**Manager, Product Development | Interview Task**

Congratulations on moving forward to the next round of the hiring process. At this stage, we are asking you to answer a few questions and complete a reporting task. These correlate directly to work you will engage in if you are hired for this role and are designed to give you more insight about this role and to show us how you would approach the work.

Some of this information is factual and some is not. For the purpose of completing these exercises – if you need to make assumptions as you put together deliverables, please do so and be prepared during the interview to indicate where and why you have made certain assumptions.

You should spend approximately **2-3 hours** on this entire activity. Please do not spend more time as it is intended to be a timed task.

Please complete and return by the agreed upon date in advance of your interview. You can present the material in any way that best works for you.

**Part 1 – Short Answers**

1. **Talk to us about something you’ve helped create. Where did the idea come from? Why does it excite you? What were the highs and lows in the development process? 500 words or less**

I want to talk about when we took part in the IEEE Visual Analytics and Science Technology Challenge. Though the process was painful, our team still won the only Outstanding Award of Comprehensive Solution among 74 teams. In this project, we have trajectory data which tells the movement of each visitor in an amusement park and the communication data which tells when and where they sent and received the message from others. From the data, the goal is to extract a theft who steals something from the exhibition center. Though we managed to find the theft by separately visualizing and analyzing both data, we were encouraged to create some new visualization methods which can combine both data together. This is where the project excited me because we were trying to solve a larger problem in the visualization field.

The basic need for this new visualization view should include time, space, communication directions and visitor’s identification information. The basic design idea came from the visualization theory I learnt in the past experience. Without animation, taking X-axis as the time axis will be a typical choice. To show the visitors’ movements, I set the Y-axis as the spatial location. In terms of the communication information, we can add markers on the coordinate to show when (by x-axis) and where (by y axis) the message is sent or received and the color shows direction of the message (inbound/outbound). Level of details should be considered in case of overlapping, especially between visitors movement and communications directions. As the design went on, I became more and more exciting because I felt I was useful and I could use my knowledge to solve practical problems. But the downs came up after I put the design into the practical use. Some tiny problems were enlarged while the scale of the data became larger, especially for the overlapping problem. I have considered many backup solutions such as setting multiple filters to control the data volume, using the opacity to differentiate the visual depth, pruning context information for highlighting the focus, creating a zoomable space for different levels of details, etc. However, none those methods can solve the problem in essence and they may either require more complex interactions (harder to use) or lead to the mess of visual channels (harder to understand). In the end, due to the limited time (it’s a one-month contest), we still had to submit our design.

1. **Tell us about a time you had to understand a problem from a perspective that was different than your own. What did you learn? 500 words or less**

Typically, this happened very often during the discussion with the collaborators in other domains. In my most recent project, the goal is to compare different climate models and visualize their differences in a proper manner. A typical way of comparing the models is to cluster the models and see which are similar and which are dissimilar. I told them that we could use K-Means, hierarchical clustering, normalized cuts or other clustering algorithms on the models. Their concern was that it’s unnecessary to do the clustering stuff because the climate models were essentially generated by a fixed number of smaller models and they are supposed to be similar. But a more critical problem is that I was assuming that they understand the clustering algorithms but in actual they do not and may fail to help us explain the result from their view. After I insisted on doing hierarchical clustering considering the internal hierarchies of the model, the result is visualized in a dendrogram which helps the hydrologist understand how the models are grouped and separated. This is also where we distinguish us from general data analysis roles. We can make people see and understand the results through the power of graphics and interactions in a perceptive manner.

On the other side, when I wanted to project the real climate data onto the map, I found the data was not really what I expected as it changes drastically over space. So I asked the domain experts that if I could do the kernel density estimation (KDE) over the original data so that the visualization result will look better. But their answer is that they prefer keeping it in the original look. They explained that the drastic changes over space come from the coarse sampling during modeling process and if we do the interpolation over the data, it may mislead other hydrologists. As a compromise, I cut off some extreme values and did the linearly scaling while mapping the colors to the data values.

There are many other disagreements during our discussions such as the method to compute the uncertainty among models and how to manage the level of details for stakeholders, domain experts or common users. But we also managed to find the compromise across the domains. Lessons are learnt through this project. Visualization is a heavy interdisciplinary area because it specifically relies on the domain data and domain demands and finally is assessed by domain experts. It is important to switch the view to the problem when dealing with different data in different domains. As what I have done and learnt in my project, a proper visualization design should come from thorough interviews with users, widespread questionnaire for peer colleagues and other forms of survey. The visual analysis should also be conducted under the collaboration with domain experts so that we can propose scientific hypothesis and solid results.

1. **Please provide us a link to your portfolio, Linkedin, github or personal website (e.g. something that shows off your portfolio of work and projects).**

I do not have a personal website to hold and show all my projects. Most of the projects I worked on were only open to collaborators instead of the public. But luckily part of these work were submitted to YouTube and part of them were attached in my LinkedIn profile as the screenshot\*. I hope you can understand.

*The visualization project regarding uncertainty in climate modeling is attached as the screenshot in my LinkedIn profile (*[*http://www.linkedin.com/in/xingliang1*](http://www.linkedin.com/in/xingliang1)*).*

*The visualization project regarding cyber security data:* [*https://youtu.be/XehlHdDrNMk*](https://youtu.be/XehlHdDrNMk)

*The visualization project regarding spatio-temporal data:* [*https://youtu.be/LUZr3qEt7Qo*](https://youtu.be/LUZr3qEt7Qo)

*The visualization project regarding volume rendering is attached as the screenshot in my LinkedIn profile (*[*http://www.linkedin.com/in/xingliang1*](http://www.linkedin.com/in/xingliang1)*).*

\*You may only be able to see the attached pictures after building connections with me on LinkedIn.

**Part 2 – Task**

Context: The attached file is a “Teacher Summary Report” that is sent to Principals at the end of the school year with information about how their teachers performed across a few evaluation variables. This is a relatively new report that the team has produced and is looking for ways to improve it.

Your task is to:

1. **Create a “report” that represents this data for principals in a clear and engaging way. How you choose to create the report is up to you, including what tools or software you use.**

Click [here](demo/demo.html) to open the dynamic report. You may also manually open the *demo.html* file in the folder *demo*. You will need to click the button on the up left corner to load the *workbook.csv* file before you can see the visualization results. In case you do not have internet or limited functionality on your computer, please see the attached *Report.pdf* for a static report.

1. **Explain your methodology and choices made. In less than 500 words describe the assumptions you made, why you made them, what design choices you made, and what influenced them.**

Assumptions Made:

1. While plotting the evaluation score, they are assumed as zero based.
2. I assume each district has multiple schools in larger data, though some districts only have 1 school in the given data. Otherwise, the average method may not work.
3. From the given data, the overall evaluation score are assumed as the sum of all other three evaluation scores.

Data Analysis method:

1) Numerical methods include average, standard deviation, and linear regression analysis. Mean and std value are used to analyze the overall evaluation results. The linear regression model is used for analyzing the relationship among MOTP (responsor), MOSL STATE (regressor) and MOSL LOCAL (regressor). Some problems are pointed out in the report.

2) Visualization methods include rich graphics and interactions in serve for an engaging report. Visualization choices:

2-1) **Line Chart** (By District): it is important to first give the principle an overview of all the data. So I computed the average overall ratings for all districts which may help me know what it happening in global view.

2-2) **Stacked bar chart** (by Teachers): it gives a new view to the principle so that he or she can compare the teacher’s achievements. Compared to the first overall view, it gives all three evaluation metric results and the principle can analyze the achievement both from the teachers’ perspective (MOTP) or students’ perspective (MOSL).

2-3) **Scatter plot** (By Ratings). It only contains the three evaluation metrics in order to provide a deeper insight for the principle. Traditionally, people are expecting that if the teacher teaches more, the student will learn more. However, from our analysis, there are not essential connection between both scores. Moreover, we found some conflictions between the LOCAL and STATE MOSL point. This shows the need to do some improve the evaluation metrics.

In conclusion, rather than choosing the visualization design first, I prefer to choose the analysis goal first and then fit them into a visualization method which may help us reach that goal.

1. **Additionally, describe how you would evaluate the effectiveness of what you produced. Be as specific as possible including both what metrics you would want to measure and how you would define success.**

A visualization method can be evaluated from various perspectives such as the adaptability, performance, user experience, data analysis method, task goals’ accomplishment, etc.

First of all, the visualization application should be scalable for different data size. In this case, the given data is pretty small and all data processing work as handled on the front end, so some process work should be transferred to the server side once the data becomes much larger.

Secondly, one should evaluate if the visualization goal is clear. Depending on different goals, the visualization application can be developed as a platform to show off the information or a tool to support the interactive data explorations. As a stakeholder such as the principle, the visualization goal is to show them the well-analyzed visualization result. As a domain-expert, they may need more interactions to look into the interesting problems. This relates to a deeper problem that what the human role is in the visual analysis.

Thirdly, because visualization is an interdisciplinary area, one should evaluate if the data analysis method is reliable. As a visualization engineer, one may start from using some common data analysis techniques such as descriptive statistics and end with the interview with domain experts. As for the visualization evaluation method, one may collect the special cases from that area and check if there are any special assumptions to the data. As I mentioned before, I assume that each district has multiple schools in larger data. Otherwise, the average method may not work. Also, the use of linear regression models are based on several assumptions such as their linear dependency.

Fourth, one may evaluate from what the users have learnt from the visualization. If there is ground truth behind the visualization tasks, it is easy to compare the ground truth and what they have known. Otherwise, it can be conducted through online questionnaire, deep interview or other forms of surveys. Through some highlight techniques or Focus+Context techniques, some critical information can be emphasized to avoid their loss in the delivery of information. In this case, if the principle doesn’t fully understand the report, it means the visualization should be improved.

Lastly, I will say that the definition of success is decided by the accomplishment of the visual analysis tasks. To fulfill such tasks, one successful visualization application should be at least tested through the above few evaluation methods.

1. **Last, critique your own product. We know nothing is perfect, and we work continuously to improve, so share two things that you think are really great about what you produced and 2 things that you think could likely be improved over time.**

To show off: 1) From the visualization side, multiple interactive visualization are provided. Their functionalities are barely overlapped and serve for distinct goals. Rich interactions are also fused into the visualization. 2) From the visual analysis side, I think it is good to see the information and gain deeper insights from different angles, especially when the data set is small. In this project, several perspectives are provided for the principle to see the result and in final a small question about the usefulness of the evaluation metrics is proposed for deeper e reflection. Methods used in this data are also very simple and easy to understand.

To improve: 1) The small data set is not enough to build a good linear regression model and hence we cannot accurately reflect the relationship among the evaluation metrics and predict the evaluation results by each teacher or by each region. 2) Cannot show the information by districts on the map as it is better to plot them on the map for the spatial comparison.

A few definitions that will help you are:

* MOTP: The “Measure of Teaching Progress” is a rubric-based feedback and evaluation system that is used across the NYC Dept of Ed. Ratings range from “Ineffective” to “Highly Effective”
  + MOTP Points: MOTP points are given for each of 8 different categories and then totaled into a “MOTP” Point score that then leads to the rating
* MOSL: Similar to MOTP, the “Measures of Student Learning” is a score that combines many different types of data points from different assessments given throughout the year. Schools can choose from a range of assessments.
  + MOSL Points: MOSL points are captured separately for “state” assessments and “local” assessments that were selected by the school. These scores are tallied separately in this report.
* District Code and School DBN: These are two identifiers that associate the school to various records in the database. District code refers to one of the 31 districts across the city. There are more than 1,000 schools in the city and each has its own DBN.
* Overall Rating: The Overall Rating for each teacher is a combination of the MOTP and MOSL scores which then translates into a similar grade of “Ineffective” through “Highly Effective”.

A note on scores and confidentiality

1. The information in the attached data set has been scrambled and is not associated nor should be taken to represent any individual school. The scores however are representative of a real sample and provide a good real-world scenario.
2. This task and data sheet should be considered strictly confidential and not shared with anyone in any form.