NSF/IEEE-TCPP Curriculum Initiative on Parallel and Distributed Computing - Core Topics for Undergraduates (Version 2.0-beta)

Paradigms and Notations
By Target Machine Model (SIMD, Shared/Distributed Memory, Client/Server)
By Control Statement (Threads, SPMD, Data Parallel, Accelerators)

Semantics and Correctness
Tasks/Threads, Synchronization, Concurrency Control, Memory Models

Performance and Energy
By Computation (Decomposition, Program Transformations, Scheduling/Mapping) vs. By Data
(Distribution, Layout, Representation, Locality, Distributed File Systems)
Tools and Metrics (Performance Monitoring/Metrics)
Power/Energy Efficiency (Latency Tradeoffs, Load Balancing, Active/Idle power management)

Across all areas of parallel and distributed computing
Asynchrony
Concurrency and Dependency
Locality
Performance

Pervasive Topics

Classes of Parallelism
Data, Control, Pipelines, Shared/Distributed Memory

Underlying Mechanisms
Caching, Atomicity, Consistency, Coherence, Events, Handshaking, Virtualization

Floating Point Representation
Range, Precision, Rounding, Error propagation,
IEEE 754

Performance Metrics
IPC, Benchmarks, Bandwidth, Peak vs. Sustained

Power
Energy, Static vs. Dynamic, Clock/Power Gating

Scalability (HPC, Big Data)
Reliability, Fault Tolerance, Memory Hierarchy, Data Volume/Velocity Pressure

Programming Topics

Architecture Topics

Algorithms Topics

Models and Complexity
Concurrency, Asynchrony, Non-determinism,
Costs, Performance Metrics (speedup, efficiency, throughput, scalability), Tradeoffs, Model-based Notions (e.g., BSP)

Algorithmic Techniques
Decomposition (Recursion, Divide & Conquer, Blocking), Load Balancing, Multi-party Communication
(Reduction, Parallel Prefix, MapReduce, Synchronization), Mutual Exclusion and Conflict Resolution

Algorithmic Problems
Communication and Synchronization, Sorting,
Searching, Stream Processing, Spatial Problems