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TOPICWISE : COMPILER DESIGN-1 (GATE - 2019) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(17) | CORRECT(6) | INCORRECT(10) | SKIPPED(1)

Q. 1

In a compiler the module that checks the token arrangement against the source code grammar is called _____.

Have any Doubt ?

A
Lexical analyzer

B
Syntax analyzer

Correct Option

Solution :
(b)
• Lexical analyzer scan the source code as a stream of characters and counts it into meaning full lexemes.
• Syntax analyzer checks the token arrangement against the source code grammar.
• Semantic analyzer check whether the parse tree constructed follows the rules of language.
• Code optimizer do code optimization of the intermediate code.

C
Semantic analyzer

Your answer is **Wrong**

D
Code optimizer

QUESTION ANALYTICS

Q. 2

Consider the following grammar:

$S \rightarrow S \times E \mid E$
$E \rightarrow F + E \mid F$
$F \rightarrow id$

Which of the following is true?

Have any Doubt ?

A
'×' is right associative but '+' is left associative

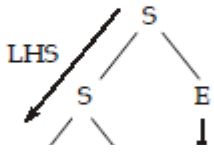
B
'+' is right associative but '×' is left associative

Your answer is **Correct**

Solution :
(b)

$S \rightarrow S \times E \mid E$
$E \rightarrow F + E \mid F$
$F \rightarrow id$

1. For expression "id × id × id".



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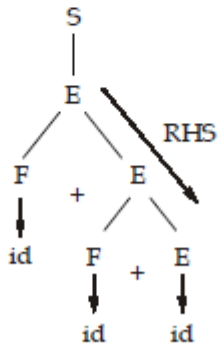
2. For expression "id + id + id".



So, '+' is left associative.

C
Both '+' and '×' are right associative

D
Both '+' and '×' re left associative

QUESTION ANALYTICS

Q. 3

Which of the following is false?

Have any Doubt ?

A
Live variable analysis used in control flow graph for register allocation.

Your answer is **Wrong**

B
Basic block does not contain jump into the middle of the block.

C
Three address code is linear representation of syntax tree.

D
With triples representation optimization can change the execution order.

Correct Option

Solution :
(d)
• With triple, optimization cannot change the execution order but with indirect triple we can.
• Live variable analysis needed in register allocation and deallocation.
• Basic block does not contain jump into middle of the block i.e. sequence of instruction where control enter the sequence at begin and exist at end.
• Three address code is linear representation of syntax tree.

QUESTION ANALYTICS

Q. 4

Consider the following grammar:
$S \rightarrow ZZ$
$Z \rightarrow xZ \mid y$
Which of the following is represent "handle" in the generation of string $"xxxyxy"$?

Have any Doubt ?

A
ZxZ

Your answer is **Wrong**

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C

$xZxy$

D

xZ

Correct Option

Solution :
(d)

String given: "$xxxyxy$"

$$S \rightarrow ZZ \rightarrow \overset{\text{Handle } \{Z \rightarrow xZ\}}{\overbrace{ZxZ}} \rightarrow Zxy \rightarrow xZxy \rightarrow xxZxy \rightarrow xxxZxy \rightarrow xxxyxy$$

- ZxZ is not handle i.e. cannot reduce to any variable.
- Zxy is not handle i.e. cannot reduce to any variable.
- $xZxy$ is not handle i.e. cannot reduce to any variable.
- xZ is handle since xZ reduce to Z in next step.

QUESTION ANALYTICS

Q. 5

Consider the following statements:
S_1 : Grammar parsed by LL(1) parser must be parsed by SLR(1) parser.
S_2 : Grammar parsed by LL(1) parser must be parsed by CLR(1) parser.
S_3 : Grammar which is not parsed by LALR(1) parser cannot be parsed by LL(1) parser.
Which of the following is true?

FAQ | Have any Doubt ?

A

Only S_1

B

Only S_1 and S_2

C

Only S_2 and S_3

Your answer is **Wrong**

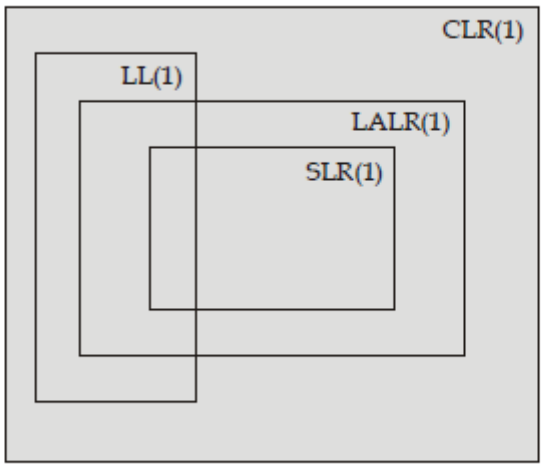
D

Only S_2

Correct Option

Solution :
(d)

Relation between LL(1), SLR(1) and CLR(1) and LALR(1) given below:



S_1 is false, S_2 is true and S_3 is false.

QUESTION ANALYTICS

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```
int main()
{
    int m = 10;
    int n, n1;
    n = ++m;
    n1 = m++;
    n --;
    -- n1;
    n - = n1;
    printf("%d", n);
    return 0;
}
```

FAQ | Have any Doubt ?

46

Correct Option

Solution :
46

```
int main ( )
①  ②  ③④
{
⑤
    int m = 10 ;
    ⑥ ⑦⑧⑨⑩
    int n , n1 ;
    ⑪⑫⑬⑭⑮
    n = ++ m ;
    ⑯⑰⑱⑲⑳
    n1 = m ++ ;
    ㉑㉒㉓㉔㉕
    n -- ;
    ㉖㉗㉘
    -- n1 ;
    ㉙㉚㉛
    n -= n1 ;
    ㉜㉝㉞㉟
    printf ( "%d" , n ) ;
      ㊱ ㊲ ㊳ ㊴㊵㊶㊷
    return 0 ;
      ㊸ ㊹㊺
}
㊻
```

Number of tokens are 46.

Your Answer is 47

QUESTION ANALYTICS

Q. 7

Consider the following grammar which is not LL(1) because LL(1) table contain multiple entry for same production.

$S \rightarrow aAbB \mid bAaB \mid \in$

$A \rightarrow S$

$B \rightarrow S$

The number of entries have multiple productions in LL(1) table are _____.

Have any Doubt ?

2

Your answer is Correct2

Solution :
2

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LL(1) Parsing table:

	a	b	$
S	$S \to aAbB$ $S \to \in$	$S \to bAbB$ $S \to \in$	$S \to \in$
A	$A \to S$	$A \to S$	
B	$B \to S$	$B \to S$	$B \to S$

QUESTION ANALYTICS

Q. 8

Assume ×, −, + and/are operators. Precedences and associativity given for those operators as following:
1. × has highest precedence among all operators and it is left associative
2. −, + and/are having equal precedence and they are right associative.
Using × as Multiplication, − as Subtraction, + as Addition and/as Division.
The output of the given expression 3 × 2 − 10 + 5 − 7 × 6 / 3 is _____.

Have any Doubt ?

5

Your answer is **Correct**5

Solution :
5

Given expression: $((3 \times 2) - (10 + (5 - ((7 \times 6) / 3))))$

$= (6 - (10 + (5 - (42/3))))$
$= (6 - (10 + (5 - 14)))$
$= (6 - (10 - 9))$
$= (6 - (1))$
$= 5$

QUESTION ANALYTICS

Q. 9

The minimum number of temporary variables are created in 3-address code for the following expression _____.

$a + b \times c + d - e - a + b \times c$

Assume order of precedence from highest to lowest as: ×, + and −. Consider associativity for + and × are not important but − is left associative.

Have any Doubt ?

2

Correct Option

Solution :
2

Here × is highest and + is next highest.
Associativity does not matter.
Select the best way so that less number of temporary variables will be created.

$a + b \times c + d - e - a + b \times c$

$= ((a + (b \times c)) + d) - e - (a + (b \times c))$
$= (((a + (b \times c)) + d) - e) - (a + (b \times c))$

Equivalent 3-address code is:

$t_1 = b \times c$
$t_2 = a + t_1$
$t_1 = t_2 + d$
$t_1 = t_1 - e$
$t_1 = t_1 - t_2$

∴ Only two temporary variables are used.

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Your Answer is 5

QUESTION ANALYTICS

Q. 10

Consider the following grammar:

$C \rightarrow PF \text{ class id } XY$
$P \rightarrow \text{public} \mid \epsilon$
$F \rightarrow \text{final} \mid \epsilon$
$X \rightarrow \text{extends id} \mid \epsilon$
$Y \rightarrow \text{implements } I \mid \epsilon$
$I \rightarrow \text{id } J$
$J \rightarrow , I \mid \epsilon$

Which of the following is true?

Have any Doubt ?

A

FIRST (C) = {public, final}
FOLLOW (X) = {implements}

B

FIRST (Y) = {implements, ∈}
FOLLOW (P) = {final}

C

FIRST (C) = {public, final, class}
FOLLOW (X) = {implements, $}

Your answer is **Correct**

Solution :
(c)

$$\begin{aligned}
\text{FIRST (C)} &= \text{FIRST (PF class id XY)} \\
&= \{\text{public}\} \cup \text{FIRST (F class id XY)} \\
&= \{\text{public}\} \cup \{\text{final}\} \cup \text{FIRST (class id XY)} \\
&= \{\text{public}\} \cup \{\text{final}\} \cup \{\text{class}\} \\
&= \{\text{public, final, class}\} \\
\text{FIRST (X)} &= \text{FIRST (Y)} \\
&= \{\text{implements}\} \cup \text{FOLLOW (C)} \\
&= \{\text{implements}\} \cup \{\$\} \\
&= \{\text{implements}, \$\} \\
\text{FIRST (Y)} &= \text{FIRST (implements I)} \cup \text{FIRST } (\epsilon) \\
&= \{\text{implements}, \epsilon\} \\
\text{FOLLOW (P)} &= \text{FIRST (F)} \\
&= \{\text{final}\} \cup \text{FIRST (class)} = \{\text{final, class}\}
\end{aligned}$$

D

FIRST (Y) = {implements}
FOLLOW (P) = {final, class}

QUESTION ANALYTICS

Q. 11

Consider the following expression grammar 'G':
A → B | a | CBD
B → C | b
C → A | c
D → d
Which of the following grammar is non-left recursive but is equivalent to G?

FAQ | Have any Doubt ?

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$B \to C \mid b$
$C \to A \mid c$
$D \to d$

B

$A \to aA' \mid bA' \mid cA'$
$A' \to cBDA' \mid BDA' \mid \in$
$B \to C \mid b$
$C \to A \mid c$
$D \to d$

Your answer is **Wrong**

C

$A \to aA' \mid bA' \mid cA'$
$A' \to BDA' \mid \in$
$B \to C \mid b$
$C \to A \mid c$
$D \to d$

D

$A \to aA' \mid bA' \mid cA' \mid cBDA'$
$A' \to BDA' \mid \in$
$B \to C \mid b$
$C \to A \mid c$
$D \to d$

Correct Option

Solution :
(d)

Given grammar:

$A \to B \mid a \mid CBD$
$B \to C \mid b$
$C \to A \mid c$
$D \to d$

$\equiv$

$A \to A \mid a \mid ABD \mid c \mid b \mid cBD$
$B \to C \mid b$
$C \to A \mid c$
$D \to d$

Removing left recursion from $A \to A \mid a \mid b \mid c \mid ABD \mid cBD$

$A \to aA' \mid bA' \mid cA' \mid cBDA'$
$A' \to BDA' \mid \in$
$B \to C \mid b$
$C \to A \mid c$
$D \to d$

QUESTION ANALYTICS

Q. 12

Consider the following SDT:

$C \to C + S \quad \{C.val = \xrightarrow{(1)}\}$
$C \to S \quad \{C.val = S.val\}$
$S \to S \times E \quad \{S.val = \xrightarrow{(2)}\}$
$S \to E \quad \{S.val = E.val\}$
$E \to id \quad \{E.val = id.num\}$

What is the missing translation (1) and (2), if the string "2 × 3 + 5 × 3 + 1 × 3" produces 160 instead of 24?

Have any Doubt ?

A

(1): $C_1.val + S.val$ and (2): $S_1.val - E.val$

B

(1): $C_1.val * S.val$ and (2): $S_1.val + E.val$

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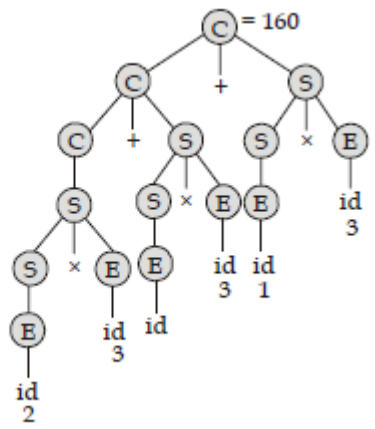


C

$(1): C_1.val * S.val$ **and** $(2): S_1.val - E.val$

D

$C_1.val + S.val$ **and** $(2): S_1.val * E.val$

QUESTION ANALYTICS

Q. 13

Consider the following grammar to generate binary fractions:

$F \rightarrow 0.B \quad \{F.val = B.val\}$
$B_0 \rightarrow 0B_1 \quad \{S_1\}$
$B_0 \rightarrow 1B_1 \quad \{S_2\}$
$B \rightarrow 0 \quad \{B.val = 0\}$
$B \rightarrow 1 \quad \{S_3\}$

If the above grammar with semantic rules calculate $\sum_{i=1}^{n} bi2^{-i}$ and each non-terminal has synthesized attribute 'val' to store its value. Then the missing semantic rules will be _____.

Have any Doubt ?

A

$S_1 : \{B_0 \cdot val = B_1 \cdot val/2\}$
$S_2 : \{B_0 \cdot val = B_1 \cdot val/2^{B_1 \cdot val}\}$
$S_3 : \{B \cdot val = 1\}$

Your answer is **Wrong**

B

$S_1 : \{B_0 \cdot val = B_1 \cdot val/2\}$
$S_2 : \{B_0 \cdot val = B_1 \cdot val + 1/2\}$
$S_3 : \{B \cdot val = 1/2\}$

C

$S_1 : \{B_0 \cdot val = B \cdot val\}$
$S_2 : \{B_0 \cdot val = B_1 \cdot val/2 + 1/2\}$
$S_3 : \{B \cdot val = 1/2\}$

D

$S_1 : \{B_0 \cdot val = B_1 \cdot val/2\}$
$S_2 : \{B_0 \cdot val = B_1 \cdot val/2 + 1/2\}$
$S_3 : \{B \cdot val = 1/2\}$

Correct Option

Solution :
(d)
Since for every 1 after fractional point represented by $1/2^i$. So, $\{B.val = 1/2\}$, then, for B_0
lower bit from fractional side added to $B.val$ i.e., $\{B_0.val = B_1.val/2+1/2\}$.

Q. 14

Consider the intermediate code given below:

1. $i = 1$
2. $j = 1$
3. $t_1 = 10 \times i$
4. $t_2 = t_1 + j$
5. $t_3 = 8 \times t_2$
6. $t_4 = t_3 - 88$
7. $a[t_4] = 0.0$
8. $i = j + 1$
9. If $j <= 10$ goto (3)
10. $i = i + 1$
11. If $i <= 10$ goto (2)
12. $i = 1$
13. $t_5 = i - 1$
14. $t_6 = 88 \times t_5$
15. $a[t_6] = 1.0$
16. $i = i + 1$
17. If $i <= 10$ goto (13)

How many nodes and edges in the control flow graph constructed for above three address code?

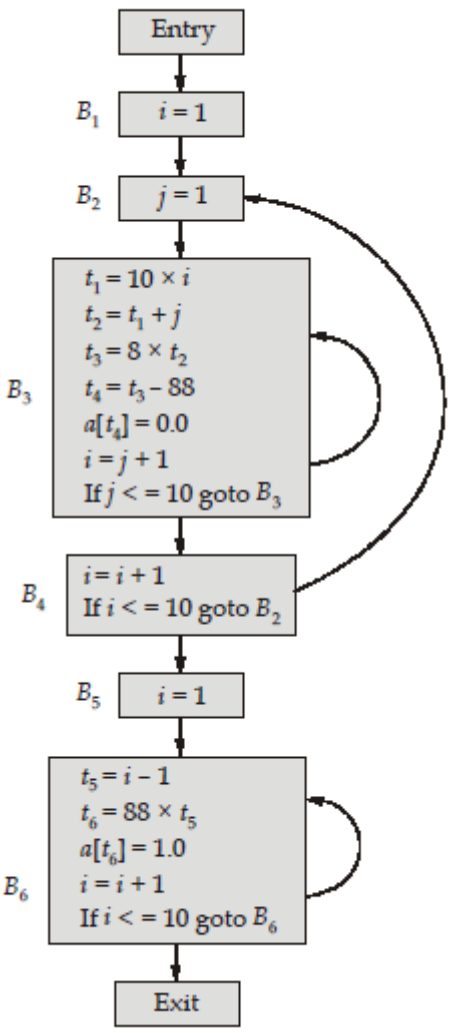
FAQ | Have any Doubt ?

A
8 and 8

B
8 and 10

Your answer is **Correct**

Solution :
(b)
Control flow graph will be:



C
7 and 10

D
7 and 9

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Q. 15

Consider the following code segment:

$a = b + c;$
$c = a + x;$
$d = b + c;$
$b = a + x;$

The minimum number of total variables required to convert the above code segment to static single assignment form is _____.

Have any Doubt ?

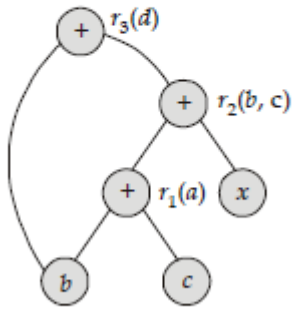
6

Correct Option

Solution :
6

$a = b + c;$ $\quad\quad$ $r_1 = b + c;$
$c = a + x;$ $\quad\quad$ $r_2 = r_1 + x;$
$d = b + c;$ $\quad \Rightarrow \quad$ $r_3 = b + r_2;$
$b = a + x;$ $\quad\quad$ $r_2 = r_1 + x;$

It can be verified by making DAG:



Total number of nodes = 6

Your Answer is 4

QUESTION ANALYTICS

Q. 16

A shift reduce parser carries out the actions. Specified within braces immediately after reducing with the corresponding rule of grammar:

$S_1 \rightarrow S_2\, a$ {$S_1 . nA_1 = S_2 . nA_1 + 1$; $S_1 . nA_2 = S_2 . nA_2$; $S_1 . \text{total} = S_2 . \text{total}$;}
$S_1 \rightarrow S_2\, b$ {$S_1 . nA_1 = S_2 . nA_1$; $S_1 . nA_2 = S_2 . nA_2$; $S_1 . \text{total} = S_2 . \text{total} + S_2 . nA_2$;}
$S_1 \rightarrow S_2\, c$ {$S_1 . nA_1 = 0$; $S_1 . nA_2 = S_2 . nA_1$; $S_1 . \text{total} = S_2 . \text{total}$;}
$S_1 \rightarrow a$ {$S_1 . nA_1 = 1$; $S_1 . nA_2 = 0$; $S_1 . \text{total} = 0$;}
$S_1 \rightarrow b$ {$S_1 . nA_1 = 0$; $S_1 . nA_2 = 0$; $S_1 . \text{total} = 0$;}
$S_1 \rightarrow c$ {$S_1 . nA_1 = 0$; $S_1 . nA_2 = 0$; $S_1 . \text{total} = 0$;}

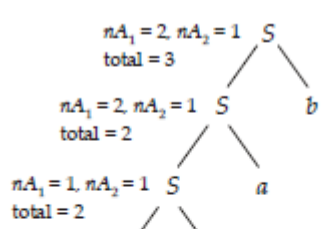
The final output (S_1 total for) input string "*abbcabcabab*" that corresponds to the pattern $(a(a \mid b)^* c + (a \mid b)^* b)^*$ is _____.

FAQ | Have any Doubt ?

3

Correct Option

Solution :
3



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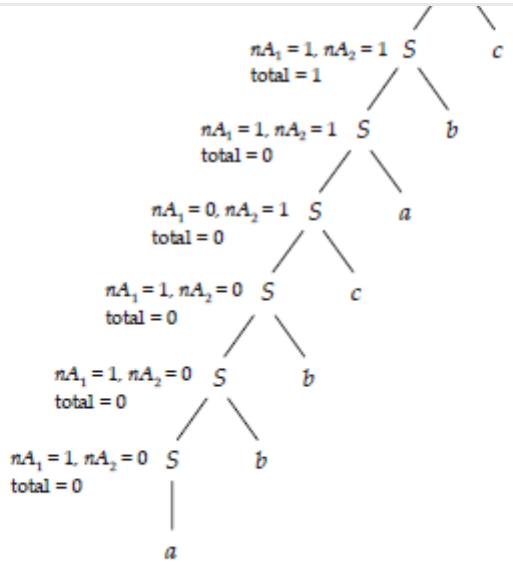

So final value of S_1 . total is 3.

QUESTION ANALYTICS

Q. 17

The following program uses six temporary variables *p, q, r, s, t* and *u*. The code is:

$p = 6$
$q = 7$
$t = p * q$
$s = t + p$
$u = 8$
$u = s * p$
$s = p + u$
$r = r * q$
$t = t + p$
return t

Assuming that all operations take their operands from registers. The minimum number of registers needed to execute this program without spilling is _____.

FAQ | Have any Doubt ?

5

Correct Option

Solution :
5

$r_1 = 6$
$r_2 = 7$
$r_3 = r_1 * r_2$
$r_4 = r_3 + r_1$
$r_5 = 8$
$r_4 = r_4 * r_1$
$r_4 = r_1 + r_4$
$r_4 = r_4 * r_2$
$r_3 = r_3 + r_1$
return r_3

So, total 5 registers are required to execute this program without spilling.

Your Answer is 3

QUESTION ANALYTICS