CD CAT1 QB – Answers

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

Ans 1. a) A translator is a program that takes a program in high level language as input and produces a program in machine language. Beside program translation, the translator performs another very important role, the error-detection.

Types of Translators

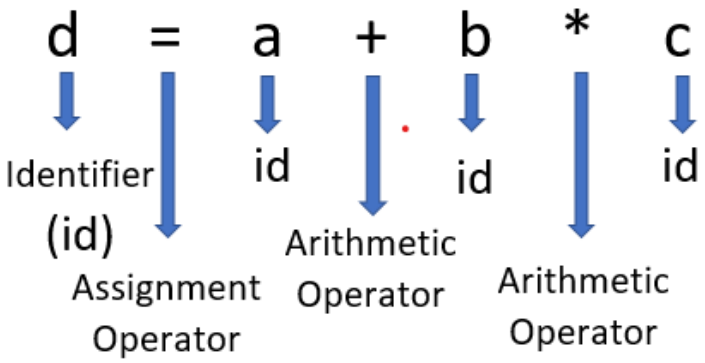
1) Interpreter –
   - An interpreter is a program that appears to execute a source program as if it were machine language.
   - An interpreter translates the entire source code line by line.
   - Examples of interpreted languages are **Perl, Python and MATLAB**
2) Compiler –
   - A compiler is a program that translates a high-level language program into a functionally equivalent low-level language program.
   - A compiler translates the entire source code in a single run.
   - Examples of compiled languages are **C, C++, C#, Java**

1. b) Explain various phases of compilers comes under front end.

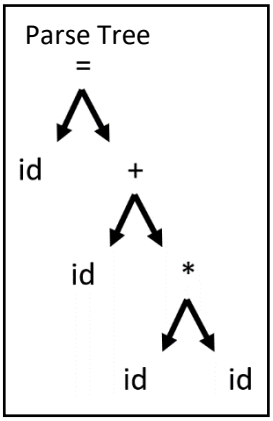
Ans 1. b) **Phases of Compilers - Front End**

I. Lexical Analyzer (Scanner)
- Left to Right scanning
- Then separation of continuous expressions into single element which we will call 'Token'.
- Example

d = a + b * c



- Steps we performed are :-
  i. Scanning
  ii. Tokenization
  iii. Naming of each token



II. Syntax Analyzer (Parser)
- Syntax Analyzer → checks syntax
- Semantic Analyzer → checks logic
- Generates a Parse Tree

III. Intermediate Code Generation
- Three Address Code
- c = a + b
- Example

id = id + id * id

id

id = id + id ∵ (id * id = id)

2. a) Explain the following terms.

Ans 2. a)

i) Cross Compilers

- Cross compiler is a compiler that runs on one machine & produce the object code on another machine.
- The Cross Compiler is used to implement the compiler which is characterized by 3 languages
  a) The Source Language
  b) The Object Language
  c) The Language in which it is written

ii) Bootstrap Compilers

- The compiler which is written in its own language is called bootstrap compiler.
- The technique for producing a self-compiling compiler

iii) Just in time Compiler

- A way of executing computer code that involves compilation during execution of a program (at run time) rather than before execution.
- This reduces overall time taken for compilation of code to machine language.

2. b) Explain various phases of compilers comes under back end.

Ans 2. b) Phases of Compilers - Back End

I. Code optimization
   - Attempt to improve the intermediate code
   - necessary to have a faster executing code or less consumption of memory.

II. Code generation
   - Generates code for the target machine
   - Assembly code

3. a) Explain Top-Down Parser with example.

Ans 3. a) Top-Down Parser:

- A parsing technique that involves starting with the highest-level nonterminal symbol of the grammar and working downward to derive the input string.
- Example:

S → Start Symbol

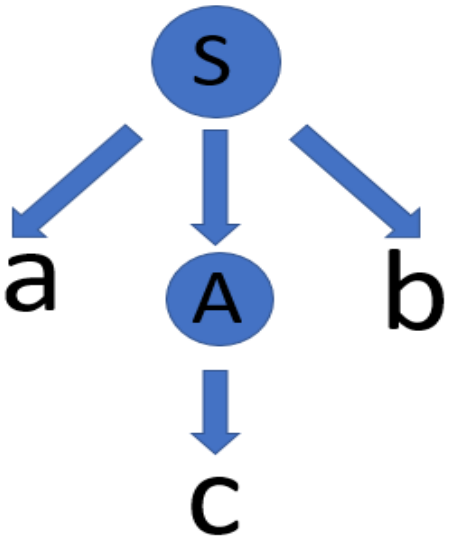
↓

ω → String of terminal symbol

S → aAb

A → cd/c } A → cd | A → c

ω → abc } – Required string



3. b) Find the FIRST () and FOLLOW () for the following grammar.

- S→ aIJh
- I → IbSe / c
- J→ KLKr / Є
- K→ d / Є
- L→ p / Є

Ans 3. b)

- S→ aIJh
- I → cI'
- I' → bSeI' / Є
- J→ KLKr / Є
- K→ d / Є
- L→ p / Є

FIRST(S)→{a}
FIRST(I)→{c}
FIRST(I')→{b}
FIRST(J)→{d,p,r}
FIRST(K)→{d, Є}
FIRST(L)→{p, Є}

FOLLOW(S)→{$}
FOLLOW(I)→{}
FOLLOW(I')→{}
FOLLOW(J)→{}
FOLLOW(K)→{}
FOLLOW(L)→{}

4. a) Show whether given grammar is LL(1) or not.

- S → AaAb/BbBa
- A→ Є
- B→ Є

Ans 4. a) Condition for LL(1) - ∵ FIRST(α) ∩ FIRST(β) = { Φ }

FIRST (AaAb) → FIRST (A) – {ε} U FIRST (aAb)
FIRST (BbBa) → FIRST (b) – {ε} U FIRST (bBa)

FIRST (AaAb) ∩ FIRST (BbBa)) = { Φ }
∴ The given grammar is LL(1)

FIRST (A) → {ε}
FIRST (B) → {ε}
FIRST (S) → FIRST (AaAb) U FIRST (BbBa)
→ {a} U {b}
→ {a,b}
FOLLOW (S) → {$}
FOLLOW (A) → FIRST (aAb) | FIRST (b)
→ {a} | {b}
→ {a,b}
FOLLOW (B) → FIRST (Bba) | FIRST (a)
→ {b} | {a}
→ {b,a}

Predictive Parsing Table:

	a	b	$
S	S → AaAb	S → BbBa	
A	A→ Є	A→ Є	
B	B→ Є	B→ Є	

4. b) Explain why Top-Down Parser is called left most derivative Parser.

Ans 4. b)

The reason that top-down parsing follows the left-most derivation for an input string ω and not the right-most derivation is that **the input string ω is scanned by the parser from left to right, one symbol/token at a time**.

5. a) Find the reduced grammar equivalent to CFG

- G {S A B C } { a b d} S P where P contains = (, , , , , , , ,)
- S → AC / SB
- A→ bASC / a
- B → aSB / bbC
- C → Bc / ad

5. b) Consider the following Grammar

- E → TA
- A → +TA/ϵ
- T → FB
- B → *FB/ϵ
- F → (E)/id

Find FIRST() and FOLLOW() for each and every non terminal

6. a) Compare SLR C LR and LALR Parser

Ans 6. a)

SLR Parser	LALR Parser	CLR Parser
It is very easy and cheap to implement.	It is also easy and cheap to implement.	It is expensive and difficult to implement.
SLR Parser is the smallest in size.	LALR and SLR have the same size. As they have a smaller number of states.	CLR Parser is the largest. As the number of states is very large.
Error detection is not immediate in SLR.	Error detection is not immediate in LALR.	Error detection can be done immediately in CLR Parser.
SLR fails to produce a parsing table for a certain class of grammars.	It is intermediate in power between SLR and CLR i.e., SLR ≤ LALR ≤ CLR.	It is very powerful and works on a large class of grammar.
It requires less time and space complexity.	It requires more time and space complexity.	It also requires more time and space complexity.

6. b) Consider the following grammar:

- S → / / aSbS bSaS ϵ

a) Show that this grammar is ambiguous by constructing two different leftmost derivation for the sentence abab .

7. a) Consider the following grammar

- S → ABC
- A→ a/ϵ
- B→ r/ϵ
- C→ b/ϵ

Construct parsing table with LL Parser

Ans 7. a)

FIRST (A) → FIRST (a) U FIRST (ε)
→ {a} U {ε}
→ {a, ε}

FIRST (B) → FIRST (r) U FIRST (ε)
→ {r} U {ε}
→ {r, ε}

FIRST (C) → FIRST (b) U FIRST (ε)
→ {b} U {ε}
→ {b, ε}

FIRST (S) → FIRST (ABC)
→ FIRST (A) - {ε} U FIRST (BC)
→ {a, ε} - {ε} U {r, ε} U {b, ε}
→ {a, ε} - {ε} U {r, ε} U {b, ε}
→ {a} U {r, b ,ε}
→ {a , r, b , ε}

FOLLOW (S) → {$}

FOLLOW (A) → FIRST (BC) - {ε} U FOLLOW (S)
→ {r, b ,ε} - {ε} U {$}
→ {r, b , $}

FOLLOW (B) → FIRST (C) - {ε} U FOLLOW (S)
→ {b ,ε} - {ε} U {$}
→ {b, $}

FOLLOW (C) → {b, $}

Parsing Table (Not Sure)

	a	b	r	$
S	S → ABC	S → ABC	S → ABC	
A	A→ a	A→ ϵ	A→ ϵ	A→ ϵ
B		B→ ϵ	B→ r	B→ ϵ
C		C→ b		C→ ϵ

7. b) Consider the following grammar

- E → CC
- C→ cC
- C→ d

Construct LR Parser

8. a) Show , Quadruple Triple and Indirect triples for the following expression .
- (a + b) * (c + d) + (a + b + c)

Ans 8. a)

i. Quadruple Representation

Location	Operator	Operand 1	Operand 2	Result
(1)	+	a	b	t1
(2)	+	c	d	t2
(3)	*	t1	t2	t3
(4)	+	t1	c	t4
(5)	+	t3	t4	t5
(6)	-	t5		

ii. Triple Representation

Location	Operator	Operand 1	Operand 2
(1)	+	a	b
(2)	+	c	d
(3)	*	(1)	(2)
(4)	+	(1)	c
(5)	+	(3)	(4)
(6)	-	(5)	

iii. Indirect Triple Representation

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

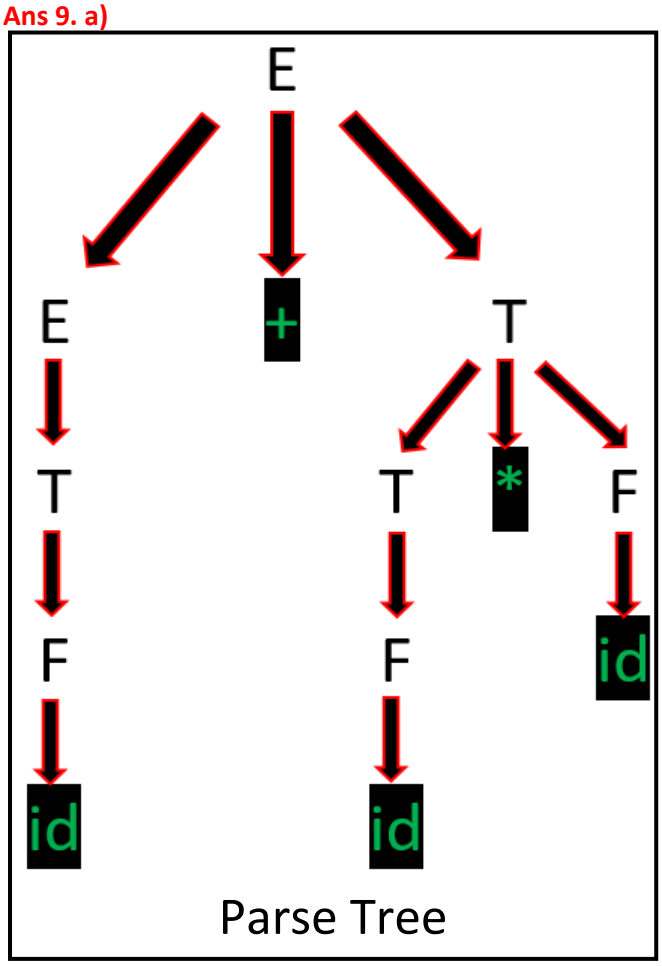
8. b) Find the TAC for following code: - if (B >) D and A < C then P an else Q b = +1 = +1;

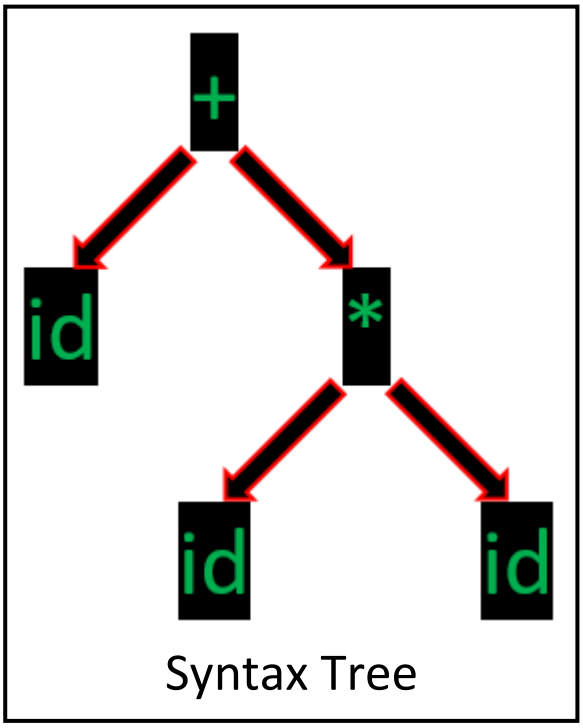
9. a) For the given grammar:

- E-> E + T/T
- T-> T * F/F
- F-> (E)/id

Construct parse tree and syntax tree for string
w = id + id * id

Ans 9. a)





9. b) Differentiate between Synthesized Attributes and Inherited Attributes.

S.NO	Synthesized Attributes	Inherited Attributes
1.	An attribute is said to be Synthesized attribute if its parse tree node value is determined by the attribute value at child nodes.	An attribute is said to be Inherited attribute if its parse tree node value is determined by the attribute value at parent and/or siblings' node.
2.	The production must have non-terminal as its head.	The production must have non-terminal as a symbol in its body.
3.	A synthesized attribute at node n is defined only in terms of attribute values at the children of n itself.	An Inherited attribute at node n is defined only in terms of attribute values of n's parent, n itself, and n's siblings.
4.	It can be evaluated during a single bottom-up traversal of parse tree.	It can be evaluated during a single top-down and sideways traversal of parse tree.
5.	Synthesized attributes can be contained by both the terminals or non-terminals.	Inherited attributes can't be contained by both, it is only contained by non-terminals.
6.	Synthesized attribute is used by both S-attributed SDT and L-attributed SDT.	Inherited attribute is used by only L-attributed SDT.

7.	**EX:-** **E.val -> F.val**  	**EX:-** **E.val = F.val**