Operations and Methods

Object-Oriented Analysis and Design

CSCI 6448 - Fall 1998

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Goals of this Lecture

- Present the notions of
  - Operations
  - Methods
- Relate them to
 - Each other
  - Events
  - State Changes

Definitions

- Operation
  - A process that can be requested as a unit
    - e.g. a named process with inputs and outputs
    - Describes "what" the process does
- Method
  - The specification of an operation
  - Provides details on "how" a process is accomplished

Relationship to Events

- An Event indicates a noteworthy change
- An operation is the agent of change
 - Without operations there would be no events
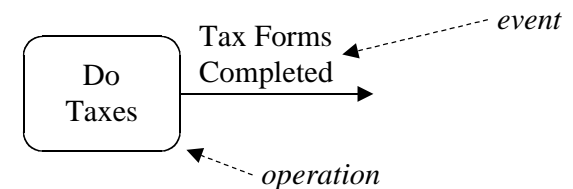
Input Variables

- Operations can take input variables
  - Each variable is a place holder for an object of a particular type
  - In analysis, these types serve as indexes for the operation
    - Thus we could ask the question, what operations affect a particular type?
  - Martin and Odell (page 144) show three representations of input variables

Martin & Odell Input Variables

Employ Person

Person
Employ Person

«attach»

Employ Person (Person)
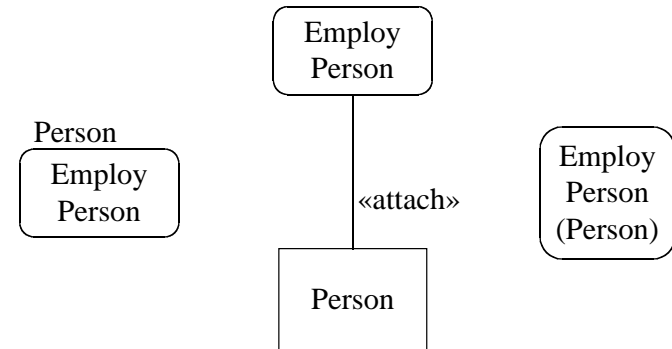
Person

Discussion

- This notation is not in the UML
- However, its useful in analysis
  - You may know about operations before you know what types they affect
- Eventually, a design decision will place an operation with a particular type
  - At that point, use a class diagram to specify the operation's signature

Output Variables

- Output variables indicate the objects returned by operations
- Each operation also produces an event
- Events can be used to document an operation's output variables
  - Document events textually; then place their description near your state, activity, and interaction diagrams

Two basic types of operations

- Query
  - An operation collects information about the system and returns it as output
- Change
  - The operation is performing a state change of some sort
- What events get generated by the former?

Events for Query Operations

- Typically, the event associated with a query is a creation event
  - In particular, the query is returned in the form of an object that carries the retrieved information
- In general, however, an operation does not always have to generate an event
  - Implicitly, it generates "operation finished"

Multiple events

- Operations can generate multiple events
  - As we have seen with activity and state diagrams
- Events can be generated concurrently
  - Use a synchronization bar to model this situation in an activity diagram

Preconditions and Postconditions

- An operation can have a pre- and post-condition
- Precondition
  - The constraints under which an operation will perform correctly
- Postcondition
 - The conditions that result when an operation completes

Relationship to Events

- Events have pre- and post-states
- How do they relate to operation pre- and post-conditions?
  - An operation's conditions are more general
    - They may specify input and/or state requirements (we need two validated orders)
  - They should subsume the event's pre- and post-state conditions
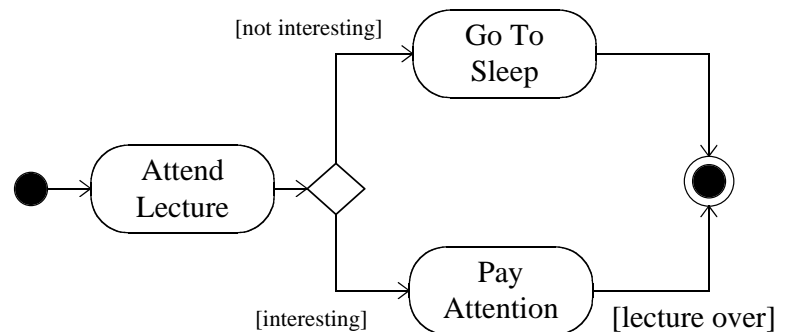
Clock Operations

- A clock operation is an operation that emits a specified pattern of clock-tick events
- Two types of time in system analysis
  - Relative time
    - Event A occurs before Event B
  - Clock time
    - Seconds, minutes, hours, years, etc.
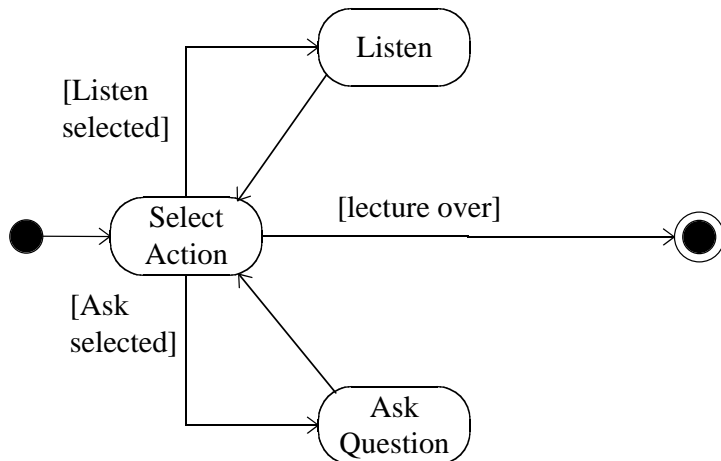
Clock Notation (Not in UML)

Internal
Clock Operation

External
Clock Operation
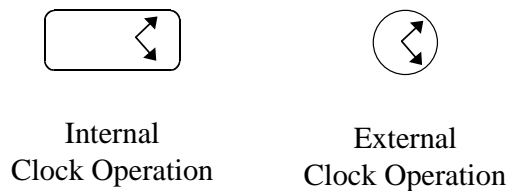
You can use these in your activity diagram, if you need to indicate that an activity does something at regular intervals
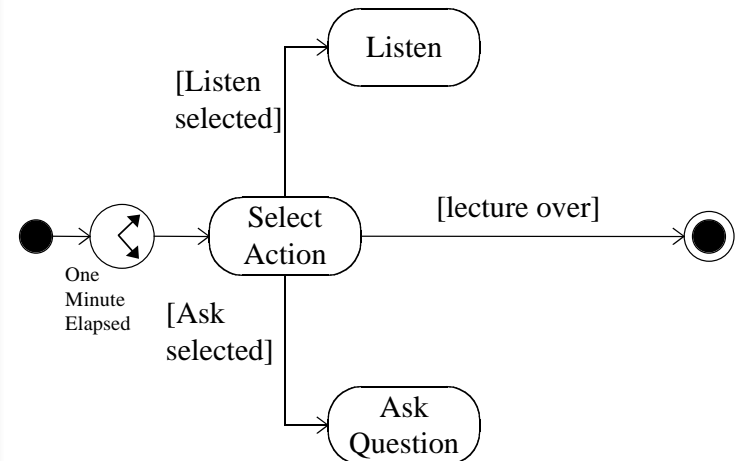
Example revisited

[not interesting]

Go To Sleep

Attend Lecture

Pay Attention

[interesting]

[lecture over]

Decompose "Pay Attention"

[Listen selected]

Listen

Select Action

[lecture over]

[Ask selected]

Ask Question

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Decompose "Pay Attention"

[Listen selected]

Listen

One Minute Elapsed

Select Action

[lecture over]

[Ask selected]

Ask Question

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More information on Methods

- Methods specify the steps of an operation
  - They can invoke other operations
  - These sub-operations have methods associated with them
  - Decomposition stops when you reach the level of a basic or compound event (as described in the last lecture)

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How to specify methods?

- Pseudocode
  - Method: Have Breakfast
    - Start
    - Prepare Bowl of Cereal;
    - Prepare Coffee;
    - ...
- Activity Diagrams
  - See page 159 of Martin and Odell

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Key Properties of Methods

- **High Cohesion**
  - A method's operational components work together to achieve one purpose
- **Loose Coupling**
  - Communicate as little information as possible between operations
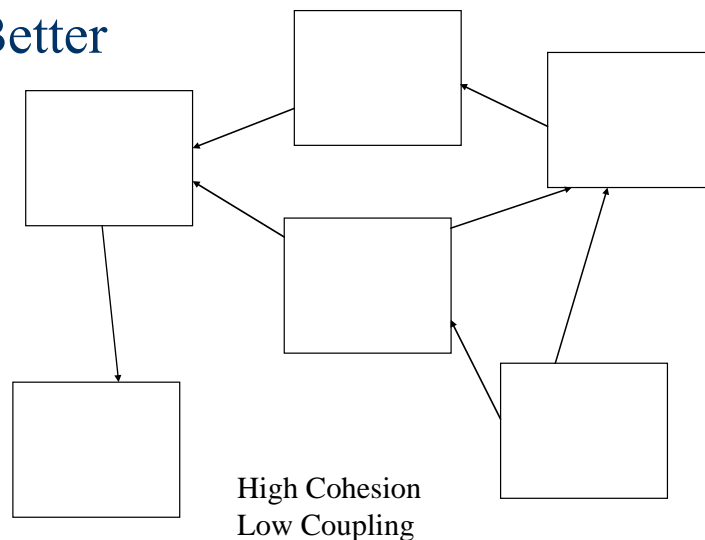- **Helps to achieve reusable methods**

Bad

Low Cohesion
High Coupling

Better

High Cohesion
Low Coupling
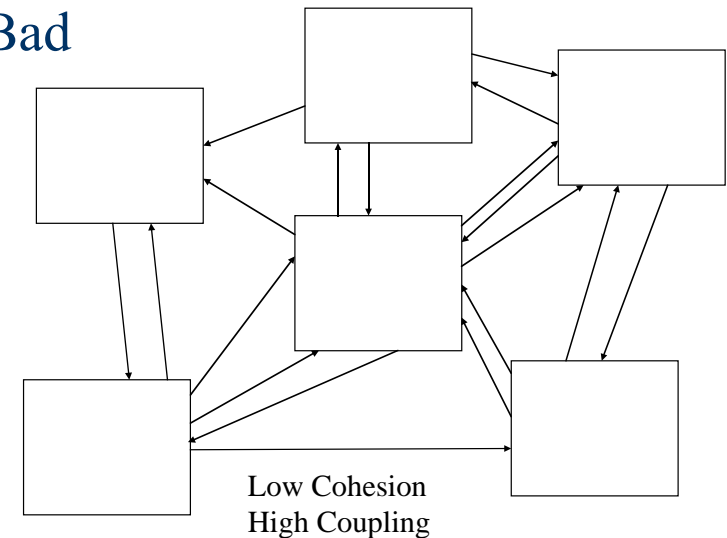
Multiple Methods

- **An operation can have multiple methods**
  - This allows the team to propose alternative approaches to achieving the operation
  - Or, one method may be optimized for time while another is optimized for space
  - Or a method may be specialized for a particular type of input variable
    - This is a precursor to polymorphism