Time-Series Data

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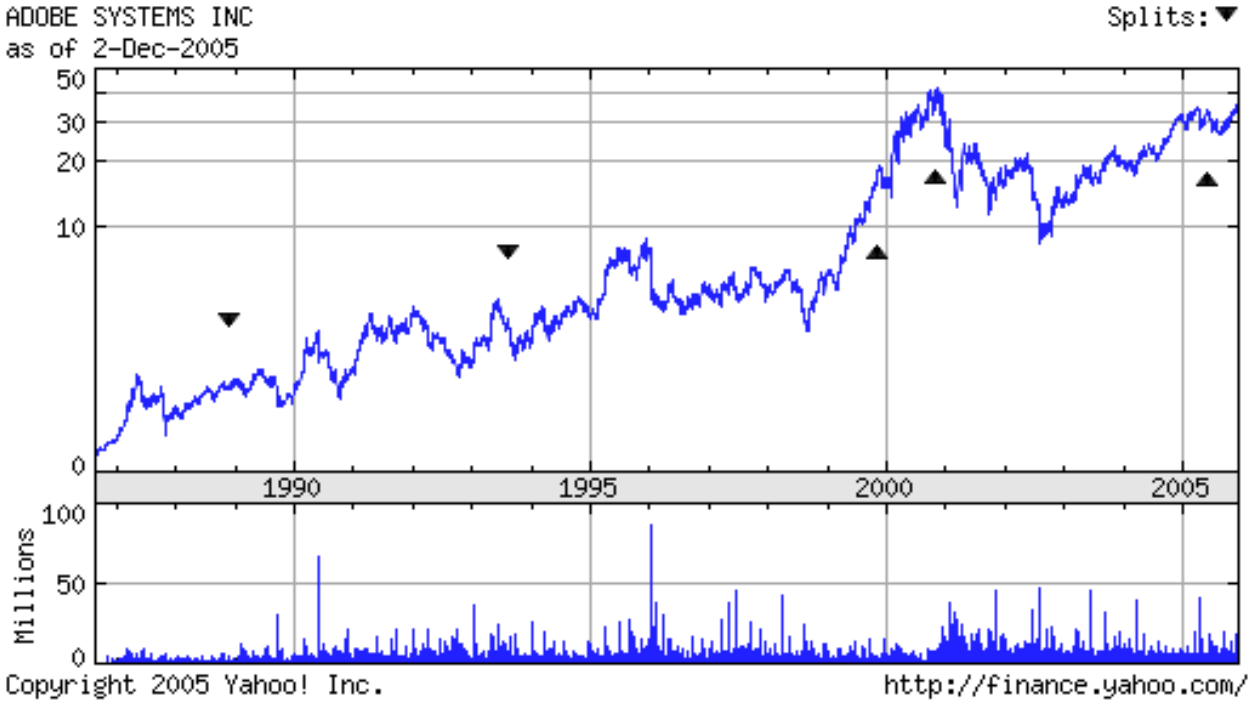
CS 533c

Why do you care?

- Time-series data is all over the place.

What is Time-Series Data?

- Lines.



What is Time-Series Data?

- Usually periodic

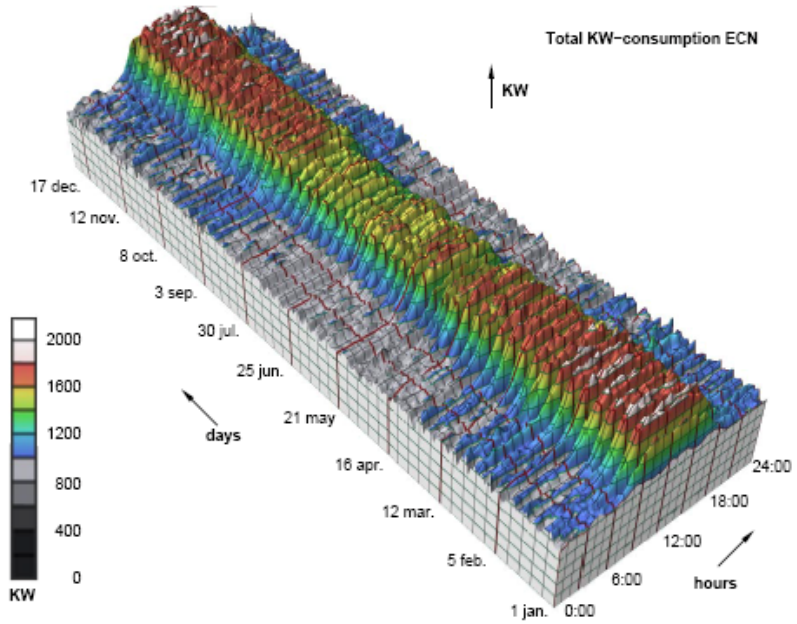


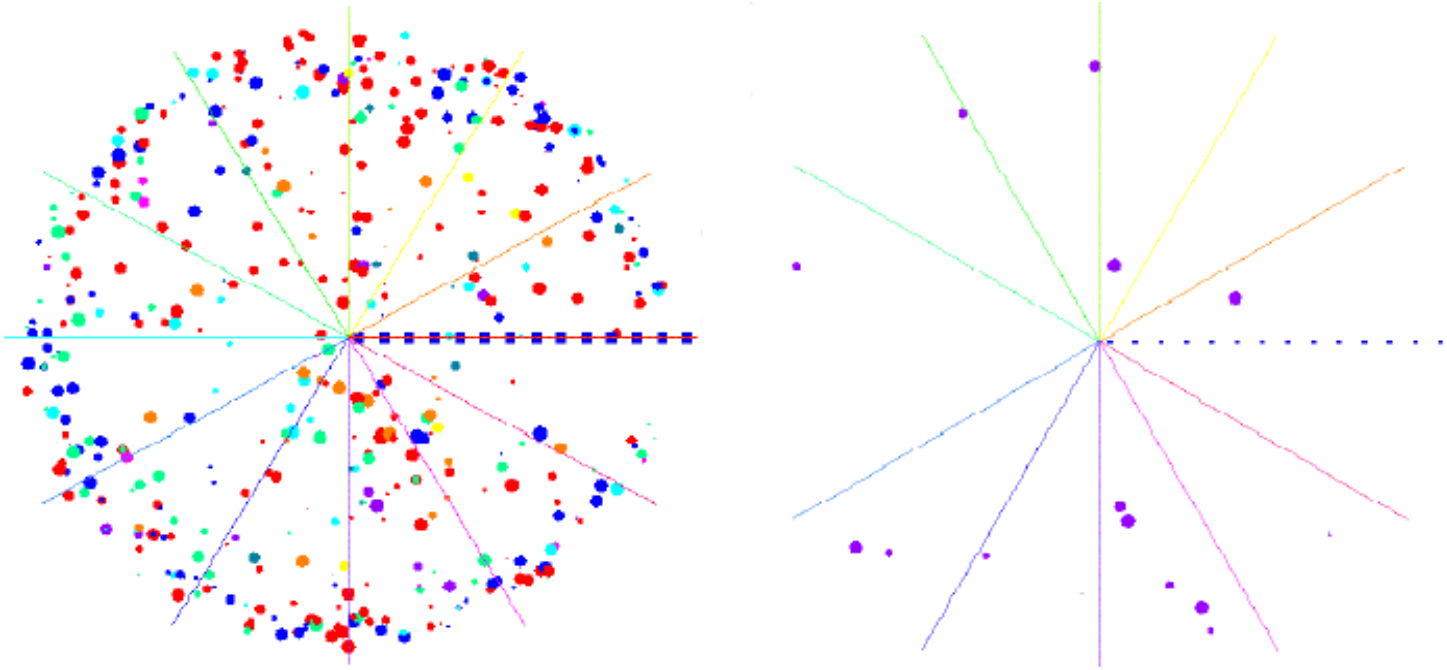
Figure 1. Power demand by ECN, displayed as a function of hours and days

Source: van Wijk and van Selow, *Cluster and Calendar based Visualization of Time Series Data,* 1999

Spiral Viewer (Carlis et al)

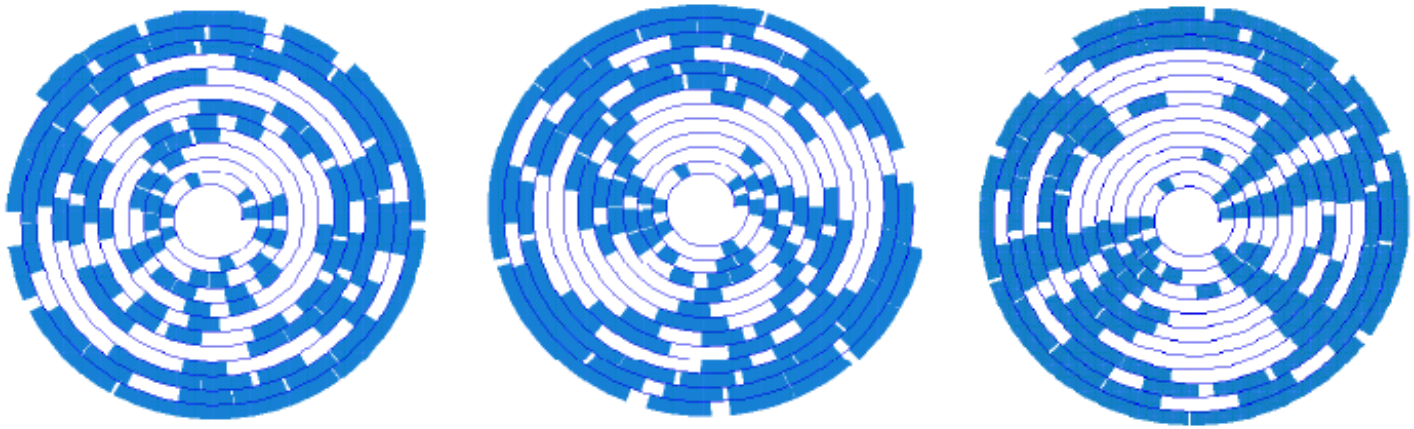
- Angle ⇔ position in cycle
- Radius ⇔ cycle number

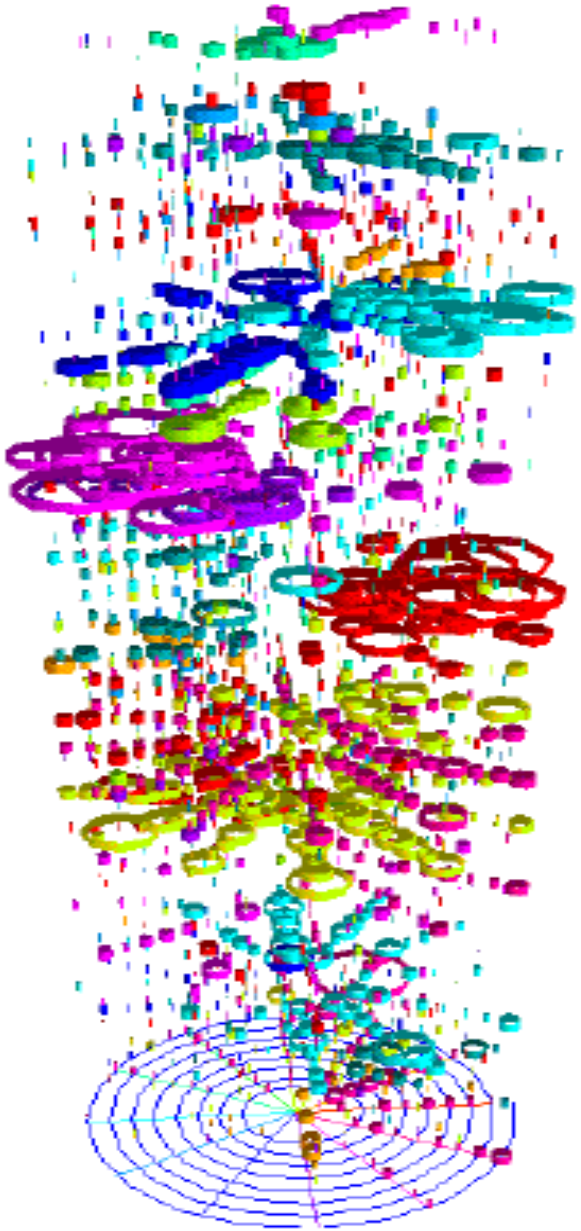
Color, diameter available for use



Unknown periodicity

- Tweak period in realtime to find periodicity
- Example: music



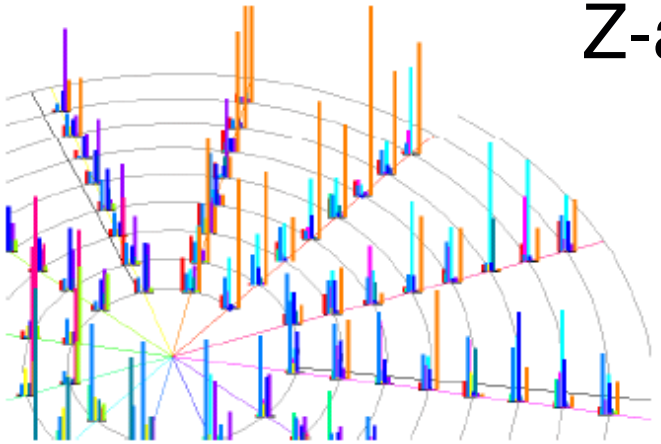


Helices

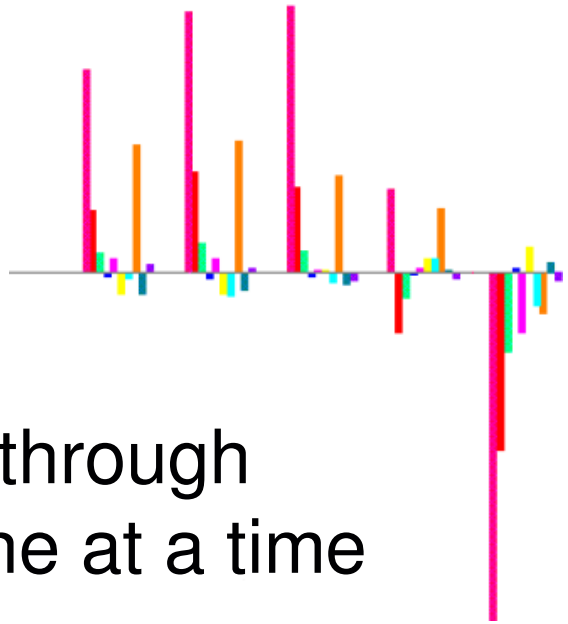
- Example: Chimp eating habits
- Angle ⇔ day of year
- Radius ⇔ year
- Z-axis* ⇔ type of food
- Color ⇔ type of food
- Diameter ⇔ amount

(Rings to beat occlusion)

Spiral barchart



Z-axis used for data



Can step through
spokes one at a time

User feedback

- Qualitative feedback from 12 users
- “Buy into the notion of a spiral display”
- Couldn’t self-operate
- Wanted more

Good points of paper

- Compelling visuals
- Gave examples
- Has software
- Some user feedback

Bad points of paper

- Examples not compelling
- Graphs unlabeled
- Difficult to see quant info
- Questionable movie data
- Weak user eval
- Advantages over Cartesian?

Time-series bitmaps

Repurposes heavily:

- Chaos Game Representation
- SAX
- Windows Explorer

Chaos Game Representation

- Assign corner of square to each base
- For each symbol, take a step in *symbol* direction of half distance
- Color corresponds to number of times a pixel visited

Pan troglodytes
(Chimp)

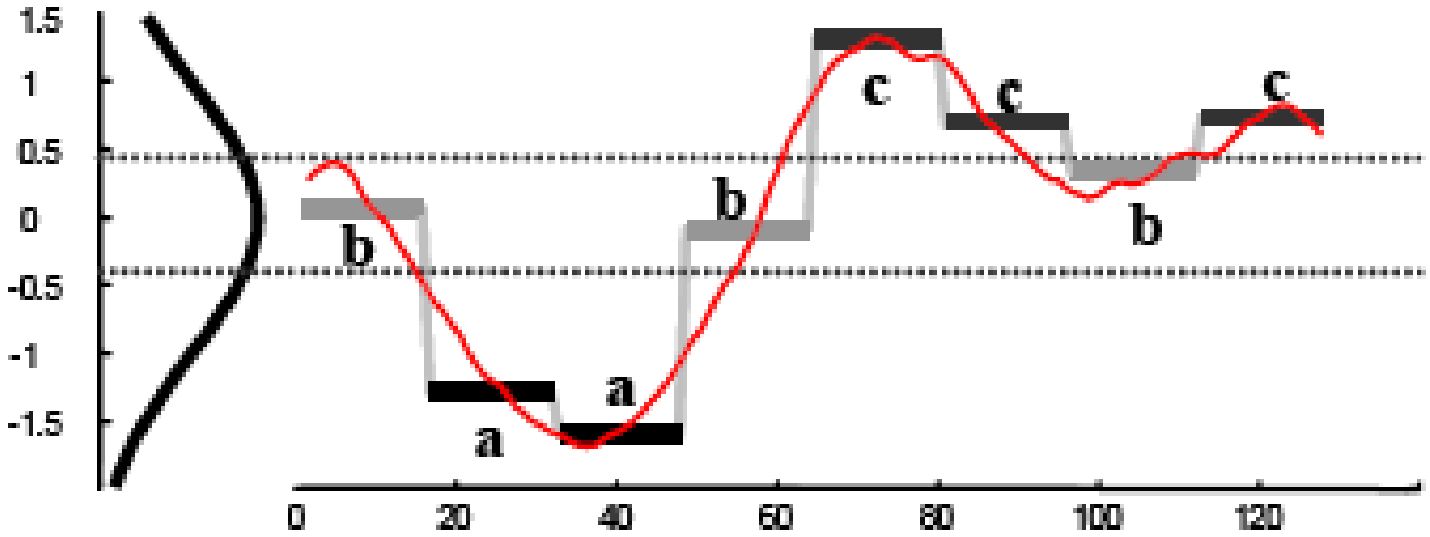
Elephas maximus
(Asian elephant)

Homo sapiens

Loxodonta africana
(African elephant)

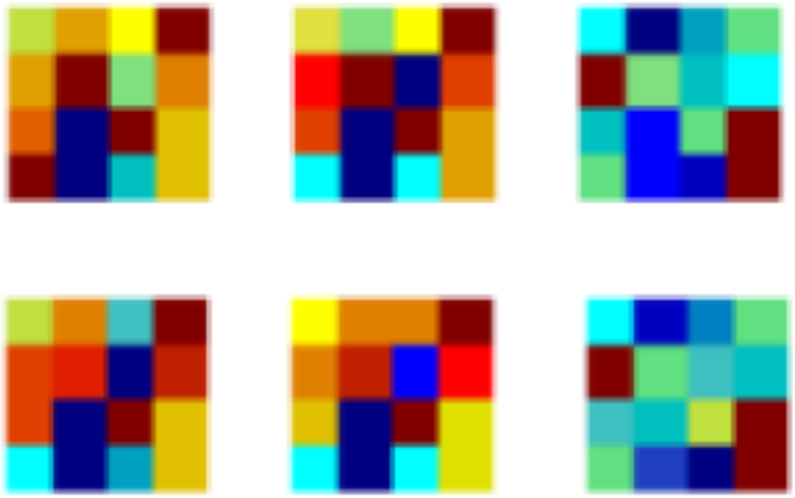
SAX

- Converts reals into equiprobable letters
- Eliminate trends with narrow window
- Uses: clusters, motifs, anomalies



Time-series bitmaps

- Data -> SAX -> CGR -> bitmap
- Linear color mapping (JET)
- Length normalization

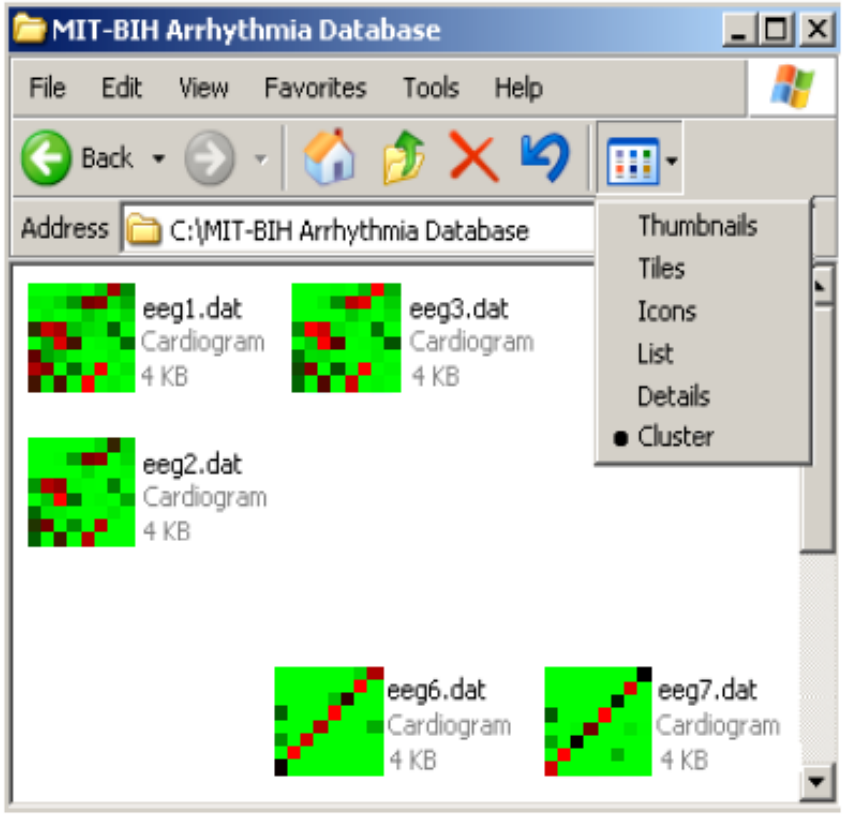


Ubiquity

Use filesystem:

- Thumbnails
- Cluster (using MDS)

Comparisons only



Real-world data

- Clustering heterogenous data (15 sets)
  - Better than ARIMA or Markov
- Clustering of 20 ECG patients (perfect)
- Video classification
  - Better than Euclidian or DTW
- Classifying ECG data (perfect)

Good points

- Pretty cool idea
- Repurposes material from other fields well
- Ubiquitous visualization (filesys)
- Impressive results

Bad points

- Didn’t explain CGR well
- Didn’t explain Windows clustering
- Data sets relatively small
- No user testing

Summary

- Spirals. Cool pictures, what use?
- Bitmaps. Less cool, perhaps more useful.

References

- *Interactive Visualization of Serial Periodic Data*, John V. Carlis and Joseph A. Konstan, Proc UIST 98.
- *Time-series Bitmaps: A Practical Visualization Tool for working with Large Time Series Databases* Kumar, N., Lolla N., Keogh, E., Lonardi, S. , Ratanamahatana, C. A. and Wei, L. (2005). Proc. SDM '05, pp. 531-535