Parallel Computing Techniques for High-Performance Probabilistic Record Linkage

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Project web page: **http://datamining.anu.edu.au/linkage.html**

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Project Description and Aim

- A collaborative research project between the ANU and the NSW Health Department
- Use of (free) open-source software tools to develop open-source record linkage software
  - Step 1: Develop high-performance techniques for record linkage $\Rightarrow$ **Faster linkage of larger data sets**
  - Step 2: Explore machine learning and data mining techniques for record linkage $\Rightarrow$ **Better linkage quality**

The aim is to facilitate (epidemiological) research with free and improved tools for record linkage

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A Collaborative Research Project

- Australian National University Data Mining Group
  - **Peter Christen**, Department of Computer Science
  - **Markus Hegland**, School for Mathematical Sciences
  - **Stephen Roberts**, School for Mathematical Sciences
  - **Ole M. Nielsen**, School for Mathematical Sciences and Australian Partnership for Advanced Computing (APAC)
  - **Justin Zhu**, Computer Science Honours student
- New South Wales Health Department
  - **Tim Churches**, Epidemiology and Surveillance Branch
  - **Kim Lim**, Epidemiology and Surveillance Branch

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Open Source Software Tools

- Scripting language *Python*
  - Easy and rapid prototype software development
  - Provides lists and dictionaries (lookup tables)
  - Can handle large data sets stable and efficiently
  - Many external modules, easy to extend
  - Available from **www.python.org** (Windows, Unix, Mac)
- Parallel libraries *MPI* and *OpenMP*
  - For communication between processes
  - Widespread use in high-performance computing (quasi standards) $\Rightarrow$ Portability and availability

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Target Computing Platforms

- Workstation or PC cluster
  - Commodity PCs connected via local area network
  - Widespread availability, no extra costs
  - Use as virtual parallel computer (nights / weekends)
- Multiprocessor (SMP) servers
  - Example: *Sun Enterprise, HP Superdome*
  - 4 – 30 CPUs, Gigabytes of memory, Terabytes of disk
- High-performance super-cluster
  - Example: *APAC National Facility (Compaq Alphaserver)*
  - >100 CPUs, Gigabytes of memory, mass data storage

Linux Cluster 'Bunyip' and APAC National Facility

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Status and Ongoing Work

- Project started in January 2002 (officially March)
- Implemented and tested *Python* modules
  - Name encodings: *Soundex*, *NYSIIS*, *Double-Metaphone*
  - String comparators: *Jaro*, *Winkler*, *Bigram*, *Edit distance*
- Currently working on standardisation routines
  - *NAME* (almost finished), *GEOCODE* and *LOCALITY*
- Students
  - Justin Zhu (Honours) *Hidden Markov Models*
  - Agnes Boskovitz (PhD) *Inductive Logic Data Cleaning*

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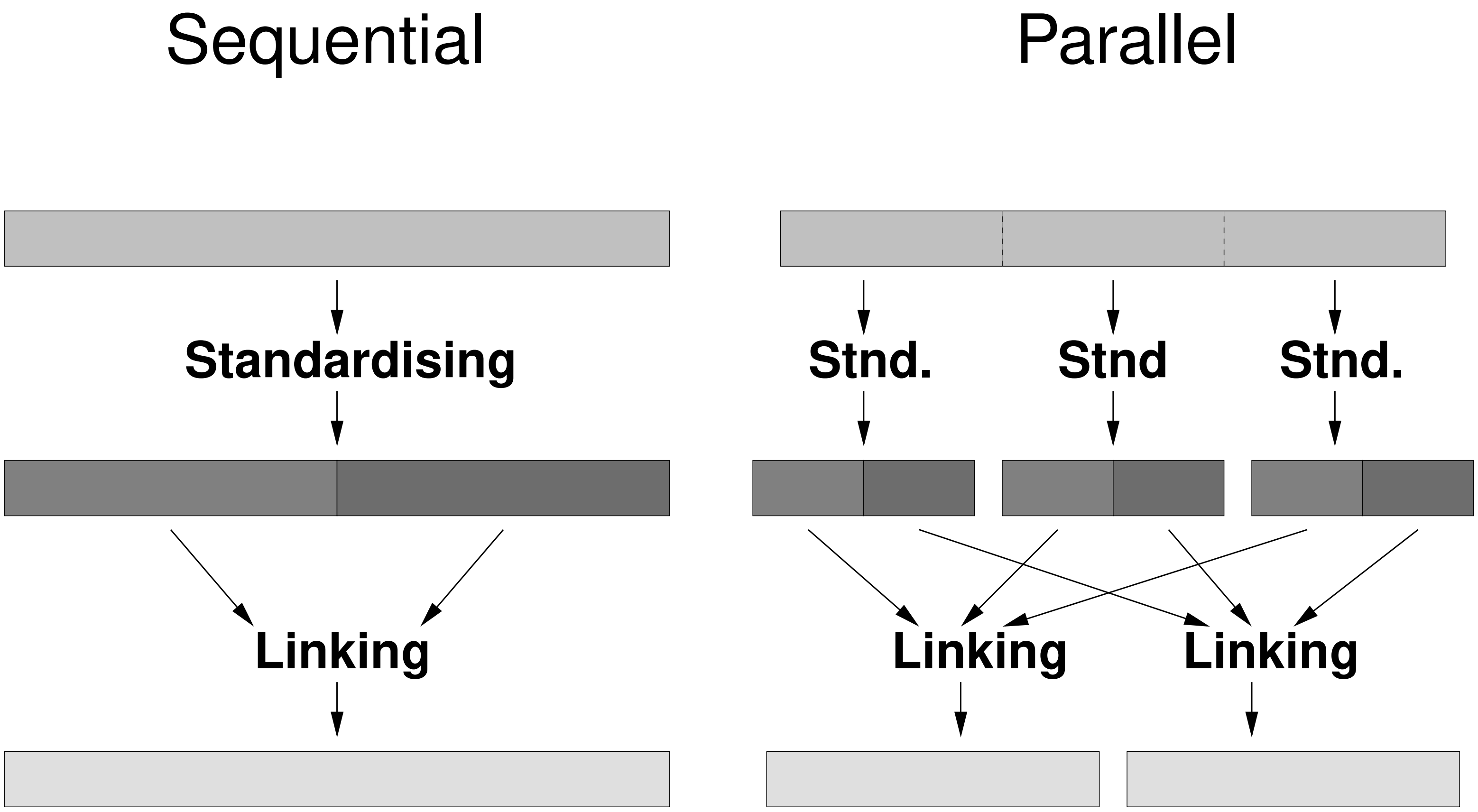
Standardisation Approach

- Routines for *NAME*, *GEOCODE* and *LOCALITY*
- *NAME* standardisation:
  - Remove unwanted characters, replace certain characters by others. Example: Replace *[*, *{*, < with *(*
  - Split into a list of words and separators
    Example: *['ms', 'monica', '(', 'mon', ')', 'meyer', '-', 'miller']*
  - Assume and use sequence structure
  - Extract titles from beginning of list (use lookup tables)
  - Handle easier names first (e.g. if only two words left)
- Similar for *GEOCODE* and *LOCALITY*

Parallelisation Approach



Data Mining Approach

- Data mining and machine learning techniques to learn data characteristics
  - Clustering (as alternative for blocking?)
  - Predictive modelling
  - Decision trees and rules (for matches / non-matches?)
- Training data needed to build model
  (pairs of known matches and known non-matches)
- *ANU Data Mining* group has several years of experience in predictive modelling, handling of health data sets, data processing, etc.

Outlook

- A new approach to probabilistic record linkage
  - High-performance and parallel computing
  - Open-Source software
  - Data mining and machine learning techniques
- Future extension of this project likely
  - ARC Linkage grant for 2003
- Further collaborations are welcome
- Prototype software available in second half of 2002

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