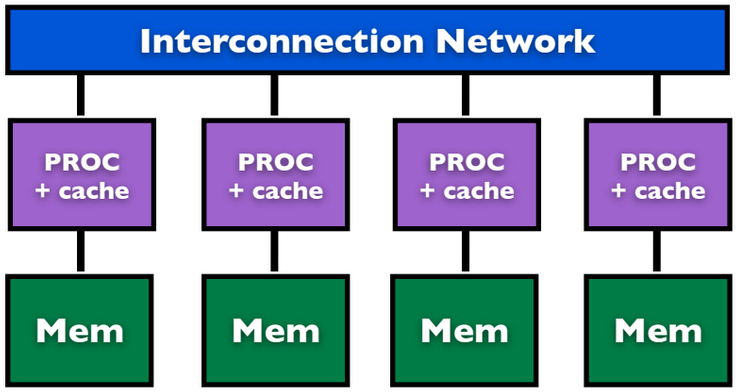
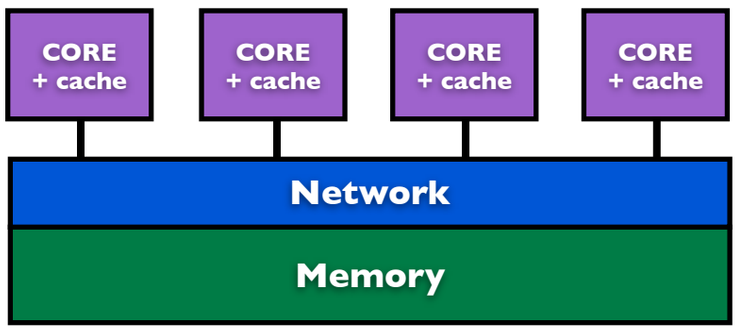
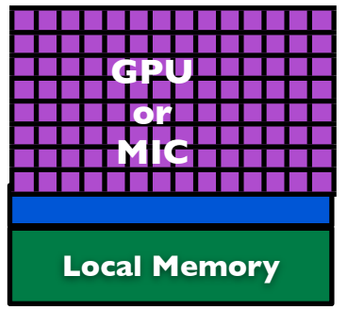
Distributed Memory



Shared Memory

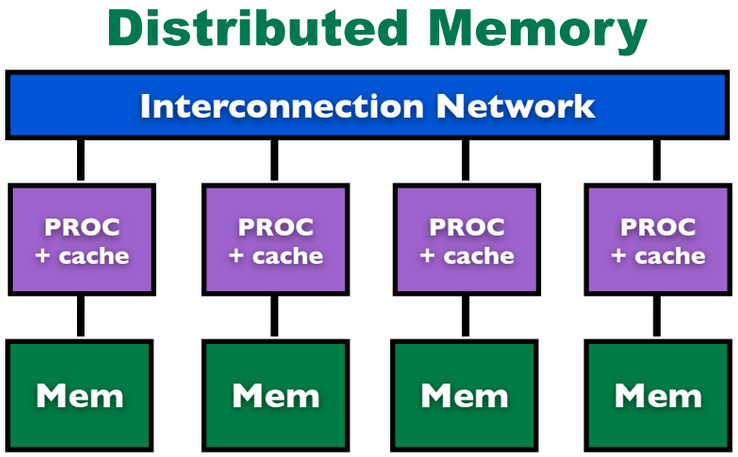


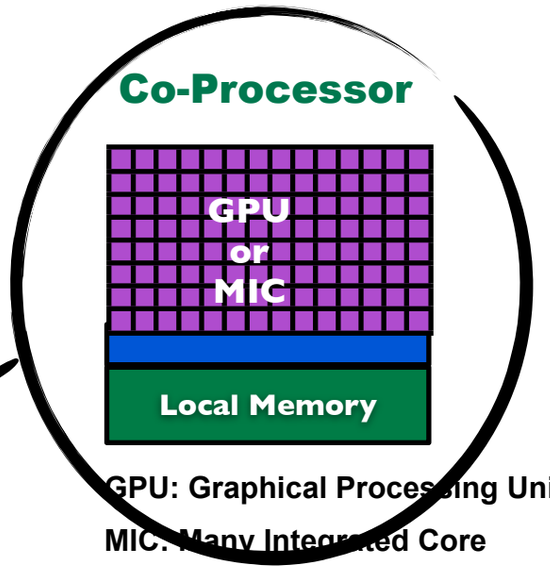
Co-Processor

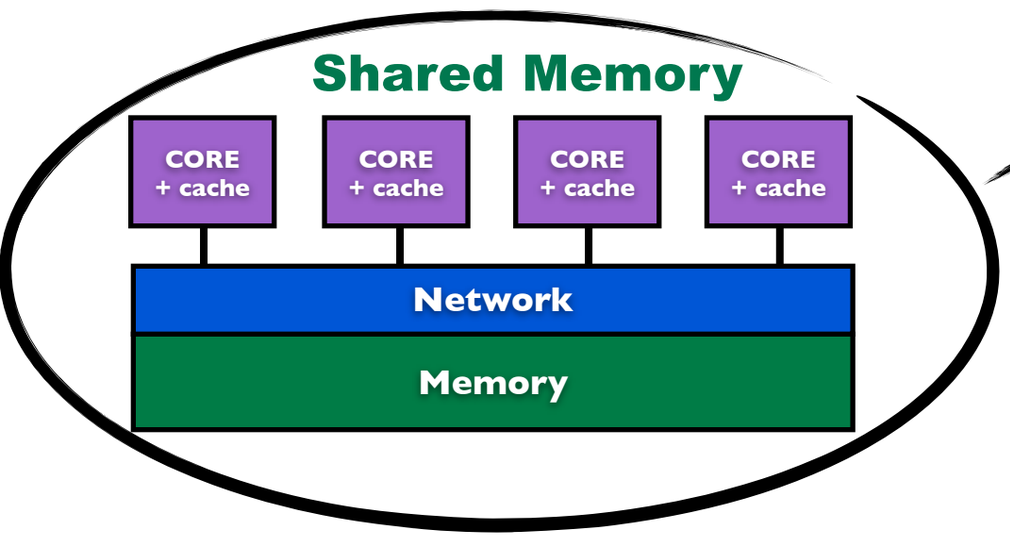


GPU: Graphical Processing Unit

MIC: Many Integrated Core







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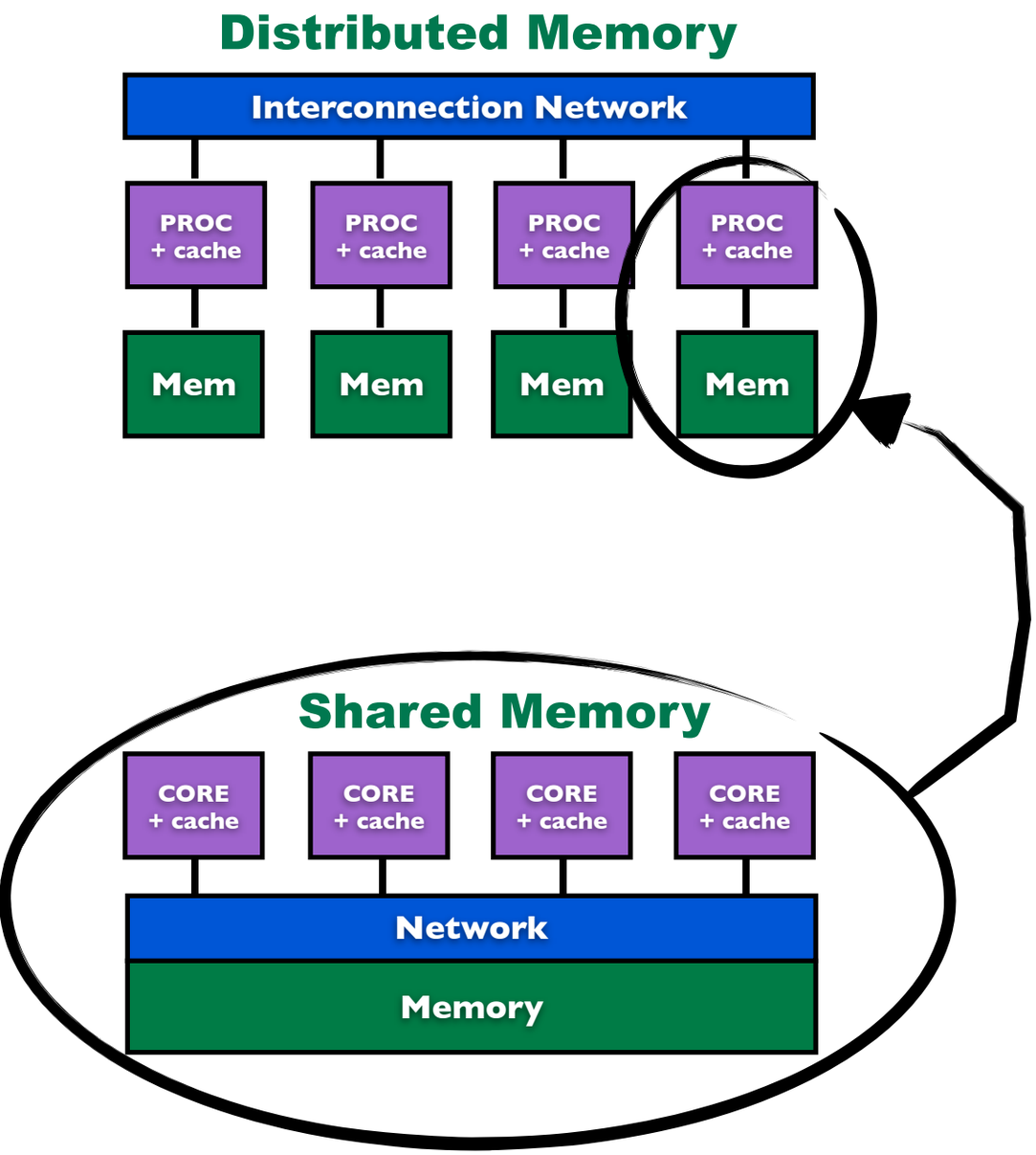

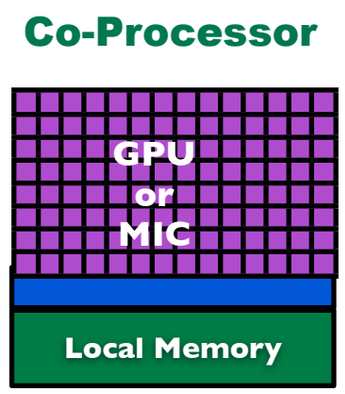

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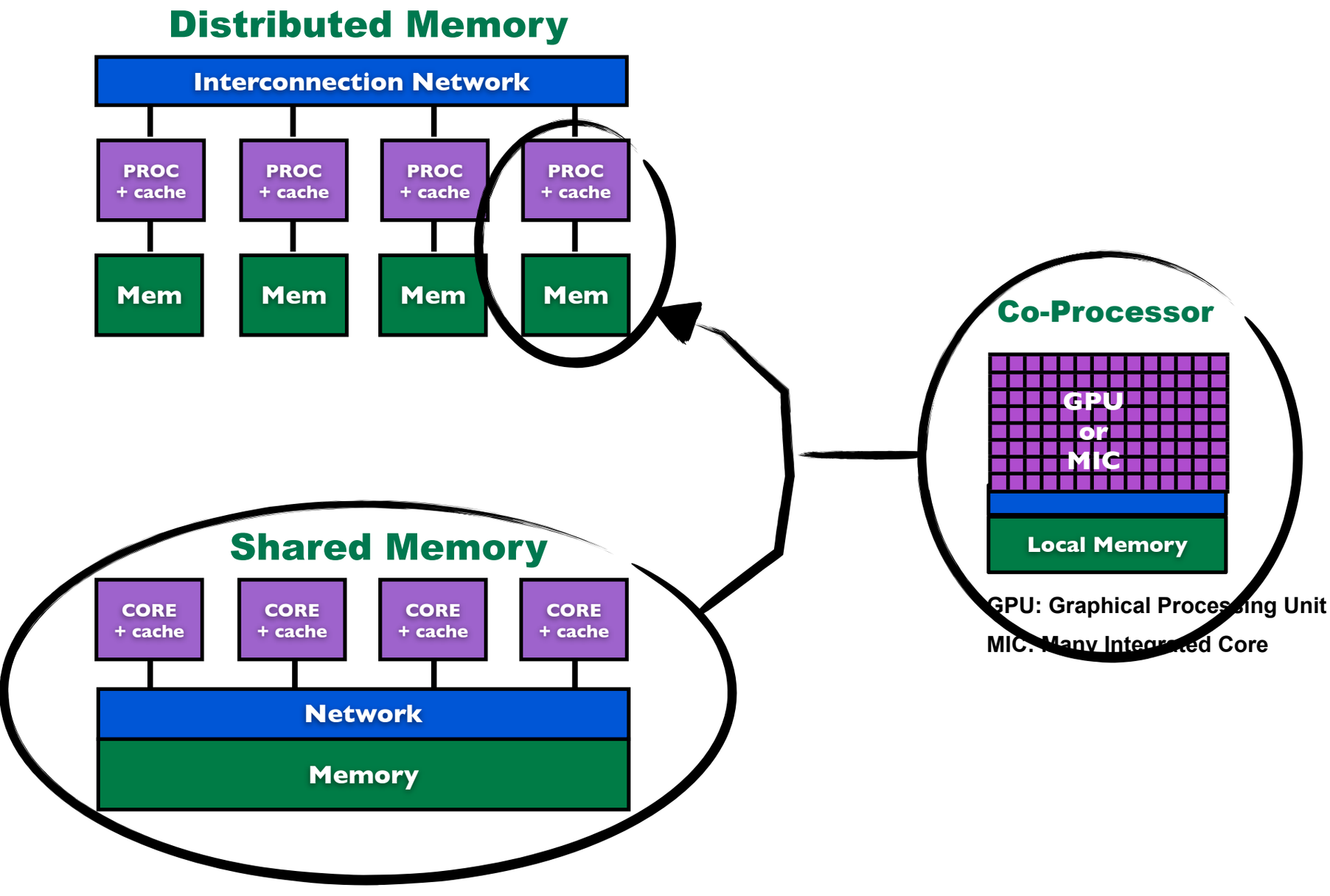
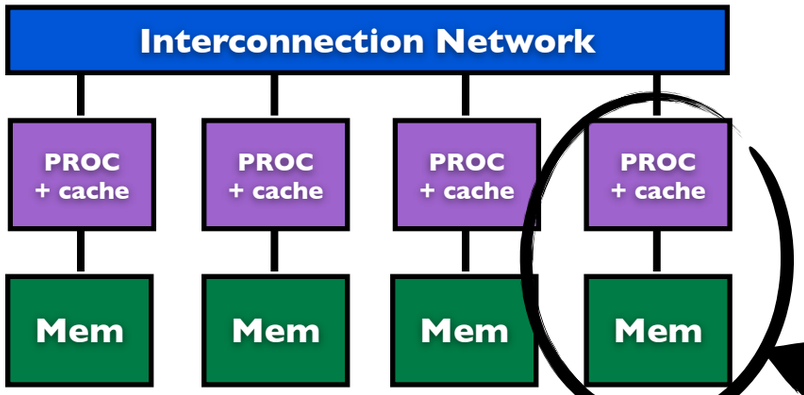


GPU: Graphical Processing Unit

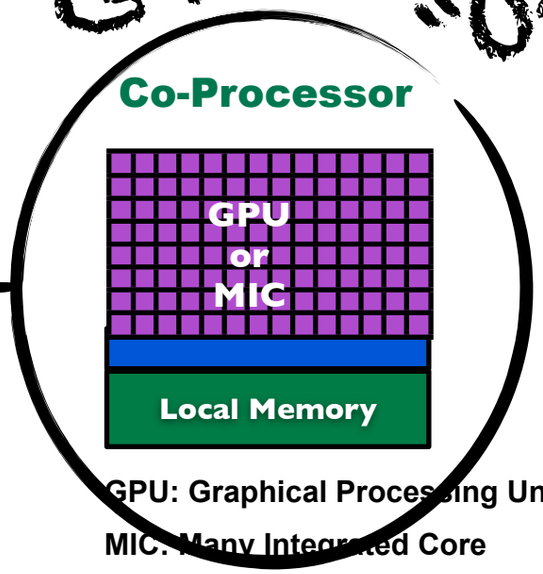
MIC: Many Integrated Core

Cluster "Distributing"

Distributed Memory



GPU or Manycore "Offloading"

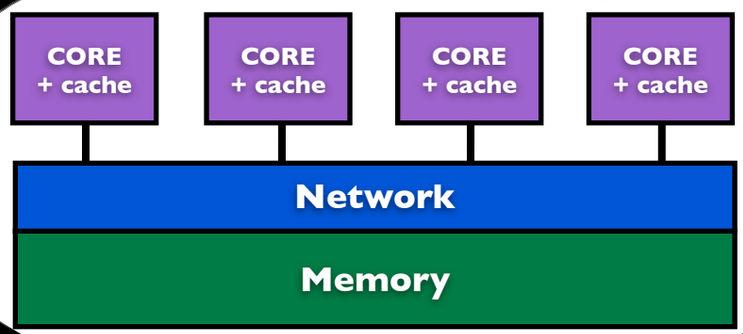


GPU: Graphical Processing Unit

MIC: Many Integrated Core

Multicore

Shared Memory



"Multithreading"

Distributed Memory

Interconnection Network

PROC + cache | PROC + cache | PROC + cache | PROC + cache

Mem | Mem | Mem | Mem

Focus on who owns what data and what communication is needed

Sockets
MPI
HADOOP

Co-Processor

GPU or MIC

Local Memory

Same Task on Blocks of data

CUDA
OpenCL
OpenACC

GPU: Graphical Processing Unit

MIC: Many Integrated Core

OpenMP
OpenACC

Shared Memory

CORE + cache | CORE + cache | CORE + cache | CORE + cache

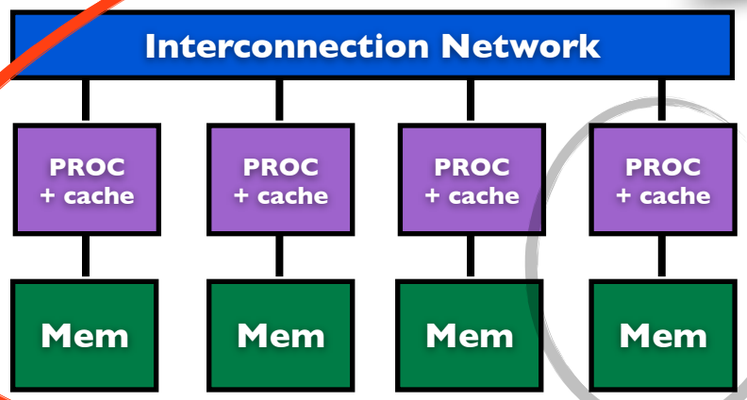
Network

Memory

Focus on which tasks can be parallel

OpenMP
Threads
fork

Distributed Memory



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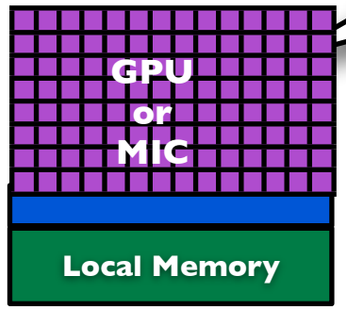
Sockets
MPI
HADOOP

Co-Processor



Same Task on Blocks of data

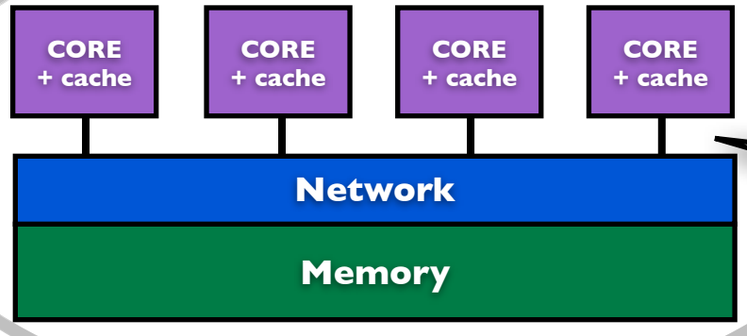
CUDA
OpenCL
OpenACC

GPU: Graphical Processing Unit

MIC: Many Integrated Core

OpenMP
OpenACC

Shared Memory



Focus on which tasks can be parallel

OpenMP
Threads
fork

Distributed Memory

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Network

Memory

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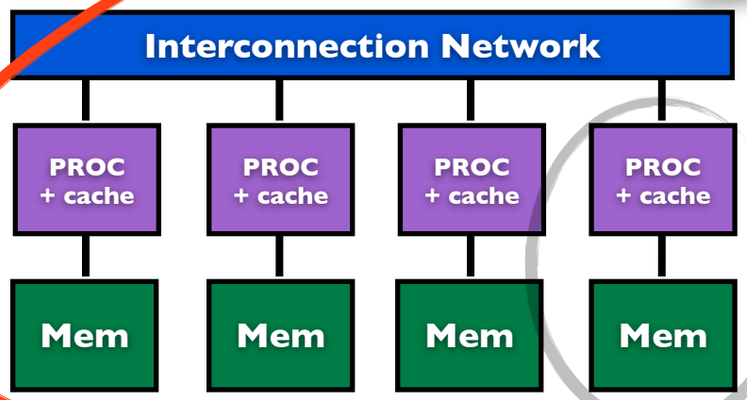
Threads
fork

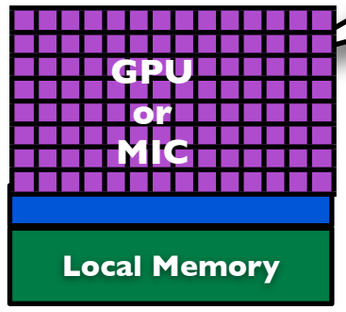
Distributed Memory



Focus on who owns what data and what communication is needed

Sockets
MPI
HADOOP

Co-Processor



Same Task on Blocks of data

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OpenCL
OpenACC

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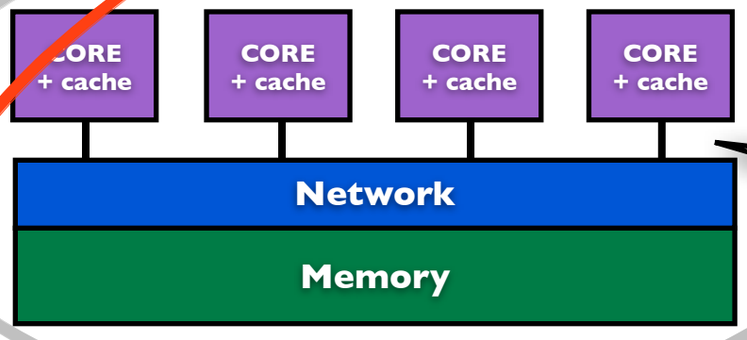
MIC: Many Integrated Core

OpenMP
OpenACC

Shared Memory



Focus on which tasks can be parallel

OpenMP
Threads
fork

Distributed Memory

Interconnection Network

PROC + cache | PROC + cache | PROC + cache | PROC + cache

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Focus on who owns what data and what communication is needed

Sockets
MPI
HADOOP

snow
Rmpi
pbdMPI

RHIPE

Co-Processor

GPU or MIC

Local Memory

Same Task on Blocks of data

CUDA
OpenCL
OpenACC

GPU: Graphical Processing Unit

MIC: Many Integrated Core

Shared Memory

CORE + cache | CORE + cache | CORE + cache | CORE + cache

Network

Memory

Focus on which tasks can be parallel

.C
.Call
Rcpp
OpenCL
inline

OpenMP
OpenACC

OpenMP
Threads
fork

multicore
(fork)

snow + multicore = parallel

snow
Rmpi
pbdMPI

Focus on who owns what data and what communication is needed

Sockets
MPI
Hadoop

RHIPE

LAPACK
BLAS

ScaLAPACK
PBLAS
BLACS

PETSc

Trilinos

Distributed Memory

Interconnection Network

PROC + cache | PROC + cache | PROC + cache | PROC + cache

Mem | Mem | Mem | Mem

Co-Processor

Same Task on Blocks of data

GPU or MIC

Local Memory

GPU: Graphical Processing

MIC: Many Integrated Core

CUDA
OpenCL
OpenACC

.C
.Call
Rcpp
OpenCL
inline

OpenMP
OpenACC

CUBLAS

MAGMA

MKL
ACML
LibSci

Shared Memory

CORE + cache | CORE + cache | CORE + cache | CORE + cache

Network

Memory

Focus on which tasks can be parallel

OpenMP
Threads
fork

DPLASMA

multicore
(fork)

PLASMA

snow + multicore = parallel

Distributed Memory

Interconnection Network

PROC + cache | PROC + cache | PROC + cache | PROC + cache

Mem | Mem | Mem | Mem

Focus on who owns what data and what communication is needed

snow
Rmpi
pbdMPI

Sockets
MPI
Hadoop

RHIPE

LAPACK
BLAS

ScaLAPACK
PBLAS
BLACS

PETSc

Trilin

pbdDMAT

Co-Processor

GPU or MIC

Local Memory

GPU: Graphical Processing

MIC: Many Integrated Core

Same Task on Blocks of data

CUDA
OpenCL
enACC

.C
.Call
Rcpp
OpenCL
inline

OpenMP
OpenACC

magma

CUBLAS

MAGMA

MKL
ACML
LibSci

HiPLARM

DPLASMA

PLASMA

Shared Memory

CORE + cache | CORE + cache | CORE + cache | CORE + cache

Network

Memory

Focus on which tasks can be parallel

OpenMP
Threads
fork

multicore
(fork)

snow + multicore = parallel

pbdR
Programming with Big Data in R

snow
Rmpi
pbdMPI

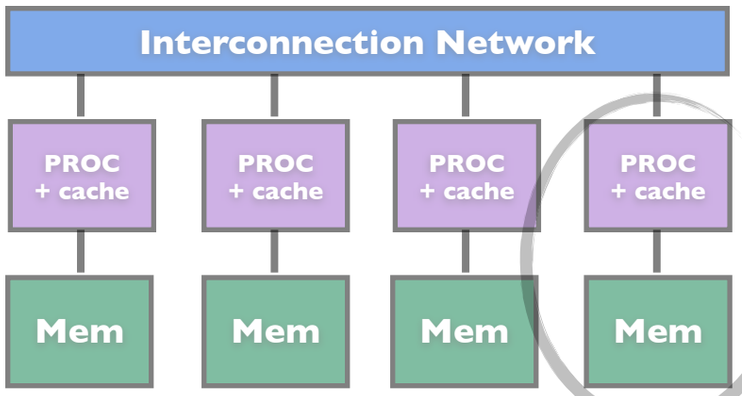
Focus on who owns what data and what communication is needed

Sockets
MPI
Hadoop

RHIPE

LAPACK
BLAS

Distributed Memory



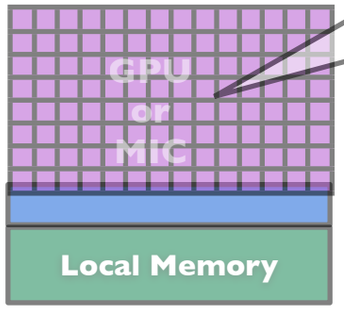
ScaLAPACK
PBLAS
BLACS

PETSc

Trilin

pbdDMAT

Co-Processor



Same Task on Blocks of data

CUDA
OpenCL
OpenACC

.C
.Call
Rcpp
OpenCL
inline

OpenMP
OpenACC

magma

CUBLAS

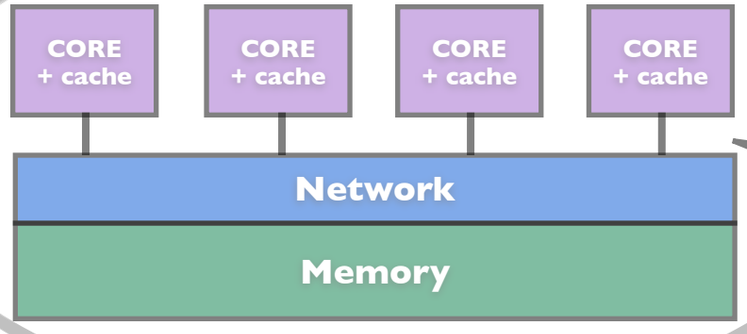
MAGMA

MKL
ACML
LibSci

GPU: Graphical Processing Unit

MIC: Many Integrated Core

Shared Memory



Focus on which tasks can be parallel

OpenMP
Threads
fork

HiPLARM

DPLASMA

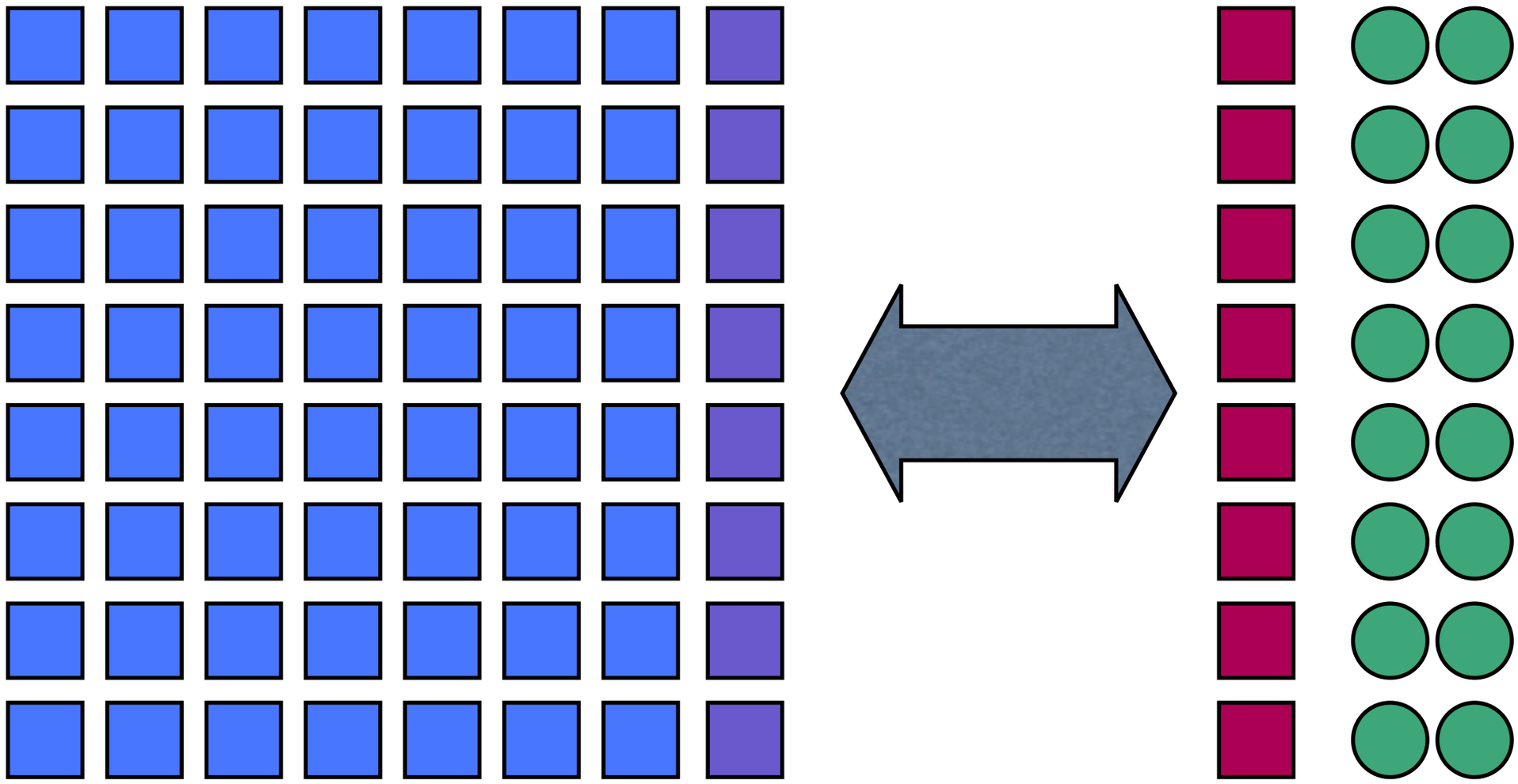
PLASMA

multicore
(fork)

snow + multicore = parallel

Supercomputer

Parallel File System



Compute Nodes

I/O Nodes

Storage Servers

Disk