Semantics of Programming Languages
Supervision 2

All work should be submitted in PDF form 36 hours before the supervision to the email `josi2@cam.ac.uk`. If you have any questions on the course please include these at the top of the supervision work and we can talk about them in the supervision.
Please give both the original and modified code for any exercises that requires code to be changed. The extensions are encouraged but should only be attempted after the main work has been attempted.

L2

1. What changes are made between L1 and L2 in respect to:
   (a) syntax or expressions and types?
   (b) the definition of values?
   (c) the typing environment?
2. What is the difference between $\Gamma(x)$ in (var) and $\Gamma(\ell)$ in assign and deref?
3. To what extend are let and fn rules related? Could we define one in terms of the other?
4. With the L2 Beta semantics on slide 59, do we still have determinacy and why?
5. How have these theorems changed from L1 to L2
   - Progress
   - Type Preservation
   - Uniqueness of Typing
6. What does it mean for an expression e to be closed? (closed(e)).
7. Rewrite the rules op +, op1, op2, if1, if2, if3, app1, app2 and fn using big-step semantics $\Downarrow$ instead of small-step semantics $\rightarrow$.

$$\Downarrow : \text{expr} \times \text{store} \rightarrow \text{value} \times \text{store}$$

Exercises 4.7

- **Ex18** Please use the fv definition of slide 55.
- **Ex19** Please use the σ definition of slide 56. Sh
- **Ex21**
- **Ex22**
- **Ex23** Consider the var and fn cases
- **Extension: Ex24**
- **Ex25**