CS6210 Project 2 Report

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Implementation Summary

Service:

The service takes in requests from a client with parameters (x, p) to a function which does (2^x)modp. The service should then reply with the return value via a response. The data structure which manages the requests/responses is a ring buffer in shared memory.

1) Ring Buffer

The ring buffer is stored in shared memory. The basic idea is that the ring buffer is a fixed length data structure which has linked start and end nodes. A request is inserted into the ring buffer at the end position. Since the ring buffer is looped, the end node will eventually reach old data and overwrite it, but this is an intended behavior of a ring buffer. The ring buffer then chews requests in a simple round robin algorithm.

2) Request/Response Handling

```
struct request {
  int x;
  int p;
  pthread_cond_t response_ready;
};
```

A request is triggered by a conditional mutex variable in shared memory. The client executes a make_request() call which is part of our services library available to the client. Make_request() will write the service parameters, trigger the service that a new request has arrived via conditional variable, and return the request ID to the client.

Once the service has processed the requests, the response is generated and stored back in the ring buffer. The service then notifies the client that a response has been filled, and the client retrieves the response using another library call available to the clients.

Client:

The sample client is relatively simple. The idea is that the client makes many threads which generate service requests and synchronously receive responses.

1) Threads

The threads are pthreads created by using the pthread.h library. We create 128 threads a stagger them by 10useconds so that the requests are staggered by 10us.

2) Synchronous Calls

We make the thread requests synchronous by blocking on the thread using `pthread_mutex_lock` to block all other threads from executing while one thread has a lock. The thread releases the lock when the request is received.

3) Request/Response

The request and response handling is done via helper functions in our server library that the client has access to. These include make_request(), read_response() to aid the client and not giving them direct access to any data structures or shared memory that could cause problems in the service.

Results:

```
Request (20, 97) = 93. Time elapsed(us)  802
Request (18, 97) = 33. Time elapsed(us)  806
Request (16, 97) = 61. Time elapsed(us)  827
Request (21, 97) = 79. Time elapsed(us)  832
Request (23, 97) = 95. Time elapsed(us)  837
Request (29, 97) = 96. Time elapsed(us)  839
Request (22, 97) = 24. Time elapsed(us)  14
Request (23, 97) = 96. Time elapsed(us)  20221
Request (28, 97) = 96. Time elapsed(us)  881
Request (23, 97) = 93. Time elapsed(us)  14
Request (27, 97) = 65. Time elapsed(us)  916
Request (23, 97) = 25. Time elapsed(us)  20266
Request (28, 97) = 12. Time elapsed(us)  14
Request (17, 97) = 3. Time elapsed(us)  947
Request (26, 97) = 50. Time elapsed(us)  952
Request (21, 97) = 95. Time elapsed(us)  957
Request (24, 97) = 33. Time elapsed(us)  20320
Request (27, 97) = 25. Time elapsed(us)  14
Request (19, 97) = 3. Time elapsed(us)  998
Request (19, 97) = 65. Time elapsed(us)  1003
Request (20, 97) = 48. Time elapsed(us)  14
Request (27, 97) = 3. Time elapsed(us)  20107
Request (28, 97) = 12. Time elapsed(us)  1046
Request (29, 97) = 6. Time elapsed(us)  1051
Request (29, 97) = 95. Time elapsed(us)  1056
Request (29, 97) = 65. Time elapsed(us)  15
Request (29, 97) = 81. Time elapsed(us)  1091
Request (24, 97) = 95. Time elapsed(us)  21
Request (21, 97) = 61. Time elapsed(us)  14
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Request (30, 97) = 61. Time elapsed(us) 14
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Request (23, 97) = 12. Time elapsed(us) 14
Request (25, 97) = 3. Time elapsed(us) 14
Request (22, 97) = 93. Time elapsed(us) 19
Request (30, 97) = 81. Time elapsed(us) 14
Request (16, 97) = 6. Time elapsed(us) 14
Request (26, 97) = 81. Time elapsed(us) 19
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Request (26, 97) = 24. Time elapsed(us) 338
Request (30, 97) = 93. Time elapsed(us) 2962
Request (21, 97) = 96. Time elapsed(us) 2967
Request (19, 97) = 25. Time elapsed(us) 2972
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Request (24, 97) = 96. Time elapsed(us) 357
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Request (25, 97) = 89. Time elapsed(us) 421
Request (20, 97) = 95. Time elapsed(us) 427
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Request (24, 97) = 24. Time elapsed(us) 619
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Request (19, 97) = 6. Time elapsed(us) 629
Request (25, 97) = 6. Time elapsed(us) 14
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Request (24, 97) = 6. Time elapsed(us) 14
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Request (25, 97) = 24. Time elapsed(us) 706
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Request (27, 97) = 79. Time elapsed(us) 723
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Request (28, 97) = 65. Time elapsed(us) 14
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Request (24, 97) = 89. Time elapsed(us) 794
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Request (30, 97) = 96. Time elapsed(us) 14
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Request (27, 97) = 48. Time elapsed(us) 3291
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Request (25, 97) = 95. Time elapsed(us) 13
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Request (17, 97) = 93. Time elapsed(us) 3427
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Request (25, 97) = 3. Time elapsed(us) 3481
Request (26, 97) = 3. Time elapsed(us) 13
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Request (28, 97) = 81. Time elapsed(us) 14
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Request (21, 97) = 93. Time elapsed(us) 19
Request (21, 97) = 89. Time elapsed(us) 14
Request (27, 97) = 81. Time elapsed(us) 13
Request (28, 97) = 65. Time elapsed(us) 14
Request (29, 97) = 96. Time elapsed(us) 14
Request (26, 97) = 25. Time elapsed(us) 19
Request (29, 97) = 93. Time elapsed(us) 13
Request (18, 97) = 33. Time elapsed(us) 19
Request (26, 97) = 24. Time elapsed(us) 14
Request (19, 97) = 48. Time elapsed(us) 14
Request (17, 97) = 81. Time elapsed(us) 3365
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Request (29, 97) = 12. Time elapsed(us) 14
Request (27, 97) = 33. Time elapsed(us) 18
Request (25, 97) = 50. Time elapsed(us) 14
Request (23, 97) = 48. Time elapsed(us) 14
Request (22, 97) = 95. Time elapsed(us) 19
Request (28, 97) = 24. Time elapsed(us) 13
Request (30, 97) = 33. Time elapsed(us) 14
Request (30, 97) = 61. Time elapsed(us) 14
Request (27, 97) = 93. Time elapsed(us) 14
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Request (28, 97) = 81. Time elapsed(us) 251
Request (30, 97) = 12. Time elapsed(us) 257
Request (29, 97) = 96. Time elapsed(us) 262
Request (26, 97) = 96. Time elapsed(us) 267
Request (24, 97) = 6. Time elapsed(us) 286
Request (28, 97) = 96. Time elapsed(us) 293
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Request (30, 97) = 6. Time elapsed(us) 13
Request (29, 97) = 33. Time elapsed(us) 19
Request (29, 97) = 3. Time elapsed(us) 14
Request (30, 97) = 12. Time elapsed(us) 13
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Request (27, 97) = 24. Time elapsed(us) 14
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Request (20, 97) = 95. Time elapsed(us) 14
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Request (26, 97) = 24. Time elapsed(us) 13776
Request (21, 97) = 81. Time elapsed(us) 13494
Request (23, 97) = 24. Time elapsed(us) 13494
Request (14, 97) = 89. Time elapsed(us) 13494
Request (21, 97) = 6. Time elapsed(us) 13473
Request (26, 97) = 33. Time elapsed(us) 13474
Request (18, 97) = 6. Time elapsed(us) 13473
Request (13, 97) = 12. Time elapsed(us) 13473
Request (22, 97) = 33. Time elapsed(us) 13470
Request (17, 97) = 24. Time elapsed(us) 13470
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Request (26, 97) = 81. Time elapsed(us) 13659
Request (18, 97) = 33. Time elapsed(us) 13659
Request (24, 97) = 24. Time elapsed(us) 13659
Request (29, 97) = 96. Time elapsed(us) 13647
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Request (20, 97) = 93. Time elapsed(us) 13682
Request (29, 97) = 24. Time elapsed(us) 51
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Request (22, 97) = 65. Time elapsed(us) 4293983132
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Request (27, 97) = 65. Time elapsed(us) 14
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Request (19, 97) = 6. Time elapsed(us) 32
Request (27, 97) = 93. Time elapsed(us) 4293983139
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Request (21, 97) = 89. Time elapsed(us) 169
Request (21, 97) = 65. Time elapsed(us) 161
Request (27, 97) = 89. Time elapsed(us) 102
Request (25, 97) = 95. Time elapsed(us) 174
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Request (23, 97) = 33. Time elapsed(us) 151
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Request (23, 97) = 48. Time elapsed(us) 309
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Request (24, 97) = 96. Time elapsed(us) 183
Request (27, 97) = 24. Time elapsed(us) 170
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Request (23, 97) = 96. Time elapsed(us) 164
Request (27, 97) = 95. Time elapsed(us) 17
Request (21, 97) = 79. Time elapsed(us) 165
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Request (28, 97) = 96. Time elapsed(us) 14
Request (28, 97) = 48. Time elapsed(us) 19
Request (29, 97) = 95. Time elapsed(us) 14
Request (24, 97) = 93. Time elapsed(us) 14
Request (25, 97) = 89. Time elapsed(us) 19
Request (26, 97) = 96. Time elapsed(us) 14
Request (29, 97) = 89. Time elapsed(us) 14
Request (18, 97) = 12. Time elapsed(us) 19
Request (29, 97) = 95. Time elapsed(us) 14
Request (28, 97) = 93. Time elapsed(us) 14
Request (29, 97) = 95. Time elapsed(us) 19
Request (30, 97) = 48. Time elapsed(us) 14
Request (25, 97) = 89. Time elapsed(us) 14
Request (27, 97) = 24. Time elapsed(us) 19
Request (30, 97) = 95. Time elapsed(us) 14
Request (26, 97) = 96. Time elapsed(us) 13
Request (30, 97) = 95. Time elapsed(us) 19
Request (19, 97) = 81. Time elapsed(us) 14
Request (29, 97) = 24. Time elapsed(us) 14
Request (24, 97) = 95. Time elapsed(us) 19
Request (30, 97) = 93. Time elapsed(us) 14
Request (26, 97) = 81. Time elapsed(us) 14
Request (27, 97) = 81. Time elapsed(us) 15
Request (27, 97) = 93. Time elapsed(us) 18760
Request (20, 97) = 89. Time elapsed(us) 14
Request (21, 97) = 12. Time elapsed(us) 34
Request (29, 97) = 48. Time elapsed(us) 18935
Request (27, 97) = 81. Time elapsed(us) 18995
Request (24, 97) = 95. Time elapsed(us) 19056
Request (25, 97) = 33. Time elapsed(us) 33
Request (25, 97) = 95. Time elapsed(us) 33
Request (26, 97) = 96. Time elapsed(us) 32
Request (26, 97) = 81. Time elapsed(us) 32
```

```
Request (27, 97) = 65. Time elapsed(us) 32
Request (27, 97) = 96. Time elapsed(us) 32
Request (28, 97) = 48. Time elapsed(us) 32
Request (28, 97) = 93. Time elapsed(us) 33
Request (29, 97) = 24. Time elapsed(us) 33
Request (25, 97) = 93. Time elapsed(us) 14143
Request (30, 97) = 65. Time elapsed(us) 32
Request (28, 97) = 24. Time elapsed(us) 33
Request (28, 97) = 65. Time elapsed(us) 40
Request (29, 97) = 48. Time elapsed(us) 33
Request (27, 97) = 61. Time elapsed(us) 32
Request (25, 97) = 95. Time elapsed(us) 14479
Request (28, 97) = 96. Time elapsed(us) 32
Request (26, 97) = 48. Time elapsed(us) 32
Request (29, 97) = 65. Time elapsed(us) 32
Request (26, 97) = 95. Time elapsed(us) 14706
Request (30, 97) = 81. Time elapsed(us) 34
Request (29, 97) = 96. Time elapsed(us) 33
Request (28, 97) = 48. Time elapsed(us) 41
Request (30, 97) = 65. Time elapsed(us) 33
Request (27, 97) = 93. Time elapsed(us) 39
Request (29, 97) = 65. Time elapsed(us) 34
Request (28, 97) = 48. Time elapsed(us) 41
Request (30, 97) = 96. Time elapsed(us) 33
Request (29, 97) = 81. Time elapsed(us) 33
Request (30, 97) = 95. Time elapsed(us) 36
Request (27, 97) = 48. Time elapsed(us) 6016
Request (23, 97) = 93. Time elapsed(us) 15
Request (21, 97) = 96. Time elapsed(us) 18040
Request (30, 97) = 96. Time elapsed(us) 190
Request (30, 97) = 89. Time elapsed(us) 31
Request (27, 97) = 12. Time elapsed(us) 32
Request (29, 97) = 95. Time elapsed(us) 17955
Request (28, 97) = 24. Time elapsed(us) 31
Request (28, 97) = 95. Time elapsed(us) 18013
Request (23, 97) = 61. Time elapsed(us) 18002
Request (29, 97) = 33. Time elapsed(us) 27
Request (30, 97) = 65. Time elapsed(us) 38
Request (29, 97) = 48. Time elapsed(us) 18084
Request (26, 97) = 81. Time elapsed(us) 18088
Request (29, 97) = 24. Time elapsed(us) 18187
Request (30, 97) = 65. Time elapsed(us) 94
Request (27, 97) = 3. Time elapsed(us) 67
Request (16, 97) = 48. Time elapsed(us) 18372
Request (30, 97) = 65. Time elapsed(us) 19
Request (17, 97) = 48. Time elapsed(us) 46
Request (18, 97) = 96. Time elapsed(us) 52
Request (29, 97) = 95. Time elapsed(us) 18822
Request (25, 97) = 93. Time elapsed(us) 18960
Request (28, 97) = 93. Time elapsed(us) 19076
Request (24, 97) = 89. Time elapsed(us) 19216
Request (23, 97) = 93. Time elapsed(us) 19384
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Request (24, 97) = 96. Time elapsed(us) 45
Request (26, 97) = 48. Time elapsed(us) 19740
Request (27, 97) = 12. Time elapsed(us) 3737
Request (23, 97) = 96. Time elapsed(us) 23647
Request (24, 97) = 81. Time elapsed(us) 23780
Request (28, 97) = 33. Time elapsed(us) 23851
Request (25, 97) = 33. Time elapsed(us) 23930
Request (23, 97) = 33. Time elapsed(us) 24004
Request (24, 97) = 48. Time elapsed(us) 14
Request (25, 97) = 89. Time elapsed(us) 15
Request (26, 97) = 33. Time elapsed(us) 15
Request (27, 97) = 89. Time elapsed(us) 15
Request (16, 97) = 89. Time elapsed(us) 24479
Request (30, 97) = 24. Time elapsed(us) 24586
```