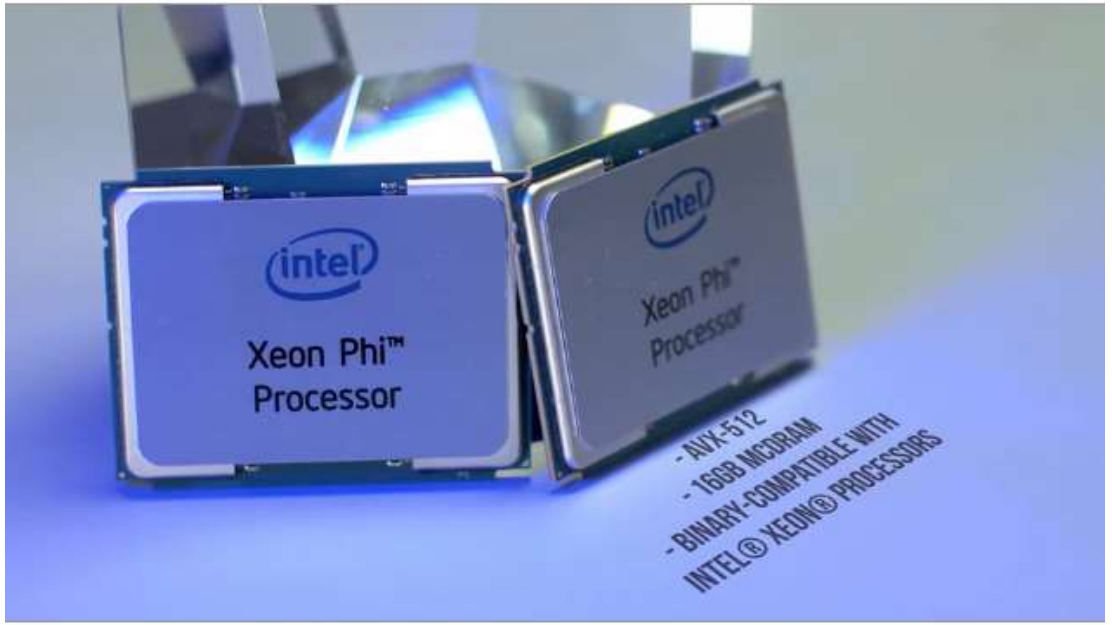
HPC & Parallel Programming Approaches

ASCI RED (1970) Super computer

9297 Intel Pro processors, 2.38 Tera Floating Point operations per sec



- **2017 Intel Xeon Phi processor**

With same power in single chip

- **CORI (9152 Intel Xeon Phi processors with 140000 Tera Floating Point operations per sec)**

Installation

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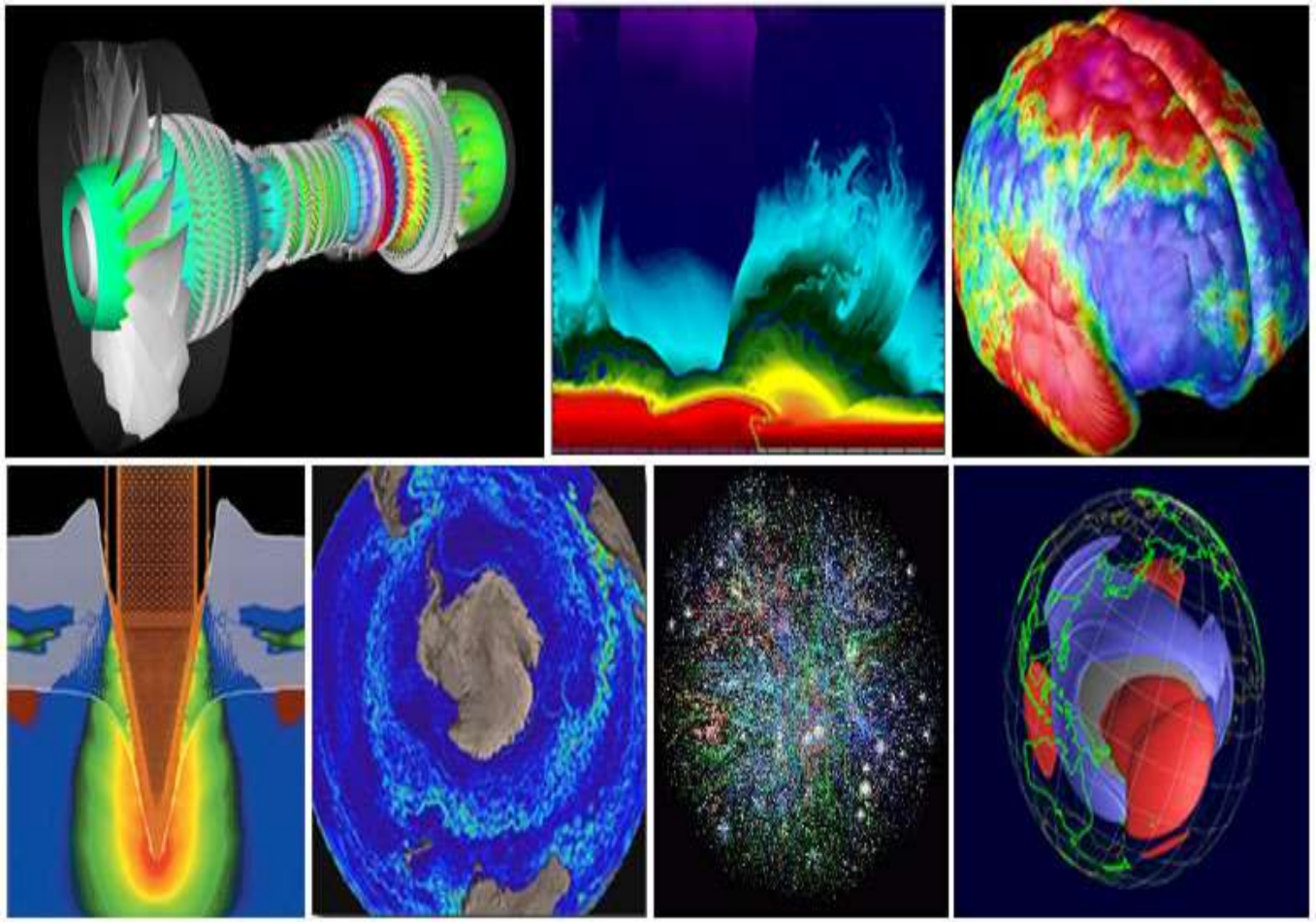
High performance computing enable exciting Science

- Finding cures for diseases (radiation therapy) and predicting natural disasters (earthquake prediction)
- Development of clean energy (wind turbines) and protection of environment (climate modelling)
- Automobiles safer (Virtual crash tests) and teach computers to detect crime (fraud detection)
- Create machines to help people with disabilities (Natural Speech applications)



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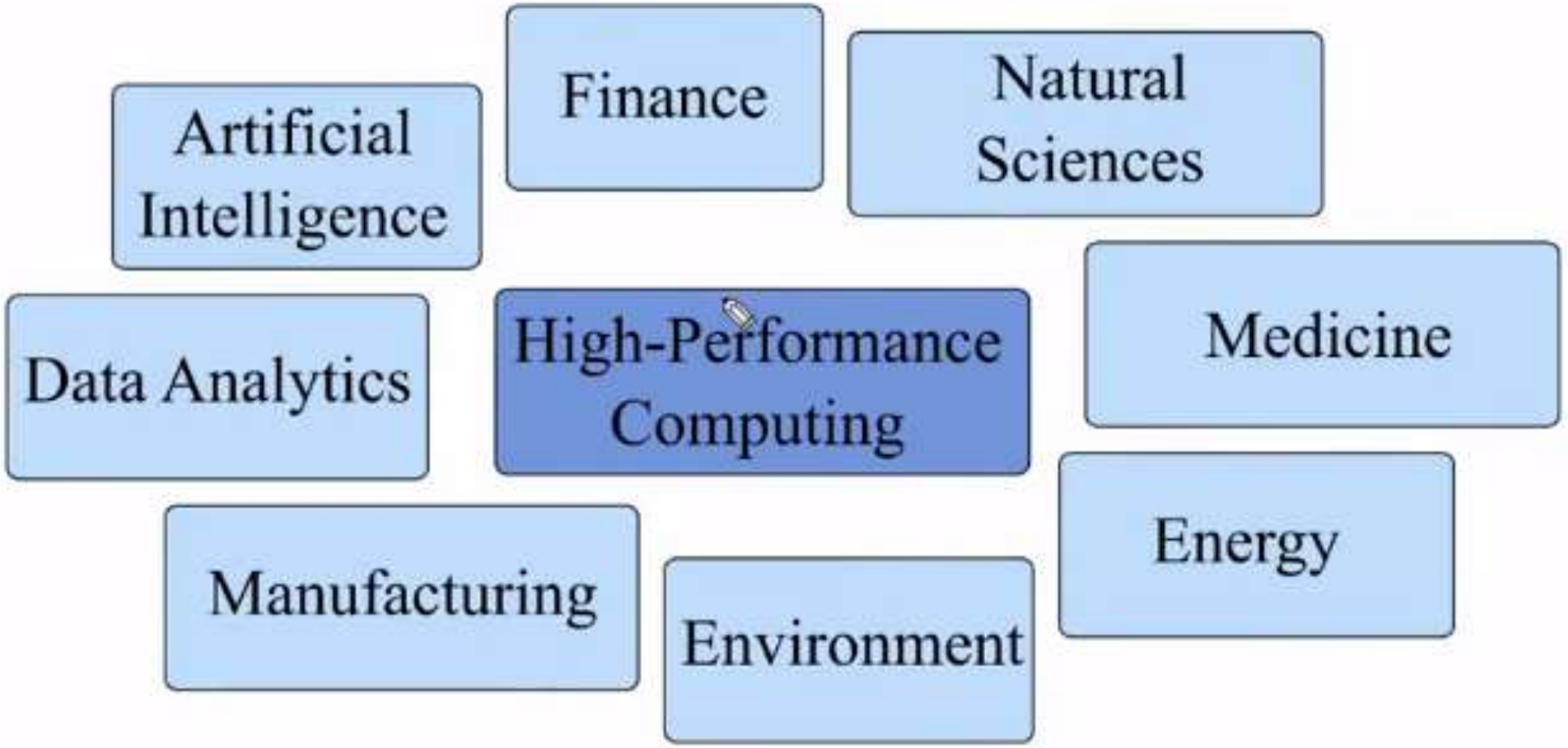

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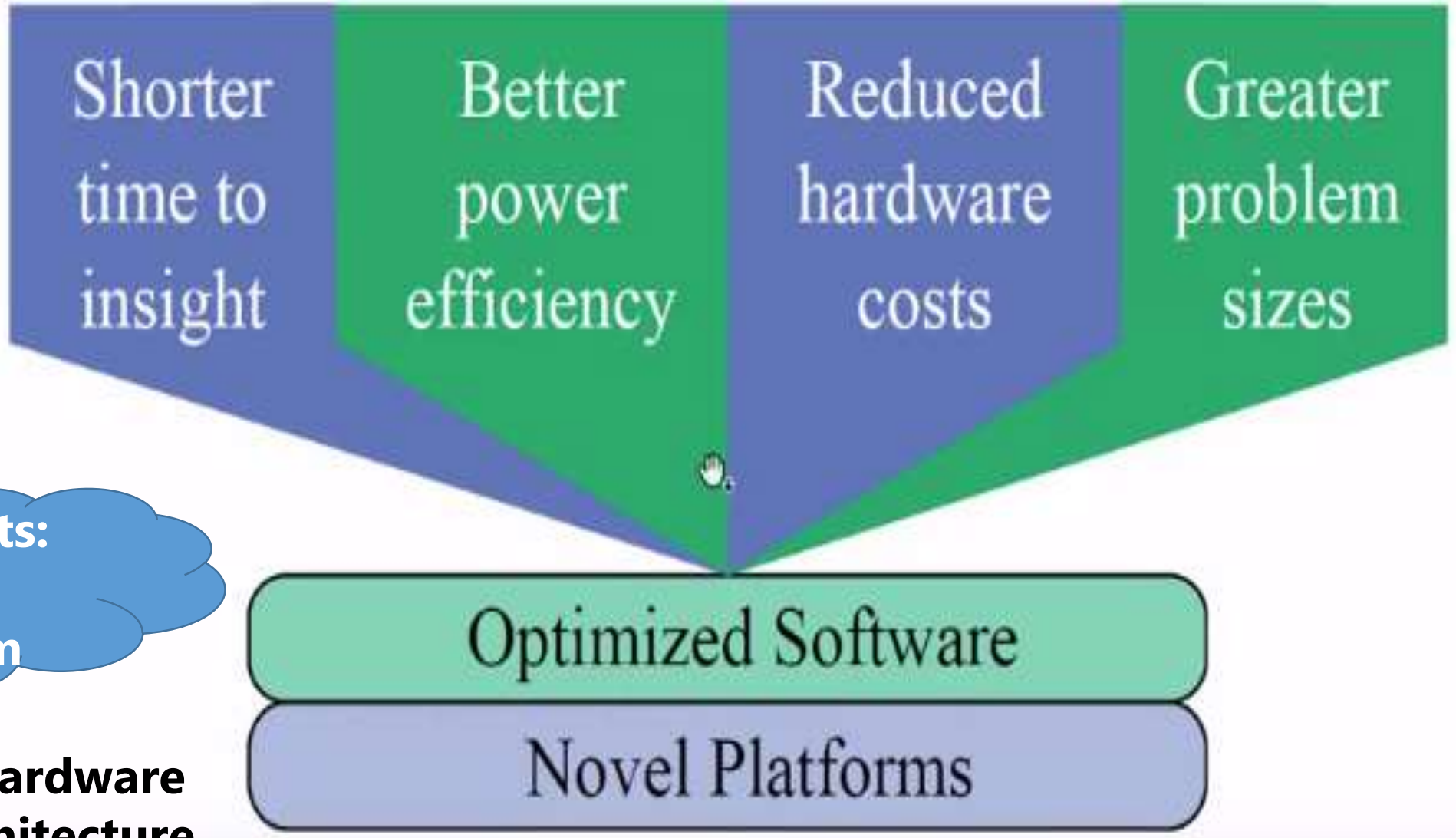
Performance Needs



HPC Aspects: exploit parallelism

Evolution of Hardware Computer Architecture

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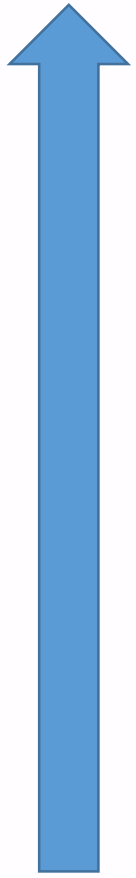
Parallel Programming layers

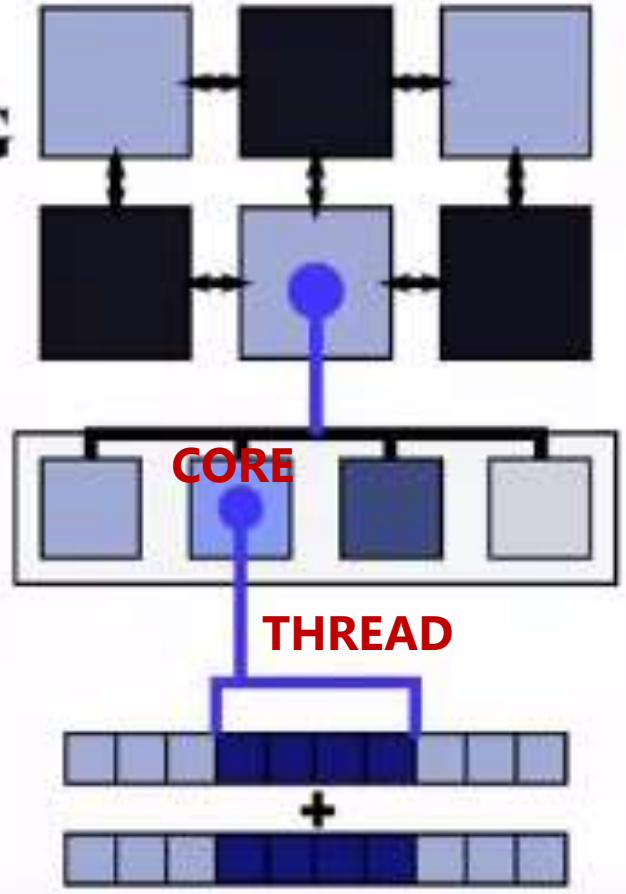


LAYER

CLUSTER COMPUTING
in distributed memory

MULTITHREADING
in shared memory

VECTORIZATION
of floating-point math



Frame Work

```
MPI_Sendrecv(data, k,
   MPI_DOUBLE, data2,
   ... );
```

```
#pragma omp parallel for
for (j = 0; j < m; j++)
  ComputeSubset(j);
```

```
#pragma omp simd
for (i = 0; i < n; i++)
  A[i] += B[i];
```

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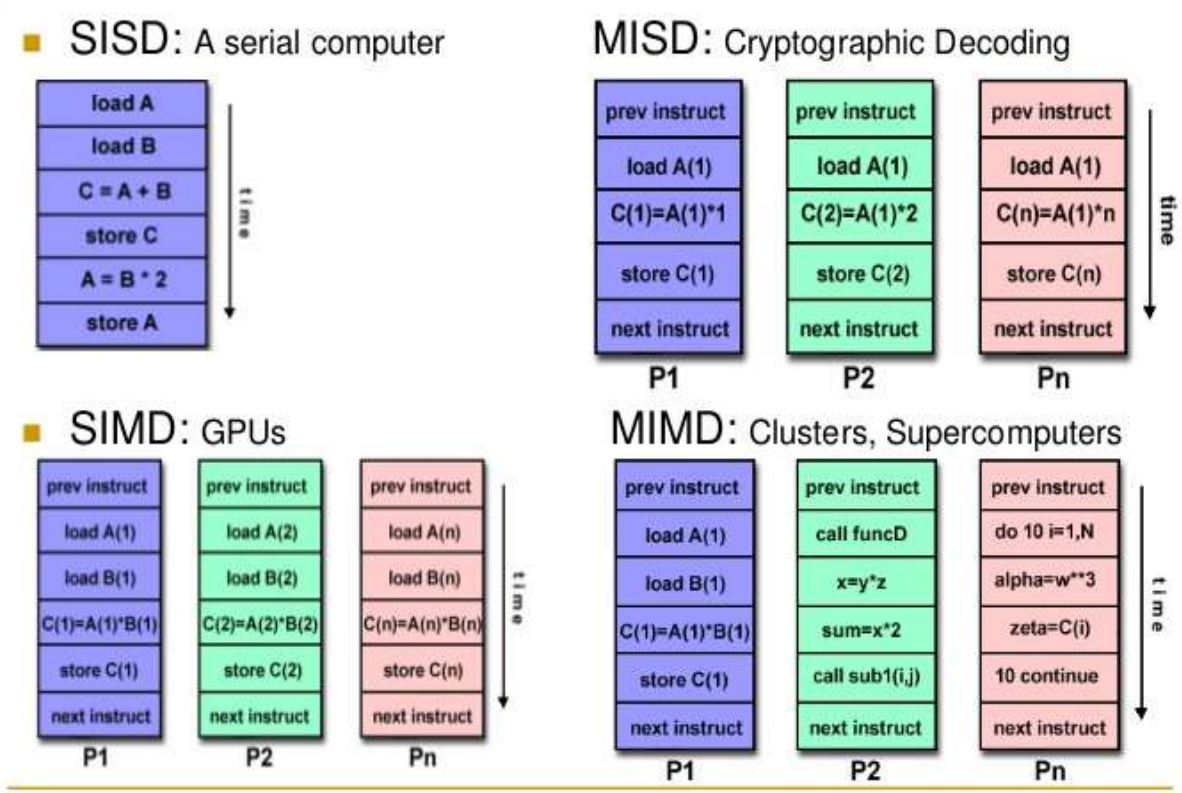
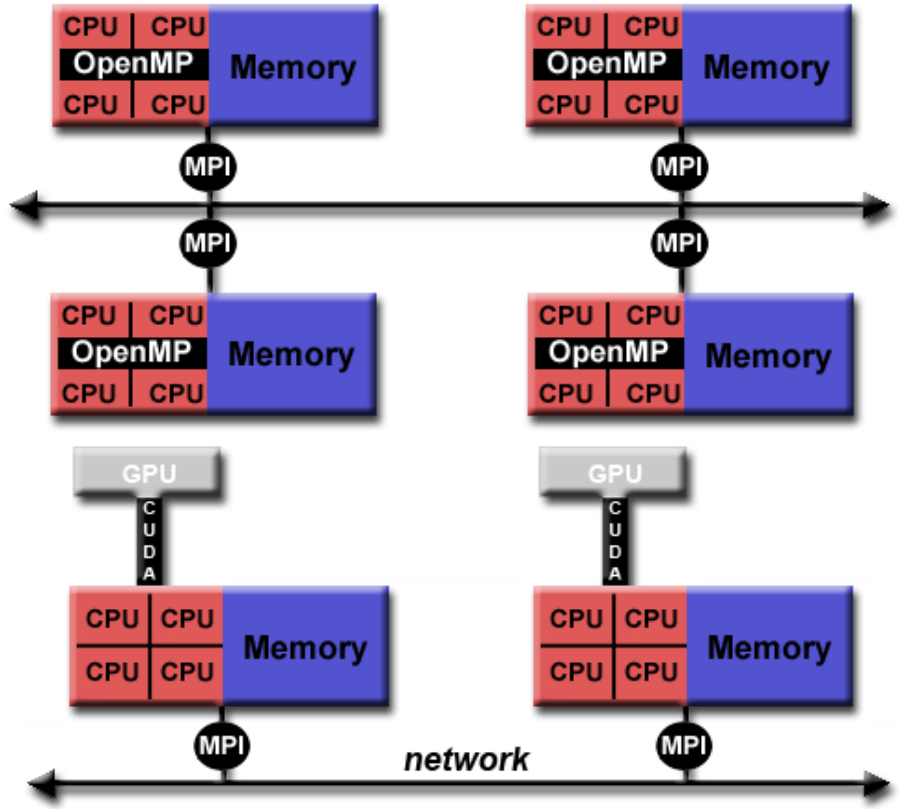
Parallel Computing Taxonomy



Parallel Computing Architectures



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