1) Show that one-to-all broadcast of an m-word message can be performed in time $(t_s + t_w m + t_h (\log p + 1)) \log p$ on a balanced binary tree on which each of the $p$ leaves is a processor and each intermediate node is a switching node. Assume that a message takes $t_s + t_w m + t_h l$ to traverse a path with $l−1$ switching nodes.

2) Modify algorithms 4.1, 4.2, and 4.3 so that they work for any number of processes not just the powers of 2.

3) Write a procedure along the lines of algorithm 4.6 for performing all-to-all reduction on mesh.