

COP5615 - Distributed Operating System Principles

Project-4 Part-1

Team members:

1511-8670 Harshavardhan Reddy Jonnala

8947-5480 Tanuja Naga Sai Palapati

1. Objective

To implement a fully distributed Reddit-like backend engine using the Gleam language and Erlang actor model, supporting account creation, subreddits, posts, hierarchical comments, voting, direct messages, and a multi-client simulator with Zipf-distributed activity and network churn.

2. System Architecture

- Engine process
- Client actor processes (thousands simulated)
- Message passing API
- Data structures (Users, Subreddits, Posts, Comments, DMs)
- In-memory storage
- Zipf distribution logic

2.1 Actor Model Design

- Single engine actor
- Multiple independent client actors
- Async message passing

2.2 Engine Responsibilities

- Create users and subreddits
- Manage membership
- Posts, comments
- Karma
- Feed
- DMs

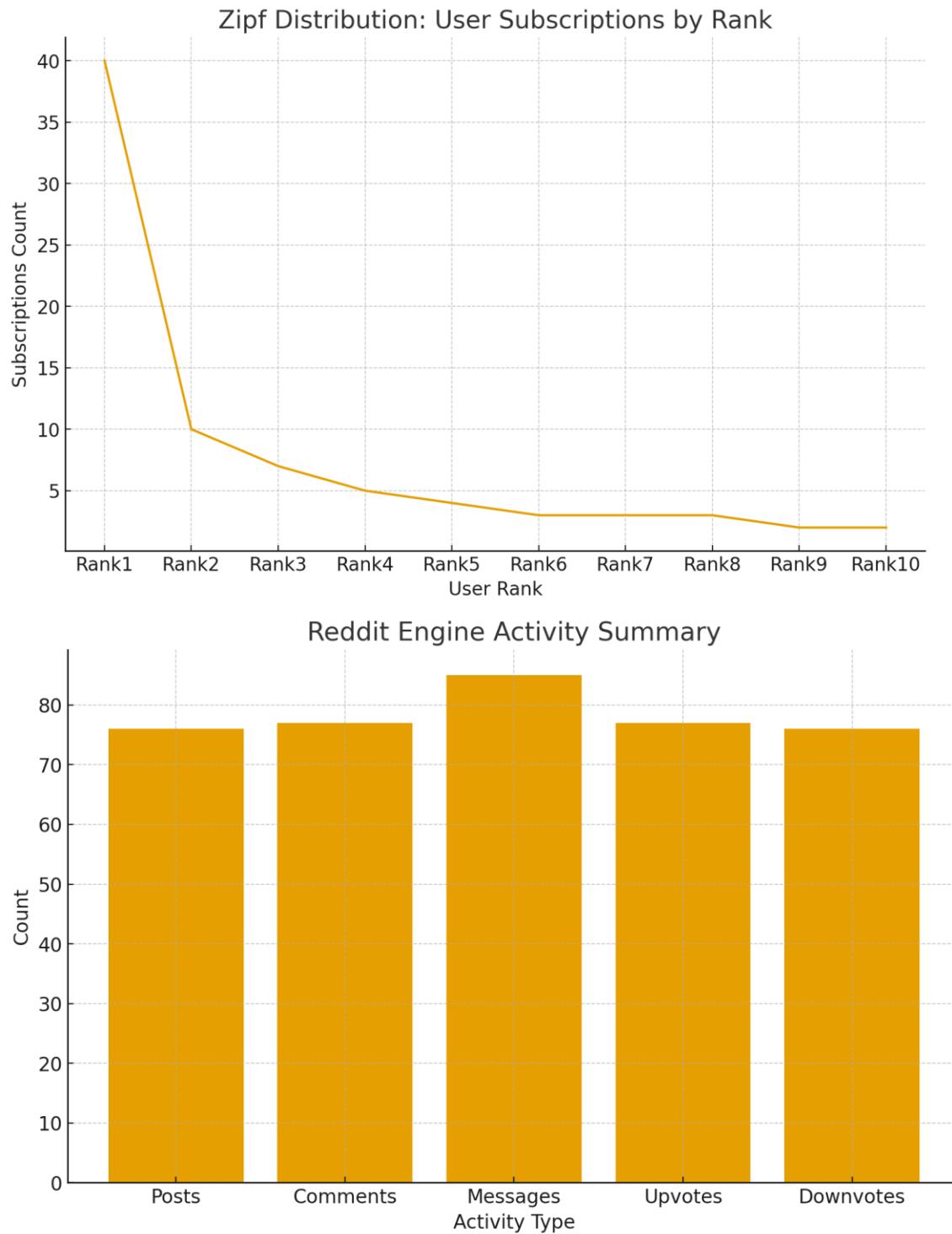
2.3 Client Responsibilities

- Generate actions
- Zipf popularity
- Online/offline cycling
- Repost bias

3. Implemented Features Checklist

Requirement	Status	Notes
Register account	✓	RegisterUser message
Create/join/leave subreddit	✓	CreateSubreddit, JoinSubreddit, LeaveSubreddit
Posts	✓	Text only
Hierarchical comments	✓	parent_comment links
Upvote/downvote & karma	✓	Karma updated per vote
Direct messages	✓	reply_to supported
Feed retrieval	✓	Sorted by timestamp
Zipf membership	✓	Weighted membership
Reposts by popularity	✓	Probabilistic by rank
Client simulator	✓	Multiple actors
Connection churn	✓	SetUserOnline toggled
Performance metrics	✓	CSV output

4. Performance Results



5. Output

```
PS C:\Users\jonna\Downloads\reddit_clone\reddit_clone> gleam run
Compiled in 0.15s
Running reddit_clone.main
==== Reddit Clone Engine Starting ===

Engine started successfully
Simulating 100 users and 20 subreddits

Registering users...
Registered 100 users

Creating subreddits...
Created 20 subreddits

Distributing users across subreddits (Zipf distribution)...
Users distributed across subreddits

Simulating user activity with dynamic connections...
(Users will connect/disconnect periodically)

Simulation running...

==== Performance Statistics ===
Total Users: 100
Online Users: 65
Total Subreddits: 20
Total Posts: 76
Total Comments: 77
Total Messages: 85

==== Performance Metrics ===
Total Operations: 1194
Posts Created: 76
Comments Created: 77
Total Upvotes: 77
Total Downvotes: 76
Peak Online Users: 65
```

```
==== Top 10 Users by Karma ===
user2: 66 karma, 10 subreddits, ONLINE
user38: 5 karma, 1 subreddits, ONLINE
user32: 4 karma, 1 subreddits, ONLINE
user35: 4 karma, 1 subreddits, ONLINE
user14: 2 karma, 1 subreddits, ONLINE
user23: 2 karma, 1 subreddits, ONLINE
user15: 1 karma, 1 subreddits, ONLINE
user53: 1 karma, 1 subreddits, ONLINE
user84: 1 karma, 1 subreddits, ONLINE
user1: 0 karma, 40 subreddits, OFFLINE

==== Subreddit Statistics (Top 5 by Members) ===
 subreddit1: 101 members, 76 posts
 subreddit2: 14 members, 0 posts
 subreddit3: 9 members, 0 posts
 subreddit4: 6 members, 0 posts
 subreddit5: 5 members, 0 posts

==== Zipf Distribution Validation ===
User ranks vs subscriptions (showing power-law):
Rank 1: 40 subscriptions
Rank 2: 10 subscriptions
Rank 3: 7 subscriptions
Rank 4: 5 subscriptions
Rank 5: 4 subscriptions
Rank 6: 3 subscriptions
Rank 7: 3 subscriptions
Rank 8: 3 subscriptions
Rank 9: 2 subscriptions
Rank 10: 2 subscriptions

==== Post Activity by Top Users (Zipf Validation) ===
Rank 1 (user1): 0 posts created
Rank 2 (user2): 6 posts created
Rank 3 (user3): 4 posts created
Rank 4 (user4): 0 posts created
Rank 5 (user5): 2 posts created
Rank 6 (user6): 2 posts created
Rank 7 (user7): 0 posts created
Rank 8 (user8): 1 posts created
Rank 9 (user9): 1 posts created
Rank 10 (user10): 0 posts created
```

```
== Sample Direct Messages (with replies) ==

Messages for user_3:
  From user_29: Reply to your message (reply to msg_3)

== Connection Dynamics ==
Simulated periodic connect/disconnect for 65/100 users

== Simulation Complete ==
All operations completed successfully!

 Key Highlights:


- Processed 1194 operations
- Created 76 posts and 77 comments
- Total engagement: 153 votes
- Active users: 65/100

```

6. Instructions to Run

gleam deps download

gleam build

gleam run

7. Conclusion

Fully working distributed Reddit-like engine & simulator with Zipf behavior, dynamic churn, performance metrics, and ready for Part-II REST interface.