LifeFlow: Visualizing an Overview of Event Sequences

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CHI 2011
vancouver, bc
LifeFlow: Visualizing an Overview of Event Sequences by Krist Wongsuphasawat is licensed under a Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License.
(7:00 am, Wake up)
LIFE

"Event Sequence"

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Human Activities

( 7:00 am, Wake up )  ( 7:10 am, Shower )  ( 7:30 am, Breakfast )
Traffic Incidents Logs

( 9:30 am, Notification )

( 9:55 am, Units arrived )

( 10:30 am, Scene cleared )
Event Sequences

Human Activities
Electronic Health Records
Traffic Incident Logs
Usability Study Logs
Web logs

and more...
Physicians at Washington Hospital Center
Electronic Health Records

- E.g. patient transfers in the hospital
- Event types:

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARRIVAL</td>
<td>Arrive the hospital</td>
</tr>
<tr>
<td>EMERGENCY</td>
<td>Emergency room</td>
</tr>
<tr>
<td>ICU</td>
<td>Intensive Care Unit</td>
</tr>
<tr>
<td>FLOOR</td>
<td>Normal room</td>
</tr>
<tr>
<td>DISCHARGE-ALIVE</td>
<td>Leave the hospital alive</td>
</tr>
<tr>
<td>DIE</td>
<td>Leave the hospital dead</td>
</tr>
</tbody>
</table>
Improve the Quality of Care

Emergency Department

Patient ID: 45851733
- 12/02/2008 14:26 Arrival
- 12/02/2008 14:26 Emergency
- 12/02/2008 22:44 ICU
- 12/05/2008 05:07 Floor
- 12/08/2008 10:02 Floor
- 12/14/2008 06:19 Discharge

Patient ID: 45851732
- 12/02/2008 14:26 Arrival
- 12/02/2008 14:26 Emergency
- 12/02/2008 22:44 ICU
- 12/05/2008 05:07 Floor
- 12/08/2008 10:02 Floor
- 12/14/2008 06:19 Discharge

Patient ID: 45851731
- 12/02/2008 14:26 Arrival
- 12/02/2008 14:26 Emergency
- 12/02/2008 22:44 ICU
- 12/05/2008 05:07 Floor
- 12/08/2008 10:02 Floor
- 12/14/2008 06:19 Discharge

6,000+ patients per month

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Visualizing event sequences
From one event sequence...

- Single record

Patient ID: 45851737
12/02/2008 14:26 Arrival
12/02/2008 14:26 Emergency
12/02/2008 22:44 ICU
12/05/2008 05:07 Floor
12/08/2008 10:02 Floor
12/14/2008 06:19 Discharge

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To multiple event sequences...

- Search [Fails06], [Wang08], [Vrotsou09], ...
To multiple event sequences...

- Search \([\text{Fails06}], [\text{Wang08}], [\text{Vrotsou09}], \ldots\)
To multiple event sequences...

• Search  
  [Fails06], [Wang08], [Vrotsou09], ...

• Group  
  [Phan07], [Burch08], [Wang09], ...

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To multiple event sequences...

- Search
- Group
- Summarize?
Summarize

e.g. 1) What happened to the patients after they arrived?

2) What happened to the patients before & after ICU?
Overview / Summary

Millions of records
Challenges

• Display millions of records on one screen
  – Limited space (typical monitors)
  – Scalability (millions of records?)
  – Aggregation

• While preserve important information
  – What are all the possible sequences?
  – How long is the gap between each pair of events?
LIFEFLOW

Picture > 1000 words
LifeFlow > 1000 event sequences
LIFEFLOW

... is novel

... is scalable

... provides the missing overview

... summarizes all possible sequences and time gap between events
LifeFlow: Visualizing an Overview of Event Sequences

VIDEO
LifeFlow Design
LifeFlow: Visualizing an Overview of Event Sequences

DEMO

LifeFlow Demonstration
Case Study #1: Medical

6,000+ patients per month

Improve the Quality of Care

Feedback

• Big picture + anomalies
• Less worry about query formulation, more time thinking about new questions
• Long-term monitoring
Case Study#2: Transportation

200,000+ traffic incidents

Compare traffic agencies
100 years!
Clean the data.
Agency

Time

Notification

Return to normal
Case Study#2: Transportation

200,000+ traffic incidents

Compare traffic agencies

Feedback

• Reveal unexpected sequences
• Identify data errors
• Can ask more questions, faster, and richer
User Study

- 10 participants

Goals:
- Learnability
- Strategies / Problems

Procedure:
- 12-minute training
- 15 tasks

Results:
- Participants can perform given tasks.
Quotes

“Oh! This is very cool!”

“The tool is easy to understand and easy to use.”

“Very easy to find common and uncommon sequences”

“LifeFlow provides a great summary of the big picture.”

“Can I use it with my dataset?”
Conclusions

• **LifeFlow**
  – Overview
  – All sequences + gap between events

• **2 case studies + 1 user study**
  – Show big picture + reveal anomalies
  – New questions from the data
  – Easy to learn

• **Applicable to many domains**
Acknowledgement

• Washington Hospital Center
  Phuong Ho, Mark Smith, David Roseman
  [http://www.whcenter.org](http://www.whcenter.org)

• National Institutes of Health (NIH)
  Grant RC1CA147489-02

• CATT Lab
  Michael Pack, Michael VanDaniker, Nikola Ivanov
  [http://www.cattlab.umd.edu](http://www.cattlab.umd.edu)
Conclusions

• LifeFlow
  – Overview of event sequences
  – All sequences + gap between events
• 2 case studies + 1 user study
  – See big picture + reveal anomalies
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  – Easy to learn
• Applicable to many domains

HCIL’s 28th Annual Symposium
May 25–26, 2011
University of Maryland  #HCIL

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Any question?
THANK YOU
Your comments are welcome.