ITCS 6162: Knowledge Disc in Databases
Summer II 2016

Research Project

You will be submitting your work in progressive way as mentioned in this schedule:

Deliverables	Due Date
Question 1 (normal and periodic patterns)	Monday August 1st , 2016
Question 2 (Anomalies and causal relationship)	Monday August 10th , 2016

This project was designed in reference of Visual Analytics Science and Technology (VAST) 2016 Mini-Challenge 2 (**http://vacommunity.org/2016+VAST+Challenge%3A+MC2**).

Problem Overview

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.

Your Job

As an expert in **knowledge discovery**, 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 **knowledge discovery** 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
- A current list of employees, roles, and office assignments
- A description of the data formats and fields provided
- Proximity sensor data for each of the prox zone regions
- HVAC sensor readings and status information from each of the building's HVAC zones
- Hazium readings from four sensors.

You will be asked to answer the following types of questions:

1. a/ What are the typical patterns in the prox card data? What does a typical day look like for GAStech employees?

   b/ Describe up to ten of the most interesting patterns that appear in the building data. Describe what is notable about the pattern and explain its possible significance.

2. a/ Describe up to ten 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.

   b/ Describe up to five 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.