RANK Improvement WORKBOOK

GATE 2023

Computer Science & Information Technology

Compiler Design

MADE EASY Publications

www.madeeasypublications.org

Contents

RANK Improvement WORKBOOK

Computer Science & Information Technology

01 Basics of a Compiler

LEVEL 1 Questions

Q.1 In which of the following memory is less
(a) Single pass compiler
(b) Multipass compiler
(c) Both occupies equal memory
(d) None of these

Q.2 In which of the following, relocation is done before loading
(a) Static relocation
(b) Dynamic relocation
(c) Both (a) and (b)
(d) None of these

Q.3 Allow several executing programs to share one copy of a subroutine or library is
(a) Linkage editor
(b) Dynamic linking
(c) Both (a) and (b)
(d) None of these

Q.4 In which of the following linking is done at run time
(a) Static linking
(b) Dynamic linking
(c) Both (a) and (b)
(d) None of these

Q.5 Removing # include < > is called as
(a) Macro expansion
(b) Pre processing
(c) File inclusion
(d) None of these

Q.6 Which of the following is correct?
(a) Compiler takes more memory than interpreter.
(b) Interpreter takes more memory than compiler.
(c) Both takes equal memory.
(d) None of these

Q.7 The process of assigning the load addresses to the various parts of the program and adjusting the code and data in the program to reflect the assigned address is called
(a) Assembling
(b) Loading
(c) Relocation
(d) Allocation

Q.8 In which of the following phase of a compiler undeclared variable error is detected
(a) Lexical analysis
(b) Syntax analysis
(c) Semantic analysis
(d) None of these

Q.9 Match the following:

List-I
A. Token
B. Parse tree
C. Type checking
D. Changing the address

List-II
1. Relocation
2. SDT
3. Push down automata
4. Finite automata

Codes:

	A	B	C	D
(a)	4	3	2	1
(b)	4	2	3	1
(c)	3	2	4	1
(d)	None of these			

LEVEL 2 Questions

Q.10 Advantage of dynamic linking is
(a) Makes it possible for one object to be shared by several programs.
(b) It provider the ability to load the subroutines only when they are needed.
(c) Both (a) and (b)
(d) None of these

Q.11 The number of passes in a compiler depends on
(a) The structure of the programming language.
(b) The architecture of the machine in which compiler runs on.
(c) Both (a) and (b)
(d) None of these

Q.12 Which of the following statement is false?
(a) Pre-processor, assembler, linker and loaders are the cousins of compiler.
(b) Cross compiler produces the target code which runs on a different machine.
(c) Macro names will be expanded before compilation.
(d) Assembler will produces a single object module for all modules of the program.

Q.13 Match the following:

List-I	List-II
A. Hash table	1. Assembler
B. Symbol table	2. Compiler
C. Memory utilization	3. Symbol table
D. Syntax errors	4. Garbage collector

Codes:

	A	B	C	D
(a)	1	3	4	2
(b)	3	1	4	2
(c)	1	2	3	4

(d) None of these

■■■■

02 Lexical Analysis

LEVEL 1 Questions

Q.1 Which of the following is false?

(a) Lexical analyzer count the number of lines in the program.

(b) Lexical analyzer stores the information in symbol table but it can't use that information.

(c) Removing the successive symbols from the remaining input string until it forms a well formed token is called as panic node error recovery.

(d) None of these

Q.2 Find the number of tokens produced by the lexical analyzer for the following code segment:

```
int a, b;
{
    a% = b;
    x << == y;
    b & = 3;
    x += >> y;
    a++ − − − + = b;
}
```

Q.3 The earliest error produced by the compiler for the following code segment is

```
void main( )
{
    int a, b;
    a = 10; b = 20;
    if (a == b)
    {
        printf("a & b are equal);
    }
}
```

(a) Lexical error (b) Syntax error

(c) Semantic error (d) No compiler error

Q.4 The number of tokens produced by the lexical analyzer for the following '*c*' code segment is

```
int main( )
{
    int a = 5.65;
    int b, c, d;
    b = c++ * d −;
}
```

Q.5 The number of tokens present in the following *c* statement

printf("MadeEasyGate", %d %d);

(a) 7 (b) 10

(c) 12 (d) 14

Q.6 The number of tokens present in the following c statement

for(*i* = 0; *i* < > *n*, *i*++; *n*++);

(a) 16

(b) 17

(c) 20

(d) Lexical error

Q.7 The earliest error thrown by the compiler for the following '*c*' code segment is

```
main( )
{
    int a, b;
    if (a > b
    a = a + 1;
    else
    b = b − 1;
}
```

(a) Lexical error (b) Syntax error

(c) Semantic error (d) None of these

LEVEL 2 Questions

Q.8 The number of errors that can be produced by the lexical analysis for the following '*c*' code is

```
itn x, y;
main( )
{
    int a = 09;
    int b = 0b2;
    int c = 0xA;
}
```

Q.9 The earliest error produced by the compiler for following C code segment is

```
# include <stdio.h>
void main( )
{
    int x = 0;
    if (x = = 0);
    {
        printf("Gate);
    }
}
```

(a) Lexical error (b) Syntax error
(c) Semantic error (d) None of these

Q.10 The earliest error produced by the compiler for the following C code segment is

```
# include <stdio.h>
void main( )
{
    int add;
    add( )
    printf("Gate");
}
```

(a) Lexical error (b) Syntax error
(c) Semantic error (d) No error

Q.11 The earliest error produced for the following C code segment is

```
# include <stdio.h>
int main( )
{
    int add;
    add( );
    printf("Gate");
}
```

(a) Lexical error (b) Syntax error
(c) Semantic error (d) No error

Q.12 The earliest error produced for the following C code segment is

```
# include <stdio.h>
int main( )
{
    add( );
    printf("Gate");
}
void add( )
{
}
```

(a) Lexical error (b) Syntax error
(c) Semantic error (d) No error

Q.13 Which of the following is/are true?

(a) Lexical analysis produces the token after the request from syntax analysis.
(b) Lexical analysis can produce the error if the length of the identifier accedes the maximum length.
(c) The set of rules for a token are defined by the productions of the grammar.
(d) Set of rules is called pattern and they are represented by a regular expression.

■■■■

03 Syntax Analysis

LEVEL 1 Questions

Q.1 Which of the following is true?
(a) If a grammar *G* is LL(1) then G is also SLR(1).
(b) If a grammar *G* is SLR(1) then G is also LR(0).
(c) If a grammar *G* is LALR(1) then G is also LL(1).
(d) If a grammar *G* is LL(1) then G is also LL(2).

Q.2 The following grammar is
$G = \{S \rightarrow bAd \mid bBd, A \rightarrow a, B \rightarrow a\}$
(a) SLR(1) but not LR(0)
(b) LALR(1) but not SLR(1)
(c) CLR(1) but not LALR(1)
(d) None of these

Q.3 Consider the following grammar:
$G = \{E \rightarrow T \mid T + E, T \rightarrow P \mid P * T, P \rightarrow id\}$
For the input string $x + y * z$ the number of handles present using bottom up parser will be
(a) 6 (b) 7
(c) 8 (d) None of these

Q.4 For any CFG to apply the one of the parsing techniques which of the following is/are necessarily be eliminated from the grammar
(a) Ambiguity
(b) Left recursion
(c) Left factoring
(d) None of these

Q.5 Which of the following can be used even the grammar is ambiguous?
(a) Recursive descent parsing
(b) Brute-Force technique
(c) LR(*k*) parser
(d) None of these

Q.6 The following grammar is
$G = \{S \rightarrow SA \mid A, A \rightarrow a\}$
(a) LL(1) but not SLR(1)
(b) SLR(1) but not LL(1)
(c) Both LL(1) and SLR(1)
(d) None of these

Q.7 Consider the following grammar:
$G = \{E \rightarrow T \mid T + E, T \rightarrow R \mid R * T, R \rightarrow id\}$
The number of handles for the input string $a + b * c$ using bottom-up parser will be
(a) 5 (b) 6
(c) 7 (d) 8

Q.8 The number of shift operations in shift-reduce parsing for the input string id + id * id is
(a) 5 (b) ≤ 5
(c) ≥ 5 (d) None of these

Q.9 Consider the following grammar:
$G = \{S \rightarrow bSAb \mid \in, A \rightarrow aA \mid \in\}$
The entries of M[S, b] and M[A, $] in the correspond LL(1) parsing table M are
(a) $\{S \rightarrow \in\}$ and $\{A \rightarrow \in\}$
(b) $\{S \rightarrow bSAb, S \rightarrow \in\}$ and $\{A \rightarrow \in\}$
(c) $\{S \rightarrow bSAb\}$ and $\{A \rightarrow \in\}$
(d) None of these

Q.10 Eliminate the left factoring from the following grammar:
$G = \{P \rightarrow 0P \mid 0P1 \mid 00Q \mid 1, Q \rightarrow 1Q \mid 1P\}$
(a) $\{P \rightarrow 0P' \mid 1, P' \rightarrow P \mid P1 \mid 0Q, Q \rightarrow 1Q', Q' \rightarrow Q \mid P\}$
(b) $\{P \rightarrow 0P' \mid 1, P' \rightarrow PP'' \mid 0Q, P'' \rightarrow 1 \mid \in, Q \rightarrow 1Q', Q' \rightarrow 0P' \mid 1Q' \mid 1\}$
(c) $\{P \rightarrow 0P' \mid 1, P' \rightarrow PP'', P'' \rightarrow 0Q \mid 1 \mid \in, Q \rightarrow 1Q', Q' \rightarrow Q \mid P\}$
(d) None of these

Q.11 The total number of procedures of the non-terminals in recursive descent parsing for the following grammar is

$G = \{S \to A * E \mid E, E \to id - A \mid F, A \to S - E \mid A + F, F \to id\}$

(a) 4 (b) 5
(c) 7 (d) None of these

Q.12 Let $G = \{S \to AaBS \mid b, A \to aA \mid \in, B \to bA \mid a\}$
Find Follow(S), Follow(A) and Follow(B)
(a) {$}, {a, b, $}, {a, b}
(b) {$}, {a, b}, {a, b}
(c) {$}, {a, b}, {a, b, $}
(d) None of these

Q.13 Let $G = \{S \to aAB \mid BaC, A \to aA \mid Bb, B \to cB \mid \in, C \to Ab \mid a\}$
Find the first set of S, A, B, C of the above grammar
(a) {a, c}, {a, b, c}, {c, ∈}, {a, b}
(b) {a, c, ∈}, {a, b, c}, {c, ∈}, {a, c}
(c) {a, c}, {a, b, c}, {c, ∈}, {a, b, c}
(d) None of these

Q.14 Let $G = \{S \to ABC, A \to aCb \mid AC, B \to Bb \mid \in, C \to cA \mid \in\}$
The total number of elements in follow sets of the non-terminals S, A, B, C is _____.

Q.15 Which of the following grammar is LL(1)?
(a) $\{E \to T + F \mid -T, T \to +F \mid -E, F \to a\}$
(b) $\{S \to AaB \mid Bb, A \to bB \mid aS, B \to \in\}$
(c) $\{S \to ACBa \mid bB, A \to aS \mid cC, B \to Cb \mid a, C \to \in\}$
(d) None of these

Q.16 Which of the following are viable prefixes?
$G = \{S \to ABa, A \to aS \mid b, B \to bB \mid b\}$
(a) aAB (b) AB
(c) aSb (d) Ab

[MSQ]

Q.17 Which of the following is operator grammar?
(a) $G = \{E \to E + T \mid T, T \to TF - \mid id, F \to id\}$
(b) $G = \{E \to E * T \mid T - F, T \to T * F \mid F, F \to \in\}$
(c) $G = \{E \to T + E \mid F - T, T \to F * id \mid id, F \to id\}$
(d) None of these

Q.18 Which of the following is/are true?
(a) If there are different handles present at the same time on top of a stack then the grammar is ambiguous.
(b) If all the symbols in a sentential form are terminals there it is called as sentence.
(c) Set of viable prefixes of a grammar in regular language.
(d) None of these

[MSQ]

Q.19 The following grammar is
$G = \{S \to AbB \mid a, A \to aA \mid a, B \to b\}$
(a) LR(0) but not SLR(1)
(b) SLR(1) but not LR(0)
(c) Both LR(0) and SLR(1)
(d) None of these

Q.20 The number of states in SLR(1) parser for the following grammar is _____.
$G = \{S \to (A) \mid A; B, A \to Ba \mid \in, B \to bS\}$

Q.21 The following grammar is
$G = \{E \to aTF \mid +F, T \to F * T \mid b, F \to bT \mid a\}$
(a) LR(0) but not SLR(1)
(b) SLR(1) but not LR(0)
(c) Both LR(0) and SLR(1)
(d) None of these

Q.22 Which of the following is false?
(a) A left recursive grammar is not SLR(1).
(b) A left factor grammar is not SLR(1).
(c) Every unambiguous grammar is SLR(1).
(d) Every LR(0) grammar is also SLR(1) but every SLR(1) may not be LALR(1).

[MSQ]

Q.23 Which of the following is true?
(a) The number of states of on LALR(1) parser is always equal to CLR(1) of a grammar.
(b) CLR(1) is the most powerful method.
(c) The number of states in SLR(1) and LALR(1) parsers may be equal.
(d) Ambiguous grammar can never be parsed using an LR(k) parser for any $k \geq 3$.

[MSQ]

Q.24 The following grammar is
$G = \{S \to AA \mid aB, A \to Bb \mid c, B \to b\}$
(a) LALR(1) but not SLR(1)
(b) LR(1) but not LALR(1)
(c) Both SLR(1) and LALR(1)
(d) None of these

Q.25 For the above grammar the number of states in both LALR(1) and LR(1) parsers respectively are
(a) 11 and 14 (b) 12 and 14
(c) 13 and 14 (d) None of these

Q.26 Consider the following grammar:
$G = \{S \to @AbC \mid +B \mid a, A \to Bb \mid c,$
$B \to C + A \mid b, C \to aC \mid a\}$
Find the number of items in the state Goto(I_0, @) where I_0 is the initial state of LR(1) parser of the given grammar.

Q.27 Let the number of states in SLR(1), LALR(1) and CLR(1) parsers for the grammar $\{S \to aS \mid b\}$ be n_1, n_2 and n_3 respectively.
Then which of the following is true?
(a) $(n_1 = n_2) < n_3$ (b) $(n_1 < n_2 < n_3$
(c) $(n_1 = n_2) \le n_3$ (d) $n_1 = n_2 = n_3$

Q.28 The following grammar
$G = \{S \to Aa \mid aB \mid a, A \to b, B \to aB \mid b\}$ is
(a) LL(1) but not LL(2)
(b) LL(2) but not LL(1)
(c) Both LL(1) and LL(2)
(d) Neither LL(1) nor LL(2)

Q.29 Which of the following is true?
(a) The error entries in LALR(1) may be more than SLR(1) for a grammar.
(b) The error entries in CLR(1) is more than LALR(1).
(c) Shift entries in LR(0) is same as SLR(1).
(d) Reduce entries in SLR(1) is same as LALR(1).

[MSQ]

Q.30 An ambiguous grammar can be parsed using
(a) Top down parsing
(b) Bottom up parsing
(c) Both (a) and (b)
(d) None of these

LEVEL 2 Questions

Q.31 The following grammar is
$G = \{E \to id \mid id\ (E) \mid E + id\}$
(a) SLR(1) but not LR(0)
(b) LR(1) but not SLR(1)
(c) LL(1) and also LR(1)
(d) None of these

Q.32 Eliminate the left recursion from the following grammar:
$G = \{S \to SaA \mid b, A \to ASb \mid aB, B \to Ba \mid \in\}$
(a) $\{S \to bS', S' \to aAS' \mid \in, A \to aBA',$
$A' \to SbA' \mid \in, B \to \in\}$
(b) $\{S \to bS', S' \to aAS' \mid b, A \to aBA',$
$A' \to SbA' \mid \in, B \to B', B' \to aB' \mid \in\}$
(c) $\{S \to bS', S' \to aAS' \mid \in, A \to aBA',$
$A' \to SbA' \mid \in, B \to aB' \mid \in, B' \to aB' \mid \in\}$
(d) None of these

Q.33 Which of the following is true?
(a) If LR(0) has no conflict then SLR(1) may have the conflicts.
(b) If SLR(1) has no conflict then LR(0) never contains any conflicts.
(c) If LALR(1) has no conflicts then CLR(1) never contains any conflicts.
(d) If CLR(1) has no conflicts then LALR(1) may have the conflicts.

[MSQ]

Q.34 Which of the following grammar is ambiguous?
(a) $\{S \to AaBb, A \to aA \mid a, B \to b\}$
(b) $\{S \to aAb, A \to aA \mid B, B \to bB \mid \in\}$
(c) $\{S \to ABC, A \to aA \mid b \mid \in, B \to bB \mid b, C \to c\}$
(d) $\{S \to aS \mid aA, A \to bA \mid b\}$

Q.35 Let $G = \{S \to A * S \mid -S \mid \in, A \to B + C \mid Ba \mid \in,$
$B \to aB + \mid \in, C \to S - C \mid bA\}$
Find first set of the non-terminals S, A, B, C
(a) $\{a, -, \in\}, \{a, \in\}, \{a, \in\}, \{a, \in, -\}$
(b) $\{a, +, -, \in\}, \{a, \in\}, \{a, \in\}, \{a, b, +, -\}$
(c) $\{a, *, +, -, \in\}, \{a, +, \in\}, \{a, \in\}, \{a, b, *, +, -\}$
(d) None of these

Q.36 Find the entries of M[S, d] and M[B, a] in the corresponding LL(1) parsing table M of the following grammar:

$G = \{S \to AaC \mid db, A \to Bb \mid \epsilon, B \to Sc \mid A, C \to bCAd \mid \epsilon\}$

Q.37 The following grammar is

$G = \{S \to @Ab \mid B \# a, A \to aS \mid \epsilon, B \to bB \mid \#\}$

(a) LL(1) but not SLR(1)
(b) SLR(1) but not LL(1)
(c) Both LL(1) and SLR(1)
(d) None of these

Q.38 Which of the following is LR(1)?

(a) $\{S \to aSa \mid a\}$
(b) $\{P \to R * Q \mid + Q, Q \to -P \mid \epsilon, R \to id + R \mid id\}$
(c) $\{S \to A + B \mid aA, A \to Aa \mid b, B \to b\}$
(d) None of these

[MSQ]

Q.39 For a grammar $G = (V, T, P, S)$ the size of LL(1) parsing table where $|V| = 3$ and $|T| = 4$ is _____.

Q.40 For a grammar $G = (V, T, P, S)$ the size of LL(2) parsing table where $|V| = 4$ and $|T| = 3$ is _____.

■■■■

04 Syntax Directed Translation

LEVEL 1 Questions

Q.1 Which of the following is false?
(a) Every S-attributed SDT is also L-attributed SDT.
(b) Every L-attributed SDT uses inherited attribute.
(c) Every S-attributed SDT uses synthesized attribute.
(d) Meaning of the statements will be verified using semantic actions.

Q.2 Which of the following is safe in coercion
(a) Widening conversion
(b) Narrowing conversion
(c) Both (a) and (b)
(d) For better output no conversion is safe

Q.3 The following SDT is

$A \rightarrow (\ B$	{A.place = B.place}
$B \rightarrow +C\ )\ D$	{B.val = C.val + 1; D.val = C.val}
$D \rightarrow id$	{D.val = id.val}

(a) S-attributed
(b) L-attributed
(c) Both (a) and (b)
(d) None of these

Q.4 The attributes of the operators are given as follows:

Operator	Precedence	Associativity
–	High	Right
+	Medium	Left
*	Low	Left
/	Greater than +	Left

The value of the expression:
3 –15 / 3 – 8 * 2 + 7 * 2 + 12 / 4 is _____.

Q.5 Consider the following grammar:
$E \rightarrow E + T \mid E - T \mid T$
$T \rightarrow T * E \mid T \div F \mid F$
$F \rightarrow digit \mid (E)$
$Digit \rightarrow 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9$
Which of the following operator has highest precedence?
(a) + (b) –
(c) * (d) None of these

Q.6 In the above grammar associativity of * is
(a) Left
(b) Right
(c) No associativity
(d) None of these

Q.7 The following SDT is

$S \rightarrow Aa$	{S.x = A.y}
$A \rightarrow BaS$	{B.x = A.y}
$A \rightarrow b$	{A.x = b.val +1}
$B \rightarrow AS$	{A.y = S.x}

(a) S-attributed
(b) L-attributed
(c) Both (a) and (b)
(d) None of these

LEVEL 2 Questions

Q.8 Consider the following SDT:

$S \rightarrow AaBb$	{print '1'}
$A \rightarrow bA$	{print '2'}
$\mid b$	{print '3'}
$B \rightarrow Ba$	{print '4'}
$\mid a$	{print '5'}

If input is bbaaab then'' o/p is _____.
(a) 32451 (b) 34215
(c) 32541 (d) None of these

Common Data Questions for 9 and 10:

Q.9 Consider the following SDT:

$S \rightarrow A.S_1$	{S.val = S_1.val – A.val}
$S \rightarrow A$	{S.val = A.val}
$A \rightarrow A_1; B$	{A.val = B.val * A_1.val}
$A \rightarrow B$	{A.val = B.val}
$B \rightarrow id$	{B.val = id.val}

If input = 5.3; 4.2.6; 3; 5 then output is _____.

Q.10 The number of reductions for the above input string is

Q.11 Consider the following SDT:

$E \rightarrow E_1 + G$	{E.val = E_1.val * G.val}
$\vert T * E_1$	{E.val = T.val + E_1.val}
$\vert T$	{E.val = T.val}
$T \rightarrow T_1 - F$	{T.val = T_1.val – F.val}
$\vert F$	{T.val = F.val}
$G \rightarrow id$	{G.val = id.val}
$F \rightarrow id$	{F.val = id.val}

If input = 8 – 6 * 7 – 4 + 5 then output is _____.

Q.12 If the compiler performs automatic type conversion then the values of *a*, *b*, *c* for the following code segment as a result of type conversion

int *a* = 5.68;
boolean *b* = 3;
int *c* = *b*;

(a) 5, 3, 3 (b) 5, True, True
(c) 5.68, True, 3 (d) 5, True, 1

Q.13 Consider the following SDT:

$T \rightarrow FT'$	{T′.*i* = F.val; T.val = T′.*s*}
$T' \rightarrow *FT_1'$	{T_1'.*i* = T′.*i* + 3 * F.val; T′.*s* = T_1'.*s*}
$T' \rightarrow \in$	{T′.*s* = T′.*i*}
$F \rightarrow id$	{F.val = id.val}

Where .*i* and .*s* corresponding to inherited and synthesized attributes respectively. The value of the expression 4 * 5 is _____.

■■■■

05 Intermediate Code Generation

LEVEL 1 Questions

Q.1 The postfix notation for the following infix expression is

$x * (y - (3 - s) * u) + (((x / y) + 3) - u) * (x ** y)$

(a) $x\ y\ z\ s - - u * * x\ y / z + u - x\ y * * * +$

(b) $x\ y\ z\ s - u - * * x\ y / z\ u + - x\ y * * * +$

(c) $x\ y\ z\ s - u * - * x\ y + / z\ u - x * y * * +$

(d) None of these

Q.2 Find the number of leader statements in the following code segment:

$a = x < 10$

$b = x > 20$

$c = x! = y$

if (a) goto L_1

if $z(b)$ goto L_2

if $z(c)$ goto L_2

$L_1 : x = 0$

L_2 : _____

Q.3 The 3-address code for the following 'C' code segment is

```
while (i < = n – 1)
{
    a[i] = x * y;
    i = i + 1;
}
```

(a)
$t_1 = n - 1$
L_1 : if $i > t_1$ goto L_2
$t_2 = x * y$
$a[i] = t_2$
$i = i + 1$
goto L_1
L_2 : _____

(b)
$t_1 = n - 1$
if $i > t_1$ goto L
$t_2 = x * y$
$a[i] = t_2$
$i = i + 1$
L : _____

(c)
$t_1 = n - 1$
if $i \le n$ goto L_1
goto L_2
$L_1 : t_2 = x * y$
$a[i] = t_2$
$i = i + 1$
L_2 : _____

(d) None of these

Q.4 The number of leader statements for the following code segment is

$t_1 = 10$

L_1 : if $(t_1 > t_2)$ goto L_2
$a = t_1 + 5$
$t_2 = t_1 - t_2$
goto L_3
$t_2 = t_3 + 5$

L_2 : if$z\ t_3 > t_1$
$a = b + 7$
$t_1 = a + b$
goto L_1

$L_3 : a = a - b$

Q.5

Operator	Operand-1	Operand-2	Result
+	a	b	t_1
*	c	t_1	t_2
–	t_2	a	t_3
÷	t_3	t_1	t_4
=	t_4		x

Find the expression represented by the above 3-address code?

Q.6 The number of nodes and edges in CFG for the following expression _____.
If $(a < b)$ && $(c > b)$ then $b = 1$ else $b = 0$

Q.7 The number of temporary variables in SSA form for the following code segment is

$a = x + c$
$b = a + x$
$a = b - y$
$b = a + b$
$a = b * x$

Q.8 The number of nodes and edges in the DAG for the following expression is _____.

$(x + y) - ((x + y) * (x + y)) + ((x + y) * (x + y)) + ((x + y) \div (x + y))$

LEVEL 2 Questions

Q.9 If x and y represent number of nodes and edges in DAG for the following code segment then the value of $x + y$ is _____.

$a = b + c$
$x = a[i]$
$a[i] = b$
$y = b + x$

Q.10 The number of nodes and edges in a CFG for the following 3-address code is

$a = b + c$
$t_1 = a * c$
$t_2 = b + t_1$
L_1 : if $t_1 < t_2$ goto L_2
$x = a[i]$
$y = t_1 + t_2$
if $a > b$ goto L_1
$z = z * y$
L_2 : $b = z - a$
$t_2 = t_1 + t_2$

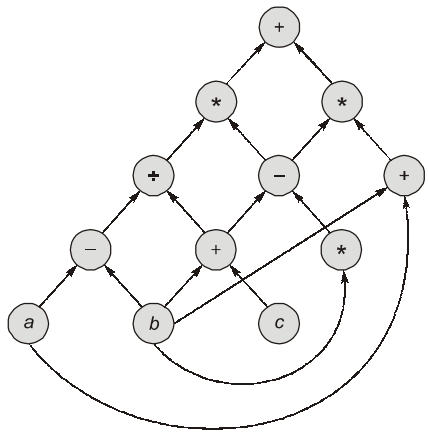
Q.11 Find the number of nodes and edges in the control flow graph for the following 3-address code segment

$t_1 = a \div b$
$t_2 = c + d$
if $(t_1 > t_2)$ goto L_1
$b = b + 1$
$c = c + 1$
goto L_2
L_1 : $b = b - 1$
$c = c - 1$
L_2 : $a = a + 5$
$b = b + 5$

Q.12 Find the number of nodes and edges is CFG for the following code segment

```
int madeeasy(int n)
{
    int i = 0;
    while (n! = 1)
    {
        if(n % 2 == 0)
            n = n / 2;
        else
            n = 2 * n + 1;
        i = i + 1;
    }
    return i;
}
```

Q.13 The expression represents by the following DAG:



(a) $(a - b) \div (b + c) * (b + c) - (c * b) + (b + c) * (a + b)$
(b) $((a - b) \div (b + c)) * (b + c) - (b * c) + ((b + c) - (b * c)) * (b + a)$
(c) $((a - b) \div (b + c)) * ((b + c) - (b * c)) + (b + c) - (b * c) * (b + a)$
(d) None of these

■■■■

06 Code Optimization and Run Time Environment

LEVEL 1 Questions

Q.1 In which of the following memory allocation scheme the size of the data must be known at compile time?
(a) Stack allocation
(b) Static allocation
(c) Heap allocation
(d) All of the above

Q.2 Which of the following is not a field of an activation record?
(a) Control link
(b) Access link
(c) Return value
(d) Garbage collector

Q.3 In which of the following a strength reduction code optimization can be applied.
(a) $x = 3 * y$
(b) $z = a * y$ where a is a large constant
(c) $x = \frac{z}{4}$
(d) $y = x + x$

Q.4 Consider the following 3-address code segment, the number of statements in which atleast 5 variables are in live is
1. $a = b + c$
2. $e = d - a$
3. $b = c + f$
4. $f = e - b$
5. if $a > b$ goto 3
6. return a

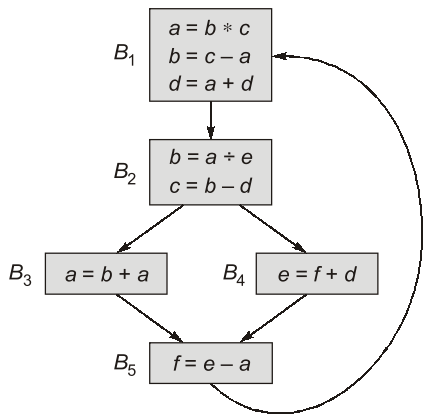
(a) 1 (b) 2
(c) 3 (d) 4

Q.5 Which of the following is not a garbage collection algorithm?
(a) Mark and sweep
(b) Copy collection
(c) Reference counting
(d) None of these

Q.6 Which of the following is true?
(a) A program may contains an unbounded number of variables.
(b) A program must execute on a machine with a bounded number of registers.
(c) Two variables can use the same register if they are never in use at the same time.
(d) Register allocation uses liveness information.

LEVEL 2 Questions

Q.7 Consider the following CFG. The variables that are live in both block 2 and block 4 are



(a) $\{a, d, e, f\}$ (b) $\{a, b, c, d, e, f\}$
(c) $\{a, b, e, f\}$ (d) $\{a, d, f\}$

Q.8 The following code has

```
for(i = 0, i < n; i++)
{
    a = b * c + i;
    for (j = 1; j < n; j++)
    {
        k = a * j + b * i;
        m = 3 + a * j;
    }
}
```

(a) The code has loop invariant optimization.
(b) The code has copy propagation.
(c) The code has common sub expression elimination.
(d) The code has loop fusion.

Q.9 The following code contains:

```
for(i = 1, i < a –10; i++)
{
    x = z * y;
    y = i * 10;
    z = z * y;
}
```

(a) Common sub expression
(b) Code motion
(c) Reduction in strength
(d) Induction variable

■■■■