Visual Analysis of Cloud Computing Performance using Behavioral Lines

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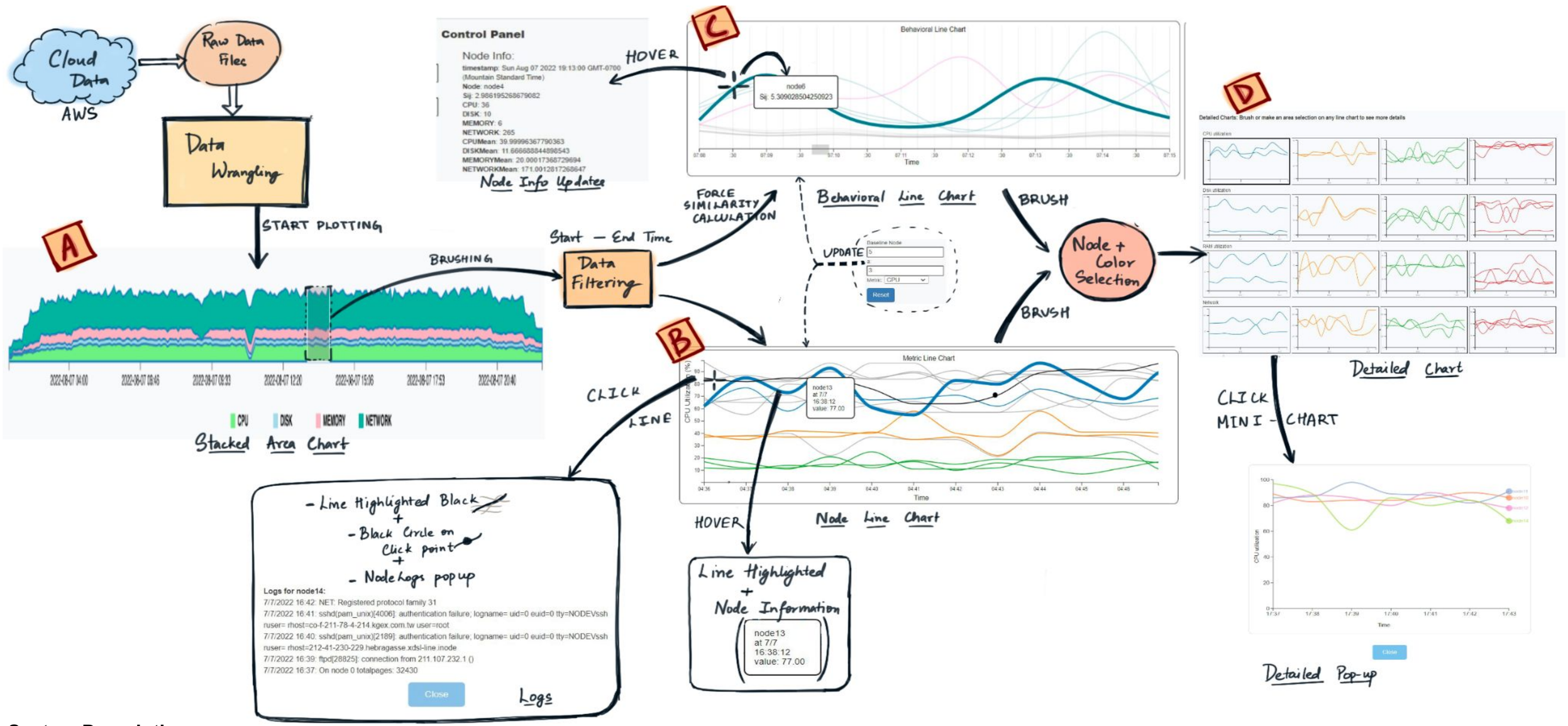
Introduction

- **Motivation**: To build a visualization and analysis system capable of handling large amounts of highly varying and multivariant data. To gain insights on datasets that contain data points over a wide range of metrics and time that have a varying correlation with each other.
- **Domain Abstraction**: User can be anyone wishing to compare data which has multiple metrics that are correlated and vary drastically over a time period. Our implementation focuses specifically on analyzing large scale cloud systems.
- **Data Domain**: The dataset should be made of various metrics or attributes collected over a time period from any source. Our data is from a cloud computing system which consists of many nodes.
- **Task Abstraction**: Analyzing trends, Compare similarity, Summarize Distribution, Locate outliers.

Datasets

- Performance metrics of clusters of instances with each cluster running different applications.
- CPU, Memory, Network, Disk Utilization and application logs are part of the dataset. Downloaded these files from the AWS cluster that we spawned to generate the metrics. Dataset Type: Tabular.
- All the metrics are of type Ordered (Quantitative). Timestamp is Ordinal (Temporal).



System Description

[A] **Stacked Area Chart:** Shows the overall view of the dataset normalized for all the attributes of the nodes and each attribute or metric is shown as a stack in the chart. Interactions: On brushing, the start and end time are provided to the other charts for showing detailed view in the selected time window.

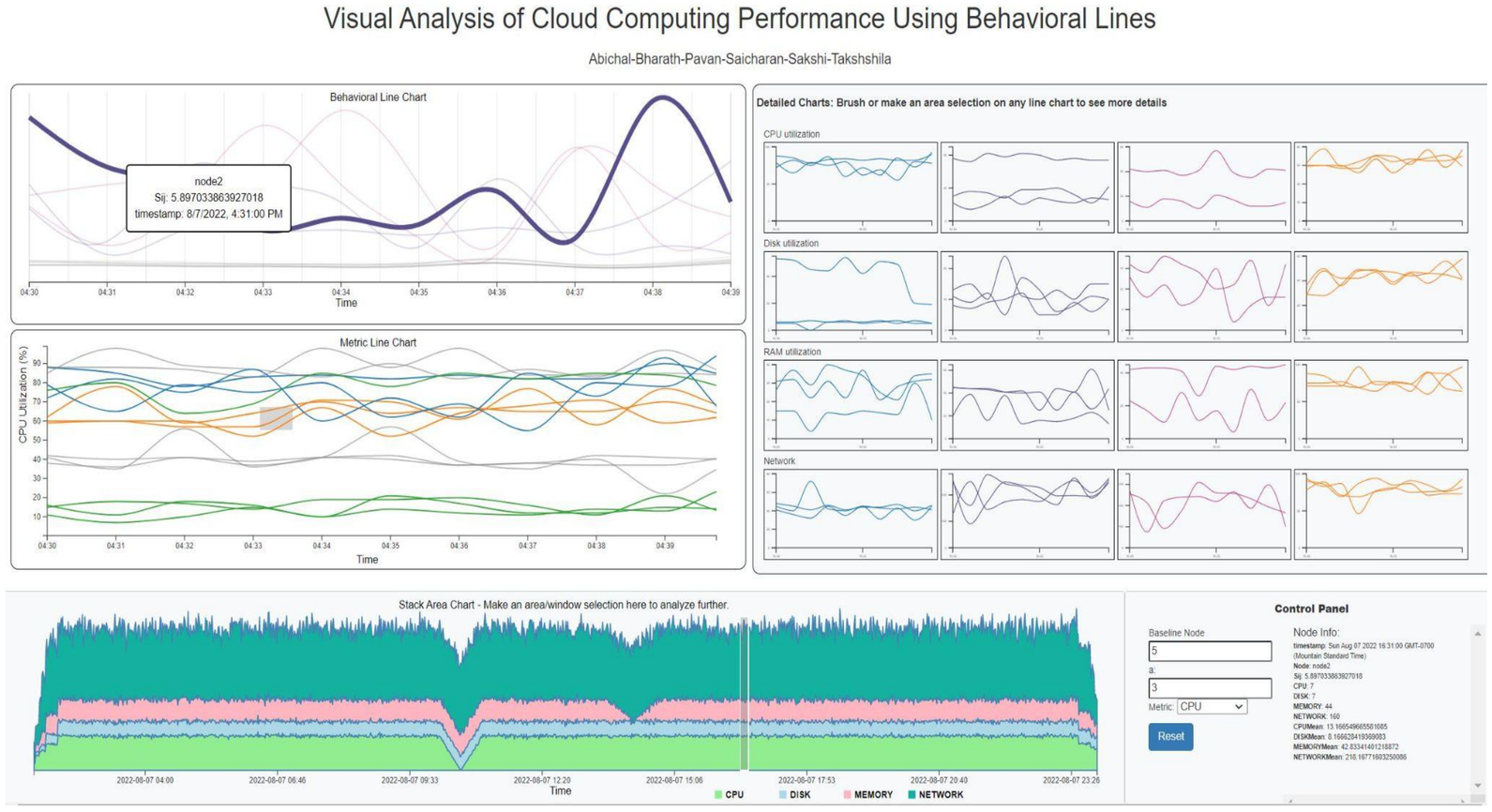
[B] **Metric Line Chart**: Line chart for plotting **actual values** of attributes. This is based on the attribute selected in the control panel. Interactions: On brushing, it selects the lines to be visualized in the detailed chart and gives the group of lines a color. On hover, the line gets highlighted and details of the node is shown in the tooltip. On click, the line gets colored in black and a pop-up with logs of the given node at that selected timestamp and some history is displayed. (**extension**)

[C] **Behavioral Line Chart:** Shows the **behavioral similarity** of the attributes of the nodes based on the selected baseline node (**extension**) in the control panel. Interactions: On brushing, selected lines form a cluster and are given a color x in the chart and also a detailed chart is plotted for it with the same color. On Hover, the line gets highlighted, similarity and relevant node info is shown in the control panel. (**extension**)

[D] **Cluster Detailed Chart** : Grid of **minicharts** at the right. Contains node-level detail for all the metric in a juxtaposition manner. On clicking pop-up showing detailed view of each chart (**extension**)

Results/Analysis

- **Stacked Area Chart**: Looking at the area and stack heights, a user or an analyst can understand which metric/resource is being overused/underused and which stack is the culprit for the overall high/low at any given time. The user can select a timestamp window over which they want to analyze the attributes of the nodes through Metric and Behavioral Chart.
- **Metric Line Chart**: Check the logs of a specific node per metric(probably outliers or ones with higher requirements). Looking at the relative positions of the nodes per metric, a user can group the nodes which are similar by selecting them. These selected nodes form a cluster and get plotted in detailed charts.
- **Behavioral Line Chart**: The charts show how nodes are similar/dissimilar to each other based on the force values. Can do further analysis by changing the base line node, and window size for mean and standard deviation calculation in algorithm.
- **Cluster Detailed Charts**: The user can compare multiple metrics simultaneously of the group of nodes selected from the line charts. The user views the detailed chart of a metric more keenly by clicking on it (opens a popup of the chart which is enlarged).



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