Observer / Template Methods (cont.)

Comp-304 : Observer / Template Methods (cont.)
Lecture 27

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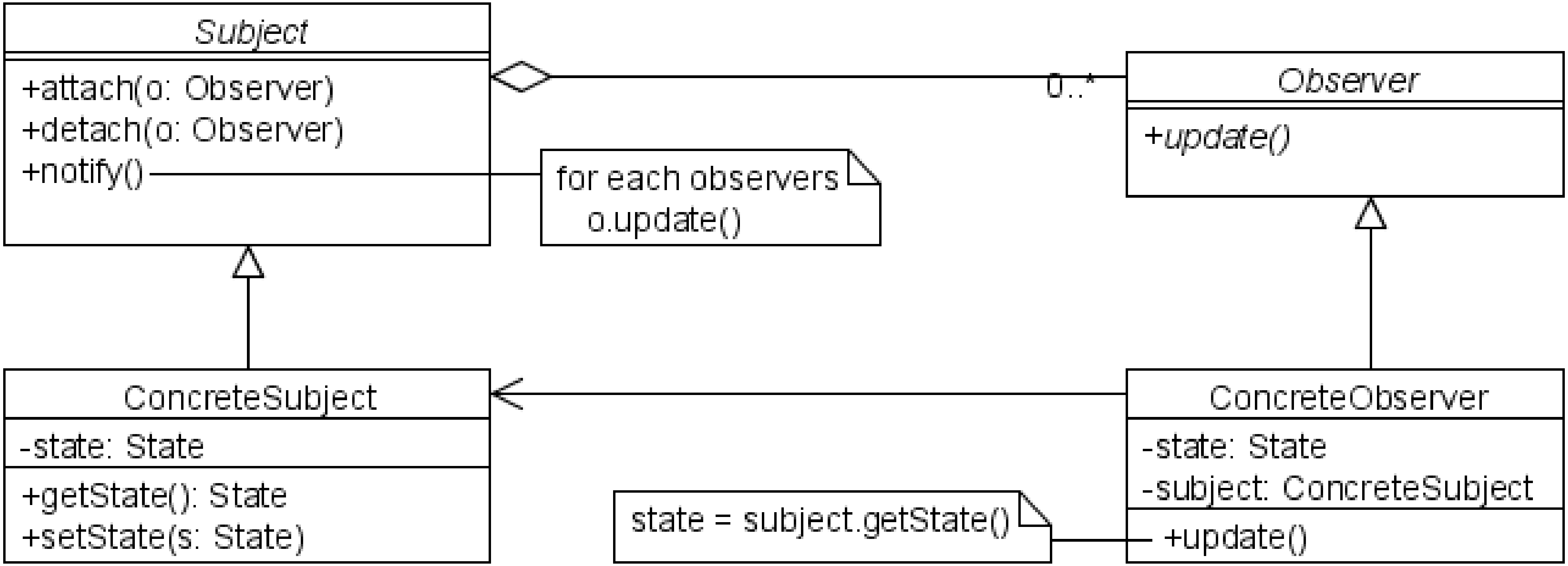
Questions?

- What is a design pattern?
- What are the participants of the observer pattern?

Class Diagram



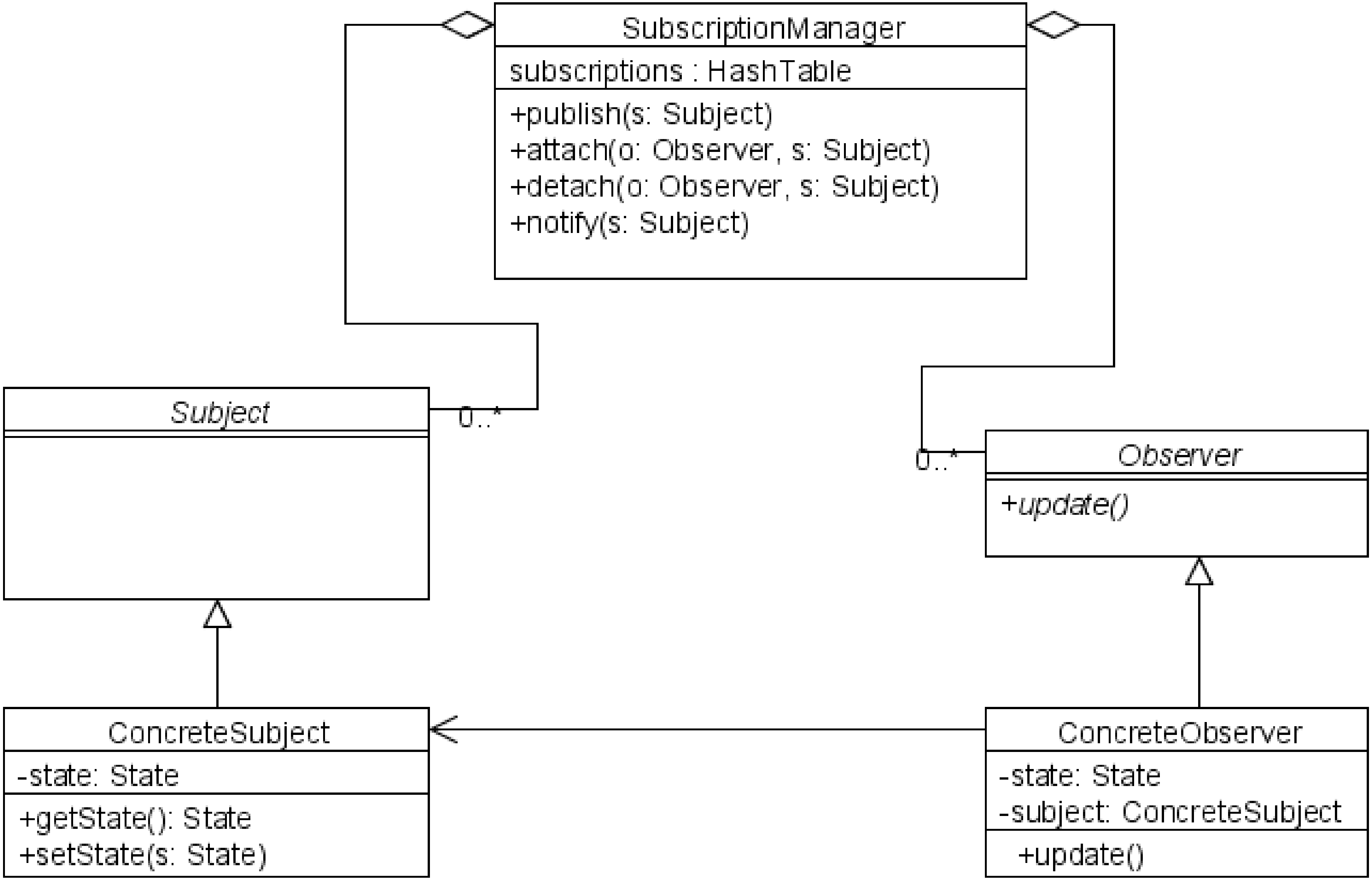
Implementation Concerns

- The Observer pattern has numerous implementation concerns:
  - Push vs Pull ?
  - Who stores the subscription?
  - Observing more than one subject.
  - Who triggers update?
  - Deleting subjects and observers?
  - Subject's self-consistency
  - Complex subscriptions
  - Observers/Subject

Who stores the subscriptions?

- In a traditional Observer Pattern, the subject manages it's own subscriptions.
- This adds overhead to that class.
  - Clusters the API.
  - Forces it to deal with attach/detach method calls.
- In a system with a low number of subscription, this is not a problem.
- However, this is a burden to the subject if there are many subscriptions.
- What can I do?

Subscription Manager



SubscriptionManager

subscriptions : HashTable

+publish(s: Subject)
+attach(o: Observer, s: Subject)
+detach(o: Observer, s: Subject)
+notify(s: Subject)

0..*

Subject

0..*

Observer

+update()

ConcreteSubject

-state: State

+getState(): State
+setState(s: State)

ConcreteObserver

-state: State
-subject: ConcreteSubject

+update()

Notify()

- Who can/should trigger notify?
- When do we call a notify?

Who triggers notify()?

- It's a question of safety vs performance.
- Safety: after every setState(), we do a notify() and update() are sent.
  - This insures a consistent state.
  - It's very expensive when there are many setState() calls.
- Performance: we do a nofity() after having completed the necessary setStates().
  - We don't flood the system with update() calls.
  - There is a danger of having inconsistencies.
  - There is a danger that the call to notify is omitted

Deleting the Subject

- If a subject is deleted, what should happen to its observer?

Deleting the Subject

- We could delete the observers.
- It's never that simple.
  - Other objects might refer to those observers.
  - The observers might be attached to other observers.
- Maybe the subject could warn the observer?

Deleting the Observer

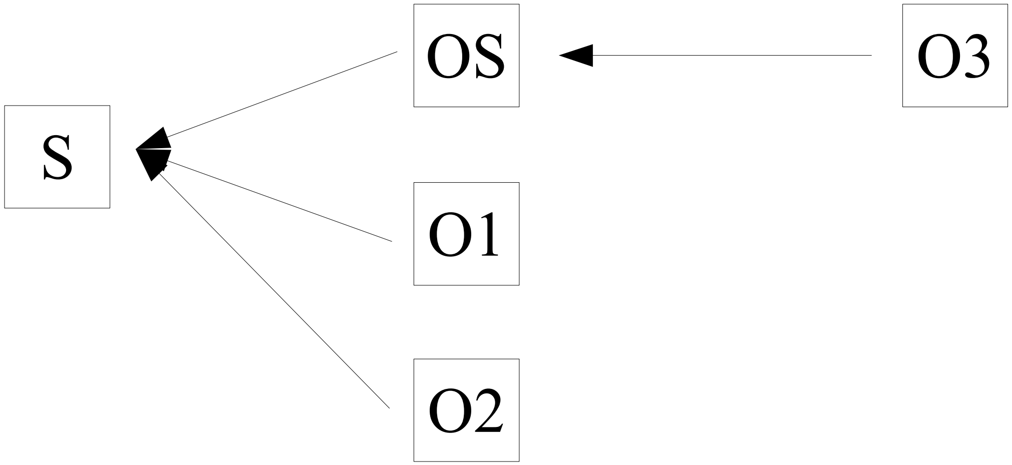
- If an observer is deleted, what should happen to its subject?

Deleting the Observer

- It's important to detach() the observer before deleting it.
- Is there anything different between this detach() and a normal detach() call?

Observer / Subject

- An object could be both a subject and an observer.
  - In our example, OS is an observer and a subject.
  - What happens when OS calls s.getState()?
  - Most likely it will update its state, triggering a notify() and an update() call to O3.
  - What happens if S observes O1? We would get a loop.
  - If an object can be both an observer and a subject, we need to deal with loop.



Specific Interest

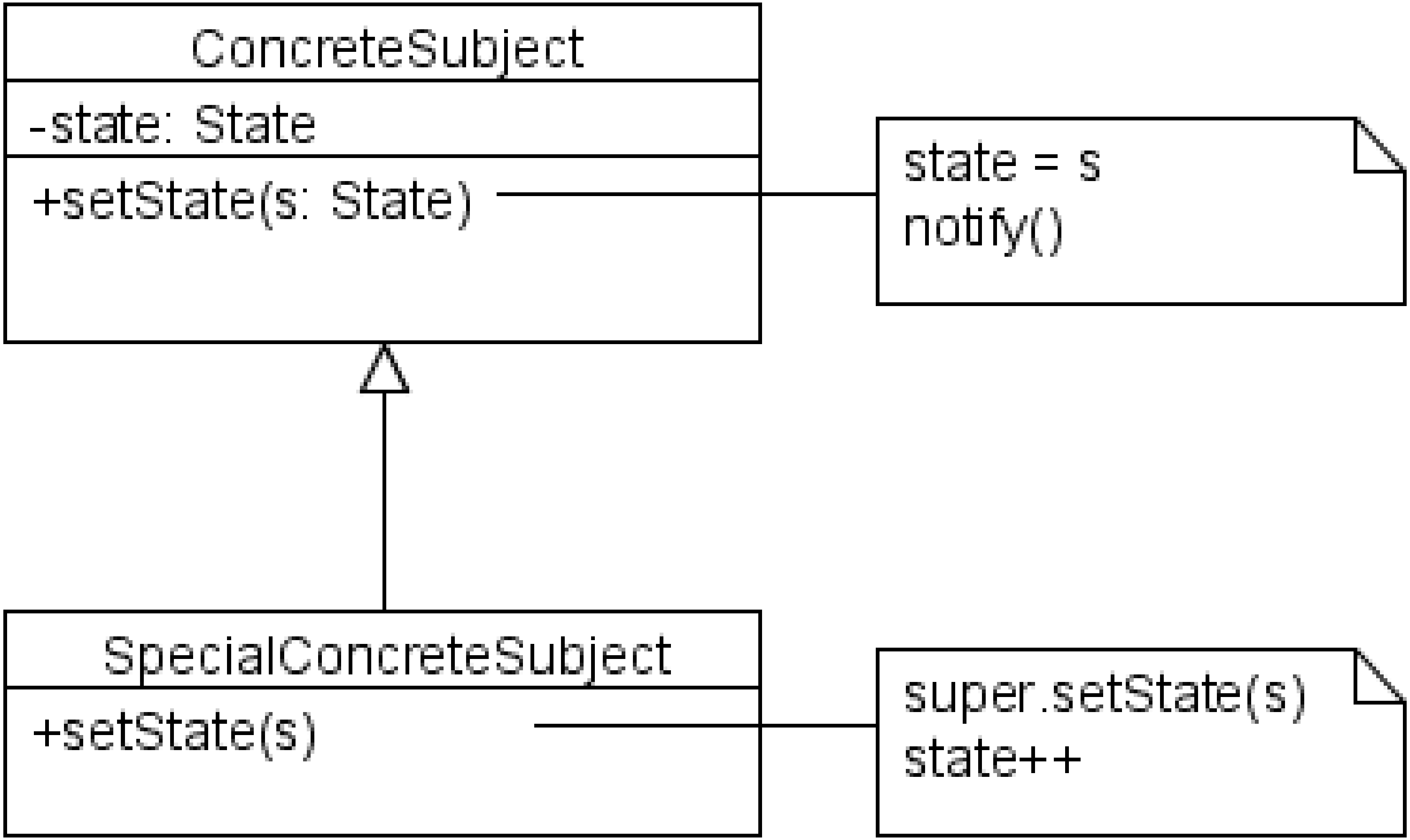
- As we have already mentioned, the subscription mechanisms could be altered to deal with specific interests.
- In other words, an observer could specify what part of the state it is interested in.
  - Register with a player object, but only wish to receive updates about positions.
  - Register with the stock exchange object, but only wish to receive updates about stocks trading for more that 10$.
- While the complete state doesn't need to be sent, we have to keep track of what each observer want.

Increased overhead

- In the scenario where subscriptions deal with specific interest, each subscriptions must be tracked separately
- When the state of a subject is modified, each subscriptions must be checked.
  - Information sent to the observers depends on their individual subscriptions.
  - In particular case, we might need to check the subscription to see if update() is even called.
- This means we are no longer broadcasting information in a generic fashion.
- Preparing and sending each of these updates is very time consuming.

Self-consistency

- Do you see a problem?



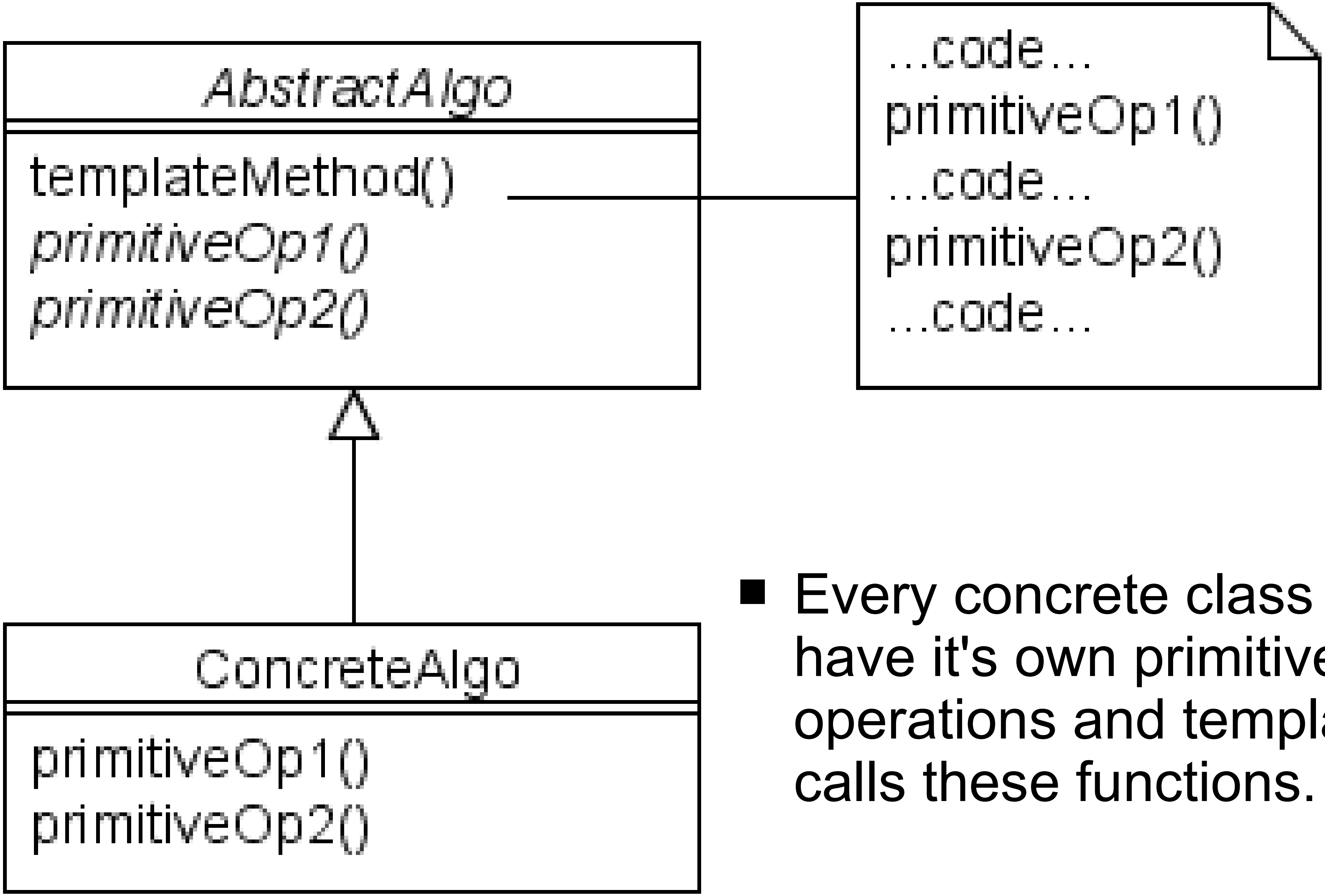
Self-consistency

- Special care must be taken when extending the subject object.
- The trick is that every method must respect self-consistency as a pre-condition and post-condition.
- This means that before the state is changed, the system should be consistent.
- This also means that after the state is changed, the system should also be consistent (or at least converge towards a consistent state).
- Instead of sub-classing, the template method design pattern is much more secure.

Template Method Pattern

- Define the skeleton of an algorithm in an operation, deferring some steps to subclasses.
- Template methods refine certain steps of an algorithm without changing an algorithms structure.

Example



- Every concrete class can have it's own primitive operations and template calls these functions.

Concerns

- The biggest challenge in template methods is making sure the method is used properly.
  - Users need to know and understand which methods need to be overridden and which method is the template.
- Luckily, most OO programming have constructs that help us out with this.
  - Abstract methods, final methods, etc.
- One of the most important things to keep in mind is to minimize the number of primitive operations.
  - Keeps things simple and easier to implement.

Solution to Observer Problem

- Template Method allows us to solve the self-consistency problem.
- The idea is that the setState() method should be a template method with notify() as it's last line.
- Sub-classes can then vary the behavior of the subject by changing the primitive operations.