Course Outline

February

Tue	4	**1. Introduction.** Overview of the course; data-parallel computing, prefix computations, segmented operations, work and critical path, Brent's theorem. PS1 out.
Thu	6	**2. The data-parallel abstraction.** Implementation of data-parallel model on fixed-connection networks, EREW vs. CRCW, randomized routing on hypercubic networks, provably good routing.
Tue	11	**3. Sorting.** Bitonic sort, radix sort, sample sort.
Thu	13	**4. NESL.** The NESL data-parallel language, nested parallelism, matrix multiplication, parallel quicksort. Lab 1 — data-parallel programming.
Tue	18	**Presidents Day.** No class (Monday schedule).
Thu	20	**5. List ranking.** Pointer jumping, work-efficient parallel prefix. PS1 due. PS2 out.
Tue	25	**6. Tree and graph algorithms.** Euler tour, tree contraction, connected components.
Thu	27	**7. String matching.** Finding a pattern in a string, Breslauer-Galil algorithm. Lab 1 due.

March

Tue	4	**8. Multithreaded programming.** The Cilk language, work and critical path, Brent's theorem, busy leaves scheduling, randomized work-stealing. PS2 due. Lab 2 — Multithreaded programming.
Thu	6	**9. Analysis of multithreaded algorithms.** Algorithms for sorting, matrix multiplication, LU-decomposition; analysis of time.
Tue	11	**10. Race conditions.** Detecting and localizing determinacy races; the SP-bags algorithm. PS3 out.
Thu	13	**11. Provably good scheduling I.** Blumofe-Leiserson scheduling algorithm; recycling game.

Tue	18	**12. Provably good scheduling II.** Blumofe-Leiserson scheduling algorithm.
Thu	20	**13. Space bounds.** Space for algorithms scheduled with busy-leaves. Blelloch-Gibbons-Matias scheduling algorithm. Lab 2 due. Term project.
Tue	25	**Spring Break.**
Thu	27	**Spring Break.**

April

Tue	1	**14. Shared-memory models.** Sequential consistency, Dijkstra's and Dekker's mutual-exclusion algorithms, Cypher's lower bound. PS3 due.
Thu	3	**15. Wait-free synchronization.** Universality of compare-and-swap (Herlihy), etc.
Tue	8	**16. Message passing.** Message-passing libraries, protocols, avoiding deadlock. Term project proposal due.
Thu	10	**17. Active-message programming.** Consumption assumption, overproduction, protocol safety, termination detection. Lab 3 — Active messages.
Tue	15	**18. Distributed shared memory I.** Dag-consistency, the Backer algorithm, analysis of page faults.
Thu	17	**19. Distributed shared memory II.** Semantics of dag-consistency; relation to location consistency.
Tue	22	**Patriots Day.** No class.
Thu	24	**20. Workstation scheduling.** Awerbuch-Leighton algorithm.
Tue	29	**21. Macroscheduling.** Scheduling adaptively parallel jobs. Lab 3 due.

May

Thu	1	**22. I/O.** Permuting and sorting data on disks.

Tue	6	**23. Advanced topics.**
Thu	8	**24. Advanced topics.**
Tue	13	**25. Term project presentations.**
Thu	15	**26. Term project presentations.**