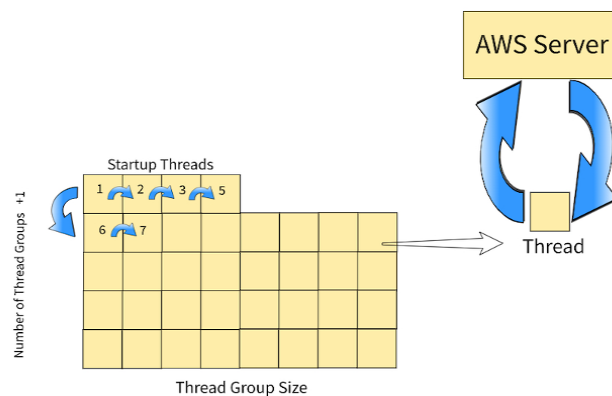


CS6650 Assignment 1
Sumer Bal

<https://github.com/sumersb/Client-Concurrency-Server>

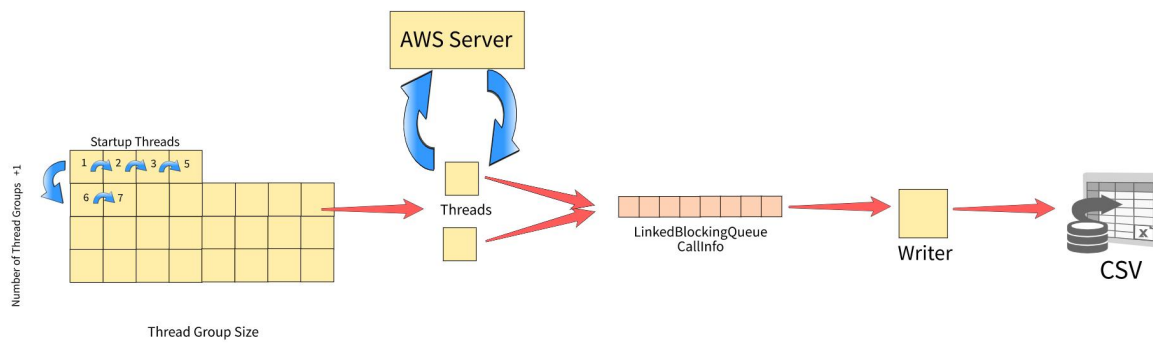
Side Note : Sorry for the delay I am dealing with some health issues

My client design was for the client for part 1 was to create a Client Thread Manager which initializes a jagged array with the number of thread groups inputted +1 indices. There are 10 startup threads in the first index and thread group size threads in every other index. This allows me to loop through the array easily to initialize and start each thread. The thread then sends 1000 Post and Get Requests to the AWS Server. The Client Thread Manager then waits for the completion of each thread to know when all the requests to the server have been completed. A small visual is shown below of the thread array is shown below.



Jagged Thread Array where each thread calls AWS Server

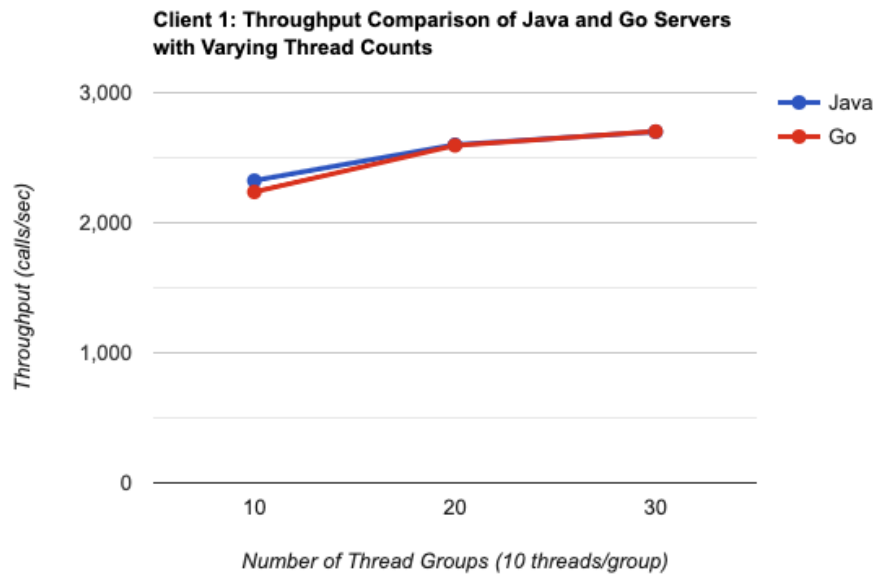
For the client in part 2 I used the format from the client in part 1. I created a class called ClassInfo which takes in all the information for an individual request. Then I created a linked blocking queue which takes in CallInfo instances. While threads are concurrently adding to the linked blocking queue, the Writer thread is concurrently taking out CallInfo from the queue and adding them to the MergingDigest instance (used to calculate percentiles) and writing them to a CSV. I used the MergingDigest package to be able to find the percentiles and the writer adds the data values to the MergingDigest instance. Once all threads are completed the ClientThreadManager uses all the information gathered by the writer when it was processing the request information from the Linked Blocking Queue and then the thread manager processes the input to calculate the wall time, throughput, mean, median, percentile. ClientThreadManager controls all the threads. A figure of the idea can be seen below.



Client threads produce Call Info to Queue and Writer consumes and processes data to CSV

The ClientThreadManager calls the writer and client threads concurrently allowing both processes to be done simultaneously and the Linked Blocking Queue allows the threads to safely add to the queue without risk of race conditions.

The graphs from running the client can be seen below as well as the data used to generate the data.



Go Server

Java Server

```
Number Thread Groups: 10
Thread Group Size: 10
Server Calls: 200000
Wall Time: 89.393005 seconds
Throughput: 2237.3115 calls per second

Process finished with exit code 0

Number Thread Groups: 20
Thread Group Size: 10
Server Calls: 400000
Wall Time: 154.13701 seconds
Throughput: 2595.0938 calls per second

Process finished with exit code 0

Number Thread Groups: 30
Thread Group Size: 10
Server Calls: 600000
Wall Time: 222.098 seconds
Throughput: 2701.51 calls per second

Process finished with exit code 0
```

```
Number Thread Groups: 10
Thread Group Size: 10
Server Calls: 200000
Wall Time: 86.073006 seconds
Throughput: 2323.609 calls per second

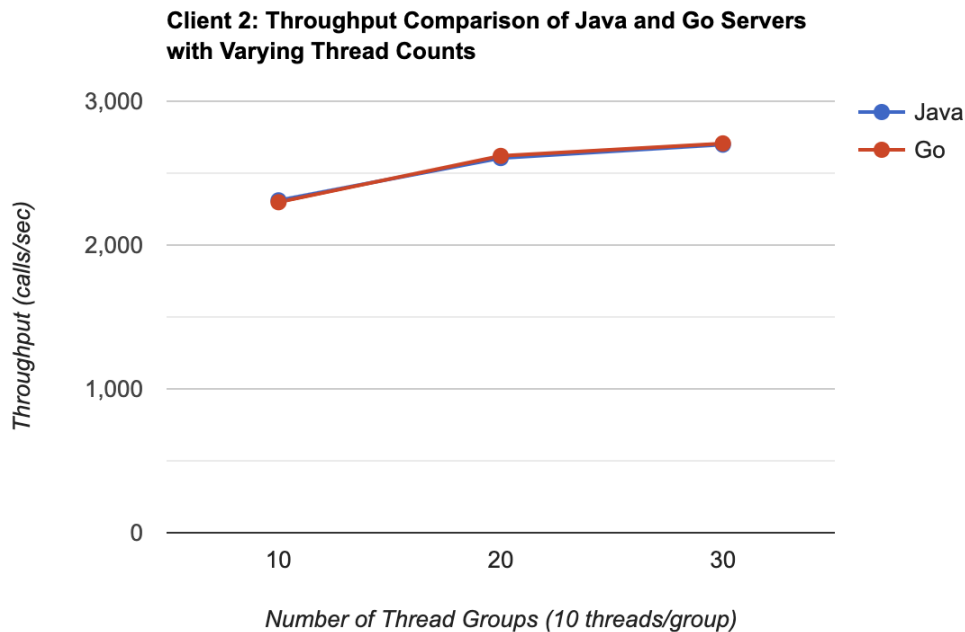
Process finished with exit code 0

Number Thread Groups: 20
Thread Group Size: 10
Server Calls: 400000
Wall Time: 153.824 seconds
Throughput: 2600.3743 calls per second

Process finished with exit code 0

Number Thread Groups: 30
Thread Group Size: 10
Server Calls: 600000
Wall Time: 222.21501 seconds
Throughput: 2700.0876 calls per second

Process finished with exit code 0
```



Go Server

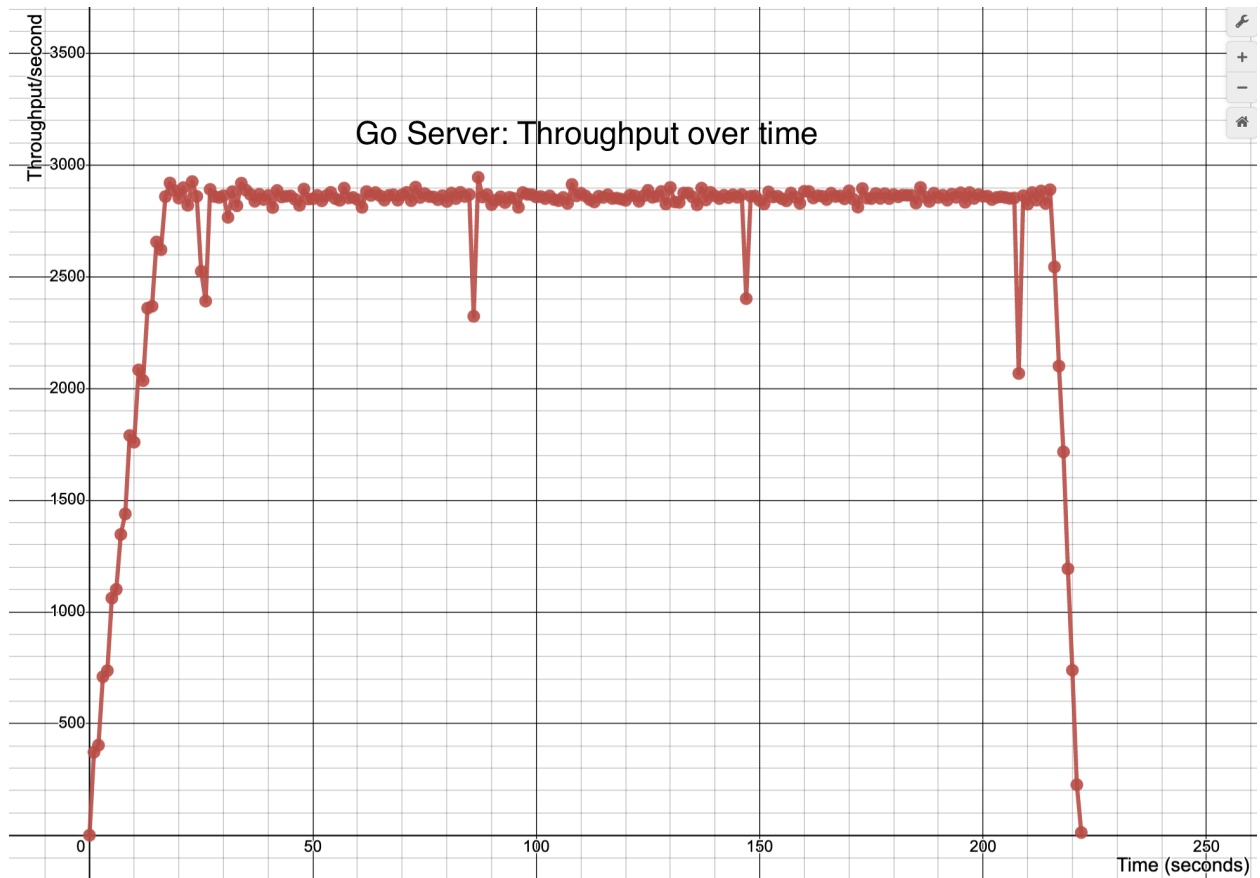
Number Thread Groups: 10 Thread Group Size: 10 Server Calls: 200000 Wall Time: 87.04401 seconds Throughput: 2297.6885 calls per second Mean: 33.32544 Median: 32.740568635937976 99 Percentile: 54.0155238303902 Max Latency: 265 Min Latency: 16 Process finished with exit code 0	Number Thread Groups: 20 Thread Group Size: 10 Server Calls: 400000 Wall Time: 152.654 seconds Throughput: 2620.3047 calls per second Mean: 58.00527 Median: 62.61328883053245 99 Percentile: 89.87816540065992 Max Latency: 264 Min Latency: 16 Process finished with exit code 0	Number Thread Groups: 30 Thread Group Size: 10 Server Calls: 600000 Wall Time: 221.57501 seconds Throughput: 2707.8865 calls per second Mean: 83.37368 Median: 91.16908114355 99 Percentile: 123.60451682266773 Max Latency: 1003 Min Latency: 16
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Java Server

```
Number Thread Groups: 10
Thread Group Size: 10
Server Calls: 200000
Wall Time: 86.51 seconds
Throughput: 2311.8713 calls per second
Mean: 33.857025
Median: 33.49837510355383
99 Percentile: 52.06291040348659
Max Latency: 329
Min Latency: 18
Process finished with exit code 0
```

```
Number Thread Groups: 20
Thread Group Size: 10
Server Calls: 400000
Wall Time: 153.55501 seconds
Throughput: 2604.9297 calls per second
Mean: 59.10994
Median: 64.52561833251355
99 Percentile: 87.5373524113628
Max Latency: 336
Min Latency: 17
Process finished with exit code 0
```

```
Number Thread Groups: 30
Thread Group Size: 10
Server Calls: 600000
Wall Time: 222.376 seconds
Throughput: 2698.1328 calls per second
Mean: 84.15502
Median: 92.59311158821585
99 Percentile: 122.64470934364917
Max Latency: 369
Min Latency: 18
Process finished with exit code 0
```



Throughput at every second (second, Throughput)

```
(0,0),(1,379),(2,400),(3,730),(4,716),(5,1098),(6,1072),(7,1415),(8,1424),(9,1713),(10,1736),(11,2023),(12,2044),(13,2312),(14,2350),(15,2619),(16,2595),(17,2838),(18,1946),(19,2967),(20,2057),(21,2075),(22,2840),(23,2879),(24,2855),(25,2871),(26,2797),(27,2803),(28,2871),(29,2869),(30,2863),(31,2861),(32,2871),(33,2858),(34,2876),(35,2860),(36,2854),(37,2881),(38,2858),(39,2905),(40,2860),(41,2856),(42,2859),(43,2850),(44,2852),(45,2868),(46,2845),(47,2861),(48,2865),(49,2857),(50,2866),(51,2865),(52,2876),(53,2856),(54,2855),(55,2864),(56,2873),(57,2858),(58,2852),(59,2842),(60,2866),(61,2826),(62,2916),(63,2775),(64,2925),(65,2870),(66,2842),(67,2913),(68,2859),(69,2874),(70,2855),(71,2862),(72,2853),(73,2875),(74,2856),(75,2864),(76,2847),(77,2850),(78,2903),(79,2459),(80,2879),(81,2869),(82,2841),(83,2878),(84,2866),(85,2868),(86,2852),(87,2868),(88,2851),(89,2887),(90,2849),(91,2855),(92,2871),(93,2858),(94,2851),(95,2854),(96,2888),(97,2833),(98,2871),(99,2865),(100,2857),(101,2849),(102,2869),(103,2862),(104,2875),(105,2856),(106,2853),(107,2866),(108,2871),(109,2846),(110,2870),(111,2843),(112,2871),(113,2849),(114,2873),(115,2852),(116,2864),(117,2854),(118,2915),(119,2859),(120,2866),(121,2862),(122,2865),(123,2822),(124,2914),(125,2828),(126,2855),(127,2901),(128,2826),(129,2882),(130,2915),(131,2866),(132,2853),(133,2840),(134,2873),(135,2870),(136,2836),(137,2909),(138,2867),(139,2855),(140,2265),(141,2906),(142,2853),(143,2871),(144,2868),(145,2861),(146,2861),(147,2881),(148,2876),(149,2869),(150,2843),(151,2884),(152,2821),(153,2907),(154,2873),(155,2854),(156,2865),(157,2878),(158,2858),(159,2850),(160,2860),(161,2872),(162,2856),(163,2860),(164,2850),(165,2878),(166,2870),(167,2854),(168,2863),(169,2860),(170,2864),(171,2859),(172,2899),(173,2857),(174,2871),(175,2851),(176,2863),(177,2886),(178,2829),(179,2896),(180,2873),(181,2858),(182,2870),(183,2836),(184,2912),(185,2844),(186,2893),(187,2878),(188,2849),(189,2875),(190,2857),(191,2865),(192,2869),(193,2833),(194,2885),(195,2881),(196,2904),(197,2841),(198,2866),(199,2886),(200,2501),(201,2772),(202,2875),(203,2860),(204,2836),(205,2905),(206,2878),(207,2881),(208,2853),(209,2856),(210,2870),(211,2863),(212,2907),(213,2867),(214,2877),(215,2804),(216,2426),(217,2050),(218,1506),(219,1017),(220,456),(221,132),(222,17),
```

Client Statistics

Java Server Client Part 1

Number Thread Groups: 10
Thread Group Size: 10
Server Calls: 200000
Wall Time: 86.073006 seconds
Throughput: 2323.609 calls per second

Number Thread Groups: 20
Thread Group Size: 10
Server Calls: 400000
Wall Time: 153.824 seconds
Throughput: 2600.3743 calls per second

Number Thread Groups: 30
Thread Group Size: 10
Server Calls: 600000
Wall Time: 222.21501 seconds
Throughput: 2700.0876 calls per second

Go Server Client Part 1

Number Thread Groups: 10
Thread Group Size: 10
Server Calls: 200000
Wall Time: 89.393005 seconds
Throughput: 2237.3115 calls per second

Number Thread Groups: 20
Thread Group Size: 10
Server Calls: 400000
Wall Time: 154.13701 seconds
Throughput: 2595.0938 calls per second

Number Thread Groups: 30
Thread Group Size: 10
Server Calls: 600000
Wall Time: 222.098 seconds
Throughput: 2701.51 calls per second

Java Server Client Part 2

Number Thread Groups: 10
Thread Group Size: 10
Server Calls: 200000
Wall Time: 86.51 seconds
Throughput: 2311.8713 calls per second
Mean: 33.857025
Median: 33.49837510355383
99 Percentile: 52.06291040348659
Max Latency: 329
Min Latency: 18

Number Thread Groups: 20
Thread Group Size: 10
Server Calls: 400000
Wall Time: 153.55501 seconds
Throughput: 2604.9297 calls per second
Mean: 59.10994
Median: 64.52561833251355
99 Percentile: 87.5373524113628
Max Latency: 336
Min Latency: 17

Number Thread Groups: 30
Thread Group Size: 10
Server Calls: 600000
Wall Time: 222.376 seconds
Throughput: 2698.1328 calls per second
Mean: 84.15502
Median: 92.59311158821585
99 Percentile: 122.64470934364917
Max Latency: 369
Min Latency: 18

Go Server Client Part 2

Number Thread Groups: 10
Thread Group Size: 10
Server Calls: 200000
Wall Time: 87.04401 seconds
Throughput: 2297.6885 calls per second
Mean: 33.32544
Median: 32.740568635937976
99 Percentile: 54.0155238303902
Max Latency: 265
Min Latency: 16

Number Thread Groups: 20
Thread Group Size: 10
Server Calls: 400000
Wall Time: 152.654 seconds
Throughput: 2620.3047 calls per second
Mean: 58.00527
Median: 62.61328883053245
99 Percentile: 89.87816540065992
Max Latency: 264
Min Latency: 16

Number Thread Groups: 30
Thread Group Size: 10
Server Calls: 600000
Wall Time: 221.57501 seconds
Throughput: 2707.8865 calls per second
Mean: 83.37368
Median: 91.16908114355
99 Percentile: 123.60451682266773
Max Latency: 1003
Min Latency: 16