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Tutorials for Decision Procedures Exercise Sheet 13

Install and run the program PiVC. You do not need an external solver as the new versions of PiVC use a webservice for these tasks. Thus you have to be online to use it. You can find PiVC and some samples on <https://cs.stanford.edu/people/jasonaue/pivc/>. Please submit your solutions (i.e., the annotated programs) as text files.

Exercise 1: Partial Correctness of Abs 4 Points

Prove partial correctness of the program `Abs` by performing the following steps.

1. Load the example program `Abs`. Replace the postcondition with `true`. Make sure that the flag “Generate Runtime Assertions” in the “Settings” menu is not checked. Hit “Compile”. All verification conditions should now be valid (green).
2. Check the flag “Generate Runtime Assertions” menu and add the loop invariants that are needed to prove them. All verification conditions should be valid (green).
3. Now set the postcondition back to

```
forall ix. (0 <= ix && ix < |rv| -> rv[ix] >= 0)
```

Add the necessary invariants to prove the correctness of the program.

Exercise 2: Partial Correctness of InsertionSort 4 Points

Prove partial correctness of the program `InsertionSort` by performing the following steps.

1. Load the example program `InsertionSort`. Replace the postcondition with `true`. Hit “Compile”. All verification conditions should now be valid (green).
2. Check the flag “Generate Runtime Assertions” and add the loop invariants that are needed to prove them. All verification conditions should be valid (green).
3. Now set the postcondition back to `sorted(rv,0,|rv|-1)`. Add the necessary invariants to prove the correctness of the program.

Exercise 3: Termination of InsertionSort

2 Points

Prove termination of the example program `InsertionSort`.

Choose *one* of the following settings to solve this exercise:

- Replace the postcondition by `true`. Add the loop invariants and the ranking function to show correctness of the loop invariants and termination.
- Take your solution from the previous exercise and extend it with the annotations needed to prove termination. Make sure that partial correctness is still given, and if necessary, adjust the loop invariants.