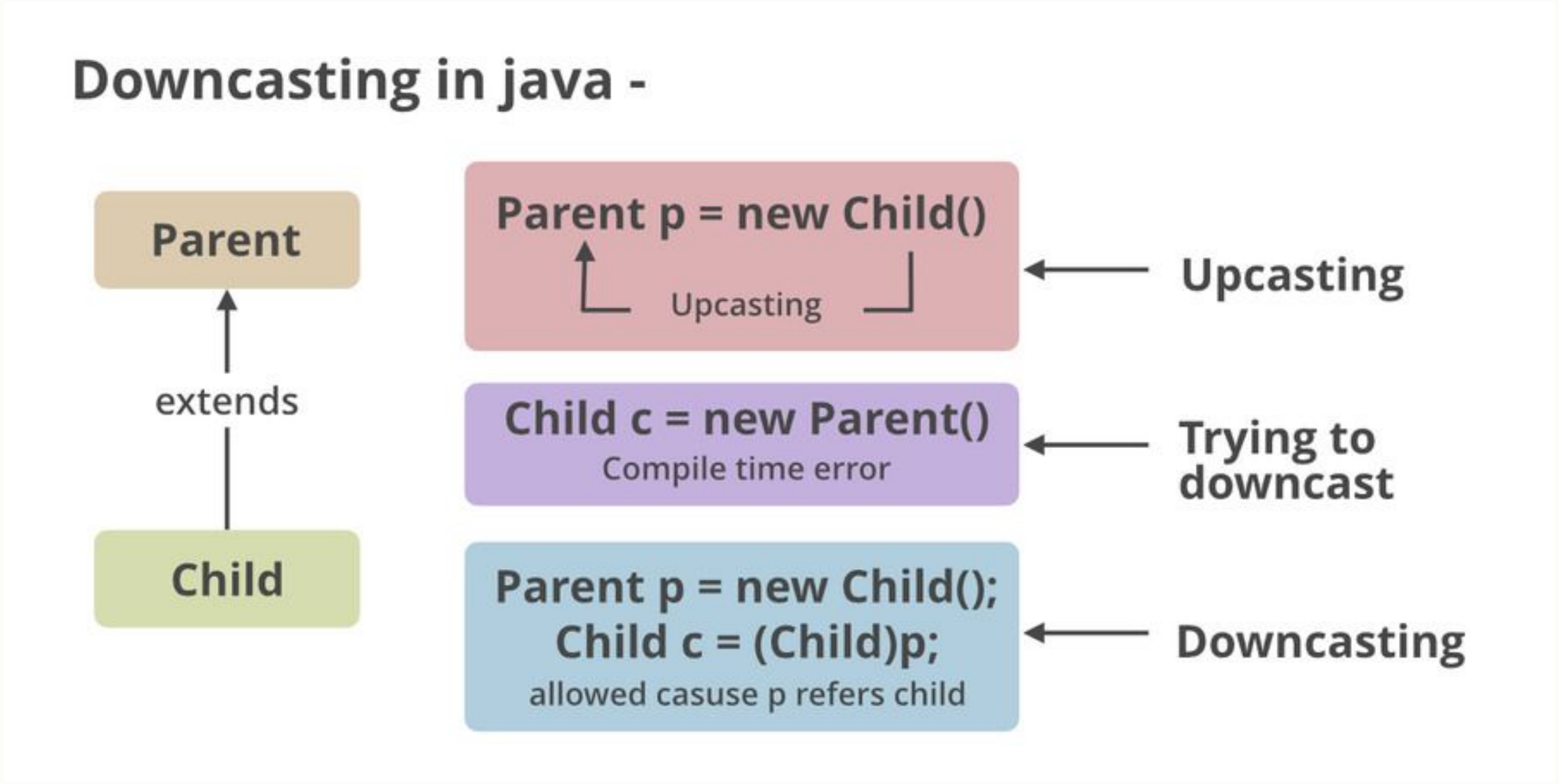
Casting

- Java will let you convert between types
- Cast to interfaces

- checkOut((Borrowable) b3);

- Upcasting vs. downcasting

Casting


Downcasting in java -
Parent
extends
Child
Parent p = new Child()
Upcasting
Upcasting
Child c = new Parent()
Compile time error
Trying to downcast
Parent p = new Child();
Child c = (Child)p;
allowed casuse p refers child
Downcasting

Well Developed Classes

- By convention, classes should be well developed
- What does this mean?
- Ease of use

Well Developed Classes

- Encapsulation
- toString()
- Comparable (+ ators)
- Copyable
- Robust Exceptions

Aside: toString()

- When we write a toString()
- We are *overriding* an existing method
- This is different from overloading
- This comes from the parent class (object) class in this case

Complex Comparable

- We've seen simple comparable
- -1, 0, +1
- This can be strung together for more complex ordering!

- I.e. sort by ddNumber, then by title
- Let's do it!

Complex Comparable

- Where should we put this?
- First compare ddNumbers
- How do we compare the Strings?
- Let’s check the documentation

Complex Comparable

- Comparable is for *natural ordering*
- What if we wanted to define another way of sorting our class?

- Comparator Class
- Used for arbitrary ordering
- Defined *elsewhere*

Copyable

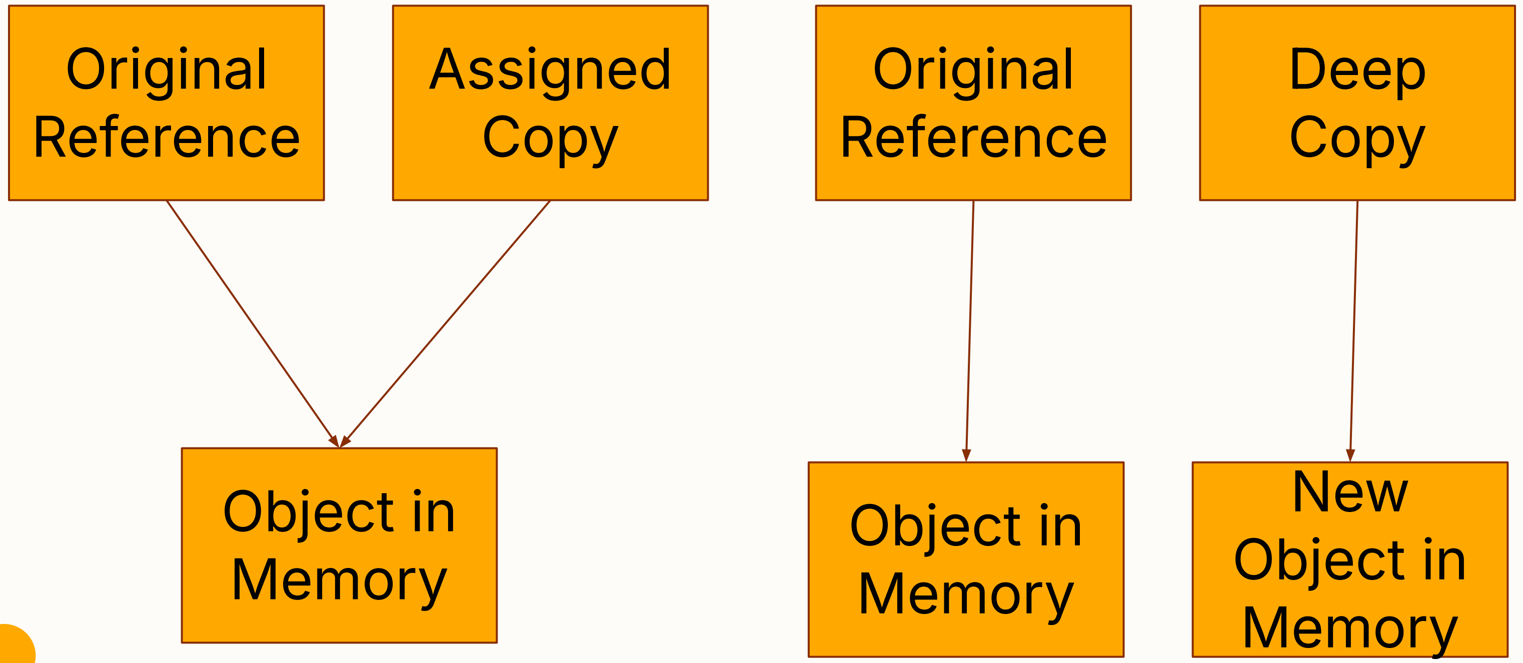
- Good classes should be easy to use and copy

- Special constructors to make this easier
- Copy Constructors

Why Copy Constructors

- What happens if we don’t use a copy constructor
- Book b1 = new NonFictionBook(...);
- Book b2 = b1;
- b2.setDDNumber(90.12)

Shallow vs Deep Copying



Let’s revisit some old ideas

- Type casting
- What happens if we do a bad cast?
- What makes something a bad cast?

Casting

```
Book b1 = new FictionBook(
    14.01,
    "Twilight"
);
```

Can I cast b1 to a NonFictionBook?

Uh oh!

- ClassCastException
- Occurs when we try to cast to a subclass that our object is not an instance of
- Let's look at the documentation

Instantiation

- How can I avoid these exceptions?
- In other words, how can I verify the instance of an object?

- instanceof keyword!

instanceof

- Used to verify instantiation of an object
- All lowercase, all one word
- Often used in conditionals

- if (b1 instanceof FictionBook)

What are Exceptions?

- Not a magical entity
- Exception is a standard Java class
- extends Throwable
- What is an Error?
- Let's look at the documentation

What are Exceptions?

- Would be really nice to be able to make our own Exceptions
- Specific for our own classes
- Remember setDDNumber?

Throw keyword

- Used to generate an exception at the current point
- Will cause the program to crash if not caught at a different point

What happens if I extend Exception?

- We can create our own exceptions
- These can be thrown and caught just like any other exception
- What does it mean to be thrown?
- Let's make our own Exception

Throw vs Throws

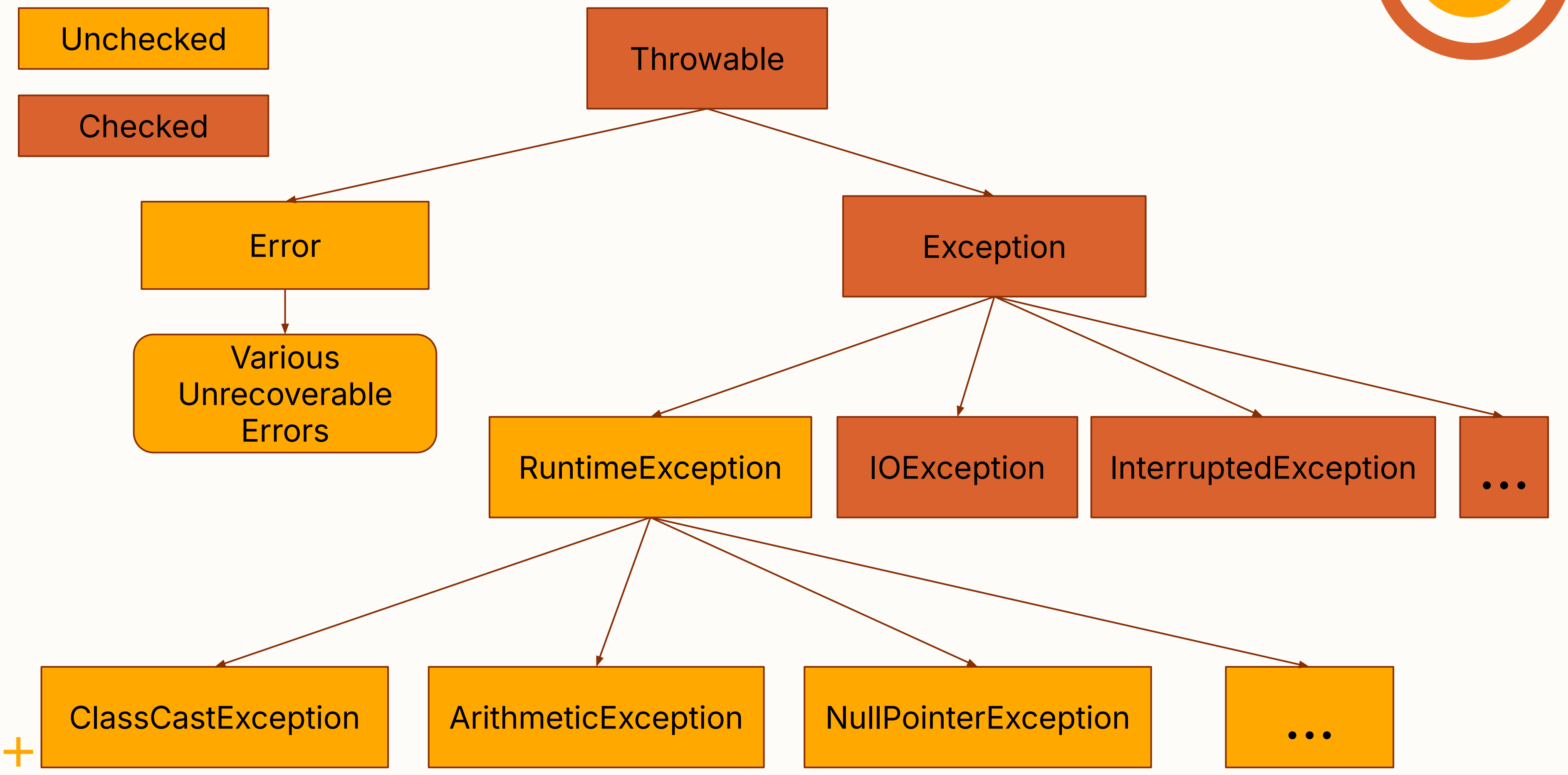
- Throws says an exception *could* occur
- Used for checked exceptions

- Throw creates a new exception at the current point
- Forces an exception to occur

When should our Exception be handled?

- Some exceptions you might have seen get mad when you don’t “handle” them
- InteruptedException, IOException

- Others just let it happen
- FileNotFoundException, ClassCastException


Unchecked
Checked
Throwable
Error
Exception
Various Unrecoverable Errors
RuntimeException
IOException
InterruptedException
...
ClassCastException
ArithmeticException
NullPointerException
...

When should our Exception be handled?

- instanceof RuntimeException
  - Unchecked until runtime
- Instanceof Exception
  - Handle checked at compile time
  - try/catch
  - throws