HW 1 Solution
CS 421 – Spring 2014
Revision 1.0

Assigned January 23, 2014
Due February 2, 2014, 11:59 pm

1 Change Log

1.0 Initial release.

2 Solutions

1. (15 pts) Below is a fragment of OCaml code, with various program points indicated by numbers with comments.

    (code and solution on next page)

    Below is a fragment of OCaml code, with various program points indicated by numbers with comments.

    ```
    3 * 7;;
    (* 1 *)
    let x = 22;;
    let y = x / 2;;
    (* 2 *)
    let z =
      let x = 15 * y
      in
    (* 3 *)
      (x,y);;
    (* 4 *)
    let w = x + y
     in
    (* 5 *)
     2 * w;;
    (* 6 *)
    let f x = y * x;;
    (* 7 *)
    let x = f y;;
    (* 8 *)
    ```

    For each of program points 1 through 8 please describe the environment in effect after evaluation has reached that point. You may assume that the evaluation begins in an empty environment, and that the environment is cumulative thereafter. The program points are supposed to indicate points at which all complete preceding declarations (including local ones in scope) have been fully evaluated. Answers should be written as a set of bindings (without the use of the update operator).

```
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(* 7 *)
let x = f y;;
(* 8 *)
```

$\rho_1 = \emptyset$

$\rho_2 = \{x \mapsto 22, y \mapsto 11\} + \rho_1 = \{x \mapsto 22, y \mapsto 11\}$

$\rho_3 = \{x \mapsto 165\} + \rho_2 = \{x \mapsto 165, y \mapsto 11\}$

$\rho_4 = \{z \mapsto (165, 11)\} + \rho_2 = \{z \mapsto (165, 11), x \mapsto 22, y \mapsto 11\}$

$\rho_5 = \{w \mapsto 33\} + \rho_4 = \{w \mapsto 33, z \mapsto (165, 11), x \mapsto 22, y \mapsto 11\}$

$\rho_6 = \rho_4$

$\rho_7 = \{f \mapsto c_f\} + \rho_6 = \{f \mapsto c_f, z \mapsto (165, 11), x \mapsto 22, y \mapsto 11\}$
where $c_f = \langle x \to y * x, \rho_6 \rangle$

$\rho_8 = \{x \mapsto 121\} + \rho_7 = \{f \mapsto c_f, z \mapsto (165, 11), x \mapsto 121, y \mapsto 11\}$
where $c_f = \langle x \to$ `y * x`$, \rho_6 \rangle$