Quiz 3 from Fall 2020 (Practice)

STUDENT NAME

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Q1 First Sets

3 Points

Consider the following CFG:

$S \rightarrow TTVT$
$T \rightarrow \mathbf{x} \mid \varepsilon$
$V \rightarrow \mathbf{y} \mid \mathbf{z}$

Q1.1

1 Point

Which non-terminals are in the first set of S?

- [ ] $\mathbf{x}$
- [ ] $\mathbf{y}$
- [ ] $\mathbf{z}$
- [ ] ε

Save Answer

Q1.2

1 Point

Which non-terminals are in the first set of T?

- [ ] $\mathbf{x}$
- [ ] $\mathbf{y}$
- [ ] $\mathbf{z}$
- [ ] ε

Save Answer

Q1.3
1 Point

Which non-terminals are in the first set of V?

- [ ] $\mathbf{x}$
- [ ] $\mathbf{y}$
- [ ] $\mathbf{z}$
- [ ] ε

Save Answer

Q2 Parsing
6 Points

Consider the following CFG:

$$S \rightarrow \mathbf{xy}S\mathbf{z} \mid \mathbf{x}T\mathbf{yz}$$
$$T \rightarrow \mathbf{w}T \mid \varepsilon$$

Complete the `parse_S` and `parse_T` functions below, which should parse T and S, respectively. Your functions should not return anything, but should fail if the input is invalid (if the input is valid, simply return `()`).

The structure of the program is as follows:

```
let rec parse_S toks =
    (* TODO *)

and rec parse_T toks =
    (* TODO *)
```

The *lookahead* and *match_tok* functions are provided below:

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

let match_tok toks tok =
    match toks with
    | h :: t when h == tok -> t
    | _ -> raise (ParseError "bad match")
```

Q2.1
3 Points

Implement `parse_S` below of type `string list -> unit`. The first line of your answer should be `let rec parse_S toks =`.

Enter your answer here

Save Answer

Q2.2
3 Points

Implement `parse_T` below of type `string list -> unit`. The first line of your answer should be `and rec parse_T toks =`.

Enter your answer here

Save Answer

Q3 CFG Construction
3 Points

Construct a CFG that generates strings of the form $a^x b^y$ where $y \geq 2x$.

Enter your answer here

Save Answer

Q4 Ambiguous Grammars
2 Points

Consider the following CFG:

$$S \rightarrow \mathbf{a}S \mid \mathbf{a}T$$
$$T \rightarrow \mathbf{a} \mid \mathbf{b} \mid \varepsilon$$

Prove that this grammar is ambiguous.

Enter your answer here

Save Answer

Q5 Operational Semantics

6 Points

$$\frac{}{A; n \to n} \qquad \frac{A(x) = v}{A; x \to v} \qquad \frac{A; e_1 \to v_1 \qquad A, x : v_1; e_2 \to v_2}{A;\ \textbf{let}\ x = e_1\ \textbf{in}\ e_2 \to v_2}$$

$$\frac{A; e_1 \to n_1 \qquad A; e_2 \to n_2 \qquad n_1 > n_2}{A; e_1 > e_2 \to \textbf{true}} \qquad \frac{A; e_1 \to n_1 \qquad A; e_2 \to n_2 \qquad n_1 \leq n_2}{A; e_1 > e_2 \to \textbf{false}}$$

$$\frac{A; e_1 \to \textbf{true} \qquad A; e_2 \to v}{A;\ \textbf{if}\ e_1\ \textbf{then}\ e_2\ \textbf{else}\ e_3 \to v} \qquad \frac{A; e_1 \to \textbf{false} \qquad A; e_3 \to v}{A;\ \textbf{if}\ e_1\ \textbf{then}\ e_2\ \textbf{else}\ e_3 \to v}$$

Using the above rules, fill in the blanks in the derivation show below:

$$\dfrac{\dfrac{}{\text{A, x: 7; true} \to \text{true}} \qquad \dfrac{\dfrac{\boxed{5}}{\text{A, x: 7; x} \to 7} \qquad \dfrac{}{\text{A, x: 7; 13} \to 13}}{\text{A, x: 7;}\ \boxed{3}\ \to \text{false}}\ \boxed{4}}{\text{A;}\ \boxed{2}\ \text{A, x: 7; if true then x} > 13 \text{ else true} \to \text{false}}$$

$$\text{A; let}\ \boxed{1}\ \text{in if true then x} > 13 \text{ else true} \to \text{false}$$

IMPORTANT: Double-check that the BLUE box numberings correspond with your answers; the boxes are numbered from bottom to top. We will not accept out-of-order answers.

Blank 1:

Enter your answer here

Blank 2:

Enter your answer here

Blank 3:

Enter your answer here

Blank 4:

Enter your answer here

Blank 5:

Enter your answer here

Save Answer

Save All Answers

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