

# Time Series Overview



CS 4460 - Information Visualization  
Jim Foley

J. Foley.

Last revision: August 2016

# A Time Taxonomy



- Continuous
  - Non-periodic
  - Periodic
- Discrete
  - Non-periodic (non-recurring)
  - Periodic
- More on next pages.....

# Continuous Time Data



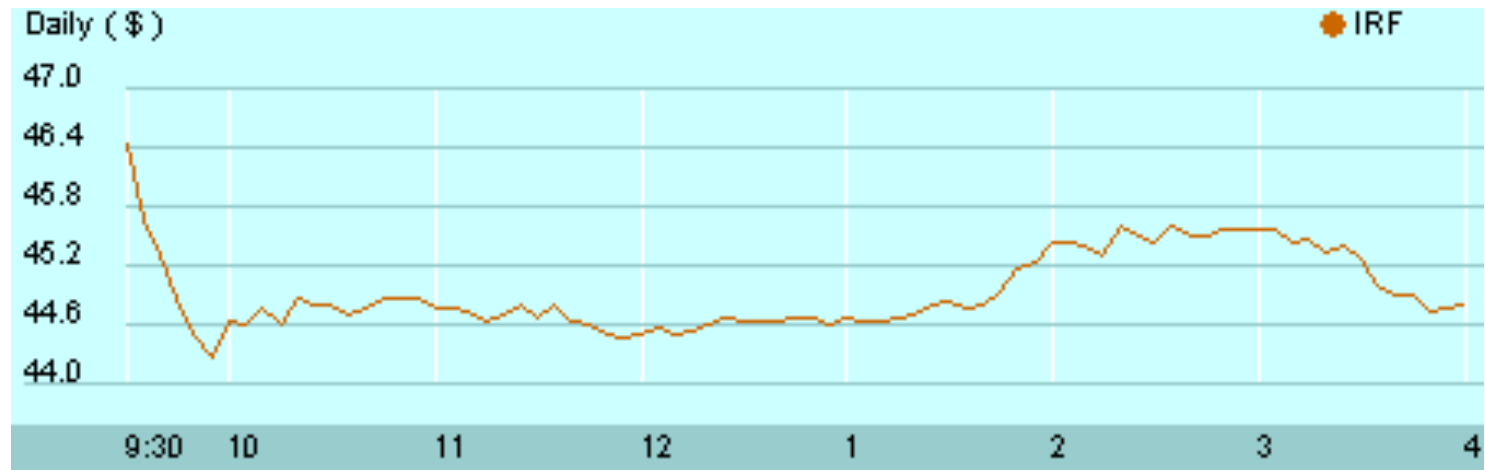
- Examples
  - Stock market prices
  - My heart rate
  - Daily temperature in Atlanta
  - Height of ocean
- Periodic – repetitive
  - Temperature in Atlanta is periodic  
Daily highs and lows, seasonal highs and lows
  - Other examples?
- Non-periodic – examples?

# Discrete Time Data

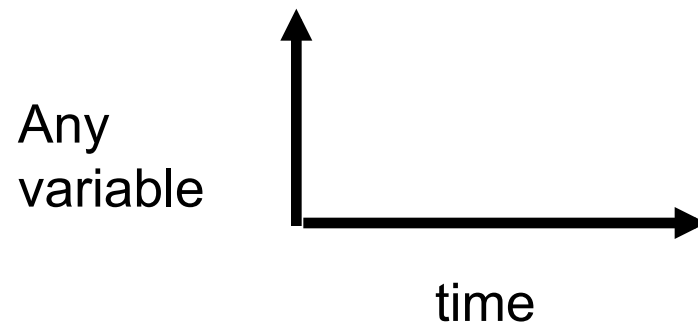


- Birth/marriage/death
- Historical events
- Train leaves at 8:05 am
- Some discrete events have duration
  - Meeting or appointment
  - Hospital stay
  - Project phase
- Some discrete events are periodic
  - Presidential elections – every four years
  - Our class meetings (but not forever 😊)
- Recall that time data can be in multivariate, tree, network data organization

# Continuous Time



Two variables – price, time of day



# Example



- A [Nationally Known Business Author Profiles Michigan Company](#)  
Trading Markets - 30 minutes ago
- B [Earnings Preview: EMC Corp.](#)  
Daily Markets - 1 hour ago
- C [Bank of America - Worst Performing Dow Component](#)  
TradersHuddle.com - 1 hour ago
- D [Computer Point takes on IBM firms in Uganda](#)  
East African Business Week - 2 hours ago
- E [IBM rolls out virtual desktop offering](#)

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STOCK ALERTS**

- <http://finance.yahoo.com/echarts?s=GOOG#symbol=goog;range=20120203,20130828;compare=;indicator=ud+volume;charttype=candlestick;crosshair=on;ohlcvvalues=0;logscale=off;source=undefined;>
- How many variables; what are they, what are data types?

# Electronic Medical Records (EMR) – no Vis



Joyce - AdvantaChart - [Chart For: Doe, Jane - 7/23/1974]

File View Pending List Scan Tests/Lab Report Billing Scan Insert Print Admin Window Switch User Help

Schedule Patients Patient Tracking Scan Pending List (22) Rx Messages Labs Ordered Labs Received Notify Patient

Close New Print Delete Refresh Task Follow Up

Location Current Location Exam #1 Move Patient Location Check out

DOB: 7/23/1974 Chart For: Doe, Jane Age: 35 yrs

Correspondence

Summary Demographics Phone Call Message To Chart Procedures Colposcopy Office Visit Antepartum Test/Labs Hospitalizations Pro

Primary Care Doctor: Dr. McCormick Referral Source: Insurance Referred By: Jane smith

Active Problems		Allergies		Hospitalizations	
Problem		Name		Date	Type
Abdom Pain Periumbilic		Codeine		07/25/2009	Discharge
Abdominal pain unspcf. site		originally thought allergic to penici...			
Cervicitis and endocervicitis		Shellfish			
Diabetes Type I Uncomplicated		Sulfa			
Fever					
Headache syndrome unspecified					
Hypertension					

Encounters		Lab Reports		Colonoscopies		Ultrasounds	
Date	Type	Date	Type	Date	Results	Date	Results
01/19/2010	Office Visit	06/30/2009	OTHER			06/11/2008	
01/19/2010	Office Visit	10/06/2008	HCGQUANT			03/07/2008	
12/15/2009	Office Visit	07/01/2008	TRANSFERRIN				
12/05/2009	Phone	04/29/2008	GC/CT				
12/05/2009	Colposcopy Biop...	04/21/2008	AFPQUAD				
12/05/2009	Antepartum	02/13/2008	OTHER				
12/04/2009	Phone	01/07/2008	LIPIDPANEL				
12/03/2009	Office Visit						
11/19/2009	Office Visit						
11/19/2009	Insertion of IUD						
11/18/2009	Office Visit						
11/17/2009	Office Visit						
11/12/2009	Office Visit						
10/27/2009	Office Visit						
10/14/2009	Office Visit						


Pap smear Reports		Mammograms		Active Medications	
Date	Results	Date	Results	Name	Dosage
05/23/2007	WNL			Altace	
				B-12	
				Calcium	
				Diaphragm	
				Diovan	

# EMR with Vis- Lifelines

In progress version of LifeLine Frame (not for demo purposes - Microsoft Internet Explorer - [Working Offline])

File Edit View Go Favorites Help

Back Links Best of the Web Channel Guide Customize Links Internet Explorer News Internet Start

 **Linda Simpson**  
Female 40

Line from input file: %:3-10-1997,3-12-1997,black,p10,Sonogram,images/babysonogra

LifeLine

92 93 94 95 96 97

Notes: Tobacco, Depression, Lyme, Arthritis, Obesity, AtrialFlutter, Flu, Pneumonia, KneePain, Fatigue, Diabetes, Diabe, Pregnancy

Hosp.: Appendectomy, Pneumonia, KneeSurgery

Tests: BloodEKG, EKG, Xray, Blood, Blood, Blood, Sonogr

Meds.: Prozac, Heartdrug, Ventolyn, Antib., Advil, Advil, Insulin, Insulin, PhysicalTherapy, LowSaltFatDiet, Flu

Immun.: TBtest, Tetanos

DATE: 5-19-88 PATIENT ID: [redacted] 17mo/3.8

LifeLine Control Panel

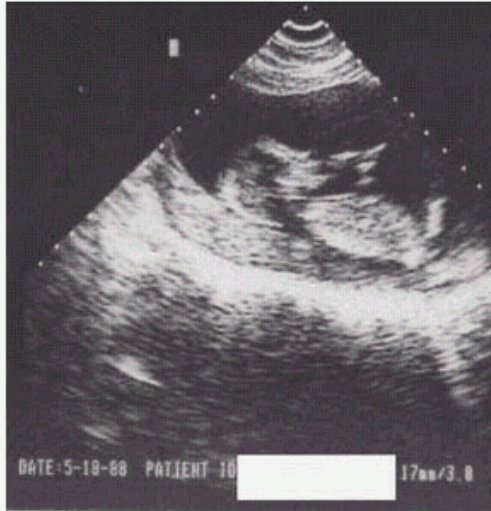
Layout Label

Default  
 Quick Compact  
 Slow Compact  
 Chronologically Ordered  
 Event Ordered

Apply OK Cancel

Warning: Applet Window

Discrete time event with duration





# How Characterize Facebook Timeline?



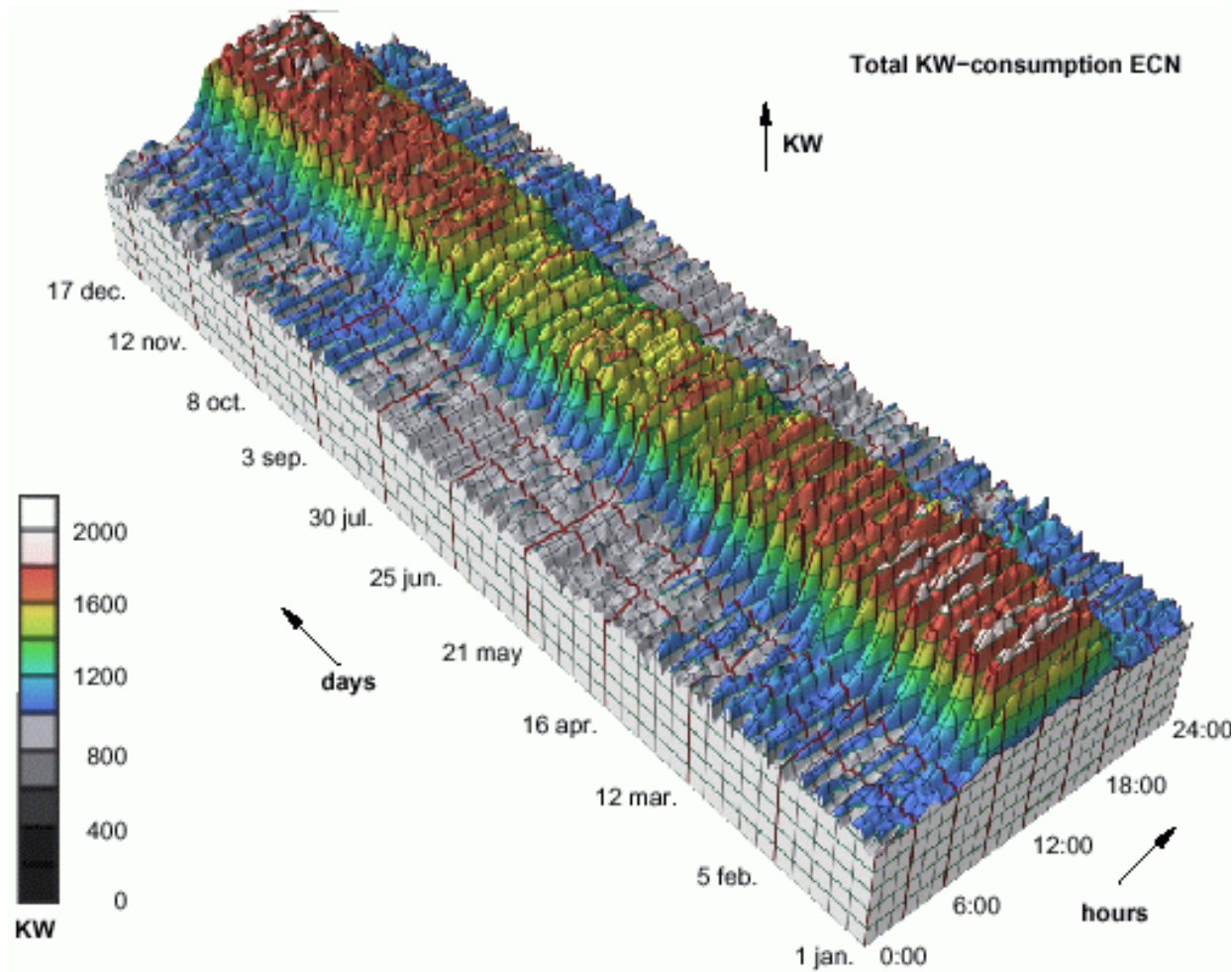
- <http://www.facebook.com/jim.foley.9083>
- What InfoViz interaction methods are used?
- How is time depicted?

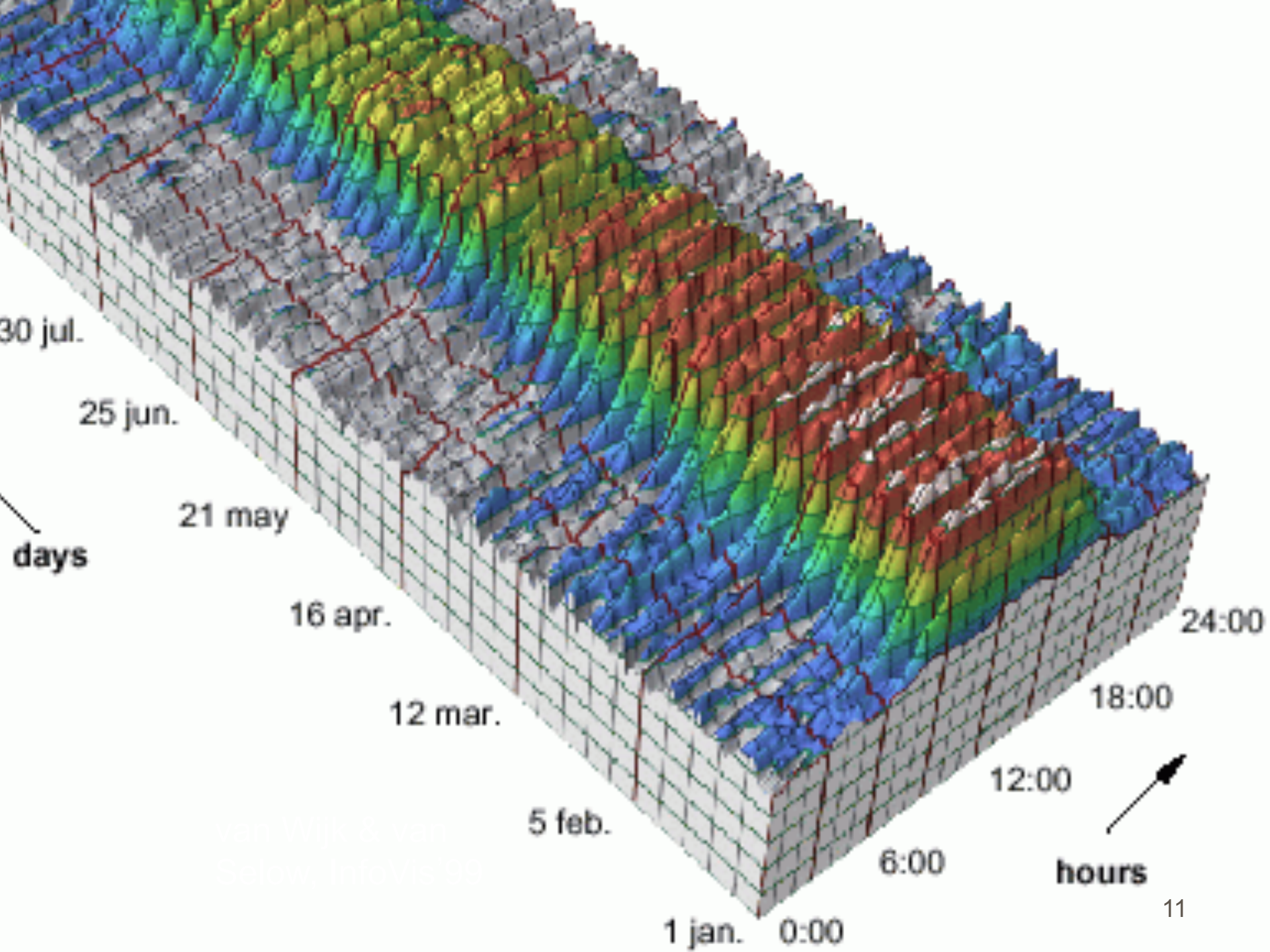
# Periodic Continuous Time Data



- Hourly energy consumption for full year

See larger view  
of data on  
next slide



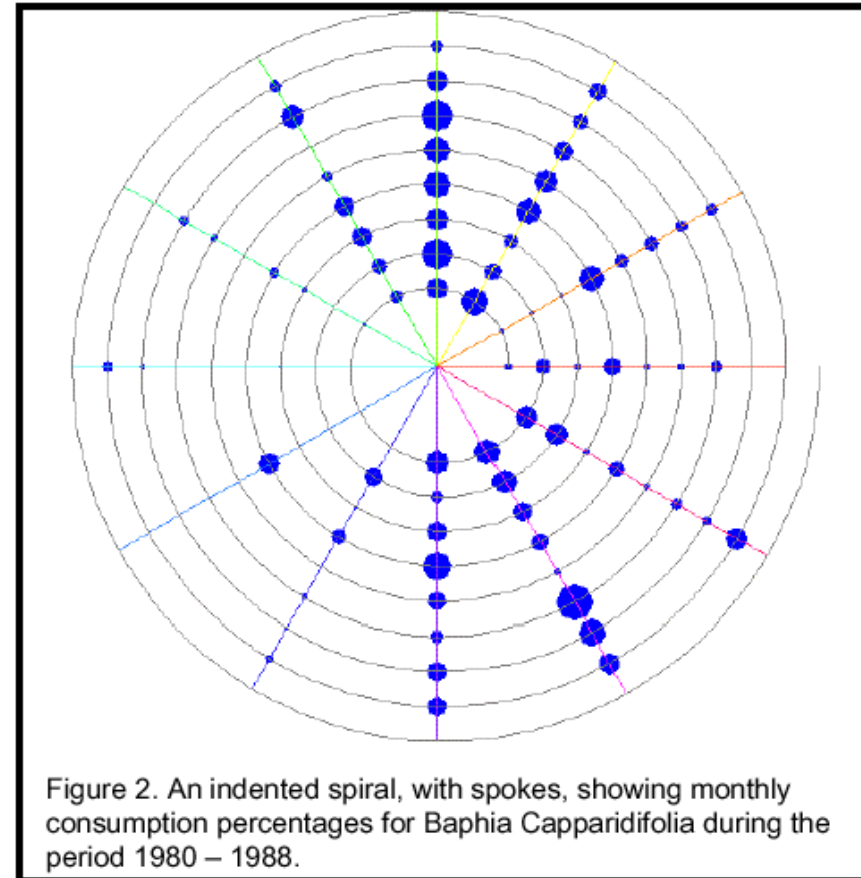


# Periodic Continuous Time Data



- 12 months (spokes)
- Value (consumption) coded by size
- Dots scaled so as not to overlap
- Extra spiral on outside provides some closure

All spiral display figures from Konstan and Carlis, *Interactive Visualization of Serial Periodic Data*, UIST '98; data set is chimpanzee food consumption.



# Example: Variations over Time

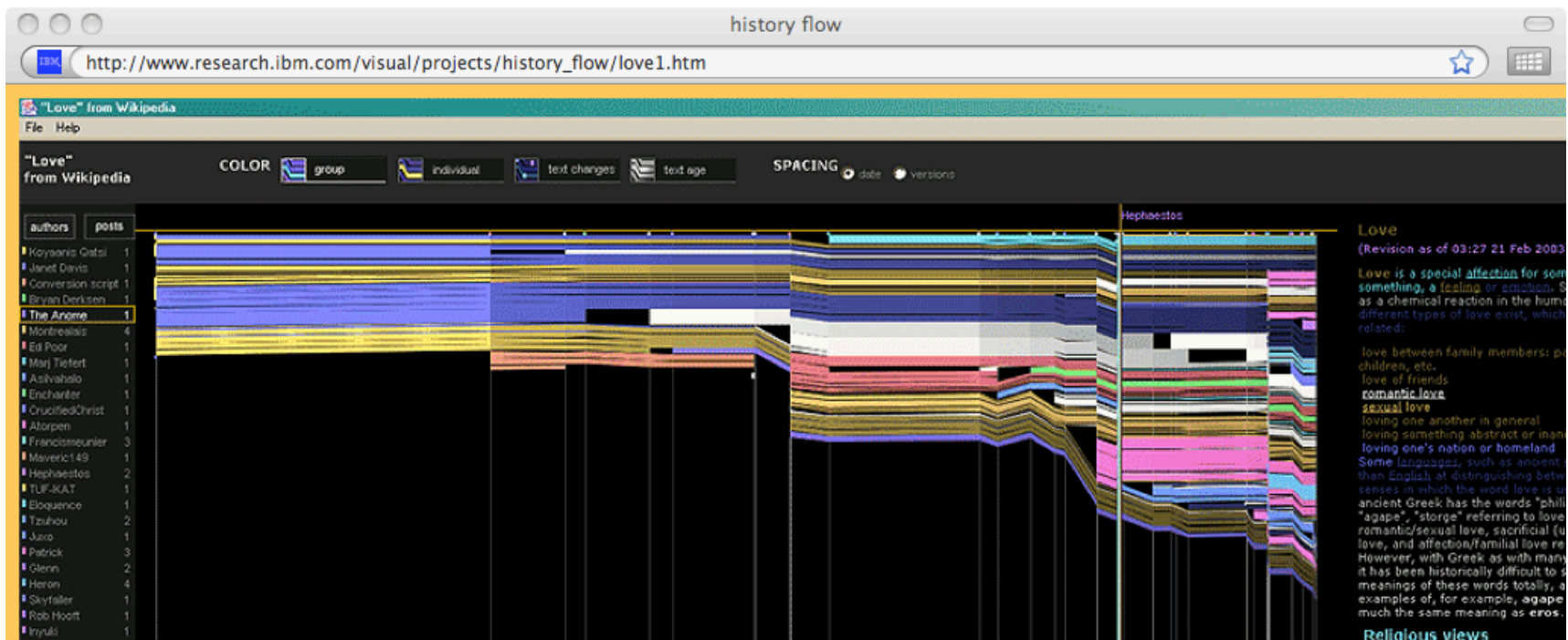


- The ThemeRiver motif can be used to depict many different variations over time.
- Example:
  - Movie popularity – NYT interactive graphic  
[http://www.nytimes.com/interactive/2008/02/23/movies/20080223\\_REVENUE\\_GRAPHIC.html](http://www.nytimes.com/interactive/2008/02/23/movies/20080223_REVENUE_GRAPHIC.html)
- The baby name web site
  - Is stacked time chart  
<http://www.babynamewizard.com/voyager>
- For each example - # vars, # cases, scalability with variables and cases?

# Example: History of Text Revisions



- IBM's 'history flow' shows changes to documents edited by multiple authors



<http://researchweb.watson.ibm.com/history/>

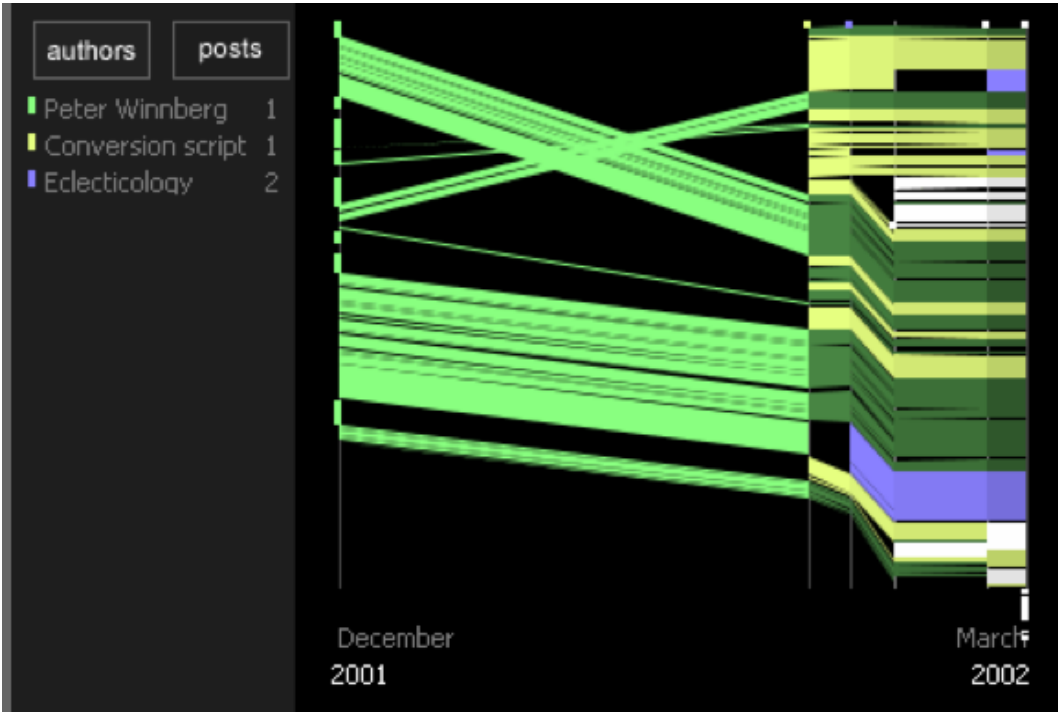
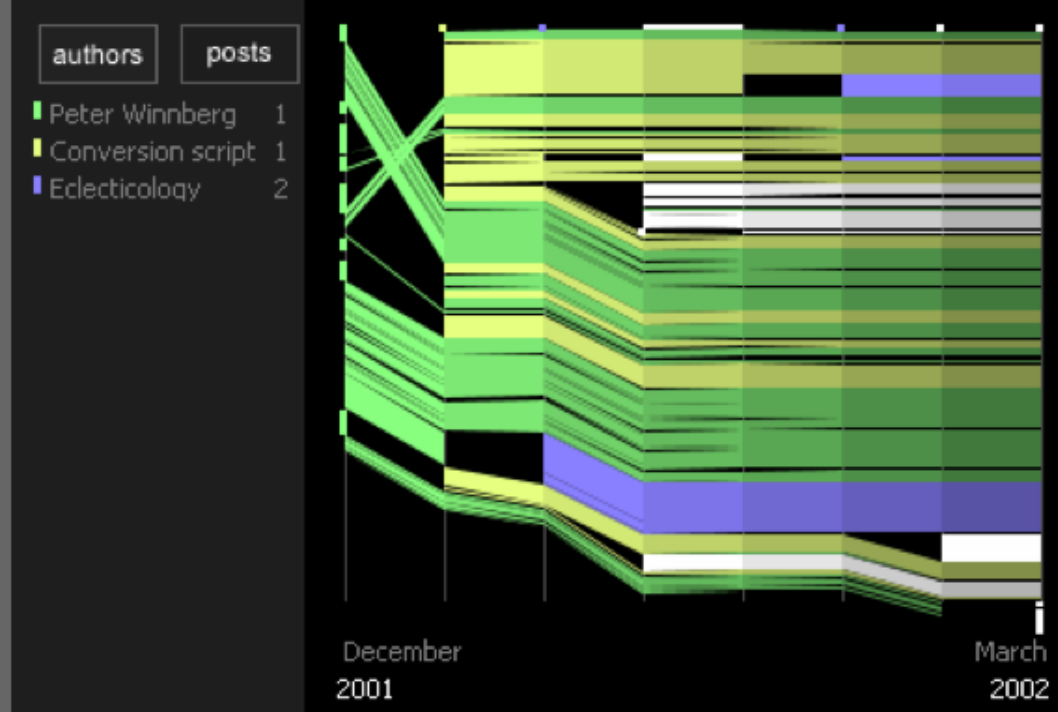
Brightness indicates text age

Registered authors color-coded

Anonymous authors in white

Spacing by revision #  
→

Spacing by time  
→

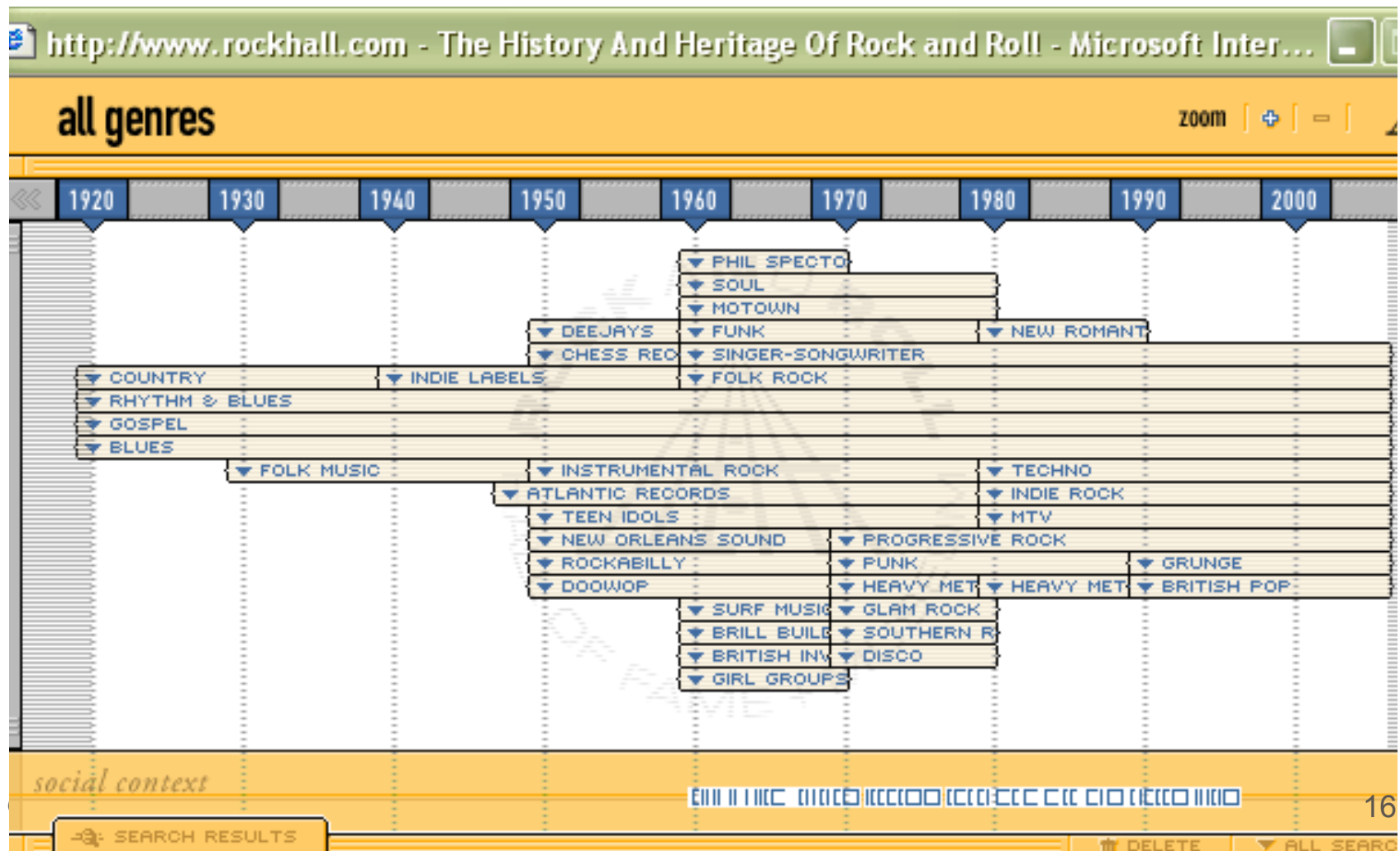


# Example: Music Over Time



History of Genres

<http://rockhall.com/timeline/> (dead link)



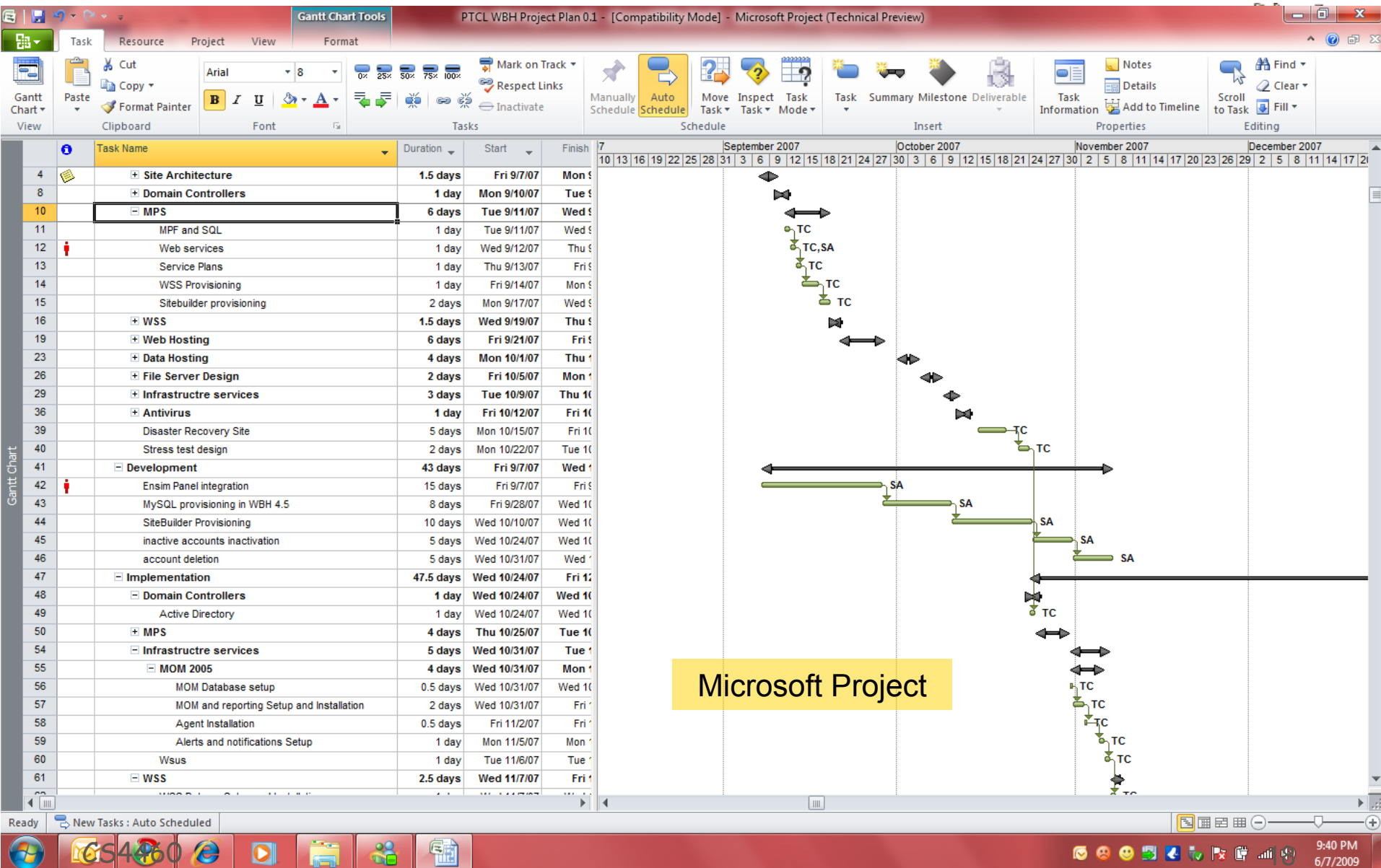


# Example: Project Management



- Project (write software, design/build plane, hire new person) involves
  - Multiple steps
  - Spread over *time*
  - Some steps depend on other steps
- How can we plan/manage project?
- With PERT/Gnatt/CPM charts, of course 😊

# Many Project Mg't Products!



# Example: Time + Geography



- Typically superimpose temporal events on a map
  - Intelligence analysis
  - Literary plot analysis
  - Military planning
  - Maybe in future plan plots for interactive games
- Following figures from GeoTime, a product of Oculus [www.oculusinfo.com/](http://www.oculusinfo.com/)

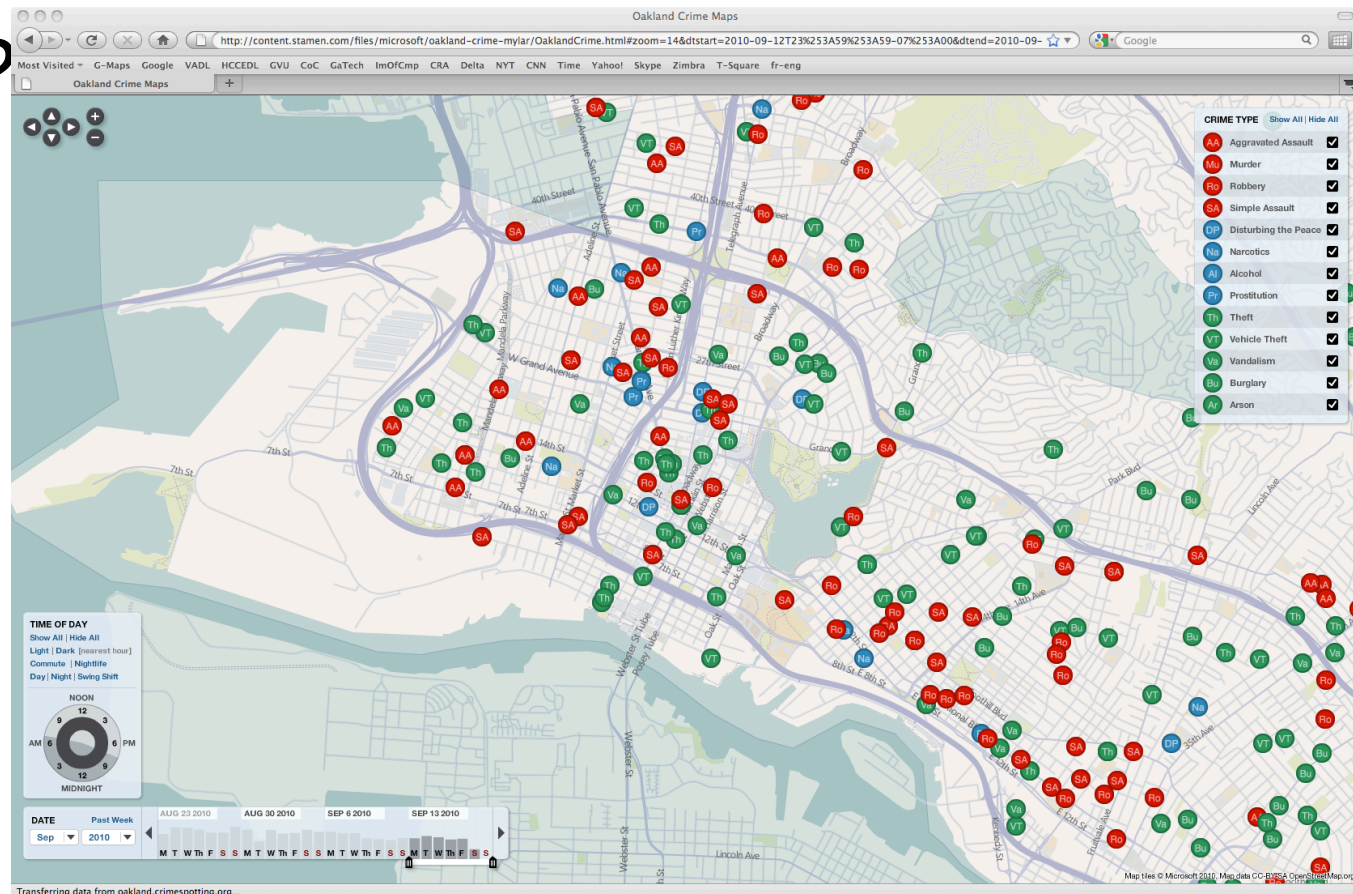
# Interactions in Space and Time



Interaction methods?

# variables?

Data types?



<http://sanfrancisco.crimespott.org/#>

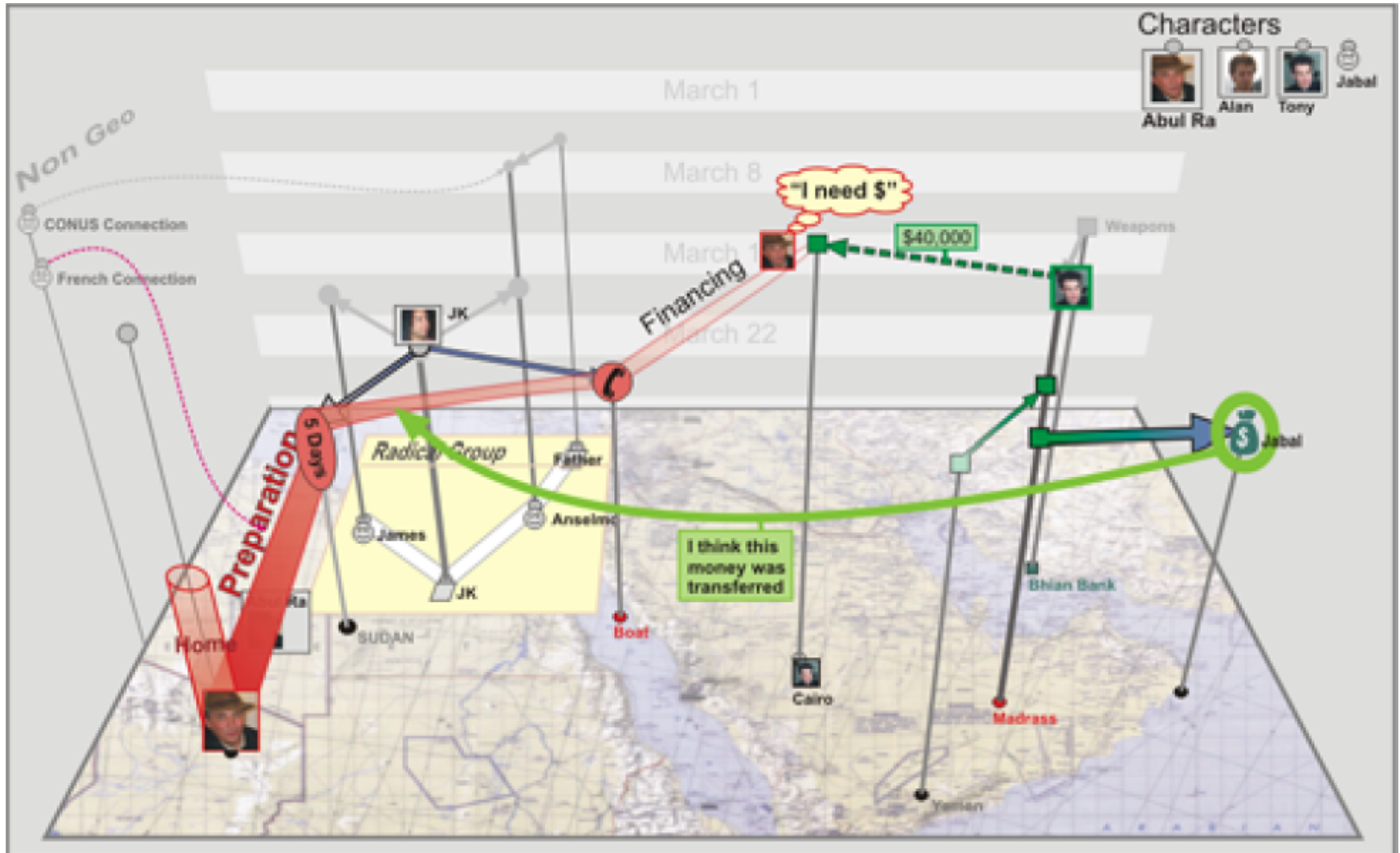
[lat=37.760&zoom=13&dtend=2014-08-18T07:00:52-07:00&hours=0-2,18-23&types=AA,Mu,Ro,SA,DP,Na,Al,Pr,Th,VT,Va,Bu,Ar&dtstart=2014-08-16T09:43:39-07:00&lon=-122.438](http://sanfrancisco.crimespott.org/#lat=37.760&zoom=13&dtend=2014-08-18T07:00:52-07:00&hours=0-2,18-23&types=AA,Mu,Ro,SA,DP,Na,Al,Pr,Th,VT,Va,Bu,Ar&dtstart=2014-08-16T09:43:39-07:00&lon=-122.438)

# Time and Geography Story



Or an intelligence analysis ....

GeoTime



# Wrapping up Time



- What are your take-aways?

# Takeaways



- How decide what type of Infovis to use with what type of temporal data?
  - Temporal data types – remember continuous, discrete, periodic; with or without duration
  - Which of the examples work with which types?
- Scalability