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ASSIGNMENT 2

Problem Defination:

Design suitable data structures and implement pass-I of a two-pass assembler for pseudo-machine in Java using object oriented feature. Implementation should consist of a few instructions from each category and few assembler directives.

1.1 Prerequisite:

Basic concepts of Assembler pass 1& pass2(syntax analyzer)

1.2 Learning Objectives:

- To understand data structures to be used in pass I of an assembler.
- To implement pass I of an assembler

1.3 . Theory Concepts:

A language translator bridges an execution gap to machine language of computer system. An assembler is a language translator whose source language is assembly language.
An Assembler is a program that accepts as input an Assembly language program and converts it into machine language.

- **TWO PASS TRANSLATION SCHEME:**

In a 2-pass assembler, the first pass constructs an intermediate representation of the source program for use by the second pass. This representation consists of two main components - data structures like Symbol table, Literal table and processed form of the source program called as intermediate code(IC). This intermediate code is represented by the syntax of Variant –I
Forward reference of a program entity is a reference to the entity, which precedes its definition in the program. While processing a statement containing a forward reference, language processor does not posses all relevant information concerning referenced entity. This creates difficulties in synthesizing the equivalent target statements. This problem can be solved by postponing the generation of target code until more information concerning the entity is available. This also reduces memory requirements of LP and simplifies its organization. This leads to multi-pass model of language processing.

- **DATA STRUCTURES OF A TWO PASS ASSEMBLER:**

Data Structure of Assembler:

a) Operation code table (OPTAB) :This is used for storing mnemonic, operation code and class of instruction
Structure of OPTAB is as follows
b) Data structure updated during translation: Also called as translation time data structure. They are

I. SYMBOL TABLE (SYMTAB) : Ii contains entries such as symbol,it's address and value.

II. LITERAL TABLE (LITTAB) : it contains entries such as literal and it's value.

III . POOL TABLE (POOLTAB): Contains literal number of the starting literal of each literal pool.

1.4 Design of a Two Pass Assembler: -

Tasks performed by the passes of two-pass assembler are as follows: **Pass I: -**

Separate the symbol, mnemonic opcode and operand fields.
Determine the storage-required foe every assembly language statement and update the location counter.
Build the symbol table and the literal table.
Construct the intermediate code for every assembly language statement.

Pass II: -

Synthesize the target code by processing the intermediate code generated during pass1
INTERMEDIATE CODE REPRESENTATION
The intermediate code consists of a set of IC units, each IC unit consisting of the following three fields
1. Address
2. Representation of the mnemonic opcode
Representation of operands
Where statement class can be one of IS,DL and AD standing for imperative statement, declaration statement and assembler directive , respectively.
8. Algorithms(procedure) :

PASS 1

- Initialize location counter, entries of all tables as zero.
- Read statements from input file one by one.
- While next statement is not END statement

I. Tokenize or separate out input statement as label,numonic,operand1,operand2 II. If label is present insert label into symbol table.

III. If the statement is LTORG statement processes it by making it's entry into literal table, pool table and allocate memory.
IV. If statement is START or ORIGEN Process location counter accordingly.
V. If an EQU statement, assign value to symbol by correcting entry in symbol table.
VI. For declarative statement update code, size and location counter.
VII. Generate intermediate code.
VIII. Pass this intermediate code to pass -2.

1.5 Conclusion:

Thus, I have studied visual programming and implemented dynamic link library application for arithmetic operation

1.6 Code:

```
import java.io.BufferedReader;
import java.io.FileReader;
import java.io.FileWriter;
import java.io.IOException;
import java.util.HashMap;

public class Pass2 {
public static void main(String[] Args) throws IOException{
        BufferedReader b1 = new BufferedReader(new FileReader("intermediate.txt"));
    BufferedReader b2 = new BufferedReader(new FileReader("symtab.txt"));
    BufferedReader b3 = new BufferedReader(new FileReader("littab.txt"));
    FileWriter f1 = new FileWriter("Pass2.txt");
    HashMap<Integer, String> symSymbol = new HashMap<Integer, String>();
    HashMap<Integer, String> litSymbol = new HashMap<Integer, String>();
    HashMap<Integer, String> litAddr = new HashMap<Integer, String>();
    String s;
    int symtabPointer=1,littabPointer=1,offset;
    while((s=b2.readLine())!=null){
        String word[]=s.split("\t\t\t");
        symSymbol.put(symtabPointer++,word[1]);
    }
    while((s=b3.readLine())!=null){
        String word[]=s.split("\t\t");
        litSymbol.put(littabPointer,word[0]);
        litAddr.put(littabPointer++,word[1]);
    }
    while((s=b1.readLine())!=null){
        if(s.substring(1,6).compareToIgnoreCase("IS,00")==0){
            f1.write("+ 00 0 000\n");
        }
        else if(s.substring(1,3).compareToIgnoreCase("IS")==0){
            f1.write("+ "+s.substring(4,6)+" ");
            if(s.charAt(9)==')'){
                f1.write(s.charAt(8)+" ");
                offset=3;
            }
            else{
                f1.write("0 ");
                offset=0;
            }
            if(s.charAt(8+offset)=='S')
```

```
f1.write(symSymbol.get(Integer.parseInt(s.substring(10+offset,s.length()-1)))+"\n");
                        else

f1.write(litAddr.get(Integer.parseInt(s.substring(10+offset,s.length()-1)))+"\n");
                    }
            else if(s.substring(1,6).compareToIgnoreCase("DL,01")==0){
                    String s1=s.substring(10,s.length()-1),s2="";
                    for(int i=0;i<3-s1.length();i++)
                            s2+="0";
                    s2+=s1;
                    f1.write("+ 00 0 "+s2+"\n");
            }
            else{
                    f1.write("\n");
            }
    }
    f1.close();
    b1.close();
    b2.close();
    b3.close();
}
}
```

OUTPUT:

```
intermediate code -
(AD,01)(C,200)
(IS,04)(1)(L,1)
(IS,05)(1)(S,1)
(IS,04)(1)(S,1)
(IS,04)(3)(S,3)
(IS,01)(3)(L,2)
(IS,07)(6)(S,4)
(DL,01)(C,5)
(DL,01)(C,1)
(IS,02)(1)(L,3)
(IS,07)(1)(S,5)
(IS,00)
(AD,03)(S,2)+2
(IS,03)(3)(S,3)
(AD,03)(S,6)+1
(DL,02)(C,1)
(DL,02)(C,1)
(AD,02)
(DL,01)(C,1)
```

Symbol Table --

A	211	1
LOOP	202	1
B	212	1
NEXT	208	1
BACK	202	1
LAST	210	1

literal table --

5	206
1	207
1	213

machine code --

```
+ 04 1 206
+ 05 1 211
+ 04 1 211
+ 04 3 212
+ 01 3 207
+ 07 6 208
+ 00 0 005
+ 00 0 001
+ 02 1 213
+ 07 1 202
+ 00 0 000
+ 03 3 212
```