Term Project Description

• Background Scenario

After the successful resolution of the 2014 kidnapping at GAStech's Abila, Kronos office, GAStech officials determined that Abila offices needed a significant upgrade. At the end of 2015, the growing company moved into a new, state-of-the-art three-story building near their previous location. Even though the employee morale rose somewhat with the excitement of the new building, there are still a few disgruntled employees in the company.

The new office is built to the highest energy efficiency standard, but as with any new building, there are still several HVAC issues to work out. The building is divided into several HVAC (heating, ventilation, and air conditioning) zones. Each zone is instrumented with sensors that report building temperatures, heating and cooling system status values, and concentration levels of various chemicals such as carbon dioxide (abbreviated CO2) and hazium (abbreviated Haz), a recently discovered and possibly dangerous chemical. CEO Sten Sanjorge Jr. has read about hazium and requested that these sensors be included. However, they are very new and very expensive, so GAStech can afford only a small number of sensors.

With their move into the new building, GAStech also introduced new security procedures, which staff members are not necessarily adopting consistently. Staff members are now required to wear proximity (prox) cards while in the building.

The building is instrumented with passive prox card readers that cover individual building zones. The prox card zones do not generally correspond with the HVAC zones. When a prox card passes into a new zone, it is detected and recorded. Most, but not all, areas are still open to staff members even if they forget their prox cards. People are somewhat careless with their prox cards, but some diligent staff members will go to the security desk and pick up a new prox card if their old one is mislaid.

As part of the deal to entice GAStech to move into this new building, the builders included a free robotic mail delivery system. This robot, nicknamed Rosie, travels the halls periodically, moving between floors in a specially designed chute. Rosie is equipped with a mobile prox sensor, which identifies the prox cards in the areas she travels through.

This project provides a two-week set of static data for you to analyze, covering May 31 to June 13, 2016.

• Your Task

As an expert in visual analytics, you have been hired to help GAStech understand its operations data. In this challenge, you are given two weeks of building and prox sensor data. Can you use visual analytics to identify typical patterns of and issues of concern? You will have the following data and supporting information at your disposal:

- A building layout for the GAStech offices, including the maps of the prox zones and the HVAC zones (Building Layout)
- A current list of employees, roles, and office assignments (Employee List.xlsx)
- A description of the data formats and fields provided (Data Formats.pdf)
- Proximity sensor data for each of the prox zone regions (BuildingProxSensorData)
- Proximity sensor data from Rosie the mobile robot (BuildingProxSensorData)
- HVAC sensor readings and status information from each of the building's HVAC zones (BuildingProxSensorData)
- Hazium readings from four sensors. (BuildingProxSensorData)

You will be asked to answer the following types of questions (Total 100pt):

1. (25pt) What are the typical patterns in the prox card data? What does a typical day look like for GAStech employees? Describe up to **five of the most interesting patterns** that appear in the building data.
2. (20pt) Describe up to **five of the most interesting patterns** that appear in the building data. Describe what is notable about the pattern and explain its possible significance.
3. (25pt) Describe up to **five notable anomalies or unusual events** you see in the data. Prioritize those issues that are most likely to represent a danger or a serious issue for building operations.
4. (30pt) Describe up to **three observed relationships between the proximity card data and building data elements**. If you find a causal relationship (for example, a building event or condition leading to personnel behavior changes or personnel activity leading to building operations changes), describe your discovered cause and effect, the evidence you found to support it, and your level of confidence in your assessment of the relationship.

*Note

1. You should answer these questions with figures (e.g., screenshot of web page you implemented) in your report. Please describe the patterns you found with fully finished sentences. Note that you must do **demonstration of your implemented system in the Final presentation**.
2. You can earn additional points (up to 30pt) by submitting a runnable code (e.g., github) or website to your report.
3. Late submissions can be received up to three days after the due date, with 10% penalty per day (1 day late – 10% / 2 days late – 20% / 3 days late – 30%).

Questions you may ask

1. **What is Hazium?** Hazium is a (fictitious) chemical that has become a recent concern on the island of Kronos. Not much is known about its effects, but it is suspected that Hazium is not good for people.
2. **Can you provide more info on the data provided in the mobile proximity card data? Are the x,y coordinates bound to a normal (x,y) plane, where in this case the plane is the floor maps?** The (x,y) coordinates are bound to a normal plane. The (x,y) plus the floor number would identify a specific location. The lower left of the provided map is (0,0) and the upper right is (189,111).
3. **What does the (x,y) coordinates represent for the mobile robot sensor?** The (x,y) coordinates for these reading represent the location of the mobile sensor.
4. **Sometimes, mobile prox data for a prox card repeats multiple times in a minute. Does this indicate the number of seconds that the prox card was within range of the sensor?** No. Multiple readings do not indicate what fraction of the minute that the mobile sensor was in proximity of the prox card.
5. **In some cases, the value of the VAV Availability Manager Night Cycle On/Off is 2. Is this a valid value?** Yes.
6. **Does F_3_Z_9 VAV Damper Position mean F_3_Z_9 VAV REHEAT Damper Position?** Yes.

References

This project is created with reference to the 2016 VAST Mini Challenge 2. You may refer to the submission of the people participated in the challenge.

- (Demo video) https://www.youtube.com/watch?v=cOLCyfdYr2Q
- (Demo video) https://www.youtube.com/watch?v=wyBWQjDKNDM
- (Paper of analysis on submission) https://apps.dtic.mil/dtic/tr/fulltext/u2/1033423.pdf