EXP NO:9 **DATE:**

DEVELOP THE BACK-END OF A COMPILER THAT TAKES THREE-ADDRESSCODE (TAC) AS INPUT AND GENERATES CORRESPONDING 8086 ASSEMBLY LANGUAGE CODE AS OUTPUT.

AIM:

To design and implement the back-end of a compiler that takes three-address code (TAC) as input and produces 8086 assembly language code as output. The three-address code is an intermediate representation used by compilers to break down expressions and operations, while the 8086 assembly code is a machine-level representation of the program that can be executed by a processor.

ALGORITHM:

1. Parse the Three-Address Code (TAC):
Input: Three-Address Code, which is an intermediate representation. For example:
t0 = b + c
t1 = t0 * d
a = t1
Output: 8086 assembly language code. For example:
MOV AX, [b] ; Load b into AX
ADD AX, [c] ; Add c to AX
MOV [t0], AX ; Store result in t0

2. Process Each TAC Instruction:
1. Initialize Registers:
o Set up the registers in 8086 assembly (e.g., AX, BX, CX, etc.) for storing intermediate results and final outputs.
o Maintain a temporary register counter for naming temporary variables in TAC (e.g., t0, t1).

2. For each TAC instruction, based on its operation:
o Identify the components: operands and operator.
o Choose an appropriate register (AX, BX, etc.) for storing intermediate results.
o If the operation involves multiple operands or temporary variables, map them to registers.

3. Translating TAC to 8086 Assembly:
Addition/Subtraction (e.g., t0 = b + c):
o Load operands into registers and perform the operation:

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MOV AX, [b] ; Load b into AX
ADD AX, [c] ; Add c to AX
MOV [t0], AX ; Store result in t0

Multiplication (e.g., t1 = t0 * d):
o Load operands into registers and perform the operation:
MOV AX, [t0] ; Load t0 into AX
MOV BX, [d] ; Load d into BX
MUL BX ; Multiply AX by BX (result in AX)
MOV [t1], AX ; Store result in t1

Assignment (e.g., a = t1):
o Move the value from a temporary variable to the target variable:
MOV [a], [t1] ; Move value of t1 into a

Division (e.g., t2 = b / c):
o Division is a bit more complex due to the 8086's limitations with the DIV instruction. For example, the result might need to be stored in AX or DX:AX (if it's a 32-bit result):

```
MOV AX, [b] ; Load b into AX
MOV DX, 0 ; Clear DX (important for division)
MOV BX, [c] ; Load c into BX
DIV BX ; AX = AX / BX (quotient in AX, remainder in DX)
MOV [t2], AX ; Store quotient in t2
```

4. Manage Memory and Registers:

Variables: Variables like a, b, c are stored in memory, so you will use memory addressing modes such as [variable_name] to access them.

Temporary Variables: Temporary variables like t0, t1, t2, etc., are stored in registers (AX, BX, etc.) or memory if there are more variables than registers available.

5. Handle Control Flow (Optional):
If the TAC contains control structures (such as loops, if-else statements, or function calls), you will need to generate labels and jump instructions in 8086 assembly.

If Statements: For example, if (x > 0) { y = 1; } could generate:

```
MOV AX, [x]
CMP AX, 0
JG positive_case ; Jump if greater
JMP end_if
```


PROGRAM:

```
#include <stdio.h>
#include <string.h>
void generateAssembly(const char* tac) {
char result[10], op1[10], op[2], op2[10];
// Parse the TAC instruction
sscanf(tac, "%s = %s %s %s", result, op1, op, op2);
// Generate assembly code based on the operator
if (strcmp(op, "+") == 0) {
printf("MOV AX, [%s]\n", op1);
printf("ADD AX, [%s]\n", op2);
printf("MOV [%s], AX\n", result);
} else if (strcmp(op, "-") == 0) {
printf("MOV AX, [%s]\n", op1);
printf("SUB AX, [%s]\n", op2);
printf("MOV [%s], AX\n", result);
} else if (strcmp(op, "*") == 0) {
printf("MOV AX, [%s]\n", op1);
printf("MOV BX, [%s]\n", op2);
printf("MUL BX\n");
printf("MOV [%s], AX\n", result);
} else if (strcmp(op, "/") == 0) {
printf("MOV AX, [%s]\n", op1);
printf("MOV BX, [%s]\n", op2);
printf("DIV BX\n");
printf("MOV [%s], AX\n", result);
} else {
printf("Unsupported operation: %s\n", op);
```

```
}
}
int main() {
const char* tacInstructions[] = {
```



```
"t0 = b + c",
"t1 = t0 * d",
"a = t1"
};
int numInstructions = sizeof(tacInstructions) / sizeof(tacInstructions[0]);
for (int i = 0; i < numInstructions; i++) {
generateAssembly(tacInstructions[i]);
printf("\n");
}
return 0;
}
```

OUTPUT:

```bash
MOV AX, [b]
ADD AX, [c]
MOV [t0], AX

MOV AX, [t0]
MOV BX, [d]
MUL BX
MOV [t1], AX

MOV AX, [t1]
MOV [a], AX
```


RESULT:

Thusthe above example provides a foundational approach to converting TAC to 8086 assembly using C. For a complete compiler back-end, you would need to handle additional aspects such as register allocation, memory management, and more complex control flow constructs.