Cluster Computing for Large-Scale Computational Problems

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Components
- Gigabit Ethernet
- Message Passing Interface
- Distributed Memory computers

Hardware Architectures
- 32-Bit architecture
  \[2^{32} : 4,294,967,296\]
- 64-Bit architecture
  \[2^{64} : 18,446,744,073,709,551,616\]

Possible solutions
- Expand hardware architecture
- Provide a set of data structures and algorithms

Available software packages
- Maple
- Mathematica
- GMP (Gnu Multi Precision library)
- NTL (Number Theory Library)

Minimal set of algorithms
- addition
- subtraction
- multiplication
- division
- comparison
Abstract Data Types

- CELL - holds single 32-bit value
  - Node of a Doubly Linked List (DLL)
    - linked list is a chain of structures or records called nodes
- LARGE - holds a large number
  - Doubly Linked List of CELLS
  - Number of cells
  - Sign of the number

Structural representation

Algorithms

- Addition
- Subtraction
- Division
- Multiplication
- Modulo division
- Modulo exponentiation

Testing

- General tests
- Consistency tests
  - Operation reversal
- Speed evaluation
  - Miller-Rabin primality test

LNAL

- 24 utility functions
- 18 integer arithmetic functions
- 14 conversion routines
- 24 assembly macros
- Modular division
- Modular exponentiation
- Miller - Rabin algorithm