Abstraction

November 8, 2019

https://en.wikipedia.org/wiki/Abstract_nonsense

Theories of Abstraction

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- Abstraction in visual art is about avoiding concrete subjects. It attempts to convey something (often an emotion) without appealing to sentiment.
- Oddly enough there's a bit of a stigma against it, despite the fact that music without lyrics has far less stigma.
- Abstraction in mathematics and computer science is about *generalization*. Take away the concrete details of certain objects and see how they are similar.

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- Although categorical abstractions are powerful, I will not discuss them much (and most of the really powerful abstractions go over my head).
- But we will study abstraction from a less mathematical viewpoint.
- I will show instances of *almost identical* code and how a programming language feature allows the two pieces of code to be generalized.

Buddy Functions

Let's consider the following functions in Java:

```
public boolean HasSmith(List<String> names) {
  for (String name : names) {
    if (name == "Smith")
      return true;
  }
  return false;
}

public  boolean HasBob(List<String> names) {
  for (String name : names) {
    if (name == "Bob")
      return true;
  }
  return false;
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  for (String name : names) {
    if (name == "Bob")
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}
```

These look pretty similar, right?

Eliminate Redundancy!

So, let's eliminate the redundancy of searching for different names by abstracting out towards a definition that takes in a string parameter to search for. This generalizes writing functions to search for specific strings.

```
public boolean HasName(String searchName, List<String> names) {
  for (String name : names) {
    if (name == searchName)
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- Why only design a function that searches for names?
- Why not search for arbitrary items so long as they are comparable?

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- Why only design a function that searches for names?
- Why not search for arbitrary items so long as they are comparable?
- Then searching for names becomes an instance of a more general problem that is solved.

Generic Structure

So, let's use some Java *generics* to generalize our program.

```
public <T extends Comparable<T>> boolean HasItem(T searchItem, List
for (T item : items) {
  if (item.equals(searchItem))
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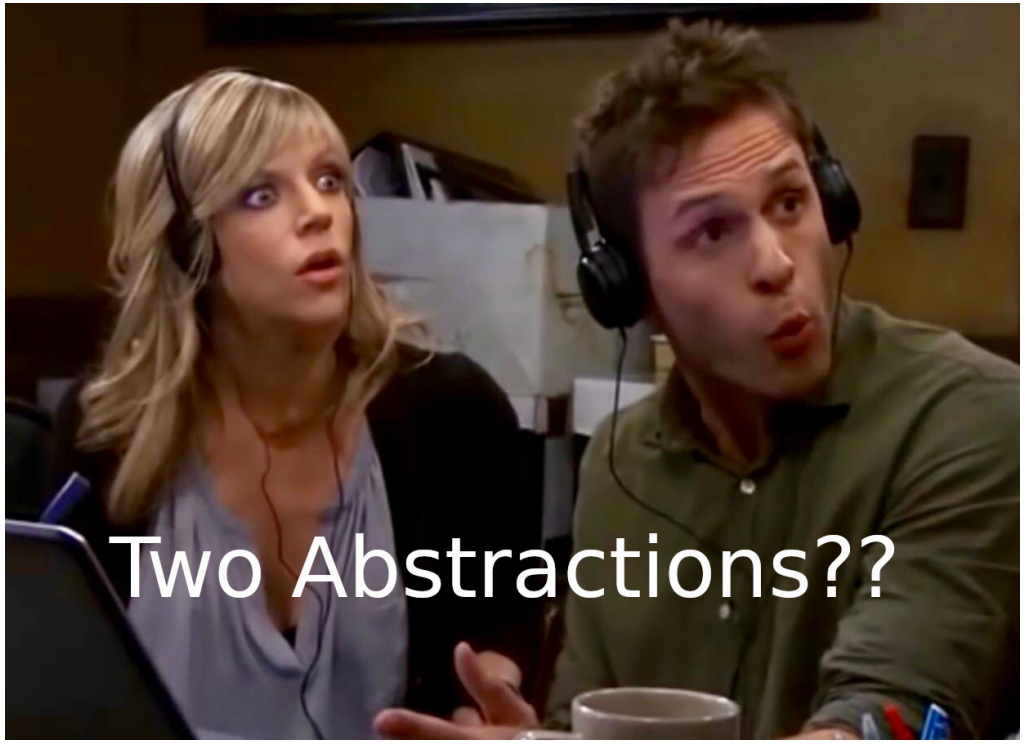
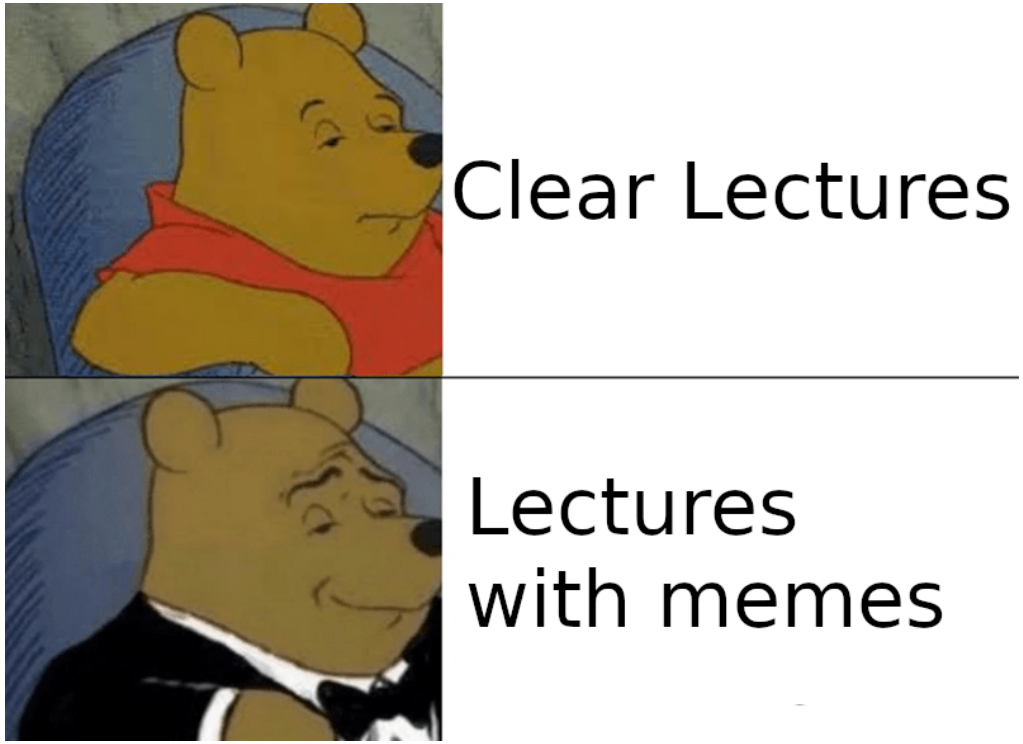
- This is nice and general!
- Can we generalize any more?
- We actually have 2 more abstractions that we can apply!

Two Abstractions??



I'm Sorry



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Predicate<String> isSmith = str -> str == "Smith";
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- We can actually consider searching for a specific item via equality as the process of seeing if an arbitrary predicate returns true for an item in a list.
- So if we wanted to check if a string equaled smith we could write:
```
Predicate<String> isSmith = str -> str == "Smith";
```
- I could then pass this as the first argument to a funciton `TestItems` that I will now define.

Last Abstraction

Here is that function now:

```
public <T extends Comparable<T>> boolean TestItems(Predicate<T> pre
for (T item : items) {
  if (pred.test(searchItem))
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