These questions are intended for self-study, to help review and deepen your understanding of the lecture. Sample answers are available. There is nothing to hand in.

1. Consider the definitions on slide 5.
   Suppose \( E = \{ a \mapsto L_1, b \mapsto L_2 \} \) and \( S = \{ L_1 \mapsto 10, L_2 \mapsto 20, L_3 \mapsto 30 \} \).
   
   a. What is \( E(a) \)?
   
   b. What is \( E(c) \)?
   
   c. What is \( \text{Dom}(E) \)?
   
   d. What is \( E + \{ d \mapsto L_2 \} \)?
   
   e. What is \( E + \{ b \mapsto L_3 \} \)?
   
   f. What is \( S(L_2) \)?
   
   g. What is \( S(E(a)) \)?
   
   h. What is \( \text{Dom}(S) \)?
   
   i. What is \( S - \{ L_2 \} \)?

2. Draw a derivation tree for \( \text{let } x \ 10 \ ( + \ x \ ( := \ x \ 21 )) \) in an empty environment and store.

3. (a) Suppose we want to add a sequencing expression to our language, where \( \text{after } \exp_1 \ \exp_2 \) evaluates \( \exp_1 \) and then \( \exp_2 \), and returns the value of \( \exp_2 \). Write down a suitable operational semantics rule for these expressions.

(b) Do we really need to have such a new kind of expression in our language? I.e., is there is an equivalent way to get the same behavior using existing expressions?