Big Data:
Longitudinal Sensor Data Visualization

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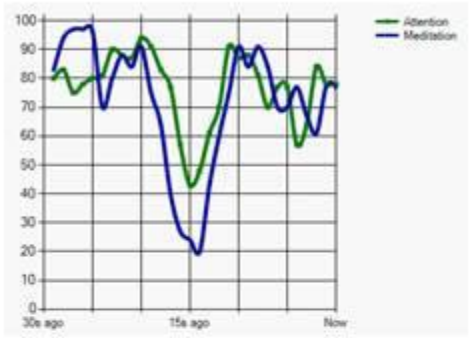
Flavia Grey

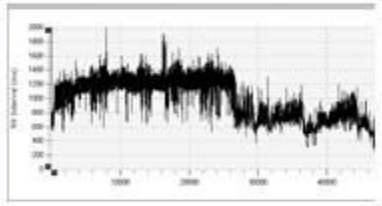
Problem

MindWave



Brain activity
→ *Attention*

FirstBeat HRV → *Stress*

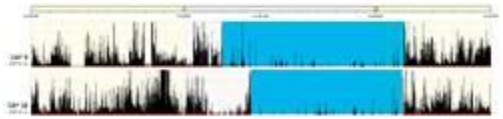


Cog Game

Hit Rate
Reaction Time

Vigiliance
→ *Fatigue*

Actigraph Sleep → *Recovery*

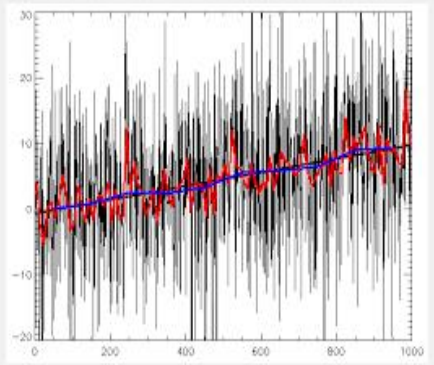


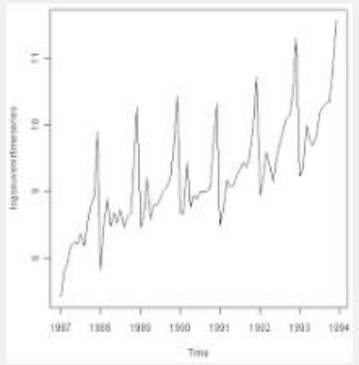
Activity Diary → *Workload*

eRing
Body movement
→ *Engagement*

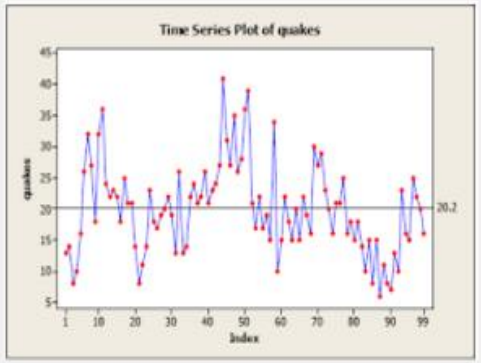
How to represent aggregated data?

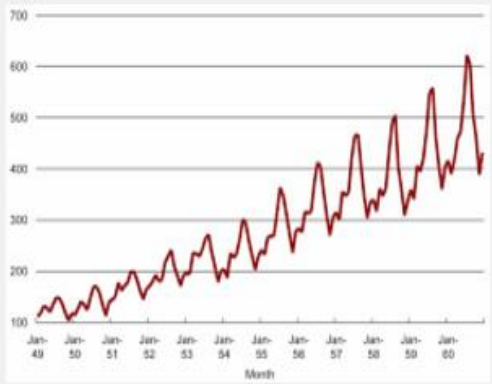
Previous Work

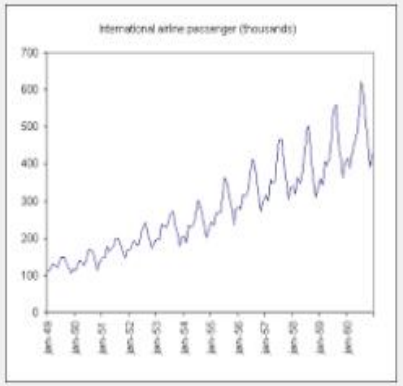


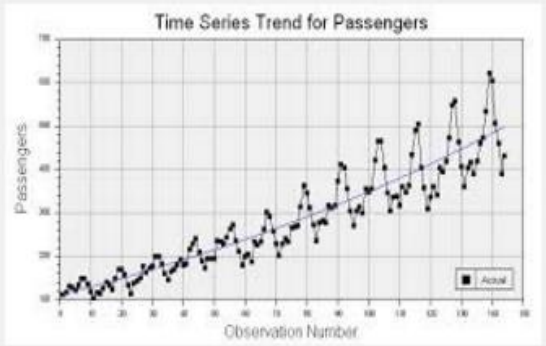


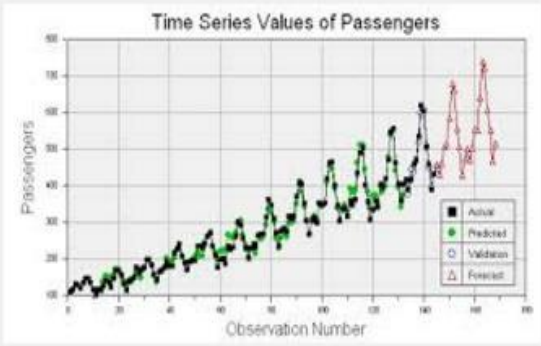

time series

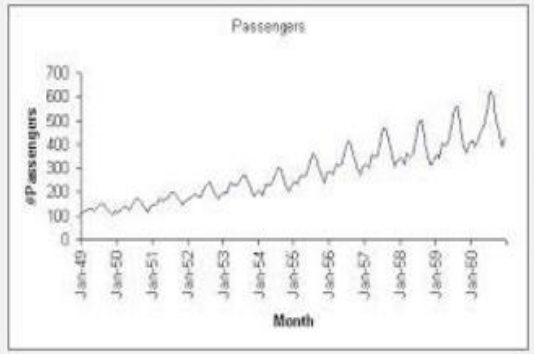

Time Series Plot of quakes
quakes
Index
20.2

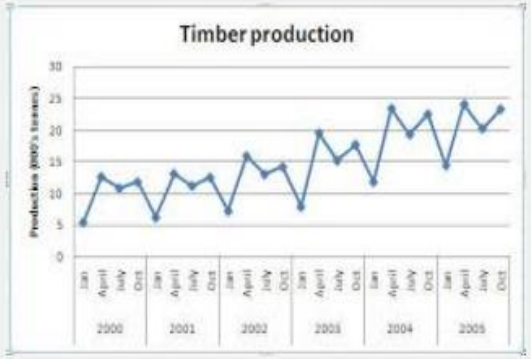


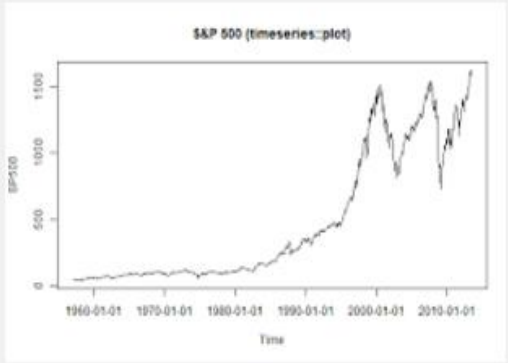

International airline passenger (thousands)

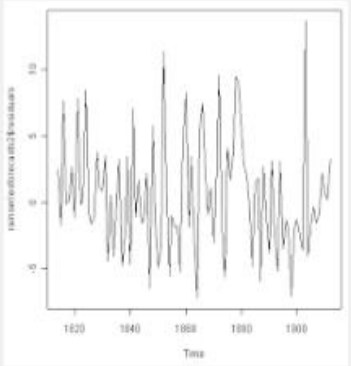

Time Series Trend for Passengers
Passengers
Observation Number
Actual

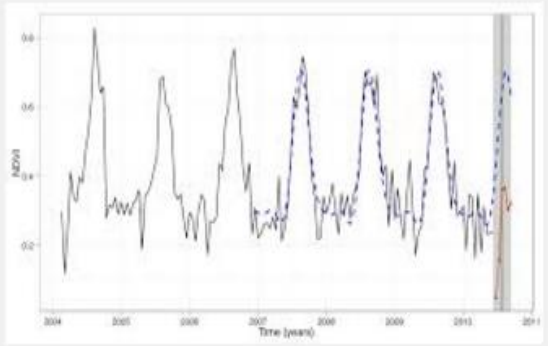

Time Series Values of Passengers
Passengers
Observation Number
Actual
Predicted
Validation
Forecast

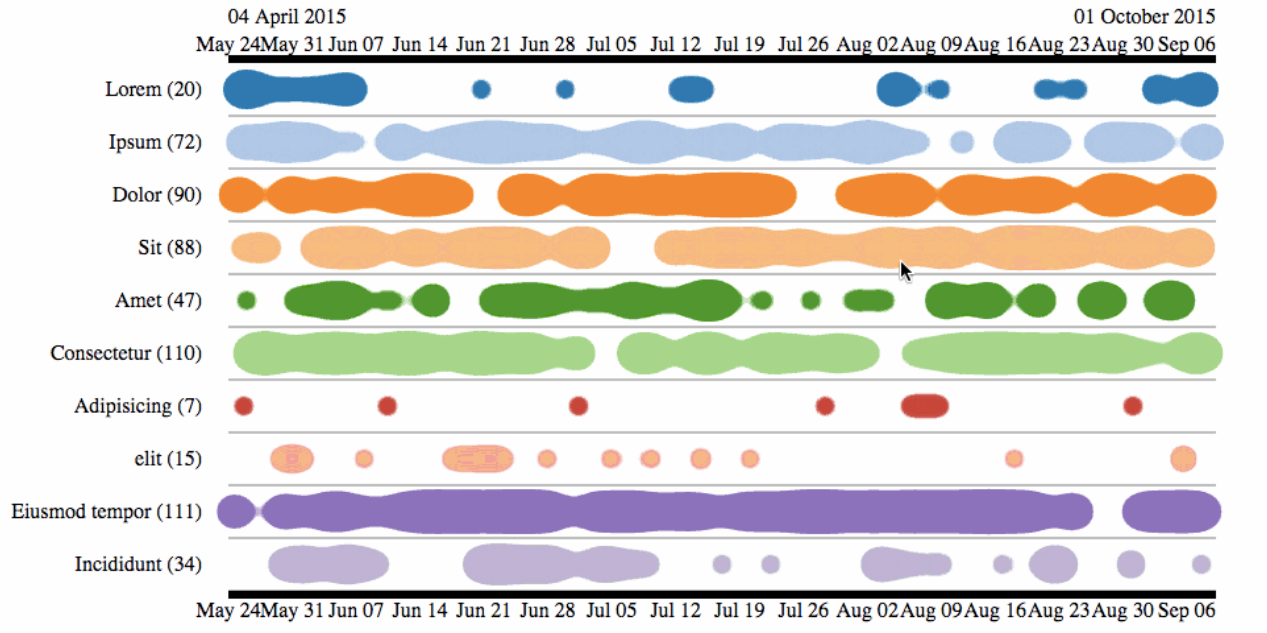

Passengers
#Passengers
Month

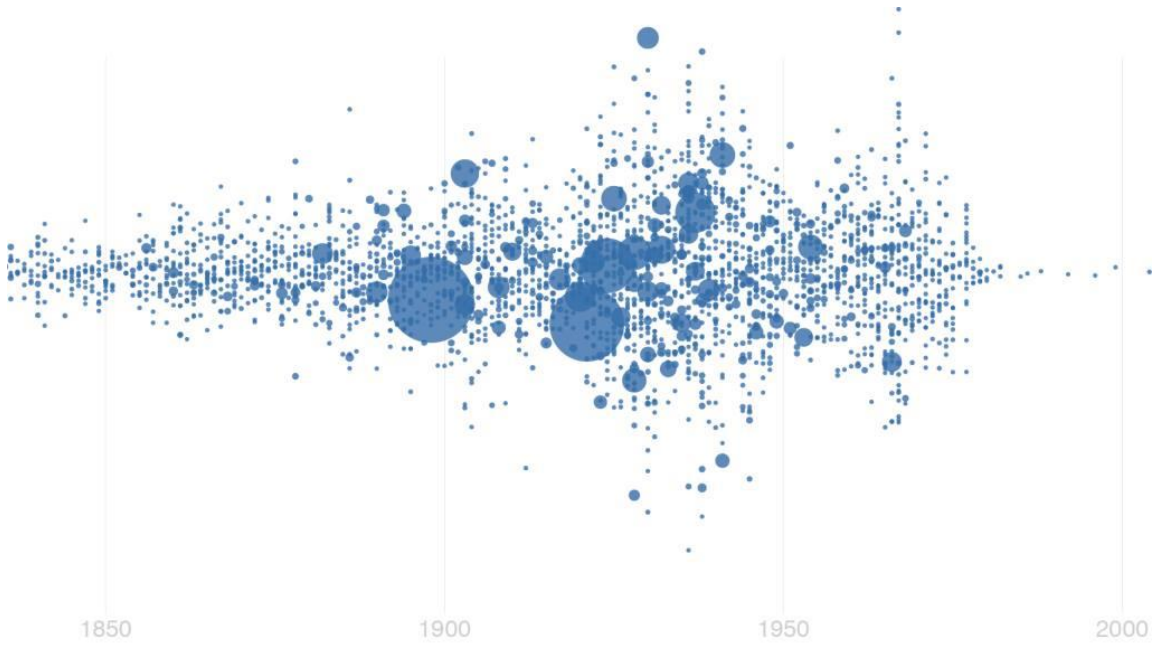

Timber production

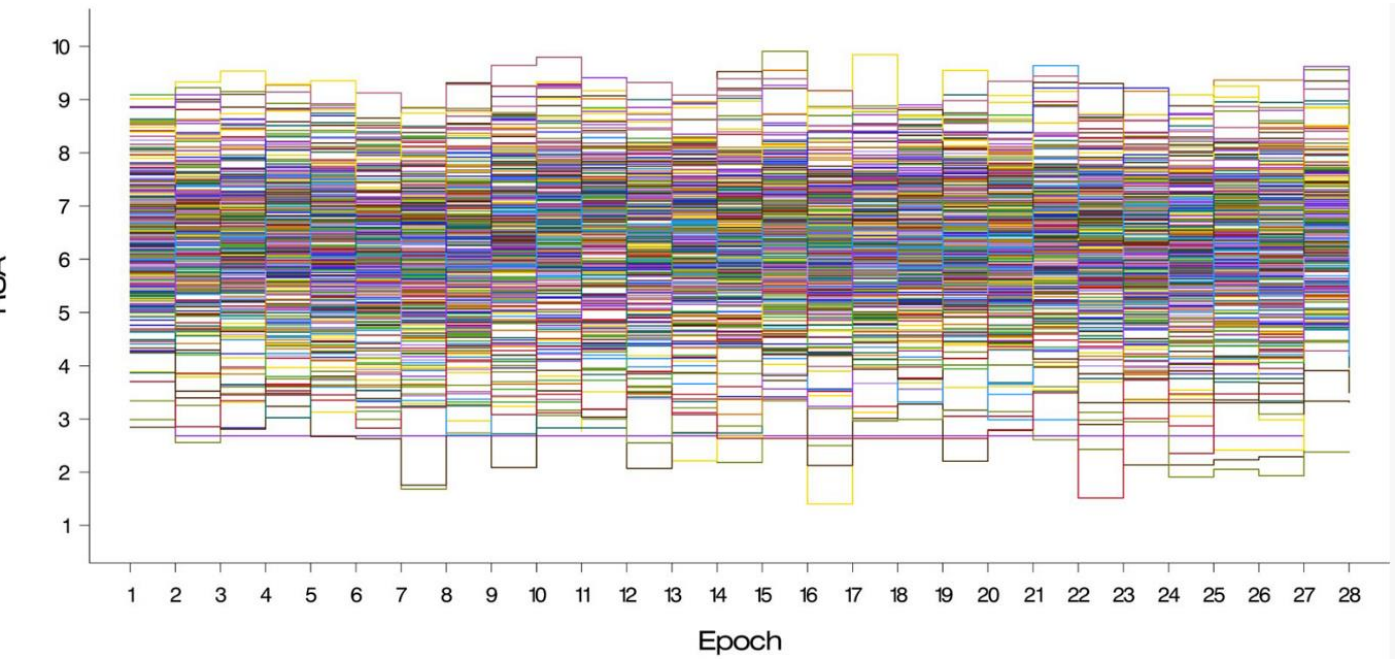

S&P 500 (timeseries::plot)
Time

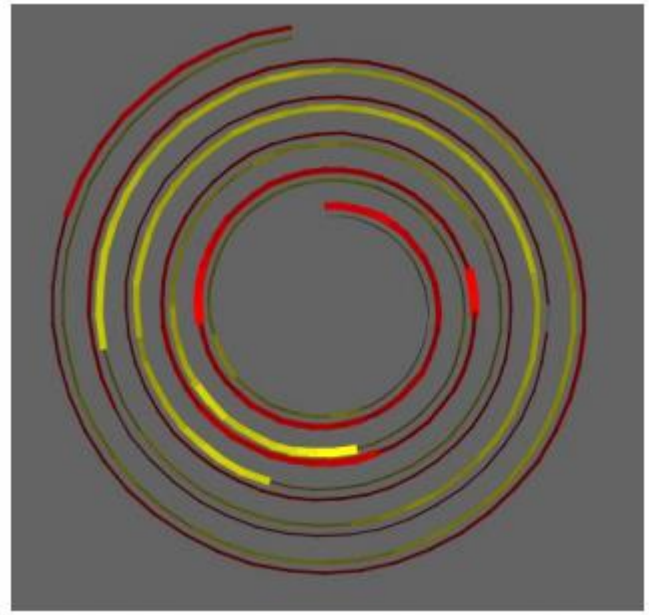


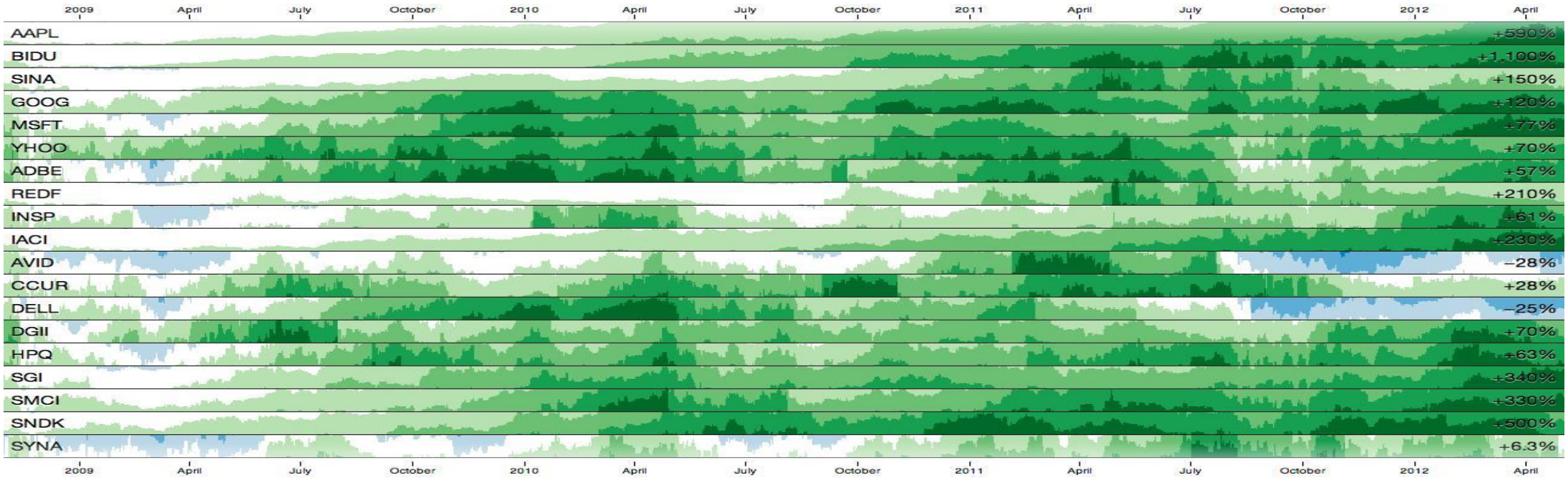

Time (years)

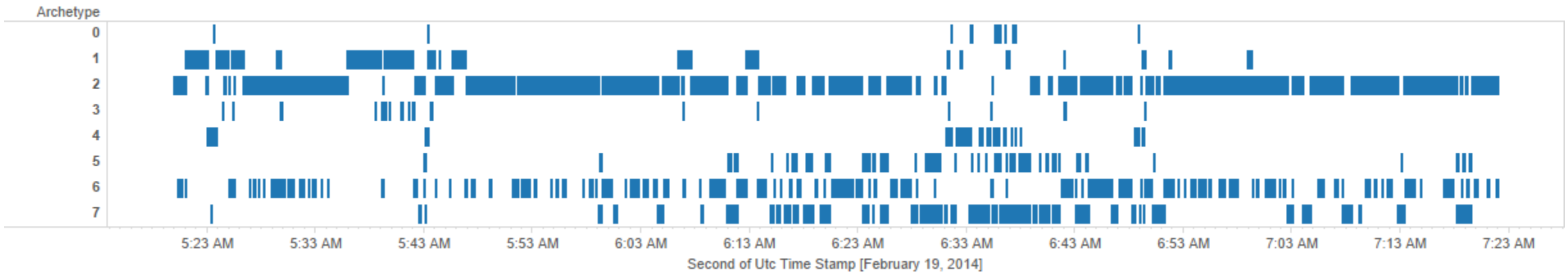

04 April 2015
01 October 2015
May 24 May 31 Jun 07 Jun 14 Jun 21 Jun 28 Jul 05 Jul 12 Jul 19 Jul 26 Aug 02 Aug 09 Aug 16 Aug 23 Aug 30 Sep 06
Lorem (20)
Ipsum (72)
Dolor (90)
Sit (88)
Amet (47)
Consectetur (110)
Adipisicing (7)
elit (15)
Eiusmod tempor (111)
Incididunt (34)
May 24 May 31 Jun 07 Jun 14 Jun 21 Jun 28 Jul 05 Jul 12 Jul 19 Jul 26 Aug 02 Aug 09 Aug 16 Aug 23 Aug 30 Sep 06


1850
1900
1950
2000


10
9
8
7
6
5
4
3
2
1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Epoch



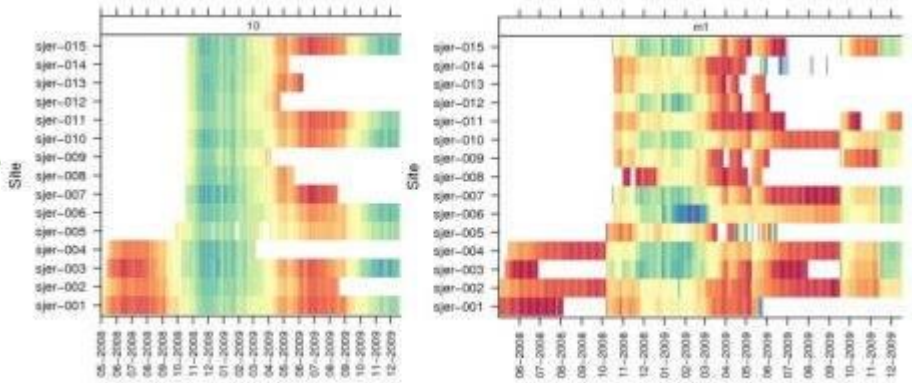

2009
April
July
October
2010
April
July
October
2011
April
July
October
2012
April
AAPL +590%
BIDU +1,100%
SINA +150%
GOOG +120%
MSFT +77%
YHOO +70%
ADBE +57%
REDF +210%
INSP +61%
IACI +230%
AVID −28%
CCUR +28%
DELL −25%
DGII +70%
HPQ +63%
SGI +340%
SMCI +330%
SNDK +500%
SYNA +6.3%

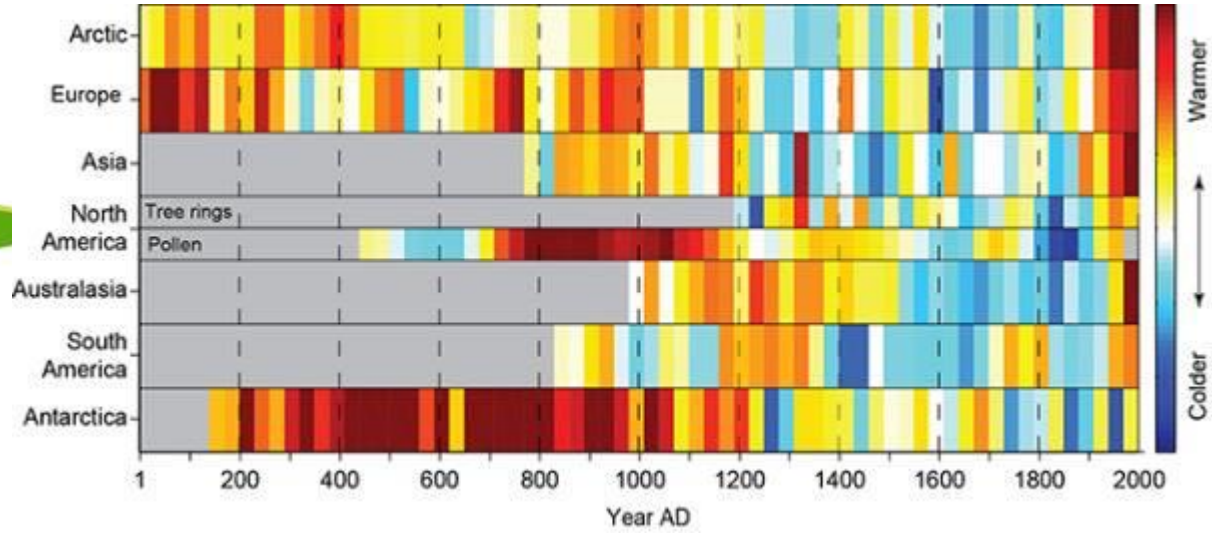

Archetype
0
1
2
3
4
5
6
7
5:23 AM
5:33 AM
5:43 AM
5:53 AM
6:03 AM
6:13 AM
6:23 AM
6:33 AM
6:43 AM
6:53 AM
7:03 AM
7:13 AM
7:23 AM
Second of Utc Time Stamp [February 19, 2014]


onset-time


inside-out

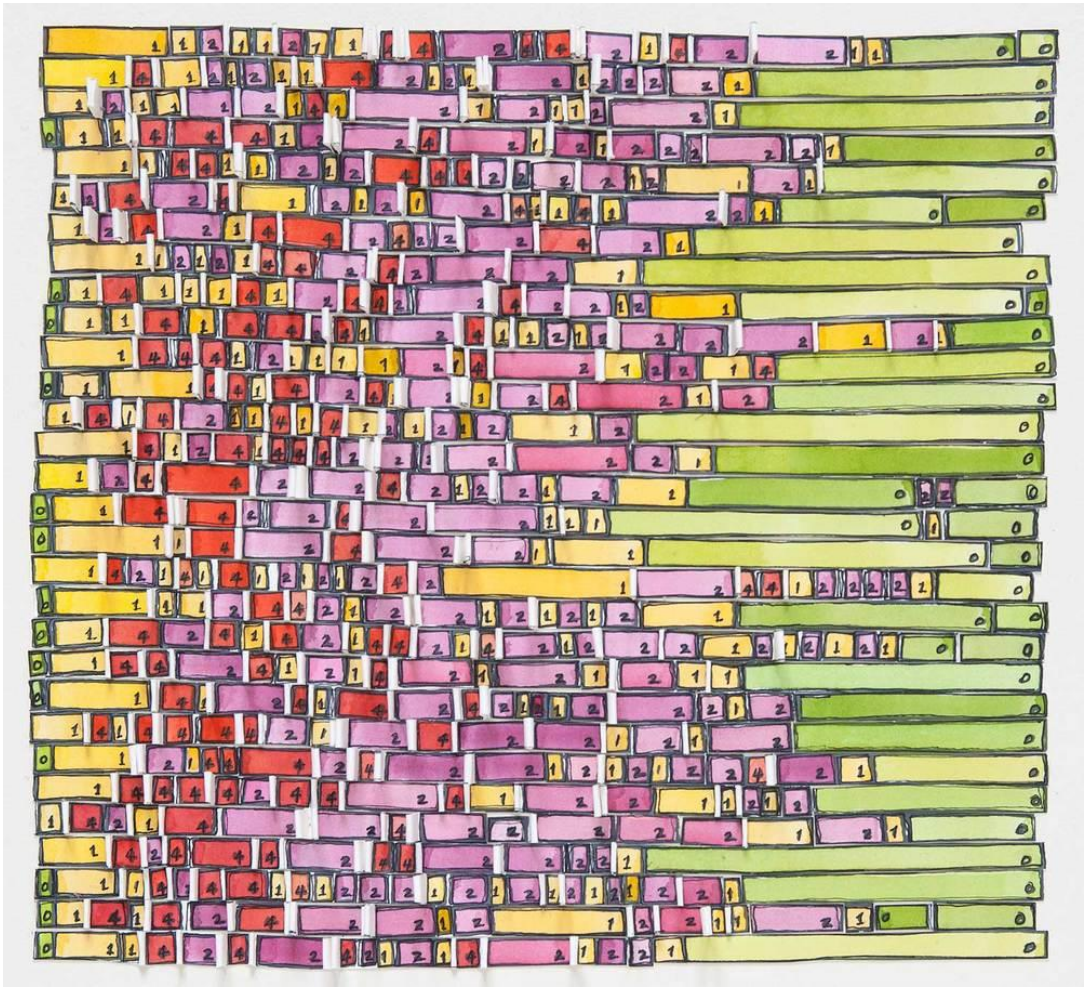

weighted


Site
sjer-015
sjer-014
sjer-013
sjer-012
sjer-011
sjer-010
sjer-009
sjer-008
sjer-007
sjer-006
sjer-005
sjer-004
sjer-003
sjer-002
sjer-001


Arctic
Europe
Asia
North America
Tree rings
Pollen
Australasia
South America
Antarctica
1
200
400
600
800
1000
1200
1400
1600
1800
2000
Year AD
Warmer
Colder

Our Proposed Visualization

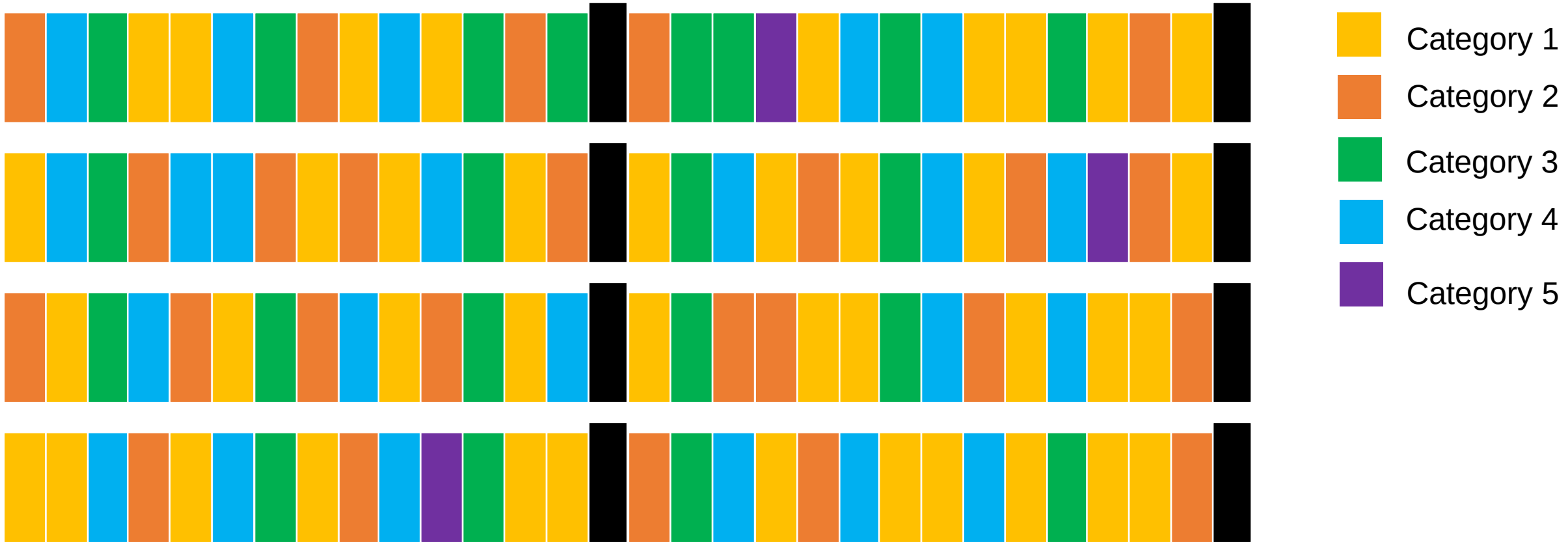
Inspiration: Laurie Frick

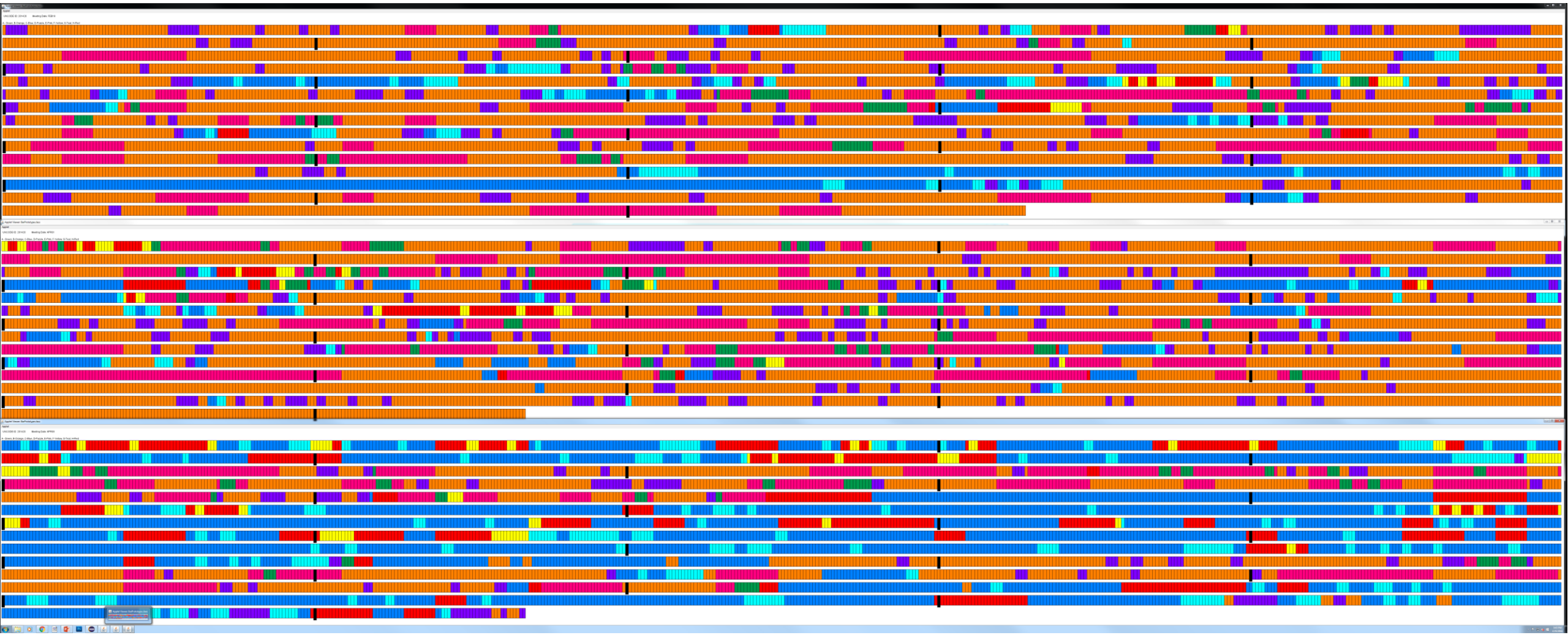


Proposed Design

Granularity of Data Collection: 1 second

Separation interval: 5 min





Progress Report Addition

Literature Review

Most physiological sensor data is represented as time series in line charts. The sensor data mostly captures continues values and the change in the value. This works well for individual data sets, but in our case we want to represent an aggregate measure of features as linked to a series of archetypes, which turns the continuous numerical data into aggregated discrete dimensional categories. The most common approach for nominal, time-series data is a Gantt chart, but this approach provides information about the general composition of the data (for example, which archetype appears most often) but makes it hard to see what is going on at a second-by-second level. Furthermore transitions between stages are intransparent and even unusual patterns are difficult to identify. This is worsened by trying to fit all the data horizontally in our screens in one same line, so the smaller our screen, the harder to see details. Our approach creates a compact version of the Gantt chart where all the archetypes are presented in one line, and avoids horizontal compacting by looping around and creating several lines in a vertical distribution.

Weber, Alexa and Muller (2001) proposed a visualization for time-series information based on spirals. Their approach works well for bringing out periodic behaviors in the data, but we believe that our approach showing time in a straight line makes it easier to understand. It enables us to include identifying blocks of a certain length of time can also lead the detecting of non-periodic behaviors.

Laurie Frick is an artist that makes hand-built work from self-tracking data. She designed an app based on her artwork called Frickbits. While the actual drawing of the data is similar to our proposed design in terms of using bars of color to depict the data, Frickbits is used to create map information. (http://www.frickbits.com/)

References

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- https://www.google.com/imgres?imgurl=http%3A%2F%2Fwww.coolinfographics.com%2Fstorage%2Fpost-images%2FPAGES%25202k%2520temperature%2520grid.jpeg%3F__SQUARESPACE_CACHEVERSION%3D1366924585749&imgrefurl=http%3A%2F%2Fwww.coolinfographics.com%2Fblog%2Ftag%2Fenvironment&docid=u5jUJd7keprKwM&tbnid=E81NrMbmZmT_4M%3A&w=600&h=264&bih=821&biw=1708&ved=0ahUKEwjOi43EyufMAhUD_IMKHW12AaUQxiAIBygF&iact=c&ictx=1
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- http://www.r-bloggers.com/interesting-use-of-levelplot-for-time-series-data/
- http://museumtwo.blogspot.com/2013/11/visualizing-tates-collection-what-open.html
- Weber, M., Alexa, M., & Muller, W. (n.d.). Visualizing time-series on spirals. *IEEE Symposium on Information Visualization, 2001. INFOVIS 2001.* doi:10.1109/infvis.2001.963273, Online at: http://cs.lnu.se/isovis/courses/spring07/dac751/papers/TimeSpiralsInfoVis2001.pdf

Project Plan

Milestones:

- 05/25 finish review and write up
- 06/03 online version of visualization
- 06/05 edit final report

Work distribution:

- Flavia: literature review, D3 representation, coding of application
- Maria: literature review, storyboard, report, support in finding sample code