CMSC312 assignment 3 report

1. WORKING SECTIONS: As far as I have been able to identify, all sections of my code are working as intended. There is a small chance that I misinterpreted the instructions regarding one or more of the implementation guidelines.
2. Show the following:
   1. The logic used to identify the terminating condition: I have my consumers sleeping for .1 seconds at the start of the looping, so the producers can add at least something to the Print Queue, so I knew the exit condition would be dependent on the value stored in the counting semaphore referred to as empty\_sem. Further testing revealed that in the case that there are more consumers than producers, simply checking the value of empty\_sem isn’t enough since the consumers can hit the check and exit before the producers finish, so I put a counter in shared memory to keep track of open processes in order to determine when the processes concluded. Combining the checks for no open processes and a 0 in empty\_sem, we arrive at a robust exit condition.
   2. How were the semaphores and other book-keeping variables shared between processes and threads: The semaphores and bookkeeping variables were shared between processes and threads by initializing the semaphores using a \_pthreadshared flag of 1, and globally declaring the variables in addition to putting variables into shared memory.
   3. What was done in the signal handler for graceful termination: I consistently encountered seg-faults when calling my detaching, so I found that I needed to ensure that only one process was reaching the detach and ctl statements, so i stored the pid of the main process and then checked in the signal handler if the current pid was equal to the main pid. I then tried using my SIGINT handler, but multiple processes continued printing, so i locked the binary semaphore to ensure that only the signal handler had access to printing, and no other processes could access stdout. I then canceled the threads first, and then killed the processes by using kill. Kill takes a pid, so i stored the pids in a shared memory array, and sequentially call kill on them. I then called the detaching and clearing on the shared memory, followed by an exit of the program.
   4. How did the LIFO and FIFO implementations differ in terms of your usage of either the buffer\_index variable or in/out pointers: I used the buffer index in shared memory in the LIFO implementation since the locations are always adjacent, and I used in/out pointers in shared memory in order to keep track of the location of the left-most element.
3. SHOW 2 RUNS OF YOUR CODE (COPY/PASTE):

LIFO: 3p, 4c

Producer 63084 added 437 to buffer

Consumer 0 dequeue 63084, 437 bytes from buffer

Producer 63082 added 337 to buffer

Consumer 1 dequeue 63082, 337 bytes from buffer

Producer 63084 added 288 to buffer

Consumer 2 dequeue 63084, 288 bytes from buffer

Producer 63083 added 772 to buffer

Consumer 3 dequeue 63083, 772 bytes from buffer

Producer 63082 added 337 to buffer

Consumer 0 dequeue 63082, 337 bytes from buffer

Producer 63084 added 288 to buffer

Consumer 1 dequeue 63084, 288 bytes from buffer

Producer 63082 added 234 to buffer

Consumer 2 dequeue 63082, 234 bytes from buffer

Producer 63082 added 234 to buffer

Consumer 3 dequeue 63082, 234 bytes from buffer

Producer 63084 added 274 to buffer

Consumer 0 dequeue 63084, 274 bytes from buffer

Producer 63084 added 585 to buffer

Consumer 1 dequeue 63084, 585 bytes from buffer

Producer 63082 added 225 to buffer

Consumer 2 dequeue 63082, 225 bytes from buffer

Producer 63084 added 585 to buffer

Consumer 3 dequeue 63084, 585 bytes from buffer

Producer 63082 added 974 to buffer

Consumer 0 dequeue 63082, 974 bytes from buffer

Producer 63084 added 561 to buffer

Consumer 1 dequeue 63084, 561 bytes from buffer

Producer 63082 added 564 to buffer

Consumer 2 dequeue 63082, 564 bytes from buffer

Producer 63084 added 556 to buffer

Consumer 3 dequeue 63084, 556 bytes from buffer

Producer 63082 added 564 to buffer

Consumer 0 dequeue 63082, 564 bytes from buffer

Producer 63084 added 556 to buffer

Consumer 1 dequeue 63084, 556 bytes from buffer

Producer 63082 added 416 to buffer

Consumer 2 dequeue 63082, 416 bytes from buffer

Producer 63084 added 542 to buffer

Consumer 3 dequeue 63084, 542 bytes from buffer

Producer 63082 added 416 to buffer

Consumer 0 dequeue 63082, 416 bytes from buffer

Producer 63084 added 666 to buffer

Consumer 1 dequeue 63084, 666 bytes from buffer

Producer 63082 added 873 to buffer

Consumer 2 dequeue 63082, 873 bytes from buffer

Producer 63084 added 666 to buffer

Consumer 3 dequeue 63084, 666 bytes from buffer

number of jobs produced: 24

Number of bytes produced: 11950

number of jobs consumed: 24

Number of bytes consumed: 11950

FIFO 3p, 4c:

Producer 80346 added 855 to buffer

Consumer 1 dequeue 80346, 855 bytes from buffer

Producer 80344 added 107 to buffer

Consumer 0 dequeue 80344, 107 bytes from buffer

Producer 80346 added 855 to buffer

Consumer 2 dequeue 80346, 855 bytes from buffer

Producer 80344 added 107 to buffer

Consumer 3 dequeue 80344, 107 bytes from buffer

Producer 80346 added 855 to buffer

Consumer 1 dequeue 80346, 855 bytes from buffer

Producer 80344 added 107 to buffer

Consumer 0 dequeue 80344, 107 bytes from buffer

Producer 80346 added 855 to buffer

Consumer 2 dequeue 80346, 855 bytes from buffer

Producer 80344 added 107 to buffer

Consumer 3 dequeue 80344, 107 bytes from buffer

Producer 80346 added 855 to buffer

Consumer 1 dequeue 80346, 855 bytes from buffer

Producer 80345 added 891 to buffer

Producer 80344 added 107 to buffer

Consumer 0 dequeue 80345, 891 bytes from buffer

Consumer 2 dequeue 80344, 107 bytes from buffer

Producer 80346 added 855 to buffer

Consumer 3 dequeue 80346, 855 bytes from buffer

Producer 80344 added 485 to buffer

Consumer 1 dequeue 80344, 485 bytes from buffer

Producer 80346 added 861 to buffer

Consumer 0 dequeue 80346, 861 bytes from buffer

Producer 80346 added 861 to buffer

Consumer 2 dequeue 80346, 861 bytes from buffer

Producer 80345 added 653 to buffer

Consumer 3 dequeue 80345, 653 bytes from buffer

Producer 80346 added 861 to buffer

Consumer 1 dequeue 80346, 861 bytes from buffer

Producer 80345 added 653 to buffer

Consumer 0 dequeue 80345, 653 bytes from buffer

Producer 80344 added 485 to buffer

Consumer 2 dequeue 80344, 485 bytes from buffer

Producer 80346 added 216 to buffer

Consumer 3 dequeue 80346, 216 bytes from buffer

Producer 80345 added 634 to buffer

Consumer 1 dequeue 80345, 634 bytes from buffer

Producer 80346 added 216 to buffer

Consumer 0 dequeue 80346, 216 bytes from buffer

Producer 80344 added 293 to buffer

Consumer 2 dequeue 80344, 293 bytes from buffer

Producer 80345 added 505 to buffer

Consumer 3 dequeue 80345, 505 bytes from buffer

Producer 80345 added 505 to buffer

Consumer 1 dequeue 80345, 505 bytes from buffer

Producer 80345 added 505 to buffer

Consumer 0 dequeue 80345, 505 bytes from buffer

Producer 80344 added 663 to buffer

Consumer 2 dequeue 80344, 663 bytes from buffer

Producer 80345 added 505 to buffer

Consumer 3 dequeue 80345, 505 bytes from buffer

Producer 80346 added 432 to buffer

Consumer 1 dequeue 80346, 432 bytes from buffer

Producer 80345 added 505 to buffer

Consumer 0 dequeue 80345, 505 bytes from buffer

Producer 80345 added 505 to buffer

Consumer 2 dequeue 80345, 505 bytes from buffer

Producer 80346 added 432 to buffer

Consumer 3 dequeue 80346, 432 bytes from buffer

Producer 80345 added 505 to buffer

Consumer 1 dequeue 80345, 505 bytes from buffer

Producer 80344 added 663 to buffer

Consumer 0 dequeue 80344, 663 bytes from buffer

Producer 80345 added 505 to buffer

Consumer 2 dequeue 80345, 505 bytes from buffer

Producer 80346 added 432 to buffer

Consumer 3 dequeue 80346, 432 bytes from buffer

Producer 80345 added 505 to buffer

Consumer 1 dequeue 80345, 505 bytes from buffer

Producer 80345 added 505 to buffer

Consumer 0 dequeue 80345, 505 bytes from buffer

Producer 80345 added 724 to buffer

Consumer 2 dequeue 80345, 724 bytes from buffer

Producer 80346 added 156 to buffer

Consumer 3 dequeue 80346, 156 bytes from buffer

Producer 80346 added 156 to buffer

Consumer 1 dequeue 80346, 156 bytes from buffer

Producer 80345 added 724 to buffer

Consumer 0 dequeue 80345, 724 bytes from buffer

Producer 80346 added 689 to buffer

Consumer 2 dequeue 80346, 689 bytes from buffer

Producer 80345 added 121 to buffer

Consumer 3 dequeue 80345, 121 bytes from buffer

Producer 80345 added 121 to buffer

Consumer 1 dequeue 80345, 121 bytes from buffer

Producer 80345 added 121 to buffer

Consumer 0 dequeue 80345, 121 bytes from buffer

Producer 80346 added 689 to buffer

Consumer 2 dequeue 80346, 689 bytes from buffer

Producer 80345 added 121 to buffer

Consumer 3 dequeue 80345, 121 bytes from buffer

Producer 80345 added 433 to buffer

Consumer 1 dequeue 80345, 433 bytes from buffer

Producer 80346 added 920 to buffer

Consumer 0 dequeue 80346, 920 bytes from buffer

Producer 80345 added 433 to buffer

Consumer 2 dequeue 80345, 433 bytes from buffer

Producer 80346 added 295 to buffer

Consumer 3 dequeue 80346, 295 bytes from buffer

Producer 80345 added 679 to buffer

Consumer 1 dequeue 80345, 679 bytes from buffer

Producer 80346 added 295 to buffer

Consumer 0 dequeue 80346, 295 bytes from buffer

Producer 80345 added 679 to buffer

Consumer 2 dequeue 80345, 679 bytes from buffer

Producer 80346 added 683 to buffer

Consumer 3 dequeue 80346, 683 bytes from buffer

Producer 80345 added 448 to buffer

Consumer 1 dequeue 80345, 448 bytes from buffer

Producer 80346 added 683 to buffer

Consumer 0 dequeue 80346, 683 bytes from buffer

Producer 80346 added 127 to buffer

Consumer 2 dequeue 80346, 127 bytes from buffer

Producer 80345 added 247 to buffer

Consumer 3 dequeue 80345, 247 bytes from buffer

Producer 80346 added 119 to buffer

Consumer 1 dequeue 80346, 119 bytes from buffer

Producer 80346 added 337 to buffer

Consumer 0 dequeue 80346, 337 bytes from buffer

Producer 80346 added 337 to buffer

Consumer 2 dequeue 80346, 337 bytes from buffer

Producer 80346 added 345 to buffer

Consumer 3 dequeue 80346, 345 bytes from buffer

Producer 80346 added 345 to buffer

Consumer 1 dequeue 80346, 345 bytes from buffer

Producer 80346 added 260 to buffer

Consumer 0 dequeue 80346, 260 bytes from buffer

number of jobs produced: 66

Number of bytes produced: 31733

number of jobs consumed: 66

Number of bytes consumed: 31733

1. EXECUTION TIME / AVG WAITING TIME \*\*ALL FLOATS ARE IN SECONDS\*\*

FIRST TABLE: LIFO

| Num of producers  Num of consumers | 2 | 4 | 6 | 8 | 10 |
| --- | --- | --- | --- | --- | --- |
| 2 | 6.384797406 / 2.679813670 | 11.744188819 / 4.590448102 | 12.344288420 / 5.066584436 | 11.980706409 / 5.131895167 | 15.683723439 / 6.424601099 |
| 4 | 9.941738823 / 4.579125385 | 12.276229426 / 5.320818532 | 12.157023487 / 5.625400208 | 13.717046028 / 4.423992015 | 18.444092579 / 5.312744111 |
| 6 | 3.093523524 / 1.724750124 | 5.746394063 / 2.422272174 | 11.830952888 / 4.460758612 | 13.579157053 / 4.436558150 | 14.816619583 / 4.998571024 |
| 8 | 13.128997242 / 6.773245819 | 13.586370209 / 4.575693229 | 8.795305467 / 3.160491775 | 11.291861166 / 4.039133408 | 12.484601466 / 4.423926341 |
| 10 | 10.525225356 / 5.441957080 | 8.463019325 /  2.863113136 | 12.419172960 / 5.061312580 | 13.041055559 / 4.915921031 | 11.144850449 / 4.882928592 |

SECOND TABLE: FIFO

| Num of producers  Num of consumers | 2 | 4 | 6 | 8 | 10 |
| --- | --- | --- | --- | --- | --- |
| 2 | 10.536232873 / 4.843307570 | 13.052486649 / 4.723566180 | 14.870794845 / 5.725485959 | 16.115192574 / 5.366771861 | 12.617871798 / 4.727259716 |
| 4 | 8.625568751 / 3.756156774 | 11.735342639 / 3.524932648 | 12.758035678 / 5.075448000 | 13.115730245 / 4.589308600 | 16.795411998 / 5.574982545 |
| 6 | 5.076154332 / 2.577705889 | 12.569872560 / 4.195156254 | 13.103695736 / 4.886703696 | 11.265911426 / 4.597888708 | 12.724308967 / 4.626259746 |
| 8 | 7.927996184 / 3.635638136 | 10.459677187 / 4.202647503 | 15.979084820 / 5.431967366 | 14.800178117 / 5.593091630 | 12.305960304 / 4.647454186 |
| 10 | 12.417299264 / 5.124528809 | 16.148213421 / 6.185665620 | 11.539844964 / 5.161250275 | 10.829059391 / 3.681134264 | 13.380042246 / 5.139326224 |