

# COMP 3610 Tutorial 1

4 August, 2023

## Exercise 1

1. According to the sos-rules of IMP, what is the successor state of the following configuration?

$\langle \text{if } !l \geq 5 \text{ then } l := !m \text{ else } m := !l, \{l \mapsto 3, m \mapsto 1\} \rangle$

2. Prove your answer from the previous step, i.e. provide a derivation tree.
3. What are the following steps/successor states?

## Exercise 2

We want to extend syntax and semantics of IMP for *Boolean negation*. That means, we want to have an additional (unary) operator 'Not'.

The full syntax is as follows:

$$\begin{aligned} E & ::= n \mid b \mid E + E \mid E \geq E \mid \neg E \mid \\ & l ::= E \mid !l \mid \\ & \text{skip} \mid E; E \mid \\ & \text{if } E \text{ then } E \text{ else } E \mid \\ & \text{while } E \text{ do } E \end{aligned}$$

Provide the sos-rules for the new operator.

## Exercise 3

Give a derivation tree to prove that

$\vdash \text{while } \text{true} \text{ do skip}$

is well-typed.

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### Exercise 4

1. Write a program  $P$  that assumes it is given two integers stored in locations  $l_1$  and  $l_2$ , respectively, determines the bigger value of the two, stores this bigger value in  $l_1$ , and returns the value. Make sure that you only use the syntax given on slide 33 in the first lecture.
2. Prove that your program  $P$  is well typed. That means, give a type derivation for

$$l_1 : \text{intref}, l_2 : \text{intref} \vdash P : \text{int}$$