

The University of New South Wales
SENG2011: Workshop on Reasoning about Programs
Sample Mini-Examination 3

- Two questions: total time allowed: 60 minutes

ex1.dfy

0 marks

1. A singleton set is a set that consists of exactly one element. Dafny does not know the following property of singleton sets:

If s is a singleton set and the integer i is a member of s then $s = \{i\}$.

Write a Dafny lemma with signature:

```
lemma IAmSingle(s:set<int>, i:int)
```

that proves **by contradiction** this property. Note:

- It must use the *reductio ad absurdum* template shown in lectures.
 - You may not call any other lemmas in the proof.
 - You must provide proper justification in every step of the proof.
2. Demonstrate that Dafny has ‘learnt’ this property by writing a method that checks the general case. You may call the method anything that does not conflict with Dafny.

Limit the time you spend on each exercise.

Submission: give **se2011 sample3 ex1.dfy** (command will not work before the exam)

ex2.dfy

0 marks

Write a verified Dafny method with signature:

```
method GetEven(s: array<nat>) modifies s
```

that changes each of the odd elements in a given array into even elements by adding 1 to the odd element. The array may be of any length. You may assume all the elements are natural numbers.

For example, if the array is [3,2,17,9] then **GetEven** adds 1 to each of the odd elements 3, 17 and 9, resulting in [4,2,18,10]. Another example is the array [100], which does not change as it contains no odd elements. An example of an actual Dafny testcase is:

```
var a:array<nat> := new nat[] [0,9,4];  
assert a[0]==0 && a[1]==9 && a[2]==4;  
GetEven(a);  
assert a[0]==0 && a[1]==10 && a[2]==4;
```

Limit the time you spend on each exercise.

Submission: give se2011 sample3 ex2.dfy (command will not work before the exam)

End of Short Sample Examination