CSCI.6962/4962 Software Verification Spring 2018
Proof Assignment 2

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This assignment is to be done either **individually** *or* **in pairs**. *Do not show your code to any other group and do not look at any other group's code. Do not put your code in a public directory or otherwise make it public. However, you may get help from the instructor. You are encouraged to use the LMS Discussions page to post problems so that other students can also answer/see the answers.*

Part I. Natural number orderings

Exercise 8.35 (a) & (c) (Page 472). We can define a function returning the *maximum* of a pair of natural numbers as follows:

```
extend-module N {
  declare max: [N N] -> N [[int->nat int->nat]]

  module Max {

    assert* def := [(y < x ==> x max y = x)
                    (~ y < x ==> x max y = y)]

    define [less2 not-less2] := def

  } # close module Max
} # close module N
```

The names `Max.less2` and `Max.not-less2` are short for "the second argument of `max` is (is not) less than the first."

(a) Prove that `max` is *idempotent*; that is, `(forall x .  x max x = x)`.

⋆ (c) Prove that `max` is associative.

Part II. Relations

Exercise 10.20 (Page 524). Prove the following properties about relations:

```
define range-theorem-2 :=
  (forall R1 R2 . range (R1 /\ R2) subset range R1 /\ range R2)

define dom-theorem-3 :=
  (forall R1 R2 . dom R1 \ dom R2 subset dom (R1 \ R2))

define range-theorem-3 :=
  (forall R1 R2 . range R1 \ range R2 subset range (R1 \ R2))
```

Requirements

Due Date: Monday, **04/02, 7:00PM.**

Grading: *The assignment will be graded mostly on correctness, but code clarity / readability will also be a factor (comment, comment, comment!).*

Submission: *Please submit a ZIP file with your code, including a README file. Your ZIP file should be named with your LMS user name(s) as the filename. Examples:* `userid1.zip`, `userid1_userid2.zip`. *Only submit one assignment per pair via LMS. In the README file, place the names of each group member (up to two). Your README file should also have a list of specific features/bugs in your solution.*