

Assignment-1 Report

OS – CS3510

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Code Design

```
6  /**
7  * @brief Recursive implementation to output Collatz Sequence for positive integer n
8  *
9  * @param n
10 * /
11 void CollatzAlgo(int n){
12     if(n <= 0){
13         printf("ERROR: Negative input provided to CollatzAlgo.\n");
14         return;
15     }
16
17     // Base case (Stop when sequence reaches 1)
18     if(n==1){
19         printf("1\n");
20         return;
21     }
22
23     printf("%d, ", n); // Output the current value in the sequence.
24     if(n % 2 == 0) // If n is even
25         CollatzAlgo(n/2);
26     else // If n is odd
27         CollatzAlgo(3*n + 1);
28 }
```

- ◆ The logic to output (to stdout) the Collatz Sequence for a positive integer n is contained in the function CollatzAlgo().
 - ◆ We first do an error checking to ensure n is positive
 - ◆ If n is 1, then the conjecture has been verified, and 1 is added to the sequence, and the function returns.
 - ◆ If n is greater than 1, then n is added to the sequence (printed to standard output) and the Collatz Algorithm is applied to it as follows
 - ◆ If n is even, CollatzAlgo is recursively called for n/2, as in the algorithm.
 - ◆ Similarly, if n is odd, CollatzAlgo is recursively called for 3*n + 1, as in the algorithm.
 - ◆ Hence the function CollatzAlgo() outputs the sequence from n to 1 after the Collatz algorithm is repeatedly applied to it
- In the main function, we

```
31 // Get input from user
32 int n;
33 printf("Enter the value of n(positive integer) for which the Collatz Conjecture will be tested: ");
34 scanf("%d", &n);
35 if(n <= 0){
36     printf("ERROR: Invalid value entered.\n");
37     return 1;
38 }
```

- ◆ First, the user is prompted to enter the value of n for which the child process will output the Collatz sequence.
- ◆ The input is read from the terminal and stored in n.

- ◆ If the input was not a positive integer, an error message is printed and the program terminates.

```
40 // fork the parent process, and store the result of forking in pid
41 pid_t pid = fork();
```

- After getting the input from user, the parent process is forked, and the return value of fork() is stored in pid.

```
43 if(pid < 0){ // If pid < 0, implies forking failed
44     printf("ERROR: Child process creation failed!\n");
45     return 1;
46 }
```

- If the pid is less than zero, that implies that the forking failed. Hence an error message is printed and the program terminates.

```
47 else if(pid == 0){ // Value of pid is zero for child process
48     printf("\nIn child process.\n");
49     printf("Collatz Sequence for %d is as follows: \n", n);
50     CollatzAlgo(n);
51 }
```

- For the child process, the value of pid is zero.
 - ◆ Hence it enters this branch.
 - ◆ The child process calls the function CollatzAlgo() for n, which outputs the sequence for given n.
 - ◆ Then the child process returns 0 from the main function, hence completing the child process

```
52 else if(pid > 0){ // pid > 0 for parent process
53     wait(NULL); // The parent process waits until the child completes execution.
54     printf("\nChild process execution successfully completed. \nIn parent process.\n");
55 }
```

- For the parent process, the value of pid is greater than zero (= process id of the child process)
 - ◆ Hence it enters this branch.
 - ◆ The parent process is made to wait until the child process finishes execution
 - ◆ Once that happens, the parent process outputs that the child process has completed and now the parent process is executing.
 - ◆ Finally, the parent process also finishes execution after returning 0 from main() function.

Result Analysis

Following is the output obtained in the terminal for an example run where $n=35$ is provided as the input.

```
taha_adeel@IdeaPad: ~/Desktop/OS/Assignment-1
$ ./main
Enter the value of n(positive integer) for which the Collatz Conjecture will be tested: 35

In child process.
Collatz Sequence for 35 is as follows:
35, 106, 53, 160, 80, 40, 20, 10, 5, 16, 8, 4, 2, 1

Child process execution successfully completed.
In parent process.

taha_adeel@IdeaPad: ~/Desktop/OS/Assignment-1
$
```

- ◆ As outlined in the code design, this result can be easily analysed.
- ◆ After the input is taken from the user, the parent process is forked.
- ◆ The child process enters the if-else branch where the call to `CollatzAlgo()` is called, outputting the desired sequence onto standard output.
- ◆ Meanwhile, the parent process which was waiting for child process to finish execution resumes after child process is completed.
- ◆ Hence the given output is reached.