MES Wadia College of Engineering Pune-01

Department of Computer Engineering

Name of Student:	**Class:**
Semester/Year:	**Roll No:**
Date of Performance:	**Date of Submission:**
Examined By:	**Experiment No: Group A-01**

Group A: ASSIGNMENT NO: 01

AIM: Design suitable Data structures and implement Pass-I and Pass-II of a two-pass assembler for pseudo-machine. Implementation should consist of a few instructions from each category and few assembler directives. The output of Pass-I (intermediate code file and symbol table) should be input for Pass-II.

OBJECTIVES:

- To implement basic language translator by using various needed data structures.
- To implement basic Assembler Pass I and Pass II

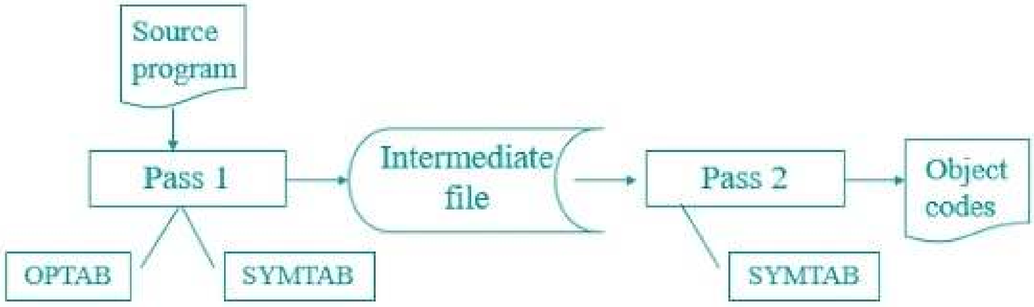
PRE-REQUISITES:

1. Eclipse java.
2. Basics of Language processors.

APPARATUS:

THEORY:

Design of two pass assembler:



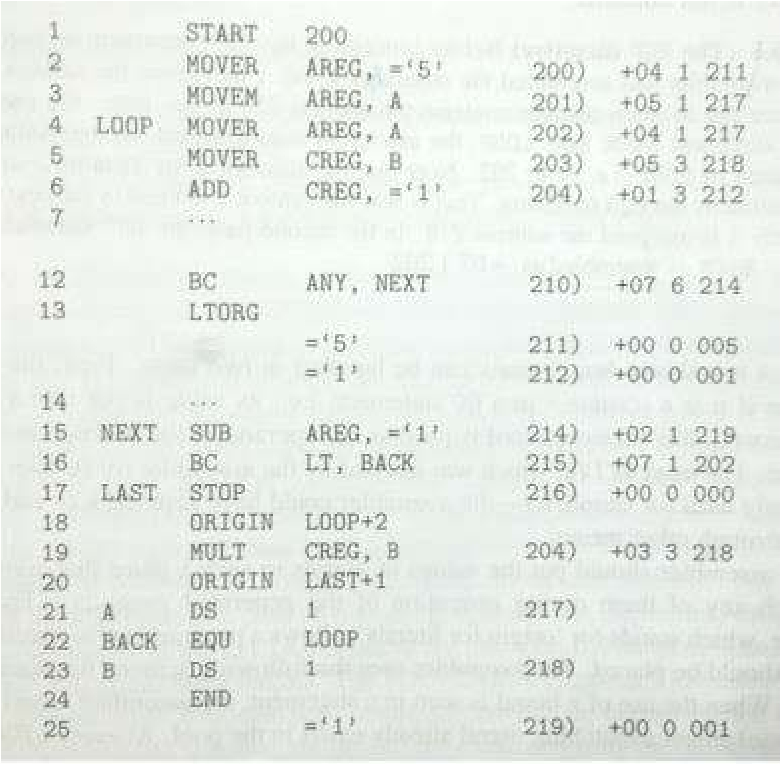
Algorithm (Assembler First Pass) :

```
1. loc_cntr :=0;(default value)
pooltab_ptr :=1;  POOLTAB[1] := 1;
littab_ptr := 1;

2. While next statement is not an END statement
   (a)  If label is present then
              this_label := symbol in label field;
              Enter (this_label, loc_cntr) in SYMTAB.
   (b)  If an LTORG statement then
            (1) Process literals LITTAB [POOLTAB [pooltab_ptr]]. . .LITTAB[littab_ptr -1] to allocate memory ant put the address in the address field. Update loc_cntr accordingly.
            (2) pooltab_ptr := pooltab_ptr  + 1;
            (3) POOLTAB [pooltab_ptr] := littab_ptr;
   (c)  If a START or ORIGIN statement then
              loc_cntr := value specified in operand field ;
   (d)  If an EQU statement then
            (1) this_addr := value of < address spec>;
            (2) Correct the symtab entry for this_label to (this_label , this_addr).
   (e)  If a declaration statement then
            (1) code := code of the declaration statement;
            (2) size := size of memory  area required by DC/DS.
            (3) loc_cntr := loc_cntr + size;
            (4) Generate IC '(DL,code). . .' .
   (f)  If an imperative statement then
            (1) code := machine opcode from OPTAB;
            (2) loc_cntr := loc_cntr + instruction length from OPTAB;
            (3) If operand is a literal then
                     this_literal := literal in operand field;
                     LITTAB[littab_ptr] := this_literal;
                     littab_ptr := littab_ptr + 1;
                 else (i.e. operand is a symbol)
                     this_entry := SYMTAB entry number of operand;
                     Generate IC '(IS, code)(S, this_entry)';

3. (Processing of END statement)
      (a) Perform step 2(b).
      (b) Generate IC '(AD, 02)'.
         (c) Go to Pass II.
```

e.g.

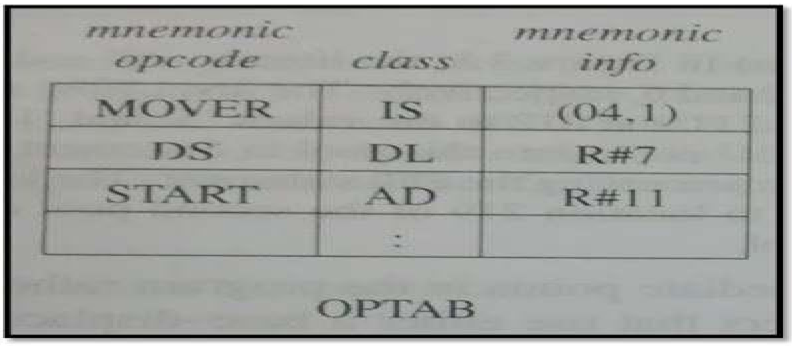


```
1           START   200
2           MOVER   AREG, ='5'     200)  +04 1 211
3           MOVEM   AREG, A        201)  +05 1 217
4   LOOP    MOVER   AREG, A        202)  +04 1 217
5           MOVER   CREG, B        203)  +05 3 218
6           ADD     CREG, ='1'     204)  +01 3 212
7           ...

12          BC      ANY, NEXT      210)  +07 6 214
13          LTORG
                    ='5'           211)  +00 0 005
                    ='1'           212)  +00 0 001
14          ...
15  NEXT    SUB     AREG, ='1'     214)  +02 1 219
16          BC      LT, BACK       215)  +07 1 202
17  LAST    STOP                   216)  +00 0 000
18          ORIGIN  LOOP+2
19          MULT    CREG, B        204)  +03 3 218
20          ORIGIN  LAST+1
21  A       DS      1              217)
22  BACK    EQU     LOOP
23  B       DS      1              218)
24          END
25                  ='1'           219)  +00 0 001
```

Pass I Use following Data Structures

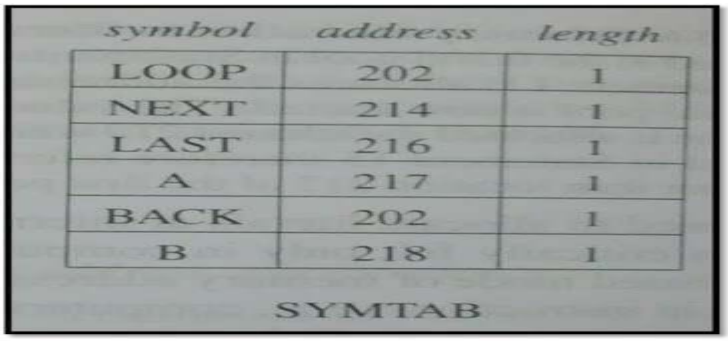
- OPTAB



mnemonic opcode	class	mnemonic info
MOVER	IS	(04,1)
DS	DL	R#7
START	AD	R#11
	:	

OPTAB

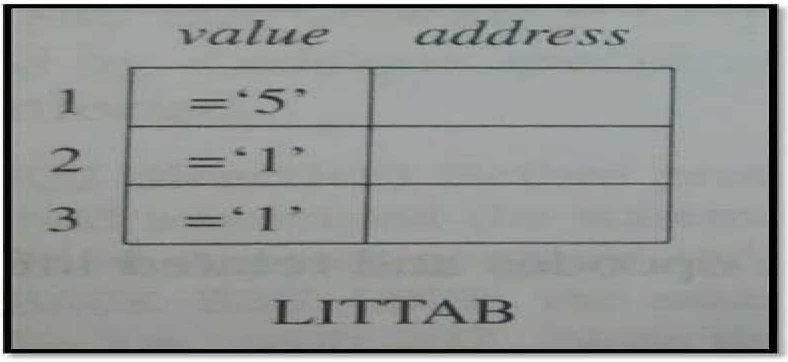
- SYMTAB



symbol	address	length
LOOP	202	1
NEXT	214	1
LAST	216	1
A	217	1
BACK	202	1
B	218	1

SYMTAB

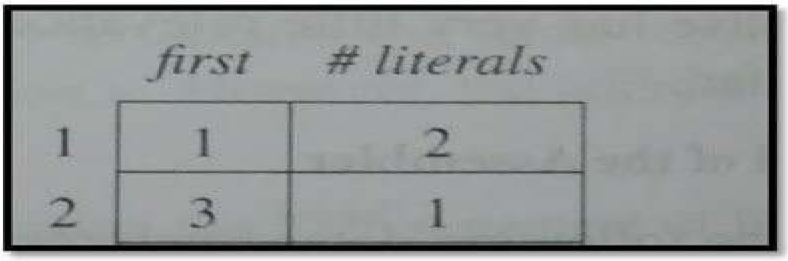
- LITTAB



	value	*address*
1	=‘5’	
2	=‘1’	
3	=‘1’	

LITTAB

- POOLTAB



	first	*# literals*
1	1	2
2	3	1

Algorithm for pass II assumes that the intermediate code is stored in the file. Target code will be assembled in the area named code area.

Algorithm (Assembler Second Pass):

```
1. code_area_address:= address of code_area;
   pooltab_ptr :=1;
   loc_cntr :=0;

2.While next statement is not an END statement

  (a)  Clear machine_code_buffer ;
  (b)  If an LTORG statement

         (i)  Process literals in LITTAB[POOLTAB[poottab_ptr]]... LTAB
              [POOLTAB[pooltab_ptr+1]]-1 similar to processing of constants in a DC statement ,
i.e.
              assemble the literals in machine_code_buffer;
        (ii)  size:= size of memory area required for literals;
       (iii)  pooltab_ptr := pooltab_ptr+1;
```

```
 (c)   If START or ORIGIN statement then
       (i) loc_ctr := value specified in operand feild;
       (ii)size:=0;

 (d)   If a DECLARATION STATEMENT
       (i) IF a DC statement then
                    Assemble the constant in machine_code_buffer.
      (ii)size:= size of memory area required by DC/DS;

 (e)  if an IMPERATIVE STSATEMENT
      (i) Get operand address from SYMTAB or LITTAB.
      (ii) Assemble Instruction in macheine_code_buffer.
      (iii) size:=size of instruction.

  (f) IF size != 0 then
      (i) Move content of machine_code_buffer to the address code_area_address +loc_cntr;
      (ii)  loc_cntr:= loc_cntr+size;

3. (Processing of END statement)
     (a) Perform step 2(b) and 2(f).
     (b) Write code_area into output file.
```

CONCLUSION:

QUESTIONS:

1) What is forward reference? How it is handled in 2 pass assembler?
2) What is ORIGIN statement?
3) Explain EQU statement with example.
4) Explain variants of intermediate code?
5) Which data structures are used in pass I?
6) Which data structures are used in Pass II?
7) Give Example of LTORG statement.