CSE344
System Programming

Homework #4
Design Report

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Author
Gökbey Gazi KESKİN

Step-by-Step Algorithm

1-**Main thread** initializes semaphores, sets SIGINT handler function, checks the given command line arguments and if they are true, sets C, N and input file path.

2-**Main thread** initializes supplier thread's attributes as detached and creates the supplier thread with input file path as its only parameter.

3-**Main thread** creates c consumer threads with a struct named consumer_args as their parameters. This structure consists of 2 integers (n and consumer ID).

4-**Main thread** joins the consumer threads one by one in a for loop and waits for them to terminate.

5-**Supplier** opens the input file path and reads it one character at a time. Than according to this character ('1' or '2') it posts the corresponding System V semaphore. When SIGINT is received or the EOF is reached at input file, it closes the input file descriptor and exits using pthread_exit system call.

6- **Each Consumer** runs a 0 to n for loop and posts both semaphores atomically if it is possible and waits otherwise. When SIGINT is received or loop ran n times, it exits using pthread_exit.

7- When all consumers are exited, **Main thread** proceeds from where it left off, removes both semaphores, frees it's allocated resources and exits.

Tests

Test 1 – 20 ‘1’s, 20 ‘2’s

n = 4 c = 5

Initial Values:

```
2022-05-12 14:02:53:278|Consumer-0 at iteration 0 (waiting). Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:278|Consumer-2 at iteration 0 (waiting). Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:278|Consumer-3 at iteration 0 (waiting). Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:278|Consumer-1 at iteration 0 (waiting). Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:278|Supplier: read from input a '1'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:278|Consumer-4 at iteration 0 (waiting). Current amounts: 0 x '1', 0 x '2'.
```

Process:

```
2022-05-12 14:02:53:281|Supplier: read from input a '1'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: delivered a '1'. Post-delivery amounts: 1 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: read from input a '2'. Current amounts: 1 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Consumer-0 at iteration 3 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
```

Last Iteration:

```
2022-05-12 14:02:53:281|Consumer-3 at iteration 3 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Consumer-3 has left.
2022-05-12 14:02:53:281|Supplier: read from input a '1'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: delivered a '1'. Post-delivery amounts: 1 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: read from input a '2'. Current amounts: 1 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Consumer-4 at iteration 3 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Consumer-4 has left.
2022-05-12 14:02:53:281|Supplier: read from input a '1'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: delivered a '1'. Post-delivery amounts: 1 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: read from input a '2'. Current amounts: 1 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Consumer-0 at iteration 3 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: read from input a '1'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: delivered a '1'. Post-delivery amounts: 1 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Consumer-0 has left.
2022-05-12 14:02:53:281|Supplier: read from input a '2'. Current amounts: 1 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Consumer-1 at iteration 3 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:02:53:281|The supplier has left.
2022-05-12 14:02:53:281|Consumer-1 has left.
2022-05-12 14:02:53:281|Consumer-2 at iteration 3 (consumed). Post-consumption amounts: 1 x '1', 0 x '2'.
2022-05-12 14:02:53:281|Consumer-2 has left.
```

Test 2 - 500 ‘1’s, 500 ‘2’s

n=50, c=10

```
2022-05-12 14:18:19:618|Consumer-45 at iteration 9 (consumed). Post-consumption amounts: 1 x '1', 0 x '2'.
2022-05-12 14:18:19:618|Consumer-46 at iteration 9 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:618|Consumer-45 has left.
2022-05-12 14:18:19:618|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:618|Consumer-46 has left.
2022-05-12 14:18:19:618|Supplier: read from input a '2'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:618|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 1 x '2'.
2022-05-12 14:18:19:618|Supplier: read from input a '1'. Current amounts: 0 x '1', 1 x '2'.
2022-05-12 14:18:19:618|Supplier: delivered a '1'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:618|Supplier: read from input a '2'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:619|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 1 x '2'.
2022-05-12 14:18:19:618|Consumer-48 at iteration 9 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:619|Supplier: read from input a '1'. Current amounts: 0 x '1', 1 x '2'.
2022-05-12 14:18:19:619|Consumer-48 has left.
2022-05-12 14:18:19:619|Supplier: delivered a '1'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:619|Supplier: read from input a '2'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:619|Consumer-47 at iteration 9 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:619|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 1 x '2'.
2022-05-12 14:18:19:619|Consumer-47 has left.
2022-05-12 14:18:19:619|Supplier: read from input a '1'. Current amounts: 0 x '1', 1 x '2'.
2022-05-12 14:18:19:619|Supplier: delivered a '1'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:619|Consumer-49 at iteration 9 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:18:19:619|Consumer-49 has left.
2022-05-12 14:18:19:619|The supplier has left.
```

Test 3 - 500 ‘1’s, 500 ‘2’s

n=20, c= 25

```
2022-05-12 14:20:01:384|Supplier: read from input a '2'. Current amounts: 2 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Supplier: delivered a '2'. Post-delivery amounts: 1 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Consumer-19 at iteration 19 (consumed). Post-consumption amounts: 1 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Consumer-19 has left.
2022-05-12 14:20:01:384|Supplier: read from input a '2'. Current amounts: 1 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Supplier: read from input a '2'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 1 x '2'.
2022-05-12 14:20:01:384|Consumer-22 at iteration 19 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Supplier: read from input a '1'. Current amounts: 0 x '1', 1 x '2'.
2022-05-12 14:20:01:384|Consumer-22 has left.
2022-05-12 14:20:01:384|Consumer-20 at iteration 19 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Consumer-20 has left.
2022-05-12 14:20:01:384|Supplier: delivered a '1'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Supplier: read from input a '2'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 1 x '2'.
2022-05-12 14:20:01:384|Supplier: read from input a '1'. Current amounts: 0 x '1', 1 x '2'.
2022-05-12 14:20:01:384|Supplier: delivered a '1'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Consumer-24 at iteration 19 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Consumer-24 has left.
2022-05-12 14:20:01:384|Supplier: read from input a '2'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Supplier: delivered a '2'. Post-delivery amounts: 0 x '1', 1 x '2'.
2022-05-12 14:20:01:384|Supplier: read from input a '1'. Current amounts: 0 x '1', 1 x '2'.
2022-05-12 14:20:01:384|Supplier: delivered a '1'. Post-delivery amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|The supplier has left.
2022-05-12 14:20:01:384|Consumer-23 at iteration 19 (consumed). Post-consumption amounts: 0 x '1', 0 x '2'.
2022-05-12 14:20:01:384|Consumer-23 has left.
```

Error Tests

```
gokbey@gokbey-ABRA-A5-V15-3:~/Desktop/sysprog_hw4$ ./hw4 -N 20 -C 25
Missing Arguments.
Terminating..
```

```
gokbey@gokbey-ABRA-A5-V15-3:~/Desktop/sysprog_hw4$ ./hw4 -N 20 -C 25 -F input -X test
There are more arguments than needed. Ignoring them and proceeding
2022-05-12 14:23:46:995|Supplier: read from input a '1'. Current amounts: 0 x '1', 0 x '2'.
2022-05-12 14:23:46:995|Supplier: delivered a '1'. Post-delivery amounts: 1 x '1', 0 x '2'.
2022-05-12 14:23:46:995|Consumer-1 at iteration 0 (waiting). Current amounts: 0 x '1', 0 x '2'.
```

```
gokbey@gokbey-ABRA-A5-V15-3:~/Desktop/sysprog_hw4$ ./hw4 -N 3 -C 4 -F input
N should be greater than 1 and C should be greater than 4.
Terminating..
```

```
gokbey@gokbey-ABRA-A5-V15-3:~/Desktop/sysprog_hw4$ ./hw4 -N 20 -C 25 -F input.txt
open_inputfd: No such file or directory
gokbey@gokbey-ABRA-A5-V15-3:~/Desktop/sysprog_hw4$
```

Valgrind Results

```
HEAP SUMMARY:
    in use at exit: 272 bytes in 1 blocks
  total heap usage: 43 allocs, 42 frees, 15,060 bytes allocated
```

```
LEAK SUMMARY:
   definitely lost: 0 bytes in 0 blocks
   indirectly lost: 0 bytes in 0 blocks
     possibly lost: 272 bytes in 1 blocks
   still reachable: 0 bytes in 0 blocks
        suppressed: 0 bytes in 0 blocks
```

Possibly lost bytes are due to detached supplier thread. Pthread library should handle it.