# IT250 – AUTOMATA & COMPILER DESIGN

## ASSIGNMENT 8

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**Notations:**

**$ -** This sign indicates that the input is complete and now generate the intermediate code (output) for the inputted code. Hence, after the $ sign, the output will be displayed as per the code logic. The $ symbol acts the terminator for the code.

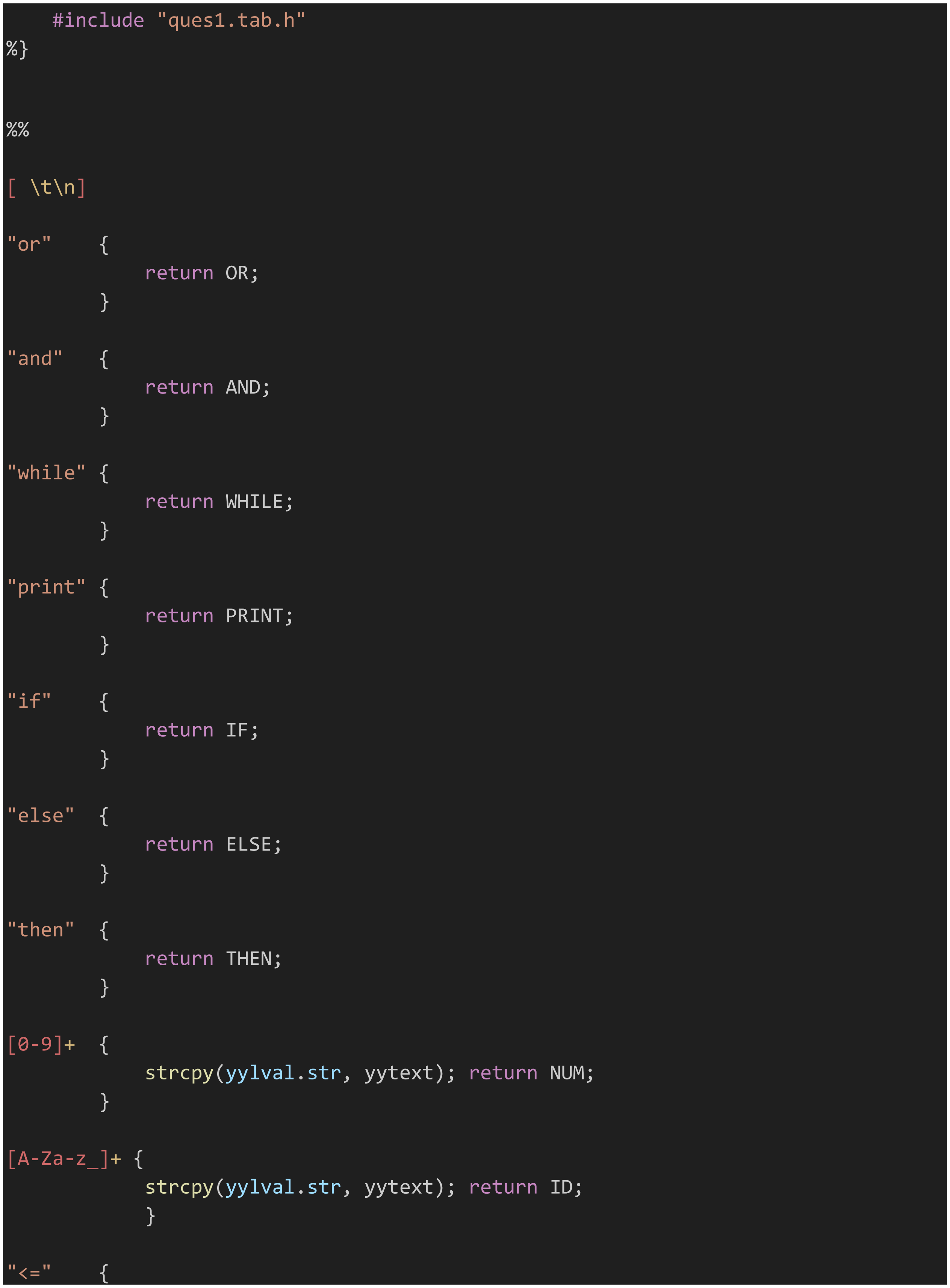
**Note**:

Since the written code generates intermediate code for the while loop, the code written works for both the given inputs and generates the required output.

## Code Written:

## LEX Code:

```
%{
    #include <stdio.h>
```



```
    #include "ques1.tab.h"
%}


%%

[ \t\n]

"or"    {
            return OR;
        }

"and"   {
            return AND;
        }

"while" {
            return WHILE;
        }

"print" {
            return PRINT;
        }

"if"    {
            return IF;
        }

"else"  {
            return ELSE;
        }

"then"  {
            return THEN;
        }

[0-9]+  {
            strcpy(yylval.str, yytext); return NUM;
        }

[A-Za-z_]+ {
            strcpy(yylval.str, yytext); return ID;
            }

"<="    {
```

```
            return LE;
        }

">="    {
            return GE;
        }

"=="    {
            return EQ;
        }

"!="    {
            return NE;
        }

[ \n]+     {}

.       {
            return yytext[0];
        }

"$\n"   {
            return END;
        }

%%

int yywrap(){
    return 0;
}
```

## YACC Code:

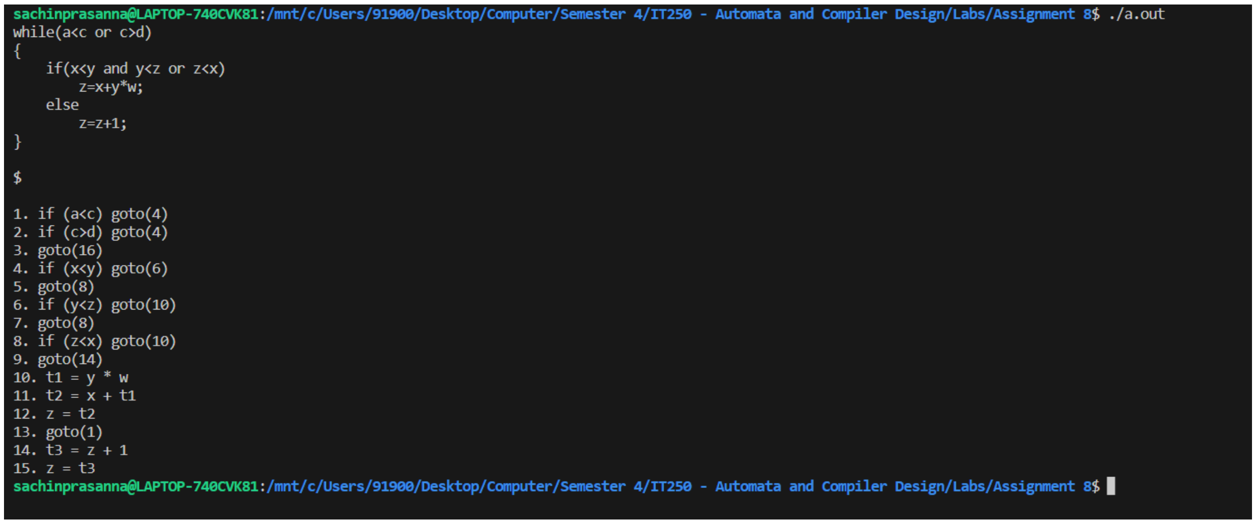
```
%{
    #include <stdio.h>
    #include <string.h>

    char outputBuffer[1000];
    int line = 1;
    int variable = 0, ptr = 0;
    int temp[1000];
    void update(){
        if(outputBuffer[0] == '\n'){
            for(int i = 0; i < strlen(outputBuffer); i++){
                outputBuffer[i] = outputBuffer[i + 1];
            }
        }
        variable++;
        line++;
    }

    void singleupdate(){
        if(outputBuffer[0] == '\n'){
            for(int i = 0; i < strlen(outputBuffer); i++){
                outputBuffer[i] = outputBuffer[i + 1];
            }
        }
        line++;
    }

    temp[0] = 1;
    outputBuffer[0] = '\0';

    void printIntermediateCode(){
        printf("1. ");
        line = 2;
        for(int i = 0; i < strlen(outputBuffer); i++) {
            if(outputBuffer[i] == '\n') printf("\n%d. ", line++);
            else printf("%c", outputBuffer[i]);
        }
        printf("\n");
    }

%}

%union{
    char str[1000];
}

%type <str> COND
%type <str> STMTS
%type <str> BLOCK
%type <str> STS
%type <str> S
%type <str> BODY
```

```
%type <str> STMT
%type <str> NUM
%type <str> ID
%type <str> IFSTMT
%type <str> ELSESTMT


%token ID NUM WHILE LE GE EQ NE OR AND PRINT END IF ELSE THEN
%right '='
%left AND OR
%left '<' '>' LE GE EQ NE
%left '+''-'
%left '*''/'
%left '!'
%right UMINUS

%%

S :         STS END { sprintf(outputBuffer, "%s", $1); return 0;}
            ;

STS:        BLOCK { sprintf($$, "%s", $1); }
            | STMTS ';' { sprintf($$, "%s", $1);}
            | STS STS { sprintf($$, "%s\n%s", $1, $2);}
            ;

BLOCK:      STMT '{' BODY '}' { sprintf($$, "%s %d\n%s\ngoto (%d)", $1, line + 1,
$3, temp[--ptr]); line++; }
            | STMT ';' { sprintf($$, "%s %d\ngoto (%d)", $1, line + 1, temp[--
ptr]); line++; }
            | STMT COND ';' { sprintf($$, "%s %d\n%s\ngoto (%d)", $1, line + 1,
outputBuffer, temp[--ptr]);
                              sprintf(outputBuffer, "\0");
                              line++; }
            | STMT BLOCK { sprintf($$, "%s %d\n%s\ngoto (%d)", $1, line + 1, $2,
temp[--ptr]); line++; }
            | STMT '{' '}' { sprintf($$, "%s %d\ngoto (%d)", $1, line + 1, temp[-
-ptr]); }
            ;

BODY:        BODY BODY { sprintf($$, "%s\n%s", $1, $2);}
            |BLOCK { sprintf($$, "%s", $1); }
            |STMTS ';' { sprintf($$, "%s", $1); }
            |IFSTMT { sprintf($$, "%s", $1); }
            |IFSTMT ELSESTMT { sprintf($$, "%s\n%s", $1, $2); }
            ;

IFSTMT:     IF '(' COND ')' BODY { sprintf($$, "%s\nif(%s == 0) goto ",
outputBuffer, $3);
                              sprintf(outputBuffer, "\0"); temp[ptr] = line;
                              ptr++; line++; }
            |IF COND BODY { sprintf($$, "%s\nif(%s == 0) goto ", outputBuffer,
$3);
                              sprintf(outputBuffer, "\0"); temp[ptr] = line;
                              ptr++; line++; }
            |IF COND THEN BODY { sprintf($$, "%s\nif(%s == 0) goto ",
outputBuffer, $3);
                              sprintf(outputBuffer, "\0"); temp[ptr] = line;
                              ptr++; line++; }
            |IF COND THEN BODY ELSE ELSESTMT { sprintf($$, "%s\nif(%s == 0) goto
", outputBuffer, $3);
                              sprintf(outputBuffer, "\0"); temp[ptr] = line;
                              ptr++; line++; }
            ;

ELSESTMT:   ELSE BODY{ sprintf($$, "goto (%d)", temp[ptr - 1]);
sprintf(outputBuffer, "\0"); temp[ptr - 1] = line; }
            ;

STMT:       WHILE '(' COND ')' { sprintf($$, "%s\nif(%s == 0) goto ",
outputBuffer, $3);
                                 sprintf(outputBuffer, "\0"); temp[ptr] = line;
                                 ptr++; line++; }
            ;

STMTS:      COND { $$[0] = '\0'; sprintf($$, "%s", outputBuffer);
                   sprintf(outputBuffer, "\0"); }
            |PRINT COND { sprintf($$, "print %s", $2); line++; }
            |STMTS ';' COND { sprintf($$, "%s\n%s", $1, outputBuffer);
                              sprintf(outputBuffer, "\0");}
            |STMTS ';' PRINT COND { sprintf($$, "%s\n%sprint %s", $1,
outputBuffer, $4);
                                    sprintf(outputBuffer, "\0");
                                    line++; }
            ;

COND:       COND '+' COND { sprintf(outputBuffer, "%s\nt%d = %s + %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update();}
            |COND '-' COND { sprintf(outputBuffer, "%s\nt%d = %s - %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update(); }

            |COND '*' COND { sprintf(outputBuffer, "%s\nt%d = %s * %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update();}

            |COND '/' COND { sprintf(outputBuffer, "%s\nt%d = %s / %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update(); }

            |'-' COND %prec UMINUS { sprintf(outputBuffer, "%s\nt%d = uminus %s",
outputBuffer, variable, $2); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            variable++;
                            singleupdate();}

            |COND OR COND { sprintf(outputBuffer, "%s\nt%d = %s or %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update(); }

            |COND AND COND { sprintf(outputBuffer, "%s\nt%d = %s and %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update(); }

            |COND LE COND { sprintf(outputBuffer, "%s\nt%d = %s <= %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update(); }

            |COND GE COND { sprintf(outputBuffer, "%s\nt%d = %s >= %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update(); }

            |COND EQ COND { sprintf(outputBuffer, "%s\nt%d = %s == %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update(); }

            |COND NE COND { sprintf(outputBuffer, "%s\nt%d = %s != %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update(); }

            |COND '<' COND { sprintf(outputBuffer, "%s\nt%d = %s < %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update(); }

            |COND '>' COND { sprintf(outputBuffer, "%s\nt%d = %s > %s",
outputBuffer, variable, $1, $3); $$[0] = '\0';
                            sprintf($$, "t%d", variable);
                            update(); }

            |COND '=' COND { sprintf(outputBuffer, "%s\n%s = %s", outputBuffer,
$1, $3); $$[0] = '\0';
                            sprintf($$, "%s", $1);
                            singleupdate(); }

            |'(' COND ')' { $$[0] = '\0'; sprintf($$, "%s", $2); }

            |NUM { sprintf($$, "%s", $1); }

            |ID { sprintf($$, "%s", $1); }
            ;

%%

int main(){
    yyparse();
    printIntermediateCode();
    return 0;
}

int yyerror(){
    printf("Parsing is failed.\n");
    return 0;
}
```

## Outputs:

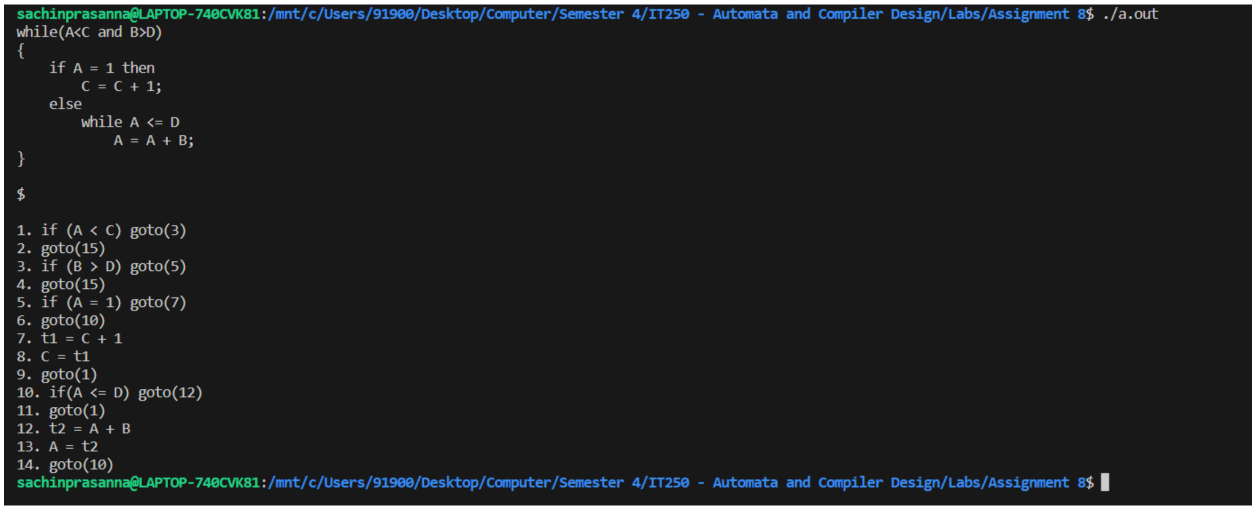
### 1)

(There was an error in the IR given in the question. The correct IR is generated as follows)



```
sachinprasanna@LAPTOP-740CVK81:/mnt/c/Users/91900/Desktop/Computer/Semester 4/IT250 - Automata and Compiler Design/Labs/Assignment 8$ ./a.out
while(a<c or c>d)
{
    if(x<y and y<z or z<x)
        z=x+y*w;
    else
        z=z+1;
}

$

1. if (a<c) goto(4)
2. if (c>d) goto(4)
3. goto(16)
4. if (x<y) goto(6)
5. goto(8)
6. if (y<z) goto(10)
7. goto(8)
8. if (z<x) goto(10)
9. goto(14)
10. t1 = y * w
11. t2 = x + t1
12. z = t2
13. goto(1)
14. t3 = z + 1
15. z = t3
sachinprasanna@LAPTOP-740CVK81:/mnt/c/Users/91900/Desktop/Computer/Semester 4/IT250 - Automata and Compiler Design/Labs/Assignment 8$
```

### 2)



```
sachinprasanna@LAPTOP-740CVK81:/mnt/c/Users/91900/Desktop/Computer/Semester 4/IT250 - Automata and Compiler Design/Labs/Assignment 8$ ./a.out
while(A<C and B>D)
{
    if A = 1 then
        C = C + 1;
    else
        while A <= D
            A = A + B;
}

$

1. if (A < C) goto(3)
2. goto(15)
3. if (B > D) goto(5)
4. goto(15)
5. if (A = 1) goto(7)
6. goto(10)
7. t1 = C + 1
8. C = t1
9. goto(1)
10. if(A <= D) goto(12)
11. goto(1)
12. t2 = A + B
13. A = t2
14. goto(10)
sachinprasanna@LAPTOP-740CVK81:/mnt/c/Users/91900/Desktop/Computer/Semester 4/IT250 - Automata and Compiler Design/Labs/Assignment 8$
```

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