



# LifeFlow:

## Visualizing an Overview of Event Sequences

Krist Wongsuphasawat  
John Alexis Guerra Gómez  
Catherine Plaisant  
Taowei David Wang  
Meirav Taieb-Maimon  
Ben Shneiderman

Human-Computer Interaction Lab  
University of Maryland

CHI 2011  
vancouver, bc

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





Time      Event type

( 7:00 am, Wake up )

event

event

event

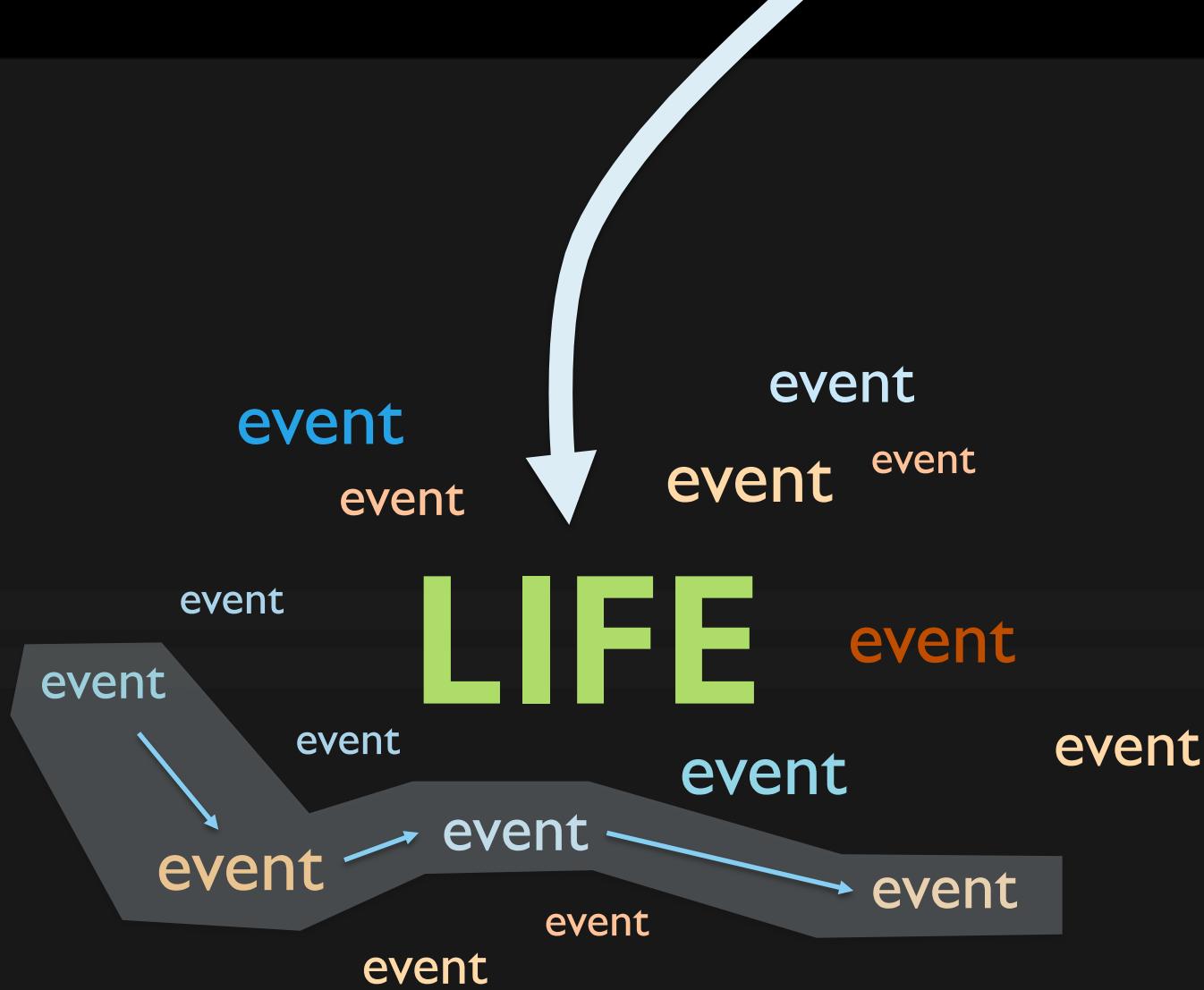
event

event

event

# LIFE

event

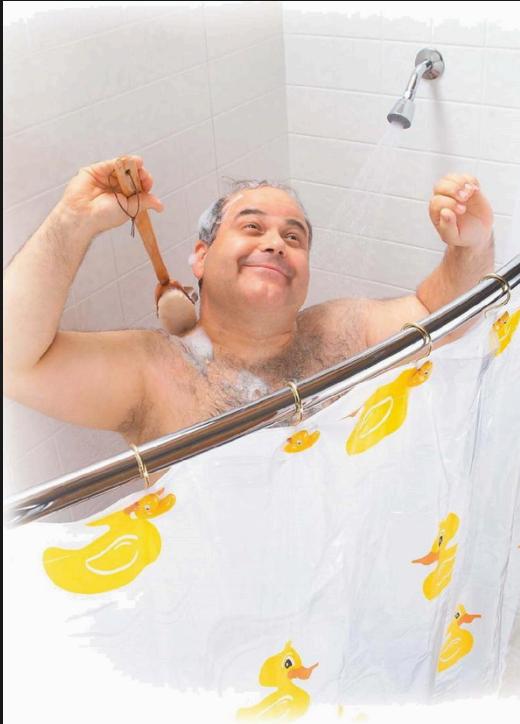


“Event Sequence”

# 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...



# Physicians at Washington Hospital Center



# Electronic Health Records

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

 ARRIVAL

Arrive the hospital

 EMERGENCY

Emergency room

 ICU

Intensive Care Unit

 FLOOR

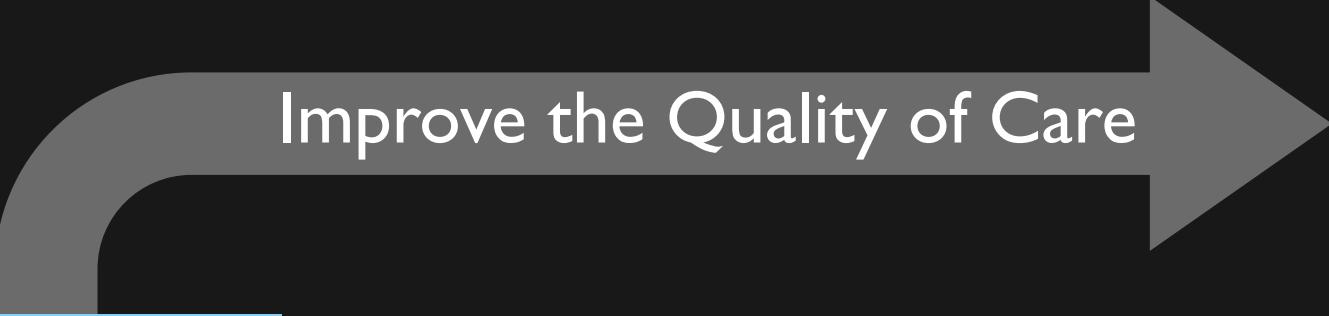
Normal room

 DISCHARGE-ALIVE

Leave the hospital alive

 DIE

Leave the hospital dead



Improve the Quality of Care

Patient ID: 45851733

Patient ID: 45851732

Patient ID: 45851731

1

1

12/02/2008 14:26 Arrival

1

1

12/02/2008 14:26 Emergency

1

1

12/02/2008 22:44 ICU

1

1

12/05/2008 05:07 Floor

1

12/08/2008 10:02 Floor

1

12/14/2008 06:19 Discharge

## Emergency Department

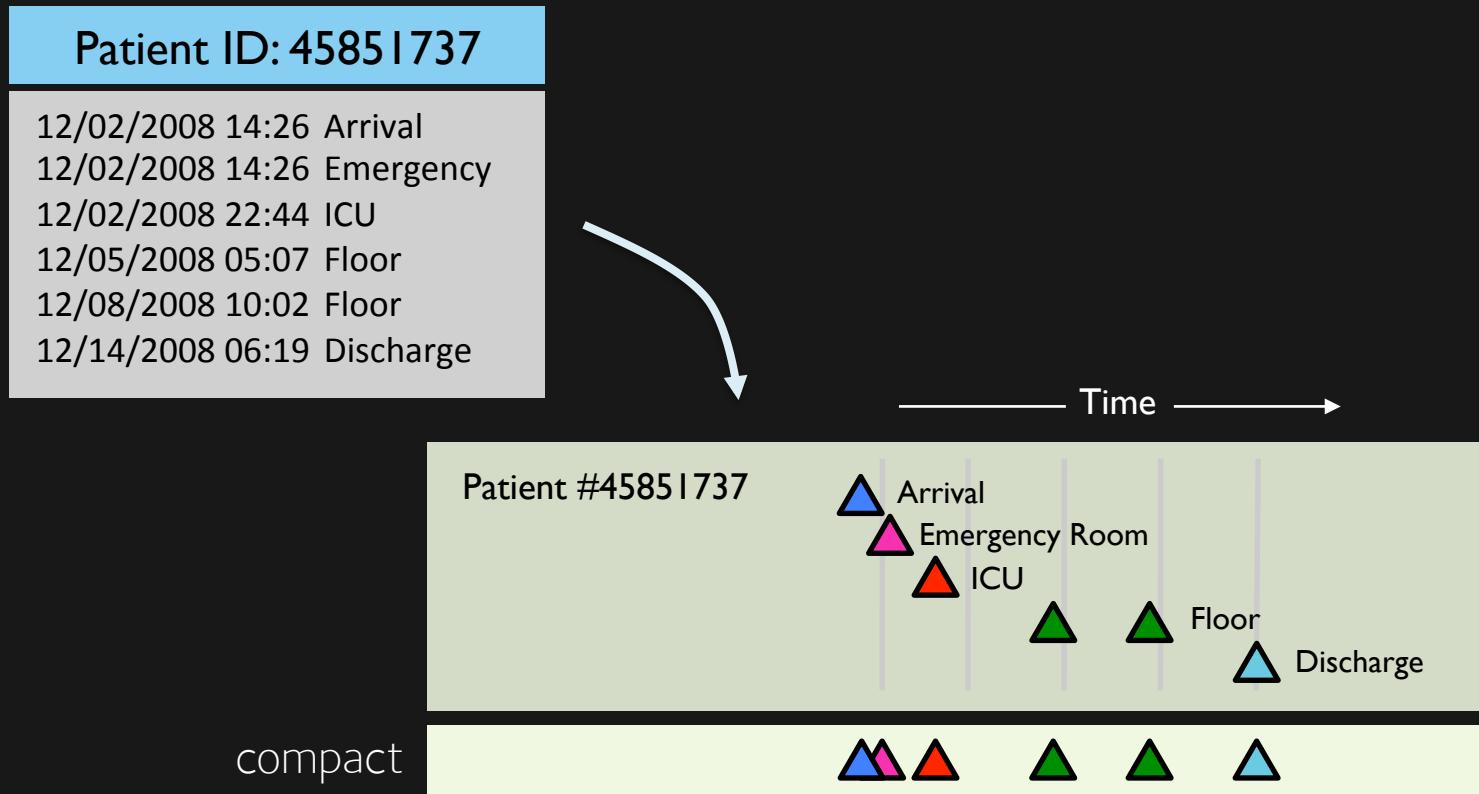
6,000+

patients per month

# Visualizing event sequences

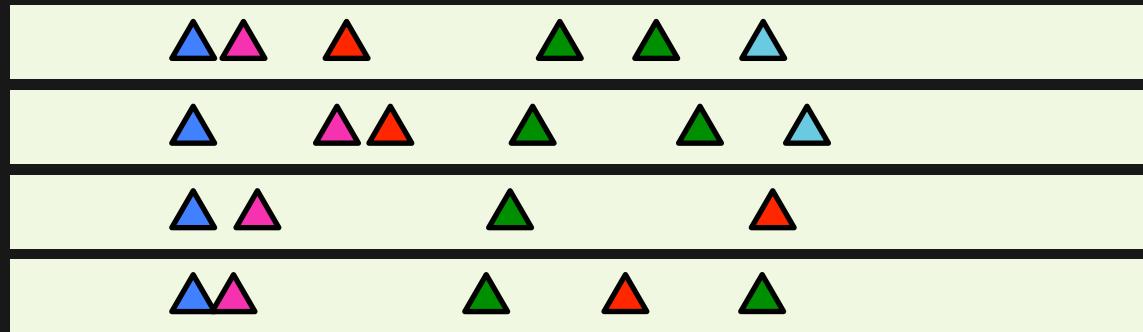
# From one event sequence...

- Single record [Cousins91], [Harrison94], [Plaisant98], ...



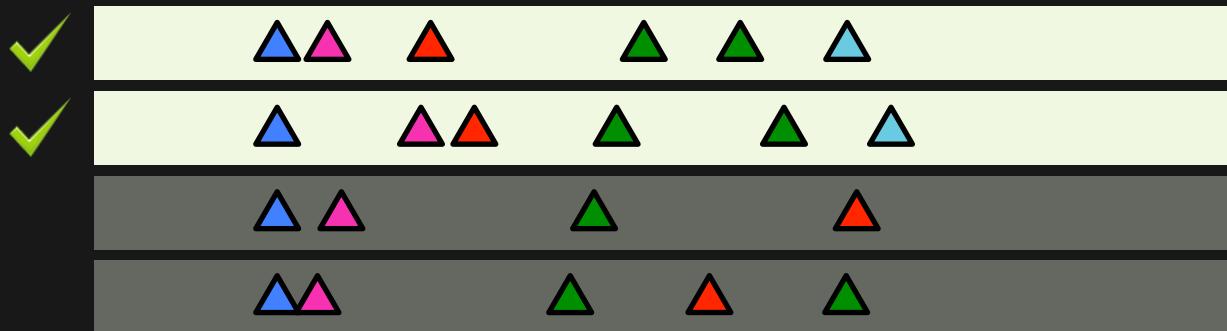
# To multiple event sequences...

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



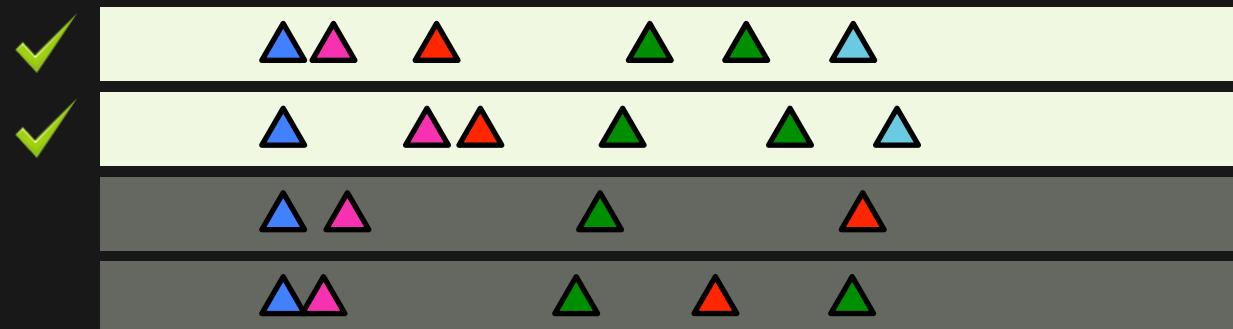
# To multiple event sequences...

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

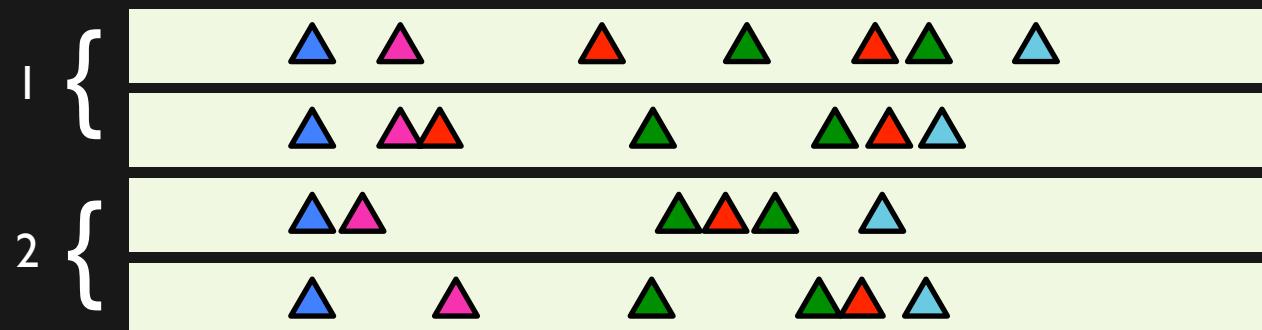


# To multiple event sequences...

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



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



# To multiple event sequences...

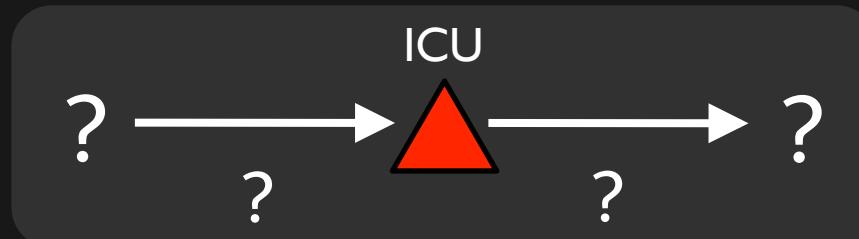
- Search
- Group
- Summarize?

# Summarize

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



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

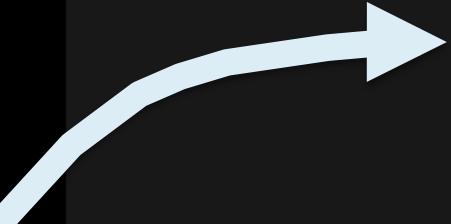


# Overview / Summary

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

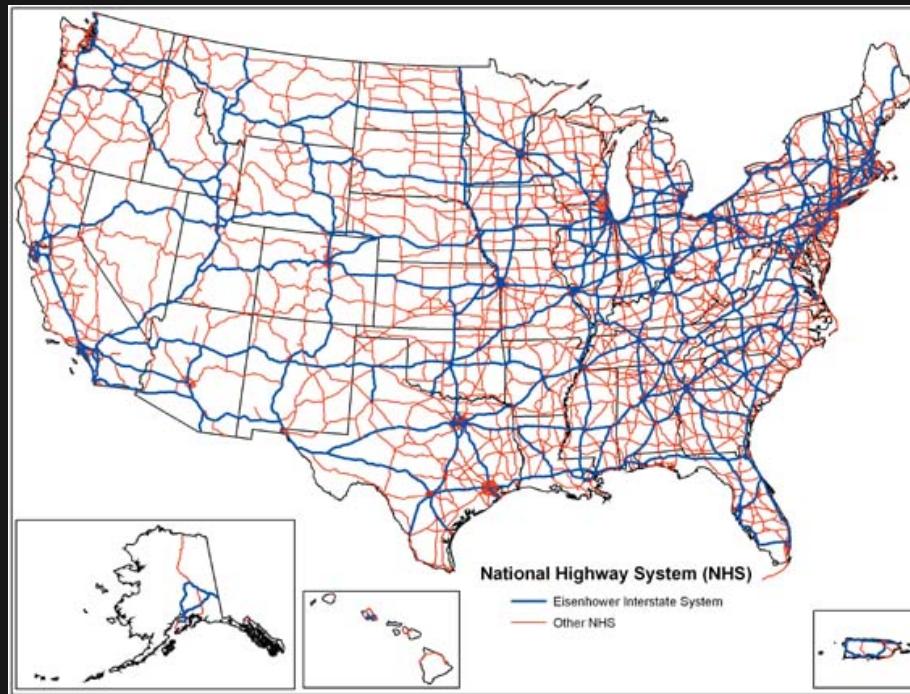
- Big picture + anomalies
- Less worry about query formulation,  
more time thinking about new questions
- Long-term monitoring

# Case Study#2: Transportation

200,000+

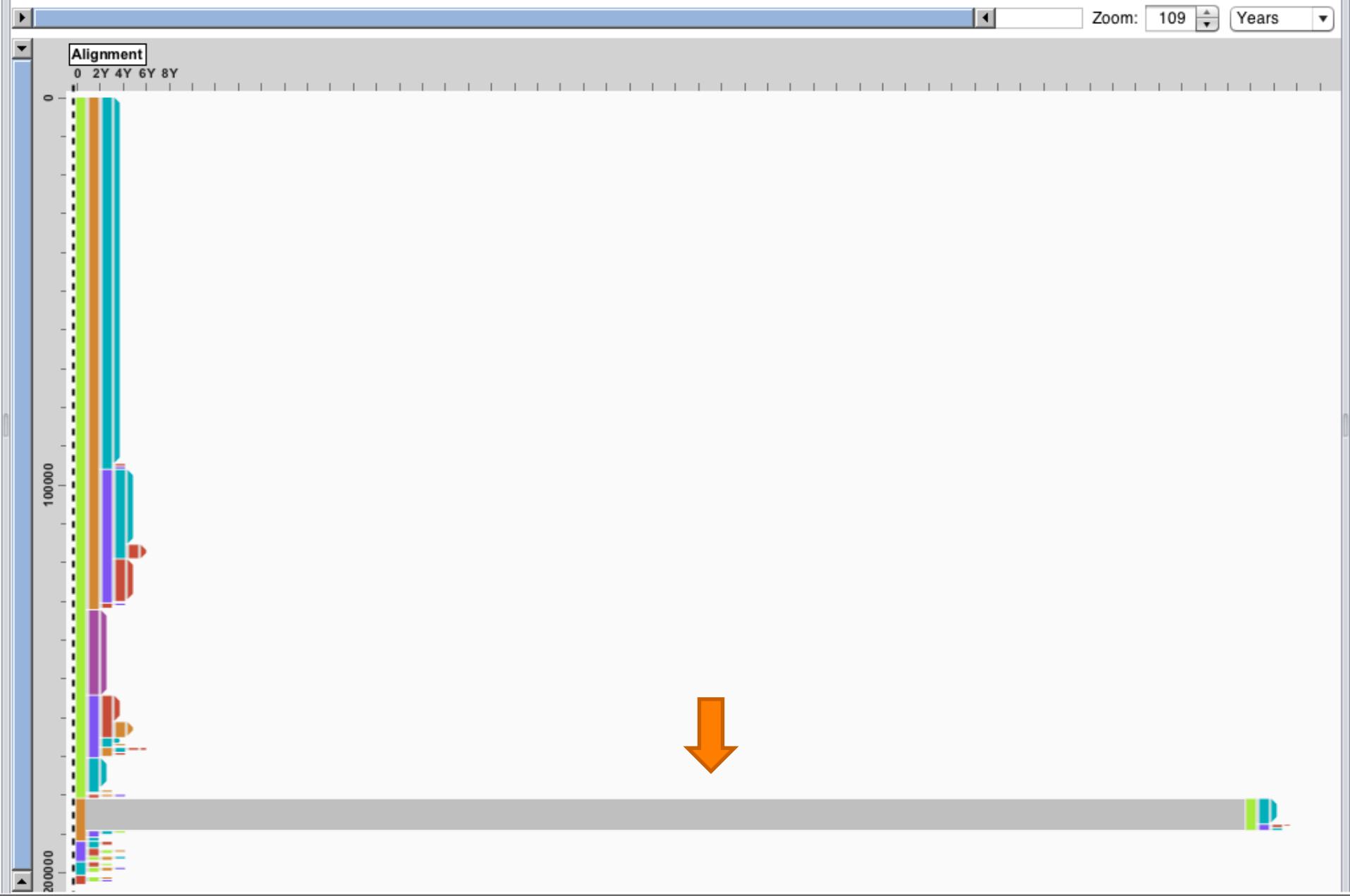
traffic incidents

Compare traffic agencies

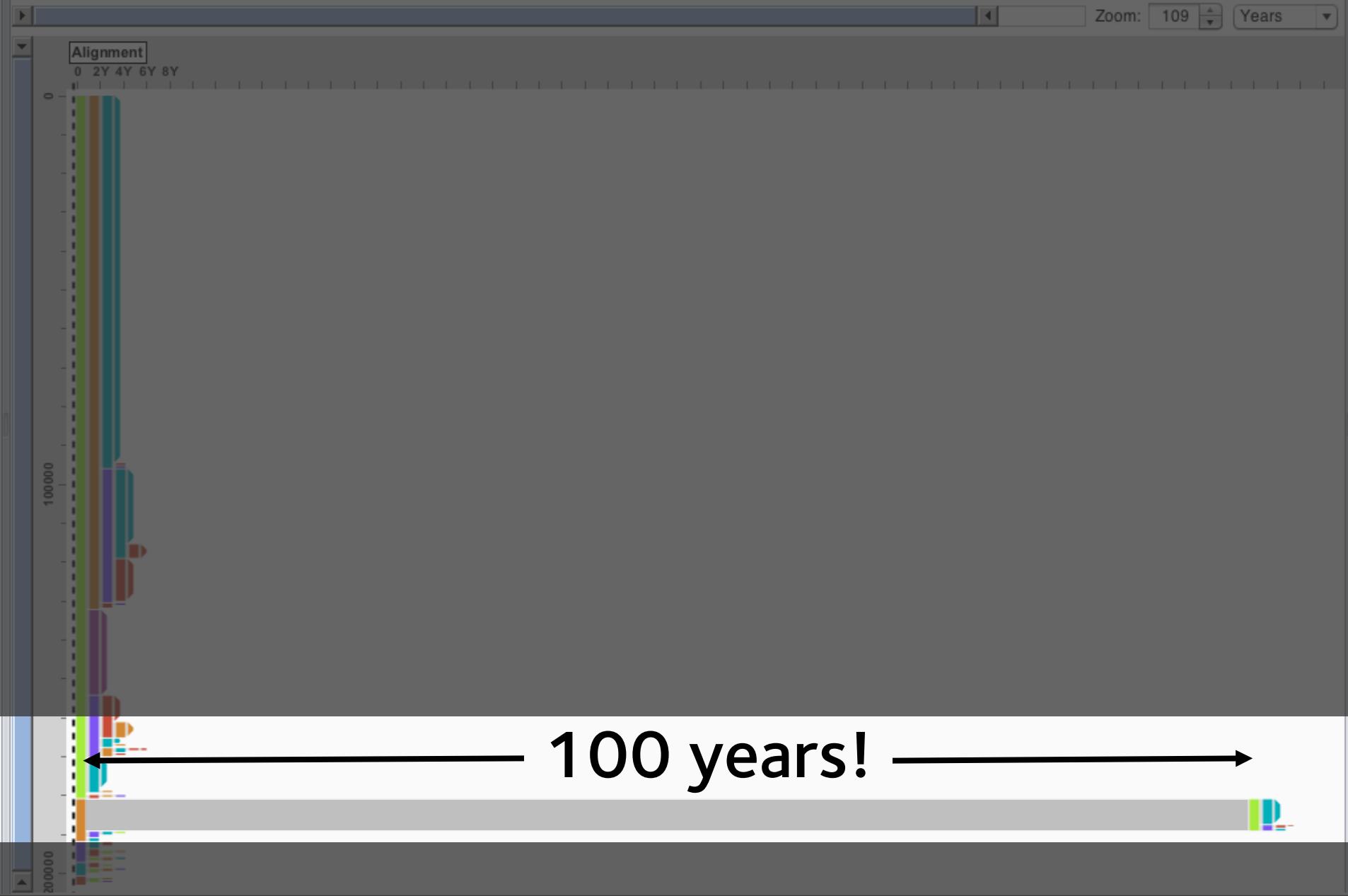


File Selection View Help

Measurement Tool



Measurement Tool



# Clean the data.



File Selection View Help

**Data Manager Control**

Raw data (CATTLab\_003\_all...) Showing: 195504/195504 re...

Selected: 0 record

All Remove them Remove others

**All Overview Timeline**

Align Filter

Please specify how to align:

 No alignment

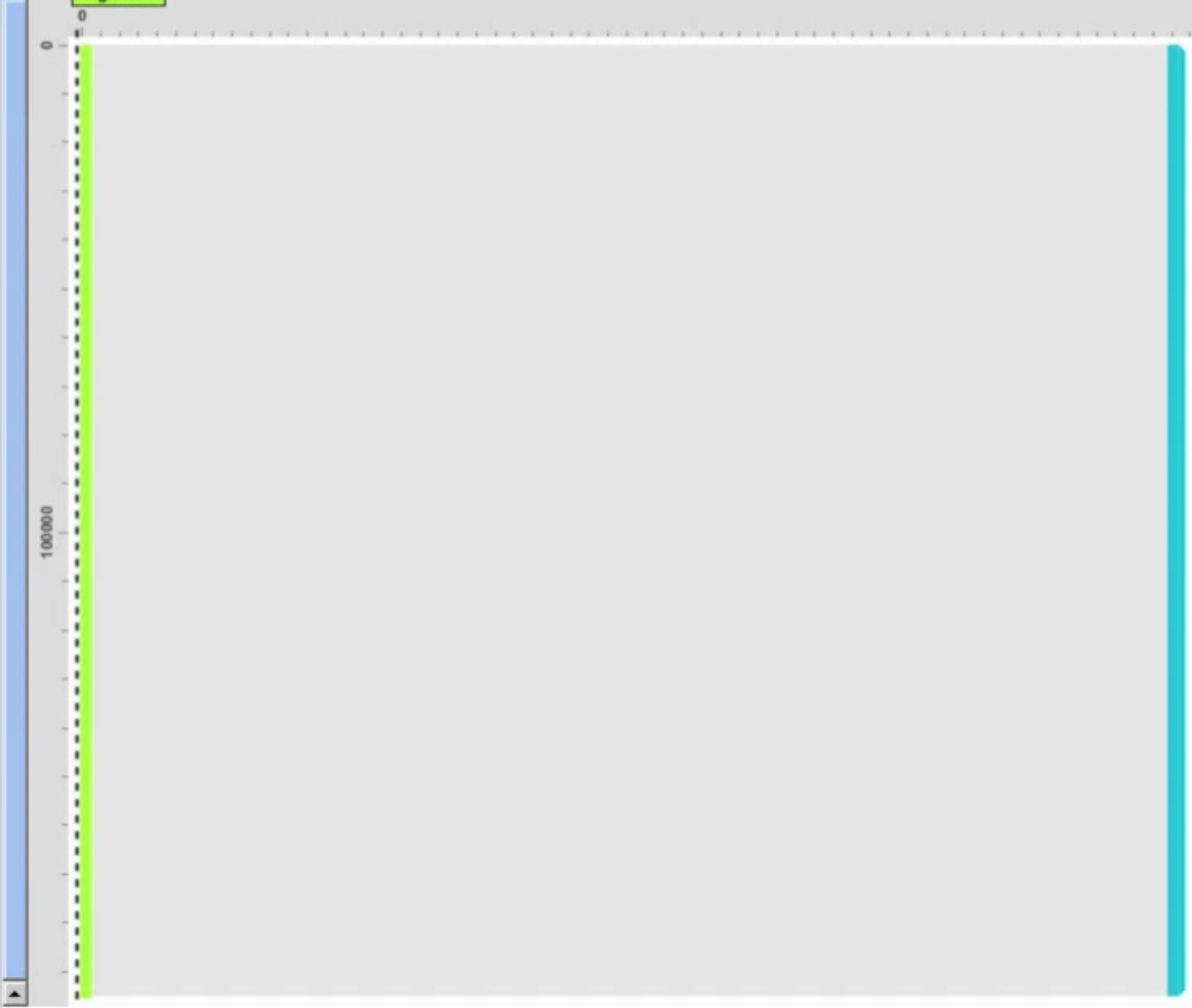
1 st Incident notific  
from the beginning

All

(no advanced option selected)

 automatic update**Legend Attribute History**

- Incident notification
- Incident arrival
- Incident clearance
- Return to normal (Aggregated)
- Incident cleared
- Lane clearance
- Return to normal

**Measurement Tool****Alignment**

Zoom: 1 Hours

File Selection View Help

**Data Manager Control**

Raw data (CATTLab\_003\_all... Showing: 195504/195504 re...)

Selected: 0 record

All Remove them Remove others

All Overview Timeline

Align Filter

Please specify how to align:

- No alignment
- 1 st Incident notific from the beginning
- All Incident notific

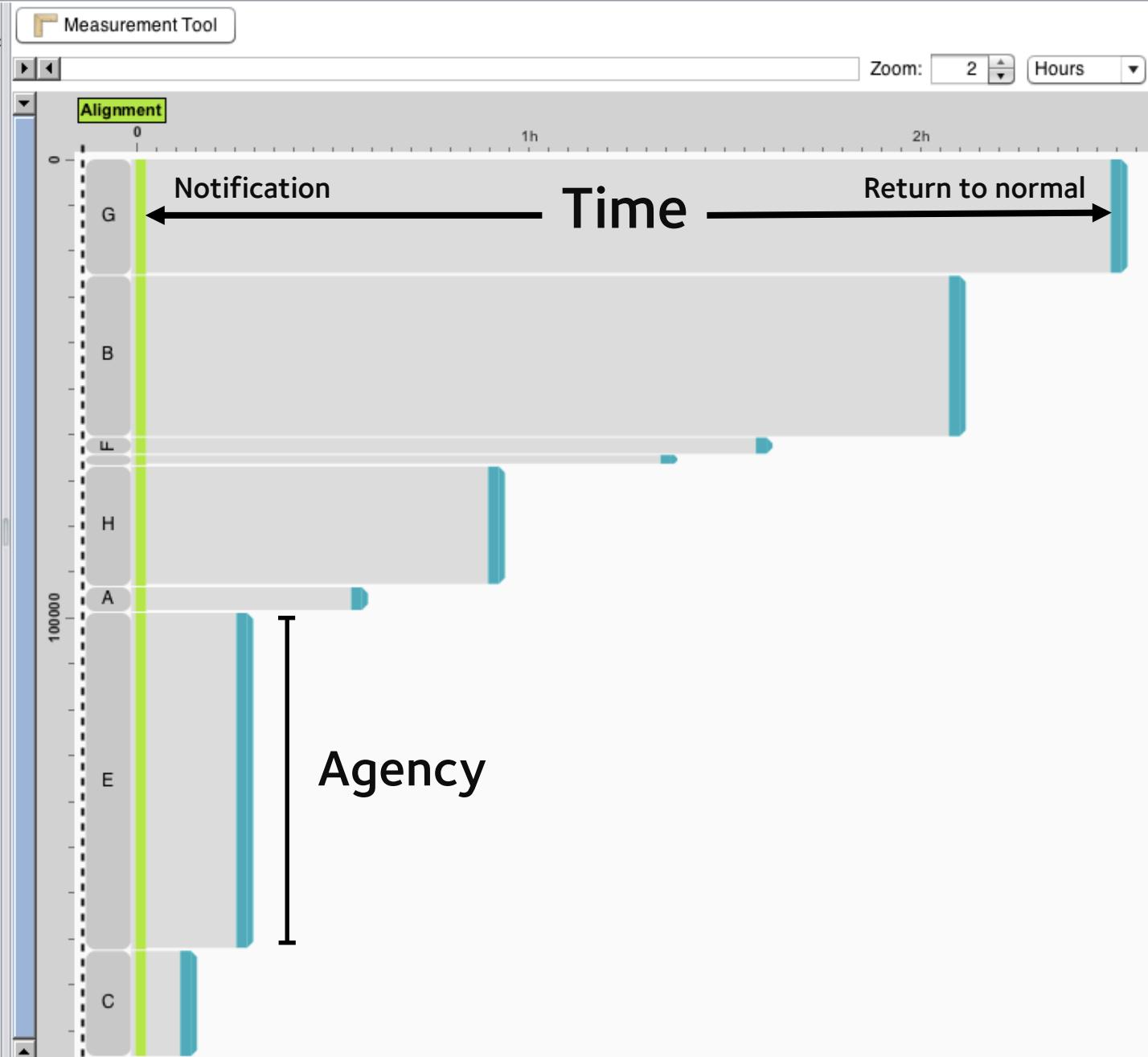
(no advanced option selected)

Advanced Options...

automatic update **Align**

**Legend Attribute History**

- Incident notification
- Incident arrival
- Incident clearance
- Return to normal (Aggregated)
- Incident cleared
- Lane clearance
- 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>

- National Institutes of Health (NIH)

Grant RC1CA147489-02  
<http://www.nih.gov>

- CATT Lab

Michael Pack, Michael VanDaniker, Nikola Ivanov  
<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
  - New questions from the data
  - Easy to learn
- Applicable to many domains



HCIL's 28<sup>th</sup> Annual Symposium  
May 25-26, 2011  
University of Maryland #HCIL



Contact me  
[kristw@cs.umd.edu](mailto:kristw@cs.umd.edu)  
[www.cs.umd.edu/hcil/lifeflow](http://www.cs.umd.edu/hcil/lifeflow)

# LifeFlow:

## Visualizing an Overview of Event Sequences

**Q&A**

Any question?



# LifeFlow:

Visualizing an Overview  
of Event Sequences



**THANK YOU**

Your comments are welcome.