EXPERIMENT - XII
LOOP UNROLLING

November 5, 2020

ADITHYA D RAJAGOPAL
ROLL NO : 9
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
COLLEGE OF ENGINEERING TRIVANDRUM

AIM

To write a program to perform loop unrolling.

THEORY

Loop Unrolling

Loop unrolling is a loop transformation technique that helps to optimize the execution time of a program. We basically remove or reduce iterations. Loop unrolling increases the program's speed by eliminating loop control instruction and loop test instructions.

ALGORITHM

Algorithm 1 Algorithm for Loop Unrolling

```
1: Start
2: Read the program from file
3: for line in program do
4:     if line is the beginning of a for loop then
5:         Identify initialization, condition and increment/decrement phase of the loop.
6:         i=start (From initialization)
7:         while condition do
8:             Print all the lines inside the loop
9:             i=i+inc
10:        end while
11:    else
12:        Print line
13:    end if
14: end for
```

SOURCE CODE

```
def printloop(lines):
        for i in lines:
                print(i,end="")

def unroll_for(program,start):
        global variables
        lines=[]
        stack=[]
        i=start+1
        while i<len(program):
                if program[i][0]=="{":
                        stack.append("{")
                        i=i+1
                        continue
                elif program[i][0]=="}":
                        stack.pop()
                        if len(stack)==0:
                                break
                lines.append(program[i])
                if len(stack)==0:
                        break
                i=i+1
        retval=i
        line=program[start]
        str=""
        for i in line[3:]:
                str+=i
        loop=str[1:len(str)-2]
        con=loop.split(";")
        init=con[0].split("=")
        init[1]=int(init[1])
        cnd=con[1]
        if "<" in cnd:
```

```
            if "=" in cnd:
                    condition=cnd.split("<=")
                    condition.append("<=")
            else:
                    condition=cnd.split("<")
                    condition.append("<")
    elif ">" in cnd:
            if "=" in cnd:
                    condition=cnd.split(">=")
                    condition.append(">=")
            else:
                    condition=cnd.split(">")
                    condition.append(">")
    condition[1]=int(condition[1])
    val=con[2]
    if "++" in val:
            inc=val.split("++")
            inc.append(1)
    elif "--" in val:
            inc=val.split("--")
            inc.append(-1)
    elif "+=" in val:
            inc=val.split("+=")
            inc[1]=int(inc[1])
    elif "-=" in val:
            inc=val.split("-=")
            inc[1]=-int(inc[1])
    if init[0]==condition[0] and init[0]==inc[0]:
            i=init[1]
            con=condition[2]
            if con=="<":
                    while i<condition[1]:
                            printloop(lines)
                            i+=inc[1]
            elif con=="<=":
```

```
                        while i<=condition[1]:
                                printloop(lines)
                                i+=inc[1]
                elif con==">":
                        while i>condition[1]:
                                printloop(lines)
                                i+=inc[1]
                elif con==">=":
                        while i>=condition[1]:
                                printloop(lines)
                                i+=inc[1]
        return retval

def loop_unroll(program):
        global variables
        i=0
        while i<len(program):
                if program[i][0:4]=="for(":
                        i=unroll_for(program,i)
                else:
                        print(program[i],end="")
                i=i+1

program=[]
print("The program is in the file p12.c.\n")
f=open("p12.c", "r")
for line in f:
        program.append(line)
        if line=="end\n":
                break
f.close()
loop_unroll(program)
```

SAMPLE OUTPUT

```
user@adithya-d-rajagopal:~/s7/cd$ cat p12.c
for(i=0;i<10;i+=2)
{
printf("Hello");
}
user@adithya-d-rajagopal:~/s7/cd$ python3 p12.py
The program is in the file p12.c.

printf("Hello");
printf("Hello");
printf("Hello");
printf("Hello");
printf("Hello");
user@adithya-d-rajagopal:~/s7/cd$
```

RESULT

A program to perform loop unrolling has been implemented using Python and the outputs were verified.