Object-Oriented Design

Why is that joke supposed to be funny?

- Objects and concerns
  - Objects have a *concern* in the sense that they have a *purpose.*
  - Which is not to say that inanimate objects are *concerned* in the sense of being *worried*.

- Likewise, all code should have a *concern, a purpose for being*.
  - A place for every concern…
  - and every concern in its place.

Concerns of Classes

- Each *class* should have a clearly focused purpose.
  - One class usually corresponds to one kind of entity
  - Each class member usually corresponds to one attribute

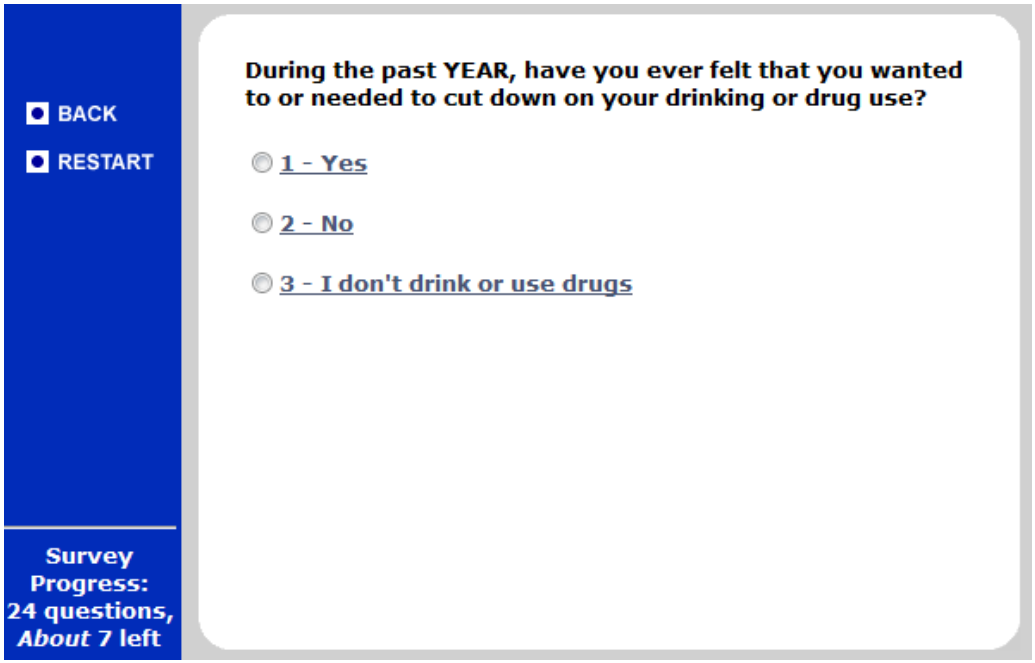
- Only code related to that purpose should be in the class.
  - Put functions together with the data that they modify.
  - Put code together if it needs to be modified at the same time.

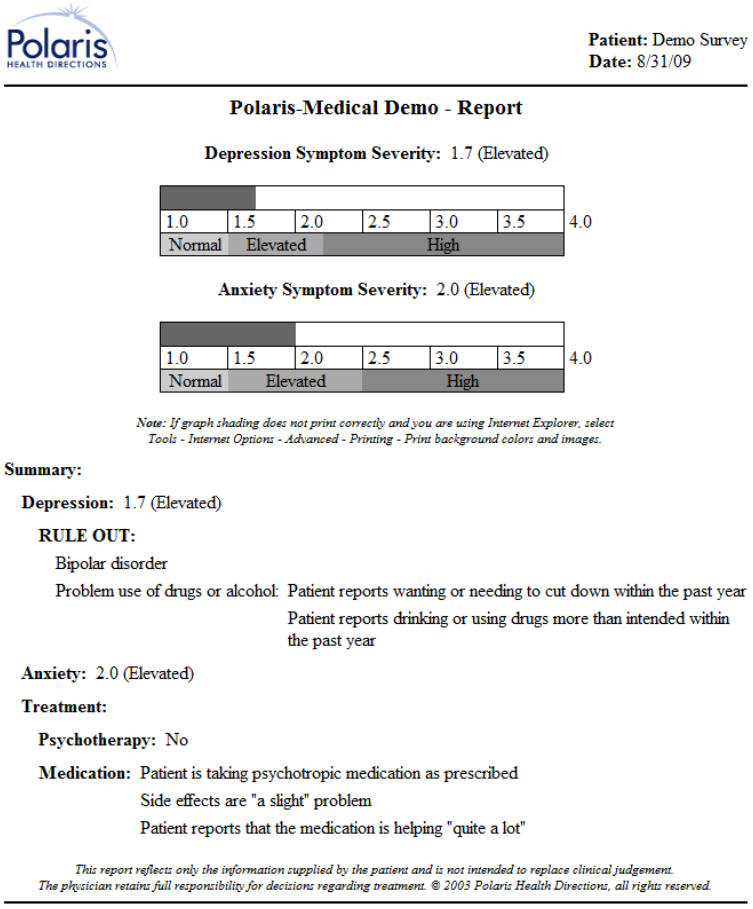
Concerns of packages

- Ditto for *packages*
  - Every package should have a purpose
  - Code should be in that package if and only if it is related to that purpose

- "Module" can refer to a class or to a package
  - Every module should have a purpose
  - Code should be in module if and only if related to that purpose

An example system to support drug and alcohol counseling





Polaris HEALTH DIRECTIONS

Patient: Demo Survey
Date: 8/31/09

Polaris-Medical Demo - Report

Depression Symptom Severity: 1.7 (Elevated)

1.0	1.5	2.0	2.5	3.0	3.5	4.0
Normal	Elevated		High			

Anxiety Symptom Severity: 2.0 (Elevated)

1.0	1.5	2.0	2.5	3.0	3.5	4.0
Normal	Elevated		High			

Note: If graph shading does not print correctly and you are using Internet Explorer, select Tools - Internet Options - Advanced - Printing - Print background colors and images.

Summary:

Depression: 1.7 (Elevated)

RULE OUT:

Bipolar disorder

Problem use of drugs or alcohol: Patient reports wanting or needing to cut down within the past year

Patient reports drinking or using drugs more than intended within the past year

Anxiety: 2.0 (Elevated)

Treatment:

Psychotherapy: No

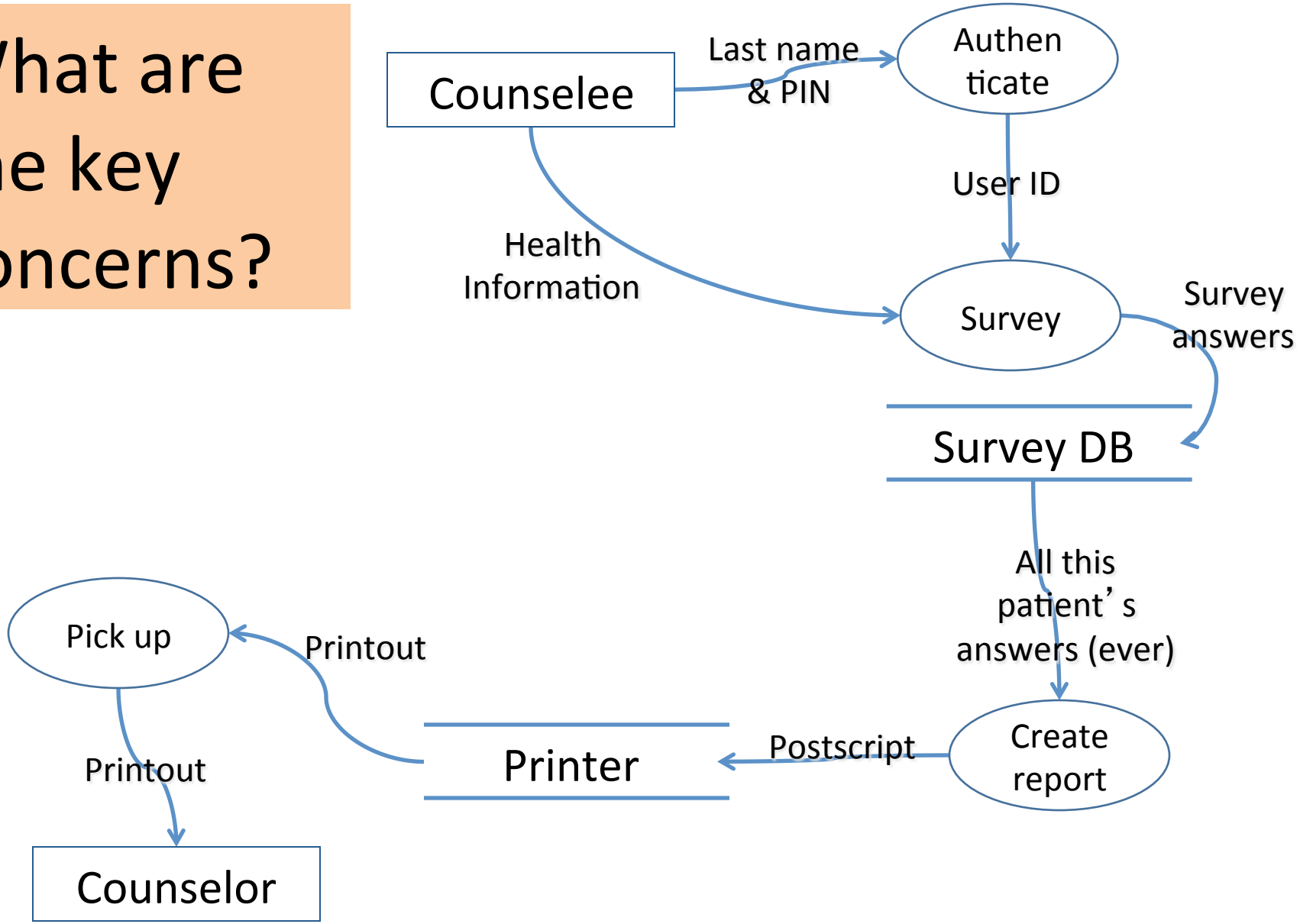
Medication: Patient is taking psychotropic medication as prescribed

Side effects are "a slight" problem

Patient reports that the medication is helping "quite a lot"

This report reflects only the information supplied by the patient and is not intended to replace clinical judgement. The physician retains full responsibility for decisions regarding treatment.

What are the key concerns?



Some key concerns

- Managing the users
  - Authenticating counselees
  - Matching counselees to counselors
- Performing the survey
  - Representing the questions
  - Representing the answers
  - Performing skip logic
  - Storing the answers
- Generating the report
  - Reading the data
  - Performing calculations in the report
  - Sending to the printer

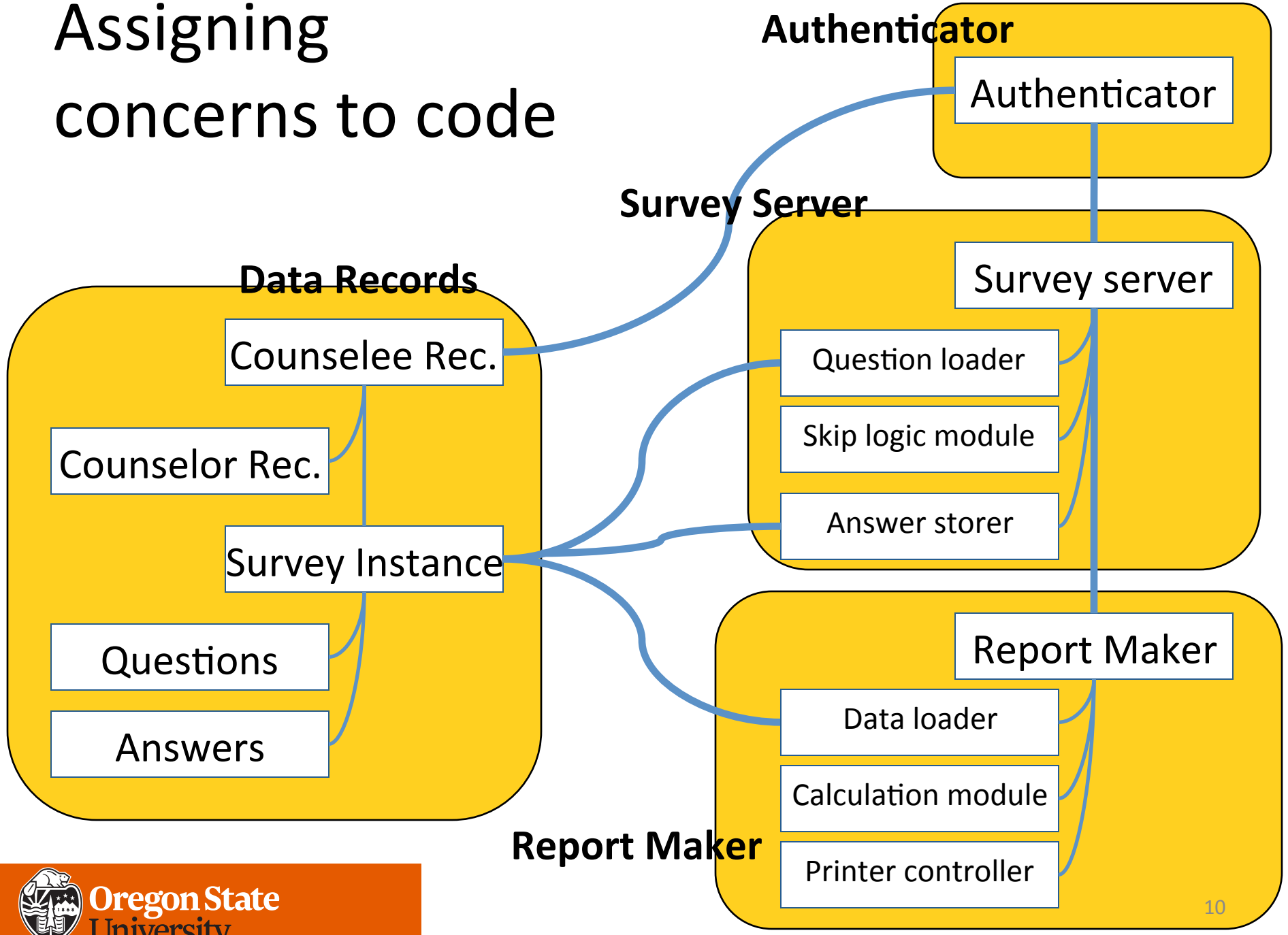
Coupling and Cohesion

- Coupling
  - When one module is involved in another module's concern
- Cohesion
  - When a module is devoted to its concern

Coupling Reduces Maintainability

- Levels of coupling
  - Content coupling (worst)
    - A modifies B
  - Common coupling
    - A and B both read/write the same data
  - Control coupling
    - A calls B
  - Stamp coupling
    - A provides structured data to B
  - Data coupling
    - A provides unstructured data to B
  - Uncoupled (best)
    - None of the above

Assigning concerns to code

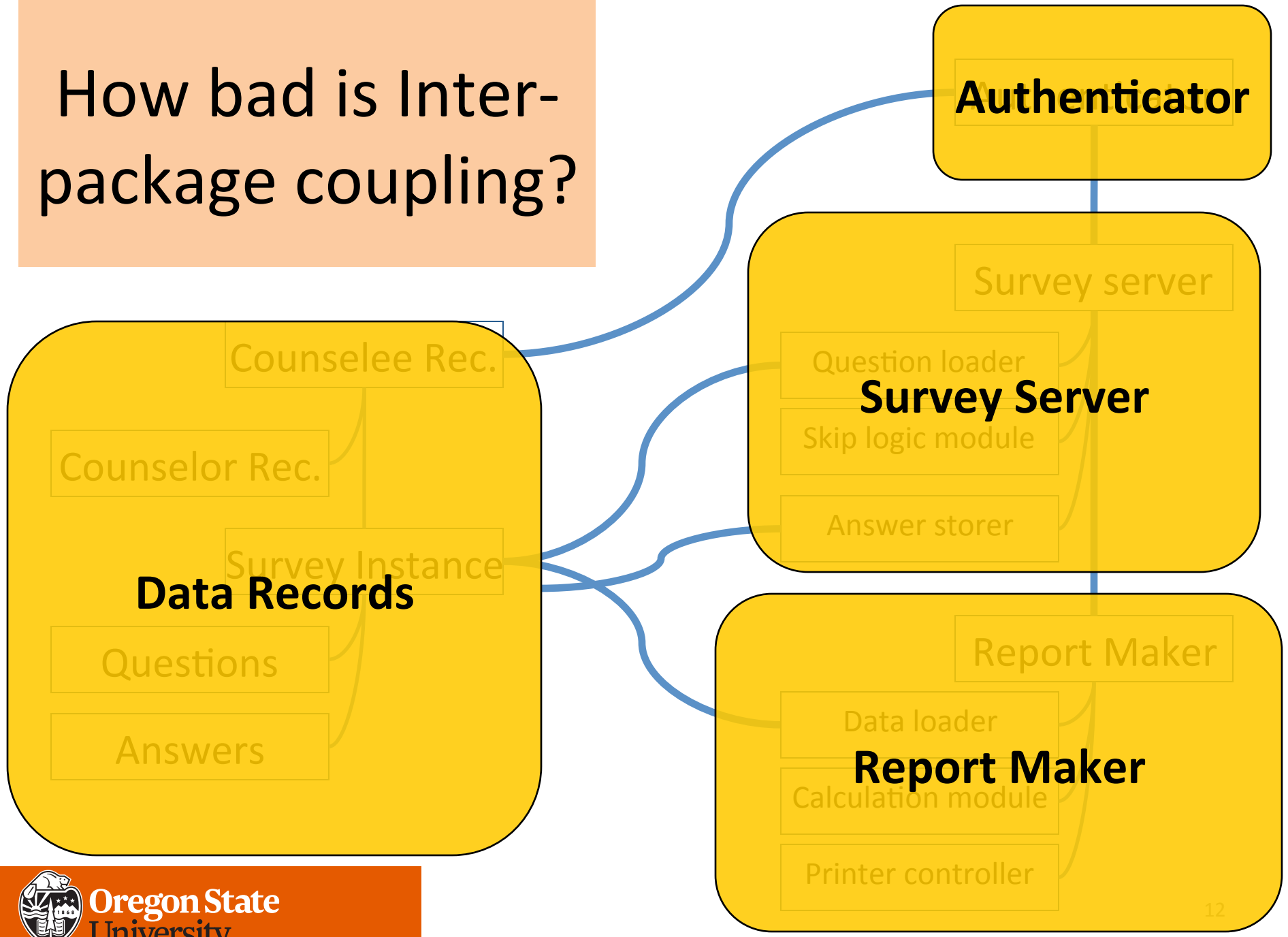


Notes about UML class diagrams

I'm omitting several pieces of the diagrams today, to make the diagrams less cluttered so that you can focus on today's lessons.

- One box per kind of entity
  - Usually list attributes
  - Interfaces & abstract attributes italicized
- Lines without arrowheads show references
  - Represents member variables in OO
  - Labeled with cardinality (multiplicity)
- Lines with open arrowheads for specialization
- Lines with regular arrowheads indicate dependencies

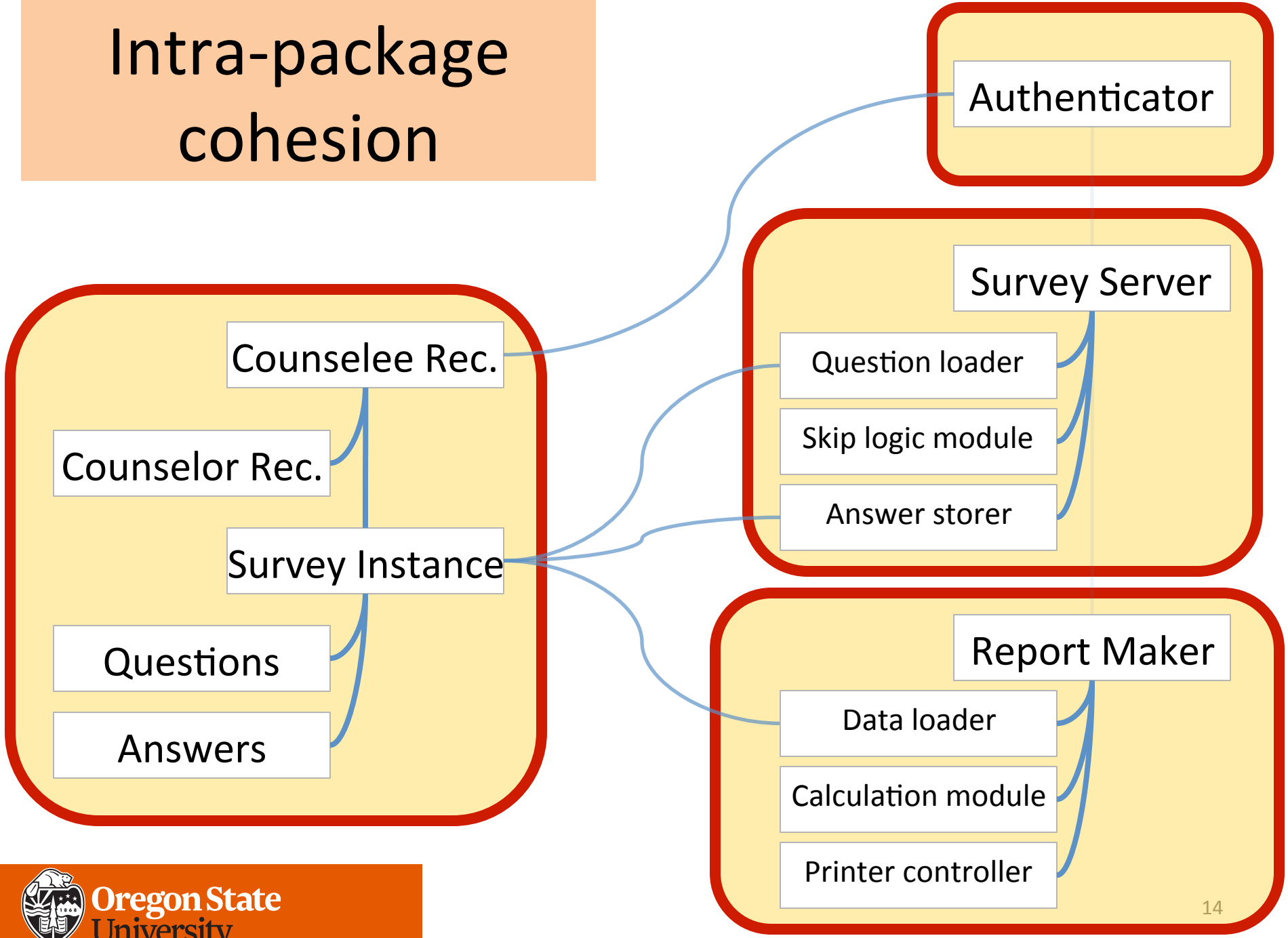
How bad is Inter-package coupling?



Cohesion Increases Mainainability

- Levels of cohesion
  - Functional/informational cohesion (best)
    - A and B work together for just one purpose
  - Communicational cohesion
    - A and B use the same data
  - Procedural cohesion
    - A executes, then B executes, and A & B have vaguely related purpose
  - Temporal cohesion
    - A executes, then B executes, but A & B do not have any related purpose
  - Logical cohesion
    - Either A or B might be executed
  - Coincidental cohesion (worst)
    - None of the above

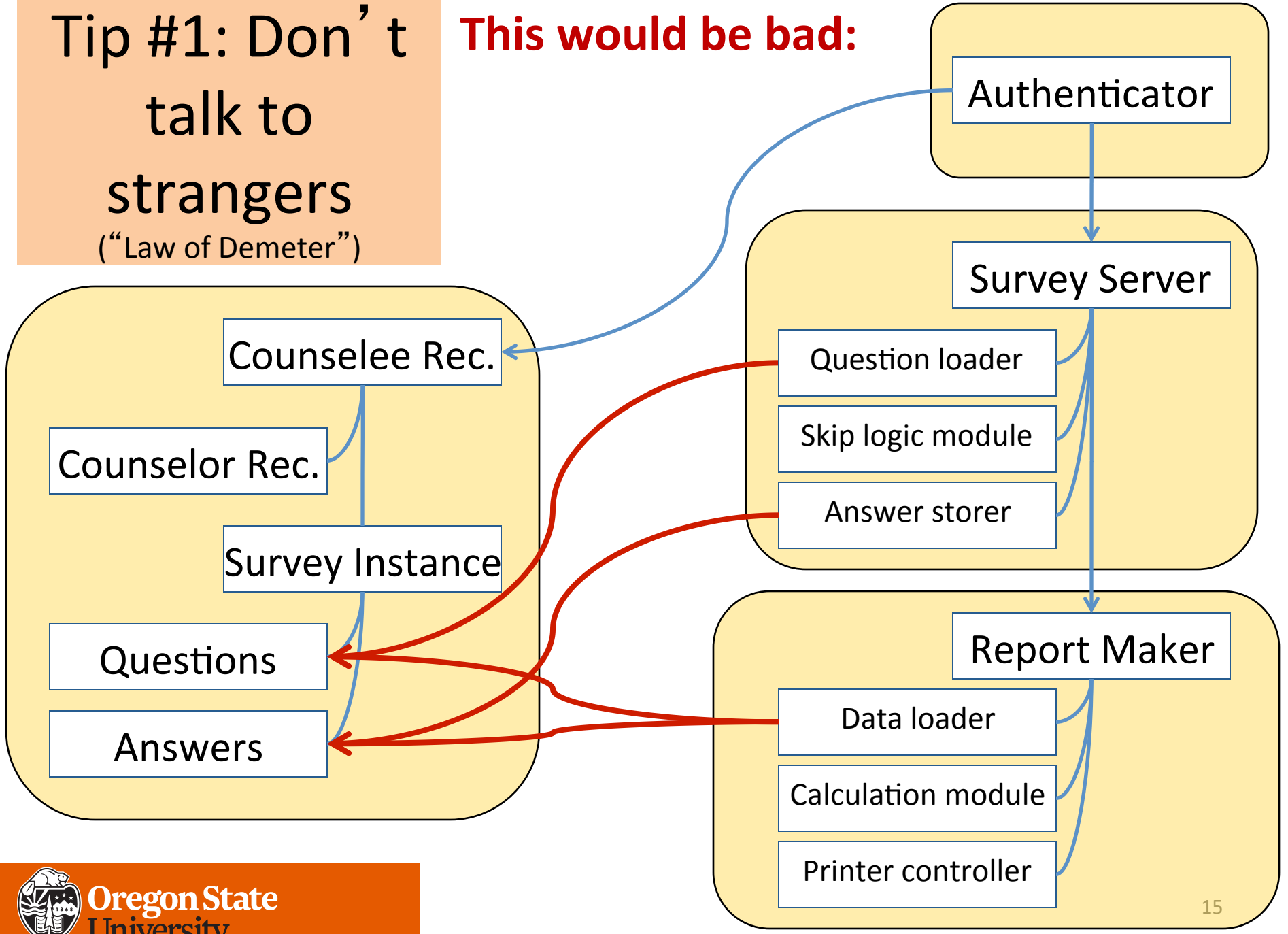
Intra-package cohesion



Tip #1: Don't talk to strangers

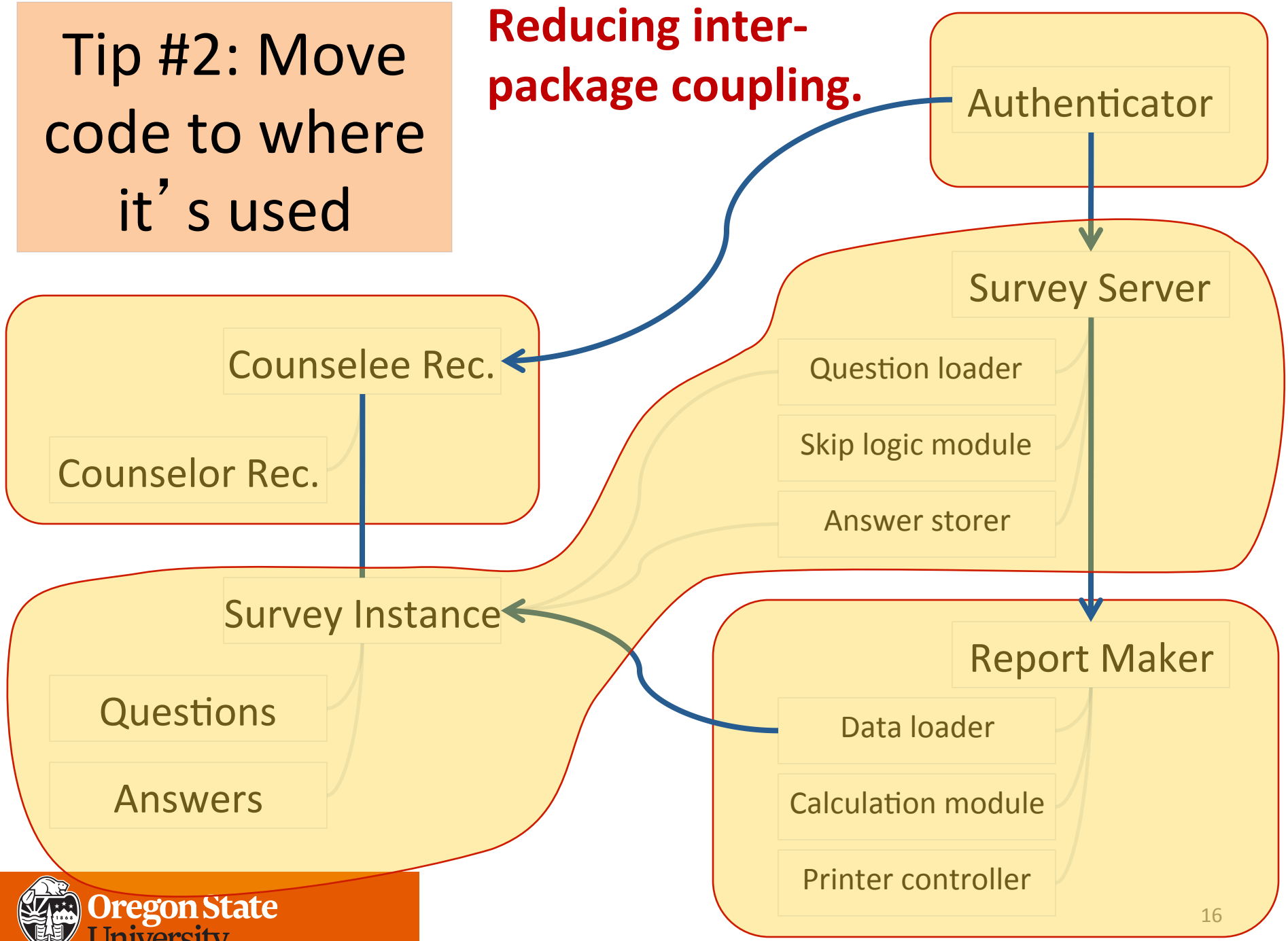
("Law of Demeter")

This would be bad:



Tip #2: Move code to where it's used

Reducing inter-package coupling.



Tip #3: Split modules to reduce cycles

- That design had no cycles
  - But here's one way to get rid of cycles when they do happen to occur…

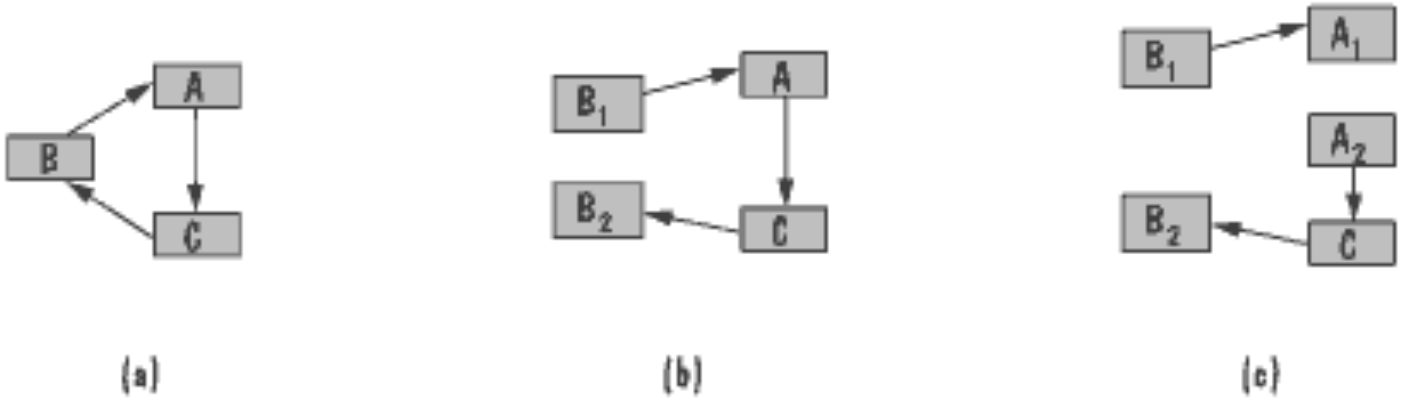
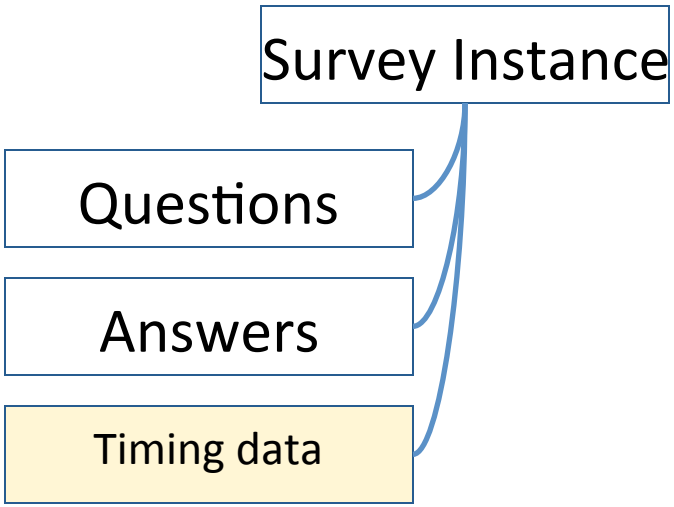
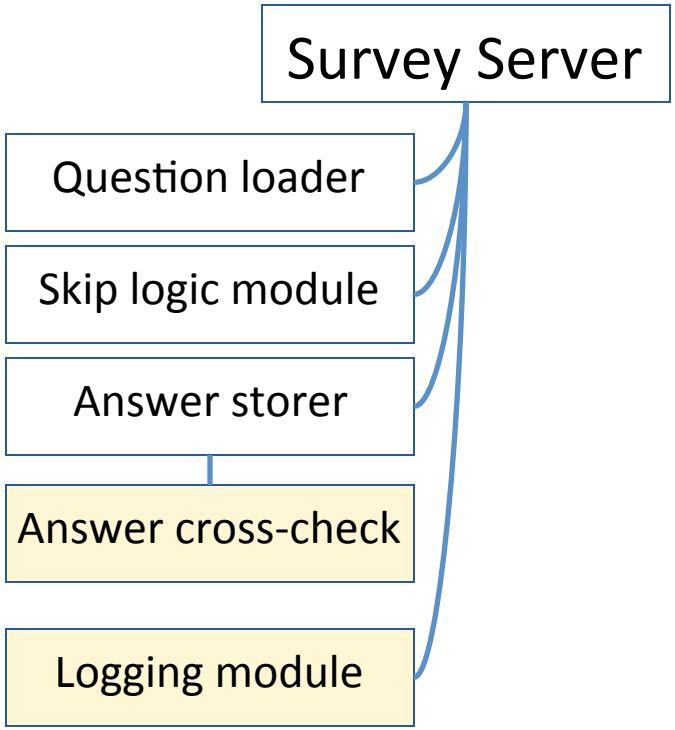


FIGURE 6.9 Sandwiching, to break a cycle in a uses graph.

Tip #4: In reuse, prefer composition over inheritance

- In general, use composition to add features or to reuse code, and use inheritance to add a new version of an entity.





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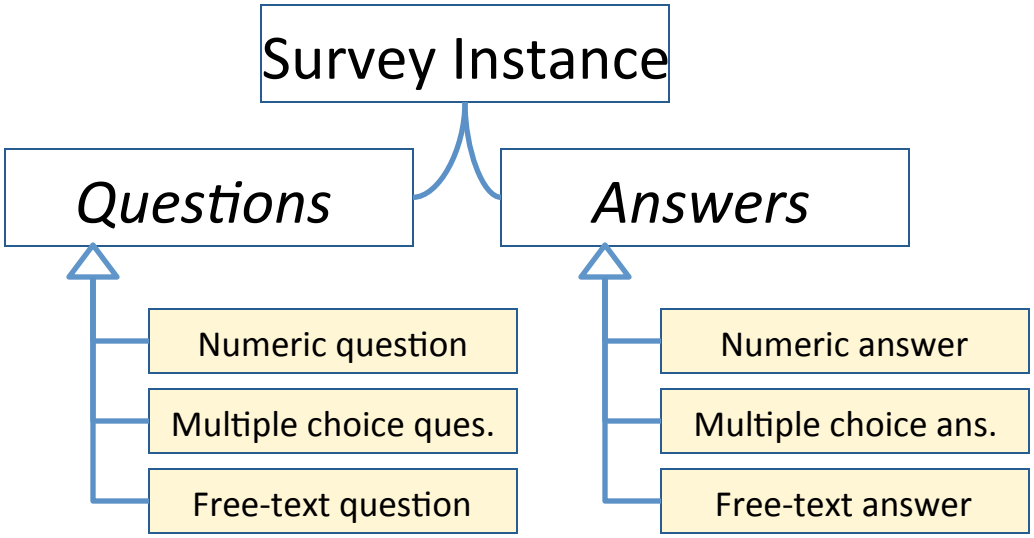

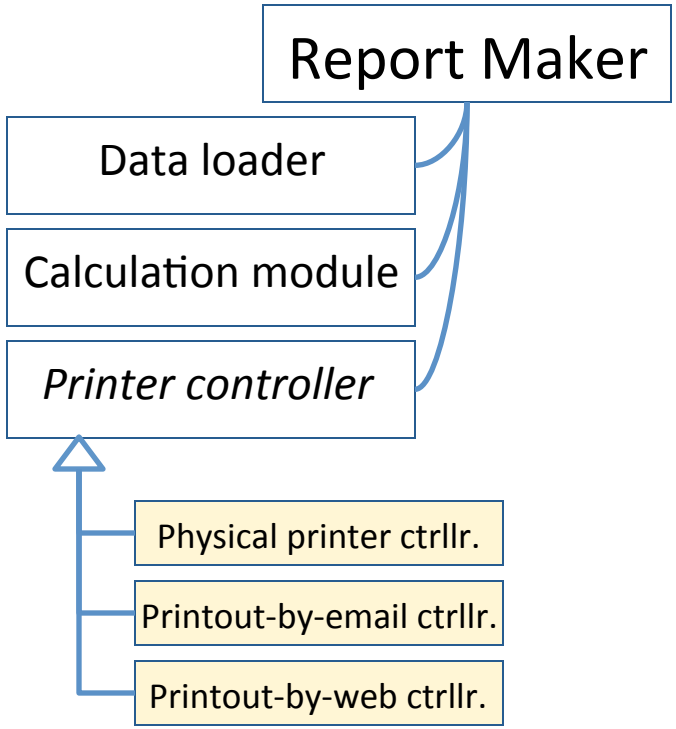

The Secret to Using Interfaces

- An interface is a promise
  - I can do this for you.
  - If you meet these preconditions, then I can meet these postconditions.
    - Functional or non-functional
- Polymorphism
  - If A and B and C and D each implement an interface, then they all make the same promise
    - But may keep the promise in different ways!

Incremental and Iterative Development

- Use incremental development
  - When much of the system's value resides in one subsection
  - When one part of the system must be completed (logically) before another

- Use iterative development
  - When the system's value is spread out over much of the system
  - When the whole system needs to work at least a bit before you can build up

Incremental and Iterative Development

- Incremental examples
  - Adding new kinds of print outs
    - From customers' standpoint, paper printout carried much of the system's value
  - Adding a new data export module
    - Logically, the main system needs to be done before we can worry about exporting data.

- Iterative examples
  - Tweaking reports and surveyor user interface to improve usability
    - Improvements to existing pieces of system
  - Adding new kinds of questions (and answers), changing reports accordingly
    - Changes are spread across system