High Performance Computing and Data Mining

Performance Issues in Data Mining

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The Data Mining Process

- Analysis: Fast data access, large memory, caching
- Preparation: Fast input and output, large memory, fast computing
- Modelling: Fast computing, large memory
- Evaluation: High performance graphics
Why High Performance Computing

- Large data collections → Memory and disk space
- Long processing times → Processing speed
- Technical limitations
  - Processor speed
  - Input / output bandwidth
  - Memory size and bandwidth
- Many problems are inherently parallel

Contemporary high performance computing always involves parallel computing
Parallel Performance

- Goal: Being $P$ times faster with $P$ processors
  - *Speedup* is usually less than $P$
  - Sequential parts in a program limit speedup
- Parallel scalability
  - Measurement how well speedup scales with increasing number of processors
    (of course scalability with data size is equally important)
- Data distribution and load balancing are critical
- Parallel programs need to be tuned for new architectures
ANU Beowulf Linux Cluster Bunyip

- 96 Dual Pentium III nodes
- 36 Gigabytes main memory
- 1,305 Gigabytes disk space
- Fast-Ethernet network
- Gordon Bell prize winner 2000
- Costs: AU$ 250,000
Australian Partnership for Advanced Computing (APAC)

- ANU Data Mining is 1 of 13 Expertise Programs
  - Conduct research and development projects
  - Provide high-level user support services
- National Facility at ANU opened in May 2001
  - Peak performance close to 1 Tera-Flops
  - 480 Compaq Alpha processors
  - Each with 1 Gigabyte of main memory
  - Connected by a fast, low latency switch
  - Disk capacity around 10,000 Gigabytes
  - Tape storage 300 Terabytes (300,000 Gigabytes)
APAC National Facility
Research at ANU Data Mining Group

- **DMtools** facilitate analysis and preprocessing
  - Access to parallel database server
  - Caching for fast retrieval
  - Uniform interface for parallel data mining algorithms
- Parallel scalable data mining algorithms
  - Predictive modelling
  - Clustering and association rules

**Aim:** Harness the power of high performance computing with a flexible toolbox
Parallel Record Linkage Initiative

- Probabilistic linkage of data sets if no common unique identifier is available
  (Probabilistic measure of how similar two records are)

- Only a few very expensive commercial programs are available (e.g. AutoMatch)

- To reduce the huge number of comparisons, blocking techniques are used
  (e.g. group records with same postcode)

- Blocking allows exploration for parallelism

- Collaboration with NSW Health Department (Tim Churches)
Outlook: Current and Future Work

- Parallel record linkage initiative  
  (High-performance linkage package, open source software)
- Extension of *DMtools*
  - Integration of parallel data mining algorithms
  - Integration of statistical and graphical packages
- Extension of predictive modelling
  - Sparse grids
  - Complex data types (sets, vectors, etc)

Visit our web site at:

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