LifeFlow: Understanding Millions of Event Sequences in a Million Pixels

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LifeFlow: Understanding Millions of Event Sequences in a Million Pixels by Krist Wongsuphasawat is licensed under a Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License.
(7:00 am, Wake up)
"Event Sequence"
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...
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

6,000+ patients per month

Patient ID: 45851733
Patient ID: 45851732
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

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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

compact
To multiple event sequences...

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

![Diagram of multiple event sequences]
To multiple event sequences...

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

- **Search**
  - [Fails06], [Wang08], [Vrotsou09], ...

- **Group**
  - [Phan07], [Burch08], [Wang09], ...

---
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
  – All possible sequences
  – Gap between each pair of events
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
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LifeFlow: Visualizing an Overview of Event Sequences

DEMO
LifeFlow Demonstration
Case Study#1: Medical

6,000+ patients per month

Feedback

• Big picture + anomalies
• Less worry about query formulation, more time thinking about new questions
• Long-term monitoring

Improve the Quality of Care
Case Study#2: Transportation

200,000+ traffic incidents

Compare traffic agencies
100 years!
Clean the data.
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
Other Datasets

e.g. researchers’ publications (from Springer)
9,000+ researchers
28 mins
Average time between first and second goals

30 mins
Average time to score the first goal

33 mins
Average time to concede the first goal
Take away messages

• Life is full of event sequences.

• LifeFlow is a visual summary that supports an exploration of event sequences.

• We will be happy to try LifeFlow with your data.
Acknowledgement

• Washington Hospital Center
  Phuong Ho, Mark Smith, David Roseman
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  http://www.nih.gov

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  (a Tier 1 Transportation Center at the University of Maryland)
  Michael Pack, Michael VanDaniker, Nikola Ivanov
  http://www.cattlab.umd.edu
Take away messages

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Contact me
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www.cs.umd.edu/hcil/lifeflow
LifeFlow: Visualizing an Overview of Event Sequences

Q&A
Any question?
THANK YOU

Your comments are welcome.