Avoiding Null

Image: Craig Adderly on pexels.com

Topics

1) My function returns an object, but sometimes its nothing!
   OK: getBiggestProvince(CANADA)
   Problem: getBiggestProvince(VADICAN_CITY)

   How can I make this less painful?

2) My object's field might reference null!

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

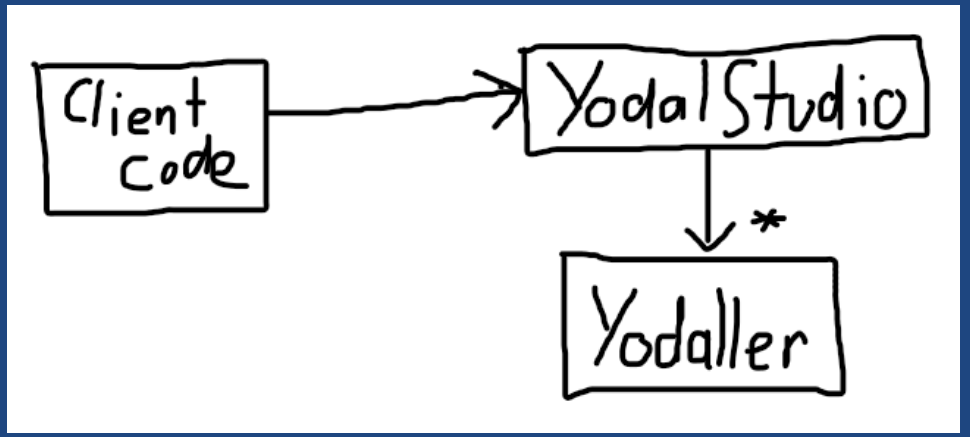
   How can I remove all my null reference checks?

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

```
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;
}
```

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

```
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

  Return an Optional from any method 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" Optional (not containing a reference)
- **`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));
}
```

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);
}
```

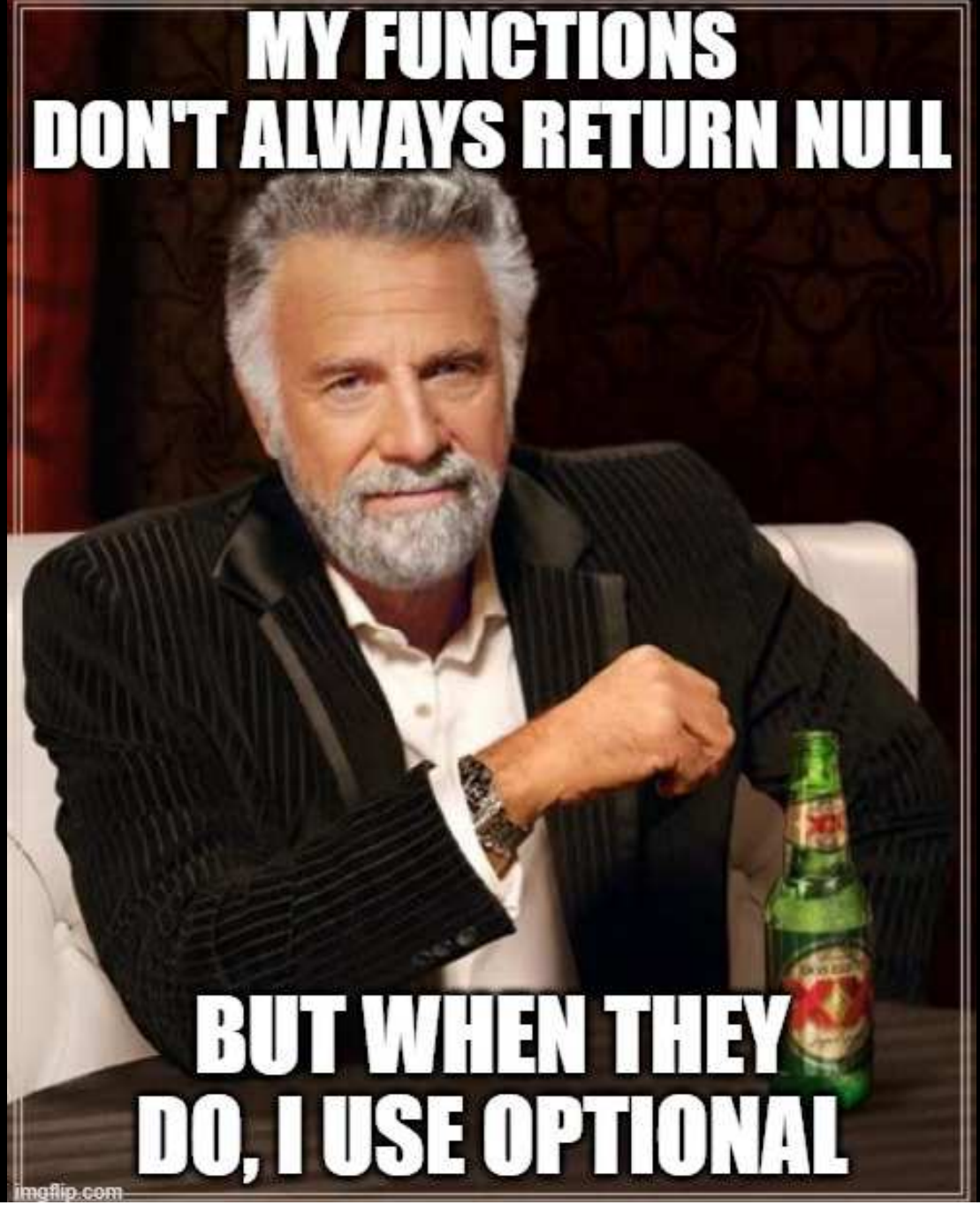
Handling an Optional: map()

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


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

ABCD: Optional

- Which of the following functions should use optional?

```
List<Admin> admins = new ArrayList<>();
List<User> users = admins;
```

a) int sum(List<Integer> data);

b) int length(List<Integer> data);

c) int max(List<Integer> data);

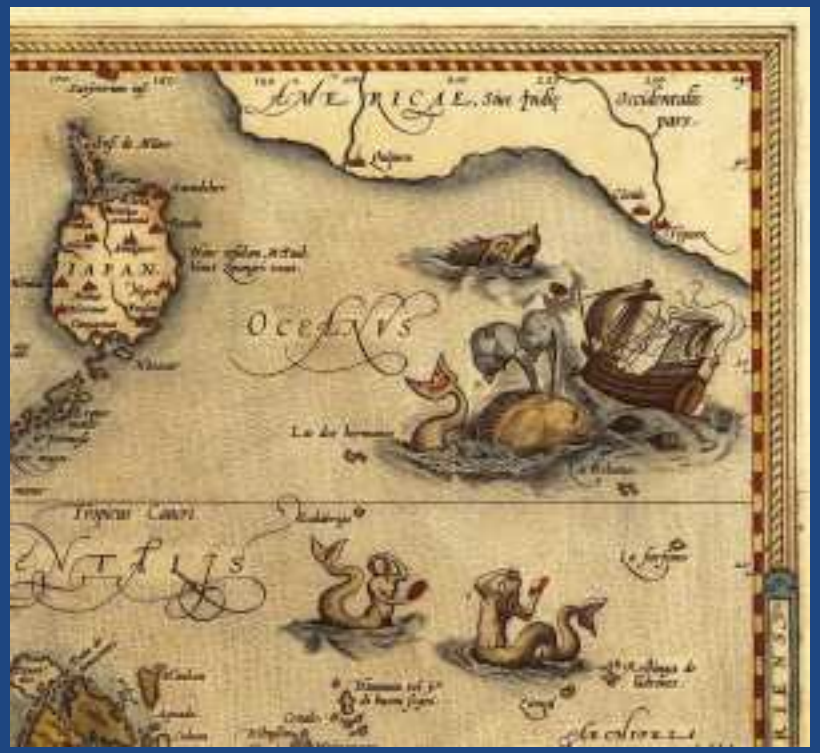
ABCD: Optional

- Which of the following is the best way to call this function?

```
Optional<Integer> getMin(List<Integer> data);
```

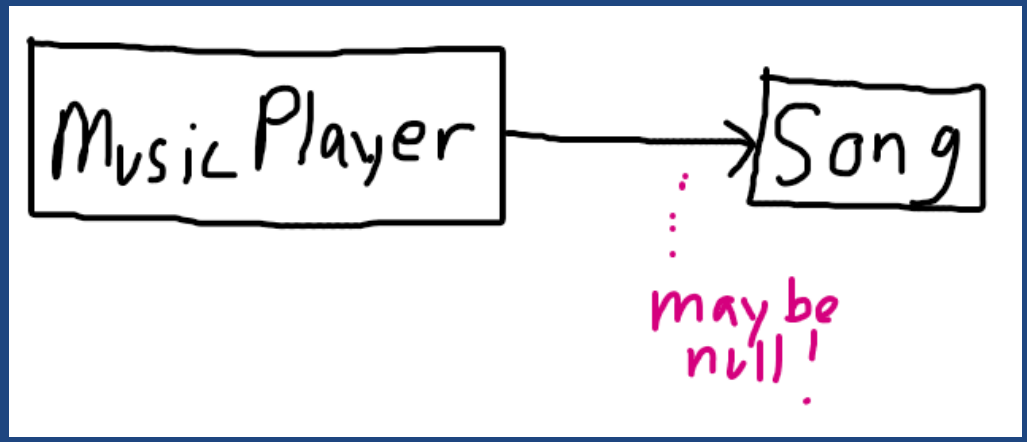
```
a) int m = getMin(data);
b) int m = getMin(data).orElse(-1);
c) int m = getMin(-1).orElse(data);
d) int m = data.getMax().orElse(-1);
```

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, ...

Many Null Checks

```
public class User {
    // ... some code omitted
    private Logger logger;

    public User(Logger logger) {
        this.logger = logger;

        if (logger != null) {
            logger.log("Constructing");
        }
    }

    public String getName() {
        if (logger != null) {
            logger.log("getName");
        }
        return name;
    }

    public int getAge() {
        if (logger != null) {
            logger.log("getAge");
        }
        return age;
    }

    ...
```

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,
    ..

NullObject

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

- Code Demo: avoiding_nulls/initial
  - User has a Logger (or not!)
    - Compare 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