

Distributed Systems

Course project

Team 32

Gnutella: Consistency

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Problem statement

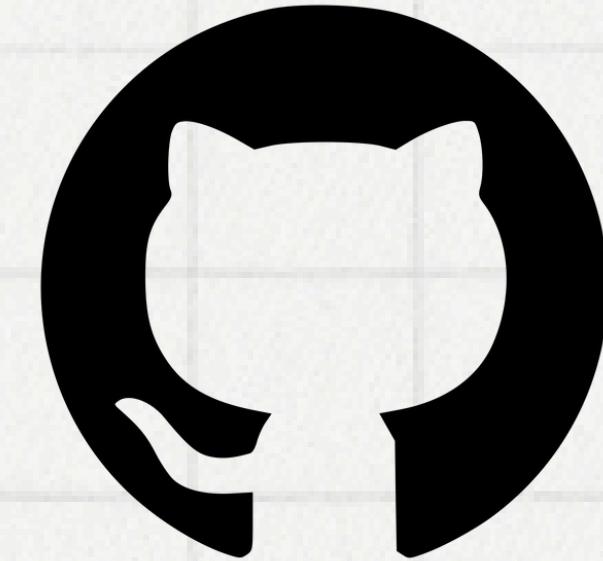
01. Implement the Gnutella Protocol

02. Add an extra feature:
Consistency

03. Analyze the network performance

Tech Stack

- Rust – Backend, core components
- Bash, Python – Analysis
- Git – version control



Timeline

Week 1

Research and plan out the implementation

Week 2

Implementation of basic features like Ping, Pong, Query, QueryHit.

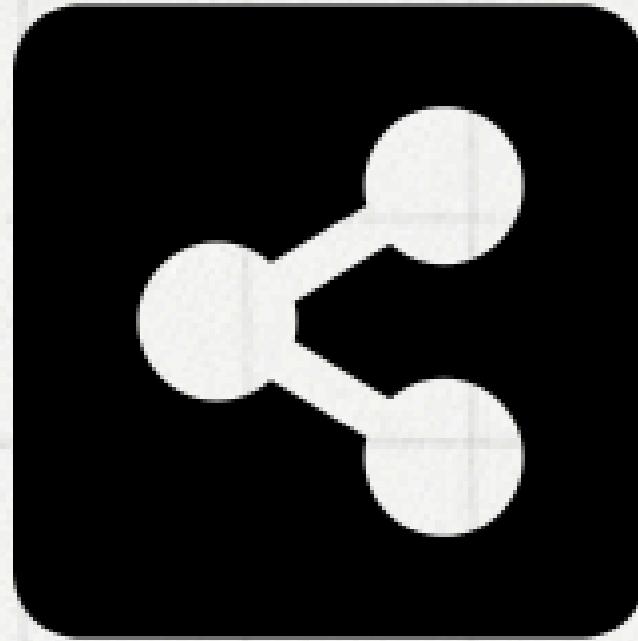
Week 3

Complete implementation of Gnutella including Push and download. Designed consistency integration into the Gnutella system.

Week 4

Implementation of consistency. Analysis of network performance.

What is Gnutella?



A decentralized Peer-to-Peer (P2P) file sharing system.

We have implemented v0.4 of Gnutella, which uses an unstructured network overlay.

Implementation

Ping:

- A joining node sends a ping message to its first connection in the network.
- That ping message is forwarded to other nodes in the network in a flooding manner.
- A node stops forwarding the ping message if TTL==0.

Pong:

- A node which receives a ping message replies with a Pong message.
- Pong messages are forwarded in exact reverse path of its ping message.
- Each node sends exactly one pong.

Implementation

Query:

- A user enters a search query.
- The nodes forward the query messages in a flooding manner to all their neighbours.

Query Hit:

- A node which have matches for the search criteria in the query message will reply with a Query Hit message.
- Query hits travel in the exact opposite path of its query message.

Implementation

Push:

- The node which initially requested a Query, after aggregating the Query Hits, lets the user pick a node to send a Push request to.
- This will prepare the node to create a HTTP stream outside of the Gnutella protocol, in order for the file download to be possible.

Downloading:

- This isn't a direct part of the Gnutella protocol, however, we have taken into account the suggestions mentioned in the protocol and have implemented them.
- The node which has sent a Push message will be asked to connect to a dedicated port that the other node has set up for a direct HTTP connection, and the file contents are sent over this HTTP stream.

Consistency

Network View Consistency:

According to the Gnutella protocol, "A servent receiving a Ping descriptor **may elect to respond with a Pong descriptor ...**"

This can cause the nodes to discover only a partial view of the network!

Solution:

- Every servent which receives a Ping message is strictly required to respond with a Pong message.
- Note that a TTL is present, so, not every node in the network will receive the Ping message in the first place.

Consistency

File consistency

To improve the performance of the protocol, it is very useful to have caches.

So, when a node downloads a file from another node, it caches this file and makes it available for other users to download.

In order to have consistent caches,

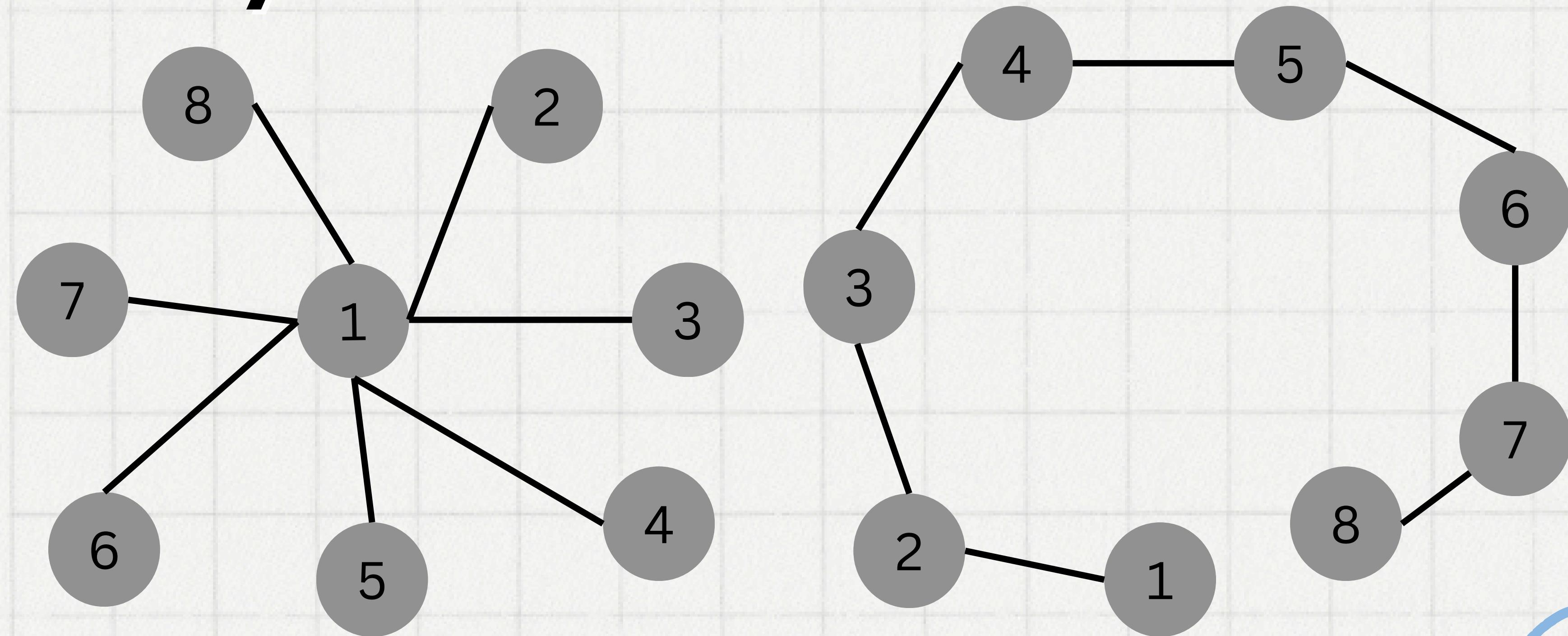
- When a node receives a file, it stores it in its cache with all the details of the node that it downloaded this file from.
- When another node sends a query which matches with a file in cache, it responds with a Query Hit message like any other node normally would.
- When the querying node sends a Push message to this node with the cached file, it first verifies with the original owner of this file for any updates.
- If any updates are made, then the updates are propagated through all the caches of this file and the initially querying node finally gets the file that it requested for.

Analysis

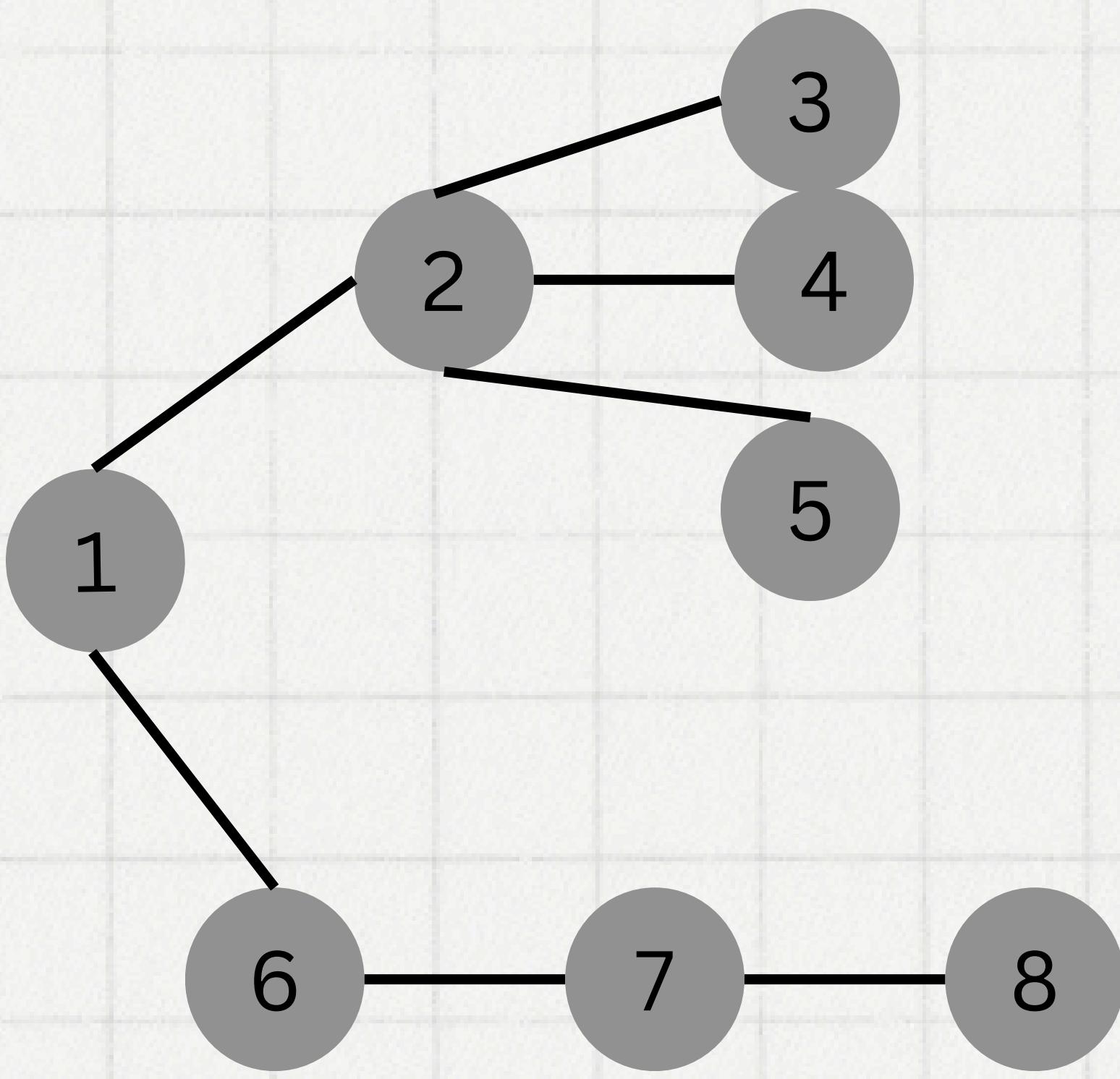
To analyse the advantages/disadvantages of the new implementation of consistency, we designed three types of networks with:

- 8 nodes in total
- 15 file names shared across the nodes.

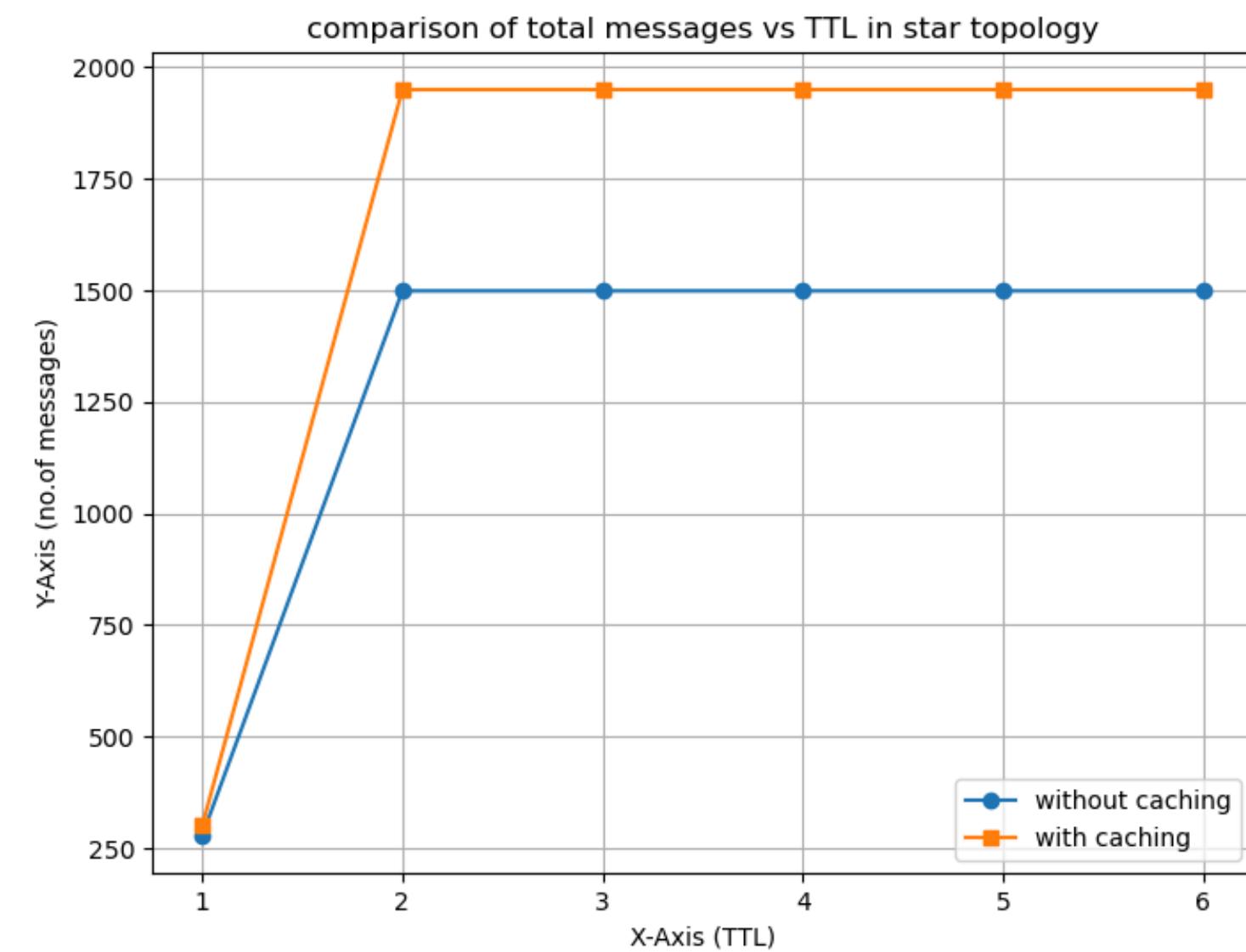
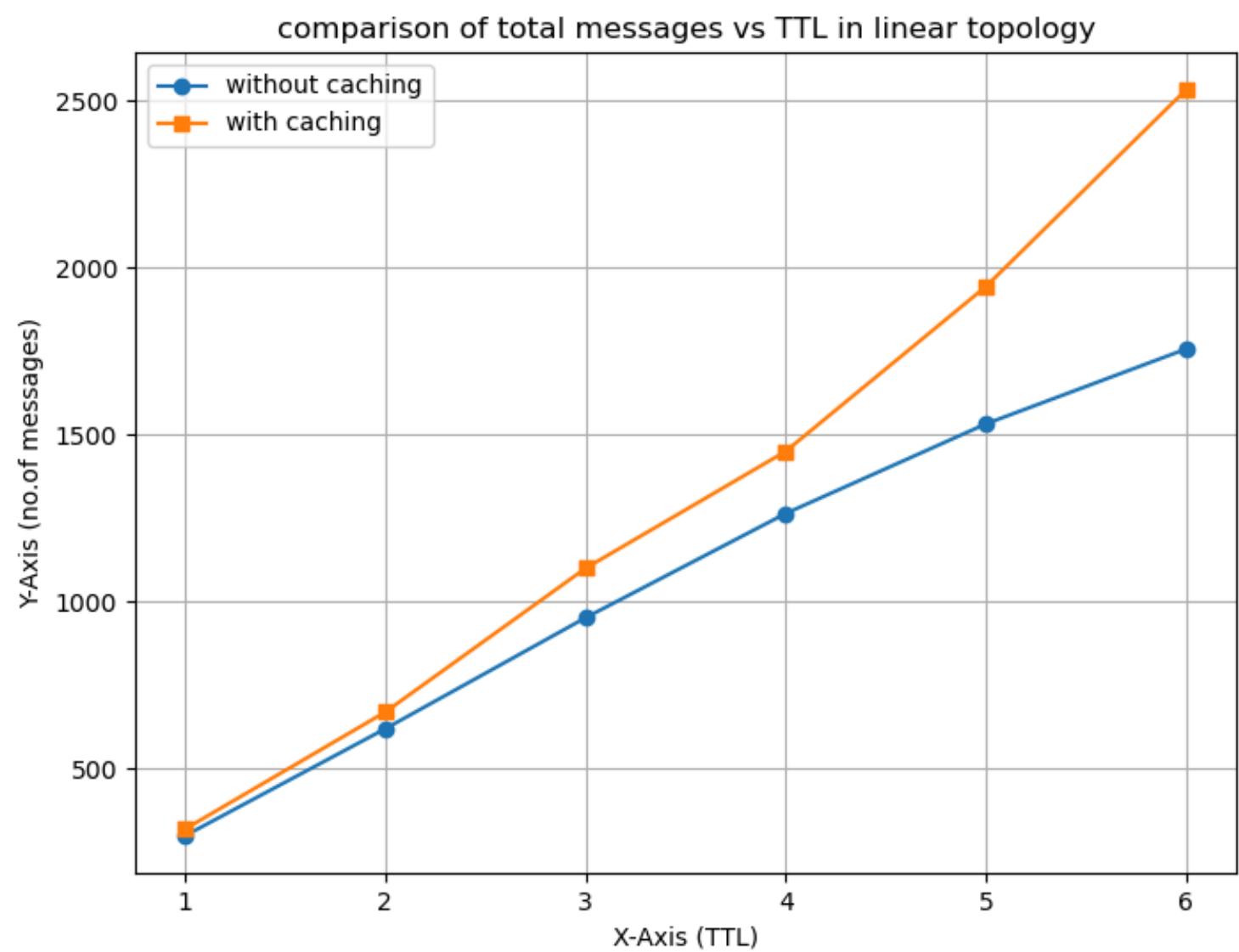
Analysis



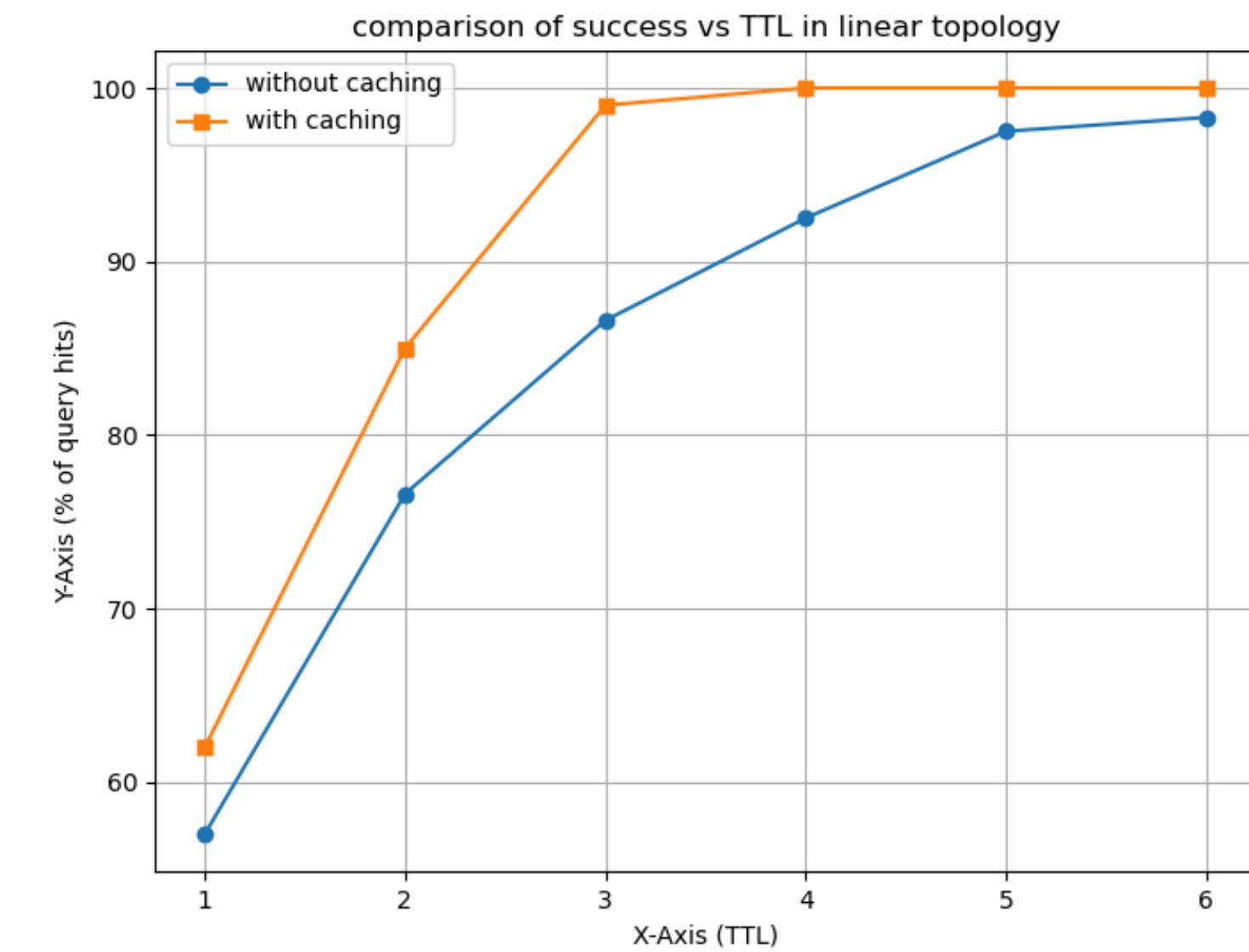
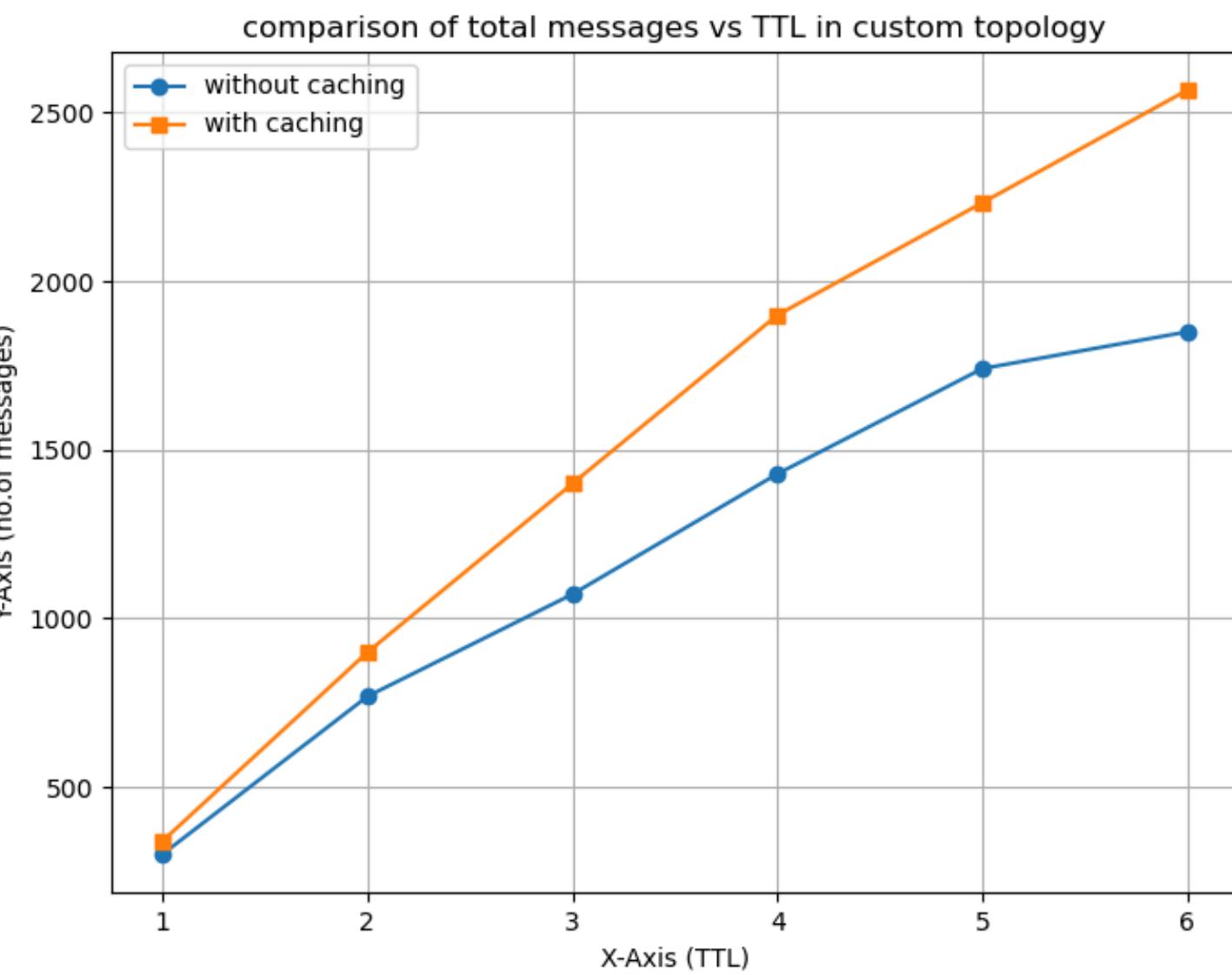
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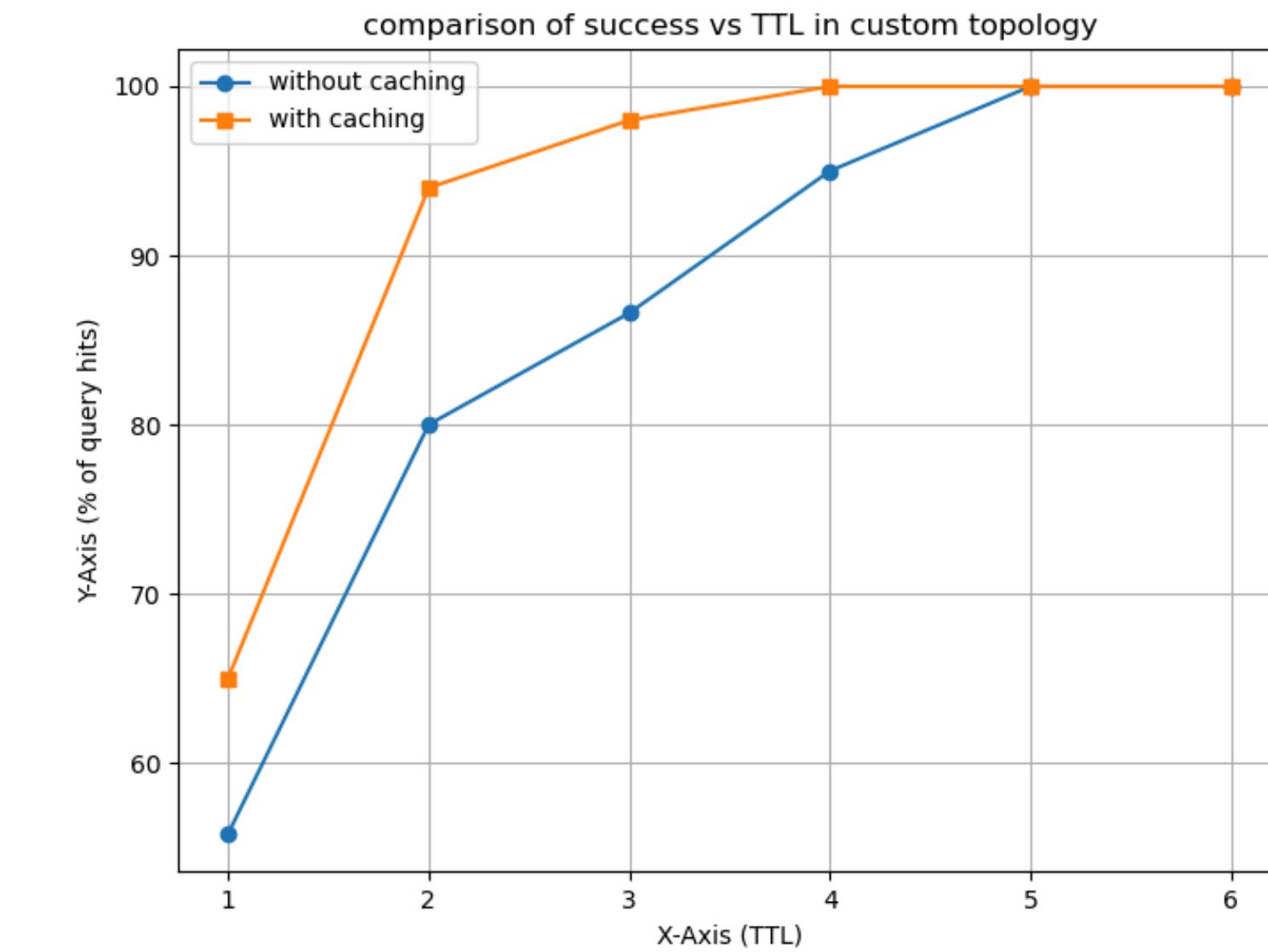
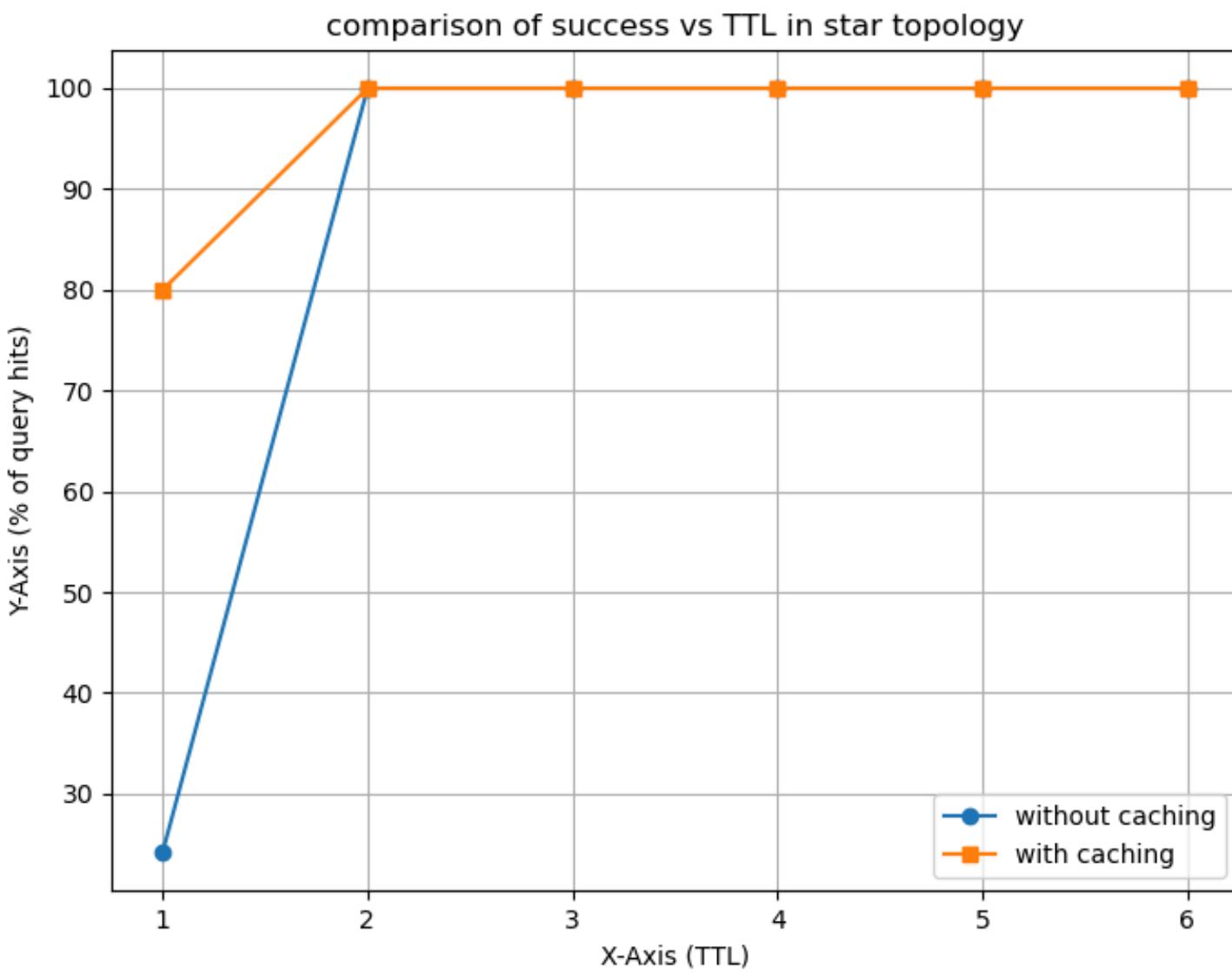
Analysis



Analysis



Analysis



Demo