CMPT 373
Software Development Methods

Complexity

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  - We want to talk about goals for software
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Laying a foundation

- Our goal for this lecture is pretty abstract.
  - We want to talk about goals for software
  - But we aren't going to look at much code
- Instead, I want to lay a foundation that you should keep in mind consistently as we consider code throughout the course.

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- Our intuition may capture these, but software complexity is nuanced

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- A modern classic example is monolith vs microservices

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- Good judgment involves writing code that can cope with evolution

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- But I will still change requirements on you deliberately

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- If we want to judge and assess it, it would be nice to define it but… we don't have a single good answer. It is openly researched & debated.
- The goal is to capture the idea that software is hard to work with.
- There are some classic definitions & even tools to check them.

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if c1:
    ...(x)
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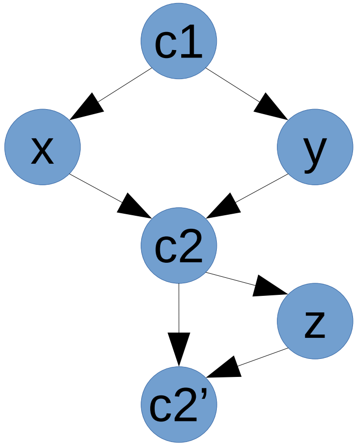

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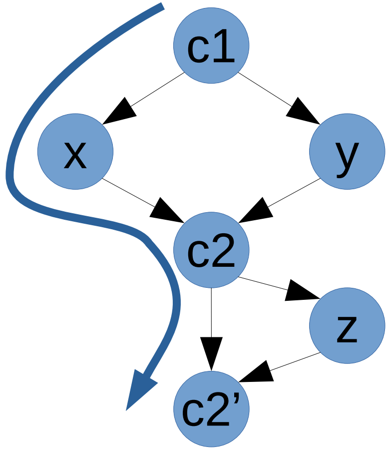

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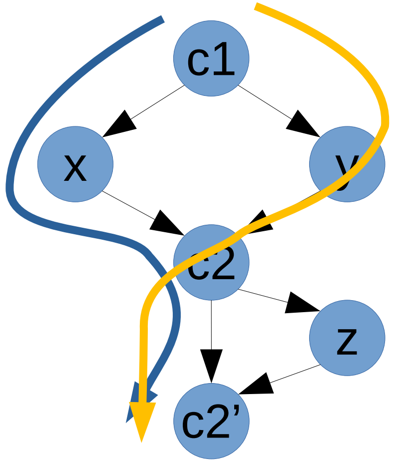

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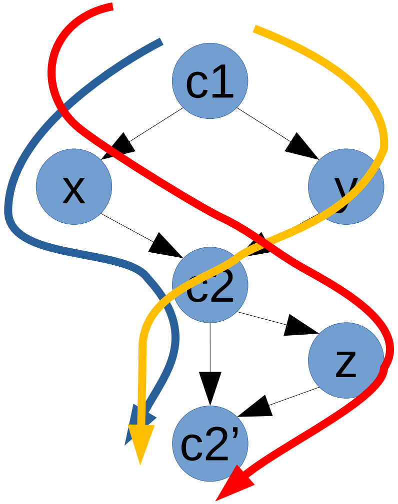

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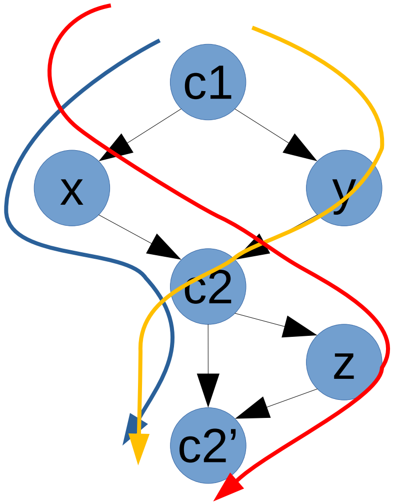

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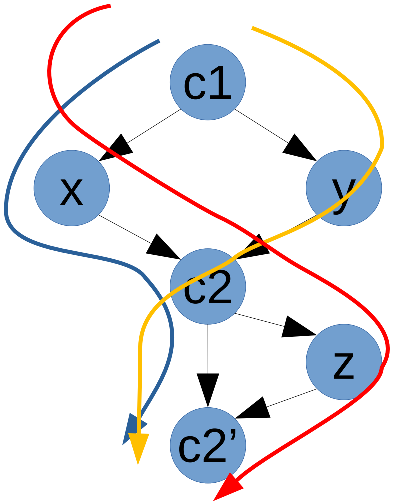

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M = 7 – 6 + 2*1 = 3

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- These are easily automated & some companies use them. Are they good?
  - Well, not really

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void foo() {
  if (c1) { m } else { n }
  if (c2) { o } else { p }
  if (c3) { q } else { r }
  if (c4) { s } else { t }
  return;
}
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M = 16 – 13 + 2*1 = 5

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```
void mn() { if (c1) { m } else { n } }
void op() { if (c1) { o } else { p } }
void qr() { if (c1) { q } else { r } }
void st() { if (c1) { s } else { t } }

void foo() {
  mn();
  op();
  qr();
  st();
  return;
}
```

M = 4 – 4 + 2*1 = 2

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M = 0 – 1 + 2*1 = 1

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  - is as effective
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- This is still clearly limited in meaning, so it isn't on the track we want

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[Watch "Simple Made Easy" for more on this perspective]

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[Watch “Simple Made Easy” for more on this perspective]

- We also have some general forms of complexity to consider
  - Inherent (essential) complexity
  - Incidental (accidental) complexity

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- We can then look for common causes to attack them
  - *Dependencies*
    Code cannot be understood in isolation because of relationships to other code.
  - ***Obscurity***
    Important information about code is not obvious.

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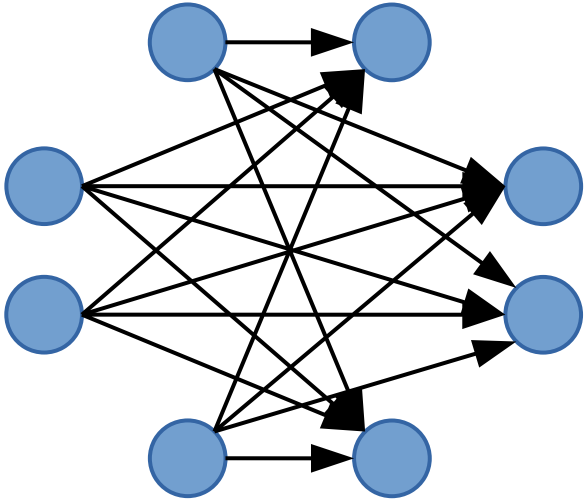

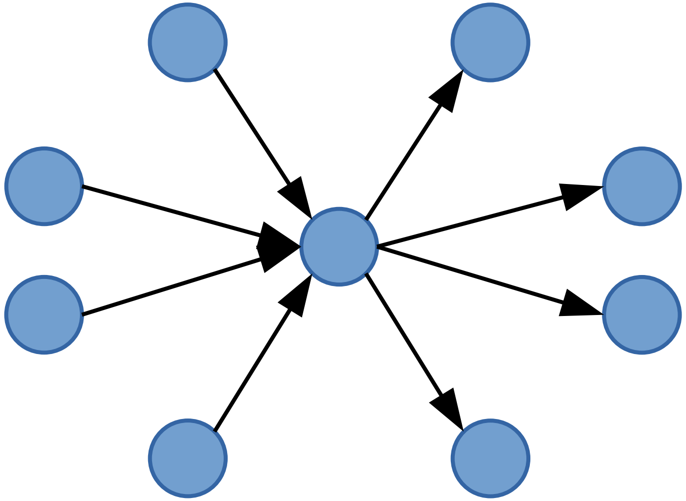

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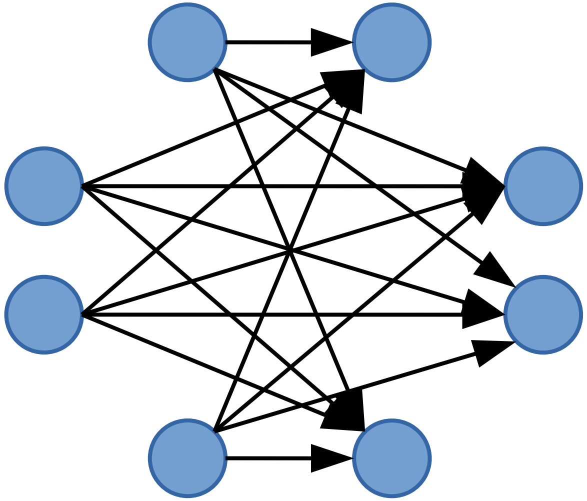

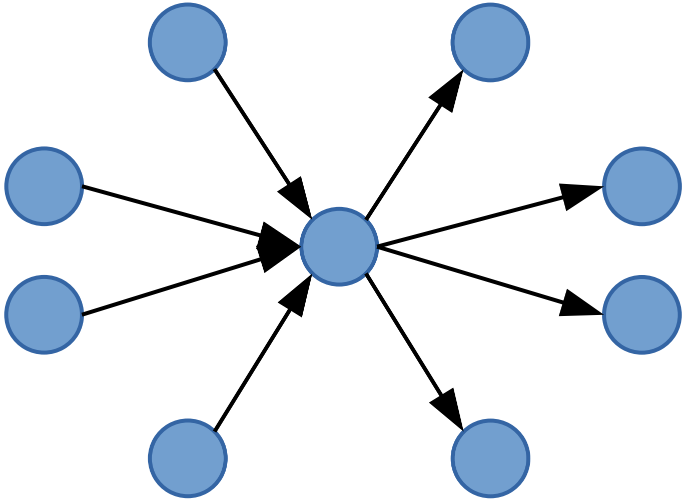

Why?

Signs of complexity

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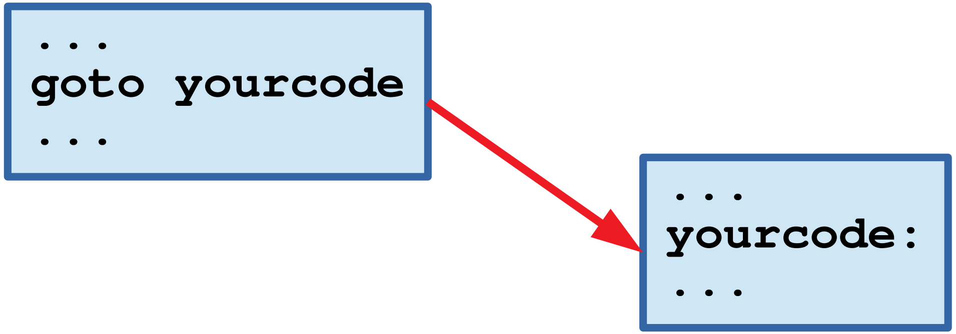
    - Content (accessing implementation of another component)



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```
... = global
```

```
int global = ...
```

```
global = ...
```

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```

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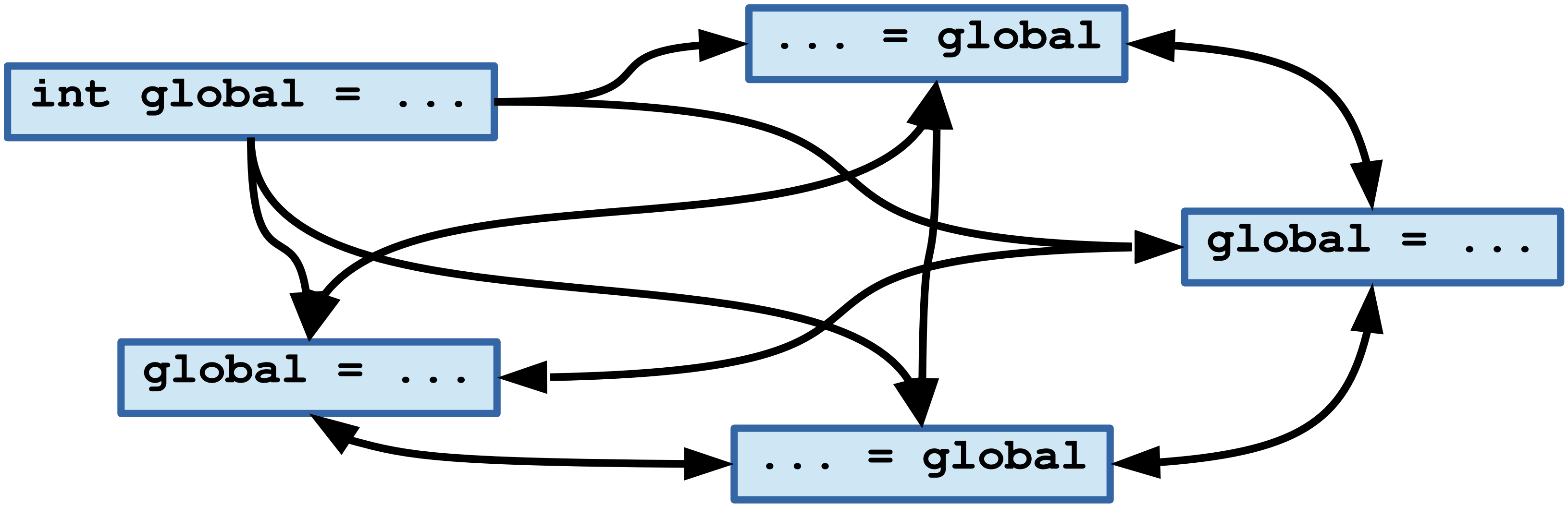

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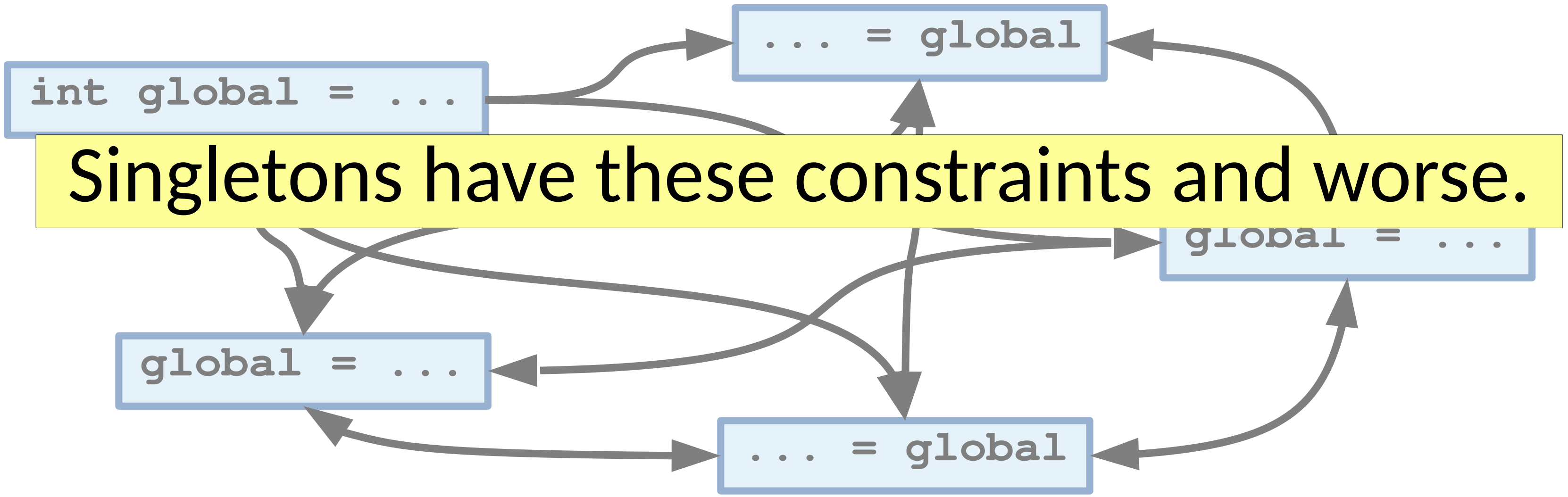

Singletons have these constraints and worse.

Signs of complexity

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  - Coupling
    - Content
    - Common global data
    - Subclassing

We will spend a day in the future on this.

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Cat cat = new Cat;
...
delete cat;
```

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```
Process p;
p.doStep1();
p.doStep2();
p.doStep3();
```

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Process p;
p.doStep1();
p.doStep2();
p.doStep3();
```

```
Process p;
p.foo();
p.bar();
p.baz();
```

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This is more insidious!

Signs of complexity

- These may present themselves in many ways
  - Coupling
    - Content
    - Common global data
    - Subclassing
    - Temporal
    - Passing data to/from each other

```
x = foo(1,2)
```

```
def foo(a, b):
    ...
```

Signs of complexity

- These may present themselves in many ways
  - Coupling
    - Content
    - Common global data
    - Subclassing
    - Temporal
    - Passing data to/from each other
    - Independence

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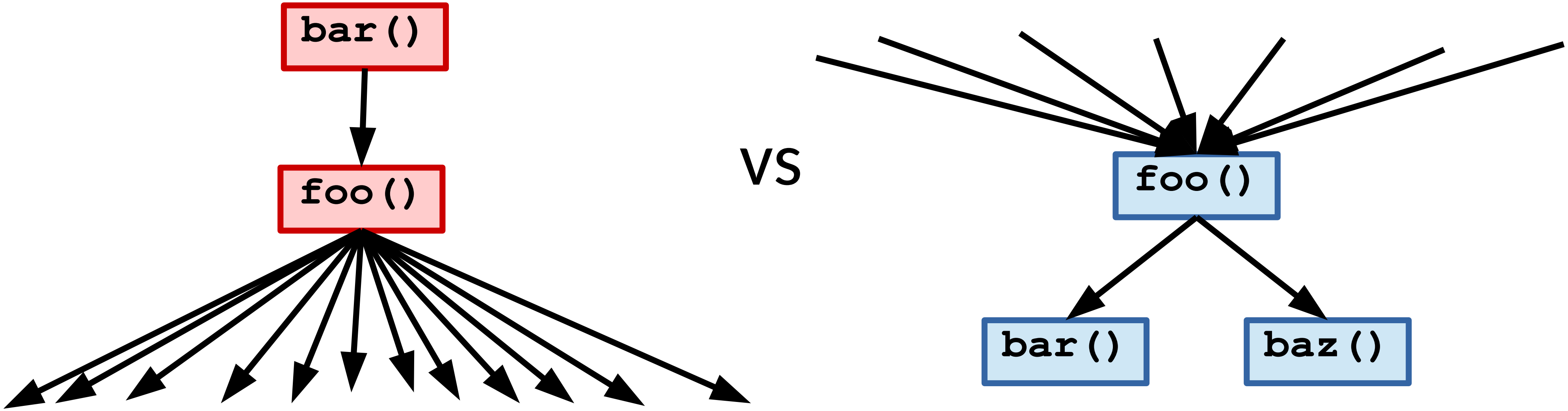
- These may present themselves in many ways
  - Coupling
  - Fan in vs fan out



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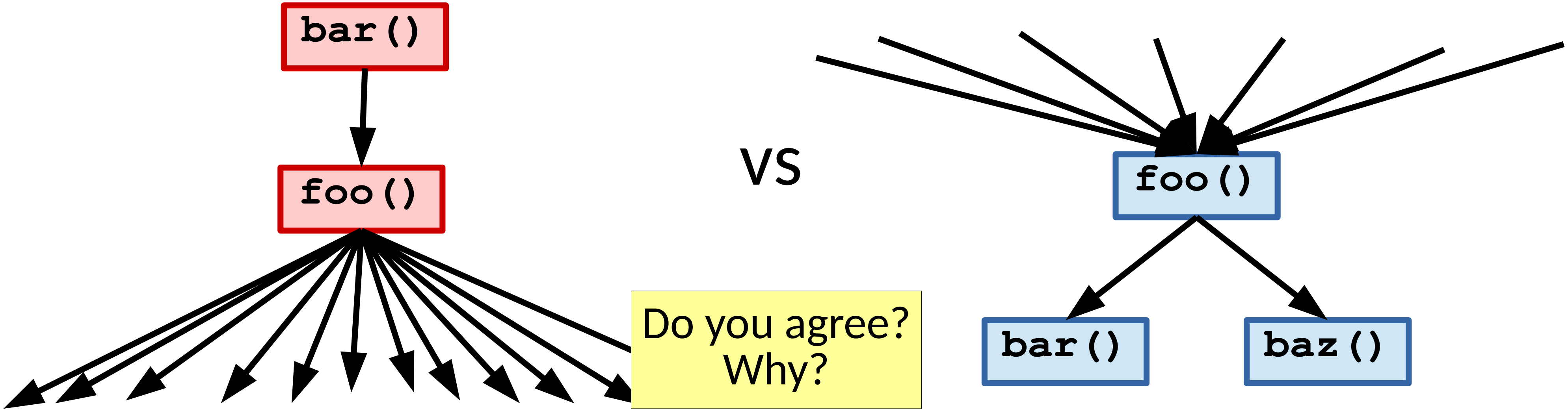

Signs of complexity

- These may present themselves in many ways
  - Coupling
  - Fan in vs fan out
  - Layers & stratification

& a consistent, self contained view per level

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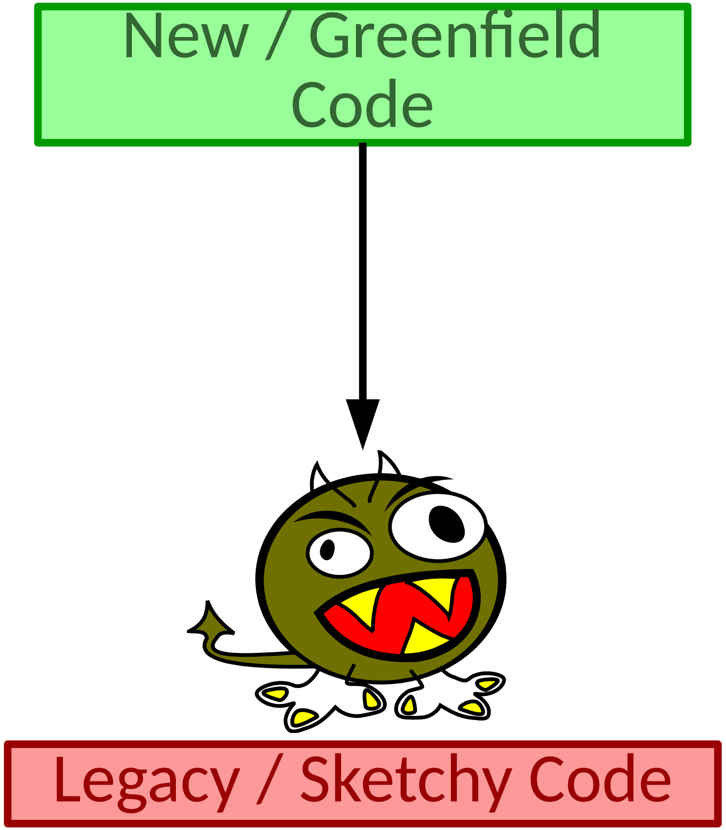

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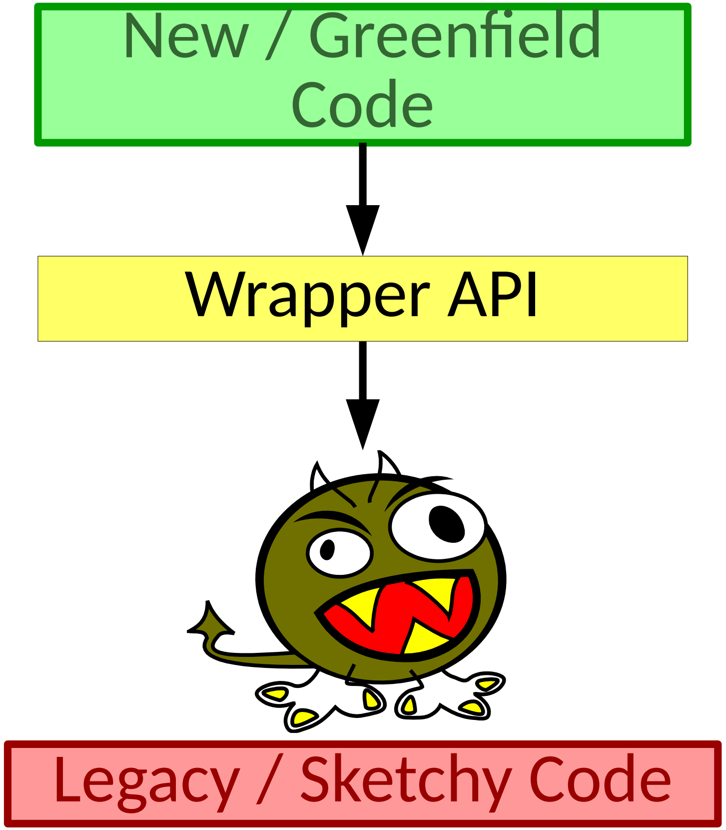

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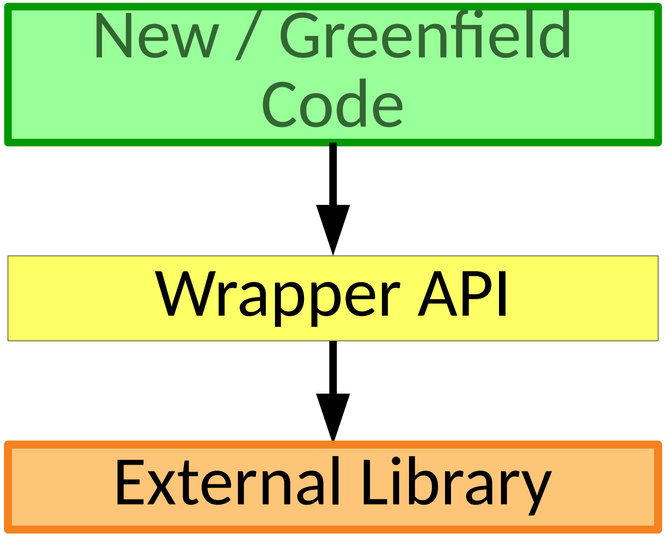

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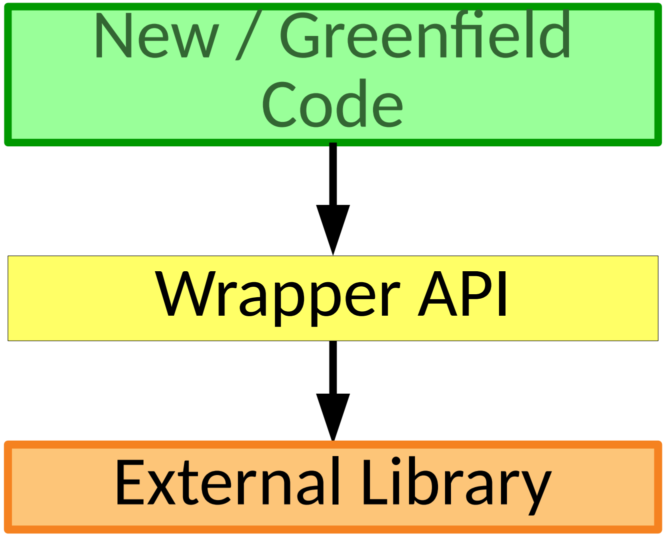
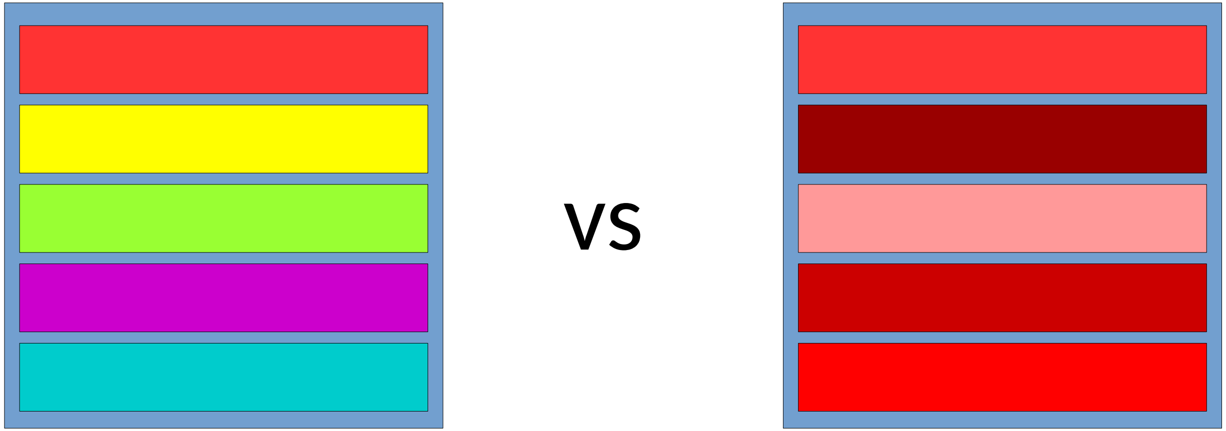


What impact does this have on invariants & types?

Signs of complexity

- These may present themselves in many ways
  - Coupling
  - Fan in vs fan out
  - Layers & stratification
  - Cohesion



Signs of complexity

- These may present themselves in many ways
  - Coupling
  - Fan in vs fan out
  - Layers & stratification
  - Cohesion
- These are only some of the signals.
  In fact you can analyze your workflow to search for other signs!

(Some) ways to seek out complexity [Tornhill 2015]

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  - Which files tend to change together?
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- More guidance can be found in “Your Code as a Crime Scene”

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  - Teams that *deliberately* manage it may become 50% faster. [Gartner]

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- Regret is part of the point.
  It indicates that you learned something along the way.

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- You should understand the high level challenges with complexity that we will be trying to address going forward
- You should understand that software engineering will involve *judgments* about trade offs and how to balance such objectives over time