Homework 2: Contracts

http://d3s.mff.cuni.cz

Department of Distributed and Dependable Systems

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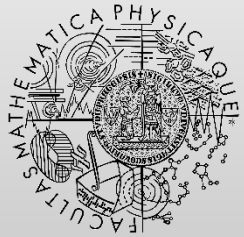

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Two alternatives

1. Dafny
   - https://dafny.org/, https://github.com/dafny-lang/dafny
   - Use plugin for VS Code or command-line tool

2. Viper
   - https://www.pm.inf.ethz.ch/research/viper.html
   - Use plugin for VS Code or web interface
     - http://viper.ethz.ch/examples/blank-example.html

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Task 1

- Implement data structure in Dafny or Viper
  - Elements: **`integer`** type, duplicate items allowed
  - Access: using element index or actual value
  - Operations
    - `void Add(int val)`
    - `int Get(int index)`
    - `int GetHigher(int val)`
      - It should return the least element greater than `val`
    - `void Remove(int index)`
    - `void RemoveAll(int val)`
    - `void Sort()`
    - `int FindMin()`
    - `bool Contains(int val)`
    - `void Clear()`
    - `int Size()`

Task 2

- Define contracts for all operations provided by your data structure
  - Contracts should capture the expected behavior
    - All typical usage patterns supported by the operations
  - Try to cover also some important corner cases
    - Example: index out of bounds

Task 3

- Write small test client for the data structure
  - It should exercise typical usage patterns and some important corners cases
    - Dafny: longer sequences of method calls
    - Viper: interaction of concurrent threads

- Note for tasks 1+3
  - We will not judge the quality of your code
    - Some prefer and use other languages (Java, C, C++, ...)

Task 4

- Verify the implementation of your data structure against the contracts

- Consider some advanced features
  - Dafny: termination
  - Viper: permissions

Task 5

- Document your solution
  - Informally describe what non-trivial properties you specified using Dafny or Viper
    - "why you did what you did"
  - Positive experience: what contracts (properties) you were able to successfully verify
  - Negative experience: what are the major observed limitations of Dafny or Viper
  - For each reported spurious error (if you get some), try to explain why the particular checker reported the error in your opinion
  - Also discuss missed errors (and possible reasons)

Notes about Viper (alternative 2)

- Special task [optional]
  - Compare the verification abilities of VC generator and symbolic execution

- Read the tutorial
  - http://viper.ethz.ch/tutorial/

Organization

- Deadline: **28.4.2025**
- Submission
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