so many time series, such little understanding

Data sets consisting of many related time series are as ubiquitous and important as they are overwhelming. From neuroscience to finance to meteorology, time series provide a wealth of information.

For small data sets, simple conclusions are obvious to derive: these three time series seem to increase sharply together; and these two follow a downward trend.

However, as the numbers increase...

...relationships become less straightforward to visualize.

patterns and connections

The primary goal of neuroscience is to understand how patterns of neuronal firing, represented by time series of neuronal membrane voltage, can encode memory and consciousness.

The belief is that, by performing calculations both in local subnetworks and across brain regions, neurons interact in concert to coordinate behavior and thought.

variable visual complexity

Our goal was to build a system for visualizing neural time series data in a way that promotes the discovery of networks and sub-networks of neurons and that allows exploration of the relationship between their patterns of activity.

The utility of such a tool is not limited to neuroscience: in finance, for example, knowledge of the relationship between various companies and of how they are grouped is essential to analyzing investments.

Nodal Exploration of Time Series

An interactive system for discovering and describing connections between large sets of related time series

cs 448b'12  •  final project  •  isaac kauvar and sheldon chang

Encouraging interaction

As opposed to presenting the user with a static graph alongside a set of time series, we wanted the user to be able to smoothly and interactively drill down, cluster, and filter. To that end, we provided sliders for rough filtering according to quantitative features of the data - such as the maximum correlation within a cluster - but we also offered the ability to expand and contract individual nodes. Additionally, we allowed side by side comparison of the time series of any node, including the juxtaposition of individual neurons and clusters.

Specifically, we performed agglomerative hierarchical clustering, with correlation as the metric of similarity between time series:

```python
while num clusters in prevLayer > 1:
    for each cluster A in prevLayer:
        B = cluster in prevLayer most similar to A
        if B already added to a cluster in newLayer:
            add A to B's cluster
        else:
            form new cluster with A and B in newLayer
            save newLayer clusters
    prevLayer = newLayer
```

However, our system was designed to be flexible enough for use with any hierarchical clustering strategy.

continuation

There are many features that we would like to add, but here are two at the top of our list:

1) Present more data to the user upon initialization of the application. This could include exhibiting small multiples of various clustering arrangements paired with selected time series, or a movie that cycles through the data in an interesting manner.

2) We would also like to make time a major aspect of the visualization by showing how the clustering changes over time.