Advanced Material

The following slides contain advanced material and are optional.

Outline

- Testing
  - What is testing
  - Unit testing
  - Automatic testing

Program verification

- Verification checks validity of a program by
  - Testing (here, functional testing on class level)
  - Proving

- Testing
  - Execute a program to check if it works
  - Verifies one particular execution of a program
  - Applicable to no/partial specification

- Proving
  - Program is statically checked (not executed)
  - Verifies every possible execution
  - Needs complete specification

Testing

- Execute program
  - Manual testing
  - Unit testing
  - Automatic testing

- If a test is successful:
  - The program works with exactly this input
  - The program could still fail with different input
- If a test fails:
  - Bug found in program

- A good test is a test that fails!

Unit testing

- Write test for a „unit" of source code:
  - In object-oriented code, mostly per routine or class
- Each test case has three steps
  - Prepare environment
  - Run test case
  - Evaluate output
- Library support exists for all major languages

Demo

Automatic testing

- Generate test cases automatically
  - Need a way to generate valid input data
  - Need a way to check validity of output data

- Any ideas?

- Input to a routine is valid if precondition is satisfied

- Output of a routine is valid if postcondition is satisfied

Automatic input generation

- Create objects at random by
  - Calling a creation routine
  - Calling commands on the object

- These objects can then be used to test a routine
  - Call routine with random input data (in case of basic types like integer)
  - Call routine with random objects, created as mentioned above

Validate input

- Check if randomly chosen objects satisfy precondition
  - If yes, this is a valid test case
  - If no, ignore this test case

Evaluate output

- For a valid test case, check if postcondition is satisfied
  - If yes, the test was successful
  - If no, there is a bug in the routine

- Test also fails if
  - any exception happens during routine evaluation, e.g. Void-call or Precondition violation

Demo