



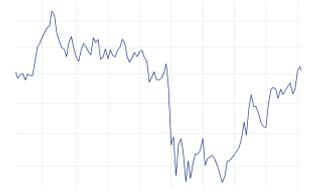
PAPERS COVERED

- Interactive Visualization of Serial Periodic Data
  - John V. Carlis and Joseph A. Konstan
- Visualizing and Discovering Non-Trivial Patterns in Large Time Series Databases
  - Jessica Lin, Eamonn Keogh, Stefano Lonardi
- Time-series Bitmaps: A Practical Visualization Tool for working with Large Time Series
  - Nitin Kumar, Nishanth Lolla, Eamonn Keogh, Stefano Lonardi, Chotirat Ann Ratanamahatana

WHAT IS TIME SERIES DATA?

WHAT IS TIME SERIES DATA?

- A value over time



WHAT IS TIME SERIES DATA?

- A value over time
  - not too useful
- A sequence of time point + value pairs
  - $\langle t_0, v_0 \rangle$
  - $\langle t_1, v_1 \rangle$
  - $\langle t_2, v_2 \rangle$
  - ...
  - $\langle t_n, v_n \rangle$

WHAT IS TIME SERIES DATA?

- $t_i \leq t_{i+1}$ 
  - not  $t_i < t_{i+1}$
- Low resolution of time
- Errors
- Discontinuities
- Multiple sources of measurement

WHAT IS TIME SERIES DATA?

- common examples:
  - financial data
  - electrocardiograms
  - meteorological data
  - production rates
  - ...

WHAT IS TIME SERIES DATA?

- Doesn't need to be a numerical value over time
  - routes
    - position over time
  - schedules
    - Activity over time (resource focused)
    - resource over time (activity focused)

TASKS WITH TIME SERIES DATA

- Finding patterns
  - periodic vs non-periodic
  - finding known patterns
    - searching
    - sequence matching
    - classification
  - finding common unknown patterns
    - motif discovery
    - clustering
  - finding rare patterns
    - anomaly detection

TASKS WITH TIME SERIES DATA

- Finding trends
  - general increasing/decreasing
  - abrupt changes
    - anomaly detection
  - correlation between variables

PAPER 1

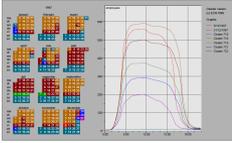
- Interactive Visualization of Serial Periodic Data
  - John V. Carlis and Joseph A. Konstan

PERIODIC DATA

- "Pure" periodic data
  - each period has identical duration
- vs event anchored periodic data
  - periods start following some event
  - time between events may be inconsistent
- Focus is on pure periodic data

PERIODIC DATA

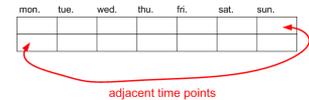
- Initial Approach: Calendars (tabular layouts)



Cluster and Calendar based Visualization of Time Series Data. Jarlie J. van Wijk and Edward R. van Selow, Proc InfoVis 99

PERIODIC DATA

- Calendar (tabular) layouts exaggerate distance between adjacent periods



PERIODIC DATA

- Calendar (tabular) layouts exaggerate distance between adjacent periods
- Solution: layout the series in a spiral



Figure 1. A Spiral of Achromatic (50 raster figures see the abstracts presentation at www.viz.wisc.edu/infovis.

PERIODIC DATA

- The end of one period is close to the start of the next.
- Encodes time with two visual attributes
  - distance from center is time
  - angle is time relative to start of period
- Values at time points must be encoded some other way
  - same with tabular layouts

