

Software Engineering (Part 1)

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Objectives

- We will cover these software engineering topics:

Stages of SW dev

How to order the stages

- Requirements analysis
- Design
- Implementation
- Debugging
- Testing
- Evaluation
- Maintenance
- Process models

Software Engineering

- Composing code is a part of what a software engineer does
- Let's consider all of the parts...

You've decided to create a software system.
What's your first step?

Agenda

- **Requirements analysis**
- Design
- Implementation
- Debugging
- Testing
- Evaluation
- Maintenance
- Process models

Requirements Analysis

- *Requirements analysis*
 - **Who** are the system's users?
 - **What** should the system do to fulfill the users' needs?

What kinds of requirements should you gather?

Requirements Analysis: Kinds

- Always:
 - **Functional** requirements
- Sometimes:
 - **Performance** requirements
 - **Data** requirements
 - **Environmental** requirements
 - **Usability** requirements

How should you go about gathering those requirements?

Requirements Analysis: Gathering

- Questionnaires
- Interviews
- Focus groups
- Direct observation
- Studying documentation



Users visit
the programmers

Programmers visit
the users

Yvonne Rogers, Helen Sharp,
Jenny Preece. *Interaction Design:
Beyond Human-Computer
Interaction (3rd Edition)*. Wiley,
2011.

How should you structure the requirements that you've gathered?

Requirements Analysis: Structuring

- Create ***Scenarios***
 - A story describing a user interaction with the (anticipated) system to achieve some goal

Requirements Analysis: Structuring

- Create *Wireframes*
 - Low-tech
 - High-tech
- Arrange the wireframes in *Storyboards*

Requirements Analysis: Structuring

- Create (tentative) *database schema*
 - Tables, fields
 - Relationships among tables
 - Primary and foreign keys

Requirements Analysis: Structuring

- Create *Prototype(s)*
 - Low-fidelity
 - High-fidelity

You probably can't fulfill all of the user's requirements. And you certainly can't fulfill all of the user's requirements right away. How should you prioritize the requirements?

Requirements Analysis: Prioritizing

- The *MoSCoW method*
 - Define each system feature as:
 - **M**: must have
 - **S**: should have
 - **C**: could have
 - **W**: won't have (this time)

Requirements Analysis: Conclusion

- In the **academic** world:
 - Student programmers often are given requirements
- In the “**real**” world:
 - (Senior) programmers often must know how to **gather**, **structure**, and **prioritize** requirements

You've determined the kinds of requirements that are relevant, gathered them, structured them, and prioritized them. What should you do next?

Agenda

- Requirements analysis
- **Design**
- Implementation
- Debugging
- Testing
- Evaluation
- Maintenance
- Process models

Design

- *Design*
 - **How** should the system work?

How should you specify the system's design?

Design: Use Cases

- Create ***use cases***
 - A use case is an elaboration of a scenario
 - A use case is *detailed* enough to be testable by QA engineers

What heuristics should you keep in mind when designing the system?

Design: Heuristics

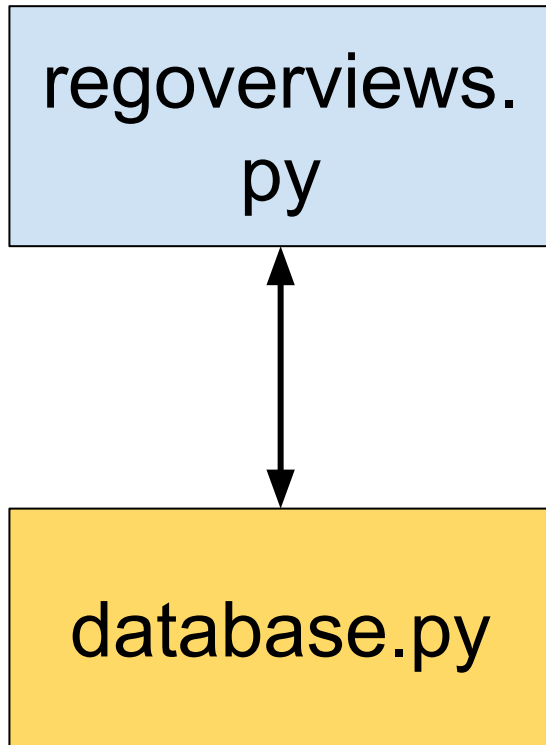
- **Use design heuristics**
 - Some are general
 - Some are specific to OO design

Design: General Heuristic 1

- Hide design decisions
 - D. L. Parnas. “On the Criteria To Be Used in Decomposing Systems into Modules”
 - <https://dl.acm.org/doi/pdf/10.1145/361598.361623>

Design: General Heuristic 1

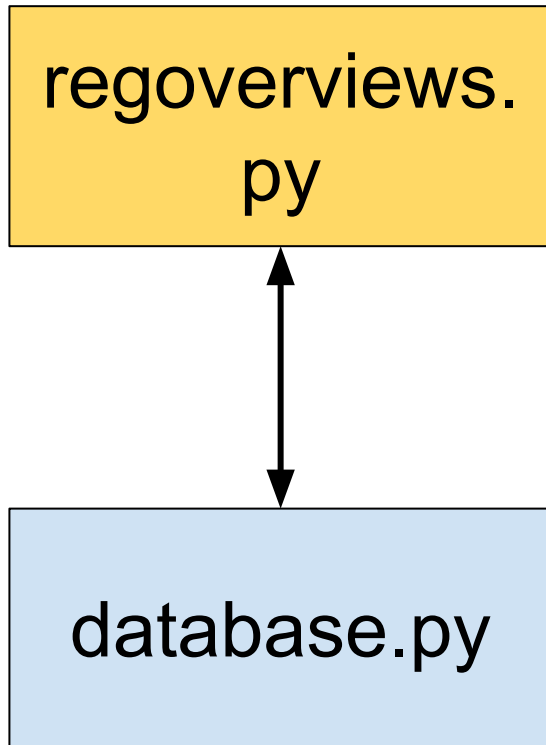
Asgt 1:



Hides design decisions
Which DBMS?
What table schema?
...

Design: General Heuristic 1

Asgt 1:



Hides design decisions
Command-line UI?
Web app UI?
Desktop/laptop UI?
...

Design: General Heuristic 2

- (Kernighan) **Detect** errors low; **handle** errors high
- (Dondero) **Detect** errors low; **handle** errors as low as you can

Brian W. Kernighan and Rob Pike.
The Practice of Programming.
Addison-Wesley. Reading, MA, 1999.

Design: General Heuristic 2

(A) Asgts: database.py

```
def get_overviews(query) :  
    ...  
    try:  
        Use the database.  
        ...  
        Return the class overviews.  
    except Exception as ex:  
        Write error msg to stderr.  
        sys.exit(1)
```

Design: General Heuristic 2

(B) Asgts: database.py

```
def get_overviews(query):  
    ...  
    Use the database.  
    ...  
    Return the class overviews.
```

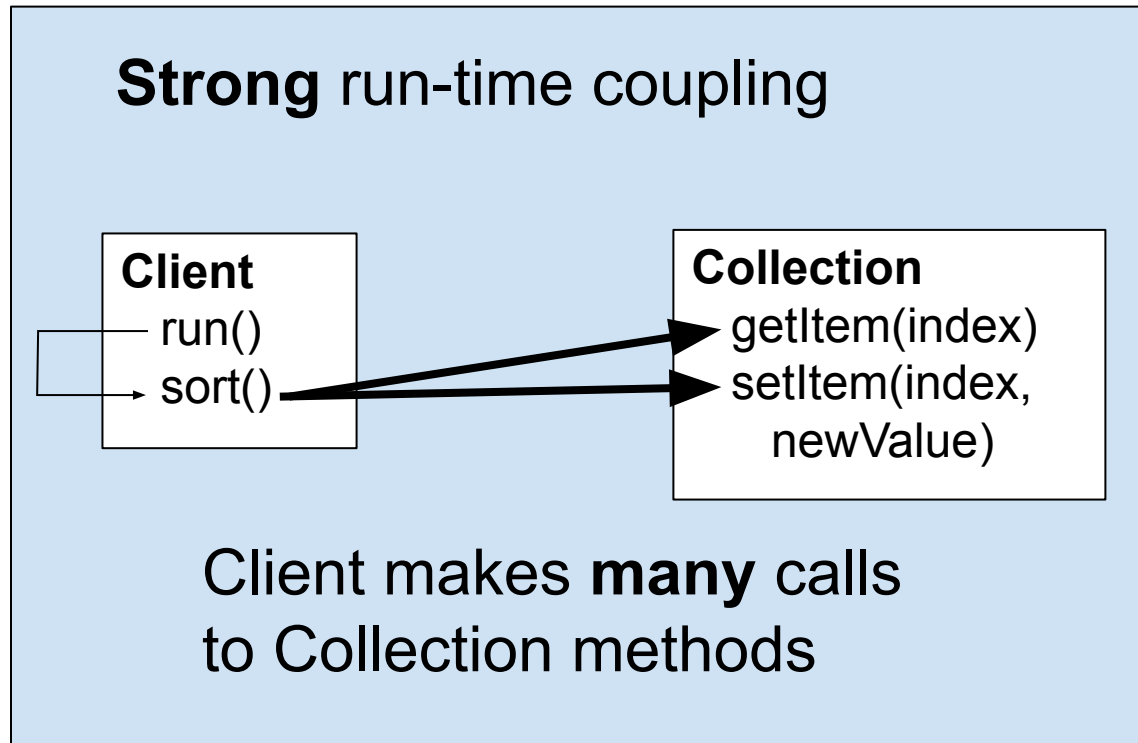
Design: General Heuristic 3

- Seek *weak coupling* among modules
 - Minimize interfaces
 - Encapsulate data
 - Encourages design decisions hiding
 - Empirically: **significant**

Design: General Heuristic 3.1

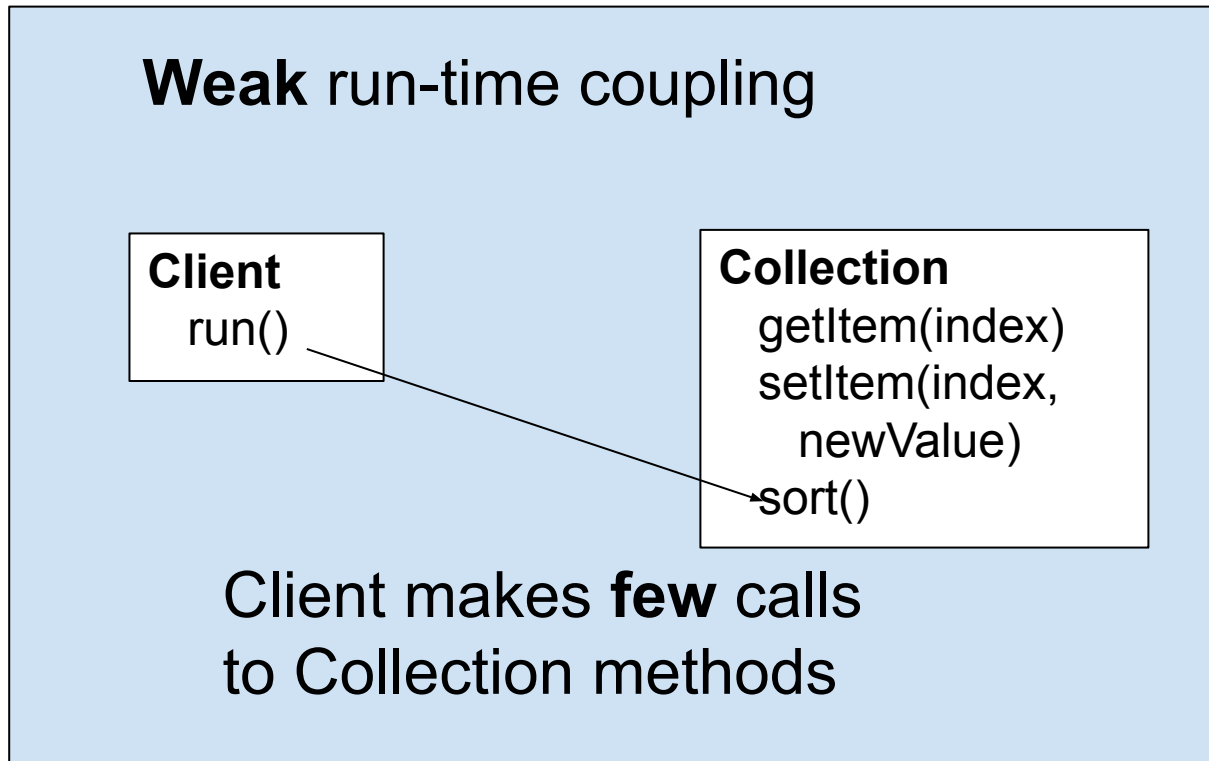
- Seek weak *run-time coupling*

Design: General Heuristic 3.1



No!

Design: General Heuristic 3.1



Yes!

Design: General Heuristic 3.1

(A) Asgts: database.py

```
class Database:
    def __init__(self):
        self._classes = []
    ...
    def connect(self):
        ...
    def get_overviews(self, query):
        Assign the class list to self_classes.

    def get_class(self, i):
        return self_classes[i]

    ...
    def disconnect(self):
        ...
```

Design: General Heuristic 3.1

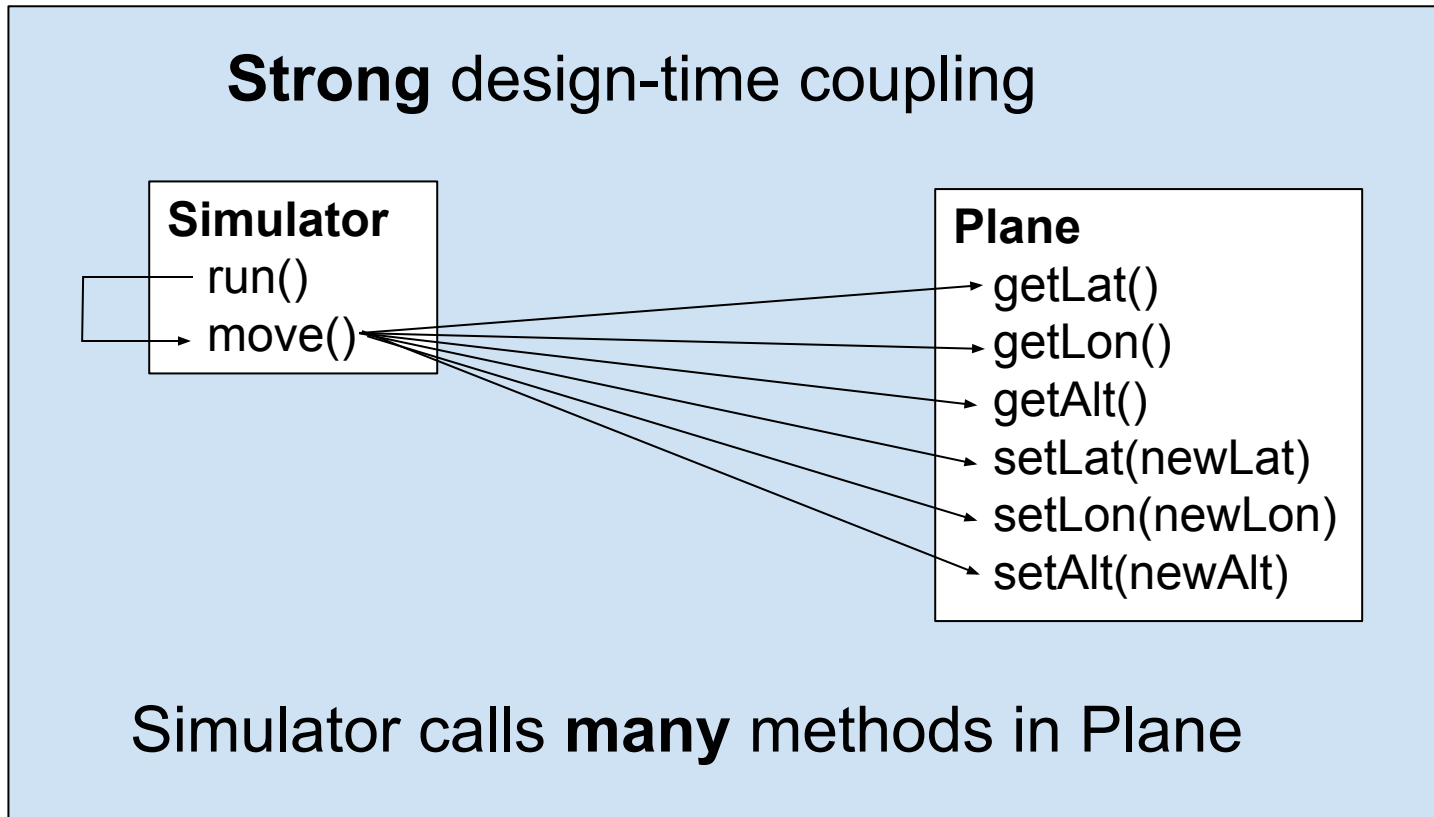
(B) Asgts: database.py

```
class Database:
    def connect(self):
        ...
    def get_overviews(self, query):
        Return the class list.
    ...
    def disconnect(self):
        ...
```

Design: General Heuristic 3.2

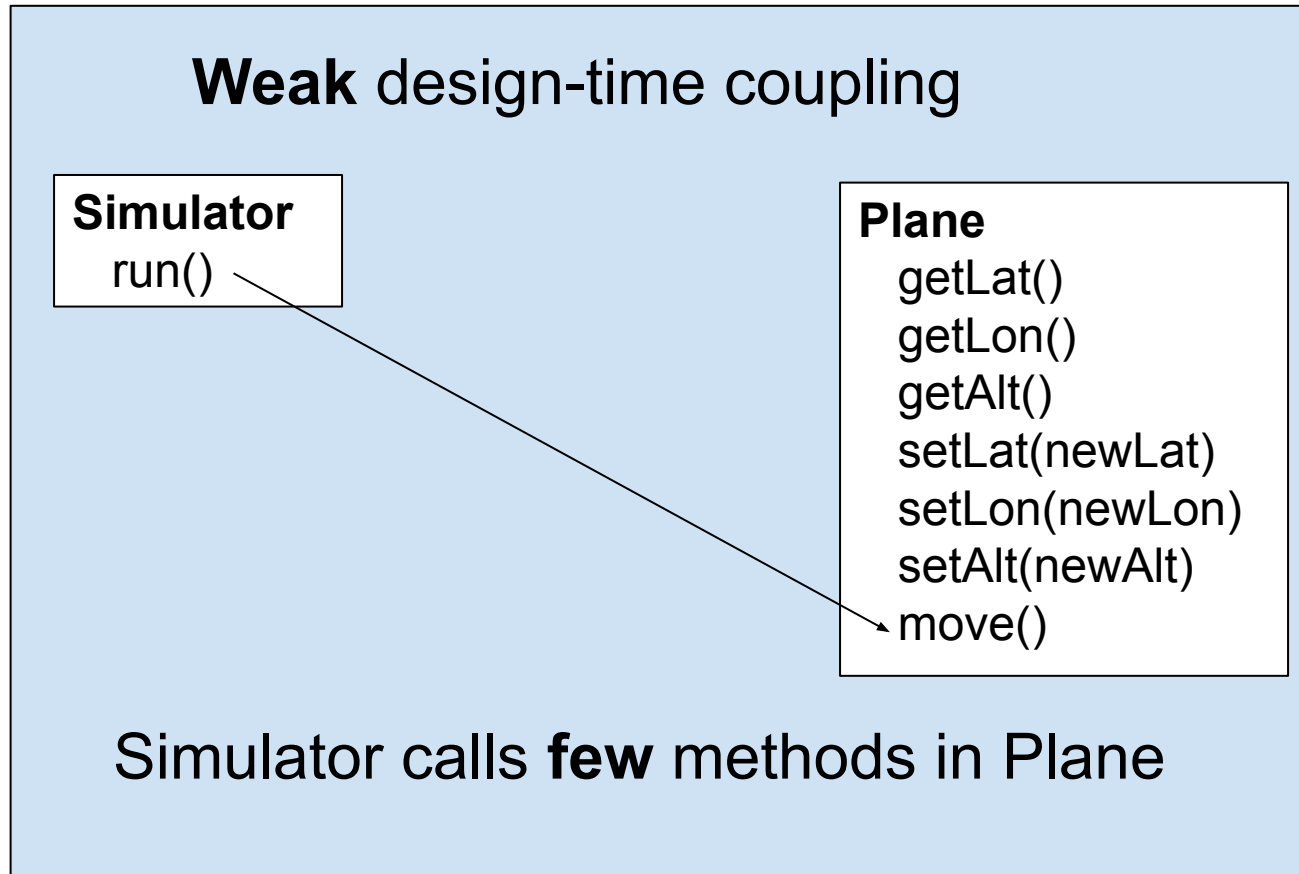
- Seek weak *design-time coupling*

Design: General Heuristic 3.2



No!

Design: General Heuristic 3.2



Yes!

Design: General Heuristic 3.2

(A) Asgts: database.py

```
def get_overviews(query):  
    Connect to the database.  
    Perform the query.  
    Disconnect from the database.  
    Return the class overviews.  
  
def get_details(classid):  
    Connect to the database.  
    Perform the query.  
    Disconnect from the database.  
    Return the class details.
```

Design: General Heuristic 3.2

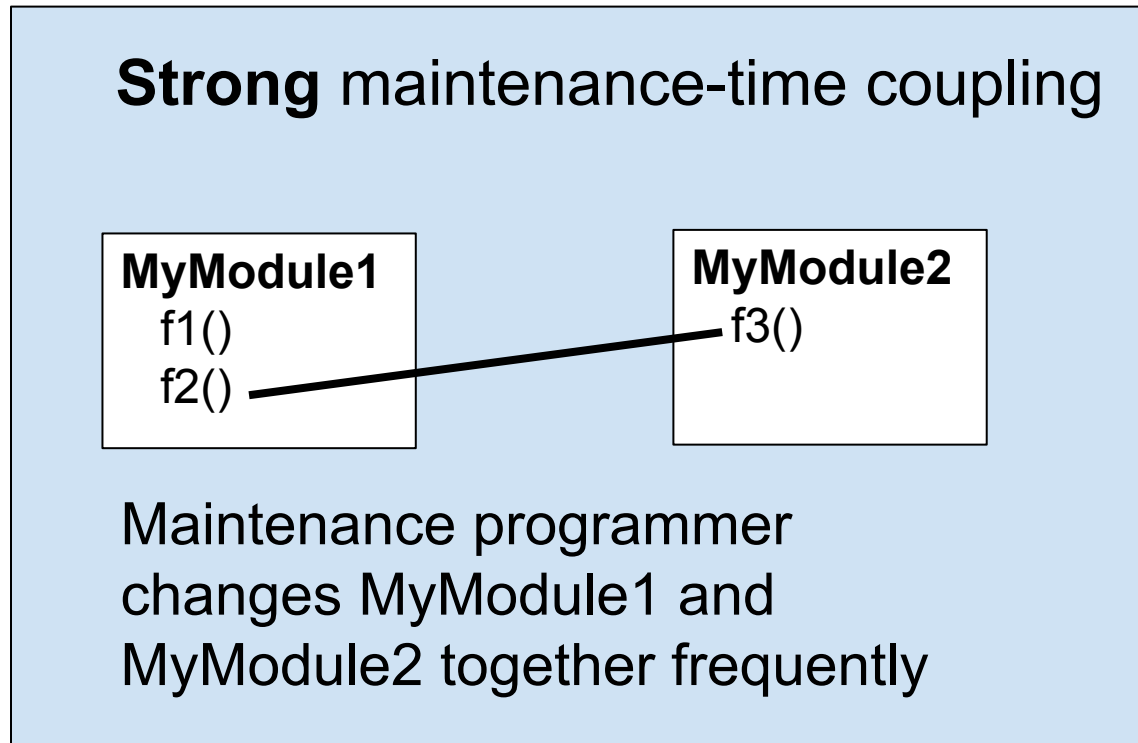
(B) Asgts: database.py

```
class Database:
    ...
    def connect(self):
        Connect to the database.
    def get_overviews(self, query):
        Perform the query.
        Return the results.
    def get_details(self, classid):
        Perform the query.
        Return the results.
    def disconnect(self):
        Disconnect from the database.
```

Design: General Heuristic 3.3

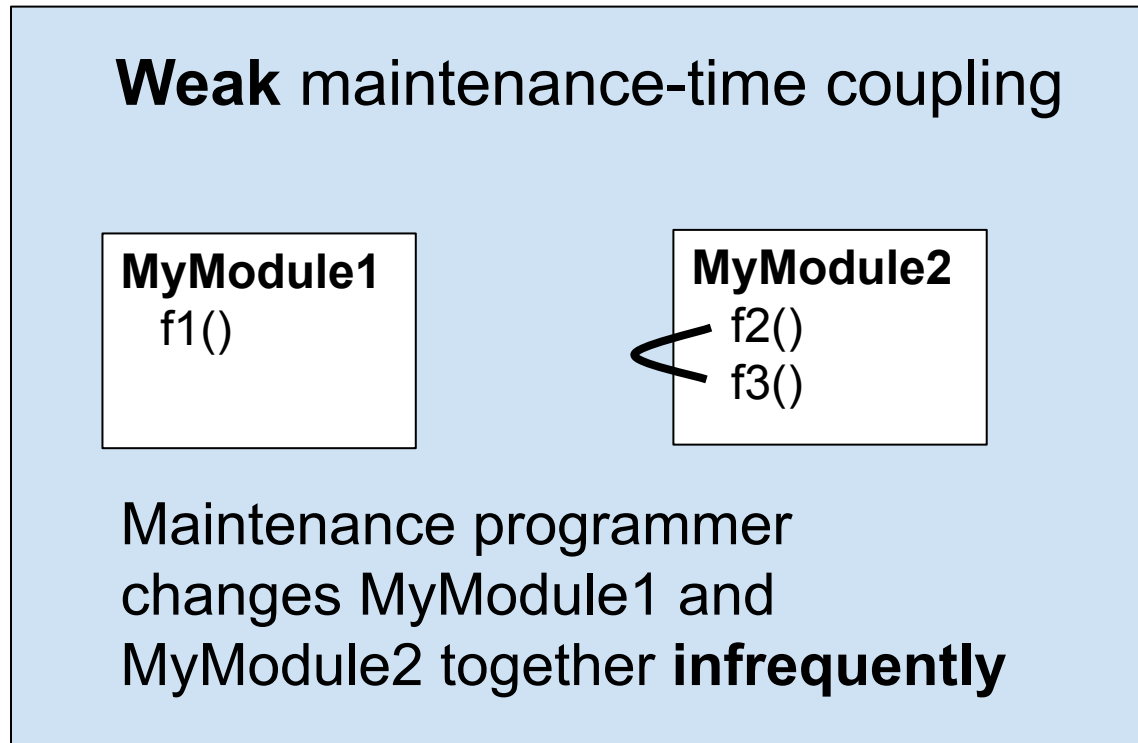
- Seek weak *maintenance-time coupling*

Design: General Heuristic 3.3



No!

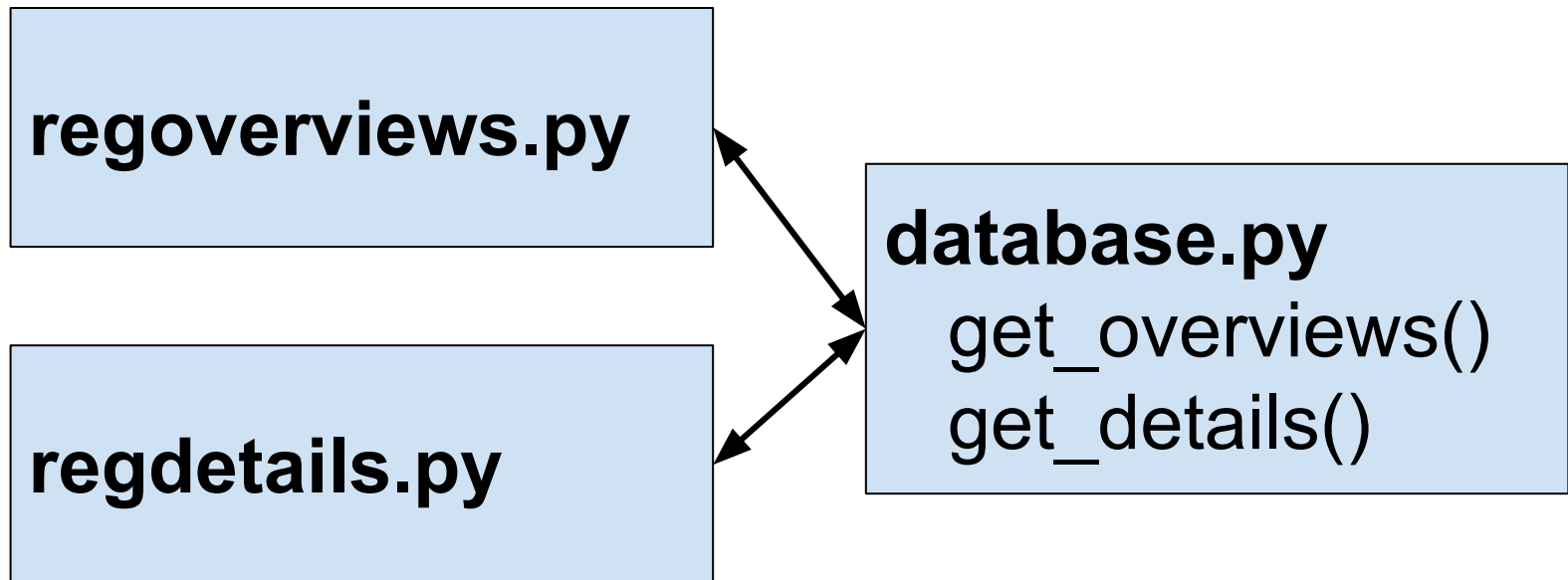
Design: General Heuristic 3.3



Yes!

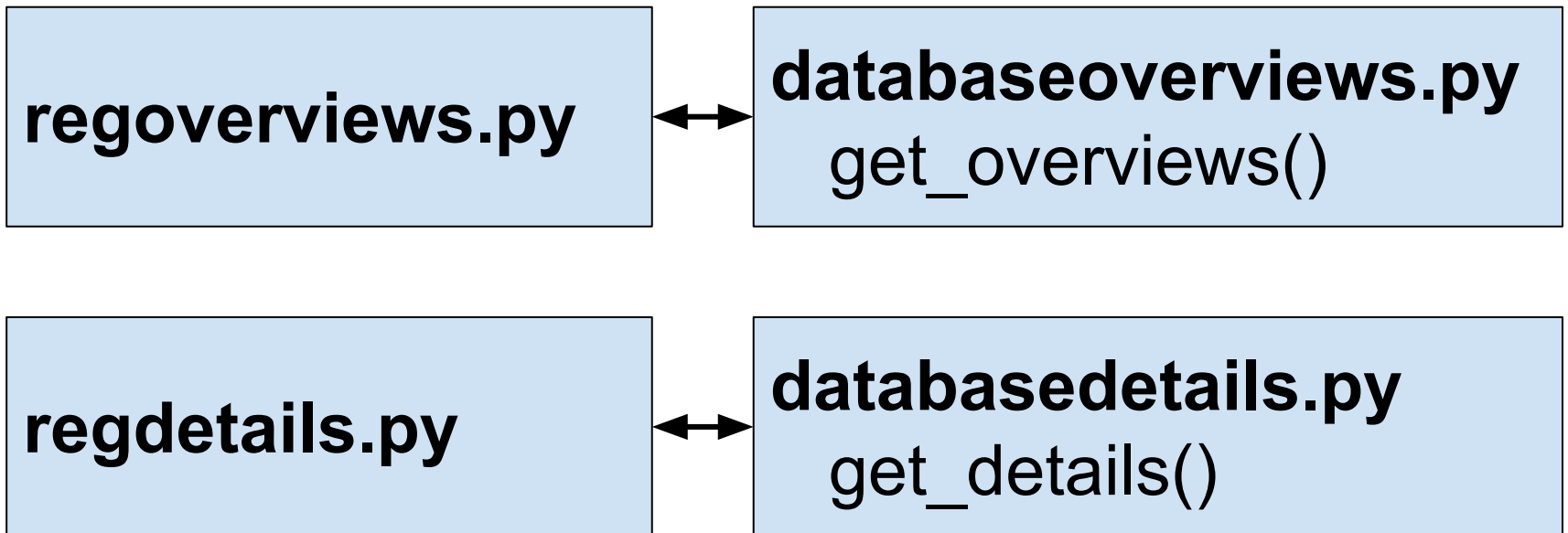
Design: General Heuristic 3.3

(A) Asgt 1:



Design: General Heuristic 3.3

(B) Asgt 1:



Design: General Heuristic 4

- Seek *strong cohesion* within modules
 - The components (fields, functions/methods) of a module should be related to each other
 - Empirically: not significant

Design: General Heuristic 4

(A) Asgts: database.py

```
def get_overviews(query):  
    ...  
    Use the database.  
    ...  
    Return the class overviews.  
  
def write_overviews(classes):  
    ...  
    Write the class overviews to stdout.
```

Design: General Heuristic 4

(B) Asgts: database.py

```
def get_overviews(query) :  
    ...  
    Use the database.  
    ...  
    Return the class overviews  
  
def get_details(classid) :  
    ...  
    Use the database.  
    ...  
    Return the class details.
```

Continued in
Software Engineering (Part 2)...