Lifelines2: Hypothesis Generation in Multiple EHRs

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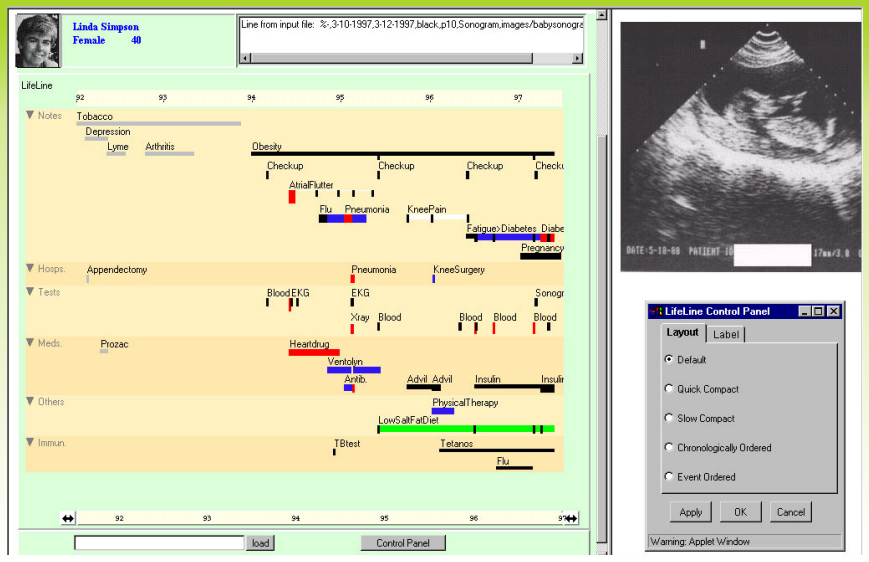
LifeLines: Overview of Patient Record



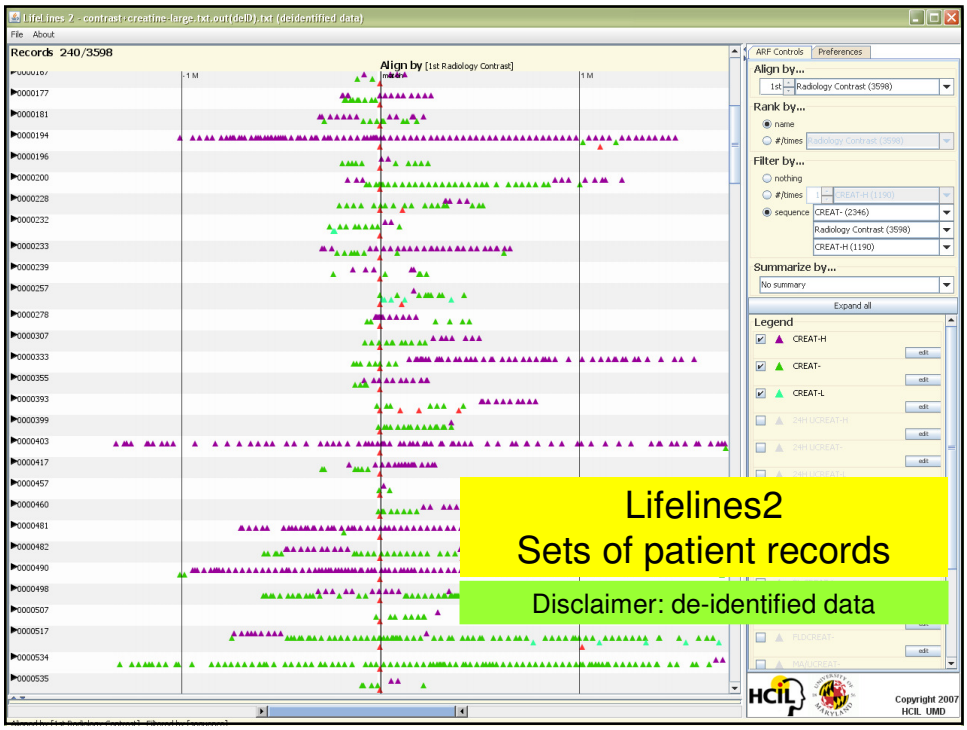
Plaisant et al.,CHI96 AMIA98 – www.cs.umd.edu/hcil/lifelines

Single record → Millions of records

- Large databases of Electronic Health Records (EHRs):

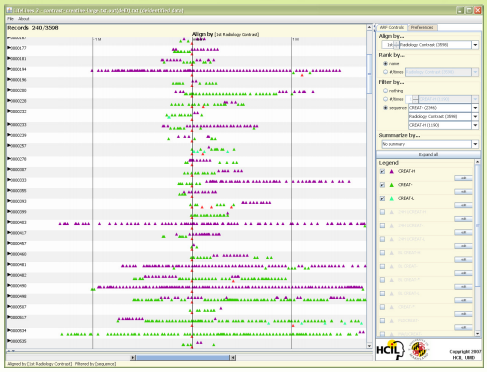
- Observational studies
- Recruitment for clinical trials
- Hospital metrics
- Alarm design and testing
- etc.

Often involves temporal comparison relative to an important event (e.g. heart attack, start of a treatment, 1st diagnosis of cancer)



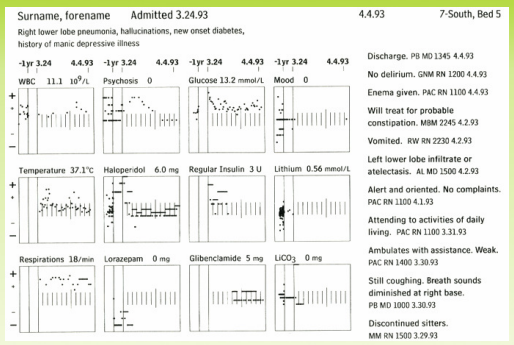
Lifelines2

- Introduce powerful combination of simple operators **Align, Rank, Filter**, and **Summarize**
  - Multiple records simultaneously visible
  - Align by sentinel events
  - Rank by frequency
  - Filter by events
  - Summaries
- Focus on **Point Events**
  - Diagnosis, lab tests, etc.
- Measure **Benefits of Alignment**

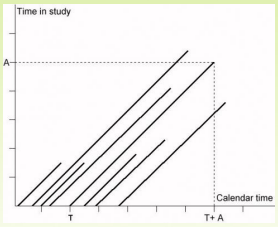


- **Sample of Related Work**
- Demo
- (Quick) Report on Studies
- Ongoing & Future Work

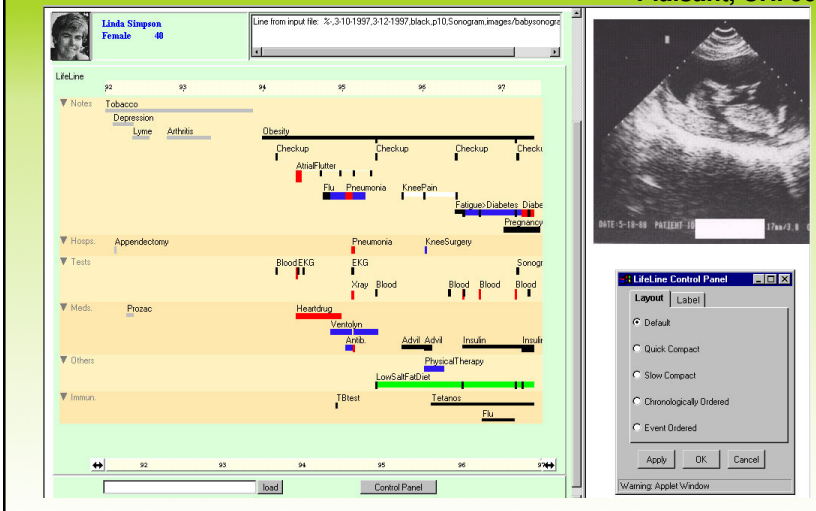
Static views



Powsner & Tufte, 1994



Lexis diagrams (Bertin)



Lifelines and improvements

Overview of categorical and/or numerical data (semantic zoom)

Plaisant, CHI 96, AMIA 98

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Overview of categorical and/or numerical data (semantic zoom)

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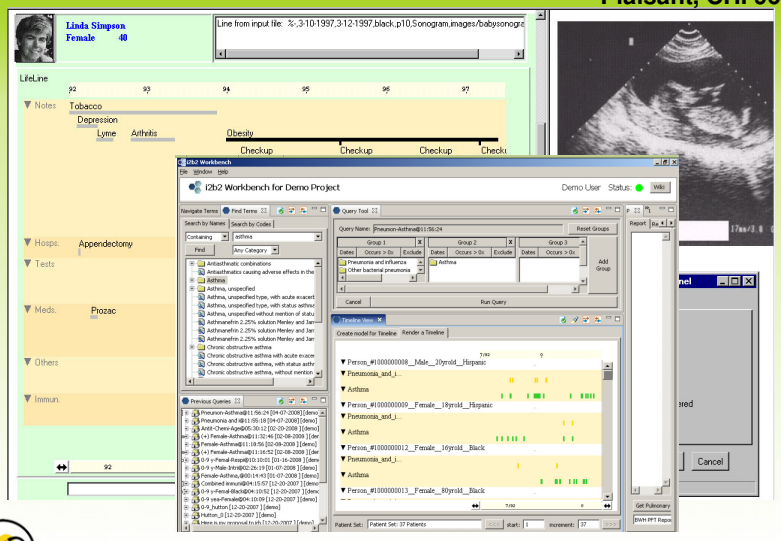
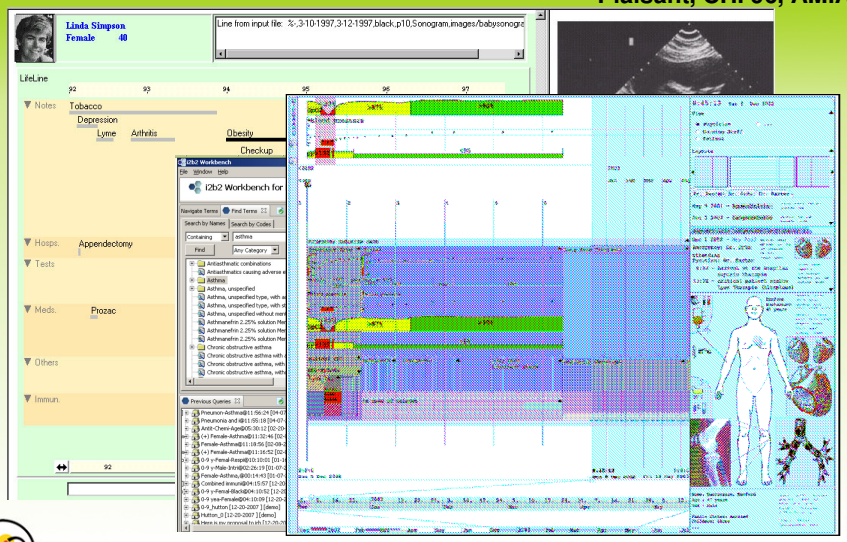


i2b2 (Murphy, AMIA 07)

Lifelines and improvements

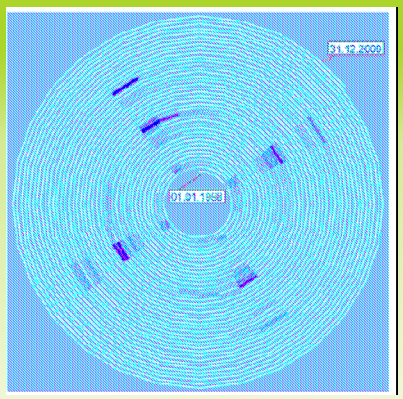
Overview of categorical and/or numerical data (semantic zoom)

Plaisant, CHI 96, AMIA 98



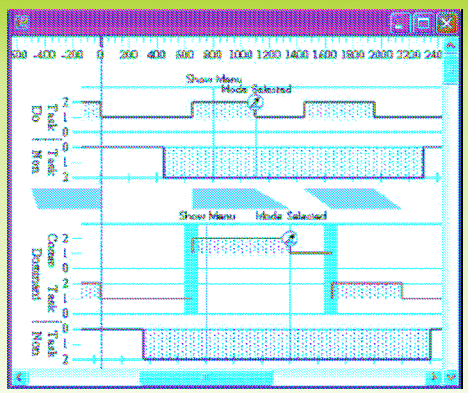
i2b2 (Murphy, AMIA 07) **Bade, CHI 2004**

Alignment Inspirations



Spiral Graph: Weber, 01
(based on Carlis, UIST 89)

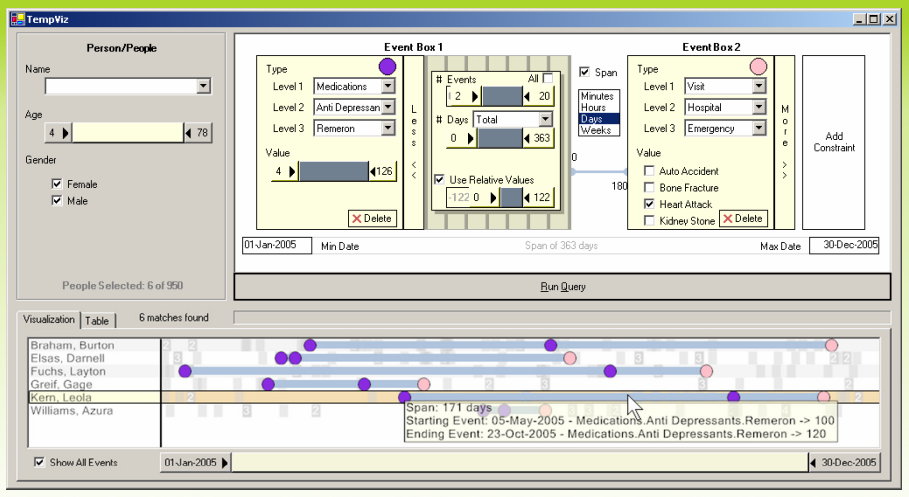
Periodic data



ExperiScope (Guimbretiere, CHI 07)
One of many example of manual alignment

PatternFinder

Specification of complex temporal queries on categorical data

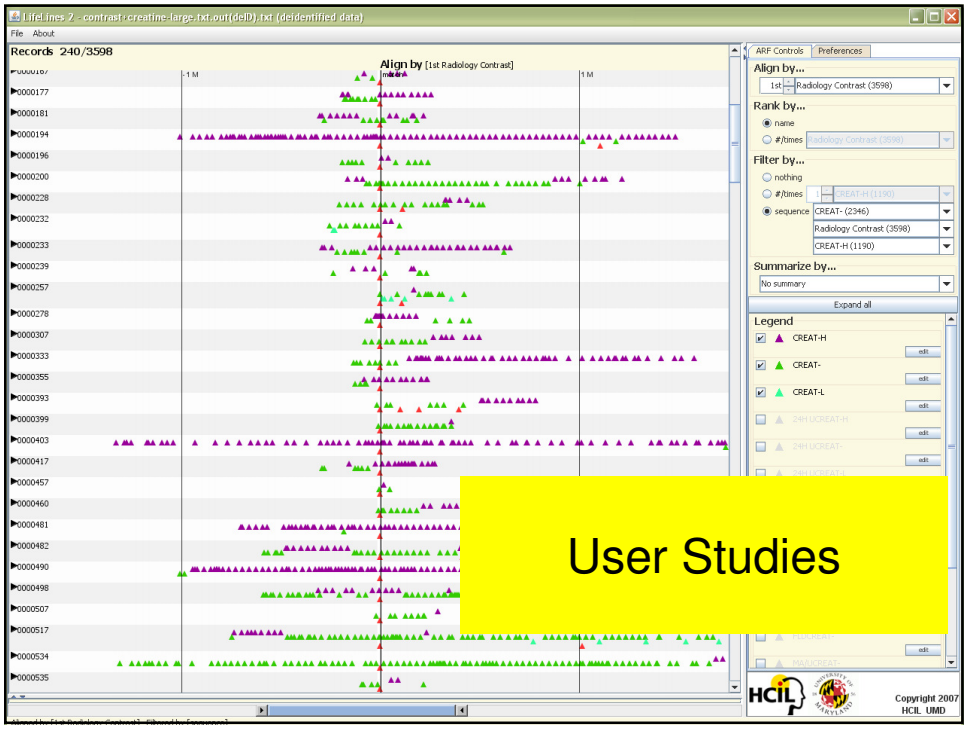


Fails, VAST 06

Ball and chain display of matches

- Sample of Related Work
- **Demo LifeLines2**
- Report on Studies
- Ongoing & Future Work

Demo



User Studies

Two user studies

- Controlled experiment on Alignment
  (some training, measure speed and error)

- Domain expert qualitative study
  (no training, think aloud, discussion)

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- Controlled experiment
  (some training, measure speed and error)
  - Benefit of alignment: **YES** (Significant improvement on complex tasks)
  - 20 participants: grad students
  - Data: synthetic student record data
    Tasks checked as domain independent

Details

- Domain expert qualitative study
  (no training, think aloud, discussion)

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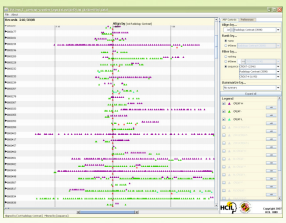
- Domain expert qualitative study
  (no training, think aloud, discussion)
  - Learnability: **GOOD**
  - General feedback and suggestions Suggestions
  - 4 participants: nurse, physician, 2 prof. of nursing
  - All experienced with EHR and medical research

Context

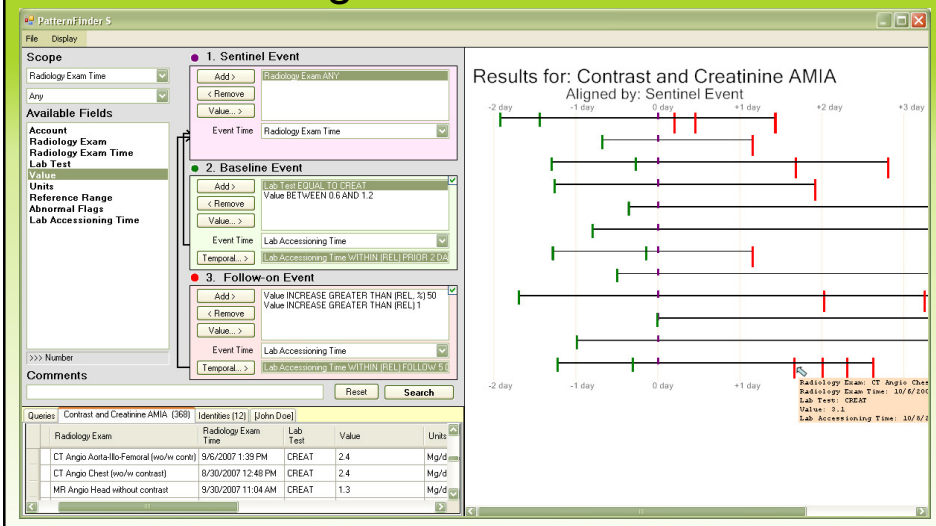
Search millions of records

Interactive visualization of results



LifeLines2

Combine Alignment with PatternFinder



Washington Hospital Center

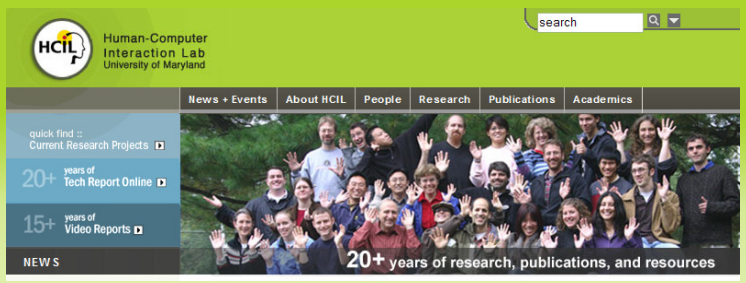
Integrate Align-Rank-Filter in i2b2

Harvard Medical School, Partners HealthCare

In summary…

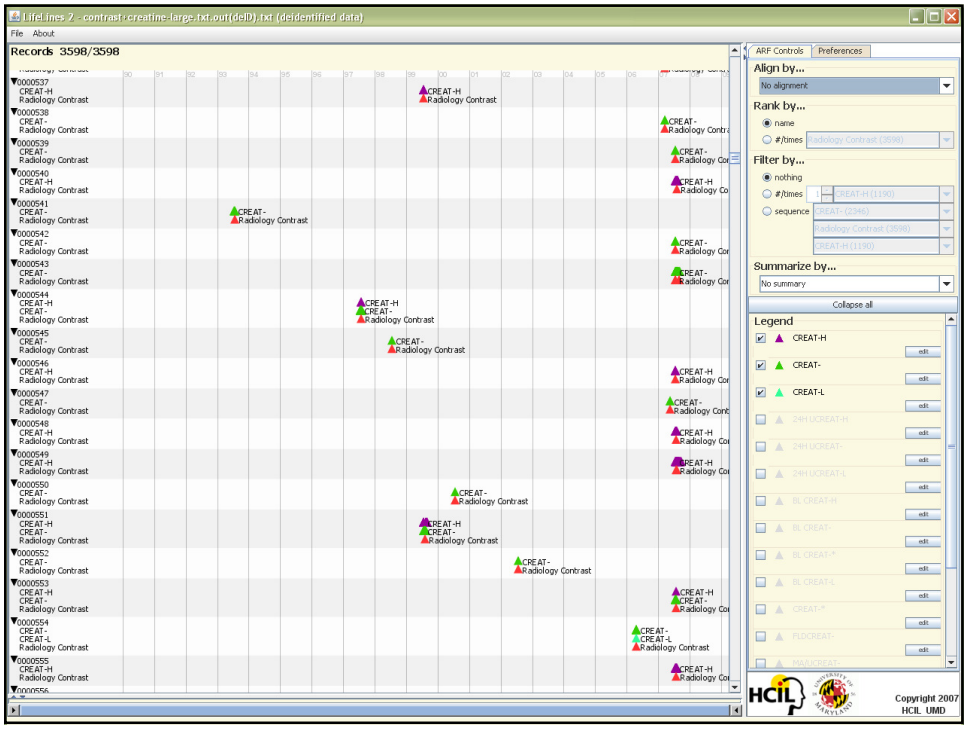
- **Align Rank, Filter, and Summarize**
  Powerful combination of simple operations to explore temporal categorical data (events)
- **Performance benefit of alignment: significant**

- **Impact**: Deployment in 2 large operational EHR systems
- **Many applicable domains**:
  - Highway incident log
  - Student records
  - Web logs
  - Vehicle fleet records



Thank you!

www.cs.umd.edu/hcil/lifelines2


Lifelines 2 - contrast-creatine-large.txt.out(delD).txt (deidentified data)
File About
Records 3598/3598
ARF Controls
Preferences
Align by...
No alignment
Rank by...
name
#/times
Filter by...
nothing
#/times
sequence
Summarize by...
No summary
Collapse all
Legend
CREAT-H
CREAT-
CREAT-L
Radiology Contrast
HCIL
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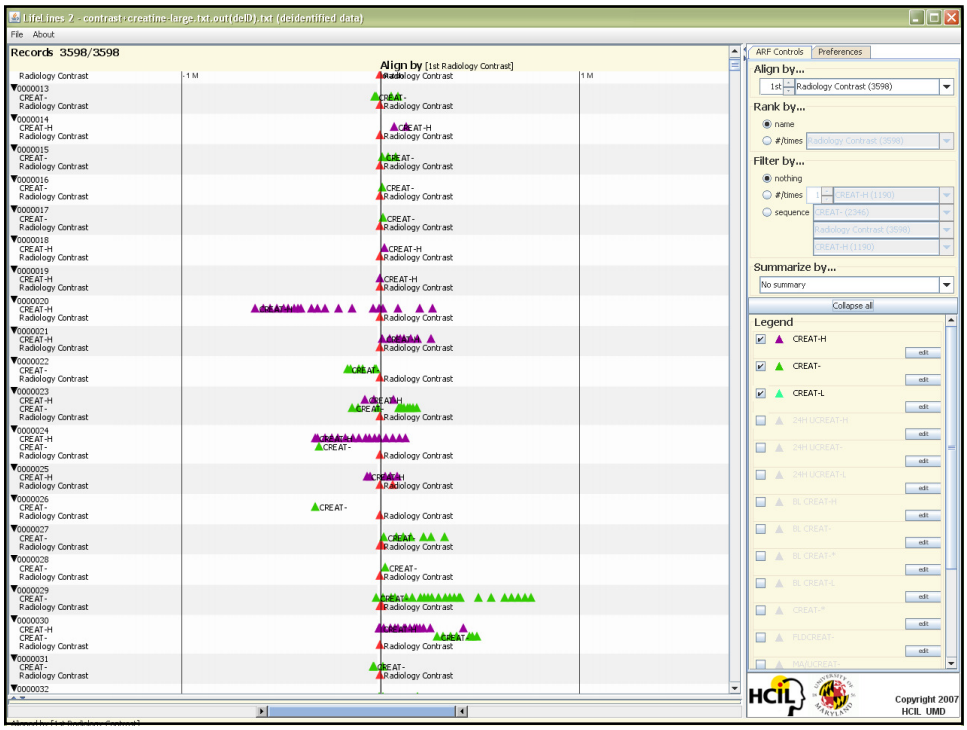
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Records 3598/3598
Align by [1st Radiology Contrast]
ARF Controls
Preferences
Align by...
1st Radiology Contrast (3598)
Rank by...
name
#/times
Filter by...
nothing
#/times
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No summary
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CREAT-H
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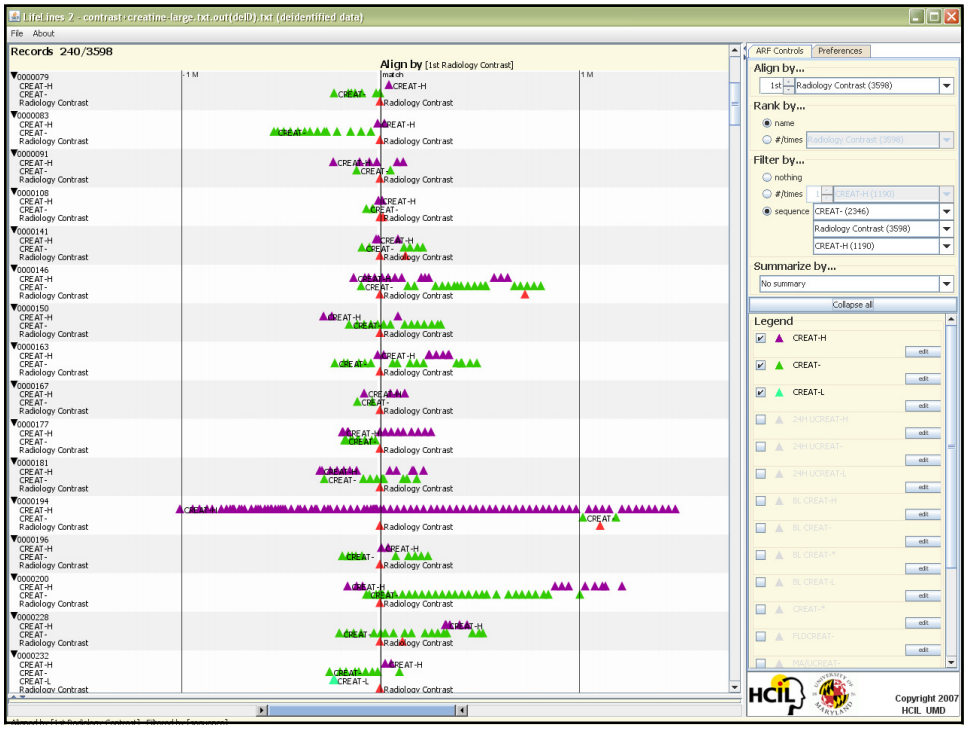
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Records 240/3598
Align by [1st Radiology Contrast]
ARF Controls
Preferences
Align by...
Rank by...
Filter by...
Summarize by...
Collapse all
Legend
CREAT-H
CREAT-
CREAT-L
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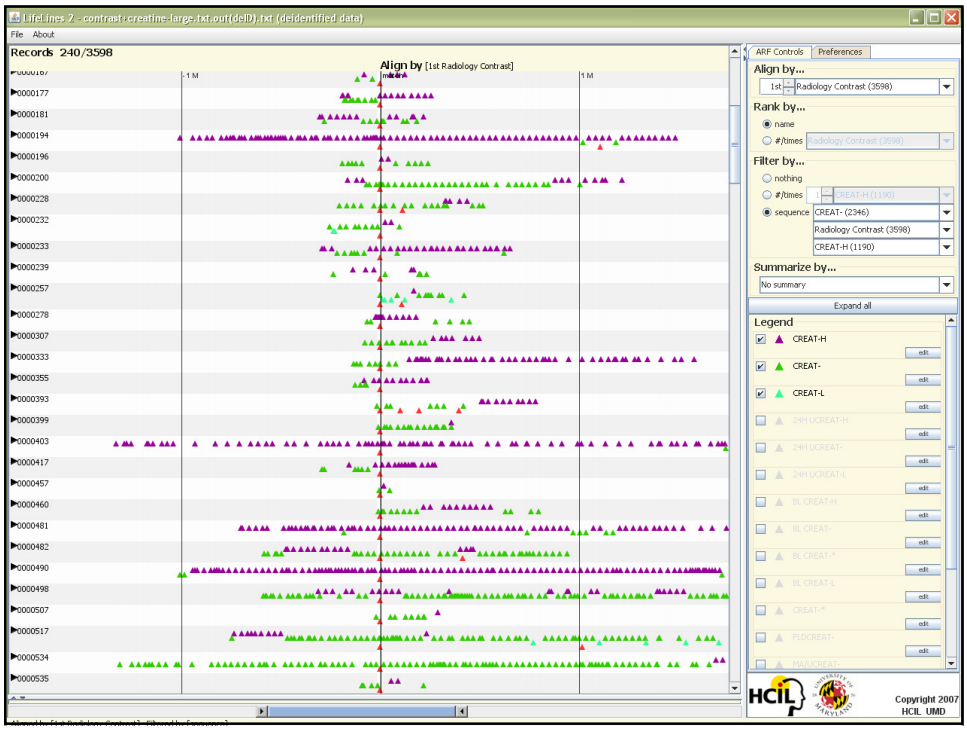
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File About
Records 240/3598
Align by [1st Radiology Contrast]
ARF Controls
Preferences
Align by...
Rank by...
Filter by...
Summarize by...
Expand all
Legend
CREAT-H
CREAT-
CREAT-L
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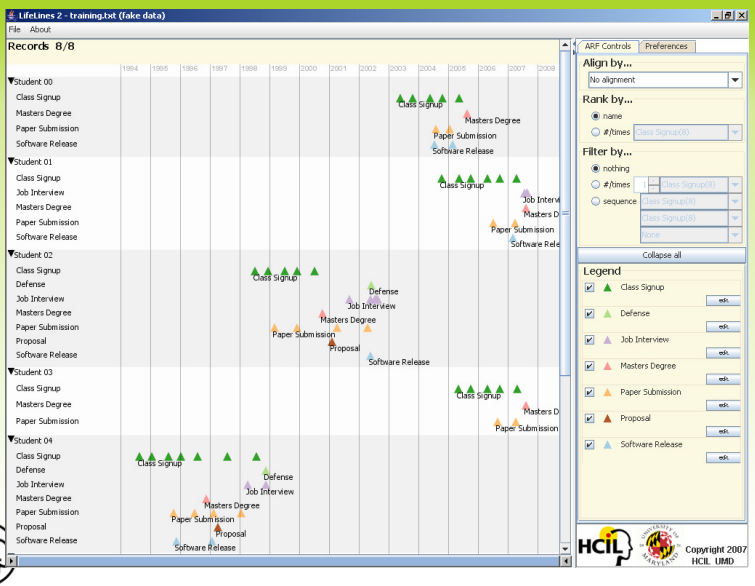
Quant. Evaluation Sample Data



Back to Evaluations

Quantitative Evaluation Tasks

Task 1: How many students submitted a paper within 1 month after proposal? (5 records)

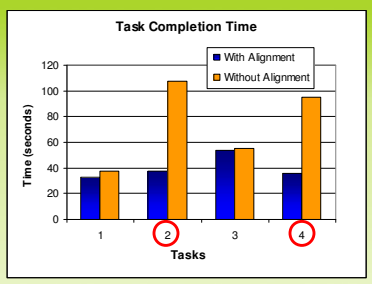
Task 2: How many students submitted a paper within 1 month after proposal? (20 records)

Task 3: How many students submitted at least 3 papers between proposal and defense?

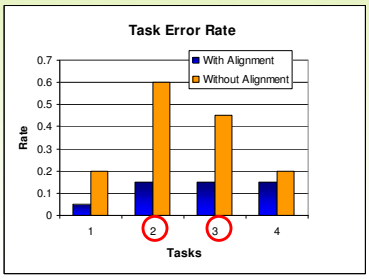
Task 4: What occurred most often within a month of a student's 1st paper submission?

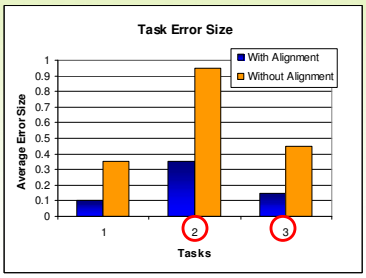
Back to Evaluations

(Alignment vs. No Alignment)



- RM 1-way ANOVA
- Counter-balanced
- Very helpful (8.3)

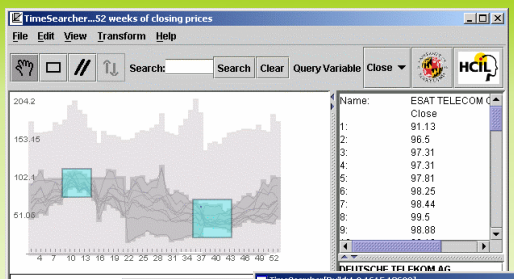




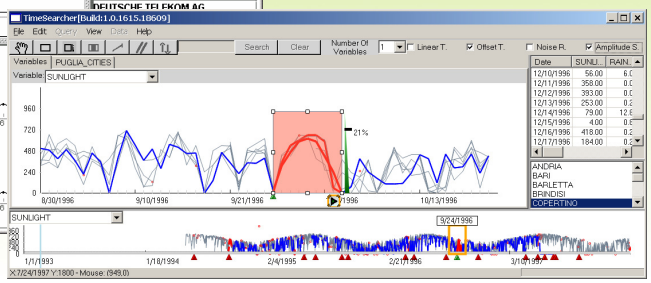
back

TimeSearcher

Dynamic queries on numerical temporal data



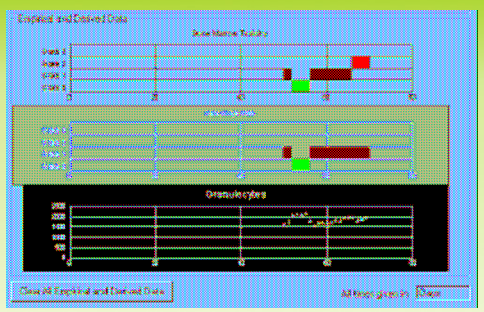
Hochheiser Infovis04



Buono VDA05

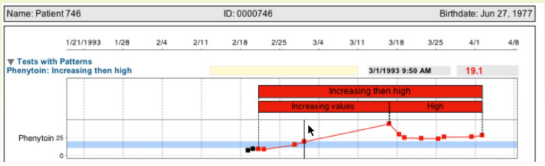
www.cs.umd.edu/hcil/timesearcher

Specification of temporal abstractions
To reason/query with them



Shahar 1999

Post 2007



No focus on interaction