Restaurant Supply Express! Drone Delivery

CS 4400: Introduction to Database Systems
Course Project: Fall 2022 Semester

Version History

Version	Date	Notes
0	September 5, 2022	Initial release
1	September 19, 2022	Added extra sample data (new delivery service: NutriFood Inc.)

Scenario Description

The following is a text description of the system you are being tasked to develop. The system requirements – explicit and implicit – are included this document, and they need to be identified and reflected in your Enhanced Entity-Relationship Diagram (EERD).

You've just arrived with a group of friends to your favorite restaurant. You're excited to enjoy your favorite dish – however, as you begin to place your order, you're informed that they're missing a key ingredient. Well, that's disappointing. Wouldn't it be nice if there was a way to get that key ingredient delivered quickly so that your craving could be fulfilled?...

…Well, wait no longer. You are being asked to design and develop a system to help manage the quick and efficient delivery of key ingredients to restaurants to help them keep their operations – and their customer's appetites – running as smoothly as possible. This system will represent one or more ingredient delivery services. Each delivery service will manage a fleet of drones. Those drones will be used to deliver the ingredients to the restaurants as quickly as possible. Restaurants will purchase ingredients from the drones. The money paid for the ingredients purchased will flow from the restaurant owners back to the drone owner's delivery service, helping each stay in business – a proverbial "win-win" situation.

The primary aim of our system is to support various delivery services. This means that it will have to manage the data related to various types of entities – namely, the people, places, and things relevant to our scenario. The single-most important resource we have is talented people. We will track people in our system as users who are acting in various capacities. Users can be restaurant owners, or employees of one of the delivery services, or possibly both. All users must be either owners or employees – our system will not keep track of any other types of user accounts. And all users must have distinct names/identifiers in this system.

Attributes that are used to identify entities in our system will normally consist of forty (40) or fewer alphanumeric characters in some regular pattern/format. This will be the default format for entity-identifying and "entity unique" attributes in our system unless otherwise noted. Dates will be represented in the "yyyy-mm-dd" date format; this will be the default format for dates in our system unless otherwise noted. Also understand that these "early" data type specifications might be superseded once we've received more sample data from the customer in later phases of the project.

We will also maintain the first name, last name, address, and birthdate of each user. The birthdate will be represented in the "*yyyy-mm-dd*" date format. This will be the default format for dates in our system unless otherwise noted. We will use the birthdate to help authenticate users for tax verification purposes, and occasionally to reward customers with special offers.

Some users might have relatively long first and/or last names, so we will ensure that we can manage first and last names that have one hundred (100) or fewer characters. Our default size for storing "general purpose"

descriptive attributes will be one hundred (100) or fewer characters unless otherwise noted. For example, since we are handling the address as a single string, so we must ensure that we can store addresses of up to five hundred (500) characters.

Employees are critical to the success of the delivery services. Our system will "centrally manage" all the employees, even those from different delivery services. This will help given the rare skills needed for this domain, and to manage potential conflicts of interest (e.g., one employee sabotaging the efforts of a rival service). Each delivery service has a distinct identifier, and a (possibly duplicated) longer name.

The services are supported by various employees. Employees can support the company in different roles – for example, by stocking and monitoring the warehouse or moving packages to the proper drones (i.e., warehouse workers); or, controlling swarms of drones (i.e., pilots). We will keep track of which employees have the skills sets needed to act in these different types of roles. One of the more experienced workers is sometimes selected to act as the sole manager for the service. There are other employee roles, such as financial data analysts or logistical coordinators, but we won't keep track of those roles explicitly in our system.

We must track the unique tax identifier (e.g., Social Security Number for some people) for each employee for legal purposes. The tax-identifier will be stored using a "*xxx-xx-xxxx*" format. We will also keep track of the date each employee was hired, along with the number of months (as an integer) that they have worked (i.e., experience) for the company. We store both values because employees sometimes take a leave of absence to train, attend conferences, or support the family (e.g., maternity leave). We must also keep track of the salary for each employee.

Pilots control the swarms of drones as they carry ingredients back and forth between the different restaurants. Each pilot must have a valid license type to signify that they have received the proper training to operate the drone safely. Flight skills also tend to improve with experience, so we must also keep track of the number of successful trips (i.e., moving a drone or swarm from its current location to a new location) for each pilot.

The warehouse workers are the people you often encounter in grocery stores stocking shelves; serving in the deli, bakery, or seafood section; or acting as a cashier. The main difference is that they work in the warehouse for the delivery service as opposed to being directly visible to the customers; and, they have somewhat unique skill requirements for working with the high-speed package routing equipment and systems needed to keep the items that need to be delivered flowing efficiently. They are also responsible for making sure that the drones are repaired, restocked, refueled, and otherwise ready to deliver ingredients as needed.

Employees are permitted to be temporarily "unemployed" (i.e., not working for any specific delivery service), though they normally work for at least one delivery service. Workers can be directly employed at multiple delivery services at the same time as part of a "time-flex" plan. Pilots, on the other hand, don't work directly with a specific service, but are contractually hired to control one or more drones. And to avoid conflicts of interest, pilots aren't permitted to fly drones for more than one delivery service at a time. Each delivery service must employ one or more workers and might also have a manager. Also, the duties for workers and drone pilots are diverse and time consuming, which prevents an employee from being a worker and a pilot at the same time.

Each delivery service will have an identifier and a name. The service identifiers will be unique, though names might be shared. Managing a service implies that you must also be employed by that service. And an employee may be the manager for at most one delivery service at a time – it's simply too much work to manage multiple services simultaneously.

Delivery services can purchase many drones to deliver orders to restaurants in a timely manner. Each drone has been purchased/sponsored by a single service, and is used to make deliveries (i.e., carry ingredients to

restaurant locations) for that service alone. Also, each drone will have an identifier that is unique for that service, but not necessarily unique across the other drones in our system; therefore, each drone must be identified relative to the specific delivery service that it supports.

A drone is configured so that it can only carry a certain number of fixed-sized packages of varying weight. The fixed-size packages facilitate easier loading of the drones. Each drone has a limited capacity of packages – the total weight (measured in pounds) of the ingredients is important but is not a limiting factor.

A drone may be controlled by at most one pilot at a time. Having multiple pilots attempting to control a single drone would eventually lead to conflicts and crashes. And given new flight control technologies, a pilot can control multiple drones at the same time more easily than before. Some drones take their flight directions directly from a pilot. Other drones don't receive directions from a pilot; rather, they take their flight directions from a "leader drone" that is being controlled directly by a pilot. These other drones act as a "swarm" that work together to move safely to the same location as the "leader" (i.e., directly controlled) drone. The drones in a swarm must move to the same location or stay where they are – always together.

Drones need to be repaired, restocked, and refueled periodically. Each drone has a limited fuel supply and moving from location to location consumes fuel based on the distance between the different locations. We must keep track of the drone's fuel supply, along with the money that has been earned from ingredient sales for that drone. We must also keep track of the drone's current location as a combination of (X, Y) coordinates, where X and Y are positive or negative numerical values. We will track the drones using a "discrete state" approach where we only keep track of the drone's current location – we don't track the points during transit. Therefore, the only valid locations for a drone are at a restaurant, or at its owning service's "home base."

The home base is the only location where the drone can be refueled, repaired, and restocked with new ingredients. And the new flight control technologies also ensure that a drone will move to a new location when, and only when, it has enough fuel to get from that new location back to home base. Also, each location also has a space limit on the number of drones that can hover and land safely in that location at the same time, so a drone can move to a certain location only if there's enough space for the drone to maneuver safely.

Delivery services offer lots of different ingredients, where each ingredient has a 'universally' identifying barcode, a name, and a unit weight measured in an even (i.e., integer) number of pounds. The unit weight is equivalent to the amount of the ingredient that will fit in one of the drone's fixed-size packages. Restaurants that wish to purchase ingredients can purchase them from a drone, but only when that drone is located at the restaurant. When a drone is at the location of a restaurant, the system should be able to provide the quantity and price per package for each of the ingredients being carried by the drone.

Also, a specific ingredient might be offered by many different services, and the inventory of possible ingredients is so large that we are not interested in tracking which specific services sell which specific ingredients. Our goal is simply to ensure that each ingredient identified by a specific barcode has a consistent name and unit weight for tracking purposes.

The managers of the delivery services will use their collected data and experience to send the drones to the restaurants that they feel are most likely to buy those ingredients. Part of that collected data includes a rating for each restaurant. The rating is an integer from one (1) to five (5), where a higher number indicates that the restaurant has been more reliable in purchasing ingredients over time. We must also track the amount of money that the restaurant has spent over time purchasing ingredients. Each restaurant has a distinctive name. Also, some restaurants have received funds from one or more owners, while other restaurants are "independently managed" (e.g., no "single owner" as recorded in our system). We must track the most recent

date that an owner has provided funds to a restaurant, along with the specific amount of money provided. Tracking previous funds/donations is not required.

Whenever a restaurant purchases an ingredient from a drone, the money spent by the restaurant must be transferred to the revenue of the appropriate delivery service. Our system must be able to track the total amount of money that has been spent for all the ingredients that a restaurant has purchased so far. It also must be able to calculate and display the total amount of money earned by each delivery service through all these sales. Note that each delivery service can sell a fixed-size package of an ingredient at a price of its choosing, and these prices can change over time (e.g., supply and demand effects).

Finally, the system must be able to calculate and display the total weight and cost of the ingredients being carried by each drone (i.e., the drone's payload). The system must also be able to calculate and display the total cost of the payloads for all the drones that it owns. The system must also be able to calculate and display the debt incurred for each restaurant owner as the sum of all the money spent buying ingredients for the restaurants for which they provide funds.

Sample Data Elements

The following data is provided to assist you in visualizing and/or validating the system design you are being tasked to develop. You are not required to submit this data. The intent is that you can use the data to check if your EERD can store the data values, relationships, etc. that we've provided in a reasonable manner. If there are elements of the data that can't be represented in an appropriate attribute, entity, or relationship, then perhaps you need to revise your design. Similarly, if there are attributes, entities, relationships, etc. that haven't been used after you've stored all of the data, then perhaps your design has unnecessary elements. This exercise doesn't guarantee that your EERD is fully correct, but it does offer some validation that you are on the correct track.

Aaron Wilson is one of the employees in our system. He has a username of **awilson5**, and lives on 220 Peachtree Street. Aaron was born on November 11, 1963, and is employed with us in a pilot role. Aaron's tax identifier is **111-11-1111** and we hired him on March 15, 2020. He has 9 months of experience with the company and earns $46,000 per year. Aaron's pilot license is commercial, and he has made 41 successful drone flights. Aaron currently flies a swarm of drones for the On Safari Foods delivery service comprised of two drones: drone #1, which he controls directly; and drone #2, which takes its flight directions from drone #1.

On Safari Foods delivery service, which has an identifier of **osf**, has its location and home base at the **southside** location, and is managed by Erica Ross. In addition to Aaron and Erica, Trey McCall is also working for them.

The swarm that Aaron is flying is currently at the **airport** location. Drone #1 (**osf-1**) has 500 units of fuel and can carry a maximum of 9 fixed-size packages. Drone #1 is carrying 5 packages of prosciutto (id: **pr_3C6A9R**) with each package priced at $20 and weighing 6 lbs. Drone #1 is also carrying 3 packages of saffron (id: **ss_2D4E6L**) with each package priced at $23 and weighing 3 lbs. Drone #2 (**osf-2**) has 450 units of fuel and can carry a maximum of 7 fixed-size packages. Drone #2 is carrying 7 packages of truffles (id: **hs_5E7L23M**) with each package priced at $14 and weighing 3 lbs.

Erica Ross is another of the employees in our system currently working with On Safari Foods. She has a username of **eross10**, and lives on 22 Peachtree Street. Erica was born on April 2, 1975, and is employed with us in a worker role. Erica's tax identifier is **444-44-4444** and we hired her on April 17, 2020. She has 10 months of experience with the company and earns $61,000 per year.

Similarly, Trey McCall is also working with On Safari Foods. He has a username of **tmccall5**, and lives on 360 Corkscrew Circle. Trey was born on March 19, 1973, and is currently employed with us in a worker role. Trey's tax identifier is **333-33-3333** and we hired him on October 17, 2018. He has 29 months of experience with the company and earns $33,000 per year. Trey also works with a rival delivery service to On Safari Foods called Herban Feast.

Herban Feast is also a delivery service with an identifier of **hf**. Herban Feast has its home base at the **airport** location and is managed by Harmon Stark. They also have Ford Prefontaine piloting their only drone.

Harmon Stark is another employee in our system currently in a worker role. He has a username of **hstark16**, and lives on 53 Tanker Top Lane. Harmon was born on October 27, 1971, his tax identifier is **555-55-5555** and we hired him on July 23, 2018. He has 20 months of experience with the company and earns $59,000 per year.

Meanwhile, Ford Prefontaine is one of the employees in our system currently in a pilot role. He has a username of **fprefontaine6**, lives on 10 Hitch Hikers Lane and was born on January 28, 1961. Ford's tax identifier is **121-21-2121** and we hired him on April 19, 2020. He has 5 months of experience with the company and earns $20,000 per year. Ford's pilot license is private, and he has made 2 successful drone flights. Ford flies a single drone for them: drone #4 (**hf-4**), which he controls directly. Drone #4 has 600 units of fuel and can carry a maximum of 6 fixed-size packages. Drone #4 is currently at the **southside** location and is carrying 6 packages of saffron (id: **ss_2D4E6L**) with each package priced at $27. None of the drones have any sales yet.

There is another delivery service named NutriFood Incorporated with an identifier of **nfi**. NutriFood Incorporated has its home base at the **airport** location but does not have a manager. Harmon Stark serves NutriFood Incorporated as a worker, and Ford Prefontaine serves them as a pilot.

Ella Charles is one of our newest employees in our system. She is very talented and has occupied the worker and pilot roles. She has a username of **echarles19**, lives on 22 Peachtree Street and was born on May 6, 1974. Ella's tax identifier is **777-77-7777** and we hired her on January 2, 2021. She has 3 months of experience with the company and earns $27,000 per year. Ella's pilot license is private, and she has made 10 successful drone flights. Currently, she isn't working with any of the delivery services.

All of these delivery services are attempting to sell their ingredients to various restaurants in the area. **Lure** is a seafood restaurant at the **airport** location (-2, -9) on the map. The **airport** location only allows one drone at a time making it difficult for the services to compete. **Lure** has a rating of 5 has purchased $20 of ingredients so far. **Ecco** is a European-themed restaurant with a rating of 3 at the **southside** location (3, -6) on the map. Ecco hasn't made any ingredient purchases yet. There's also an Italian restaurant at the **southside** location called **Tre Vele** with a rating of 4 that has made $10 of ingredient purchases so far. The **southside** location allows two drones at a time, which is a bit better for competition than the airport location, but not much. The city planners are aware of this and have unveiled a new **plaza** location at (5, 12) that supports twenty (20) drones at a time.

Finally, Jared Stone is one of the restaurant owners in our system who interested in our services. Jared has a username of **jstone5**, lives on 101 Five Finger Way and was born on January 6, 1961. Jared has provided funds for the **Lure** and **Ecco** restaurants: most recently, to **Lure** on **August 20th, 2022,** for **$10,000**, and to **Ecco** on **April 6th, 2022,** for **$27,000**.