Bounded Persistence
Pathwidth

- R. Downey and C. McCartin
  - Pgs 51-56 ACSC

- Background
  - Graph width metrics
    - Treewidth, pathwidth, cliquewidth
    - Restricting width parameter can lead to efficient algorithms
  - E.g. treewidth – gives a measure of how tree-like a graph is

- Persistence
  - New parameter for graphs
**Treewidth and tree decomposition**

- A graph $G$ has treewidth $k$ if we can associate a tree $T$ such that
  - Each node of $T$ represents a subgraph of $G$ with at most $k+1$ vertices
  - All edges and vertices of $G$ are in at least one of the nodes of $T$
  - For each vertex $v$ in $G$ the nodes of $T$ where $v$ is represented is a subtree of $T$
- Such a tree is called a tree decomposition of $G$

**Pathwidth**

- A path decomposition of a graph $G$ is a tree decomposition, where the tree is a path
- The pathwidth of $G$ is the minimum width over all possible path decompositions of $G$
  - Path decomp is also a tree decomp of $G$
  - Pathwidth is greater than or equal to treewidth
- E.g. for a complete binary tree of height $k$
  - Pathwidth $= k$
  - Treewidth $= 1$
**Bounded persistence pathwidth**

- Pathwidth doesn’t always give a true indication of the pathlike nature of a graph
  - There are some pathological cases
  - Introduce persistence to deal with this
- A path decomposition of width k in which every vertex belongs to at most l nodes of the path has pathwidth k and persistence l
  - Graphs with low width and low persistence are pathlike
  - Graphs with low width and high persistence are unnatural
- **BUT:** determining bounded persistence pathwidth is W[t]-hard

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**Factorising temporal specifications**

- Huisman and Trentelman
- CATS pgs 87-96
- Verification of multi-threaded programs
- Aim to lighten the burden of proof
- Show there exists a group of threads that establish the property while the others do not affect it
Programs and specifications

- **Programs**
  - Labelled transition systems (LTS)
  - Composition of threads $T_1 \parallel T_2$
  - Traces
- **Temporal specifications**
  - Represented using specification patterns
  - Semantics defined by mapping patterns to LTL
  - Defined in Isabelle/HOL

Specification patterns

- Describe most of the common constructs in temporal logics (e.g. LTL, CTL, ...)
- For each pattern a mapping into different logics can be defined
- Each pattern describes a property that holds in a certain scope
  - Globally, After, Before, Between, AfterUntil
- Two kinds of properties
- Occurrence
  - Absent, Universal, Exists
- Order
  - RespondsTo, Precedes
Factorisation rules

- Factorisation rules are defined for the different temporal properties
- E.g. ....

Agent-based distributed software verification

- Hunter, Robinson & Strooper
- ACSC pgs 159-164
- Techniques have been developed for verifying imperative programs
- BUT: Cost of developing proofs is too expensive
  - By hand is tedious and error prone
  - Use interactive provers instead
    - Manual steps for hard bits
    - Automatic proof construction for easy bits
  - But still too expensive
**Distributed interactive theorem proving**

- *Increase cost-effectiveness*
  - Execution of tactics in the background
  - Manual proof construction in the foreground
  - Active communication between these tasks

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**Architecture**

- User
  - Proof

- Personal Assistant
  - Broker
    - Proof Agent
    - Proof Agent
**Architecture (cont)**

- **Personal assistant**
  - Monitor proof
  - Use proof agents to construct parts of proof
  - Interface to help user complete problematic subproofs
- **Proof agents**
  - Automated reasoning capabilities
  - Encapsulate particular reasoning style, search strategy or domain
  - Provide estimate of its chance of satisfying particular goal
- **Broker**
  - Puts agents in touch with each other

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**Stemming Indonesian**

- **Asian, Williams & Tahaghoghi**
- **ACSC pgs 307-314**
- **Stemming used in information retrieval, web browsing etc.**
  - Involves finding the root of a word
  - E.g. stemming, stemmer and stems have root word stem
  - The problem is addressed fairly well in English
  - Root word is usually a prefix
  - Other languages not so easy
Stemming Indonesian (cont)

- Indonesian has a more complex class of affixes
  - Prefixes
  - Suffixes
  - Infixes
  - Confixes
- E.g. the word “pemerintah” (meaning government) has the root “perintah” (meaning govern)
- The authors compare 5 stemming algorithms for Indonesian
  - A best algorithm is found
  - Improvements are proposed to increase accuracy

Other papers

- When are two workflows the same?
  - CATS Pgs 3-11
- Concurrent program design in the extended theory of Owicki and Gries
  - CATS pgs 41-50
- A two-pronged attack on the dragon of intractability
  - ACSC pgs 183-192
  - Another parameterised complexity paper