CS383 Quiz 2

Solution

1. For the following strings, which one doesn't belong to the language GINT?

GINT:

Integer -> Integer Digit | Digit

Digit -> 0|1|2|3|45|6|7|8|9

a. 345
b. 1245
c. 405 (100%)
d. 4510

2. Which one of the following three languages' syntax is different from the others?

L1: Expr → Expr + Term | Expr – Term | Term
Term → 0|1|2|3|4|5|6|7|8|9|(Expr)

L2: Expr → Expr Op Expr | Term
Term → 0|1|2|3|4|5|6|7|8|9|(Expr)
Op → + | -

L3: Expr → Expr + Expr | Expr – Expr | Term
Term → 0|1|2|3|4|5|6|7|8|9|(Expr)

a. L1 (43%)
b. L2
c. L3
d. They are all equal. (48%)

Obviously, L2 = L3 and L1 <= L3
Only have to show L3 <= L1
(For any s in L3, split the string by + and -)
So L1 = L3

3. Which is not true about type errors?

a. Type errors occur frequently in programs.

b. Type errors can't be prevented/detected by EBNF (30%)

c. If undetected, type errors can cause severe compile errors. (48%)

d. A type system can identify type errors before they occur.

4. For the following ENBFs that define syntax for operators, which operator is right associative?

a. Term → Term + Term | Integer
b. Term → Term * Integer | Integer (17%)
c. Term → {Integer /} Term | Integer (78%)
d. Term → Term -- | Integer

5. About recursive functions, which is incorrect?

a. Recursive function must return a value. (26%)
b. It's easy to convert a *for* loop to a recursive function. (22%)
c. If a function calls itself directly, then it's a recursive function.
d. If a function calls itself indirectly, then it's a recursive function. (48%)

6. What are the free variables in the following lambda expression?

$$x\ (\lambda y \cdot y\ z\ x)\ (\lambda m \cdot \lambda n \cdot l\ m\ n)$$

a. x, z, l (91%)
b. x, y, z, l, m, n
c. x, z, n
d. y, l, m

7. For the following substitutions, which is incorrect?

a. $x[y/x] = y$
b. $(\lambda\, x \cdot z\ w)[y/x] = \lambda y \cdot z\ w$ (74%)
c. $(\lambda x \cdot (z\ x))[y/x] = (\lambda u \cdot (z\ u))$ (13%)
d. $(x\ z\ w)[y/x] = y\ z\ w$ (13%)

8. What's the result of the following lambda expression, under full beta-reduction?

$$(\lambda x \cdot x)((\lambda x \cdot x)(\lambda z \cdot (\lambda x \cdot x)z))$$

a. $\lambda\, z \cdot z$ (83%)

b. x

c. z

d. $\lambda\, z \cdot \lambda z \cdot z\ z$ (13%)

9. Which rule is incorrect about list evaluation?

a. $$\frac{}{\text{case nil of nil => } e_1 \mid x_1 :: x_2 \text{ => } e_2 \rightarrow e_1} \quad \text{(E - CaseNil)}$$

b. $$\frac{}{\text{case } v_1 :: v_2 \text{ of nil => } e_1 \mid x_1 :: x_2 \text{ => } e_2 \rightarrow e_2[v_1 / x_1][v_2 / x_2]} \quad \text{(E - CaseCons)}$$

c. $$\frac{e_1 \rightarrow e_1'}{e_1 :: e_2 \rightarrow e_1' :: e_2} \quad \text{(E - Cons1)}$$

d. $$\frac{e_2 \rightarrow e_2'}{e_1 :: e_2 \rightarrow e_1 :: e_2'} \quad \text{(E-Cons2)}$$ (74%)

10. Which rule is incorrect for the evaluation under the environment model?

a. $$\frac{E(x) = v}{(E, x) \rightarrow^* v} \quad \text{(E - var)}$$

b. (22%) $$\frac{}{(E, \lambda x.e) \rightarrow^* \{\lambda x.e, \mathrm{E}\}} \quad \text{(E - fun)}$$

c. (39%) $$\frac{(E, \mathrm{e1}) \rightarrow^* \{\lambda x.e, E_1\} \quad (E, \mathrm{e}_2) \rightarrow^* v_2 \quad (E_1[x \mapsto v_2], \mathrm{e}) \rightarrow^* v,}{(E, (\mathrm{e1}\ \ \mathrm{e2})) \rightarrow^* v} \quad \text{(E - app)}$$

d. (39%) $$\frac{(E, \mathrm{e}_1) \rightarrow^* v_1 \quad (E[x \mapsto v_1],\ \mathrm{e}_2) \rightarrow^* v_2}{(E,\ \mathrm{let\ x = e}_1\ \mathrm{in\ e}_2) \rightarrow^* v_2} \quad \text{(E-let)}$$