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LifeFlow:
Understanding Millions of Event Sequences in a Million Pixels

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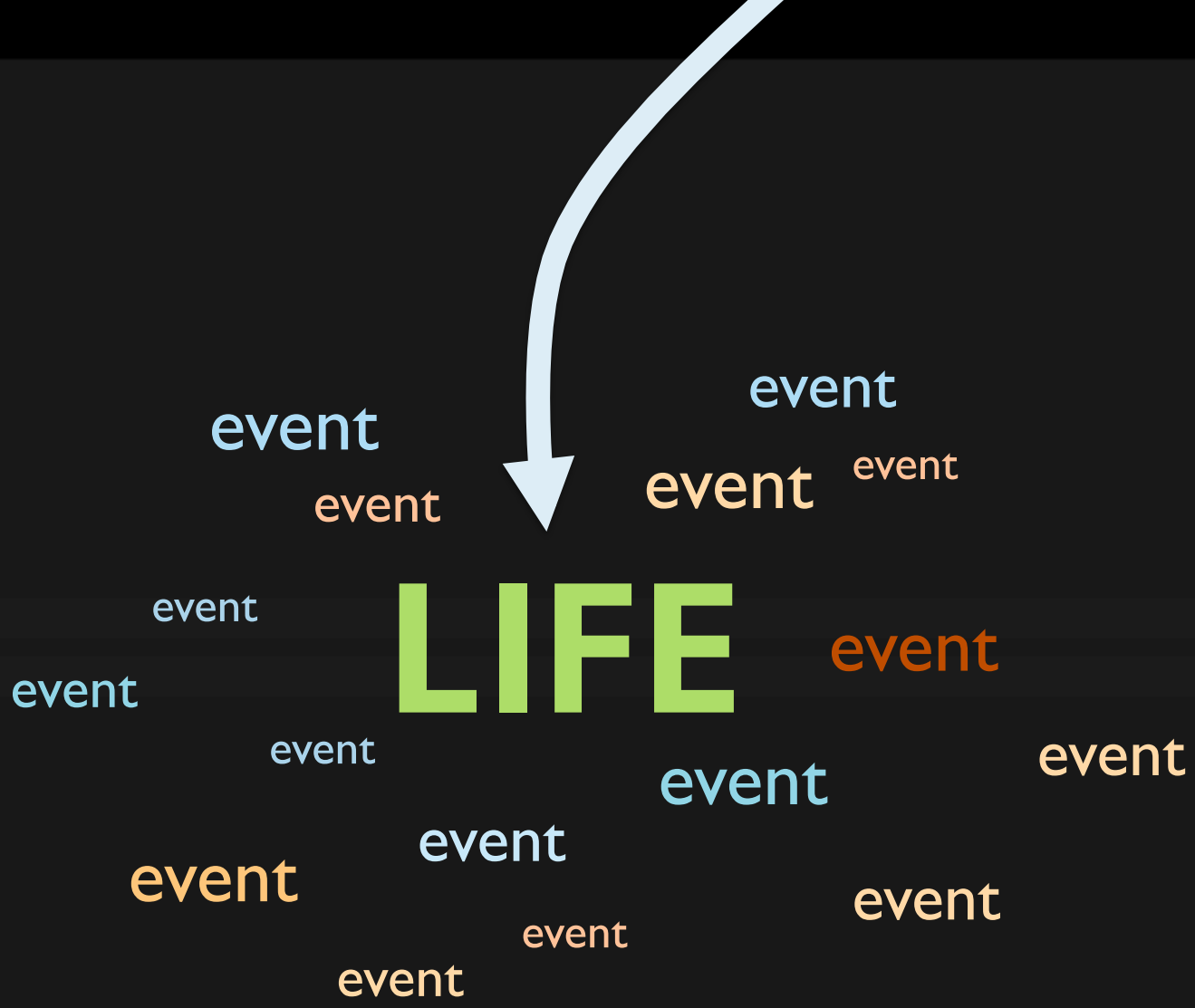
28th HCIL Symposium
May 25, 2011

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

HCIL



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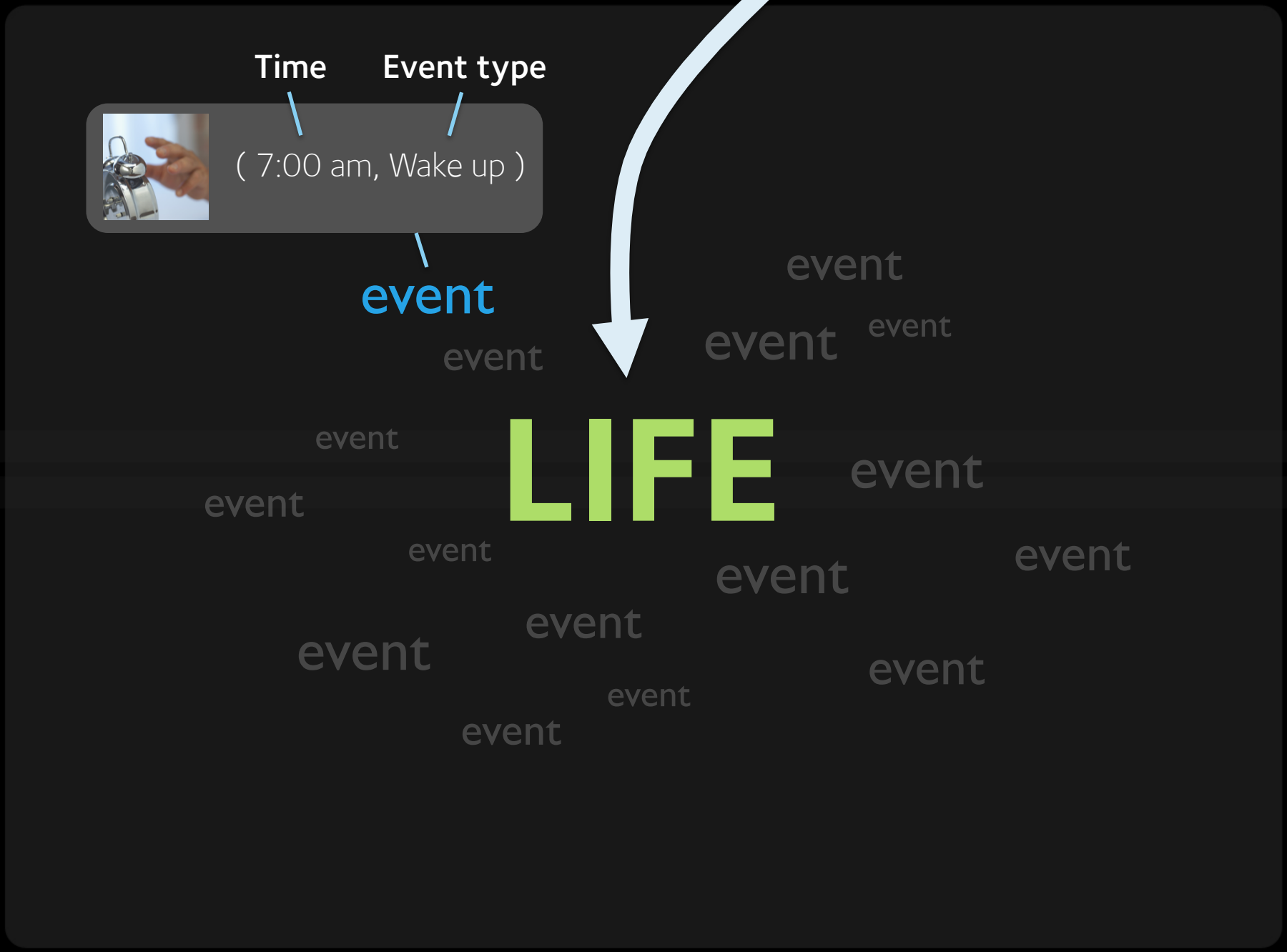

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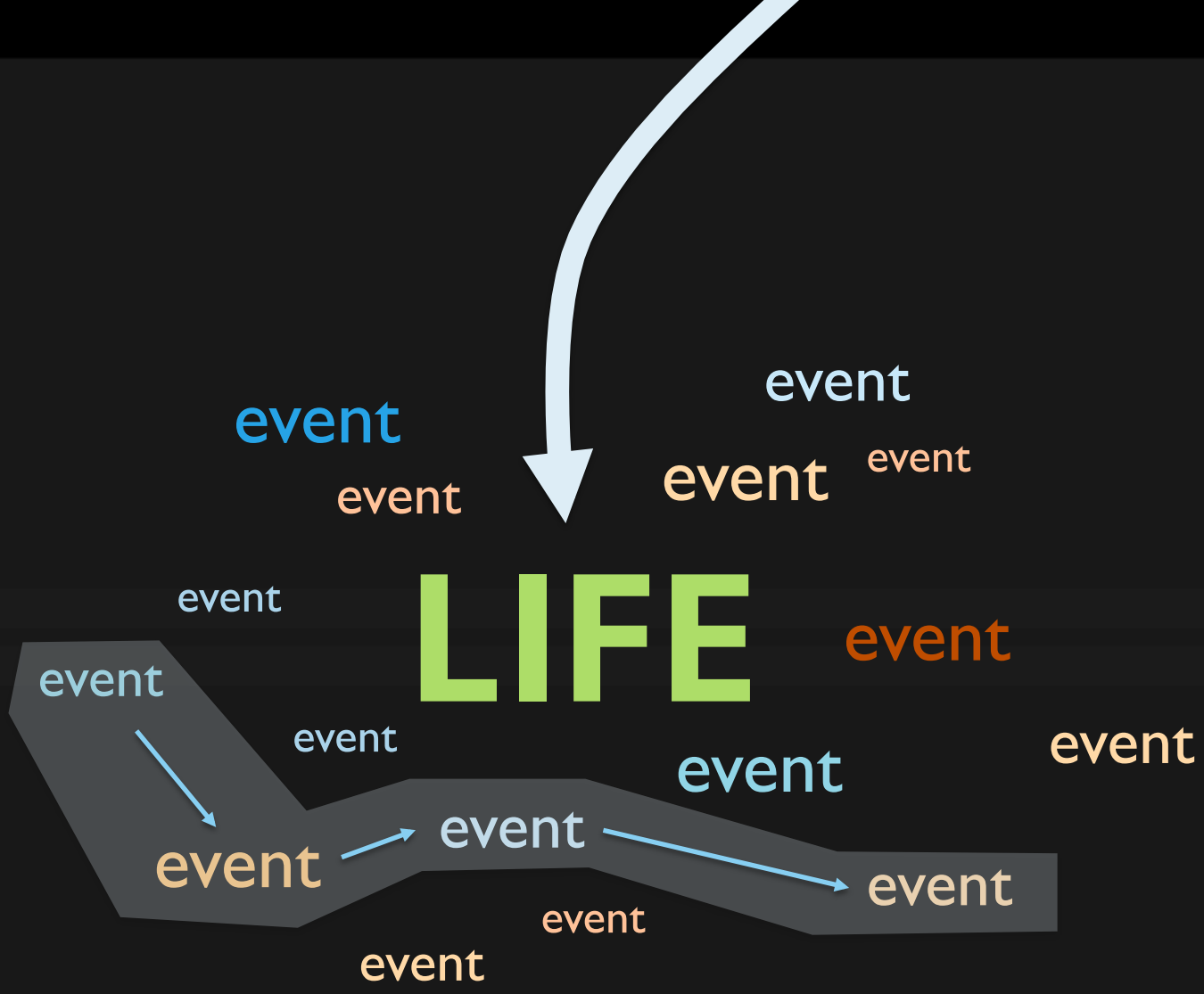

"Event Sequence"

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Human Activities

(7:00 am, Wake up)

(7:10 am, Shower)

(7:30 am, Breakfast)

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Traffic Incidents Logs

(9:30 am, Notification)

(9:55 am, Units arrived)

(10:30 am, Scene cleared)

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Event Sequences

Human Activities

Electronic Health Records

Traffic Incident Logs

Usability Study Logs

Web logs

and more...

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Physicians at

Washington Hospital Center

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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

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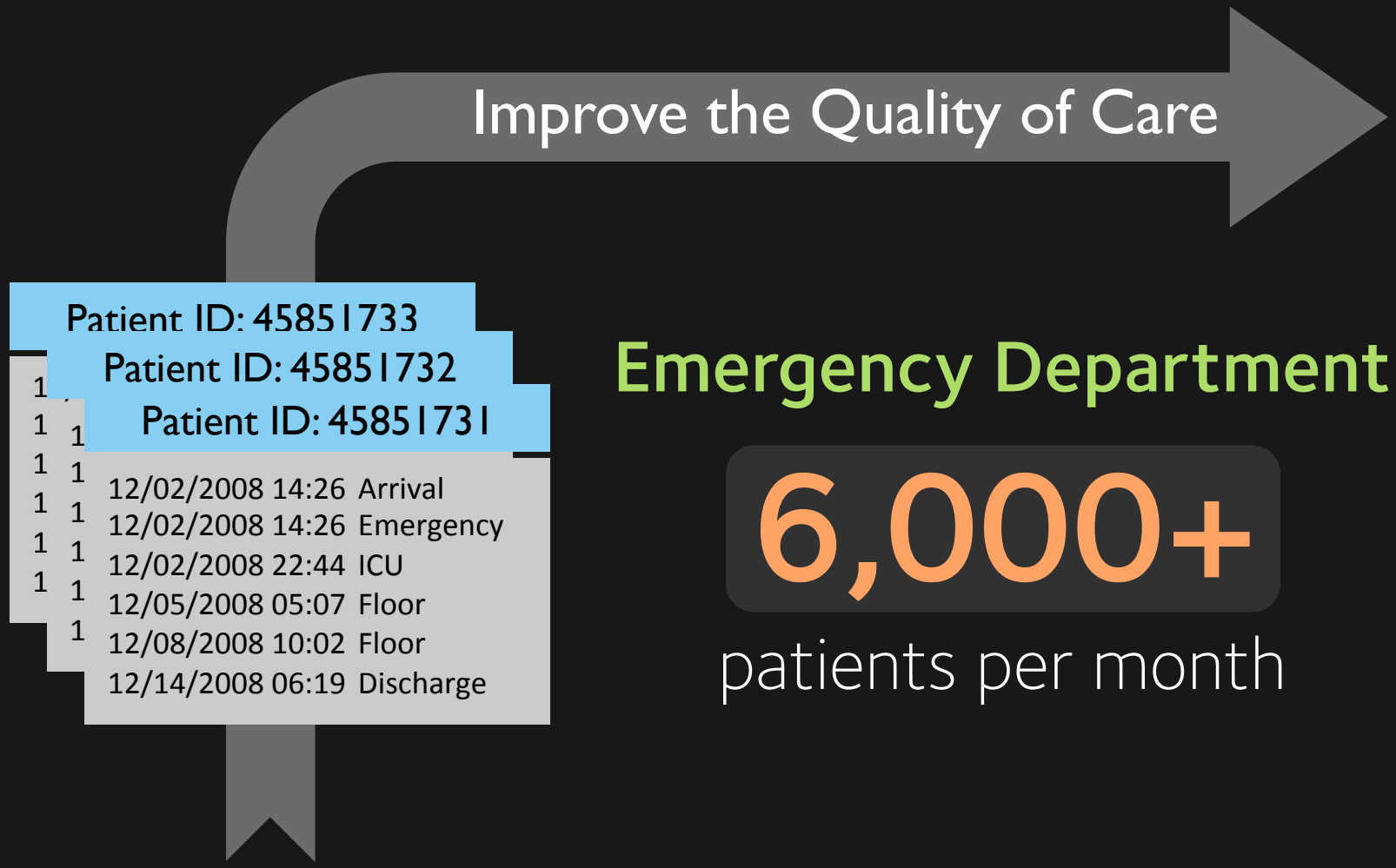

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Visualizing event sequences

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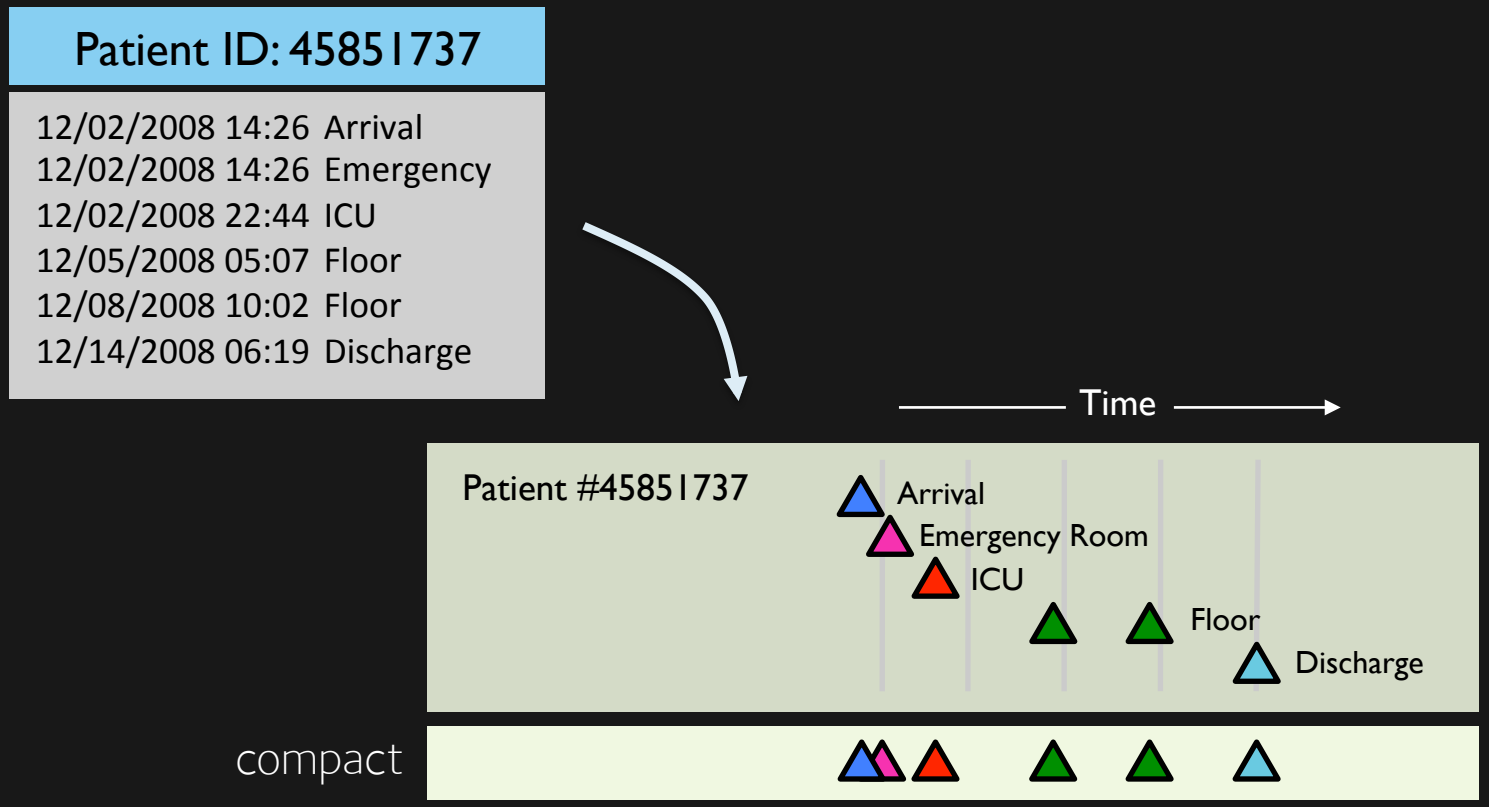
From one event sequence...

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



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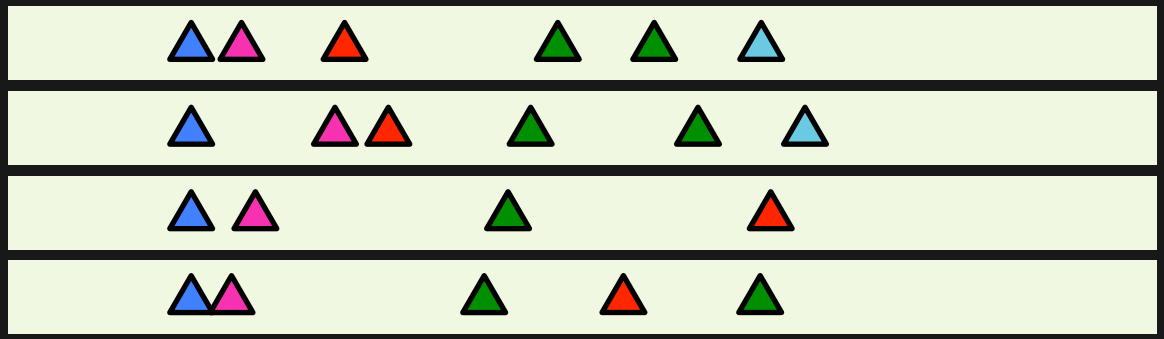
To multiple event sequences...

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



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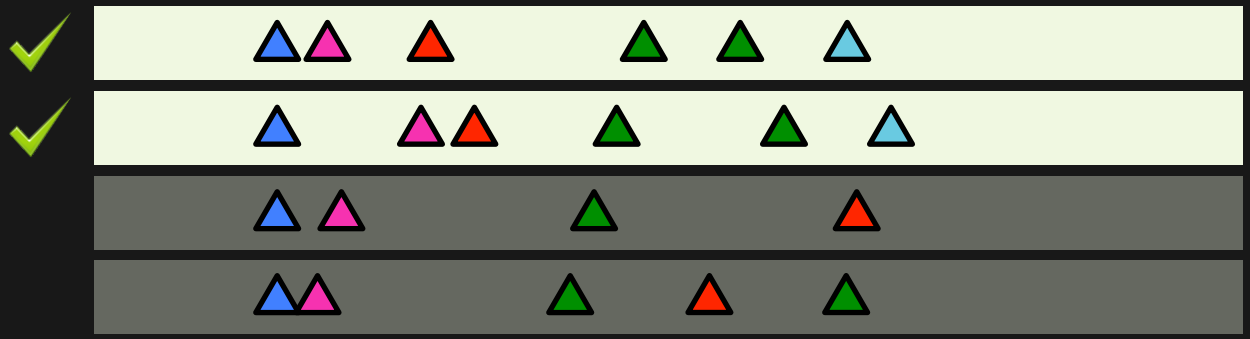

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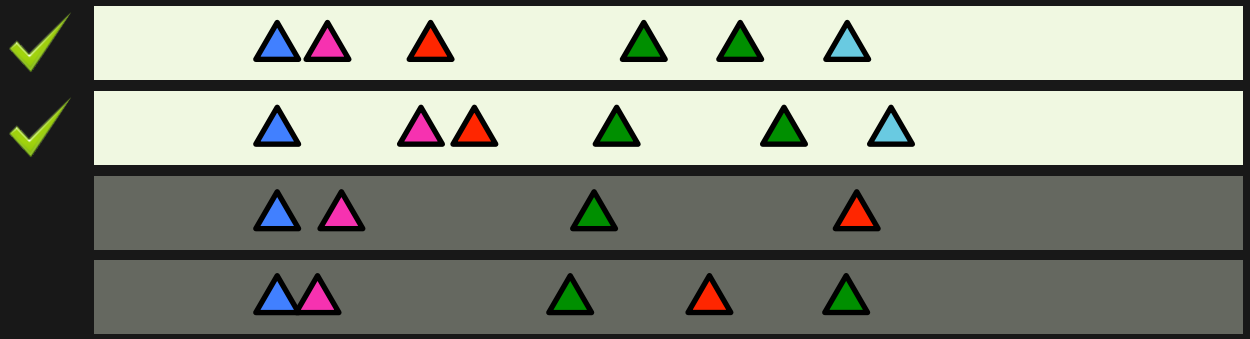
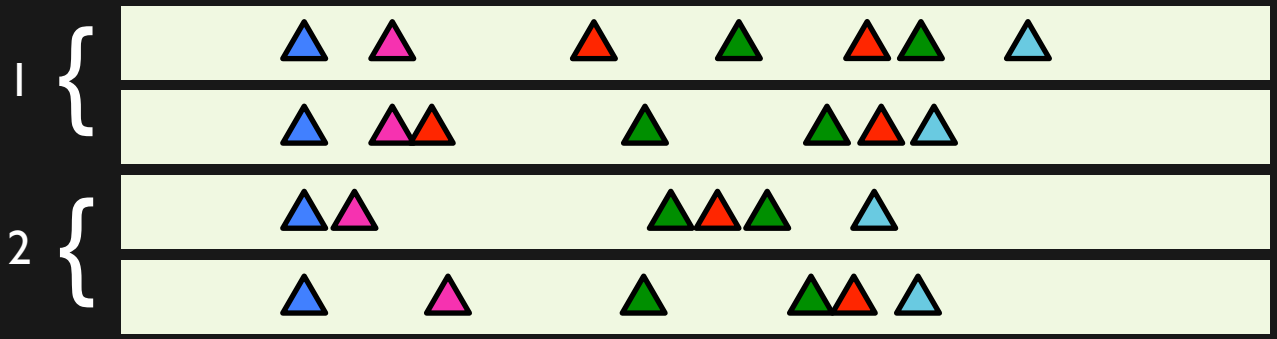
To multiple event sequences...

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



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



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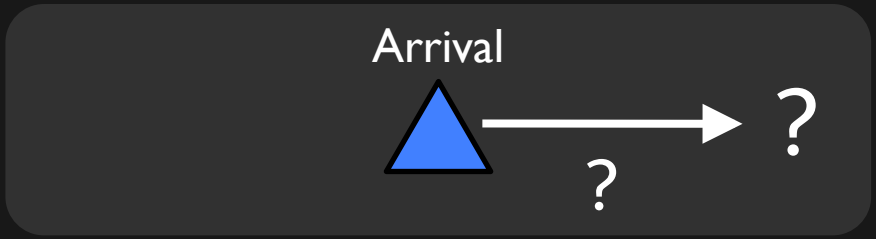
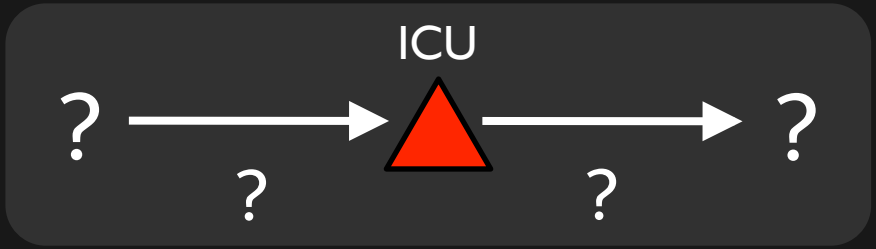
Summarize

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



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



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Overview / Summary

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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

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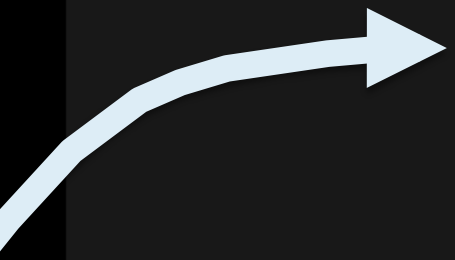

LIFEFLOW

Picture > 1000 words

LifeFlow > 1000 event sequences

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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

VIDEO
LifeFlow Design

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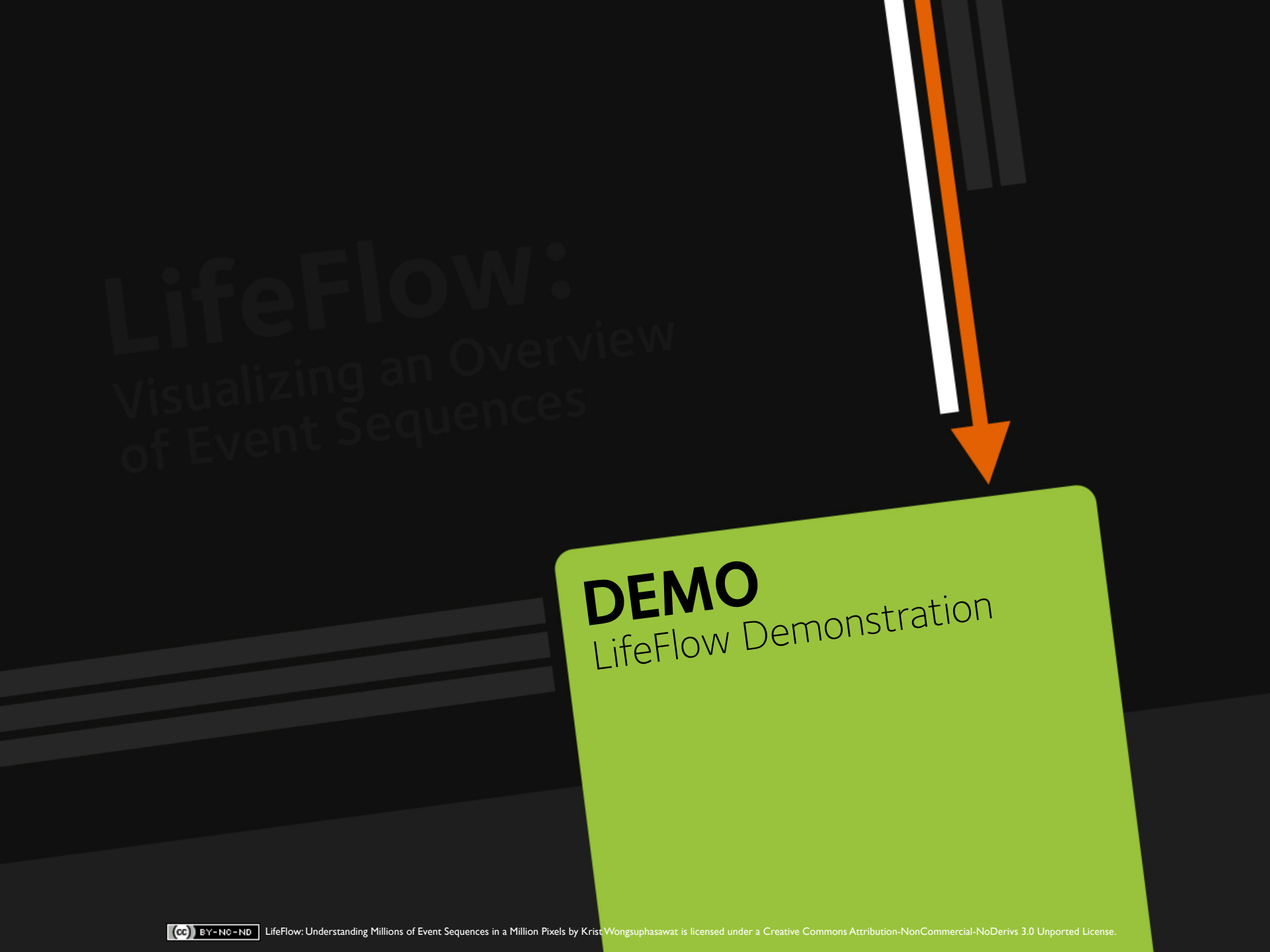

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Case Study#1: Medical

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

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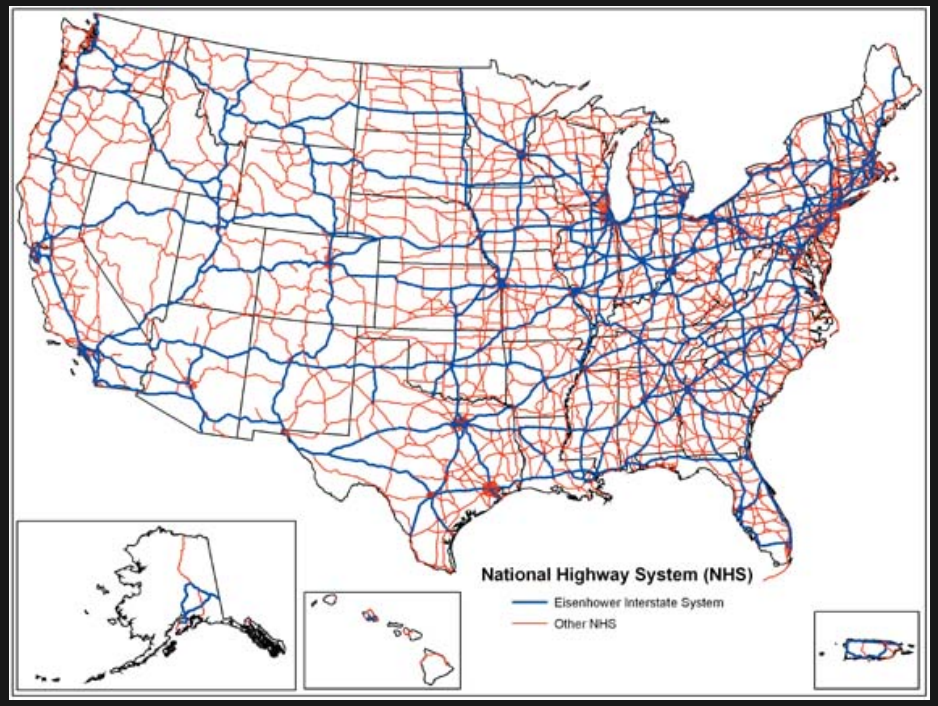
Case Study#2: Transportation

200,000+

traffic incidents

Compare traffic agencies



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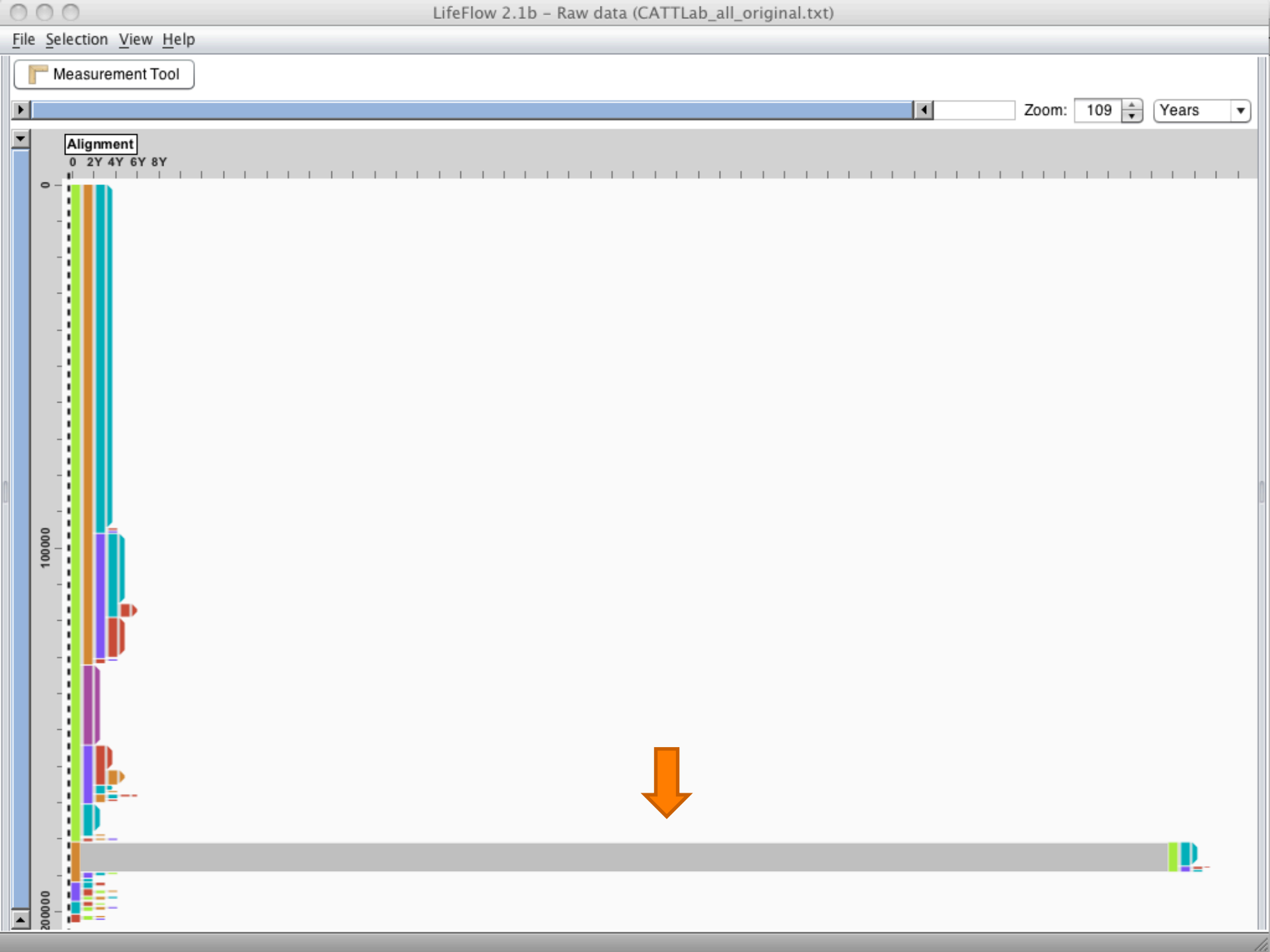
LifeFlow 2.1b – Raw data (CATTLab_all_original.txt)
File Selection View Help
Measurement Tool
Zoom: 109
Years
Alignment
0 2Y 4Y 6Y 8Y
0
100000
200000

LifeFlow 2.1b – Raw data (CATTLab_all_original.txt)
File Selection View Help
Measurement Tool
Zoom: 109
Years
Alignment
0 2Y 4Y 6Y 8Y
0
100000
200000
100 years!

Clean the data.

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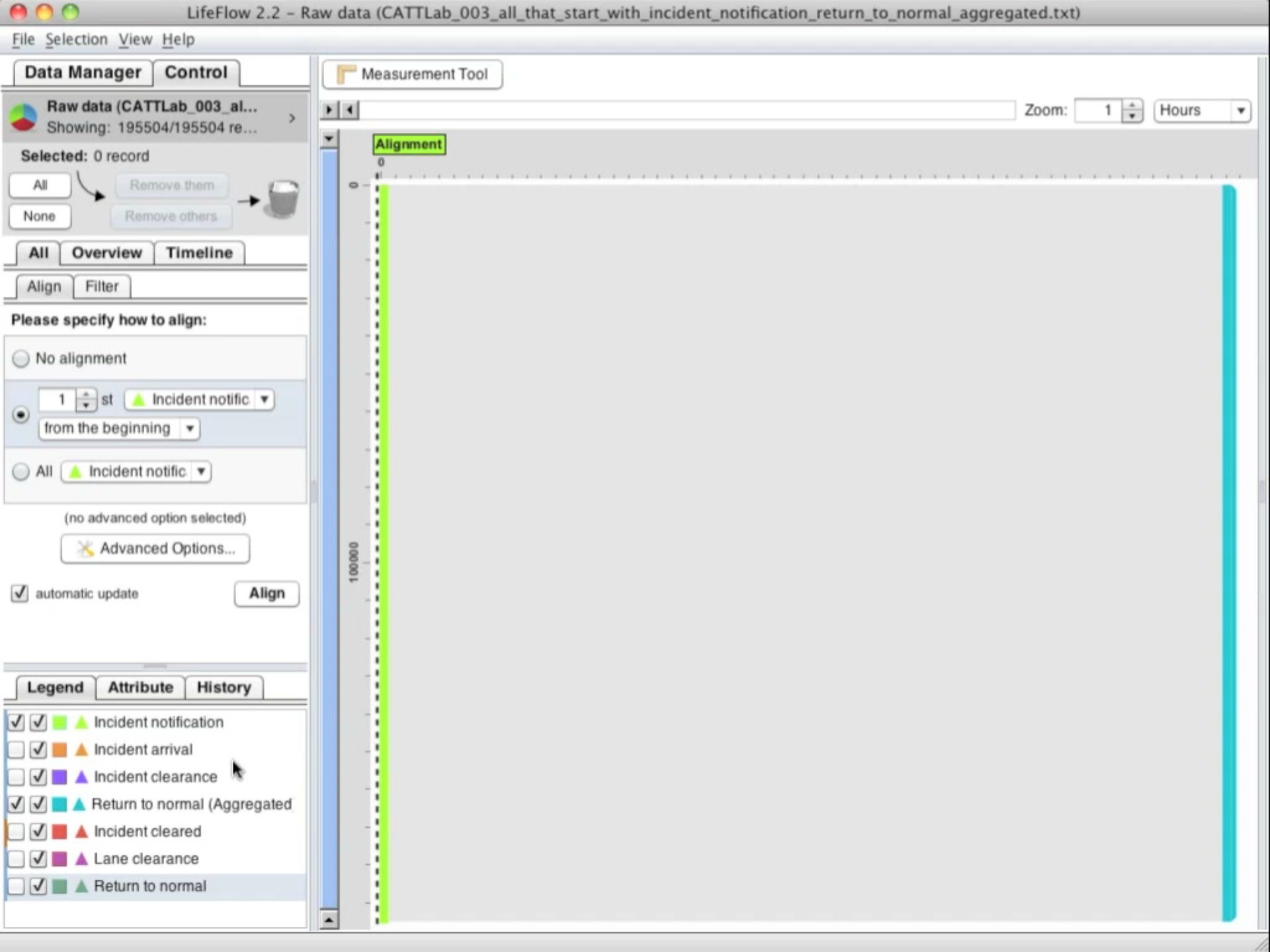
LifeFlow 2.2 - Raw data (CATTLab_003_all_that_start_with_incident_notification_return_to_normal_aggregated.txt)
File Selection View Help
Data Manager Control
Raw data (CATTLab_003_al...
Showing: 195504/195504 re...
Selected: 0 record
All
None
Remove them
Remove others
All Overview Timeline
Align Filter
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
Measurement Tool
Zoom: 1 Hours
Alignment
0
0
100000

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

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Other Datasets

e.g. researchers' publications (from Springer)

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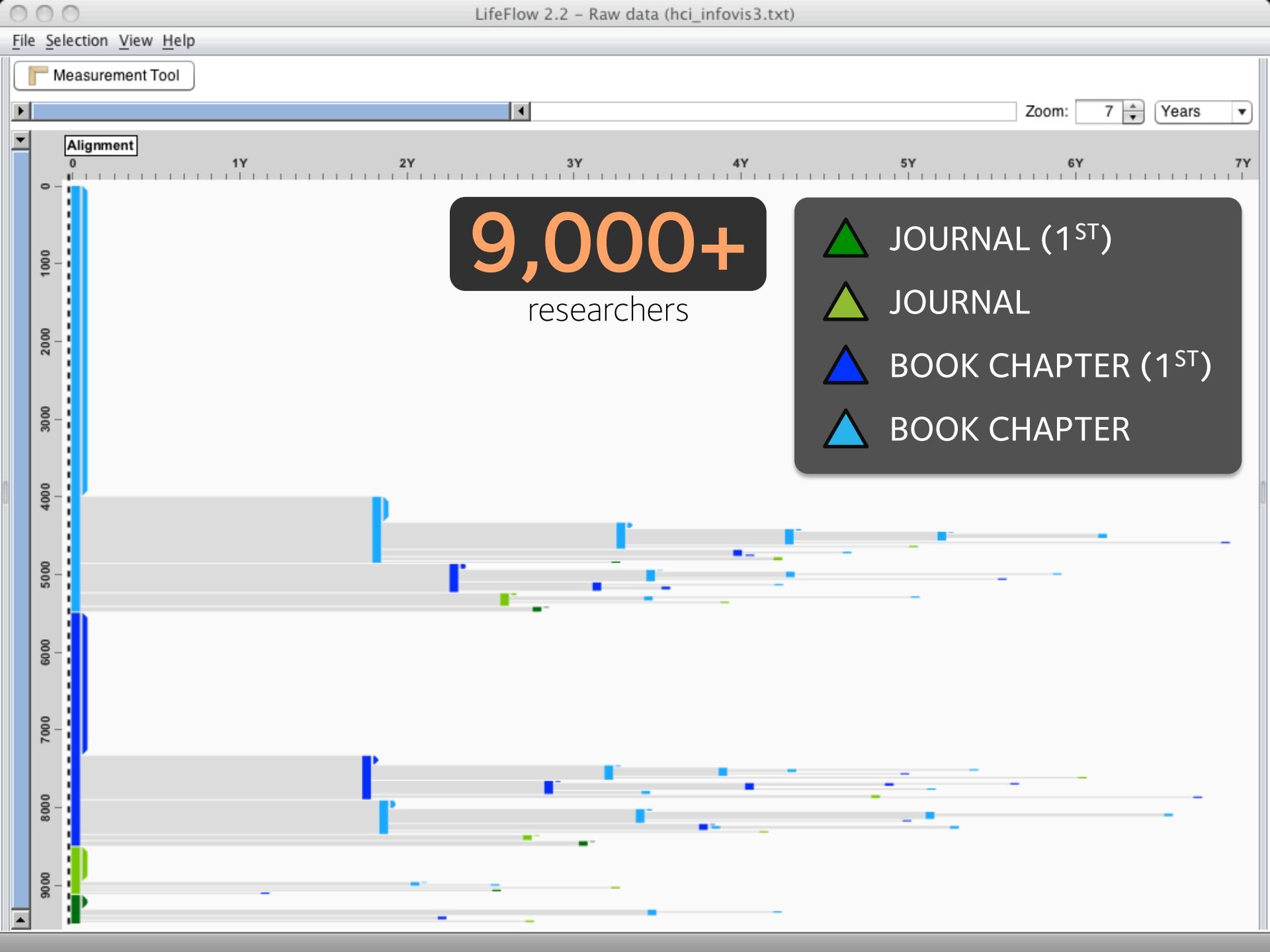

LifeFlow 2.2 - Raw data (hci_infovis3.txt)
File Selection View Help
Measurement Tool
Zoom: 7 Years
Alignment
0 1Y 2Y 3Y 4Y 5Y 6Y 7Y
0 1000 2000 3000 4000 5000 6000 7000 8000 9000
9,000+
researchers
JOURNAL (1ST)
JOURNAL
BOOK CHAPTER (1ST)
BOOK CHAPTER

LifeFlow 2.2 - Raw data (manchester_united_2010_2011.txt)

Measurement Tool

Zoom: 2 Hours

Alignment

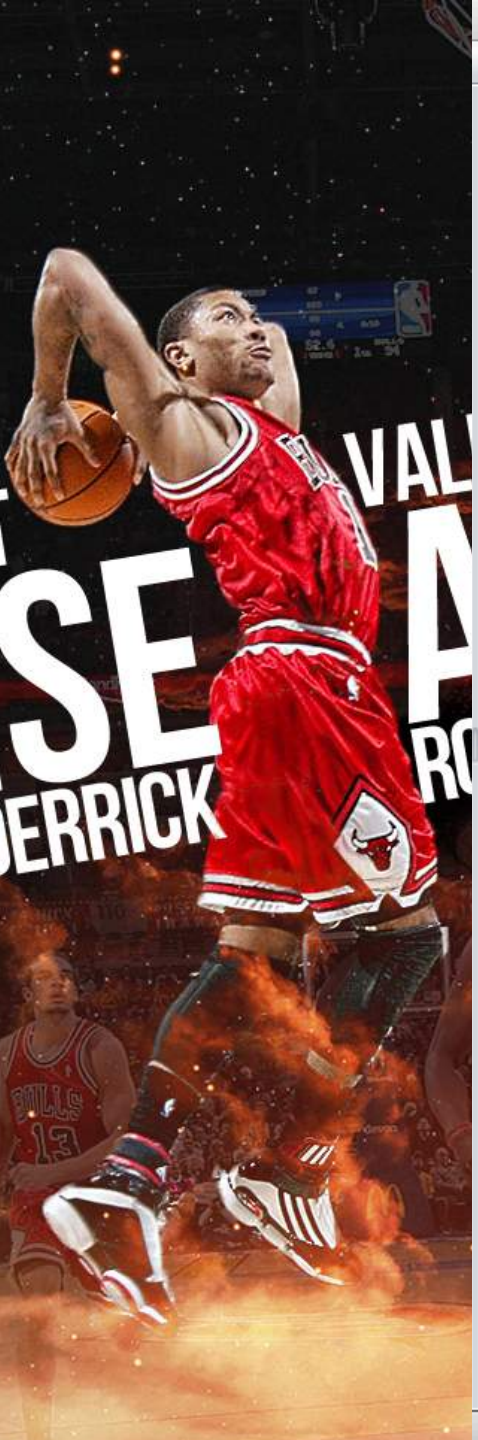
0 1h 2h

0 10 20 30 40 50 60

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



LifeFlow 2.2 - Raw data (MIA_CHI_playoffs2011_game1_byPlayer.txt)

Measurement Tool

Zoom: 15 Minutes

Alignment

0 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m 11m 12m 13m 14m

0 10 20 30 40 50

MIA

Bosh

Wade

James

Ch...

Bibby

CHI

Rose

Boozer

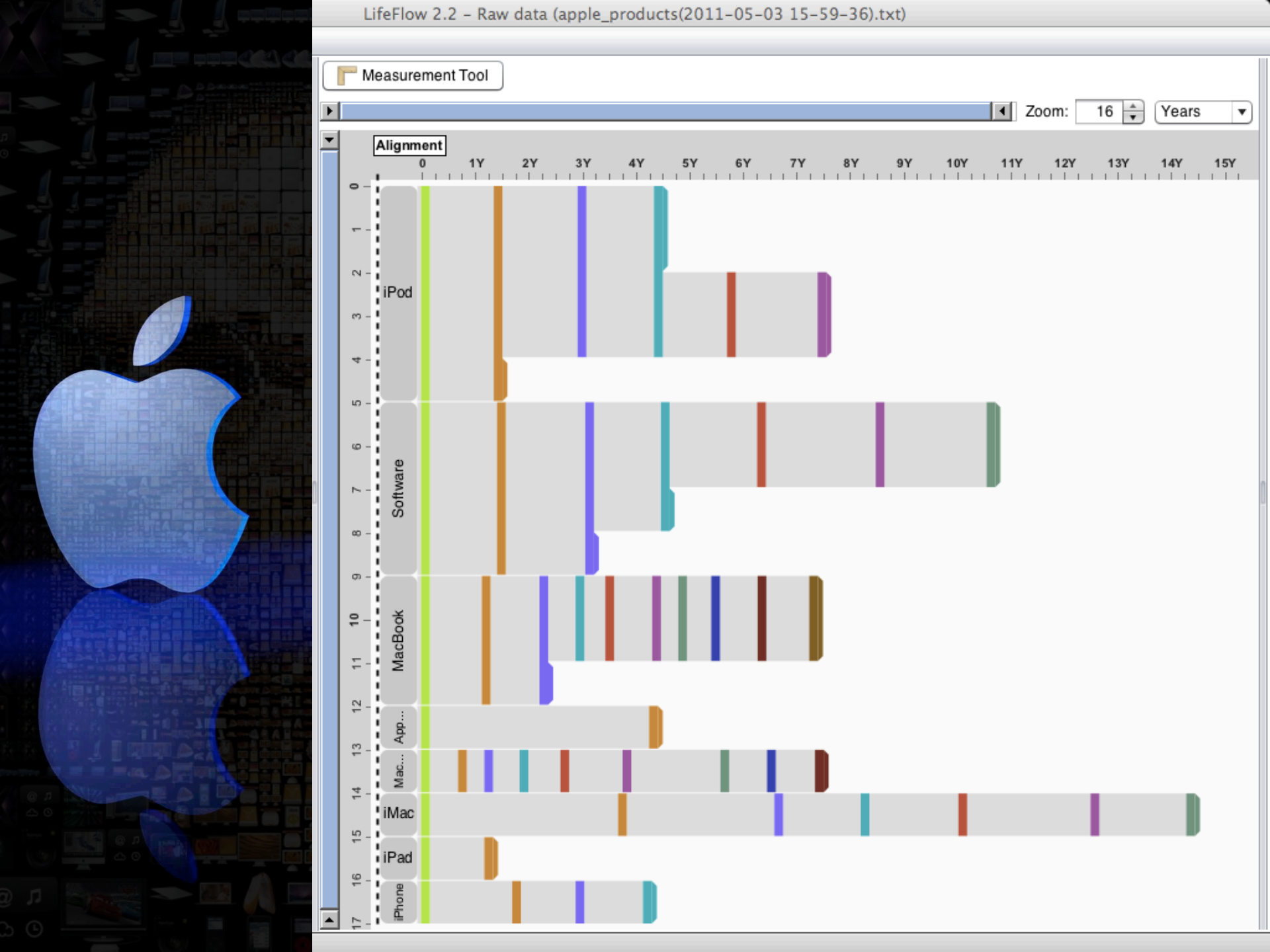
Gibson

Noah

Br...

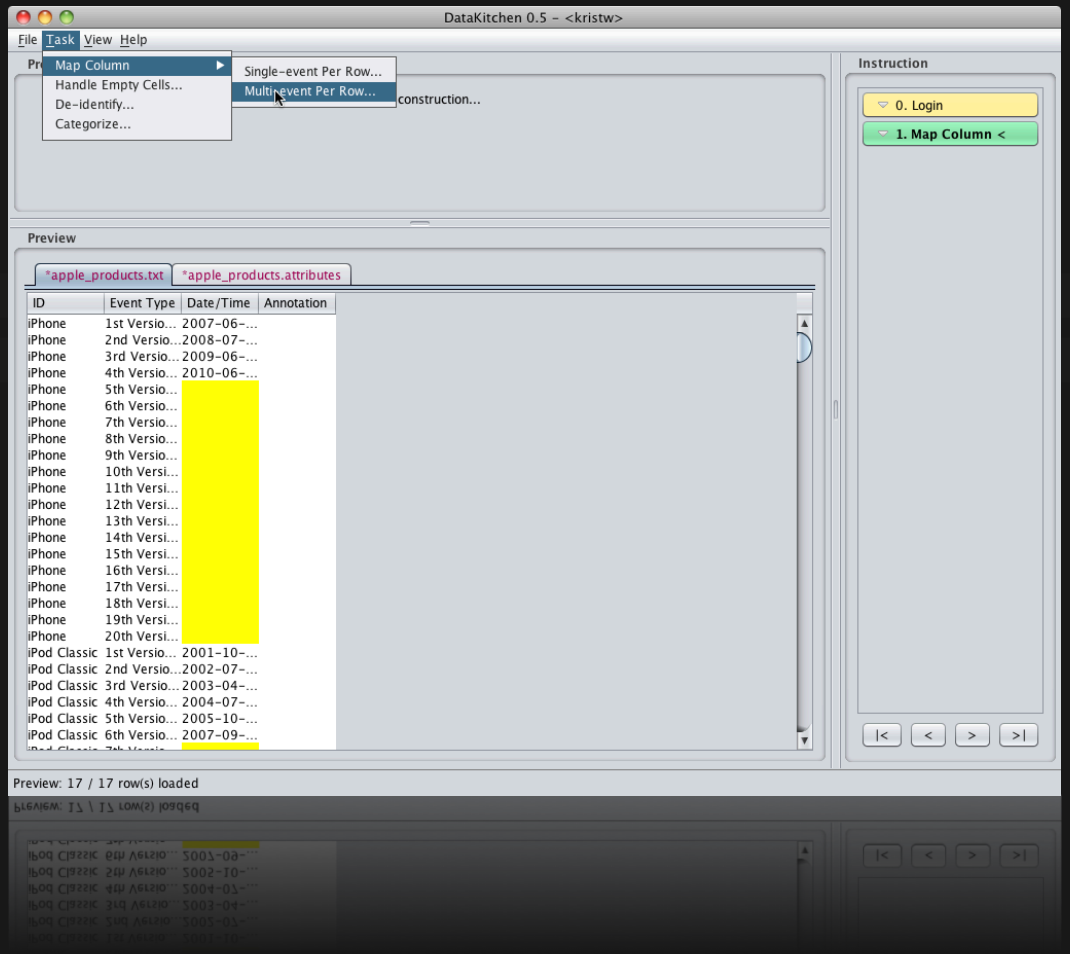
Deng

Asik


LifeFlow 2.2 - Raw data (apple_products(2011-05-03 15-59-36).txt)
Measurement Tool
Zoom:
16
Years
Alignment
0
1Y
2Y
3Y
4Y
5Y
6Y
7Y
8Y
9Y
10Y
11Y
12Y
13Y
14Y
15Y
iPod
Software
MacBook
App...
Mac...
iMac
iPad
iPhone

DataKitchen

Make your raw data ready to eat



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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.

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Acknowledgement

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  Phuong Ho, Mark Smith, David Roseman

  http://www.whcenter.org

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  Grant RC1CA147489-02

  http://www.nih.gov

- Center for Integrated Transportation Systems Management (CITSM)

  (a Tier 1 Transportation Center at the University of Maryland)

  Michael Pack, Michael VanDaniker, Nikola Ivanov

  http://www.cattlab.umd.edu

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Contact me
kristw@cs.umd.edu
www.cs.umd.edu/hcil/lifeflow

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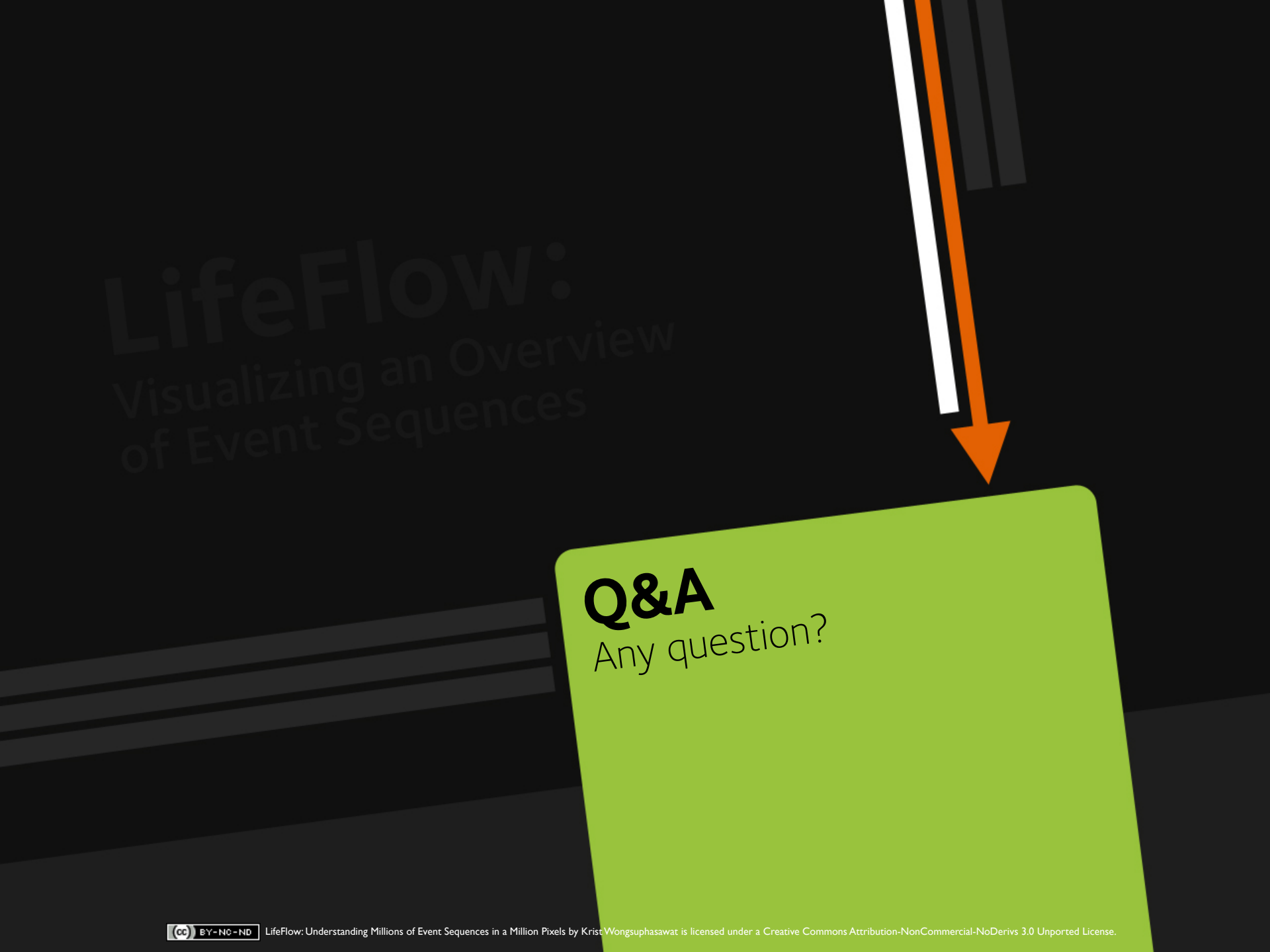

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