A Few Possible Term Paper Topics

Note: This list is based on my current interests in parallel algorithms. Feel free to choose any other topic related to the course theme.

1. The Journal of Supercomputing, Volume 73, Issue 8, August 2017
2. IEEE Transactions on Parallel and Distributed Systems
3. http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=5707134
4. https://link.springer.com/content/pdf/10.1007%2Fs10766-016-0457-y.pdf

Applying RMT theory to High-Throughput

Biological Data Parallel Algorithms for NGS Data

Computability Models for NGS Data

P2P Overlay Networks & Distributed Search

- Self-configuration of semantic overlay network
- Self-stabilizing publish/subscribe protocol for P2P networks
- Ontology based distributed information retrieval scheme
- Ontology-based semantic overlay network - self-configuration via self-stabilization
- Self-stabilized and biologically inspired P2P content distribution
- Development of Educational tools for Distributed Applications

Self-Stabilizing Algorithms:

Self-stabilization is the latest paradigm used for designing fault-tolerant distributed software. We will introducethe basic concepts in class early in the semester. There are different models of execution — central daemon, distributed daemon or the parallel daemon. One track of research has been towards designing algorithms for different graph theoretic global primitives like coloring, matching, domination, spanning trees etc. Another newer track is how to adjust the paradigm to be applicable for sensor networks, mobile ad hoc networks and P2P networks. Here are some possible topics:

- Use Master – Slave model to graph families other than unidirectional cycles and trees
- Design a self-stabilizing algorithm for popular matching.
- Design a self-stabilizing algorithm for a minimal connected dominating set. and/or global offensive alliance sets
- Design a self-stabilizing algorithm for perfect neighborhood set. A vertex is called perfect (with respect to aset S) if its closed neighborhood contains exactly one vertex in a set S. A vertex is called near perfect if it isnot perfect but is adjacent to a perfect vertex. S is called a perfect neighborhood set if every vertex is either perfect or nearly perfect.) Proposition. For any minimal dominating set D in a graph G, there exists a perfect neighborhood set of G of cardinality |D|.
- Design a self-stabilizing algorithm for Minimal Capacitated domination (each node has capacity r to dominate).
- Design self-stabilizing algorithms for any possible global predicates on the network graph - strong edgecoloring, different kinds of alliances,
- Investigate how the different models of self-stabilization can be adjusted to accommodate the realities ofmobile ad hoc networks, P2P networks, and Sensor

networks; design protocols under the revised models.

Network Topology

After an extended hiatus, there is now renewed interest in generalized DeBruijn graphs, String Graphs, andGroup graphs.

Combinatorial Objects — Assignment Problem:

The design of algorithms, and more recently parallel algorithms, to generate combinatorial objects has longfascinated both mathematicians and computer scientists. Examples of combinatorial objects may include permutations/combinations of distinct (not distinct) objects, subsets of sets, derangements, binary and k-arytrees, compositions etc. An interesting recent research area is how to map those algorithms on a particular architecture like arrays or mesh or torus or hypercube.

Parallel Data Structures:

Parallel and distributed computing seeks to extract and exploit inherent parallelism in problems, to gain speedup over sequential solutions. Since data structures play crucial role in algorithmdesign, significant advancement in parallel programming and hence wide-spread use of commercial parallel computers will not be feasible without a rich collection of efficient parallel and distributed data structures for large-scale problems. There are several issues: Design, implementation and applications of Parallel and Distributed Data Structures, Conflict-Free Data Structure Access in Multiprocessors, Mapping, Partitioning and Load Balancing Issues, Communication, Synchronization and Scheduling Issues, special purpose data structures for applications like VLSI CAD, Databases, Graphics and Image Processing, Simulation, Graph Problems, Computational Geometry, etc.

Implementations of Branch and Bound Algorithms:

Combinatorial optimization problems form a broad class of problems that are encountered in manyreal-life situations. They can be solved either by computing the exact optimal solution or by looking for good approximate solutions. Algorithms like Branch and Bound compute exact solutions while algorithms like simulated annealing, neural networks or genetic algorithms provide approximate solutions. Because the problem is NP-hard and because in certain scenarios (like VLSI layout) exact solutions are needed, parallelization of both exact and approximate solution methods are of interest and has been studied. There are several issues: load balancing strategies, best first or depth first, data dependencies, irregularity in behaviors, etc.