Assignment 4
Due next Thusday.

1 Readings

Read Chapters 3.

2 Problems

1. Embedding binary tree on 2d-mesh: Prove that a binary tree of depth $k > 4$ does not have a load-1, dilation-1, congestion-free embedding on a 2d-mesh. For this, show by induction that $2^{k+1} - 1 > 2k^2 + 2k + 1$ for $K > 4$.

2. Row-Column-based Matrix Multiplication on Local Memory Machines: Calculate the parallel time complexity of this algorithm for multiplying two nxn matrices using p processors configured in a ring C_p, showing the computation and communication phases calculations. Assume row-bands of first matrix and column-bands of second matrix are already distributed among processors.

3 Individual Programming

Develop two versions of a shared-memory sorting program for hydra based on parallelization of the bottom-up mergesort algorithm. In phase 1, each processor sequentially sorts its subarray. In Phase 2, the sorted subarrays are merged pair-wise fashioned after binary-tree-based reduction mechanism.

In (a), use barrier to synchronize across levels of reduction tree.

In (b), use global flags to indicate that the local list is sorted. If the partner's list is not ready yet, the waiting processor spins in a while loop. There would be no barrier or lock call.

Use $p = 2^k$ processors, for $k \in \{0, 1, 2, 3\}$.

Prepare a speedup plot with varying n and p. Use pure sequential time without any overhead for T_1^*. Put both algorithms data lines on the same plot.

Submission: Submit two files: (a) your source code as .txt file and on top of your file, give hydra directory, login/password, and compile/run instructions for GTA, (b) submit your speedup plot and timing tables (pdf/excel).