Avoiding Null

Image: Craig Adderly on pexels.com

Topics

1) “My function normally returns an object,
   but sometimes it cannot”

   OK: myCountry.getBiggestProvinceOrState()
   Problem: vadicanCity.getBiggestProvinceOrState()

   How can I make this less painful?

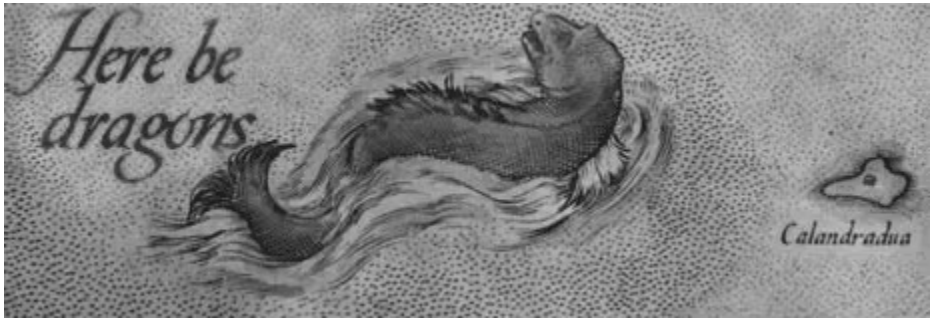
2) “My object’s field can reference null”

   OK: Cellphone has-a SimCard
   Problem: but it might not have one!

   How can I remove all my null reference checks?

Ref: Bloch, Effective Java 3rd Ed.

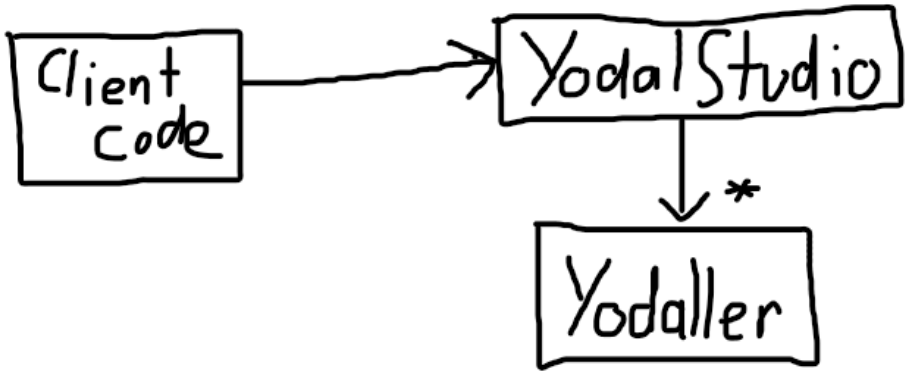
Avoid Returning Null



Motivation

- Problem:
  Sometimes a function cannot return a valid object

- Example:
  - Client wants to print the name of the loudest Yodaller
  - Client asks YodalStudio for the loudest Yodaller



- What's the challenge?

Idea 1: Return null

```
public Yodaller getLoudest_1() {
    if (students.isEmpty()) {
        return null;
    }

    Yodaller loudest = null;
    for (Yodaller y : students) {
        if (loudest == null ||
            y.getVolume() > loudest.getVolume())
        {
            loudest = y;
        }
    }
    return loudest;
}

void printLoudestName(YodalStudio studio) {
    Yodaller loudest = studio.getLoudest_1();
    if (loudest != null) {
        System.out.println(loudest.getName());
    } else {
        System.out.println("Nobody");
    }
}
```

Good

- null is fast and easy to code

Bad

- ..
- client code must remember to always check for null
- ..

Idea 2: Throw checked exception

```
class NoEntries
  extends Exception
    {}
```

```
public Yodaller getLoudest_2() throws NoEntries {
    if (students.isEmpty()) {
        throw new NoEntries();
    }

    Yodaller loudest = null;
    for (Yodaller y : students) {
        if (loudest == null ||
            y.getVolume() > loudest.getVolume())
        {
            loudest = y;
        }
    }
    return loudest;
}

void printLoudestName(YodalStudio studio) {
    try {
        Yodaller loudest = studio.getLoudest_2();
        System.out.println(loudest.getName());
    } catch (NoEntries e) {
        System.out.println("Nobody");
    }
}
```

Good

- ..

Bad

- Exceptions should be for exceptional events; not expected edge cases
- try-catch code breaks standard logic flow, is hard to read
- Exceptions can be expensive to create

Idea 3: Optional

- Optional
  ..

- Suggested Use
  Use Optional for methods which (both)
  1) cannot always return a value, and
  2) client code should *always* check for a valid value

Idea 3: Optional (cont)

```
public Optional<Yodaller> getLoudest_3() {
    if (students.isEmpty()) {
        return Optional.empty();
    }

    Yodaller loudest = null;
    for (Yodaller y : students) {
        if (loudest == null ||
        y.getVolume() > loudest.getVolume())
        {
            loudest = y;
        }
    }
    return Optional.of(loudest);
}
```

Good

- ..

- Convenient methods to minimize calling code logic

```
void printLoudestName(YodalStudio studio) {
    Optional<Yodaller> loudest = studio.getLoudest_3();
    String name = loudest.map(s -> s.getName()).orElse("Nobody");
    System.out.println(name);
}
```

Creating an Optional

- Optional.empty()
  Gives an "empty" (not containing a reference) Optional
- Optional.of(myObj)
  Holds reference to myObj; throws NullPointerException if null

```
Optional<String> getLastCommand() {
    List<String> data = getCommandHistory();
    if (data.isEmpty()) {
        return Optional.empty();
    }

    return Optional.of(data.get(data.size() - 1));
}
```

- Optional.ofNullable(myObj)
  sets it to be either empty (if null), or contain object

Handling an Optional: orElse()

- myOptional.orElse(someDefault)

  ..

```
void printLastCommand() {
    Optional<String> lastCommand = getLastCommand();

    String msg = lastCommand.orElse("No commands yet");

    System.out.println("Last command: " + msg);
}
```

Handling an Optional: map()

- Use map() to work with an Optional in powerful ways
- Give it an argument of a lambda function (a "consumer") to process the contained object (if any).

```
void printLoudestName_3(YodalStudio studio) {
    Optional<Yodaller> loudest = studio.getLoudest_3();
    String name = loudest
        .map(s -> s.getName())
        .orElse("Nobody");
    System.out.println(name);
}
```

- Can do more complex operations

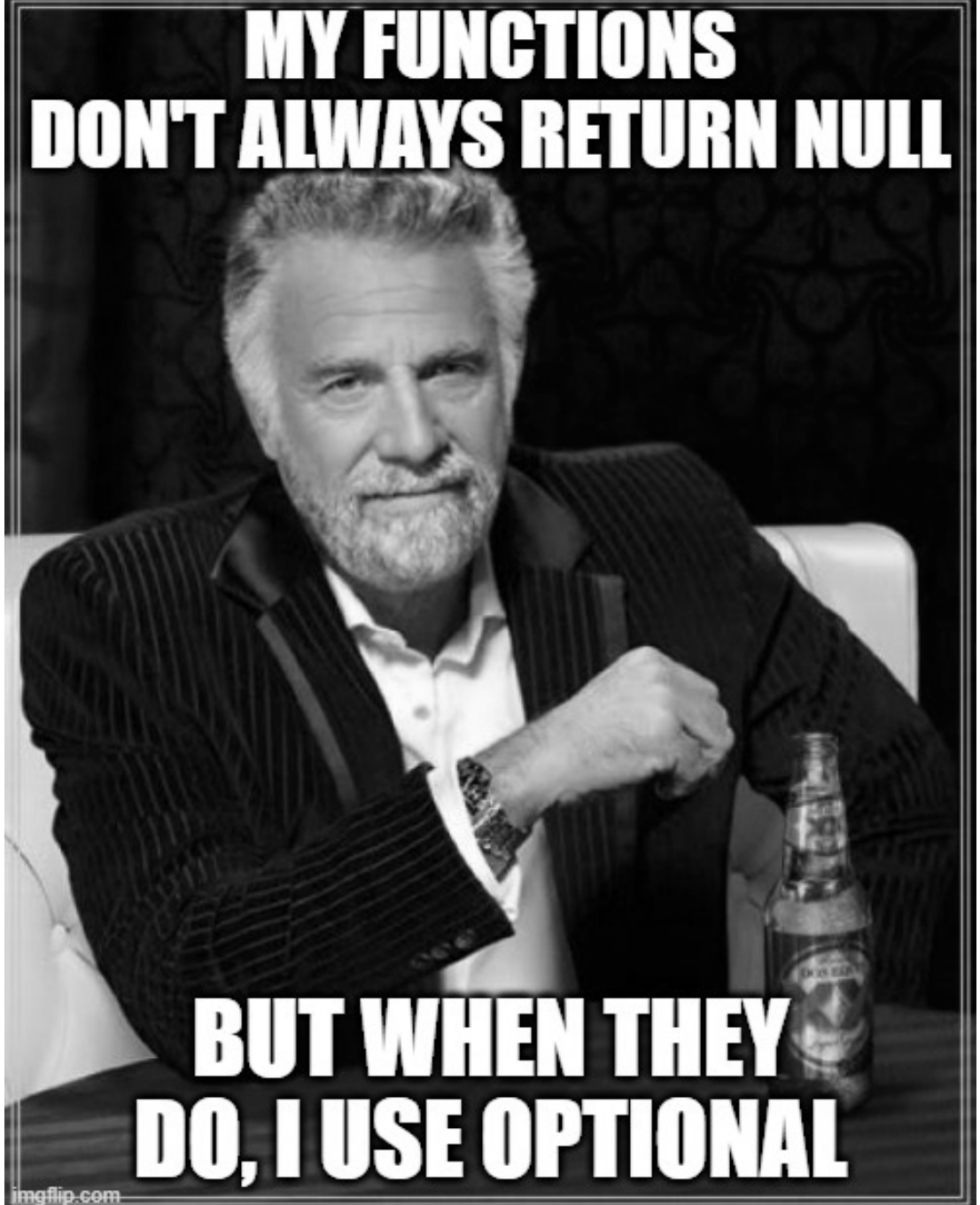
```
String s = loudest
    .map(s -> myFormatter.formatName(s.getName()))
    .orElse("Nobody");
```

Handling an Optional: Direct access

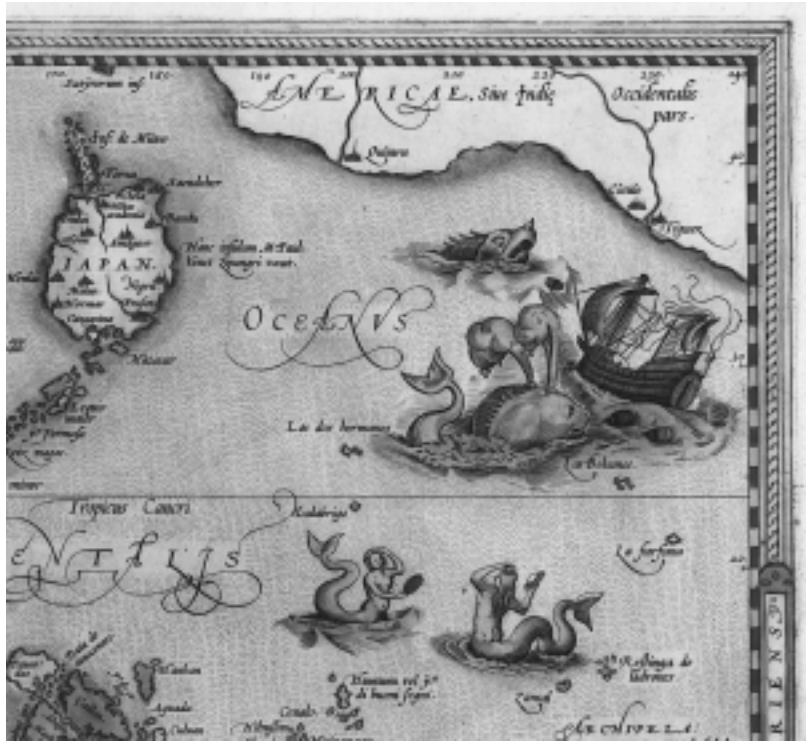
- Can manually check state and then access
  - use isPresent() or isEmpty() to check state
  - use get() to access element (throws NoSuchElementException if empty)

```
void extraLogic() {
    Optional<String> lastCommand = getLastCommand();
    String msg = "No commands yet";
    if (lastCommand.isPresent()) {
        msg = lastCommand.get();
    }
    System.out.println("Last command: " + msg);
}
```

- Tip: Avoid direct access if you can; it adds extra logic. Use Optional's other methods

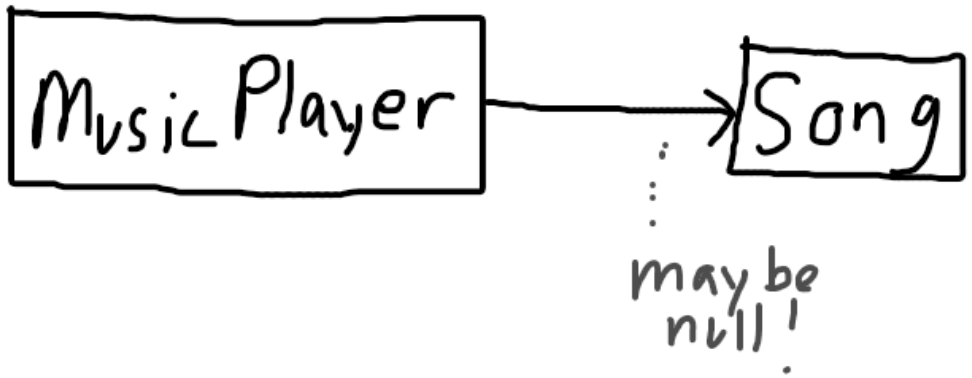

MY FUNCTIONS
DON'T ALWAYS RETURN NULL
BUT WHEN THEY
DO, I USE OPTIONAL
imgflip.com

Avoiding has-a Null



Motivation

- When our object has-a reference to an object which could be null, we have to use many null checks.
- Example
  - MusicPlayer holds reference to a Song when playing
  - Reference set to null when no song playing
  - MusicPlayer must check if Song is null on every access:
    ex: song duration, song name, artist name, ...



The null field problem

- Problems
  - Code has many checks for null
  - If you miss a null check will crash program instead of doing “nothing”
- Solution
  - Instead of referencing a null for no object, reference an object which has the same methods but does “nothing” (or default behaviour)

NullObject

- A NullObject

  ..

  (or inherits same base-class) as the normal object,

  ..

- Code Demo: Patterns-NullObject
  - See with and without null object
  - Draw class diagram for Null Object pattern

Summary

- Instead of a function returning a null,
  return an Optional object.
  - Simple access to Optional with .orElse()
  - Power access to Optional with .map()
- Instead of doing null checks on a possibly null field,
  use the Null Object pattern instead