Homework 2: Contracts
Three alternatives

1. Code Contracts
   - Use plugin for Visual Studio (rather old version)

2. Dafny
   - [https://github.com/dafny-lang/dafny](https://github.com/dafny-lang/dafny)
   - Use plugin for VS Code or command-line tool

3. Viper
   - [https://www.pm.inf.ethz.ch/research/viper.html](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](http://viper.ethz.ch/examples/blank-example.html)
Task 1

- Implement data structure in C#, Dafny, or Viper
  - Elements: integer type, duplicates 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

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

- Use static checker to verify the implementation of your data structure against the contracts

- Use the runtime checker on your test client [optional, just for Code Contracts]
Task 5

- Document your solution
  - Informally describe what non-trivial properties you specified using Code Contracts, 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 Code Contracts, 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 3)

- No runtime checker

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

- Read the tutorial
  - [http://viper.ethz.ch/tutorial/](http://viper.ethz.ch/tutorial/)
Organization

- Deadline: 27.4.2022

- Submission
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