CMSC 330, Fall 2018 — Quiz 3, Operational Semantics

NAME _____

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INSTRUCTIONS

- Do not start this quiz until you are told to do so.
- You have 15 minutes for this quiz.
- This is a closed book quiz. No notes or other aids are allowed.
- For partial credit, show all your work and clearly indicate your answers.

1. [6 pts] Given the following grammar, complete the parse functions. *lookahead* and *match_tok* are given.

$S \rightarrow A + S \mid A$

$A \rightarrow \mathbf{x} \mid \mathbf{y} \mid (S)$

```
let lookahead () : string =
  match !tok_list with
  | [] -> raise (ParseError "no tokens")
  | h::t -> h

let match_tok (a : string) : unit =
  match !tok_list with
  | h::t when a = h -> tok_list := t
  | _ -> raise (ParseError "bad match")
```

let rec parse_S () =

Solution.

```
parse_A();
if (lookahead () = "+") then
  match_tok "+";
  parse_S ()
else
  ()
```

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and parse_A () =

Solution.

```
match lookahead () with
| "x" -> match_tok "x"
| "y" -> match_tok "y"
| "(" -> match_tok "("; parse_S(); match_tok ")"
| _ -> raise (ParseError "parse_A")
```

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2. [4 pts] Translate the following rules into English and describe the operation *myst* represents.

$$\text{Mystery(1):}\frac{A;\ e \Rightarrow true}{A;\ myst\ e \Rightarrow false} \qquad \text{Mystery(2):}\frac{A;\ e \Rightarrow false}{A;\ myst\ e \Rightarrow true}$$

Solution.

- Mystery(1): Assuming e evaluates to true, myst e evaluates to false.
- Mystery(2): Assuming e evaluates to false, myst e evaluates to true.
- Operation: The myst represents a NOT operation.

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3. [10 pts] Using the rules given below, show: $A;\ let\ x = 4\ in\ let\ y = x\ in\ x + y \Rightarrow 8$

$$\frac{}{A;\ n \Rightarrow n} \qquad \frac{A(x) = v}{A;\ x \Rightarrow v}$$

$$\frac{A; e_1 \Rightarrow v_1 \quad A, x : v_1;\ e_2 \Rightarrow v_2}{A;\ \textbf{let}\ x = e_1 \textbf{in}\ e_2 \Rightarrow v_2} \qquad \frac{A;\ e_1 \Rightarrow n_1 \quad A;\ e_2 \Rightarrow n_2 \quad n_3\ is\ n_1 + n_2}{A;\ e_1 + e_2 \Rightarrow n_3}$$

Solution.

$$\dfrac{A;\ 4 \Rightarrow 4 \qquad \dfrac{\dfrac{A, x : 4(x) = 4}{A, x : 4;\ x \Rightarrow 4} \qquad \dfrac{\dfrac{A, x : 4, y : 4(x) = 4}{A, x : 4, y : 4;\ x \Rightarrow 4} \qquad \dfrac{A, x : 4, y : 4(y) = 4}{A, x : 4, y : 4;\ y \Rightarrow 4} \qquad 8\ is\ 4 + 4}{A, x : 4, y : 4;\ x + y \Rightarrow 8}}{A, x : 4;\ let\ y = x\ in\ x + y \Rightarrow 8}}{A;\ let\ x = 4\ in\ let\ y = x\ in\ x + y \Rightarrow 8}$$

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