



Workshop: Interactive Visual Exploration of Electronic Health Records

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Introduction: Interactive Visual Exploration of Electronic Health Records

Ben Shneiderman

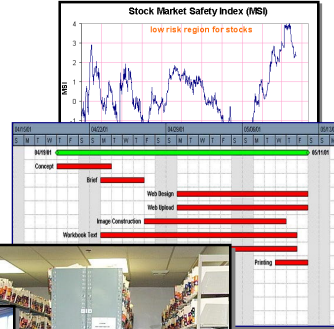
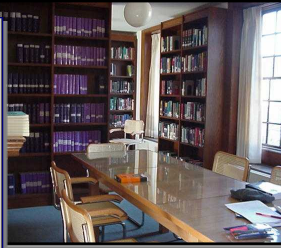
Human-Computer Interaction Lab &
Dept of Computer Science



Temporal Data is Pervasive!



- Health records
- Stock market trades
- Web log analysis
- Crime/terror activities
- Maintenance records



Business takes action

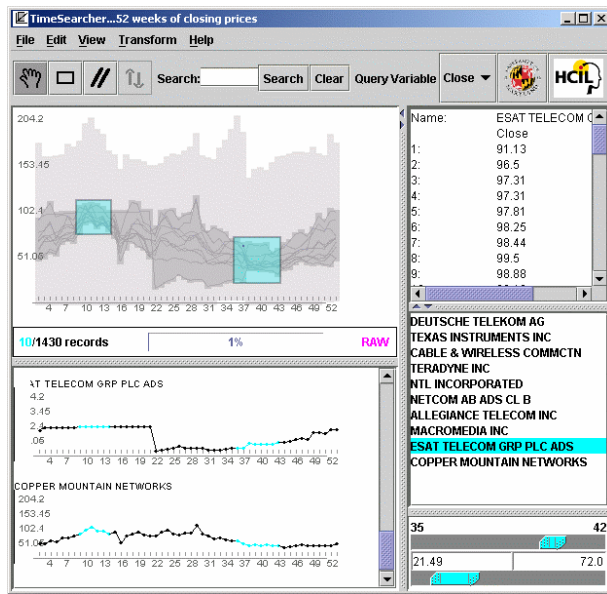
- General Dynamics **buys** MayaViz
- Agilent **buys** GeneSpring
- Google **buys** Gapminder
- Oracle **buys** (Hyperion **buys** Xcelsius)
- Microsoft **buys** Proclarity
- InfoBuilders **buys** Advizor Solutions
- SAP **buys** (Business Objects **buys** Infomersion & Inxight & Crystal Reports)
- IBM **buys** (Cognos **buys** Celequest)
- TIBCO **buys** Spotfire



Temporal Data: TimeSearcher 1.3

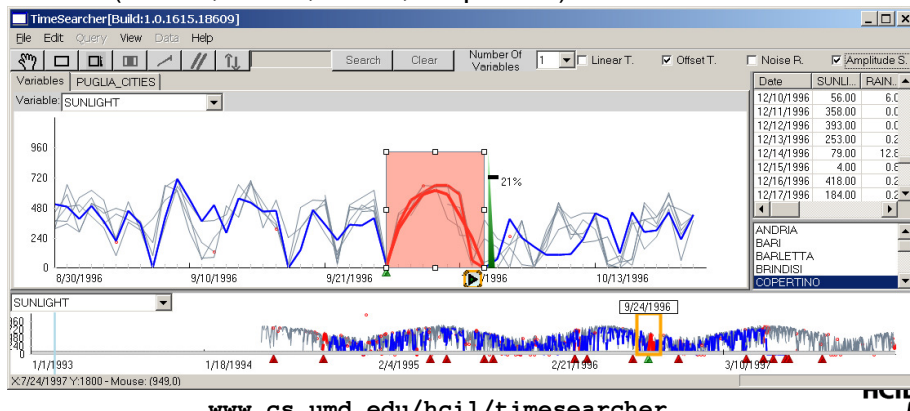
- Time series
 - Stocks
 - Weather
 - Genes
- User-specified patterns
- Rapid search

www.cs.umd.edu/hcil/timesearcher



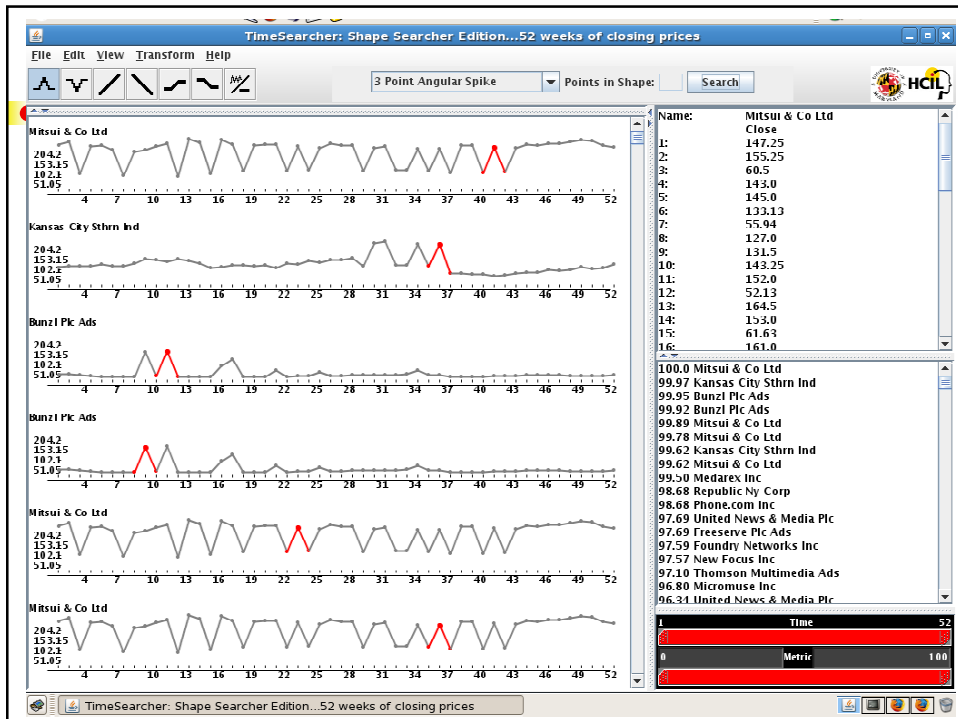
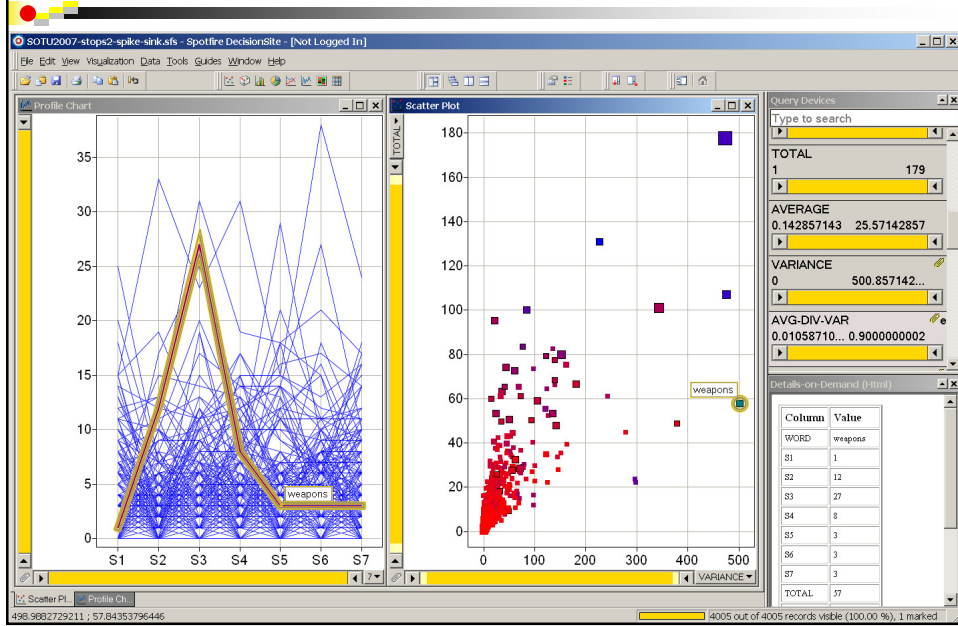
Temporal Data: TimeSearcher 2.0 & 3.0

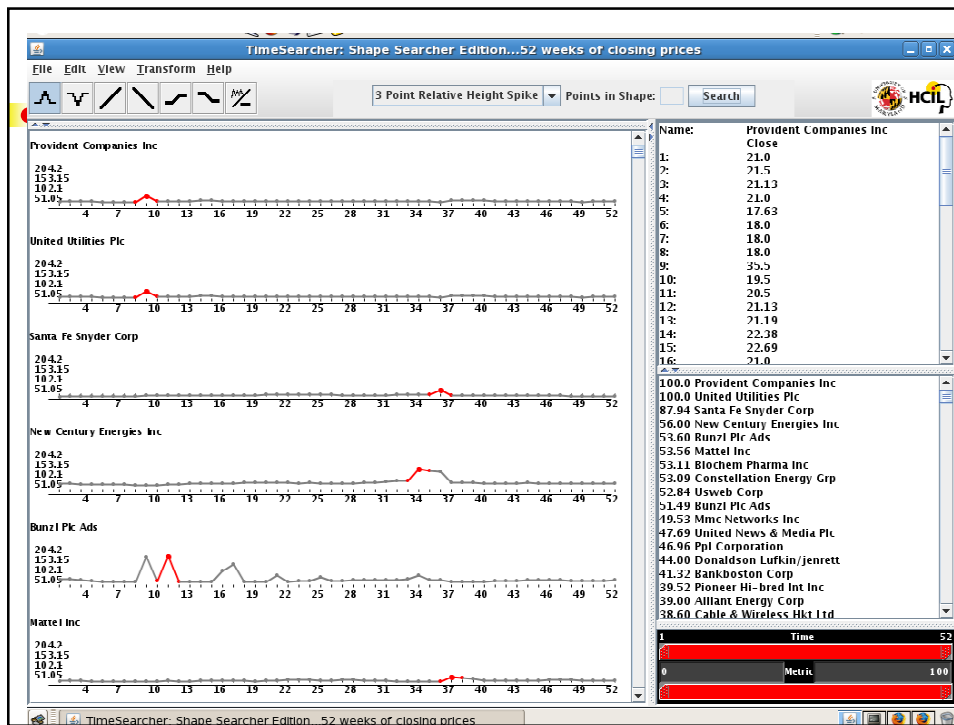
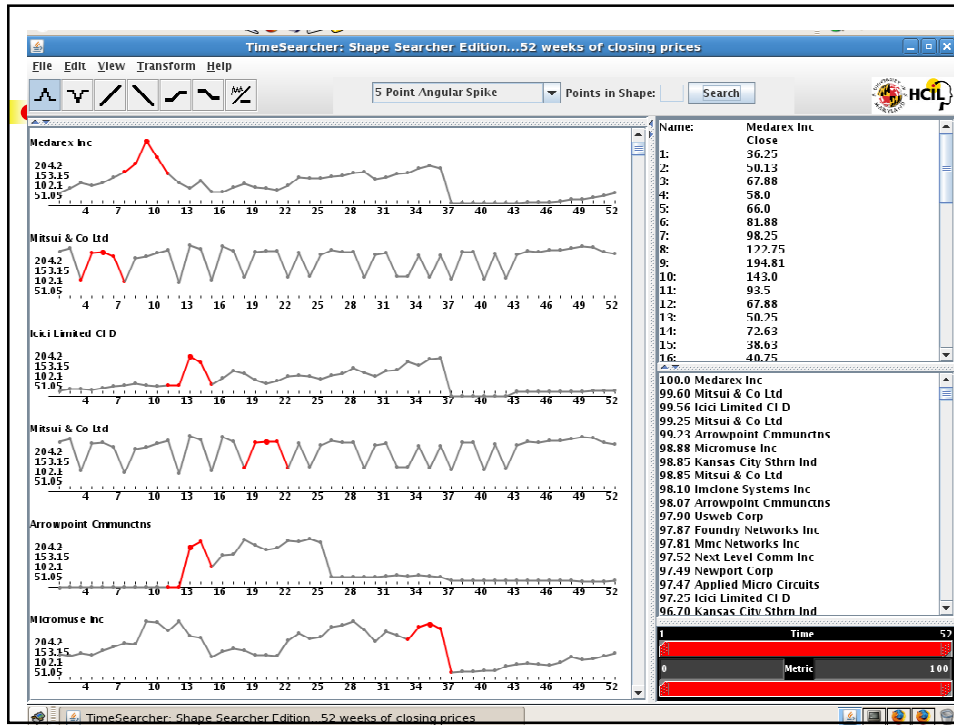
- Long Time series (>10,000 time points)
- Multiple variables
- Controlled precision in match
(Linear, offset, noise, amplitude)



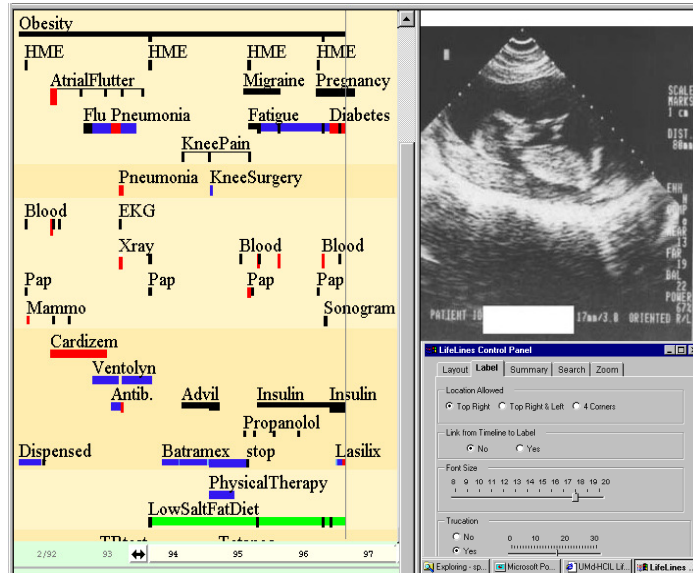
www.cs.umd.edu/hcil/timesearcher

Temporal data: Word frequencies





LifeLines: Visualizing Personal Histories



(Plaisant et al., CHI 1997)

www.cs.umd.edu/hcil/lifelines



Finding Patterns in Temporal Events

- Types of Time Data
 - Numerical Values (e.g., TimeSearcher)
 - Categorical Events & Intervals (e.g., LifeLines)
 - Categorical Events
- Goal: Find Temporal Patterns across Millions of Records
 - SQL makes it difficult to specify



Comparison with SQL

```

SELECT P.*
FROM Person P, Event E1, Event E2, Event E3, Event E4

WHERE P.PID = E1.PID
AND P.PID = E2.PID
AND P.PID = E3.PID
AND P.PID = E4.PID
AND E1.type = "Medication"
AND E1.class = "Anti Depressant"
AND E1.name = "Remeron"
AND E2.type = "Medication"
AND E2.class = "Anti Depressant"
AND E2.name = "Remeron"
AND E3.type = "Medication"
AND E3.class = "Anti Depressant"
AND E3.name = "Remeron"
AND E2.value > E1.value
AND E3.value >= E2.value
AND E2.date > E1.date
AND E3.date >= E2.date
AND E4.type = "Visit"
AND E4.class = "Hospital"
AND E4.name = "Emergency"
AND E4.value = "Heart Attack"
AND E4.date >= E3.date
AND 180 <= (E4.date - E3.date)
    
```

Patients with increasing dosages of Remeron followed by a heart attack within 180 days

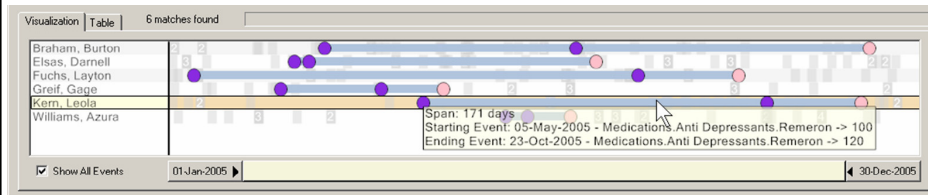


PatternFinder Interface

Patients with increasing dosages of Remeron followed by a heart attack within 180 days



Result set visualization: ball & chain



Five matches!

Patients with increasing dosages of Remeron followed by a heart attack within 180 days

www.cs.umd.edu/hcil/patternfinder



Current work

Washington Hospital Center & Partners HealthCare

- Developing taxonomy of simple queries based on interviews with physicians
- Designed interface to fit in Azyxxi-Amalga

- Lab value [HGB] increases by 50% in 10 days
- Lab value [Platelets] is high in a patient on heparin, then decreases > 20%
- Patient seen at ER & discharged, then returns to ER within 14 days & condition = [dead]



Patient History Search: WHC- PatternFinder

Pattern Search

Available Fields: MRN, Age, Sex, Lab_ObservationDtM, AbnormalFlags, Observation, Value, Units, Dx, Dsp

Filter 1: Observation EQUAL TO HGB

Filter 2: Observation EQUAL TO HGB, Value INCREASE GREATER THAN (REL.) 50

Filter 3: Observation EQUAL TO HGB, Value INCREASE GREATER THAN (REL.) 50

MRN	Age	Sex	Lab_ObservationDtM	AbnormalFlags	Observation	Value	Units
3528195	57	M	2/22/2007 5:35 PM	C	HGB	5.2	G
3528195	57	M	2/23/2007 9:24 AM	L	HGB	9.1	G
3528195	57	M	2/24/2007 5:14 PM	C	HGB	5.2	G
5319394	51	F	2/19/2007 12:53 PM	L	HGB	6.8	G
5319394	51	F	2/19/2007 11:25 PM	L	HGB	10.5	G
5319394	51	F	2/27/2007 2:47 AM	L	HGB	7	G
5319394	51	F	2/20/2007 6:57 AM	L	HGB	10.7	G
5319394	51	F	2/19/2007 11:31 AM	L	HGB	6.4	G
10455134	70	F	12/20/2006 10:49 AM	C	HGB	4.2	G
10455134	70	F	12/21/2006 8:47 PM	I	HGB	8.9	G

www.cs.umd.edu/hcil/patternfinderinAzyxxi



LifeLines2: Align-Rank-Filter

LifeLines 2 - events.txt (de-identified real data)

Records: 47/47

Timeline: 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006

Align by... calendar

Rank by... name

Filter by... nothing

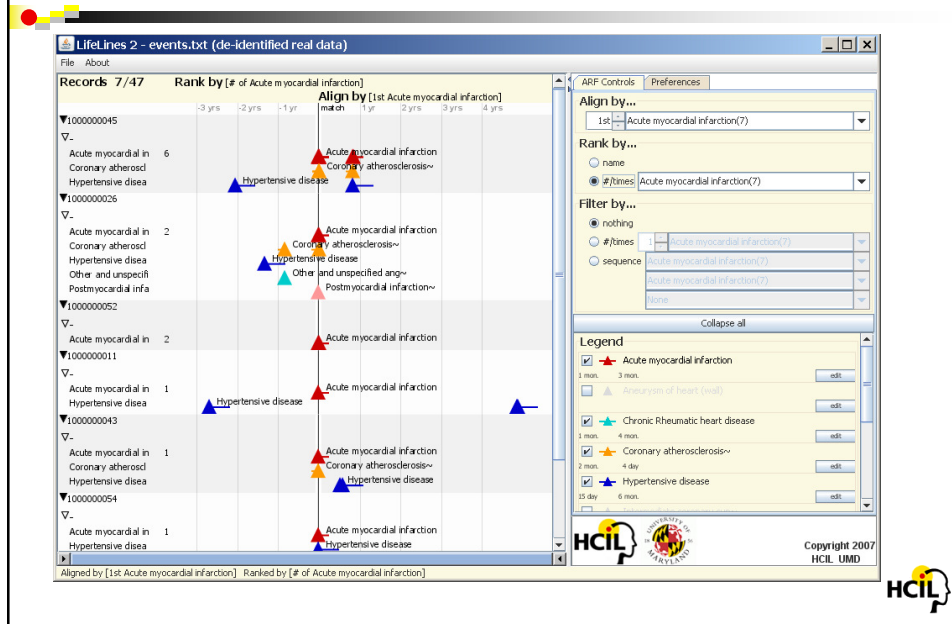
Legend:

- Acute myocardial infarction
- Aneurysm of heart (wall)
- Chronic Rheumatic heart disease
- Coronary atherosclerosis~
- Hypertensive disease
- Intermediate coronary syn~

www.cs.umd.edu/hcil/lifelines2



LifeLines2: Align-Rank-Filter



Take Away Messages

- Queries for temporal events are possible!
 - Visual specification
 - Rapid execution
 - Visualization of results: ball & chain view
- Goal: Facilitate medical treatment & research

Thanks to:

Washington Hospital Center & Partners HealthCare

www.cs.umd.edu/hcil/patternfinderinAzyxxi
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