

Midterm-2 (1st term 2023-24)

CSC 340

KSU

Student Name:

Student ID Number:

Section time:

Serial number:

Q1) Consider the following CFG

$$\begin{aligned} E &\rightarrow TE' \\ E' &\rightarrow TE' \mid \epsilon \\ T &\rightarrow \underline{FT'} \\ T' &\rightarrow *FT' \mid \epsilon \\ F &\rightarrow \underline{(E)} \mid id \end{aligned}$$
$$\begin{aligned} \text{first}(E) &= \{ \ast, id \} \\ \text{first}(E') &= \{ (, id, \epsilon \} \\ \text{first}(T) &= \{ (, id \} \\ \text{first}(T') &= \{ (, id \} \\ \text{first}(F) &= \{ (, id, \ast, \epsilon \} \end{aligned}$$

A) Find the first and follow sets for each symbol in the following table. (6 grades)

Symbol	First set	Follow set
E	(, id	\$,)
E'	(, id, ε	\$,)
T	(, id	{(, id, \$,)}
T'	{ x , ε}	{(, id, \$,)}
F	(, id	x , (, id, \$,)
(({(, id}

$\text{follow}(E) = \{ \$,) \}$
 $\text{follow}(E') = \{ \}$

$$\text{follow}(\underline{T}) = \text{follow}(E) = \{ \$,) \}$$
$$= \{ (, id, \$,) \}$$
$$\text{Follow}(T') = \text{Follow}(T)$$

Follow(F) = {5, 7, 8, 9} long to the language of

$$U_{\text{coll}}(T)$$
$$\text{follow}(T) = \text{first}(E) = \{ \epsilon, id \}$$

B) Give an example of a string of at least two characters that does not belong to the language of the above grammar. (2 grades)

many possible answers including
*id
)id

- C) Give an example of a string of at least two characters that belongs to the language of the above grammar (2 grades)

many possible answers including

(\$
()

- D) Construct the corresponding LL(1) parsing table. (6 grades)

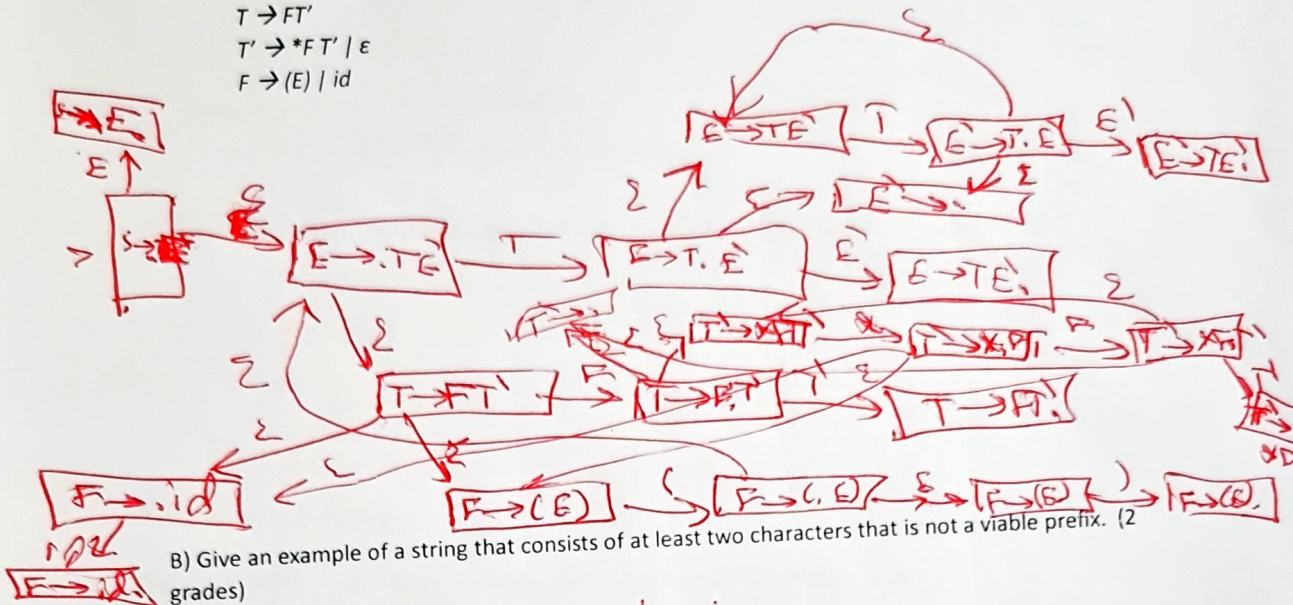
	*	()	id	\$
E		TE'		TE'	
E'		TE'	ϵ	TE'	ϵ
T		FT'		FT'	
T'	$*FT'$	ϵ	ϵ	ϵ	ϵ
F		(E)		id	

- E) Is the grammar LL(1)? Explain your answer. (2 grades)

yes, there is no multiply defined entries in the table

Q2) A) Construct an NFA that determines if the contents of a stack is a viable prefix for the following grammar. (6 grades)

$S \rightarrow E$
 $E \rightarrow TE'$
 $E' \rightarrow TE' \mid \epsilon$
 $T \rightarrow FT'$
 $T' \rightarrow *FT' \mid \epsilon$
 $F \rightarrow (E) \mid id$



B) Give an example of a string that consists of at least two characters that is not a viable prefix. (2 grades)

many possible solutions including: id

c) Give an example of a string that consists of at least two characters that is a viable prefix. (2 grades)

many possible answers including: $(id$

d) Give an example of a grammar that is not SLR(1) grammar. (3 grades)

any ambiguous grammar will do
 e.g. $E \rightarrow E + E \mid E * E \mid id$

Q3) A) Rewrite the following rules using the correct notation

1) The expression $x \&\& y$ is of type Boolean if both x and y are of type Boolean. (2 grades)

$$\frac{\begin{array}{l} \vdash x : \text{bool} \\ \vdash y : \text{bool} \end{array}}{\vdash x \&\& y : \text{bool}}$$

2) The expression $x < y$ is of type Boolean if both x and y are of type Integer. (2 grades)

$$\frac{\begin{array}{l} \vdash x : \text{int} \\ \vdash y : \text{int} \end{array}}{\vdash x < y : \text{bool}}$$

B) Consider the following rule

The expression $x < y$ is of type Boolean if both x and y are of convertible types.

1) Write the rule in the correct notation. (3 grades)

$$\frac{\begin{array}{l} \vdash x : T_1 \\ \vdash y : T_2 \\ T_1 \leq T_2 \text{ or } T_2 \leq T_1 \end{array}}{\vdash x < y : \text{bool}}$$

2) Suggest the minimal modifications to the type system that we need to make so that we can compare float values with integer values. (2 grades)

make either $\text{int} \leq \text{float}$
or $\text{float} \leq \text{int}$