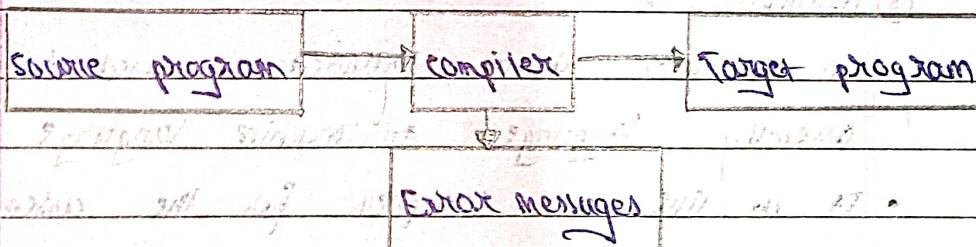


Assignment No.1

Ques. 1) Explain different types of translators with example.

→ ① Compiler: →

- A compiler is a translator used to convert high-level programming language into low-level programming language.
- It converts the whole program in one session and reports errors detected after the conversion.
- The compiler takes time to do its work as it translates high-level code to lower-level code all at once and then saves it to memory.
- Compiler is processor-dependent and platform dependent.
- But it has been addressed by a special compiler, a cross compiler and a source-to-source compiler.

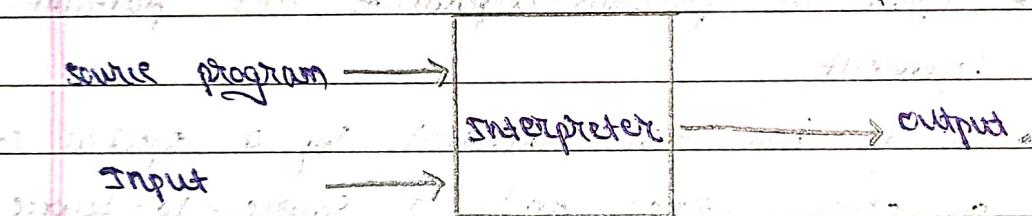


② Interpreter: →

- It is a translator which is used to convert program in high-level language to low-level language.
- It translates line by line and reports the

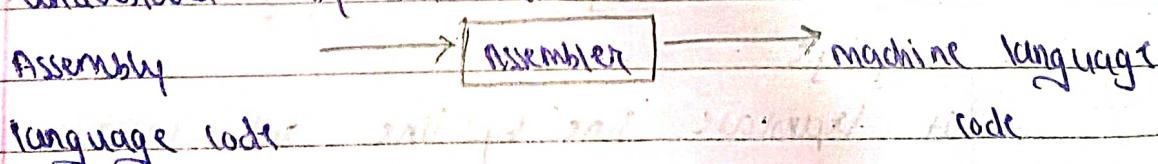
error once it is encountered during the translation process.

- It directly executes the operations specified in the source program when the input is given by the user.
- It gives better error diagnosis than a compiler.
- It is faster than compiler as it immediately executes the code upon reading the code.
- Also it is more portable than compiler as it is not processor dependent, you can work on hardware architectures.



### ③ Assembler :-

- An assembler is a translator used to translate assembly language to machine language.
- It is like a compiler for the assembly language and interactive like an interpreter.
- Assembly language is difficult to understand as it is a low level programming language.
- The machine code can be directly understood by the CPU.



Q. 2 a) Explain some rules for calculating FIRST() and FOLLOW()

→ \* To calculate FIRST(): → ~~difficult~~

FIRST( $\alpha$ ) → set of those terminals with which the strings ~~are derived~~ from  $\alpha$

If  $\alpha = xyz$ , then FIRST( $\alpha$ ) will be computed as follows:

①  $\text{FIRST}(\alpha) = \text{FIRST}(xyz) = \{x\}$  if  $x$  is terminal

For eg.,  $S \rightarrow aB$

$$B \rightarrow b$$

∴  $\text{FIRST}(S) \Rightarrow \text{FIRST}(ab)$   
 $\Rightarrow \{a\}$

②  $\text{FIRST}(\alpha) = \text{FIRST}(xyz) = \text{FIRST}(x)$  if  $x$  does not drive to an empty string. i.e.  $x$  must

$\text{FIRST}(x)$  does not contain  $\epsilon$

for eg.,  $S \rightarrow Bq$

$$B \rightarrow b$$

∴  $\text{FIRST}(S) \Rightarrow \text{FIRST}(ba)$   
 $\Rightarrow \{b\}$

③ If  $\text{FIRST}(x)$  contains  $\epsilon$ , then

$\text{FIRST}(\alpha) = \text{FIRST}(xyz) = \text{FIRST}(x) - \{\epsilon\} \cup \text{FIRST}(yz)$

for eg.,  $S \rightarrow Bq$

$$B \rightarrow bC$$

$\text{First}(S) \rightarrow \text{First}(ba)$

$$\text{FIRST}(B) \rightarrow \{b, \epsilon\}$$

$$\begin{aligned}\text{FIRST}(S) &\rightarrow \text{FIRST}(a) - \{\epsilon\} \cup \text{FIRST}(a) \\ &\rightarrow \{b, c\} - \{\epsilon\} \cup \{a\} \\ &\rightarrow \{b, a\}\end{aligned}$$

\* To calculate FOLLOW( ): →

$\text{FOLLOW}(n) \rightarrow$  set of terminals that immediately follow  $n$  in any string occurring on the right side of productions of the grammar

If  $A \rightarrow B\beta$  is a production - then  $\text{FOLLOW}(B)$  will be computed as :

①  $\text{Follow}(B) \rightarrow \text{FIRST}(\beta)$ ; if  $\text{FIRST}(\beta)$  does not contain  $\{\epsilon\}$

for eg.  $S \rightarrow aAB$

$\text{Follow}(S) \rightarrow \{\$\}$

$\text{Follow}(A) \rightarrow \text{FIRST}(\beta)$   
 $\rightarrow \{b\}$

②  $\text{Follow}(B) \rightarrow \text{FIRST}(\beta) - \{\epsilon\} \cup \text{Follow}(A)$

if  $\text{FIRST}(\beta)$  contains  $\{\epsilon\}$

for eg.  $S \rightarrow aAB$

$A \rightarrow \alpha, \beta$

$B \rightarrow \gamma, \delta$

$\text{Follow}(S) \rightarrow \{\$\}$

$\text{Follow}(A) \rightarrow \text{FIRST}(\beta) - \{\epsilon\} \cup \text{Follow}(S)$   
 $\rightarrow \{c, \epsilon\} - \{\epsilon\} \cup \{\$\}$   
 $\rightarrow \{c, \$\}$

Ques. 2b) Find the FIRST and FOLLOW sets for each non-terminal of the grammar given below:

$$S \rightarrow ABA \mid bca$$

$$A \rightarrow (BCD)^*$$

$$B \rightarrow (cd)^*$$

$$C \rightarrow ee^*$$

$$D \rightarrow bsc^*$$

$\rightarrow$  ~~Final stages of first set~~

$$\text{FIRST}(S) \rightarrow \text{FIRST}(ABA) \cup \text{FIRST}(bca) \quad \dots \text{(1)}$$

$$\begin{aligned} \text{FIRST}(A) &\rightarrow \text{FIRST}(BCD) \cup \text{FIRST}(e) \\ &\rightarrow \{c, e\} \end{aligned}$$

$$\text{FIRST}(B) \rightarrow \text{FIRST}(cd)^* \cup \text{FIRST}(ad) \quad \dots \text{(2)}$$

$$\text{FIRST}(C) \rightarrow \text{FIRST}(ee^*) \cup \text{FIRST}(e)$$

$$d \rightarrow \{e, e^*\} \cup \{e\}$$

$$\text{FIRST}(D) \rightarrow \text{FIRST}(bsc^*) \cup \text{FIRST}(a)$$

$$(a) \text{FIRST}(a) \rightarrow hbc^* \quad \dots \text{(3)}$$

$$\text{FIRST}(bsc^*) \rightarrow \text{FIRST}(bc^*) \cup \text{FIRST}(s)$$

$$\text{FIRST}(bc^*) \rightarrow \text{FIRST}(b) \cup \{e\} \cup \text{FIRST}(c^*)$$

$$\rightarrow \{e, e^*\} - \{e\} \cup \{d\}$$

$$\rightarrow \{e, d\}$$

From (2),

$$\text{FIRST}(B) \rightarrow \text{FIRST}(cd)^* \cup \text{FIRST}(ad)$$

$$\rightarrow \{e, d\} \cup \{a\}$$

$$\rightarrow \{e, d, a\}$$

$$\begin{aligned}\text{FIRST}(ABA) &\rightarrow \text{FIRST}(A) - \{\epsilon\} \cup \text{FIRST}(B) \\ &\rightarrow \{\epsilon, \epsilon\} - \{\epsilon\} \cup \{e, d, a\} \\ &\rightarrow \{e, d, a\}\end{aligned}$$

from ①,

$$\begin{aligned}\text{FIRST}(S) &\rightarrow \text{FIRST}(ABA) \cup \text{FIRST}(b(a)) \\ &\rightarrow \{e, d, a\} \cup \{b\}\end{aligned}$$

$$\text{follow}(S) \rightarrow \{\$\}$$

$$\text{follow}(A) \rightarrow \text{FIRST}(BA) \cup \text{follow}(S) \cup \text{follow}(B) \quad \text{---②}$$

$$\text{follow}(B) \rightarrow \text{FIRST}(a) \cup \text{FIRST}(D)$$

$$\begin{aligned}&\rightarrow \{a\} \cup \text{FIRST}(D) - \{\epsilon\} \cup \text{FIRST}(D) \\ &\rightarrow \{a\} \cup \{\epsilon, \epsilon\} - \{\epsilon\} \cup \{b, a\} \\ &\rightarrow \{a, b, a\}\end{aligned}$$

$$\begin{aligned}\text{follow}(C) &\rightarrow \text{FIRST}(A) \cup \text{FIRST}(DA) \cup \text{FIRST}(D) \\ &\rightarrow \{e, \epsilon\} - \{\epsilon\} \cup \{d\} \cup \{b, a\}\end{aligned}$$

$$\rightarrow \{a, b, c, d\}$$

from ③,

$$\begin{aligned}\text{follow}(n) &\rightarrow \{e, d, a\} \cup \{\$\} \cup \{a, e, b\} \\ &\rightarrow \{a, b, d, e, \$\}\end{aligned}$$

$$\text{follow}(D) \rightarrow \text{follow}(n) \cup \{a, b, c\}$$

$$\rightarrow \{a, b, d, e, \$\}$$

Q.3) construct an LRL(1) parsing table for the following grammar:

$$S \rightarrow Aa \mid aA \mid BC \mid bBa$$

$$A \rightarrow d$$

$$B \rightarrow d$$



Q.4 Find the whether the following grammar is LL(1) or not.

$$S \rightarrow AB \mid eDg$$

$$A \rightarrow ab \mid c$$

$$B \rightarrow dC$$

$$C \rightarrow eC \mid \epsilon$$

$$D \rightarrow fD \mid \epsilon$$

→

$$\text{FIRST}(S) \rightarrow \text{FIRST}(AB) \cup \text{FIRST}(eDg) \dots \textcircled{1}$$

$$\begin{aligned} \text{FIRST}(A) &\rightarrow \text{FIRST}(ab) \cup \text{FIRST}(c) \\ &\rightarrow \{a, c\} \end{aligned}$$

$$\begin{aligned} \text{FIRST}(B) &\rightarrow \text{FIRST}(dC) \\ &\rightarrow \{d\} \end{aligned}$$

$$\begin{aligned} \text{FIRST}(C) &\rightarrow \text{FIRST}(eC) \cup \text{FIRST}(\epsilon) \\ &\rightarrow \{e, \epsilon\} \end{aligned}$$

$$\begin{aligned} \text{FIRST}(D) &\rightarrow \text{FIRST}(f) \cup \text{FIRST}(\epsilon) \\ &\rightarrow \{f, \epsilon\} \end{aligned}$$

$$\text{FIRST}(AB) \rightarrow \{a, c\}$$

From ①,

$$\begin{aligned} \text{FIRST}(S) &\rightarrow \{a, c\} \cup \{e\} \\ &\rightarrow \{a, c, e\} \end{aligned}$$

$\text{FIRST}(a) \cap \text{FIRST}(B) \rightarrow \{\emptyset\} \dots \textcircled{2}$

$\text{FIRST}(AB) \cap \text{FIRST}(eoa) \rightarrow \{\emptyset\}$

$\{a, c\} \cap \{e\} \rightarrow \{\emptyset\}$

$\text{FIRST}(ab) \cap \text{FIRST}(c) \rightarrow \{\emptyset\}$

$\{a\} \cap \{c\} \rightarrow \{\emptyset\} \dots$

$\text{FIRST}(ec) \cap \text{FIRST}(e) \rightarrow \{\emptyset\}$

$\{e\} \cap \{e\} \rightarrow \{\emptyset\}$

$\text{FIRST}(fd) \cap \text{FIRST}(e) \rightarrow \{\emptyset\}$

$\{f\} \cap \{e\} \rightarrow \{\emptyset\}$

$\text{Follow}(s) \rightarrow \{\$\}$

$\text{Follow}(a) \rightarrow \text{FIRST}(B)$

$\rightarrow \{d\}$

$\text{Follow}(B) \rightarrow \text{Follow}(S)$

$\text{Follow}(S) \rightarrow \{\$\}$

$\text{Follow}(c) \rightarrow \text{Follow}(B)$

$\rightarrow \{\$\}$

FOLLOW(D)  $\rightarrow$  FIRST(u)

$\rightarrow \{a\}$

a	b	c	d	e	f	g
s $\rightarrow_{NB} sba$	$s \rightarrow_{AB} bcd$	$c \rightarrow e$	$d \rightarrow f$	$s \rightarrow_{AB} bed$		
a $\rightarrow ablc$	$a \rightarrow ablc$					
b	$b \rightarrow dc$	$c \rightarrow e$	$d \rightarrow f$	$c \rightarrow ed$		
c		$c \rightarrow ed$	$d \rightarrow f$	$e \rightarrow f$		
d $\rightarrow e$					$d \rightarrow fd$	

(P5) show quadruple, triple & indirect triple  
for the following:

$$-(a+b) * (c+d) + (a+b+c)$$

$$\rightarrow n = -(a+b) * (c+d) + (a+b+c)$$

$$t_1 = a+b$$

$$t_2 = -t_1$$

$$t_3 = c+d$$

$$t_4 = t_2 * t_3$$

$$t_5 = t_1 + t_4$$

$$t_6 = t_4 + t_5$$

Quadruple representation

operator	operand 1	operand 2	Result
(1) +	a	b	t <sub>1</sub>
(2) -	t <sub>1</sub>	t <sub>2</sub>	
(3) +	c	d	t <sub>3</sub>
(4) *	t <sub>2</sub>	t <sub>3</sub>	t <sub>4</sub>
(5) +	t <sub>1</sub>	c	t <sub>5</sub>
(6) +	t <sub>4</sub>	t <sub>5</sub>	t <sub>6</sub>

### Triple Representation :

	operator	operand 1	operand 2	
(1)	+	a	b	
(2)	-	(1)		
(3)	+	c	d	
(4)	*	(2)	(3)	
(5)	+	(1)	(	
(6)	+	(4)	(5)	

### Indirect triple :

(1)	
(2)	
(3)	
(4)	
(5)	
(6)	