Report of Assignment 2:

Currently, I finished all the basic requirement of step1 and step2. However, from thre test result, we see that the performance is really poor. From the file step1.output, unfortunately, I found that the wall time are really long and currently seems **not scalable** at all :(

The skeleton is all derived from the Assignment1. I removed the method that removes messages that previously expires after TTL. Then I created a rest web service (which contains a static CAServer instance, sort of a sington pattern) and handle each method defined in CAServer previously. The communication between server and client is basically based on JSON. I use GET and POST method to access the rest service. Once server side has done processing, it will return a Response variable cointains a proper status code as well as returned data wrapped in JSON format. This application works with Tomcat.

This was run in a concurrent mode where Publishers and Subscribers run simultaneously

- [Pub1] Totally cost 137627 ms
- [Pub2] Totally cost 189765 ms
- [Sub3] Totally cost 136237 ms
- [Sub4] Totally cost 180667 ms

There are several reasons that might be the cause:

- I used **synchronized methods rather than async methods** for all rest web service
- HTTP communication costs much time
- Json parser costs much time

The first one is supposed to be the most critical reason.

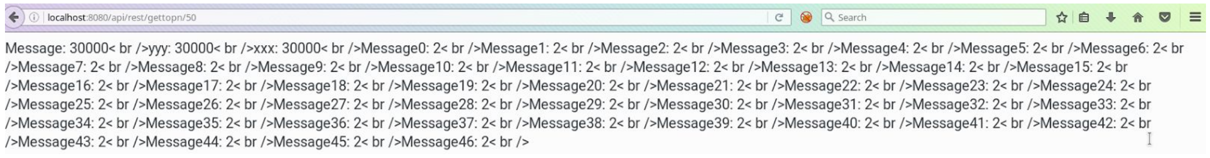
For step 2, I am using SQLite as the database backend. I can confirmed that the functionality is corrent by reading the step2.output and the screenshot of result of getTopN method listed below. There're still some problems, where some of them are the same as described in step1:

- The problem of long wall time found in step1 still exist
- If there's no sync while manipulating database, then there's a high probability that will cause a segment fault (Yes it's a segment fault in JAVA, probably caused by racing condition). Once I add sync to each data CURD method, the wall time becomes even longer though this problem does not exist anymore.
- I am trying to update each word occured in a message to database after fully scanned a message. That means, if there're N different words in a message, then I need to run SQL query for N times to update the word count for each word in this message. Since I am using SQL (to be specificied it's SQLite), it seems not an ideal way and I am trying to find a better way (maybe NOSQL solution like MongoDB? I am not familiar with that which means roughly it will cost me much time to learn).
- Because database operations takes a lot more time, and the publishContent() method is called and handled in a syncronized order, the wall time of publisher increased a lot compared to step 1.**(In this case Publishers and Subscribers are run concurrently)**

    - [Pub1] Totally cost 513368 ms
    - [Pub2] Totally cost 803858 ms, which is **more than 13 minutes**!
- If I run Publishers first then run Subscribers, the result is as listed below and which seems quite better. We can indicate that concurrent runnning of Publishes and Subscribers (previous result) might be a reason why the system has a poor performance because it probably reached the throughput QPS.
    - [Pub1] Totally cost 282289 ms
    - [Pub2] Totally cost 539916 ms
- For subscribers, there's not much change so the performance is similar to step1
- Because the concurrent processing efficiency is too low, there's even timeout happened (100ms) for subscribers. That's the reason why step2.output got 90k lines where step1.output runs the same test and only got 60k lines output. The extra 30k lines of log are mainly timeout info of subscribers.

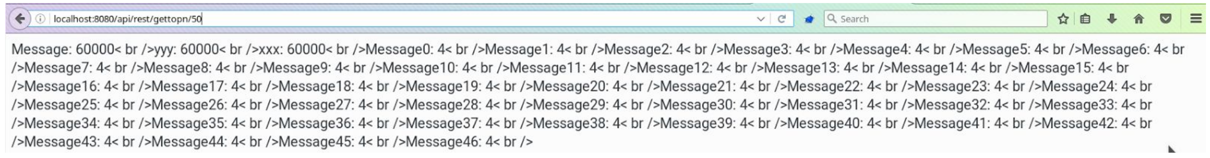
I defined the message everytime Publisher send to be a constant string "Message xxx yyy Message" and the order of that message. So the result listed below is exactly what we expected.

First getTopN result after running clients once:



```
Message: 30000< br />yyy: 30000< br />xxx: 30000< br />Message0: 2< br />Message1: 2< br />Message2: 2< br />Message3: 2< br />Message4: 2< br />Message5: 2< br />Message6: 2< br
/>Message7: 2< br />Message8: 2< br />Message9: 2< br />Message10: 2< br />Message11: 2< br />Message12: 2< br />Message13: 2< br />Message14: 2< br />Message15: 2< br
/>Message16: 2< br />Message17: 2< br />Message18: 2< br />Message19: 2< br />Message20: 2< br />Message21: 2< br />Message22: 2< br />Message23: 2< br />Message24: 2< br
/>Message25: 2< br />Message26: 2< br />Message27: 2< br />Message28: 2< br />Message29: 2< br />Message30: 2< br />Message31: 2< br />Message32: 2< br />Message33: 2< br
/>Message34: 2< br />Message35: 2< br />Message36: 2< br />Message37: 2< br />Message38: 2< br />Message39: 2< br />Message40: 2< br />Message41: 2< br />Message42: 2< br
/>Message43: 2< br />Message44: 2< br />Message45: 2< br />Message46: 2< br />
```

Second getTopN result after running clients twice:



```
Message: 60000< br />yyy: 60000< br />xxx: 60000< br />Message0: 4< br />Message1: 4< br />Message2: 4< br />Message3: 4< br />Message4: 4< br />Message5: 4< br />Message6: 4< br
/>Message7: 4< br />Message8: 4< br />Message9: 4< br />Message10: 4< br />Message11: 4< br />Message12: 4< br />Message13: 4< br />Message14: 4< br />Message15: 4< br
/>Message16: 4< br />Message17: 4< br />Message18: 4< br />Message19: 4< br />Message20: 4< br />Message21: 4< br />Message22: 4< br />Message23: 4< br />Message24: 4< br
/>Message25: 4< br />Message26: 4< br />Message27: 4< br />Message28: 4< br />Message29: 4< br />Message30: 4< br />Message31: 4< br />Message32: 4< br />Message33: 4< br
/>Message34: 4< br />Message35: 4< br />Message36: 4< br />Message37: 4< br />Message38: 4< br />Message39: 4< br />Message40: 4< br />Message41: 4< br />Message42: 4< br
/>Message43: 4< br />Message44: 4< br />Message45: 4< br />Message46: 4< br />
```

Currently, the portion I am going to improve is to **make all methods asyncronized if possible**. I am a little busy these day abd that's the reason why it havn't been done yet. I am going to try **using JMS to buffer the income message to process the word count in async mode** which means saving much time for publishers.