COL 380	April 19, 2016
Homework 3	
Instructor: Subodh Sharma	**Due: April 22, 23:55 hrs**

NOTE: All submissions must be made in the pdf format. Hand written assignments will not be accepted.

Problem 1: Bcast

We provide below an algorithm to implement Bcast protocol over a hypercube of 2^d nodes with d dimensions. This algorithm assumes that node 0 is the root node.

Algorithm 1 Bcast Algo

```
1:  BCAST(d, myId, msg) {
2:      mask := 2^d − 1
3:      for i := d − 1 to 0 {
4:          mask := mask ⊕ 2^i                          ▷ ⊕ is boolean XOR
5:          if myId && mask == 0 {
6:              if myId && 2^i == 0 {
7:                  dest := myId ⊕ 2^i
8:                  send(msg, dest)
9:              } else
10:                 src := myId ⊕ 2^i
11:                 recv(msg, src)
12:             }
13:         }
14:     }
15: }
```

- Modify the algorithm above so that instead of node 0, now a source node supplied as an argument to the BCAST algorithm can act as a root node. (4 marks)
- Modify the above algorithm such that it can work for any number of nodes and not just for powers of 2. (4 marks)

Problem 2: Prefix Scan

Familiarize yourself with the prefix sum algorithm for adding n numbers. Assuming you have p number of nodes organized in a hypercube with dimensions $log\, p$ and with the even distribution of numbers on p nodes, provide an algorithm to compute prefix sum on this hypercube. Further, assume it takes t_a to add two numbers and t_s is the startup time for sending a message and t_w time to traverse a message between two directly connected nodes. Provide an expression for the total time taken by the prefix sum algorithm. (8 marks)

Problem 3: Butterfly Communication

Familiarize yourself with the butterfly communication structure and implement a function to compute sum of n integers using nonblocking point-to-point communication primitives. Perform time-analysis of the algorithm for computing sum over a butterfly communication structure. (8 marks)