

# Homework 3

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You are encouraged to checkout the tutorials available on theDafny page. You need to submit a document describing your detailed answer to question 1.3 and two Dafny files: for questions 1.2 and 2.

## Problem 1

The method foo below assumes a natural number  $n \geq 0$  and returns natural number  $r = n * n$ .

```
method foo(n: int) returns (r: int)
requires 0 <= n
ensures r == n*n
{
  var i := 0;
  r := 0;
  while i < n
  {
    r := r + 2*i + 1;
    i := i + 1;
  }
}
```

1. Experiment with some values for the input  $n$ , and using “a pen and a paper”, and check whether indeed the method returns the square value of the input if the input is non-negative.
2. Propose corresponding pre- and post-conditions, invariants and ranking functions to prove the total correctness of the method in Dafny
3. Prove correctness (using the same pre- and post-conditions) with “pen and paper” (using weakest-preconditions, verification conditions for invariants and for ranking functions).

## Problem 2

Verification of the Dutch National Flag algorithm was discussed in lecture 6. Check the this tutorial on using Dafny to verify it. Your task is to generalize it to 4 colours instead of 3, and to verify the result with Dafny.