ECE 358, S'16 — Assignment 2

Total # Points = 31, Due: Sun, May 22, 11:59:59pm

Instructions Your submission must be typeset and in pdf.

1. (5 points) Consider the Chord DHT with an m-bit ID and n peers, that uses Finger Tables for lookup$(\cdot)$. A lookup(k) is initiated at some peer with ID p, and the Finger Table at p says that a peer with ID q is the next peer to whom the query should be forwarded. Suppose we use the operator "$-$" between two IDs to indicate the number of peers between them in the ring.

Disprove the following claim: $q - p \geq (k - p)/2$.

Note 1: the notion of "$-$" in this question is different from the lectures. Which is the point of this problem. In the lectures, we showed that when distance is measured by the length of the arc, we do indeed cover at least half the distance with each hop. Here, what we are saying is that when the distance is measured as number of peers, we do not necessarily cover half the distance.

Note 2: we always measure distance clockwise. I.e., in the direction of increasing key values, modulo 2^m. To use the example from Slide Deck 3, Page 5, if $q = 20$ and $p = 4$, then measured as number of peers, $q - p = 4$; the peers with ID $9, 11, 14, 18$. If $q = 4$ and $p = 20$, then $q - p = 3$; the peers with ID $21, 28, 1$.

2. In a Chord DHT with m-bit identifiers:

(a) (5 points) With Finger Tables as discussed in the lecture, suppose we have $n - 1$ peers, and we insert a new, i.e., an n^{th}, peer. What is the worst-case number of Finger Tables that need to be updated?

(b) (5 points) Suppose we do not employ Finger Tables. And at each peer p, we maintain only a lookup table of one entry, *succ*$(p+1)$, What is the worst-case number of lookup tables that need to be updated?

3. Call a function $f(m)$ "linear in its input m," if there exists a positive constant c_1 and a constant c_0 such that $f(m) = c_1 m + c_0$. For example, $g(m) = 0.25m - 12$ is linear in m.

(a) (5 points) Show that the exists $f(m)$ that is linear in m such that for every integer $m \geq 1$, the number of hops to do lookup(k) for a key k in a Chord DHT that uses m-bit identifiers and Finger Tables, is $\leq f(m)$.

(b) (5 points) Show that there exists $g(m)$ that is linear in m such that, for every integer $m \geq 1$, in the worst-case, the number of hops to do lookup(k) is $\geq g(m)$.

4. Suppose we have the following two IP subnetworks: N_1: 1.2.3.160/28, and, N_2: 1.2.3.0/24. For each of the following IP addresses, does it lie in N_1, N_2, both or neither? Your response should begin with one of those choices, and be followed by a brief justification.

(a) (2 points) 1.2.3.4

(b) (2 points) 1.2.3.195

(c) (2 points) 1.2.3.171