



# **CS 342 – Operating Systems**

## **Project 1**

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## 1. Introduction

This report consists of experiments performed on `isp` (a shell program) in normal and tapped modes. In normal mode, a single unnamed pipe is used for communication between child processes. Whereas, in tapped mode, two unnamed pipes are used for data flow between child process and the main process is also on the data path.

## 2. Experiment Results

The following consists of an experiment using the generic producer consumer example – executed in two different modes. Table 1 compares the execution time in normal mode and tapped mode with varying values of  $M$ . The value of  $N$  is kept constant ( $N = 16$ ) to eliminate bias, since it does not have an impact on normal mode.

<u><b>M</b></u>	<u><b>Normal Mode</b></u>	<u><b>Tapped Mode</b></u>
<b>10</b>	0 s and 9728 ms	0 s and 10896 ms
<b>100</b>	0 s and 10364 m	0 s and 11161 ms
<b>1000</b>	0 s and 12290 ms	0 s and 13986 ms
<b>10000</b>	0 s and 26815 ms	0 s and 33619 ms
<b>100000</b>	0 s and 778779 ms	1 s and 482302 ms
<b>1000000</b>	4 s and 4814512 m	9 s and 9019278 ms

Table 1: Execution time in normal and tapped mode with varying values of  $M$  and constant  $N$ .

Below, table 2 records the execution time in tapped mode for changing values of  $N$  and  $M$ .

<u><b>N / M</b></u>	<b>10000</b>	<b>100000</b>	<b>1000000</b>
<b>1</b>	0 s and 457314 ms	1 s and 3095264 m	4 s and 7558726 ms
<b>16</b>	0 s and 319659 ms	0 s and 622125 ms	1 s and 7698128 ms
<b>256</b>	0 s and 26576 ms	0 s and 358212 ms	1 s and 7510525 ms
<b>512</b>	0 s and 25789 m	0 s and 18512 ms	1 s and 7520572 ms
<b>2048</b>	0 s and 24574 m	0 s and 18755 ms	1 s and 7192489 ms

Table 2: Execution time in tapped mode for varying values of  $N$  and  $M$ .

The time taken to conduct the experiment in both modes was measured using `gettimeofday` function.

The following command is used in `isp` to get the results of the experiments above:

```
./producer <M> | ./consumer <M>
```

### 3. Conclusions

As noted in table 1, increasing values of `M` increasing the execution time in both, normal and tapped modes. This is true since as `M` increases, producer writes more bytes and consumer reads more bytes; this consequently increases the time taken by the programs to execute. It can also be noted that normal mode runs faster than tapped mode. This takes place since there is no interception of the main process in child processes in normal mode. Whereas, in tapped mode, the main process reads the input from the first pipe and writes it in the second pipe. This causes additional overhead and increases the time of the execution.

As for table 2, the same conclusion about `M` as before can be inferred – increase in `M` results in a longer execution time in tapped mode. The increase in number of bytes to be transferred results in an increase in the time taken for execution. Similarly, it can be noted that the execution time does not change much as `N` increases. This is a valid case since the time taken to allocate a buffer for `N` is not a lot compared to number of system calls required for an increase in bytes to be transferred (value of `M`). Thus, increasing `N` does not lead to a noticeable change in the time taken for execution as compared to its counterpart, `M`.

It can be concluded that intercepting a shell (as in tapped mode) greatly increases the time taken for executing various commands as compared to normal mode. Similarly, increasing the number of bytes to be transferred inevitably increases the time taken for execution.

### 4. References

- [1] <https://brennan.io/2015/01/16/write-a-shell-in-c/>
- [2] <https://man7.org/linux/man-pages/man1/man.1.html>
- [3] Operating System Concepts, 9th edition, Silberschatz et al. Wiley