CS5320 – Assignment #1
Implementing Vector Clocks

By Harsh Agarwal
cs15btech11019

Implementation Details

Each node is represented by a thread.
Every node creates another thread for receiving messages at a port number. Every node executes internal & send events randomly.

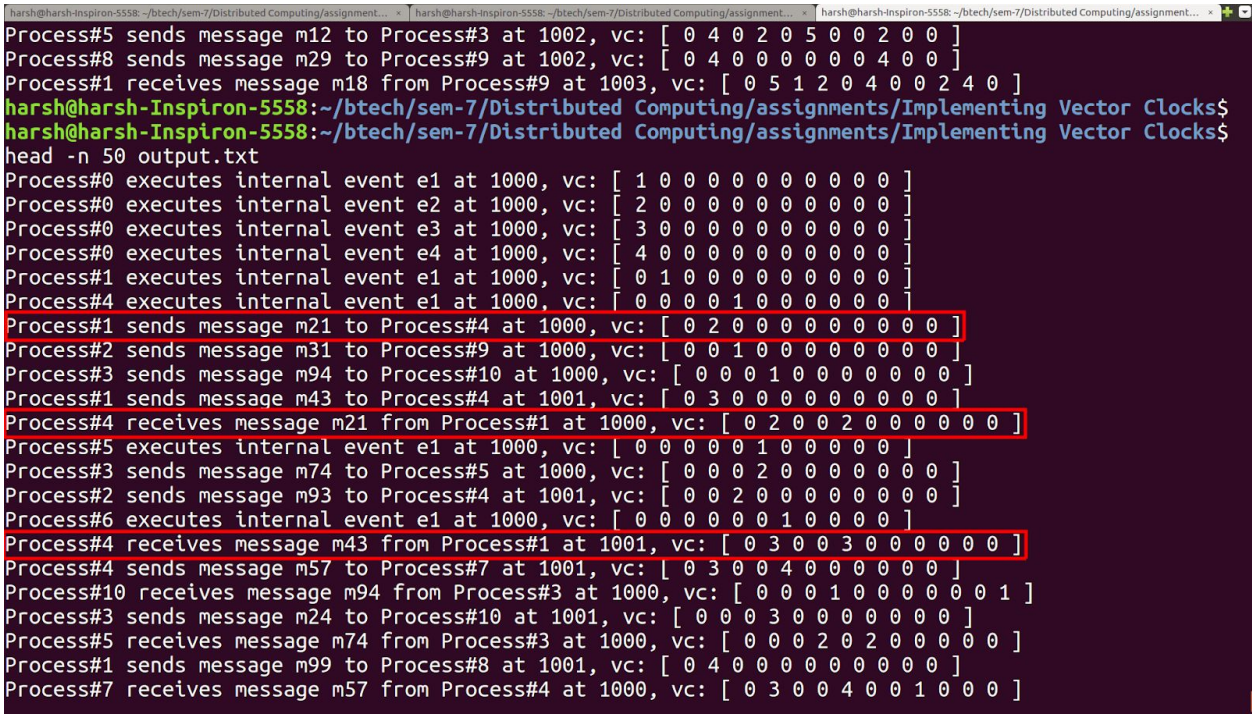
All nodes are running on different port numbers on localhost.
The port number for every node identified using *(PORT_STARTING_RANGE + nodeID)*.

vectorClock array is shared among the internal, send & receive events.

VC: For every send event, the entire vectorClock is sent as a string to the receiver.
SK: For every send event, (index,vectorClock-value) is sent as a string to the receiver.

The receiver tokenizes the received data and performs the appropriate modifications to vectorClock.

Consistency Property



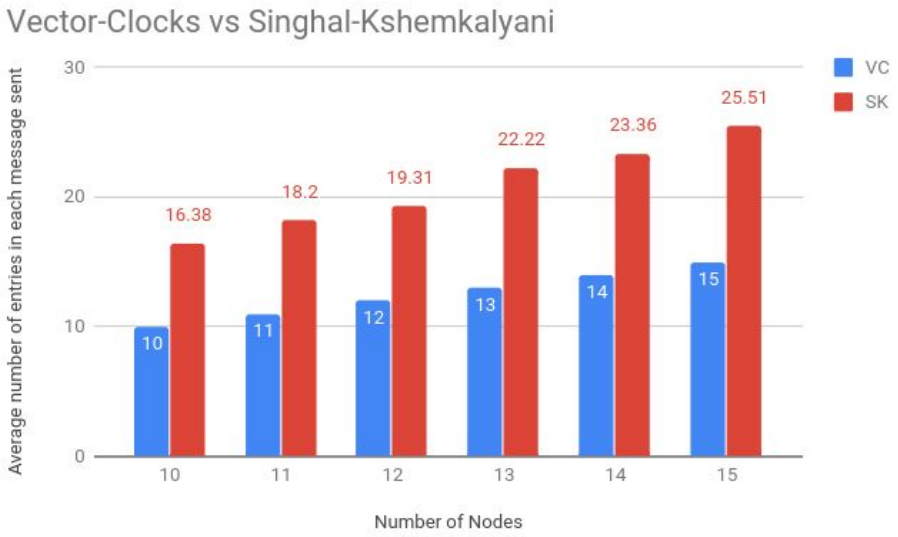
The red boxes events have a causal relationship.
This is also evident from the vector clocks.

Graphs Section

Topology #1 - Directed Complete Graph
Lambda - 2
Alpha - 1.5
M - 50

READINGS

Threads	Vector Clock	Singhal-Kshemkalyani
10	10	16.38
11	11	18.20
12	12	19.31
13	13	22.22
14	14	23.36
15	15	25.51



Topology #2 - Directed Linear Graph

Ex: for 4 nodes

Connection is as

1 2

2 3

3 4

4 1

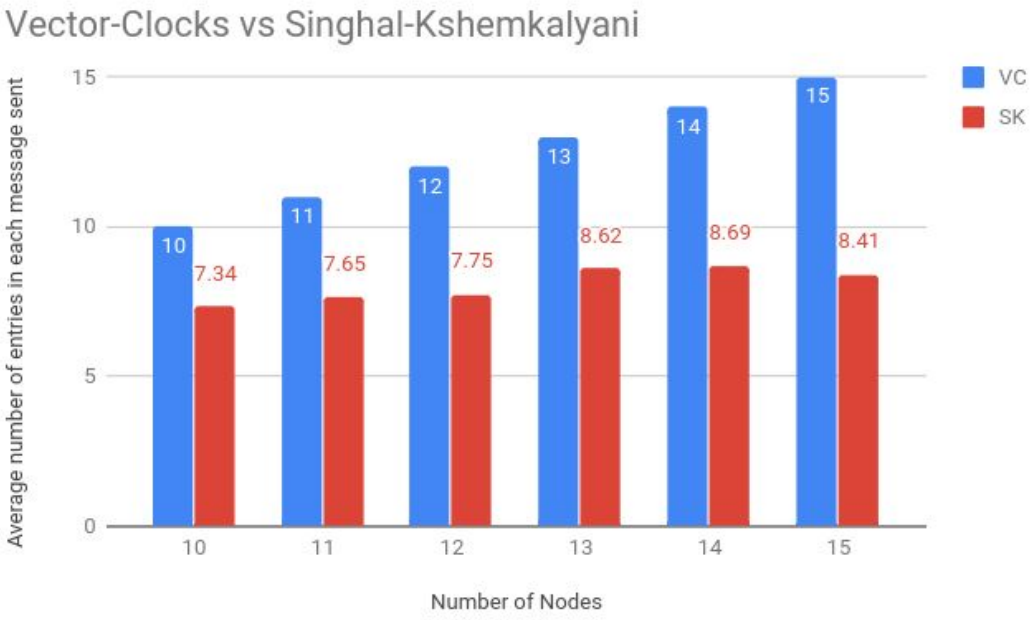
Lambda - 2

Alpha - 1.5

M - 50

READINGS

Threads	Vector Clock	Singhal-Kshemkalyani
10	10	7.34
11	11	7.65
12	12	7.75
13	13	8.62
14	14	8.69
15	15	8.41



OBSERVATIONS

- According to
  Distributed Computing Principles, Algorithms & Systems by Ajay D. Kshemkalyani & Mukesh Singhal

  Singhal-Kshemkalyani differential technique [25] is based on the observation that between successive message sends to the same process, only a few entries of the vector clock at the sender process are likely to change. This is more likely when the number of processes is large because only a few of them will interact frequently by passing messages

- For the complete graph, SK is performing poorly than VC. It is taking nearly double the space used by VC.
  This is because in the complete graph, there are interactions between every 2 processes in the system.
  Therefore in almost every send event, almost N(number of nodes) vectorClock entries are sent across the channel.
  Since the index is also piggybacked with the vectorClock value, the message size is almost double than that of VC.

Hence VC is a better algorithm for this topology.

- For the linear graph, VC is performing poorly than SK.
  This is because in this graph, a process is interacting with just 2 other processes in the system.
  Therefore in almost every send event < N(number of nodes) vectorClock entries are sent across the channel.
  Hence in this case, the extra overhead of the index is not slowing down the performance.

  Hence SK is a better algorithm for this topology.

- In case #1, the graph is increasing exponentially for SK.
  This is because on adding a new node in the topology, an extra neighbor is being added to every other node.
  VC is always equal to the number of nodes in the topology.

- In case #2, the graph is almost a straight line for SK.
  This is because on adding a new node in the topology, the number of neighbors for every node remains 2.VC is always equal to the number of nodes in the topology.