Parallel Computing Toolbox (PCT)

and

Parallel Computing in MATLAB

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The MathWorks, Inc.
MATLAB, SIMULINK, and PCT
MATLAB Parallelism Types

- **Implicit parallelism**
  - BLAS
  - LAPACK
  - FFTW
  - ...

- **Explicit parallelism**
  - PCT
    - MPI
    - Distributed arrays

- **Interactive parallelism**
  - pmode

- **Task parallelism**
  - Embarrassingly parallel
  - Independent tasks
  - parfor

- **Data parallelism**
  - +150 functions for distributed arrays
PCT Components Details

Local workers

- CCS
- LSF
- PBS
- mpiexec

- Ethernet
- InfiniBand

Local workers connect to clusters through CCS, LSF, and PBS. mpiexec manages the execution of tasks. Ethernet and InfiniBand provide network connectivity for distributed computing.
PCT Content

- matlabpool & parfor
- Parallel algorithms
  - Distributed arrays
- Message passing
  - labindex, numlabs
  - labSend, labReceive, labSendReceive
  - labBroadcast, labBarrier
  - labProbe
  - gop

- Schedulers
  - local
  - Job manager
  - mpiexec
  - Batch environment
    - CCS
    - Platform LSF
    - PBS family
    - Sun Grid Engine

- Debugging and profiling
  - Deadlock detection
  - MPI profiler
matlabpool and parfor

• Matlabpool
  - Enables parallel language features of the MATLAB language

• Parallel for loop
  - Drop down replacement of for
  - Incremental parallelization
  - Automatic language analysis
  - Reduction operations
Interactive Parallel Environment

- Window components
  - Output windows of each lab
  - Command prompt with history and search
- Local or remote labs
- Deadlock detection
Distributed Arrays in MATLAB

- Data parallelism
  - Large data sets
  - Data distributions
  - “Owner computes”
  - Single Instruction Multiple Data
  - Message passing hidden through OO overloading

- Parallel algorithms
  - Standard operators
  - Indexing
  - Linear algebra
  - Custom parallel for loops
Message Passing in MATLAB

- Basic functionality
  - 6 canonical MPI functions
- Additional functionality
  - Lock-free send/receive
  - Broadcasts, barriers
  - Reductions
- Debugging
  - pmode
- Profiling
  - MPI profiler

- Nomenclature
  - Lab vs. process
  - Index vs. rank