Real-world Software Patterns

CSE331 – Autumn 2020

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Based on slides by: Jared Moore

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Software patterns

In this class, we teach you to recognize a pattern and apply its solution.

We ask you:

▶️ To go from finding a bug to using a debugger,

▶️ To go from implementing a method to reasoning about that method by writing tests for it,

▶️ Or to go from repeating yourself in the methods of various objects to defining inheritance.

Why do this?

There are many answers. Some include:

▶️ because we say so,

▶️ because it often increases computational efficiency,

▶️ and because it often increases efficiency more generally.

But....

Why do this?

▶️ there’s a limit to the number of helpful tests to write,

▶️ inheritance doesn’t always prevent repeated code,

▶️ and what’s efficient for one isn’t always efficient for all. So, today we’ll discuss the ‘why’ of software engineering.

A software ethic

You have learned to be “ethical” software engineers.

▶️ (Where “ethics” is doing good according to the practices and culture of software engineering.)

But what about when these practices of software engineering run into the real world?

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Real-World Patterns

Looking for real-world patterns

Consider, for example:

▶️ APIs which compromises individual privacy,
▶️ software which enforces a gender binary,
▶️ and user interfaces unusable by people with different abilities.

Looking for real-world patterns

What if we could recognize design patterns not just in software but also in how software interacts with the real world?

Looking for real-world patterns

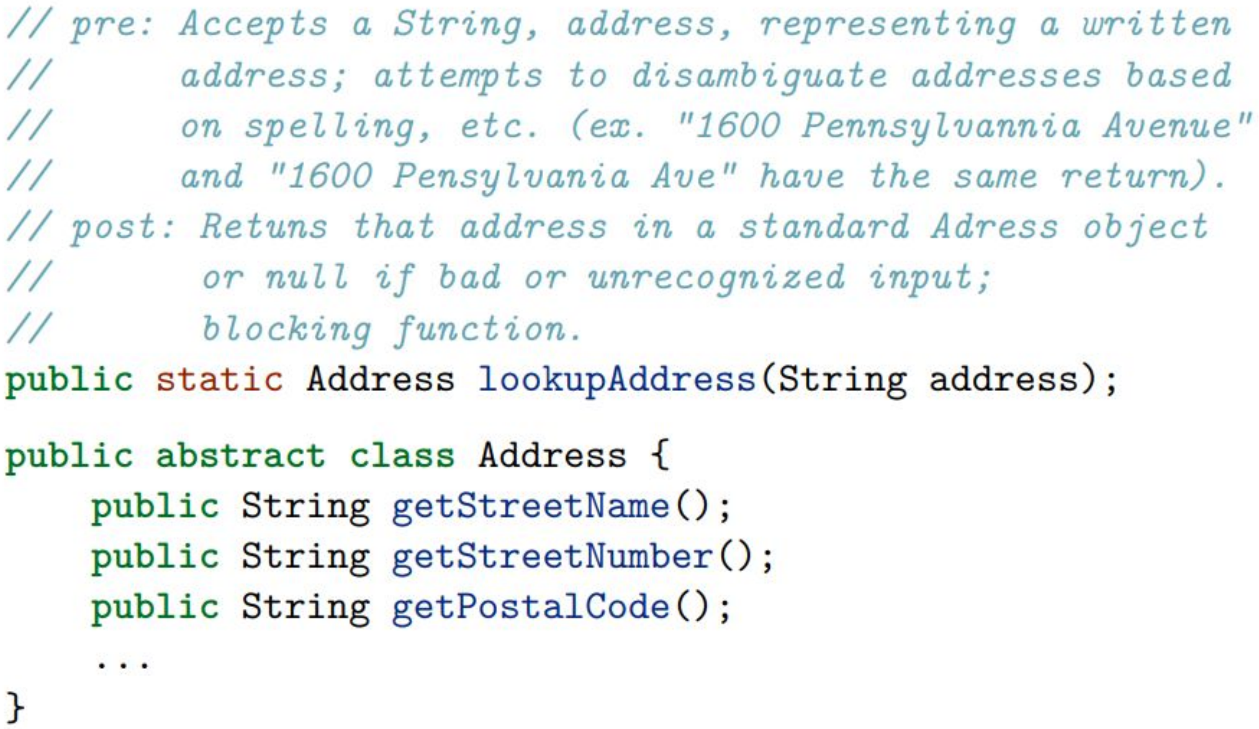
What about for:

▶️ accessibility (e.g. sightedness, handedness, mobility, deafness, and many more),
▶️ diversity (e.g. race, gender, sexuality, age, learning style, and many more),
▶️ or privacy (e.g. of individual data, of trends, from certain groups, and many other facets)?

(We might look for many other patterns besides.)

Applying those patterns

Let’s consider the following API:



```
// pre: Accepts a String, address, representing a written
//       address; attempts to disambiguate addresses based
//       on spelling, etc. (ex. "1600 Pennsylvannia Avenue"
//       and "1600 Pensylvania Ave" have the same return).
// post: Retuns that address in a standard Adress object
//        or null if bad or unrecognized input;
//        blocking function.
public static Address lookupAddress(String address);

public abstract class Address {
    public String getStreetName();
    public String getStreetNumber();
    public String getPostalCode();
    ...
}
```

Applying those patterns

Pause the video and think of the following questions:

What if.....

Applying those patterns

- ▶️lookupAddress saves all of the addresses it receives?
- ▶️ lookupAddress stores timestamps and meta-data on queries?
- ▶️ lookupAddress sends all of that information to a web-server?
- ▶️ a user of lookupAddress is recognizable based on their misspellings (e.g. always writes “Pensylvania”)?
- ▶️ or lookupAddress is used for sensitive addresses (e.g. domestic violence survivors, government dissidents)?

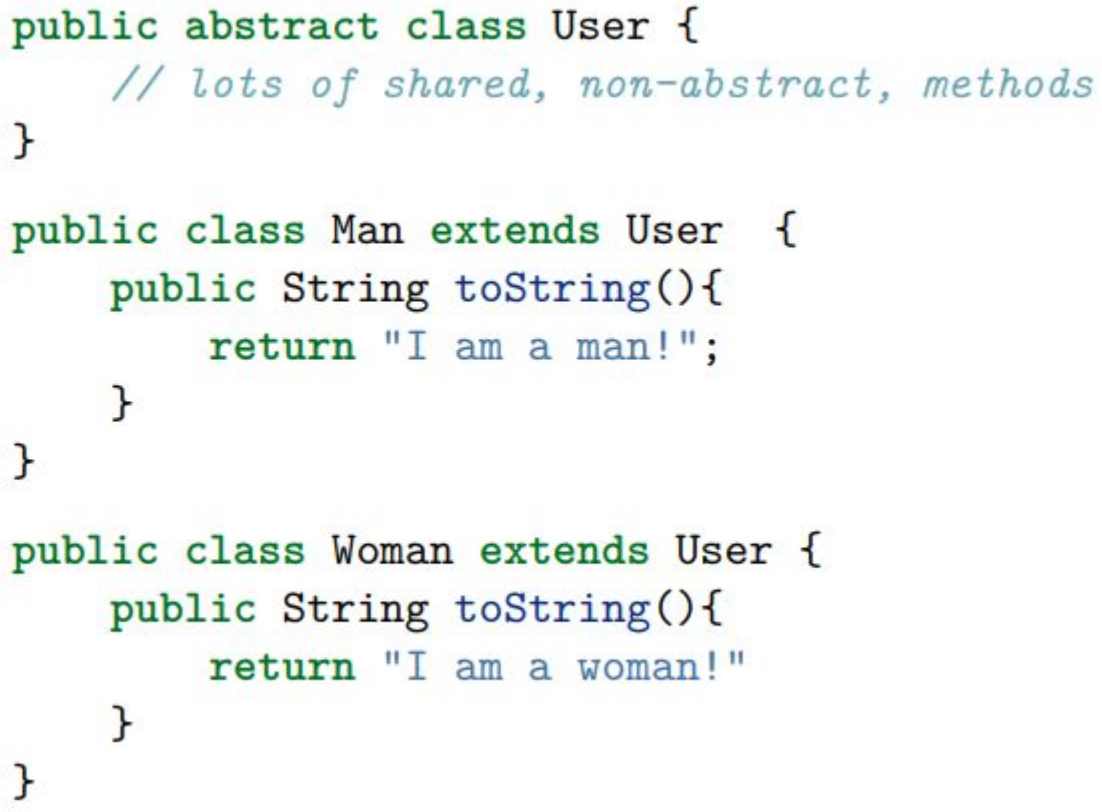
Conclusion

When we pay attention to privacy we sometimes find issues with our good software engineering practices like abstraction**.**

Inheritance and diversity

Inheritance and diversity

Let’s consider the following implementations of User.



```
public abstract class User {
    // lots of shared, non-abstract, methods
}

public class Man extends User  {
    public String toString(){
        return "I am a man!";
    }
}

public class Woman extends User {
    public String toString(){
        return "I am a woman!"
    }
}
```

Inheritance and diversity

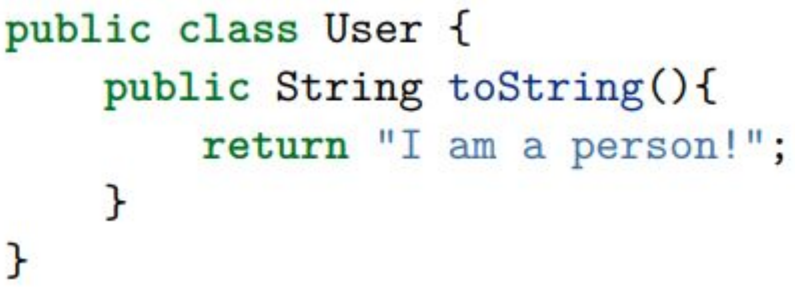
Let’s pause the video and think of the following:

▶️What might be the motivation to use a software pattern in this way?

▶️ What might an understanding of gender say about such a use of inheritance?

Inheritance and diversity

Does this ‘fix’ the problem?



```
public class User {
    public String toString(){
        return "I am a person!";
    }
}
```

Inheritance and diversity

What if:

▶️ another part of the application requires a user to be either a Man or a Woman? (e.g. a sorting function, a key in a database)

▶️ a user considers their gender mutable?

▶️ gender identity is inferred by the program as opposed to provided to it?

▶️ we allow gender identities besides Man, Woman, or none?

Conclusion

▶️ When we pay attention to diversity (here, gender) we sometimes find issues with our good software engineering practices like inheritance.

(For more check out [this poster] from an Allen School alum!)

Campus Paths and accessibility

Campus Paths and accessibility

Now let’s think a little more open ended. Recall the Campus Paths assignment. What might we say about Campus Paths regarding the pattern of (in)accessibility?

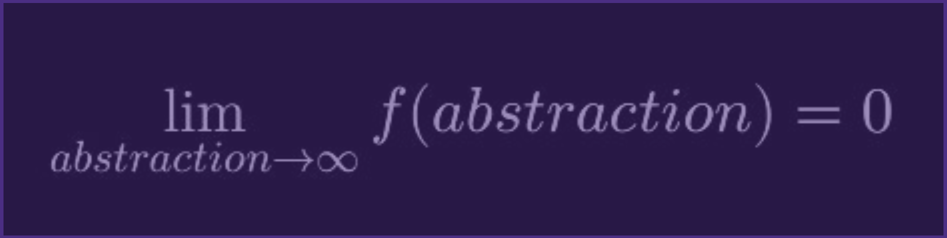
Campus Paths and accessibility

Let’s Pause the video and think of the following questions:

- ▶️Does Campus Paths have assumptions that favor some people over others?
- ▶️ (If you’re stuck: when might someone not prefer the shortest path? Why?)
- ▶️ What are those assumptions?
- ▶️ Did you notice these assumptions as you completed your assignment?
- ▶️ What could, should, or would you do about these assumptions? What should we do?

Conclusion

When we pay attention to accessibility **we sometimes find issues with our good software engineering practices like a** generic **user.**



$$\lim_{abstraction \to \infty} f(abstraction) = 0$$

Evaluating the limit of abstraction

Evaluating the limit of abstraction

Computer science is a function of abstraction:

▶️ "give me your parameters and returns," we say "not your implementation details";
▶️ "let's just assume that memory is infinite";
▶️ "how about we treat all users as the same for now."

Evaluating the limit of abstraction

Evaluating the limitations of abstraction is hard

▶️ (But such evaluation is the essence of computer science!)

So what do we do—simplify the world so we can find a closed-form optimum for it? Do we ignore the difficulties posed by abstraction? No, we critically design, test, and revise our abstractions and our design patterns to form new patterns and new abstractions.

“I Object!”

“I Object!”

“Okay, I get it,” you say, “but you haven’t told us what to do about these ‘real-world’ patterns; they aren’t fixable.”

“I Object!”

- Don’t we deal with constraints all the time?
    - (e.g. writing a good spec)
- Even when there are no ‘fixes’ often acknowledging shortcomings is enough.
    - (e.g. error messages)

“I Object!”

“Okay, I get it,” you say, “but recognizing these ‘real-world’ patterns isn’t my job; I’m just a software engineer.”

“I Object!”

- ▶️ Often these patterns occur because of software engineering and, as software engineers, we understand the software best.
- ▶️ So, whose ‘job’ is it to recognize these patterns but our own?

Learning to see, then learning to fix

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Learning to see, then learning to fix

Ask yourself:

▶️ Can you recognize not just software patterns but also patterns about the use of software in the world?

▶️ Can you communicate your technical choices to decision-makers? (When it is someone else's 'job' to decide.)

▶️ Can users, peers, colleagues, non-users, etc. communicate their needs to you?

Learning to see, then learning to fix

If not, you can learn. (After all, you did learn how to recognize software patterns.)

Thank You!

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