

A DETAILS OF THE USER STUDY

We proposed an online web-based system for user-study. Our study was approved by our institution's Institutional Review Board (*IRB*). The pipeline of the user study is shown in Figure 1. Before the user study began, all participants will be redirected to the online study system designed by us. In the very beginning, we recorded the participant's Prolific ID and provided them with the completion code at the very last of the study to trace every participant and improve the quality of the answers. The participants are required to complete all mini-tests to improve the experiment quality. The 72 tasks and the questionnaire are the subsequent procedures. Note that all participants are divided into two groups for a strict counter-balance order to mitigate the learning effects, as shown in the two paths (i.e., Task Sequence 1 and Task Sequence 2) in Figure 1. All choice and questions are required for the completion. Each participant will get a completion code after they answer all open question in the questionnaire.

Note that to avoid the participants comparing the line slopes via the arrows' vertical positions, we adjust the arrow directions the same as the target line segments to mitigate the effects. To remind each participant to perform the study carefully, we terminate the test if the participant failed one of the mini-tests at the beginning of the study (Figure 1(B)). In addition, we insert a warning page between the mini-test and the formal 36 studies to inform the participants the study and timer will begin and ask them to finish each task as quickly as possible (Figure 1(A)).

B USAGE OF OUR OPEN-SOURCE PACKAGE FOR INTERCEPT GRAPH

To support the easy implementation of VACSEN, we develop a JavaScript function and make it open-public via the URL: <https://www.npmjs.com/package/interceptgraph>. The open-sourced package supports the accurate and smooth comparison of state changes for the general public.

We provide useful API for the quick implementation of VACSEN. Specifically, we define two parameters to build the chart:

- ***svg_id***: the identification of the SVG container to draw VACSEN. The parameter only accepts the *id* of the DOM element. Note that the width and height of the SVG should be specified within the tag using *width* and *height* parameters.
- ***src***: the data source to be rendered. The parameter only accept CSV data file as input. Using the path name to the CSV file for the parameter. Note that the CSV data file should be formatted as follows: 1) no headers for the dataset; 2) the order of the data field: *name, data series 1, data series 2*; 3) use “,” for separating the attributes.

An example of the usage of the package is shown in Figure 2.



Fig. 2: An example to call the rendering function to draw an Intercept Graph conveniently and quickly. The user needs to mount the node of SVG element first, and then render the chart into the SVG element. The size of the SVG element is required to be specified in advance instead of including it in a style sheet.

C GENERATED DATASETS FOR METRIC EVALUATION

In Section 6, we use randomly-generated datasets to evaluate the metrics, i.e., line crossings and intensity ratio. For the dataset generation, we define three scale levels (i.e., small scale, medium scale, and large scale) and 81 normal distributions to perform the metric evaluation. In this section, we listed some of the charts (i.e., our approach: VACSEN, baseline approach: slope graph) driven by the datasets we generated in advance, as shown in Figure 3.

The procedure for dataset generation is as follows: first, we defined three scale levels (i.e., the small-scale, the medium-scale, and the large-scale) of the number of data items. For each scale level, an increment of 5 data items was set to cover a wider range. Assume that the axis ranges of two data series were from 0 to 100. For each *randomly-generated* dataset, we tried to generate all possible distributions for the given number of data. We applied the Gaussian Distribution to the data points generation and set three types of means and three types of standard deviations to data series (i.e., d_1 and d_2), respectively. We, therefore, generated 1215 randomly-generated datasets in total: 3 scale levels with 5 scale numbers per level \times 9 Gaussian Distributions of data series $d_1 \times$ 9 Gaussian Distributions of data series d_2 .

We evaluate VACSEN in comparison with the slope graph that VACSEN can effectively mitigate the line crossings compared to slope graph, especially for the datasets with a large number of data items (e.g., over medium scale 200). Meanwhile, VACSEN can magnify the ratio of length of two state changes, making it more intuitive to tell apart the relationship of two state changes.

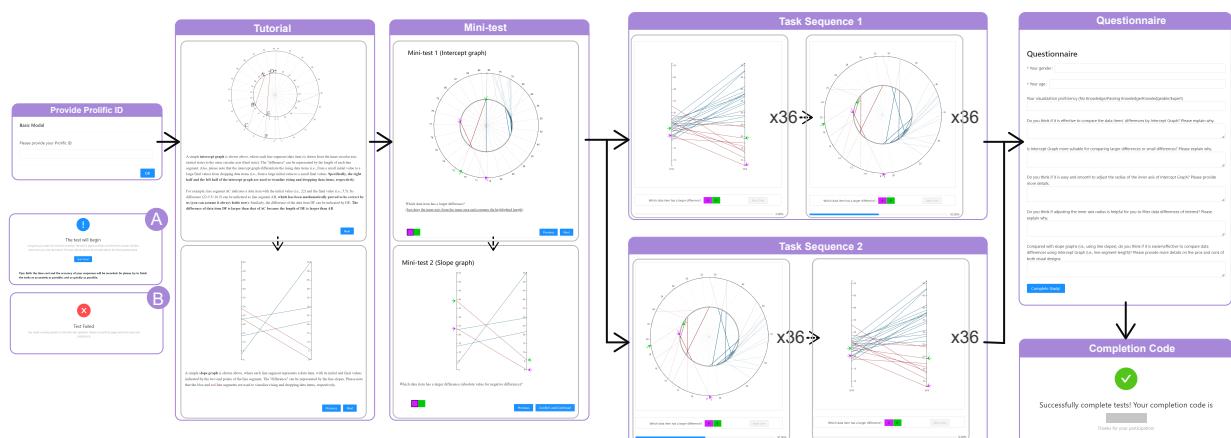


Fig. 1: The pipeline of the system for user study, consisting of the screenshots of the system interfaces. Each participants are required to complete all tasks and the questionnaire to receive the completion code at the very last of the study. Each participant was compensated with US \$3.28.

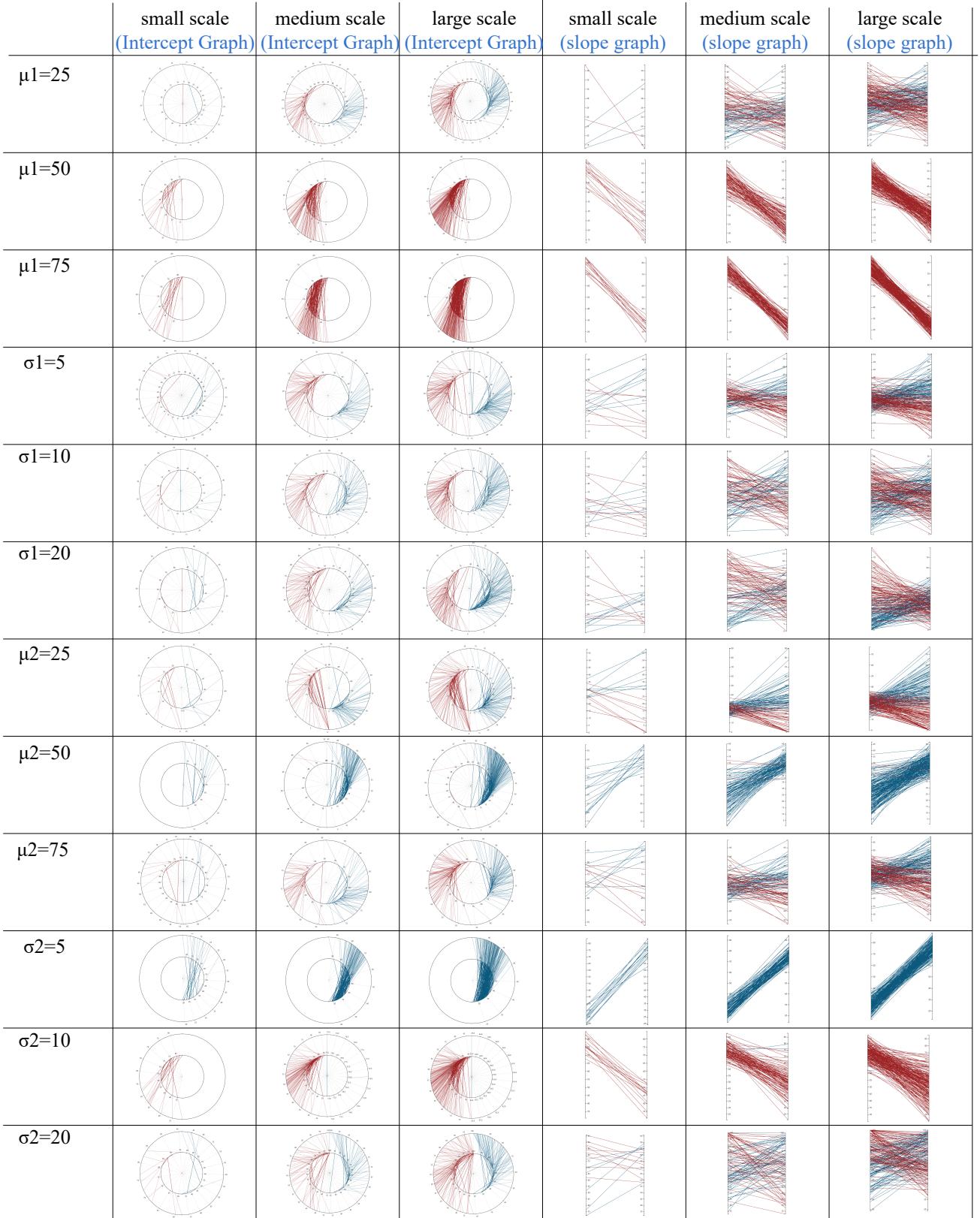


Fig. 3: The comparison of VACSEN and slope graph. We use the same generated dataset to evaluate VACSEN and slope graph. The Gaussian Distribution shown in the chart are a part of the whole set (i.e., 12 out of 81).