# CSCI-1380: Distributed Computer Systems
# Homework #3
# Assigned: 03/05/2021 – 11:59pm ET
# Due: 03/11/2021 – 11:59pm ET

## 1 Consistent Hashing

a. Consistent hashing allows you to design systems that avoid maintain state (e.g., mapping of client to server in Load balancers or mapping of key to server in Distributed hash tables (e.g., Tapestry/Chord)). While there are several key drawbacks with this approach. The design of virtual nodes is meant to explicitly solve one of them. What is this problem? How would you make N virtual nodes in your network? (There are many ways to make virtual nodes, you need only explain one method. )

b. Consider a Chord Network with an ID space between 0-127. There are 13 nodes in the DHT: 1, 8, 12, 15, 20, 21, 34, 50, 67, 81, 100, 111, 127. On which of these nodes are the objects with the following ids located?

   (a) 20
   (b) 101
   (c) 127
   (d) 0
   (e) 53
   (f) 66

c. What is the ideal or optimal size for the route table if the id space of a Chord network is between 0-1023? Why?

## 2 Tapestry

a. Given a Tapestry network with the following nodes (the base is 4): 3010 2211 3212 0131 2102 0033 1232, what is the root for the following objects?

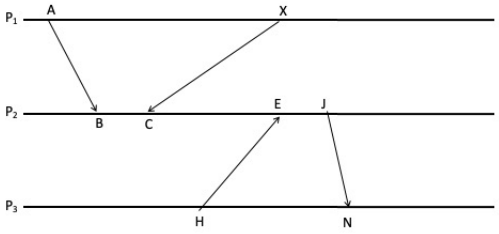
- 0121
- 2320
- 3210
- 0010
- 0320
- 2120

b. Write down a possible routing table for node 2000 (if there are multiple possibilities for an entry, you can choose project's definition of closer).

c. What is the definition of a need-to-know node? What are need-to-know nodes for node 2000?

d. Why is a routing table guaranteed to have atleast one entry in every table? If all the nodes except 3010 gracefully exit the network. What entries will it have in row "30xx"?

# 3 Time




1. For the process timeline below, provide the vector timestamps of the following events: A, C, E, H, J, N. Assume all processes start with (0,0,0), and that they occupy indices 0,1,2 from top to bottom. Recall, sending and receiving a message counts as a distinct event.

   A
   C
   E
   H
   J
   N

2. For the process timeline below, provide the logical timestamps of the following events: A, C, E, H, J, N. Assume all processes start with 0. Recall, sending and receiving a message counts as a distinct event.

   A
   C
   E
   H
   J
   N