# Parallel Computing Review

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# Final exam

- ✓40 questions during 60 minutes
- ✓Covering all topics: Chapter 1 -> Asynchronous Computation
- ✓Allowing to use any documents

# Chapter 1

- What is parallel computing?
- Applications of parallel computing
- Pipeline, data parallelism, control parallelism
- Scalability

# Chapter 2: PRAM & BSP

- PRAM
- Concurrent (C), Exclusive (E), Read (R), Write (W)
  - CRCW, CREW, EREW
- Parallel Reduction
  - Prefix sums
- BSP
  - SuperStep
- PRAM, BSP algorithms

# Chapter 3: OpenMP

- OpenMP directives
- The fork-join model of parallel execution
- #pragma omp parallel
- #pragma omp for
- Scheduling

# Chapter 4: MPI

- Communication modes
  - Blocking/Non-blocking, Synchronous
  - Buffer
- Communicator, process rank
- Point-to-point
  - MPI_Send/Recv, MPI_Isend/Recv,
- Collective communication
  - MPI_Bcast, MPI_Scatter, MPI_Gather/v, MPI_Allgather/v, MPI_Alltoall

# Chapter 5: Parallel hardware

- Processor, ALU
- Memory
- Multi-core
- Many-core
- GPU, FPGAs, TPU
- Instruction parallelism
- Data parallelism
- Thread-level parallelism
- SIMD, SIMT, SPMD

# Chapter 6 (1): Parallel computer architecture

- Flynn
  - SISD, SIMD, MISD, MIMD
- Multiprocessor
  - UMA, NUMA
- Multicomputer
- Dataflow

# Chapter 6 (11): Processor organization

- Criteria
  - Diameter, Bisection width,
- Mesh, tree, butterfly, hypercude

# Chapter 7: Hadoop & Spark

- <Key, value>
- Map/Reduce
  - Map(), combine(), partition(), reduce()
- MapReduce framework
- Hadoop
- HDFS
- ~~Algorithms~~

- Spark <> Hadoop?
- Modules in Spark

# Chapter 8: Speedup

- Speedup & efficiency
- Amdahl
- Gustafson

# Chapter 9: Embarrassingly Parallel Computations (EPC)

- EPC?
- Data parallelism
- OpenMP/MPI support EPC?
- Work pool / Processor farms
- Monte Carlo methods

# Chapter 10: Partitioning and Divide-and-Conquer

- Partitioning
- Divide-and-conquer
  - Divide, conquer & combine

# Chapter 11: Pipeline computation

- Algorithms
  - Prime number generation
  - Prefix sums
  - Sorting

# Chapter 12: Synchronous Computation (SC)

- Barrier
- SC <> EPC, BSP
- Algorithms
  - Heat distribution problems

# Chapter 13: Asynchronous Computation (ASC)

- ASC <> SC
- Chaotic Relaxation
- Load balancing (LB)
  - Static LB
  - Dynamic LB