COP5615 Distributed Operating System

Project 4 Part 1 – Twitter Clone

README

Group Members

1. Bhavya Kavdia, UFID: 7017-7277

2. Ishita Trivedi, UFID: 6893-6496

Problem Statement -

Implement a Twitter-like engine with the basic functionalities of twitter like register account, send tweets, subscription to tweets, query, search tweets, connection, and disconnection of users etc. and implement a tester/simulator to test the above functionalities.

Basic requirement – Finished

(No bonus asked in this Project)

Input -

1. noOfUsers – Denotes the number of users or clients using the twitter clone engine. For optimized performance we have kept the lower limit for this number to be 1000.

Command to run -

1. To run Project 4.1:
   dotnet fsi Project4_1.fsx <noOfUsers>

Implementation -

The twitter clone system functionality has been implemented by using the following actors to function as a client server model –

- UserActor - This is the client who is the user of the twitter clone system. The total no of users present in the system is input by the user running the program. It is used by the simulator to make tweets, retweets and search for various keywords or hashtags or mentions in the tweets. The user can also be connected or disconnected from the system and in both cases its tweets are handled by the twitter clone system.
- simulation_engine - This refers to the simulator which is used to create and register users to the server, add follower and following list for each user and finally simulate tweets and retweets for each user to implement the twitter clone functionality.
- twitterClone_engine - It behaves like a backend server for storing of user and tweet/retweet details which can be easily queried for search purposes. It also serves an important role in maintaining information about the user home timeline.

- distribution_engine – It is used for distribution of tweets and retweets amongst followers of users in the system.

Steps -

- Register Users – When the no of users has been input by the end user then the simulation_engine Actor works to create and register users to the system. It then uses zipf distribution to assign followers and make some users follow other users. Also, the server maintains a record of all users' follower list and following list for future references and easy retrieval during queries.
- Assigning of follower and following lists - For assigning followers we have implemented a Zipf distribution model in which the rank of users is inversely proportional to the no of followers it has. In other words, consider a famous user to have a very low rank then it will have a very high no of followers as compared to a user which is ranked last in the system.
- Tweets - There are two types of messages which can be sent, namely, tweets and retweets. In our system, the simulator will push the client to make 10 tweets and one retweet to each of its followers. The server stores these tweets so that they can be referred later if the user is offline or disconnected when the tweet has been received. All live tweets show up on the users' home timeline instantaneously. The server maintains a map of user ID to the pending tweets in the user pending home timeline in case of offline users.
- Retweets – The simulator can also be used to retweet an existing tweet from a user to its followers, the tweet might be present in user's home timeline or might be randomly fetched from a list of pre-defined tweets in the system. The distribution of retweets works in a similar fashion to that of tweet distribution.
- Search – The tweets in our system can be a combination of either of the three entities – a keyword, a hashtag or a user mention. Search functionality enables users to query the twitterClone_engine or the server for each of these entities. The twitter clone engine examines all the tweets as they are generated and stores different tweets containing these entities in different maps. These maps are later used for fast retrieval of tweets containing the search string and displaying top 10 reach results.

Simulator Testing and Performance –

The **maximum** no of users for which we were able to successfully build the twitter clone engine is **10000 users**.

Following are the various outputs encountered while running the twitter clone system: -

- Each user sends out 10 tweets in total to each of its followers and the total time taken to send and receive all tweets i.e., 31198700 tweets in the system is 170025.42 ms. Each user also retweets one tweet out of all its tweets to all its followers. The time taken to retweet one tweet by all the users which sums to a total of 3119870 retweets to all of their followers is 13637.95 ms.

```
Twitter Clone Engine has been created for 10000 users.
After all the tweets are sent and received in the system.....
170025.426200 ms is time taken to send and receive 31198700 tweets in the system.
After all the retweets are sent and received in the system.....
13637.953500 ms is time taken to send and receive  3119870 retweets in the system.
```

- We then select any random User 1977 and display its follower list which has been randomly populated.

```
Listing out the follower list of any random user - User1977.
45, 144, 157, 289, 411, 542, 544, 586, 644, 726, 806, 985, 1125, 1185, 1216, 1247, 1390, 1397, 1452, 1511, 1513, 1514, 1626, 1719, 1776, 1797, 1845, 1856, 1897, 1934, 2006, 2043, 2101, 2175, 2214, 2255
, 2267, 2285, 2308, 2393, 2437, 2535, 2617, 2641, 2653, 2679, 2736, 2805, 2890, 2910, 2955, 3060, 3103, 3246, 3255, 3379, 3493, 3503, 3555, 3621, 3642, 3688, 3753, 3853, 3912, 4035, 4055, 4082, 4287, 4
323, 4349, 4462, 4551, 4675, 4776, 4839, 4970, 5077, 5100, 5173, 5281, 5297, 5302, 5304, 5330, 5431, 5496, 5812, 5835, 5845, 5889, 5907, 5933, 5939, 5971, 6062, 6124, 6287, 6303, 6308, 6313, 6355, 6453
, 6457, 6474, 6512, 6513, 6527, 6557, 6563, 6590, 6630, 6647, 6855, 6937, 6947, 7000, 7023, 7042, 7075, 7079, 7345, 7480, 7498, 7615, 7654, 7761, 7814, 7831, 7855, 7904, 8067, 8094, 8099, 8109, 8139, 8
183, 8211, 8220, 8315, 8339, 8354, 8410, 8556, 8563, 8571, 8616, 8741, 8768, 8793, 8813, 8825, 8841, 8856, 8990, 9022, 9045, 9101, 9136, 9172, 9192, 9574, 9577, 9603, 9626, 9724, 9740, 9827,
User 9626 is selected as the random follower.
```

- We randomly select User 9626 and display list of users following it.

```
Following is the list of users following User 9626:-
9, 30, 64, 94, 155, 180, 182, 228, 243, 247, 260, 277, 299, 333, 435, 454, 472, 511, 517, 520, 553, 557, 565, 610, 658, 673, 696, 702, 825, 864, 866, 874, 875, 956, 979, 981, 982, 995, 1178, 1225, 1239
, 1243, 1265, 1294, 1310, 1340, 1398, 1418, 1448, 1533, 1589, 1604, 1618, 1625, 1640, 1674, 1731, 1773, 1785, 1852, 1855, 1864, 1870, 1871, 1874, 1889, 1943, 1954, 1974, 1977, 2001, 2026, 2027, 2093, 2
157, 2210, 2222, 2265, 2293, 2313, 2318, 2441, 2463, 2479, 2540, 2606, 2614, 2620, 2685, 2730, 2750, 2788, 2789, 2852, 2872, 2895, 2905, 2924, 2962, 2969, 2975, 2981, 3041, 3042, 3043, 3050, 3095, 3098
, 3120, 3139, 3158, 3202, 3214, 3325, 3350, 3410, 3414, 3430, 3432, 3446, 3452, 3478, 3498, 3576, 3610, 3647, 3749, 3778, 3809, 3830, 3970, 3989, 4010, 4015, 4062, 4064, 4073, 4141, 4195, 4222, 4244, 4
330, 4331, 4342, 4367, 4378, 4392, 4396, 4405, 4495, 4505, 4506, 4522, 4553, 4585, 4600, 4677, 4691, 4699, 4712, 4743, 4773, 4787, 4797, 4885, 5044, 5052, 5114, 5130, 5145, 5169, 5193, 5196, 5203, 5211
, 5263, 5331, 5375, 5542, 5571, 5585, 5596, 5607, 5642, 5672, 5678, 5710, 5766, 5777, 5782, 5789, 5812, 5839, 5896, 5973, 5995, 6024, 6045, 6054, 6084, 6085, 6146, 6169, 6175, 6203, 6204, 6206, 6253, 6
292, 6308, 6341, 6354, 6379, 6403, 6411, 6478, 6510, 6630, 6636, 6645, 6651, 6690, 6693, 6695, 6731, 6735, 6738, 6743, 6752, 6962, 6983, 7038, 7061, 7063, 7080, 7105, 7118, 7166, 7182, 7282, 7287, 7320
, 7327, 7336, 7352, 7360, 7366, 7396, 7415, 7423, 7428, 7436, 7460, 7463, 7469, 7475, 7476, 7509, 7541, 7559, 7664, 7690, 7706, 7756, 7800, 7866, 7913, 7916, 7924, 7989, 7998, 8017, 8052, 8053, 8067, 8
170, 8191, 8200, 8235, 8309, 8337, 8410, 8518, 8585, 8595, 8630, 8645, 8667, 8679, 8713, 8740, 8791, 8921, 9042, 9048, 9075, 9076, 9095, 9114, 9115, 9143, 9154, 9167, 9186, 9211, 9224, 9283, 9288, 9338
, 9358, 9429, 9437, 9438, 9508, 9535, 9544, 9564, 9573, 9648, 9663, 9701, 9715, 9730, 9732, 9791, 9796, 9835, 9902, 9928, 9987, 9997,
```

- We then make User 9626 offline and make User 1977 send a tweet. This tweet will not show up in its follower User 9626's home-timeline as it is offline. We also display offline User 9629s home timeline to corroborate the above statement.

```
Disconnecting User9626 by making it offline!

User1977 sends a tweet which would not show up in User9626's home-timeline as it is offline.
```

```
Displaying offline User9626's home-timeline

Tweet Id : 95050
Tweet Text : Tweeting randomly #tweet10 by @User10 related to course COP5615
Tweet Creator : User5051
Tweet has been retweeted by User9997

Tweet Id : 96458
Tweet Text : Tweeting randomly #tweet10 by @User10 related to course COP5615
Tweet Creator : User6456
Tweet has been retweeted by User9987

Tweet Id : 54809
Tweet Text : Tweeting randomly #tweet6 by @User6 related to course COP5615
Tweet Creator : User4799
Tweet has been retweeted by User9928

Tweet Id : 4825
Tweet Text : Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Creator : User4825
Tweet has been retweeted by User9902

Tweet Id : 93094
Tweet Text : Tweeting randomly #tweet10 by @User10 related to course COP5615
Tweet Creator : User3094
Tweet has been retweeted by User9835

Tweet Id : 1566
Tweet Text : Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Creator : User1566
Tweet has been retweeted by User9796

Tweet Id : 47611
Tweet Text : Tweeting randomly #tweet5 by @User5 related to course COP5615
Tweet Creator : User7611
Tweet has been retweeted by User9791

Tweet Id : 70470
Tweet Text : Tweeting randomly #tweet8 by @User8 related to course COP5615
Tweet Creator : User436
Tweet has been retweeted by User9732

Tweet Id : 11024
Tweet Text : Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Creator : User1026
```

- User 9269 is then made online, and its home-timeline is displayed which contains the tweet from User 1977, where the ID of the tweet is 100001.

```
Connecting User9626 by making it online!
Displaying online User9626's home-timeline

Tweet Id : 100001
Tweet Text : This #RandomTweet won't be visible in User9626's timeline.
Tweet Creator : User1977

Tweet Id : 95050
Tweet Text : Tweeting randomly #tweet10 by @User10 related to course COP5615
Tweet Creator : User5051
Tweet has been retweeted by User9997

Tweet Id : 96458
Tweet Text : Tweeting randomly #tweet10 by @User10 related to course COP5615
Tweet Creator : User6456
Tweet has been retweeted by User9987

Tweet Id : 54809
Tweet Text : Tweeting randomly #tweet6 by @User6 related to course COP5615
Tweet Creator : User4799
Tweet has been retweeted by User9928

Tweet Id : 4825
Tweet Text : Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Creator : User4825
Tweet has been retweeted by User9902

Tweet Id : 93094
Tweet Text : Tweeting randomly #tweet10 by @User10 related to course COP5615
Tweet Creator : User3094
Tweet has been retweeted by User9835

Tweet Id : 1566
Tweet Text : Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Creator : User1566
Tweet has been retweeted by User9796

Tweet Id : 47611
Tweet Text : Tweeting randomly #tweet5 by @User5 related to course COP5615
Tweet Creator : User7611
Tweet has been retweeted by User9791
```

- We then perform a keyword search for the keyword 'COP5615', mention search for mention of @User2, and hashtag search for searching '#tweet5' in all the tweets across the system. Below mentioned is the time taken for each of the three kinds of searches that our twitter engine handles.

```
Keyword Search - Searching for the keyword 'COP5615'
0.159400 ms is the time taken to search for string - COP5615 in system

Mention Search - Searching for mention of the user @User2
0.145100 ms is time taken to search for mention of @User2 in system.

Hashtag Search - Searching for the hashtag #tweet5
0.204500 ms is the time taken to search for #tweet5 in the system
```

- Each of the search results displays the top 10 results out of the total matches it has found. The search for keyword 'COP5615' in the tweets results in 100,000 search results and the top 10 results are -

```
The total number of search results found are 100000
Displaying top 10 results out of all the search results below -

Id of Tweet - 1
Tweet Data - Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Created By - User3

Id of Tweet - 2
Tweet Data - Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Created By - User1

Id of Tweet - 3
Tweet Data - Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Created By - User2

Id of Tweet - 4
Tweet Data - Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Created By - User5

Id of Tweet - 5
Tweet Data - Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Created By - User4

Id of Tweet - 6
Tweet Data - Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Created By - User6

Id of Tweet - 7
Tweet Data - Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Created By - User7

Id of Tweet - 8
Tweet Data - Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Created By - User8

Id of Tweet - 9
Tweet Data - Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Created By - User9

Id of Tweet - 10
Tweet Data - Tweeting randomly #tweet1 by @User1 related to course COP5615
Tweet Created By - User10
```

- The search for mention of the user '@User2' in the tweets results in 100,000 search results and the top 10 results are -

```
The total number of search results found are 10000
Displaying top 10 results out of all the search results below -

Id of Tweet - 10000
Tweet Data - Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Created By - User1

Id of Tweet - 10001
Tweet Data - Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Created By - User2

Id of Tweet - 10002
Tweet Data - Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Created By - User3

Id of Tweet - 10003
Tweet Data - Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Created By - User4

Id of Tweet - 10004
Tweet Data - Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Created By - User5

Id of Tweet - 10005
Tweet Data - Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Created By - User6

Id of Tweet - 10006
Tweet Data - Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Created By - User7

Id of Tweet - 10007
Tweet Data - Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Created By - User8

Id of Tweet - 10008
Tweet Data - Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Created By - User9

Id of Tweet - 10009
Tweet Data - Tweeting randomly #tweet2 by @User2 related to course COP5615
Tweet Created By - User10
```

- The search for the hashtag '#tweet5' in the tweets results in 10,000 search results and the top 10 results are -

```
The total number of search results found are 10000
Displaying top 10 results out of all the search results below -

Id of Tweet - 40001

Id of Tweet - 40003
Tweet Data - Tweeting randomly #tweet5 by @User5 related to course COP5615
Tweet Created By - User3

Id of Tweet - 40004
Tweet Data - Tweeting randomly #tweet5 by @User5 related to course COP5615
Tweet Created By - User4

Id of Tweet - 40005
Tweet Data - Tweeting randomly #tweet5 by @User5 related to course COP5615
Tweet Created By - User5

Id of Tweet - 40006
Tweet Data - Tweeting randomly #tweet5 by @User5 related to course COP5615
Tweet Created By - User6

Id of Tweet - 40007
Tweet Data - Tweeting randomly #tweet5 by @User5 related to course COP5615
Tweet Created By - User7

Id of Tweet - 40008
Tweet Data - Tweeting randomly #tweet5 by @User5 related to course COP5615
Tweet Created By - User8

Id of Tweet - 40009
Tweet Data - Tweeting randomly #tweet5 by @User5 related to course COP5615
Tweet Created By - User9

Id of Tweet - 40010
Tweet Data - Tweeting randomly #tweet5 by @User5 related to course COP5615
Tweet Created By - User10
```