

Searching Electronic Health Records for Temporal Patterns

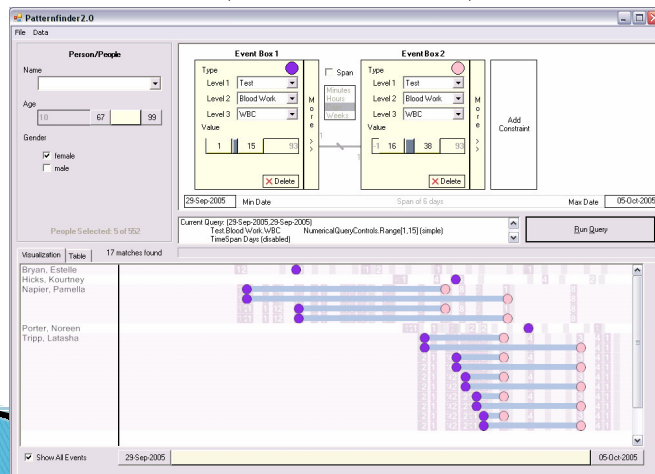
A Case Study with Azyxxi

<http://www.cs.umd.edu/hcil/patternFinderInAzyxxii>

Stanley Lam
Department of Computer Science
University of Maryland

Previous Work at HCIL

- ▶ Searching Categorical Histories with PatternFinder: Query Support for Electronic Health Records (Fails VAST 06)



Previous Work at HCIL

- ▶ LifeLines for Visualizing Patient Records (Plaisant AMIA 98)

The screenshot displays the LifeLines medical record interface for a patient named Dora Simpson. The interface is organized into several key sections:

- Header:** Patient name (Dora Simpson), address (1234 Pirate Street, Barbary Coast), phone number, and demographic information (DOB: 9/12/35, Caucasian, Male, 5'-6", 180 Lbs).
- Timeline:** A horizontal timeline from 1990 to 1996, with various medical events plotted as vertical bars.
- Problems:** A list of medical conditions including Coronary Artery Disease, Congestive Heart Failure/Cardiomyopathy, Diabetes, Silent MI, and Atrial Flutter.
- Interventions:** A list of procedures such as PTCA, Rotablator, and CABGx3.
- Progress Notes:** A section for clinical notes, with a specific note from 2/12/96 detailing post-surgery status and medication (Tylenol, Digoxin).
- Current Meds:** A list of active medications including Cardizem CD, Digoxin, Ecotrin, Insulin, K-Dur, Lasix, Percocet, Theragram, and Tylenol.
- Cath Report:** A detailed report from The Arlington Hospital, including a cath diagram showing the coronary artery anatomy.
- Med History:** A section for past medical history, listing conditions like Mild Hypoglycemia, Diabetic retinopathy, Hypertension, and Former smoker.

PatternFinder 2 Demonstration

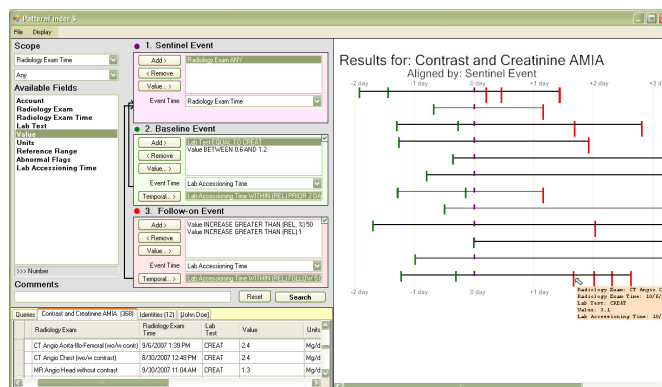
Quick Version Comparisons

- ▶ Visual query interface style
- ▶ Progressive querying
- ▶ Flat-file data source
- ▶ Amalga-esque query interface style
- ▶ Job-based querying
- ▶ SQL Server data source

PatternFinder 2

PatternFinder for Amalga

PatternFinder S Demonstration



Key Querying Feature

▶ Relational operators

- “relative increase greater than X”
- “relative increase greater than X%”
- “relative decrease greater than X”
- “relative decrease greater than X%”
- “less than value in event X”
- “equal to value in event X”
- “not equal to value in event X”

- “within X prior to (relative)”
- “within X following (relative)”
- “after X (relative)”
- “before X (relative)”
- “is equal to (relative)”

- “equal to value in event X”
- “not equal to value in event X”

Temporal Relationship

Field name
Lab Accessioning Time

Operator
within (rel) follow

Relative To
 Sentinel Time
 Baseline Event

Value
5 Day

OK Cancel

7

Key Reporting Features

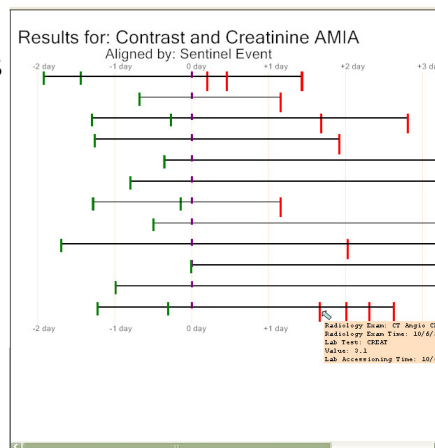
▶ LifeLines style

- Hashes of varying lengths & colors, indicating each event

▶ Ball-and-Chain style

- Circles linked by lines, indicating event sequences

▶ Align-by options



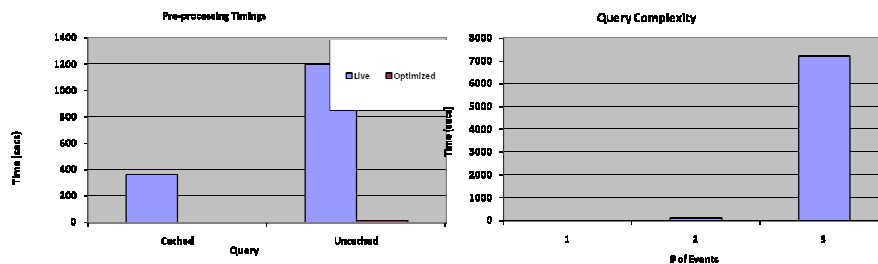
8

Implementation Difficulties

- ▶ Domain-agnostic
 - Additional level of abstraction
- ▶ Contextual problems
 - Limited domain knowledge
- ▶ Performance
 - Millions of rows
 - Over 7 terabytes of data

9

Performance



- ▶ Database size

- ▶ Query complexity

10

Design Evolution

- ▶ Tab-based interface
 - One tab for each event
 - Replaced with inline approach
- ▶ Buttons and checkbox galore
 - Options and functionality were all shown directly on the interface
 - Replaced with menu bar
- ▶ Contextual clues

11

PatternFinder for Amalga

- ▶ Domain-agnostic
 - No metadata
- ▶ Dynamic Reporting of Generic Result Data

12

Future Work

- ▶ Evaluation at Washington Hospital Center
- ▶ Direct Amalga Integration
- ▶ Multi-table / multi-view query construction
- ▶ Exporting the data
- ▶ Alarm-based querying / repeating queries

13

Conclusions

14

Acknowledgements

- ▶ Ben Shneiderman, Ph.D
- ▶ Catherine Plaisant, Ph.D

- ▶ Michael Gillam, MD (Microsoft)

- ▶ Mark Smith, MD
- ▶ David Roseman, MHA
- ▶ Greg Marchand, MD

- ▶ Partial support provided by Washington Hospital Center