

Activity 14-2: Design by Contract

Why?

Operations specifications state operation interfaces. An important technique for specifying operation semantics and pragmatics is *design by contract*, which treats a specification of operation behavior as a binding agreement between an operation and its caller.

Learning Objectives

- Understand what an operation contract is and how it obligates an operation and its caller
- Understand what preconditions, postconditions, and class invariants are
- Write operation specifications that use operation contracts

Success Criteria

- Be able to explain about the rights and obligations involved in an operation contract
- Be able to explain the terms *precondition*, *postcondition*, and *operation contract*
- Be able to write operation specifications whose behavior is stated using operation contracts

Resources

ISED section 14.2

Vocabulary

Operation specification, procedural specification, declarative specification, contract, assertion, precondition, postcondition, class invariant

Plan

1. Review *ISED* section 14.2 individually.
2. Answer the Key Questions individually, and then evaluate the answers as a team.
3. Do the Exercises as a team, and check your answers with the instructor.
4. Do the Problems and Assessment as a team.
5. Turn in the Problems and Assessment as a team deliverable.

Key Questions

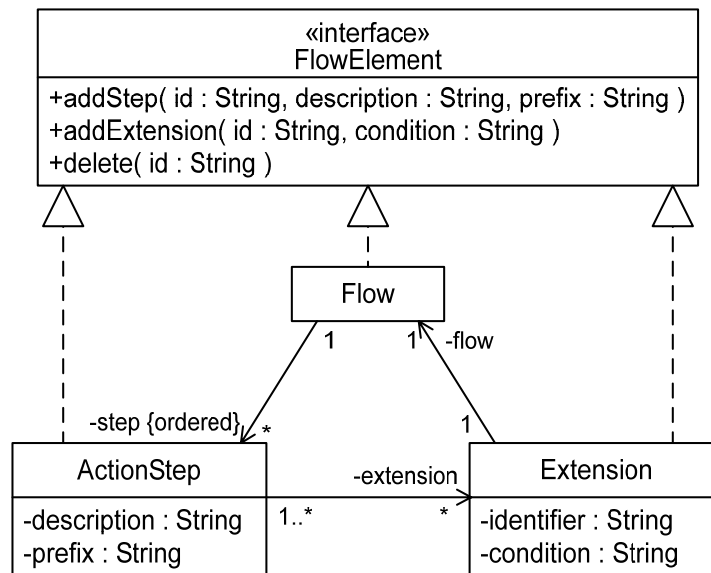
1. What is an operation specification?
2. What is the difference between procedural and declarative specifications?

Exercises

1. What sorts of things are usually stated in preconditions?
2. What sorts of things are usually stated in postconditions?
3. Summarize how an operation contract works in terms of the rights and obligations of operations and their callers.

Problems (Deliverable)

1. Specify the signature and behavior (using pre- and postconditions) of the following operations. You may have to make decisions about behavioral details in writing your specifications.
 - (a) A stack pop() operation that returns the top value on the stack.
 - (b) A sort() operation for arrays of integers.
 - (c) A binarySearch() operation that returns the location of an integer value in an array of integers.
 - (d) A read() operation that returns the current byte of a file and advances the file pointer, as long as the file is open for reading.
 - (e) A String substring() operation that returns a substring extending from an initial String index to one less than a final String index.
2. A Triangle() class has three Point attributes. It must have an area greater than 0. State a class invariant for this class. How does this invariant affect the operation contract of the class constructor Triangle(Point x, Point y, Point z)?
3. A use case description editor represents activity flows using the following class structure:



A UseCaseDescription object holds a reference to a Flow object—this is the basic flow. The basic flow has a list of ActionSteps. Each ActionStep may have one or more

Extensions. An Extension object has a condition and its own Flow. The extension Flow object has ActionSteps that may themselves have Extensions, and so on.

This structure is a tree. Modifying something in the tree requires that the item be identified. The structure uses an identification mechanism that relies on the numeric ordering of the ActionSteps in a Flow and alphabetic ordering of Extensions for an ActionStep. For example, item 3a2b is extension b associated with the second step of the flow for extension a of the third step of the basic flow.

An ActionStep has an optional unnumbered prefix holding comments about the flow at that point, such strings as “Repeat the following four steps until the query is satisfied.”

Write pre- and postconditions describing the behavior of the FlowElement operations for the Flow class. If you have time, do the same for the ActionStep and Extension classes. Can you generalize these to the FlowElement interface?

Assessment (Deliverable)

1. Did your team improve its performance from last week?
2. How could you improve your team’s performance next time?