CityConnect Bus Company

DATABASE DESIGN CS-311-A

Ukawa, Yuna

MAY 4, 2023

I. Project Description

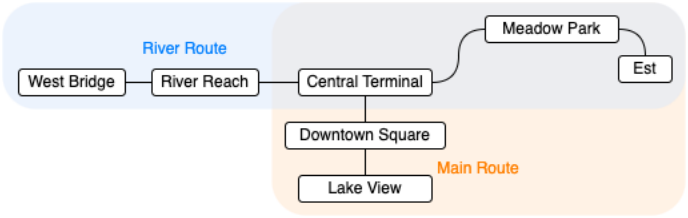
CityConnect Bus Company

Welcome to CityConnect, the premier bus company serving the local city! Our mission is to provide safe, reliable, and efficient transportation services to our passengers. With a fleet of modern buses and experienced drivers, we ensure that you arrive at your destination on time and in comfort.

CityConnect was founded over a decade ago by a team of experienced transportation professionals who saw a need for a better bus service in the city. We started with just a handful of buses and a small team of drivers, but over the years, we have grown to become the leading bus company in the region.

CityConnect has two main routes that cover all major areas of the city. Route Main starts at Lake View, stops at Downtown Square, Central Terminal, Meadow Park, and ends at Est. Route River starts at West Bridge, stops at River Reach, Central Terminal, Meadow Park, and ends at Est. Both routes offer frequent and convenient services throughout the day, making it easy for you to plan your journey.

Our buses stop at designated bus stations along each route, making it easy for you to find your way. Please refer to the city map below to see the two routes and all bus stops.



At CityConnect, we are committed to providing excellent customer service, modeled after the best practices of Japan's public transportation system. Our buses are clean and well-maintained, and equipped with comfortable seating, air conditioning, and Wi-Fi, making the ride as pleasant as possible for our passengers. Our staff are trained to be polite, helpful, and efficient.

We offer an integrated ticketing system that allows passengers to use a single card or mobile app to pay for all their transportation needs. This makes it more convenient for passengers to use public transportation, and encourages more people to switch from cars to buses.

II. User Views

1. **TimeTable at a Station** view provides information about the next six buses that will arrive at each CityConnect station, showing their bus stop number, destination, route, and departure time. The timetable display as of 20:45 (8:45PM) at the Central Terminal Station is shown below.

5/4/2040 20:45

TimeTable

STATION: Central Terminal

DEPARTURE TIME	STOP NUMBER	DESTINATION	ROUTE
20:45	3	West Bridge	River
20:50	1	Est	Main
21:00	2	Lake View	Main
21:05	1	Est	River
21:20	2	Lake View	Main
21:25	1	Est	River

Table 1. TimeTable at a Station

2. **Ride History of a Customer** view displays the ride history of a particular customer. Users can view the details of their previous trips, including the date, time, origin, destination, and fare paid. Yuna's Ride History Report is shown below.

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Ride History Report

NAME: Yuna Ukawa ID: 400001

DATETIME	ENTER	EXIT	FARE
2040-05-04 20:45	Central Terminal	Est	$ 1.60
2040-05-04 09:20	Est	Central Terminal	$ 1.60
2040-05-02 09:20	Est	Central Terminal	$ 1.60
2040-04-28 20:30	Downtown Square	Est	$ 2.40
2040-04-28 12:20	Est	DownTown Square	$ 2.40

Table 2. Ride History of a Customer

3. **Card Balance History of a Customer** view displays the balance history of a particular customer's card/ticket. Yuna's Card Balance History Report is shown below.

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Card Balance History Report

NAME: Yuna Ukawa ID: 400001

DATETIME	CHARGES	CREDITS	BALANCE
2040-05-04 20:45	$ 1.60	$ 0.00	$ 48.80
2040-05-04 20:40	$ 0.00	$ 50.00	$ 50.40
2040-05-04 09:20	$ 1.60	$ 0.00	$ 0.40
2040-05-02 09:20	$ 1.60	$ 0.00	$ 2.00
2040-04-28 20:30	$ 2.40	$ 0.00	$ 3.60
2040-04-28 12:20	$ 2.40	$ 0.00	$ 6.00

Table 3. Card Balance History of a customer

4. **Driver Schedule** view displays the schedules of a bus driver for a day. The driver schedule for the driver Teddy Park is shown below.

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Driver Schedule

NAME: Teddy Park DRIVER ID: 350001

BUS ID	ROUTE	ST1	ST2	ST3	ST4	ST5	ST6	ST7
400003	Main	7:00	7:10	7:30	7:35	7:45		
400003	Main	8:45	8:35	8:15	8:10	8:00		
350002	River	13:20	13:30	13:35			13:55	14:05
350002	River	15:05	14:55	14:50			14:30	14:20

Table 4. Driver Schedule

5. **Driver Monthly Salary Report** view shows monthly salary of drivers. The Salary Report for 2040 April is shown below.

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Driver Monthly Salary Report

YEAR: 2040 MONTH: April

DRIVER ID	DRIVER NAME	HOURLY WAGE	HOUR WORKED	SALARY
350001	Teddy Park	$ 25.30	177	$ 4478.10
350002	John Smith	$ 18.00	100	$ 1800.00

Table 5. Driver Monthly Salary Report

6. **Bus Fleet Management** view shows the buses in the company's fleet, including the make and model, the year of manufacture, and the current maintenance status.

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Bus Fleet Management

BUS ID	MAKE	MODEL	YEAR	LAST MAINTENANCE
350001	Mitsubishi	Aero Ace	2019	2040-04-10
350002	Mitsubishi	Aero Star	2021	2040-04-10
400003	Nissan	Civilian	2021	2040-04-15
400004	Mitsubishi	Aero Star	2022	2040-04-15
400005	Hino	Selega	2023	2040-05-01

Table 5. Bus Fleet Management

III. Normalization

1. Normalize User View 1 (TimeTable at a Station).
    i. Add tametable_id as PK.

    1NF - timetable (**timetable_id**, station_name, departure_time, stop_number, destination_name, route_name)

    ii. skip

    iii. Add IDs to make data easier to handle.
    station_name can be generate from station table.
    route_name and destination_name can be generate from route table.
    stop_number is related to both route_id and station_id.

    3NF - timetable (**timetable_id**, station_id, departure_time, route_id)
    3NF - station (**station_id**, name)
    3NF - route (**route_id**, name, origin_id, destination_id)
    3NF - stop_station (**station_id**, **route_id**, stop_number)

    iv. To simplify data extraction, this time add the departure time at each station to the attribute

    4NF - timetable (**timetable_id**, route_id, dep_time1, dep_time2, dep_time3, dep_time4, dep_time5, dep_time6, dep_time7)
    4NF - station (**station_id**, name)
    4NF - route (**route_id**, name, origin_id, destination_id)
    4NF - stop_station (**station_id**, **route_id**, stop_number)

2. Normalize User View 2 (Ride History of a Customer).
    i. Add customer_history_id as PK.

    1NF - customer_history (**customer_history_id**, customer_name, customer_id, datetime, enter_station_name, exit_station_name, fare)

    ii. skip

    iii. Add IDs to make data easier to handle.

    3NF - customer_history (**customer_history_id**, customer_id, datetime, enter_station_id, exit_station_id, fare)
    3NF - customer (**customer_id**, customer_name)
    3NF - station (**station_id**, name)

3. Normalize User View 3 (Card Balance History of a Customer).
    i. 1NF - customer_history (**customer_history_id**, customer_name, customer_id, datetime, charges, credits, balance)

    ii. skip

    iii. 3NF - customer_history (**customer_history_id**, customer_id, datetime, charges, credits, balance)
    3NF - customer (**customer_id**, customer_name)

4. Normalize User View 4 (Driver Schedule).
    i. 1NF - timetable (**timetable_id**, driver_id, driver_name, bus_id, route_name, dep_time1, dep_time2, dep_time3, dep_time4, dep_time5, dep_time6, dep_time7)

    ii. skip

    iii. 3NF - timetable (**timetable_id**, driver_id, bus_id, route_id, dep_time1, dep_time2, dep_time3, dep_time4, dep_time5, dep_time6, dep_time7)
    3NF - driver (**driver_id**, driver_name)
    3NF - route (**route_id**, route_name)

5. Normalize User View 5 (Driver Monthly Salary Report).
    i. 1NF - driver_salary (**year**, **month**, **driver_id**, driver_name, hourly, hour, salary)

    ii. Hourly wage can change over time, so this time I do not associate hourly to driver table.

    2NF - driver_salary (**year**, **month**, **driver_id**, hourly, hour, salary)
    2NF - driver (**driver_id**, driver_name)

    iii. 3NF - driver_salary (**year**, **month**, **driver_id**, hourly, hour, salary)
    3NF - driver (**driver_id**, driver_name)

6. Normalize User View 6 (Bus Fleet Management).
    i. 1NF - bus_fleet_management (**bus_id**, **maintenance_date**, make, model, year)

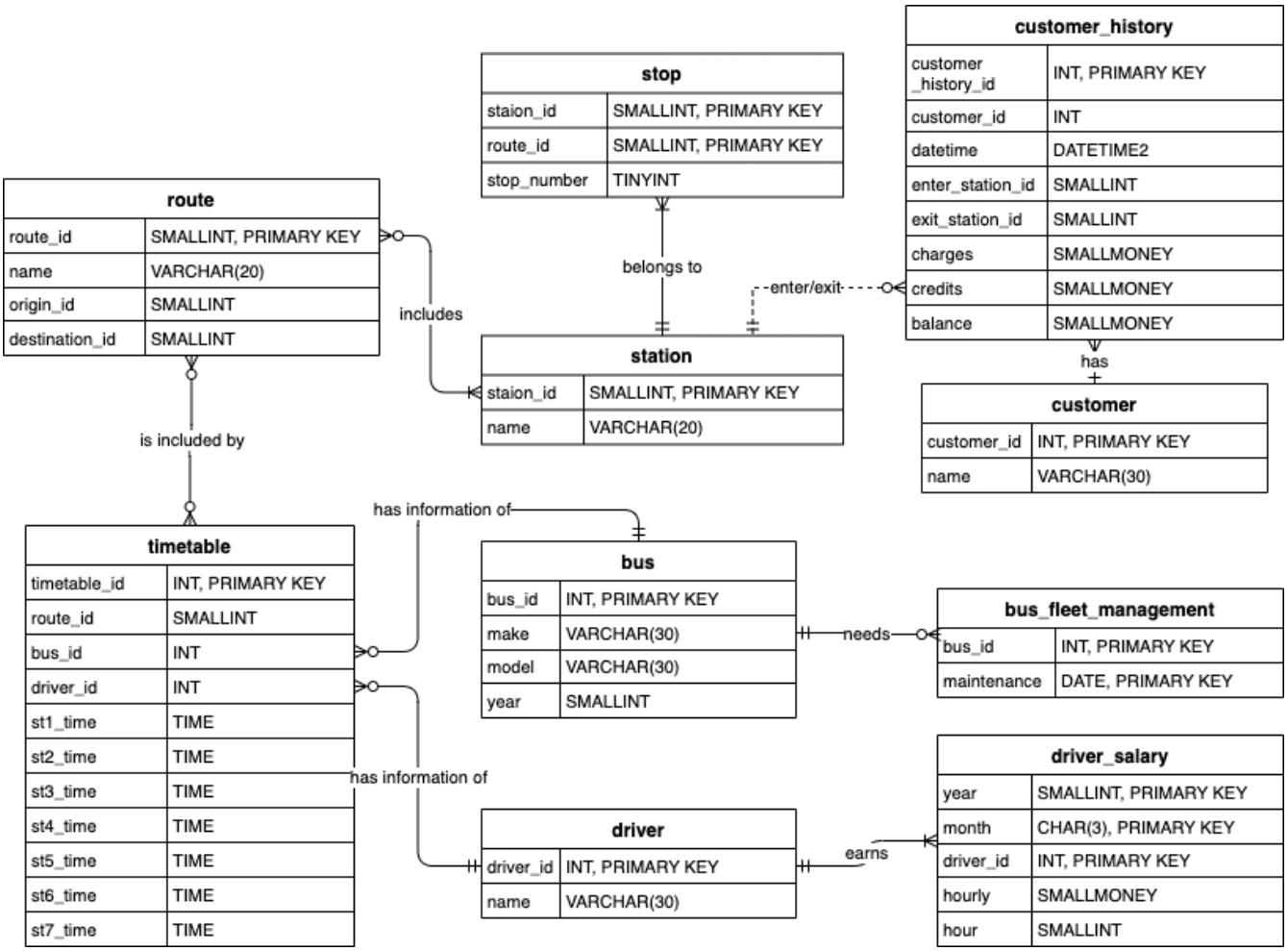
    ii. 2NF - bus_fleet_management (**bus_id**, **maintenance_date**)
    2NF - bus (**bus_id**, make, model, year)

    iii. 3NF - bus_fleet_management (**bus_id**, **maintenance_date**)
    3NF - bus (**bus_id**, make, model, year)

7. Combine all the tables.
    i. station (**station_id**, name)
    ii. route (**route_id**, route_name, origin_id, destination_id)
    iii. stop_station (**station_id**, **route_id**, stop_number)
    iv. customer (**customer_id**, customer_name)
    v. customer_history (**customer_history_id**, customer_id, datetime, enter_station_id, exit_station_id, charges, credits, balance)
    vi. timetable (**timetable_id**, route_id, bus_id, driver_id, dep_time1, dep_time2, dep_time3, dep_time4, dep_time5, dep_time6, dep_time7)
    vii. bus (**bus_id**, make, model, year)
    viii. driver (**driver_id**, driver_name)
    ix. driver_salary (**year**, **month**, **driver_id**, hourly, hour)
    x. bus_fleet_management (**bus_id**, **maintenance_date**)

IV. ER Diagram

V. Attribute-Domain Listing

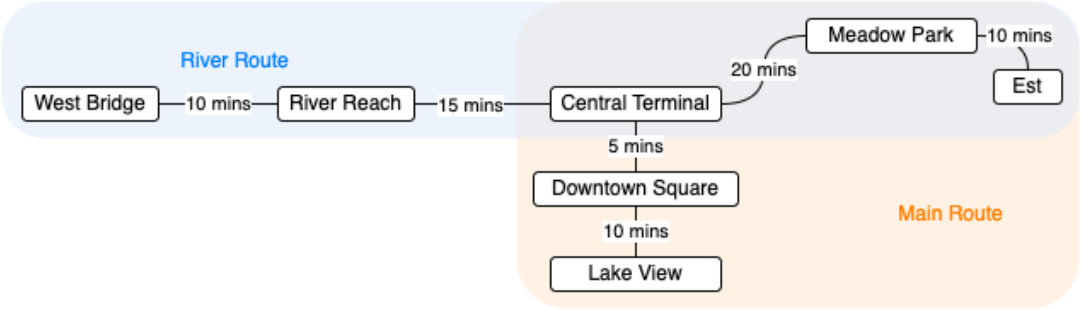


VI. Attribute-User View Matrix

Attributes	View 1	View 2	View 3	View 4	View 5	View 6
station_id	x	x				
station_name	x	x		x		
route_id	x			x		
route_name	x			x		
origin_id				x		
destination_id	x			x		
stop_number	x					
timetable_id	x			x		
st1-7_time	x			x		
bus_id				x		x
bus_make						x
bus_model						x
bus_year						x
driver_id				x	x	
driver_name				x	x	
customer_id		x	x			
customer_name		x	x			
customer_history_id		x	x			
datetime		x	x			
enter_st_id		x				
exit_st_id		x				
charges		x	x			
credits			x			
balance			x			
salary_year					x	
salary_month					x	
hourly					x	
hour					x	
salary					x	
maintenance						x

VII. Business Rules

- The time required between each station is as follows.



- Customer's balance has to be > 0.
- Each bus fleet must be checked and maintenanced every three months.
- Minimum hourly wage is $15.00.
- Hour worked must not exceed 130 hours.
- salary = hourly * hour