SS ASSIGNMENT – 5

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Write a program to implement two pass assembler.

Source Code:

```
#include<bits/stdc++.h>
#include<stdio.h>
#include<string.h>
struct MOTtable {
    char Mnemonic[6];
    int Class;
    char Opcode[3];
};
struct symboltable {
    char Symbol[8];
    int Address;
    int Size;
} ST[20];

struct intermediatecode{
    int LC;
    int Code1,Type1;
    int Code2,Type2;
    int Code3,Type3;
} IC[30];

static struct MOTtable MOT[28]={
    {"STOP",1,"00"},{"ADD",1,"01"},{"SUB",1,"02"},
    {"MULT",1,"03"},{"MOVER",1,"04"},{"MOVEM",1,"05"},
    {"COMP",1,"06"},{"BC",1,"07"},{"DIV",1,"08"},
    {"READ",1,"09"},{"PRINT",1,"10"},
    {"START",3,"01"},{"END",3,"02"},{"ORIGN",3,"03"},
    {"EQU",3,"04"},{"LTORG",3,"05"},
    {"DS",2,"01"},{"DC",2,"02"},
    {"AREG",4,"01"},{"BREG",4,"02"},{"CREG",4,"03"},
    {"EQ",5,"01"},{"LT",5,"02"},{"GT",5,"03"},{"LE",5,"04"},
    {"GE",5,"05"},{"NE",5,"06"},{"ANY",5,"07"}
};
int nMOT=28; //Number of entries in MOT
int LC=0; //Location counter
int iST=0; //Index of next entry in Symbol Table
int iIC=0; //Index of next entry in intermediate code table
```

```
int searchST(char symbol[]){
    int i;
    for(i=0;i<iST;i++)
        if(strcmp(ST[i].Symbol,symbol)==0)
            return(i);
    return(-1);
}
int searchMOT(char symbol[]){
    int i;
    for(i=0;i<nMOT;i++)
        if(strcmp(MOT[i].Mnemonic,symbol)==0)
            return(i);
    return(-1);
}
int insertST( char symbol[],int address,int size){
    strcpy(ST[iST].Symbol,symbol);
    ST[iST].Address=address;
    ST[iST].Size=size;
    iST++;
    return(iST-1);
}
void imperative(); //Handle an executable statement
void declaration(); //Handle a declaration statement
void directive(); //Handle an assembler directive
void print_symbol(); //Display symbol table
void print_opcode(); //Display opcode table
void intermediate(); //Display intermediate code
void mcode(); //Generate machine code
char s1[8],s2[8],s3[8],label[8];
void DC(); //Handle declaration statement DC
void DS(); //Handle declaration statement DS
void START(); //Handle START directive
int tokencount; //total number of words in a statement

/********* DRIVER FUNCTION *****************/
int main(){
    char file1[40],nextline[80];
    int len,i,j,temp,errortype;
    FILE *ptr1;
    printf("\nEnter Source File Name: ");
    gets(file1);
    ptr1=fopen(file1,"r");
    while(!feof(ptr1)){
        //Read a line of assembly program and remove special characters
        i=0;
        nextline[i]=fgetc(ptr1);
        while(nextline[i]!='\n'&& nextline[i]!=EOF ){
            if(!isalnum(nextline[i]))
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```
            nextline[i]=' ';
            else
            nextline[i]=toupper(nextline[i]);
            i++;
            nextline[i]=fgetc(ptr1);
        }
        nextline[i]='\0';
        sscanf(nextline,"%s",s1); //read from the nextline in s1
        if(strcmp(s1,"END")==0) //if the nextline is an END statement
            break;
        //if the nextline contains a label
        if(searchMOT(s1)==-1){
            if(searchST(s1)==-1)
                insertST(s1,LC,0);
            //separate opcode and operands
            tokencount=sscanf(nextline,"%s%s%s%s",label,s1,s2,s3);
            tokencount--;
        }
        else
            //separate opcode and operands
            tokencount=sscanf(nextline,"%s%s%s",s1,s2,s3);

        if(tokencount==0)
            //blank line
            continue; //goto the beginning of the loop
        i=searchMOT(s1);
        if(i==-1){
            printf("\nWrong Opcode .... %s",s1);
            continue;
        }
        switch (MOT[i].Class){
            case 1: imperative();break;
            case 2: declaration();break;
            case 3: directive();break;
            default: printf("\nWrong opcode ...%s",s1);
            break;
        }
    }
    print_opcode();
    intermediate();
    mcode();
    return 0;
}

/******** IMPERATIVE CODE **********/
void imperative(){
    int index;
    index=searchMOT(s1);
```

```
    IC[iIC].Type1=IC[iIC].Type2=IC[iIC].Type3=0; //intialize
    IC[iIC].LC=LC;
    IC[iIC].Code1=index;
    IC[iIC].Type1=MOT[index].Class;
    LC=LC+1;
    if(tokencount>1){
        index=searchMOT(s2);
        if(index != -1){
            IC[iIC].Code2=index;
            IC[iIC].Type2=MOT[index].Class;
        }
        else{
            //It is a variable
            index=searchST(s2);
            if(index==-1)
            index=insertST(s2,0,0);
            IC[iIC].Code2=index;
            IC[iIC].Type2=7; //VALUE 7 IS FOR VARIABLES
        }
    }
    if(tokencount>2){
        index=searchST(s3);
        if(index==-1)
            index=insertST(s3,0,0);
        IC[iIC].Code3=index;
        IC[iIC].Type3=7; //VALUE 7 IS FOR VARIABLES
    }
    iIC++;
}

/********* DIRECTIVE AND DECLARATION ********/
void declaration(){
    if(strcmp(s1,"DC")==0){
        DC();
        return;
    }
    if(strcmp(s1,"DS")==0)
        DS();
}
void directive(){
    if(strcmp(s1,"START")==0){
        START();
        return;
    }
}

/*********** DC ***********/
void DC(){
```

```
    int index;
    index=searchMOT(s1);
    IC[iIC].Type1=IC[iIC].Type2=IC[iIC].Type3=0; //intialize
    IC[iIC].LC=LC;
    IC[iIC].Code1=index;
    IC[iIC].Type1=MOT[index].Class;
    IC[iIC].Type2=6; //6 IS TYPE FOR CONSTANTS
    IC[iIC].Code2=atoi(s2);
    index=searchST(label);
    if(index==-1)
        index=insertST(label,0,0);
    ST[index].Address=LC;
    ST[index].Size=1;
    LC=LC+1;
    iIC++;
}

/*************** DS ************/
void DS(){
    int index;
    index=searchMOT(s1);
    IC[iIC].Type1=IC[iIC].Type2=IC[iIC].Type3=0; //intialize
    IC[iIC].LC=LC;
    IC[iIC].Code1=index;
    IC[iIC].Type1=MOT[index].Class;
    IC[iIC].Type2=6; //6 IS TYPE FOR CONSTANTS
    IC[iIC].Code2=atoi(s2);
    index=searchST(label);
    if(index==-1)
        index=insertST(label,0,0);
    ST[index].Address=LC;
    ST[index].Size=atoi(s2);
    LC=LC+atoi(s2);
    iIC++;
}

/***** START **********/
void START(){
    int index;
    index=searchMOT(s1);
    IC[iIC].Type1=IC[iIC].Type2=IC[iIC].Type3=0; //intialize
    IC[iIC].LC=LC;
    IC[iIC].Code1=index;
    IC[iIC].Type1=MOT[index].Class;
    IC[iIC].Type2=6; //6 IS TYPE FOR CONSTANTS
    IC[iIC].Code2=atoi(s2);
    LC=atoi(s2);
    iIC++;
```

```
}

/**** INTERMEDIATE CODE ****/
void intermediate(){
    int i;
    char decode[9][3]={" ","IS","DL","AD","RG","CC","C","S"};
    printf("\n\nIntermediate Code:");
    for(i=0;i<iIC;i++){
        printf("\n%3d)
(%s,%2s)",IC[i].LC,decode[IC[i].Type1],MOT[IC[i].Code1].Opcode);
        if(IC[i].Type2!=0){
            if(IC[i].Type2<6)
                printf("
(%s,%2s)",decode[IC[i].Type2],MOT[IC[i].Code2].Opcode);
            else
                printf(" (%s,%2d)",decode[IC[i].Type2],IC[i].Code2);
        }
        if(IC[i].Type3!=0)
            printf(" (%s,%2d)",decode[IC[i].Type3],IC[i].Code3);
    }
}
/**** PRINT SYMBOL TABLE *****/
void print_symbol(){
    int i;
    printf("\n********** SYMBOL TABLE ************\n");
    for(i=0;i<iST;i++)
    printf("\n%10s %3d %3d",ST[i].Symbol,ST[i].Address,ST[i].Size);
}

/***** PRINT OPCODE *****/
void print_opcode(){
    int i;
    printf("\n********** OPCODE TABLE ************");
    for(i=0;i<nMOT;i++)
        if(MOT[i].Class==1)
            printf("\n%6s %2s",MOT[i].Mnemonic,MOT[i].Opcode);
}

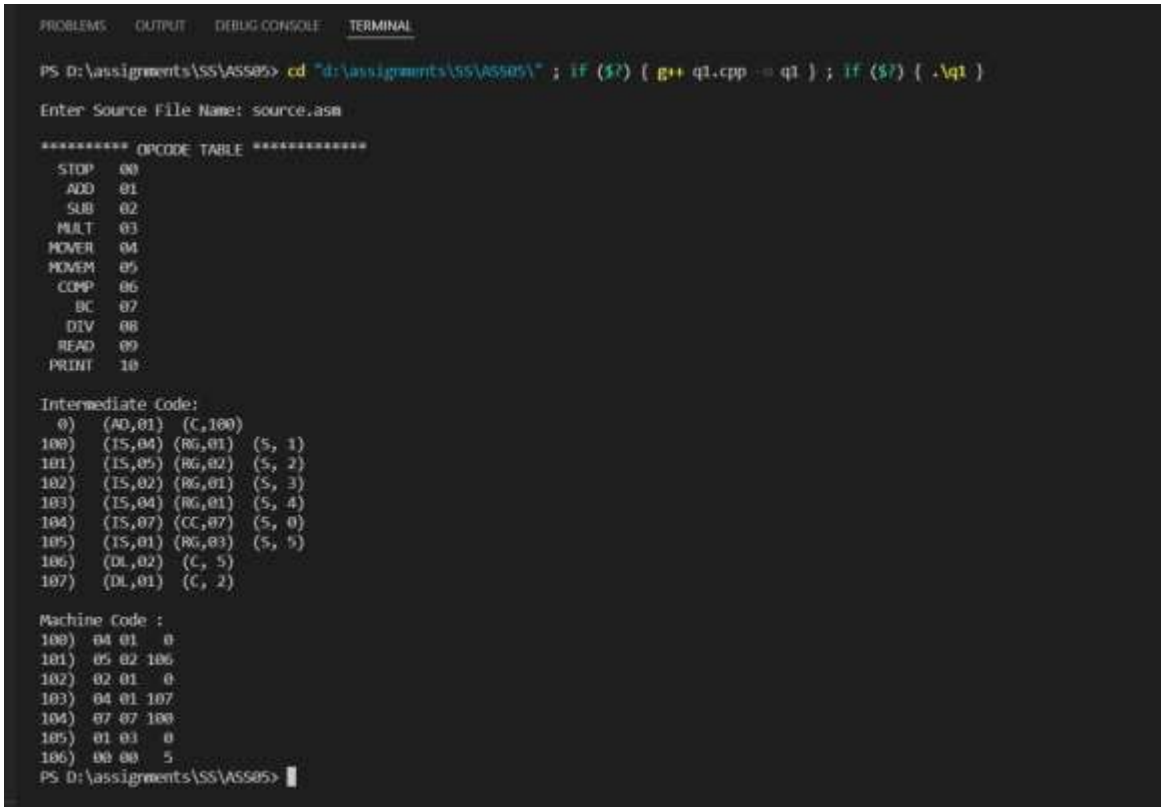
/*** MACHINE CODE *****/
void mcode(){
    int i;
    printf("\n\nMachine Code :");
    for(i=0;i<iIC;i++){
        if(IC[i].Type1==1 ){
            printf("\n%3d) %s ",IC[i].LC,MOT[IC[i].Code1].Opcode);
            if(IC[i].Type2==0)
                printf("00 000");
            else{
```

```
                if(IC[i].Type2>6)//No Register Operand
                    printf("00 %3d",ST[IC[i].Code2].Address);
                else{
                    printf("%2s ",MOT[IC[i].Code2].Opcode);
                    if(IC[i].Type3==7)
                    printf("%3d",ST[IC[i].Code3].Address);
                }
            }
        }else{
            if(IC[i].Type1==2 && strcmp(MOT[IC[i].Code1].Mnemonic,"DC")==0){
            printf("\n%3d) ",IC[i].LC);
            printf("00 00 %3d",IC[i].Code2);
        }
        }
    }
}
```

Assembly Code:

```
START 100
L1   MOVER AREG,=5
     MOVEM BREG X
     SUB   AREG,=2
     LTORG
     MOVER AREG Y
     BC any,L1
     ADD CREG,4
X    DC  5
Y    DS  2
     END
```

Output:


PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
PS D:\assignments\SS\ASS05> cd "d:\assignments\SS\ASS05\" ; if ($?) { g++ q1.cpp -o q1 } ; if ($?) { .\q1 }
Enter Source File Name: source.asm
********** OPCODE TABLE ************
STOP 00
ADD 01
SUB 02
MULT 03
MOVER 04
MOVEM 05
COMP 06
BC 07
DIV 08
READ 09
PRINT 10
Intermediate Code:
0) (AD,01) (C,100)
100) (IS,04) (RG,01) (S, 1)
101) (IS,05) (RG,02) (S, 2)
102) (IS,02) (RG,01) (S, 3)
103) (IS,04) (RG,01) (S, 4)
104) (IS,07) (CC,07) (S, 0)
105) (IS,01) (RG,03) (S, 5)
106) (DL,02) (C, 5)
107) (DL,01) (C, 2)
Machine Code :
100) 04 01 0
101) 05 02 106
102) 02 01 0
103) 04 01 107
104) 07 07 100
105) 01 03 0
106) 00 00 5
PS D:\assignments\SS\ASS05>