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1.a Explain different types of translators with example

→

Types of translators
- → Compilers
- → Assemblers
- → Preprocessors
- → Macros
- → Linkers and Loaders.

→ Compilers:

It is a translators which converts high level language into low level language i.e. source Program to Machine Program

Source lang → compilers → Machine lang

A characters stream inputted by customers goes through multiple stages/phases of compilation which at last will provide target lang. It creates an executable program.

→ Interpreters:

It is a program which executes programming

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code directly instead of just translating it into another format. It run through program code and execute it line-by-line directly. As it analize every line it is slower in running than compiles code but can take less time to interpret program code than compiles and run it.

High level language → Interpreter → Result of Program execution

→ Assembler:

It is a translator which translates assembly lang. program into equivalent machine language program of computer. Assembly language consist of mnemonics for machine op-codes so assembler perform a 1:1 translation from mnemonic to direct instruction.

Assembly language → Assembler → Machine language

→ Pre Processor:

It is a program that processes source code before it passes through compiler.

It can perform under control of what is referred to as preprocessor command lines or directives

→ Macros:

Many assembly language support a "macro" facility whereby a macro statement will translate into sequence of assembly language statement and possibly other macro statements before being translated into machine code. Therefore, a macro facility is a text replacement efficiently

→ Linker:

It is computer program that connects and combines multiple object files to create executable file.

→ Loader:

The loader is an element of operating framework and is liable for loading executable files into memory and implement them. It can compute size of program and generate memory space for it.

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2.b. Find FIRST and FOLLOW sets for each nonterminal of grammar given

$S \rightarrow ABa / bCA$

$A \rightarrow cBCD / \varepsilon$

$B \rightarrow cdA / ad$

$C \rightarrow eC / \varepsilon$

$D \rightarrow bSf / a$

$\Rightarrow$

FIRST(S) $\rightarrow$ FIRST(ABa) $\cup$ FIRST(bCA) ← (1)

FIRST(A) $\rightarrow$ FIRST(cBCD) $\cup$ FIRST(ε)

$\rightarrow \{c, \varepsilon\}$

FIRST(B) $\rightarrow$ FIRST(CdA) $\cup$ FIRST(ad) ← (2)

FIRST(C) $\rightarrow$ FIRST(eC) $\cup$ FIRST(ε)

$\rightarrow \{e, \varepsilon\}$

FIRST(D) $\rightarrow$ FIRST(bSf) $\cup$ FIRST(a)

$\rightarrow \{b, a\}$

(2) $\Rightarrow$ FIRST(B) $\rightarrow$ FIRST(C) $- \{\varepsilon\} \cup$ FIRST(cdA) $\cup$ FIRST(ad)

→ {e, ε} - {ε} ∪ {d} ∪ {a}

→ {a, d, e}

(b) ⇒

FIRST(S) → FIRST(A) - {ε} ∪ FIRST(Ba) ∪ FIRST(bCA)

→ {c, ε} - {ε} ∪ {a, d, e} ∪ {b}

→ {a, b, d, c, e}

follow(S) → {$}

follow(A) → FIRST(Ba) ∪ follow(S)

→ {a, d, e} ∪ {$}

→ {a, d, e, $}

follow(B) → FIRST(a) ∪ FIRST(CD)

→ ~~{a, e, ε} - {ε} ∪ FIRST~~

→ {a} ∪ FIRST(C) - {ε} ∪ FIRST(D)

→ {a} ∪ {e, ε} - {ε} ∪ {b, a}

→ {a, e, b}

~~follow(C) → FIRST(A) ∪ FIRST(d) ∪ FIRST(dA)~~

→

Follow(C)

~~FIRST(C)~~ → FIRST(D) ∪ FIRST(dA) ∪ FIRST(A)

→ {b, a, d} ∪ {c} ∪ Follow(S)

→ {b, a, d, c, $}

Follow(D) → Follow(A)

→ {a, d, e, $}

5. Show Quadruple, Triple and Indirect triples for following expression

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

⇒

$t_1 = a+b$

$t_2 = -t_1$

$t_3 = c+d$

$t_4 = t_2 * t_3$

$t_5 = t_1 + c$

$t_6 = t_4 - t_5$

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Quadruple

Location	Operator	arg1	arg2	Result
(0)	+	a	b	t_1
(1)	−	t_1		t_2
(2)	+	c	d	t_3
(3)	*	t_2	t_3	t_4
(4)	+	t_1	c	t_5
(5)	−	t_4	t_5	t_6

Triple:

Location	Operator	arg1	arg2
(0)	+	a	b
(1)	−	(0)	
(2)	+	c	d
(3)	*	(1)	(2)
(4)	+	(0)	c
(5)	−	(3)	(4)

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Indirect Triple

Statement	
(0)	(11)
(1)	(12)
(2)	(13)
(3)	(14)
(4)	(15)
(5)	(16)

location	Operator	arg 1	arg 2
(11)	+	a	b
(12)	−	(11)	
(13)	+	c	d
(14)	*	(12)	(13)
(15)	+	(11)	c
(16)	−	(14)	(15)

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

$S \rightarrow AB / eDa$

$A \rightarrow ab / c$

$B \rightarrow dC$

$C \rightarrow eC / \varepsilon$

$D \rightarrow fD / \varepsilon$

$\Rightarrow$ $S \rightarrow \overset{\alpha}{AB} / \overset{\beta}{eDa}$

$FIRST(\alpha) \cap FIRST(\beta) = \{\phi\}$ ← (1)

$FIRST(AB) \rightarrow FIRST(A)$

$\rightarrow \{a$

$FIRST(A) \rightarrow FIRST(ab) \cup FIRST(c)$

$\rightarrow \{a, c\}$

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

$FIRST(eDa) \rightarrow FIRST \{e\}$

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① FIRST(α) ∩ FIRST(β) = {ϕ}

FIRST(AB) ∩ FIRST(εDa)
⇒ {a,c} ∩ {e}
⇒ {ϕ}

∴ LL(1) grammars

FIRST(S) → FIRST(AB) ∪ FIRST(εDa)
FIRST(A) → FIRST(ab) ∪ FIRST(c)
→ {a,c}
FIRST(B) → FIRST{dC}
→ {d}
FIRST(C) → FIRST{eC} ∪ FIRST{ε}
→ {e,ε}
FIRST(D) → FIRST(f) ∪ FIRST{ε}
→ {f,ε}

Follow(S) → {$}
Follow(A) → ~~Follow~~ FIRST(B)
→ {d}
Follow(B) → Follow(S)
→ {$}

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Follow(C) → Follow(B)
→ {$}

Follow(P) → FIRST(a)
→ {a}

	a	b	c	d	e	f	$
S	S→AB		S→AB		S→eDa		
A	A→ab		A→c				
B		B→dC					
C					C→eC		C→ε
D	D→ε				D→fD		

2.a. Rules for calculating FIRST() and follow()

→

Rules for calculating FIRST()

- If X is a terminal then FIRST(X) is {X}.
- If X is Non-terminal and X tends to a X is production then add 'a' to first of X.
  If X > ε then add null to FIRST(X)
- If X > YZ then if FIRST(Y) = ε then FIRST(X) = {FIRST(Y) - ε} ∪ FIRST(Z)
- If X > YZ if FIRST(X) = Y, then FIRST(X) = Y

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= terminal but null. then FIRST(X) = FIRST(Y)
= terminals

Rules to find follow:

- $ is ~~draw~~ a follow of 'S' (start symbol)
- ~~If A → aBβ , β~~
- If A → aBβ , β != ε then FIRST(β) is in follow(B)
- If A → aB or A → aBβ where FIRST(β) = ε then everything in follow(A) is a follow(B)

3] Construct an LALR(1) parsing table for following grammar.

S → Aa / aAc / Bc / bBa

A → d

B → d

→ S' → S --- 0

S → . Aa --- 1

S → . aAc --- 2

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$S \rightarrow .Ba$ ... 3

$S \rightarrow .bBa$ ... 4

$A \rightarrow .d$ ... 5

$B \rightarrow .d$ ... 6

FIRST (S) → { d, a, b }

FIRST (A) → {d}

FIRST (B) → {d}

Transition step:

$S \rightarrow .S$, $

$S \rightarrow .Aa$, $

$S \rightarrow .aAc$, $

$S \rightarrow .Ba$, $

$S \rightarrow .bBa$, $

$A \rightarrow .d$, a

$B \rightarrow .d$, a

— I_0

for S $S' \rightarrow S.$, $ — I_1

for A $S \rightarrow A.a$, $ — I_2

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for B $S \to B \cdot G, \$$ I_3

for b $S \to b \cdot Ba, \$$
$B \to \cdot d, a$ I_4

for a $S \to a \cdot Ac, \$$
$A \to \cdot d, c$ I_5

for d $A \to d \cdot, a$
$B \to d \cdot, c$ I_6

$I_2 \Rightarrow$ $S \to Aa \cdot, \$$ I_7

$I_3 \Rightarrow$ $S \to Bc \cdot, \$$ I_8

$I_4 \Rightarrow$ for B : $S \to bB \cdot a, \$$ I_9
for d : $B \to d \cdot, a$ I_{10}

$I_5 \Rightarrow$ for A : $S \to aA \cdot c, \$$ I_{11}
for d : $A \to d \cdot, c$ I_{12}

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$I_9 \Rightarrow$ for a $S \rightarrow bBa\cdot, \$$ I_{13}

$I_{11} \Rightarrow$ for c $S \rightarrow aAc\cdot, \$$ I_{14}

State	Action					GoTo		
.	a	b	c	d	$	S	A	B
I_0	S5	S4		S6		1	2	3
I_1					Accept			
I_2	S7							
I_3			S8					
I_4				S10				9
I_5				S12			11	
I_6	R5		R6					
I_7					R_1			
I_8					R_3			
I_9	S13							
I_{10}	R_6							
I_{11}			S14					
I_{12}			R_5					
I_{13}					R_4			
I_{14}					R_2			

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