

MARTA Passenger Traffic

Fall 2017 - CS 4400 Database Project
Serve-Learn-Sustain

Project Purpose

Analyze, specify, design, implement, document and demonstrate an online system. You are required to use the classical methodology for database development. The system will be implemented using a relational DBMS that supports standard SQL queries. The TAs will provide you with information about how to access a college-managed MySQL server in order to implement your database and the application. The professors must approve any other alternative implementations. ***In no circumstances can you use a tool that automatically generates SQL or automatically maps programming objects into the database. You also cannot use any other software like Access or SQLite.*** Ask the professors or TAs if you have questions about which tools/languages/software are allowed.

Project Phases

The three phases of the project cover the following work-processes from the Classical Methodology for Database Development (see notes on T-Square under resources). Slides on database design methodology will be useful for phases 1 and 2: All slides have been posted on T-Square.

Regrade Policy

Once graded phases and/or quizzes are returned, there is a one-week deadline during which you can contest your grade with the TA who graded your assignment. This clock starts not when you personally get your returned paper, but when the papers are returned to the class.

Teams

Project teams consist of 3 or 4 members. You are allowed to form teams across the two sections (A & B) of the class. A team may remove a team member from further participation in the team when Phase I is turned in or when Phase II is turned in. A written notification with a proper justification must be provided to the professor and the Head TA at that time in hard-copy form.

Deliverables

Phase 1 - Submitted to T-Square and bring hard copy to class

The deliverables include (in a single PDF file):

1. A cover page - you **MUST** include all information listed on the template (See T-Square Project Folder).
 2. Enhanced Entity Relationship (EER) Diagram
 3. Information Flow Diagram
 4. A list of **logical** constraints (at least 3). You are required to include at least three logical constraints, although a fully-specified system will probably have more than that.
 5. Any assumptions made, with justification and explanation.
-
1. The EER must capture the functionalities of the system whenever applicable. (e.g, total participation, superclasses/subclasses, weak entities)
 2. The design of your system must have all functionalities. You are allowed to make up additional assumptions as long as they do not conflict with the specified constraints and requirements. You must list all your assumptions; otherwise, your EER diagram will lose points since the TA will not know you had made your own assumptions.
 3. Logical constraints that can be specified directly using ER notation will not count towards the three required. Constraints related to data type or value are not accepted as constraints.

Each team needs to turn in one hard copy (only one for the entire team). Every student must upload an electronic copy to T-Square individually. You will receive a -5 penalty if you do not submit an electronic copy. **Please write your team number clearly on the cover page.** If you do not know your team number, email the Head TA.

Phase 2 - Submitted to T-Square and bring hard copy to class

The deliverables include (in a single PDF file):

1. A cover page, same as Phase 1.
2. Copy of the EER diagram (either your phase 1 diagram, with any modifications, or the provided solution)
3. Relational Schema Diagram - identify primary and foreign keys and show referential integrity using arrows.
4. CREATE TABLE statements, including domain constraints, integrity constraints, primary keys, foreign keys, and appropriate referential triggered action clause.

Each team needs to turn in one hard copy (only one for the entire team). Every student must upload an electronic copy to T-Square individually. You will receive a -5 penalty if you do not submit an electronic copy. **Please write your team number clearly on the cover page.** If you do not know your team number, email the Head TA.

Phase 3 - Submitted to T-Square

The electronic deliverables include:

1. A cover page, same as Phase 1 and Phase 2.
2. A text file with all SQL statements for each task. (Follow the template in the Phase 2 design methodology).
 1. **NOTE:** A set of SQL statements may be required in order to complete one task. However, in such cases, the last SQL statement should show the output according to the specification. Views and nested queries may be used to support the tasks.
3. For the heavy weight project option, your source code for the application.

Notes:

1. Prior to the demo, the TAs will give guidelines for populating the database with data. The database has to be populated with this data set prior to the demo.
2. **Every student must upload an electronic copy to T-Square individually. You will receive -5 penalty if you do not submit an electronic copy.**

On Demo Day

Bring your laptop and make sure you have a text file on your laptop with all of your SQL queries just in case your application does not work. More details about demos will be discussed later this semester. **All team members must be present and on time.** Missing/late team members will receive -10 penalty.

Grading

The project consists of three phases (deliverables) as well as a final demo to the TA.

Phase 1 and Phase 2: 10% of your final grade

Phase 3:

Heavy Weight option (20%): Your team will use the embedded SQL feature of MySQL which allows you to embed SQL statements in a standalone application.

Light Weight option (5%): Your team will demo the SQL queries on the MySQL console. Your team will also be required to take the final exam.

NOTE: You can always change your project option until the demo starts. Once the TA has begun demoing your application, you cannot change from Heavy Weight to Light Weight (or vice versa).

Final Exam (15%): This is only for the students who opt for the Light Weight option. Students who opt for the Heavy Weight option **cannot** take the final exam.

Project

For this project, you will create a tool that stores passenger traffic information for the Metropolitan Atlanta Rapid Transit Authority (MARTA).

The following sections contain a functional description of the system along with some mockup screenshots. Each section explains a functionality and then presents an example screen about it. **You don't have to follow the UI designs, but your program needs to support all the functionalities. (Pay close attention to tables - they have sortable arrows to indicate which fields are sortable.)** These mockups are just for helping you to understand all the functionalities. A complete reorganization of the user interface is permissible as long as your application supports all the functionality listed below. The sections have been grouped by administrator and passenger functionality.

For the Heavy Weight option, you may implement the project as a traditional standalone application (e.g. using Java GUIs) or as a web application (e.g. using a web scripting language like PHP). We will also send an announcement about which languages/tools/software/platforms are allowed later this semester. A Piazza post will be maintained where you may ask if certain technologies are allowed.

User Accounts

Log In

A user must log in before using the application. There are two types of users - passengers and administrators. To log in, a valid username and password combination is required.

If a user provides invalid login credentials, an error message should be shown on the screen.

If a user does not have an account, they can click on the register button to create an account.

Notes:

- Username is **unique** for each user.
- Since all user types share the same login screen, you will need to determine what the user type is before proceeding to the next screen.

Log In

Username

Password

Login

Register

New Passenger Registration

After clicking the Register button on the Log In screen, the user will be redirected to a registration page to **create a passenger account**.

All fields are required except card number, if "Get a new Breeze Card" is selected.

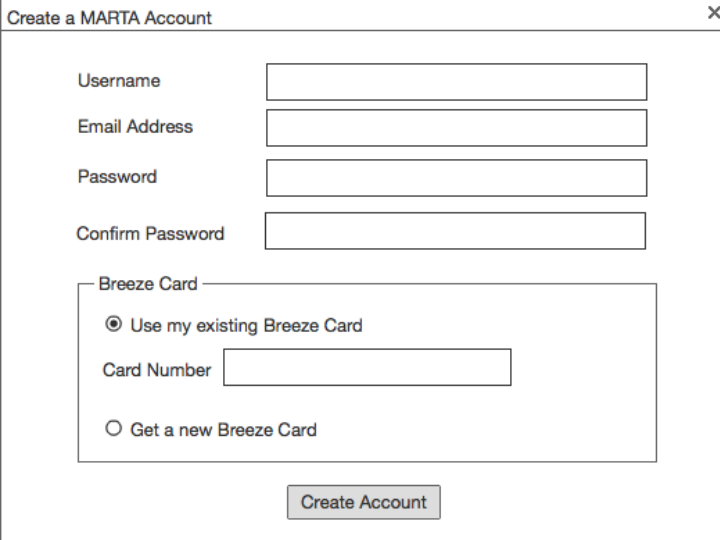
Requirements

- Username must be **unique**
- Email address must be **unique**
- Password and confirm password must match.
- Passwords must have at least eight characters.
- **Passengers must** have at least **one** Breeze Card.
- If "Get a new Breeze Card" is selected, randomly generate a new Breeze Card number that does not already exist in the database.
- If "Use my existing Breeze Card" is selected and the provided card number already belongs to another **passenger**, the account will be created but the card will be suspended. **In addition, the account should receive an additional randomly generated Breeze Card.**
- Breeze Card numbers are 16 digits long.
- An email address consists of alphanumeric characters, followed by an @ symbol, followed by alphanumeric characters, followed by a . symbol, followed by alphanumeric or . symbols.

Notes

- You should not store the password as a string in the database. Instead, run the password through some sort of hash function (most languages will have a built in hash function that you can use) and store the result. When a user logs in, you will use the same hash function to verify.
- If you generate a number that already exists, keep generating card numbers until you get one that is not in the database.
- Administrator accounts are created in the database - the create account page can only be used to create passenger accounts.
- You may validate the email address using the database (SQL CHECK constraint) or in the front-end application.
- **Only passengers have email addresses.**

If these requirements are not met, display an error message.



The screenshot shows a web form titled "Create a MARTA Account" with a close button (X) in the top right corner. The form contains the following fields and options:

- Username:** A text input field.
- Email Address:** A text input field.
- Password:** A text input field.
- Confirm Password:** A text input field.
- Breeze Card:** A section containing two radio buttons and a text input field:
 - ☒ Use my existing Breeze Card
 - ☐ Get a new Breeze Card
 - Card Number:** A text input field, which is only visible when the "Get a new Breeze Card" option is selected.
- Create Account:** A button at the bottom right of the form.

Administrator Functionality

When an administrator logs in, they should be presented with a screen that allows them to access the various functions listed. Administrator accounts can not have Breeze Cards.

An administrator can

- Create, modify, and close stations
- [Suspend, unlock, and modify owner/value of Breeze Cards](#)
- View the passenger flow report

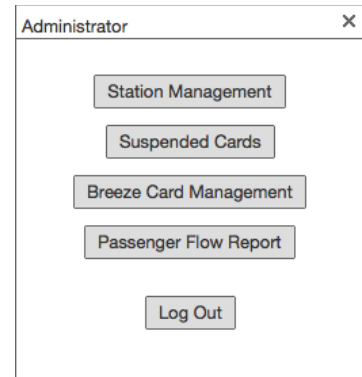
Station Management

An administrator can create and view stations from the Station Management page.

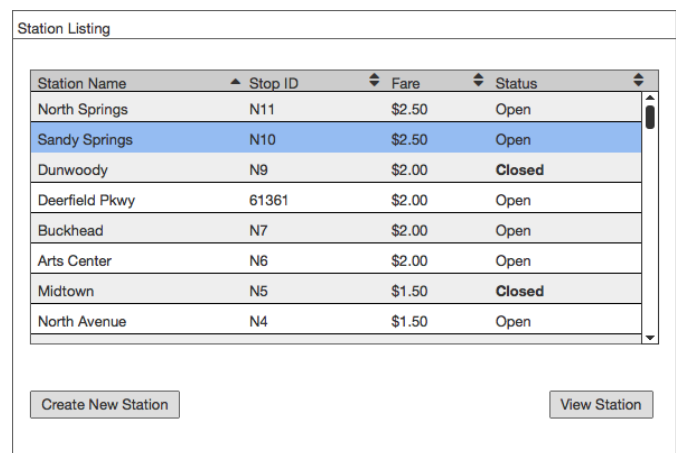
There are two types of stations - Train Stations and Bus Stations.

The list of stations should be sortable and display the station name, the Stop ID, the fare to enter the train or bus at that station, and whether the station is open or closed.

An administrator can create new stations from this screen, and view station details from this screen.



The Administrator login screen is a window titled "Administrator" with a close button (X) in the top right corner. It contains five buttons arranged vertically: "Station Management", "Suspended Cards", "Breeze Card Management", "Passenger Flow Report", and "Log Out".



The Station Listing screen is a window titled "Station Listing". It contains a table with the following data:

Station Name	Stop ID	Fare	Status
North Springs	N11	\$2.50	Open
Sandy Springs	N10	\$2.50	Open
Dunwoody	N9	\$2.00	Closed
Deerfield Pkwy	61361	\$2.00	Open
Buckhead	N7	\$2.00	Open
Arts Center	N6	\$2.00	Open
Midtown	N5	\$1.50	Closed
North Avenue	N4	\$1.50	Open

Below the table are two buttons: "Create New Station" and "View Station".

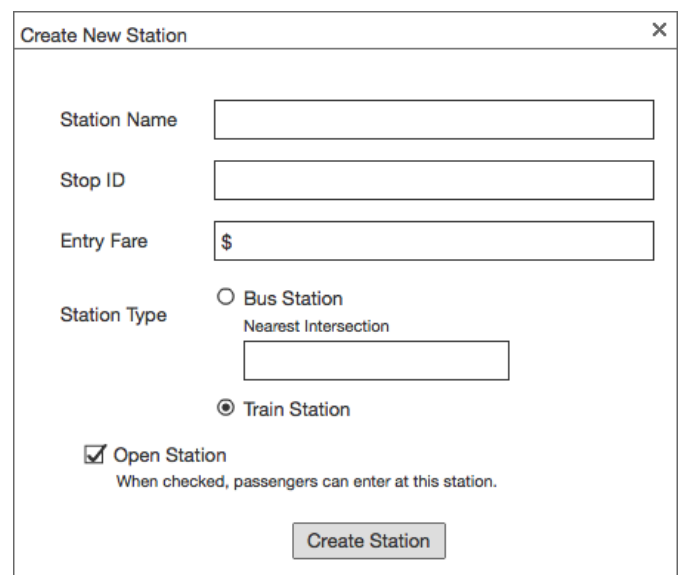
Create New Station

A new station **requires** the following information:

- Station name
- Stop ID
- Fare to enter at this station
- Station type
- Nearest intersection (Optional - Bus Station only)
- Station open or closed status

Requirements

- The combination of station name and type must be **unique**
- Stop ID must be **unique**
- The fare to enter at the station must be [between \\$0.00 and \\$50.00, inclusive](#).



The Create New Station form is a window titled "Create New Station" with a close button (X) in the top right corner. It contains the following fields and options:

- Station Name:
- Stop ID:
- Entry Fare:
- Station Type: ☐ Bus Station, ☒ Train Station
- Nearest Intersection:
- ☒ Open Station: When checked, passengers can enter at this station.
- Create Station:

View Station

On this screen, an administrator can view and update the fare and station open/closed status. The station name, stop ID, and nearest intersection are also displayed.

The fare must be between \$0.00 and \$50.00, inclusive.

Station Detail - North Springs

North Springs **Stop N11**

Fare [Update Fare](#)

Nearest Intersection Not available for train stations

☒ Open Station
When checked, passengers can enter at this station.

Suspended Cards

From the suspended cards screen, an administrator can [unlock](#) suspended Breeze Cards.

Clicking “Assign Card to New Owner” should assign it to the owner in the “New Owner” column. “Assign Card to Previous Owner” should assign the card back to the Previous Owner. Both functions should resolve all conflicts on the same card. If conflict resolution causes one or more accounts to not have a Breeze Card, generate new Breeze Cards and add it to those accounts.

Suspended Cards

Card #	New Owner	Date Suspended	Previous Owner
1446 2121 0808 1229	abmartin	08-30-2017 8:33 PM	cherlyw
1446 2121 0808 1229	hgarcia	08-31-2017 1:27 PM	cherlyw
1581 9910 0010 4404	mcferran	08-22-2017 4:55 PM	dlseals

[Assign Selected Card to New Owner](#)

[Assign Selected Card to Previous Owner](#)

Assigning the card to an owner will unlock all accounts conflicted on the same Breeze Card.

Breeze Card Management

An administrator can view all of the Breeze Cards in the database. There is a search/filter functionality to find specific Breeze Cards by owner, card number, suspension status, or value range. A blank value means that the filter is inactive. Filters are compounded together - for example, entering an owner name and a value range should apply *both* filters.

An administrator can select a card in the listing, and change the value of the Breeze Card. Breeze Cards can hold up to \$1000.00 of value. If this value is exceeded, display an error message.

Breeze Card Management

Breeze Cards

Search/Filter

Owner

Card Number

Value between and

☒ Show Suspended Cards

[Reset](#)

[Update Filter](#)

Card #	Value	Owner
1446 2121 0808 1229	\$41.50	Suspended
7346 6137 9311 4441	\$12.50	jjemson
8103 8300 9991 9933	\$70.00	kevinsholl
1401 4011 4910 7732	\$16.00	jjemson

[Set Value of Selected Card](#)

[Transfer Selected Card](#)

The administrator can transfer a Breeze Card to another passenger account. If the account does not exist or is an administrator account, display an error message. All conflicts are resolved when a card is assigned by an administrator.

Passenger Flow Report

The passenger flow report shows how many **passengers** entered and exited at a certain station, the “flow” in a given time period, and the revenue. The flow is computed as $\text{flow}_{\text{in}} - \text{flow}_{\text{out}}$. The revenue is the sum of the fares collected at the station for the given time period. The administrator can adjust the time period the report is shown for using the date/time picker. Leaving a date blank removes the constraint(s).

Notes

- Station fares can change over time, so this is **not** a simple multiplication of the current fare times the number of passengers entering a station.
- The time filters are filtering on **start time**.

Passenger Flow Report				
Start Time	08/30/2017 12:00:01 AM	Update	Reset	
End Time	08/30/2017 7:07:33 PM			
Station Name	# Passengers In	# Passengers Out	Flow	Revenue
North Springs	4919	3000	1919	\$11682.63
Sandy Springs	441	641	-200	\$882.00
Dunwoody	833	418	415	\$522.50
Deerfield Pkwy	25	60	-35	\$25.00

Passenger Functionality

After a passenger logs in, they have the following options:

- Manage Breeze Cards
- Select a Breeze Card to see its balance
- Choose a trip start point and start a trip.
- Choose a trip end point and end a trip.
- View trip history

To start a trip, the passenger selects a starting station and presses a “Start Trip” button. The trip can only be started if the passenger is not already in a trip and the selected Breeze Card has enough balance for the trip and is not suspended. A trip can only be ended if the passenger is in a trip. You should display the fare for starting at the station. The **passenger** may exit the application after starting a trip - when they log back in, they should still be in the trip. Do not list suspended Breeze Cards.

To end a trip, the passenger selects a destination station and selects "End Trip." The list of ending stations should only include stations that match the starting station. (e.g. If the **passenger** starts at a train station, they must end at a train station.)

The screenshot shows a web application window titled "Welcome to MARTA" with a close button (X) in the top right corner. The interface displays the following information:

- Breeze Card:** A dropdown menu showing the card number "7346 6137 9311 4441" and a "Manage Cards" link.
- Balance:** Displayed as "\$ 12.50".
- Start at:** A dropdown menu showing "North Springs - \$2.50" and a green "Trip in Progress" status.
- Ending at:** A dropdown menu showing "Midtown" and a blue "End Trip" link.
- Buttons:** "View Trip History" and "Log Out" buttons are located at the bottom of the window.

Manage Breeze Cards

When “Manage Cards” is clicked, a list of the passenger’s Breeze Cards should appear (excluding suspended Breeze Cards).

The passenger can add a new card by typing in a Breeze Card number and clicking “Add Card.” If the passenger adds a card that belongs to another passenger, you should suspend that Breeze Card. If the card exists, but is not associated with a **passenger account**, add it to this passenger’s account. If the card number does not exist in the database, create a new Breeze Card with the given number and set its value to \$0.00.

Clicking “Remove” on the Breeze Card should disassociate the card from this **passenger’s** account. Do not delete the card from the database. All **passenger accounts** must have at least one Breeze Card.

Manage Cards

Breeze Cards

Card Number	Value	
7346 6137 9311 4441	\$12.50	Remove
1401 4011 4910 7732	\$16.00	Remove
7361 8382 4610 0127		

Add Value to Selected Card

Credit Card #

Value

The passenger can also select a card to add value to the Breeze Card. The passenger enters their credit card number and the value they want to add. Credit card numbers are always 16 digits long. If the total value of the card (current value + new value) exceeds \$1000.00, display an error message.

View Trip History

Passengers can view their trip history. They should be able to see all the trips they took. The **passenger** can also limit the times that trip history is displayed. **The time displayed is when the trip starts (i.e. when the fare was charged to the card).**

Notes

- History is tied to a Breeze Card. If a Breeze Card was transferred from another **passenger**, you will be able to see that **passenger’s** previous trips.
- Suspended Breeze Card history should not be displayed.

Trip History

Start Time

End Time

Time	Source	Destination	Fare Paid	Card #
08/31/2017 3:14:13 PM	North Avenue	Dunwoody	\$1.50	4441
08/27/2017 11:55:43 AM	North Springs	Airport	\$2.50	4441
08/26/2017 6:19:10 PM	Airport	Midtown	\$5.00	7732
08/01/2017 4:56:22 PM	North Springs	Midtown	\$2.75	7732

Revision History

Version	Date	Comment
1.0	9/6/2017	Initial release
1.1	9/10/2017	Clarified user references to be passenger Added info about passenger email address and administrator card assignment. Changes are shown in red.
1.2	9/17/2017	Clarify that Breeze Cards are suspended, not accounts. Trip history times are start times Fare range is \$0.00 to \$50.00 Changes are shown in blue.
1.3	10/5/2017	When a passenger is created with a suspended Breeze Card, they receive another new Breeze Card. Explain what happens when a suspended card is assigned by an administrator Changes are shown in orange.