CS2102 Database Systems

AY 2020/21 Semester 1

Pet Care System Project

Final Report

Group CS2102_2021_S1_41

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1. Project Responsibilities

Project distribution and responsibilities are as follows;

Ko Gi Hun	- SQL Query Design - Web App development support - Report Writeup
Chew Zhao En	- Report Writeup - 1 Trigger - SQL Query Design
Lim Jia Ying	- Front-End Development & Design - Back-End Development & Design - Web App Deployment - Report Writeup
Putra Mohammad Danish Bin Mohd Rafee	- Application data constraints - 2 Triggers
Chan Wei Qiang Jason	- ER Diagram/ Constraints - Table Creation - Report Writeup - Web App development support

2. Data requirements and functionalities

2.1. Notable Application Data Constraints

Table Name	Attribute	Data Type	Constraints	Keys	Possible options
users	username	varchar(50)	not null	primary key	
	password _hash	varchar(64)	not null		*generated in web app
	salt	varchar(16)	not null		*generated in web app
pcs_administrators	username	varchar(50)	not null	primary key	
				foreign key references *users* on delete cascade	
pet_owners	username	varchar(50)	not null	primary key	
				foreign key references *users* on delete cascade	
care_takers	username	varchar(50)	not null	primary key	

				foreign key references *users* on delete cascade	
	employee_type	varchar(50)	not null		'part-time'
					'full-time'
	area	varchar(50)			'north'
					'south'
					'central'
					'east'
					'west'
base_prices	pet_type	varchar(50)	not null	primary key	
	price	numeric(4, 2)	not null		
			check (price>0)		
pets	username	varchar(50)	not null	foreign key references *users* on delete cascade	
	pet_type	varchar(50)	not null	foreign key references *base prices* on delete cascade	
	other keys			primary key (username, pet_name)	
bids	pet_owner	varchar(50)	not null	foreign key references *pet_owners* on delete cascade	
	care_taker	varchar(50)	not null	foreign key references *care_takers* on delete cascade	
	transfer_mode	varchar(50)	not null		'PCS Meet-up'
					'Deliver'
	daily_price	numeric(4,2)	not null		
			check (daily_price>0)		
	payment_type	varchar			'credit card'
					'NETS'

					'cash'
	other constraints and keys		check (end_date >= start_date)	primary key (pet_owner, care_taker, pet_name, start_date, end_date)	
			check (((rating between 0 and 5) or rating IS null))	foreign key (pet_owner, pet_name) references *pets* on delete cascade	
prices	care_taker	varchar(50)	not null	foreign key references *care_takers* on delete cascade	
	pet_type	varchar(50)	not null	foreign key references *base_prices* on delete cascade	
	price	numeric(4,2)	not null		
			check (price>0)		
	other keys			primary key (care_taker, pet_type)	
availabilities	care_taker	varchar(20)	not null	foreign key references *care_takers* on delete cascade	
	other constraints		check (end_date >= start_date)		
leaves	care_taker	varchar(20)	not null	foreign key references *care_takers* on delete cascade	
	other constraints		check (end_date >= start_date)		**leaves* start_date and end_date must fall between start_date and end_date in *availabilities*

Note 1: boolean types are implicitly defined to have true or false as the only options

Note 2: date types are in the form 'YYYY-MM-DD'

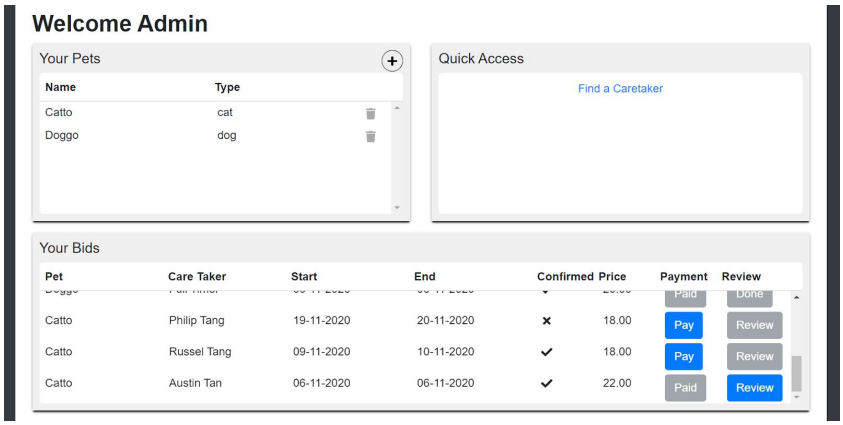
Note 3: All other attributes not described in the table above have either no constraints or only 'not null' as the only constraint. They are further described in the SQL implementation under section 3

2.2. Application Functionalities

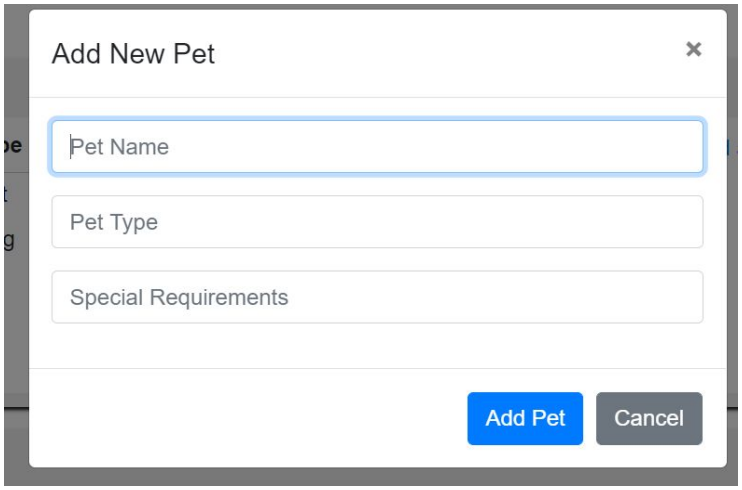
2.2.1 Pet Owner

Pet owners will be able to add pets and delete pets from the petOwner dashboard. To add a pet the pet owner can simply click on the + button and input the pet_name and pet_type in the form accordingly. To delete a pet the pet owner can simply click on the trash can on the row that the pet is on.

petOwner Dashboard:

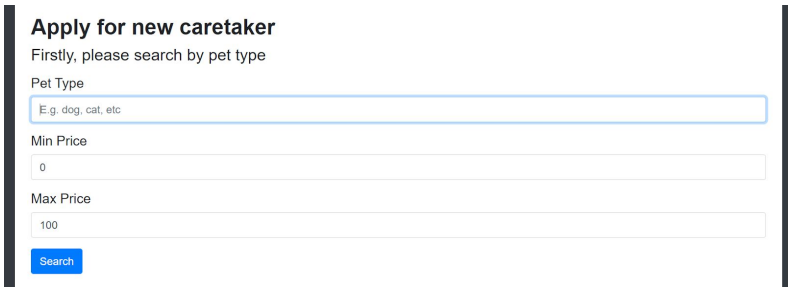


Add Pet:

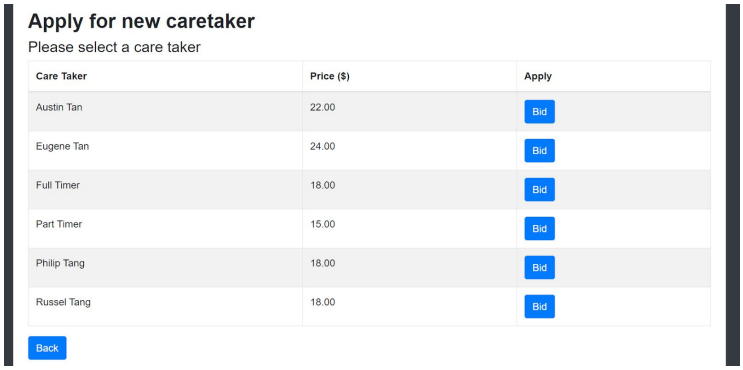


Pet owners will also be able to do a search on the caretakers using our search function using pet_type, min price and max price.

Search Form:



Search Results:



Apply for new caretaker

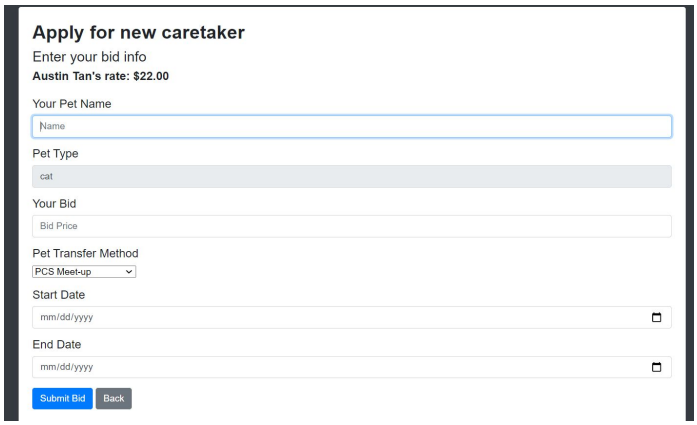
Please select a care taker

Care Taker	Price ($)	Apply
Austin Tan	22.00	Bid
Eugene Tan	24.00	Bid
Full Timer	18.00	Bid
Part Timer	15.00	Bid
Philip Tang	18.00	Bid
Russel Tang	18.00	Bid

Back

Pet owners will then be able to bid from the search results which will bring them to the bids form.

Bids Form:



Apply for new caretaker

Enter your bid info

Austin Tan's rate: $22.00

Your Pet Name

Name

Pet Type

cat

Your Bid

Bid Price

Pet Transfer Method

PCS Meet-up

Start Date

mm/dd/yyyy

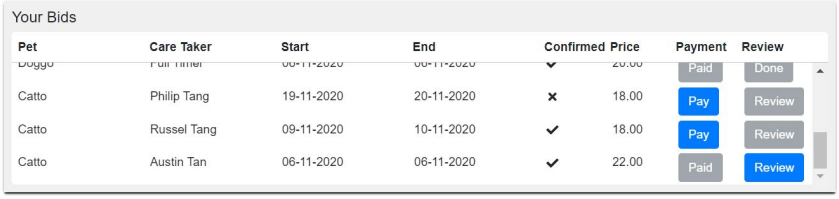
End Date

mm/dd/yyyy

Submit Bid Back

After successfully bidding for the caretaker, the pet owner will now wait for the caretaker to accept the bid. After the caretaker has accepted the pet owner's bid, the pet owner can now proceed to pay using the pay button. The pay button will change to paid after payment.

petOwner Dashboard (pay button and paid indication):

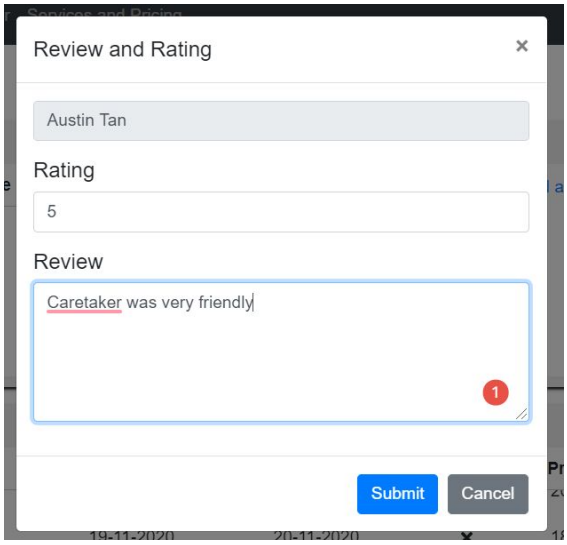


Your Bids

Pet	Care Taker	Start	End	Confirmed	Price	Payment	Review
Doggo	Full Timer	06-11-2020	06-11-2020	✓	20.00	Paid	Done
Catto	Philip Tang	19-11-2020	20-11-2020	✗	18.00	Pay	Review
Catto	Russel Tang	09-11-2020	10-11-2020	✓	18.00	Pay	Review
Catto	Austin Tan	06-11-2020	06-11-2020	✓	22.00	Paid	Review

After the service is complete, the pet owner will now be able to give rating and review to the caretaker on the specific transaction. There will be a trigger to update the avg_rating of the caretaker once the rating is submitted.

petOwner Dashboard (rating/review form):



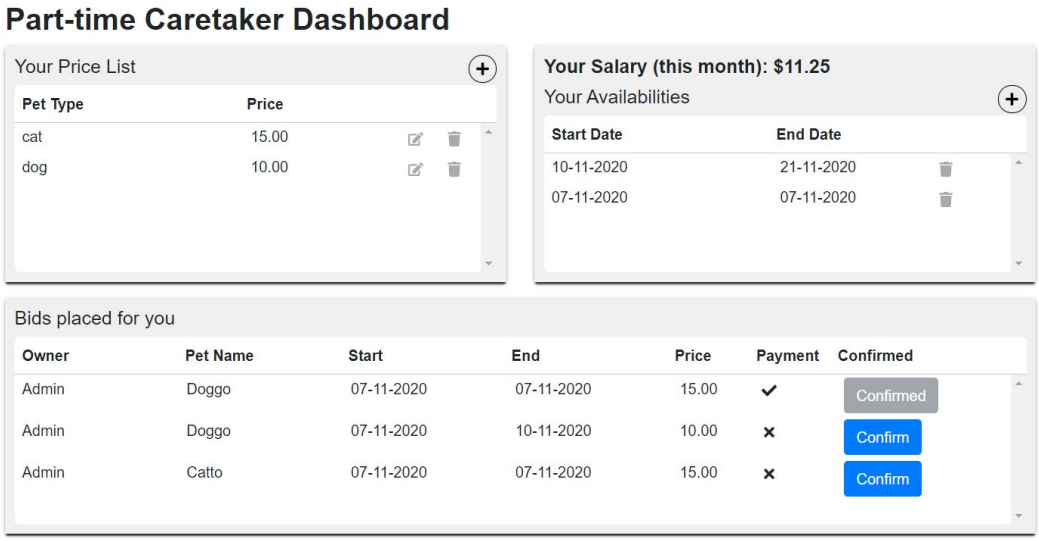
2.2.2.1 Caretaker (Part-time)

Part-time caretakers can add, edit or delete their individual prices for each pet_type.

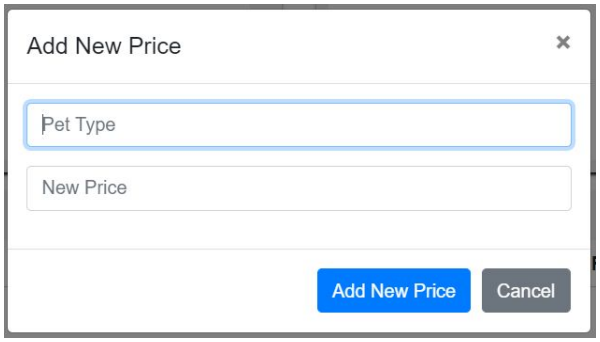
To add a price, the caretaker can simply click on the + button and input the pet_type and the corresponding price in the form accordingly. The pet_type chosen must be in the base price list declared by the admin and the value must not be lower than the base price or a corresponding error will be displayed.

To edit or delete a price the caretaker can simply click on the edit icon or the trash can on the row that the pet_type is on. Part-time caretakers have to manually accept bids from pet owners.

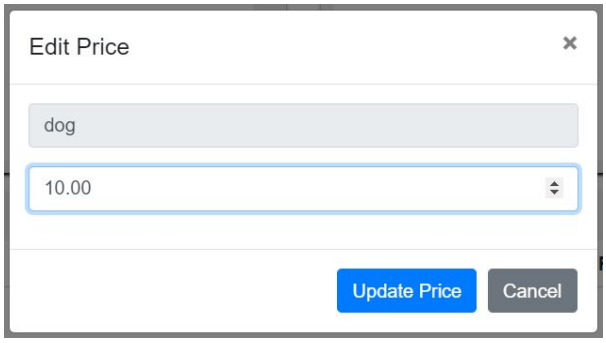
Caretaker Dashboard (Part-time) + manual bid accept:



Add Price:



Edit Price:



Part-time caretakers will have to declare their availability. Part-time caretakers will not be able to accept jobs on dates that they are not declared available. They will also be able to view their salary and the pets they have taken care of for the month. (Trigger 1: salary for caretakers)

Caretaker Dashboard (Part-time) + salary + pets taken care of:

The Part-time caretaker will then await payment and the date of transaction. After the transaction is completed, the caretaker may get a rating and review from the pet owner. (Trigger 2: avg_rating)

2.2.2.2 Caretaker (Full-time)

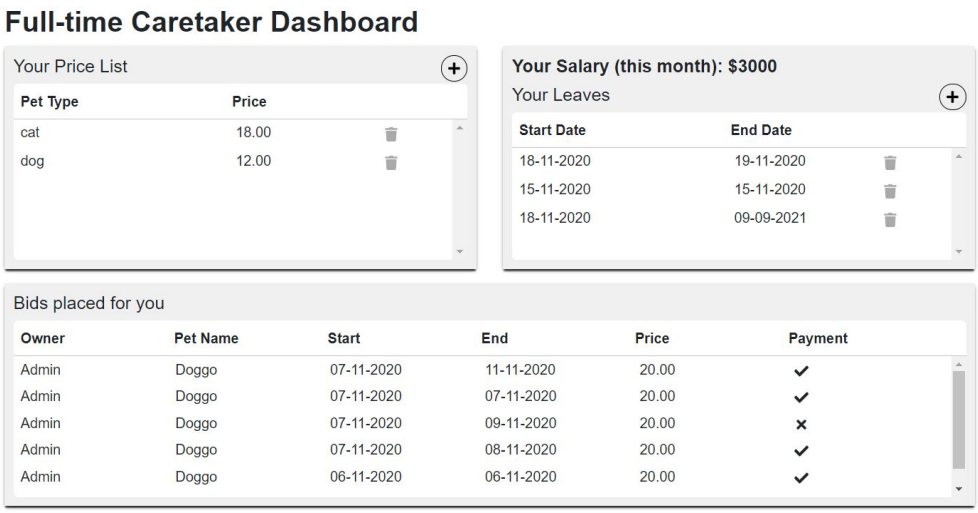
Full-time caretakers can add or delete which pet_type they are able to take care of.

To add a pet_type, the caretaker can simply click on the + button and input the pet_type. The corresponding price will be added by the system through a trigger. The corresponding price for the full-time caretaker will be the base price if his avg_rating is < 4 else the corresponding price will 1.2 * base price if his avg_rating is >=4. (Trigger 4: price computation for full-time caretakers when they add a pet type)

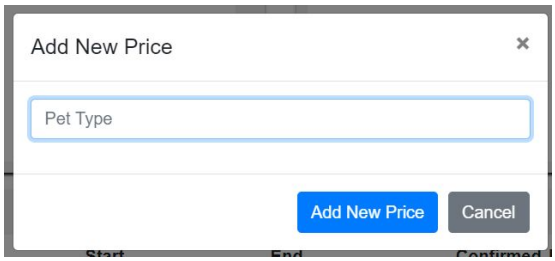
The full-time caretaker will not be able to edit his prices as it is determined by the system.

To delete a price the caretaker can simply click on the trash can on the row that the pet_type is on.

Caretaker Dashboard (Full-time):

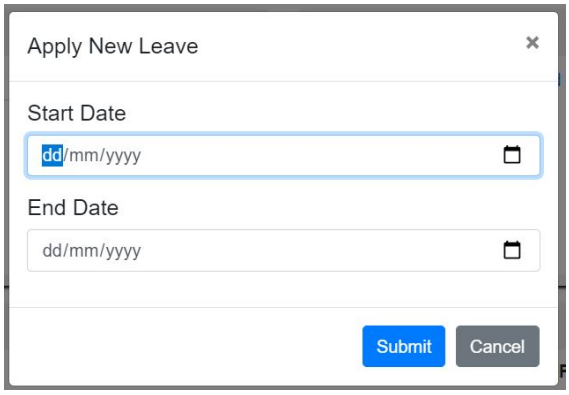


Add Price:



Full-time caretakers have to declare leaves and are available on the dates where they are not on leave. Full-time caretakers automatically accept bids from pet owners if he is available on those dates and his price is met. The automatic acceptance system checks that on every date in the bid, the full-time caretaker must have less than 5 pets under his care so that he does not go past the limit. (Trigger 3: auto accepting of jobs for full-time caretakers)

Add leaves:



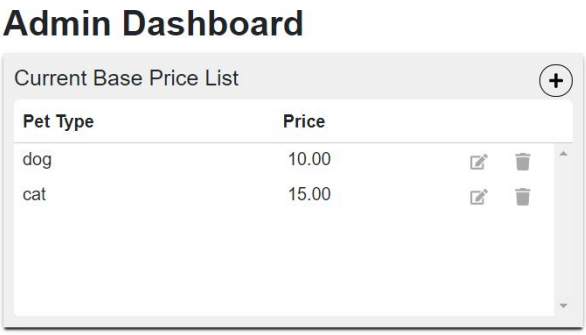
Full-time caretakers will also be able to view their salary and the pets they have taken care of for the month. (Trigger 1: salary for caretakers)

Caretaker Dashboard (Full-time) + salary + pets taken care of:
The Full-time caretaker will now await payment and the date of transaction. After the transaction, the caretaker may get a rating and review from the pet owner. (Trigger 2: avg_rating)

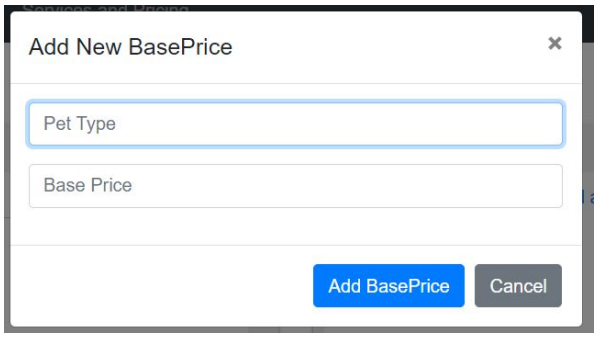
2.2.3 PCS Administrator

PCS Administrators can add, edit or delete the base price list. When the base price for a pet_type increases, part-time caretakers will automatically change their price to the new base price if their price becomes below the base price. Updating the base prices will also automatically update the base prices for the full-time caretakers as their pay is dependent on the base price. (Trigger 5: changing of base prices will update the prices 1. for part-time caretakers if their price becomes below the base price 2. For full-time caretakers a new price will be computed for them)

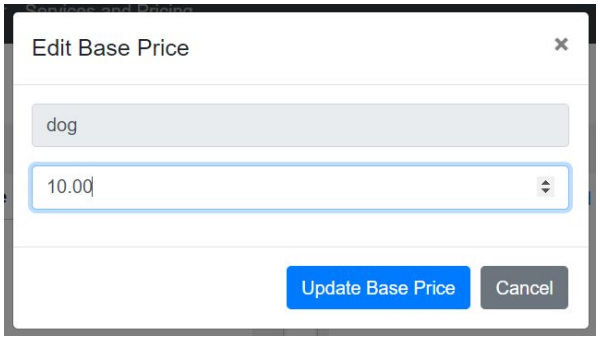
Admin Dashboard:



Add price:



Edit price:



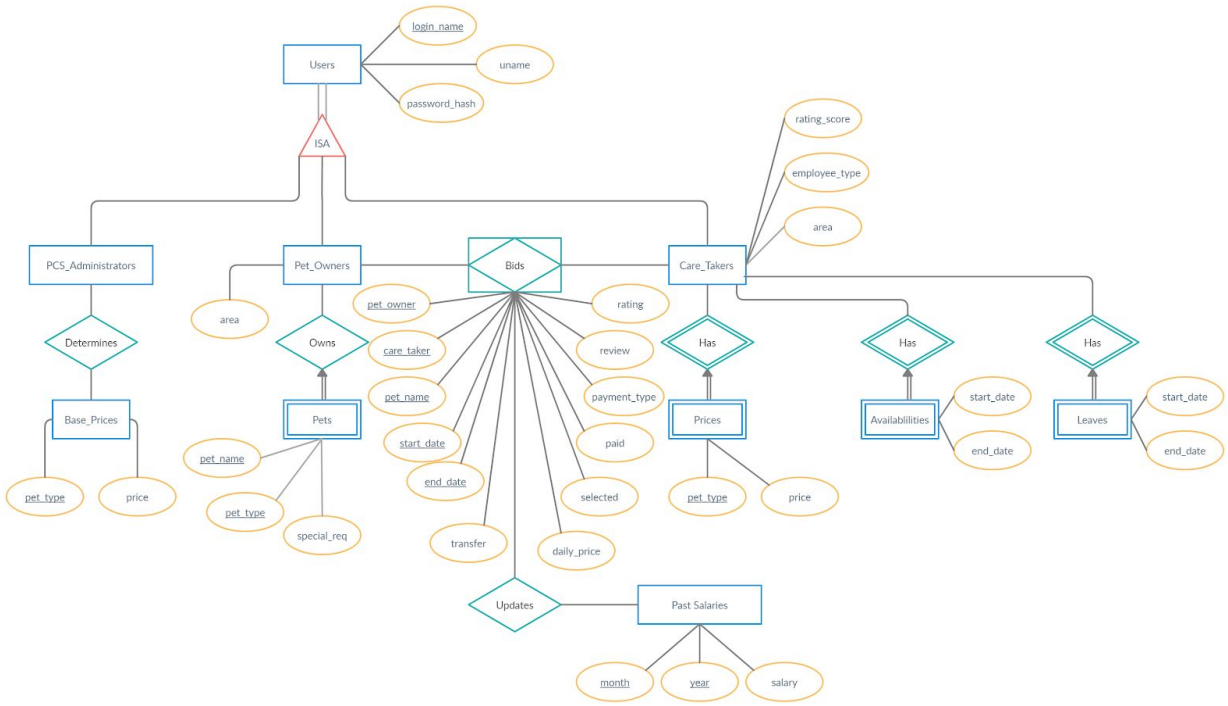
PCS Administrators also have admin access to quickly and conveniently control the user type for each user.

Admin Control Page:

All Users

Username	Display Name	Account Type
Admin	Admin	☑ Pet Owner ☐ Care Taker ☑ Admin
Part Timer	Part Timer	☑ Pet Owner ☑ Care Taker ☐ Admin
Alan Lim	Alan Lim	☑ Pet Owner ☐ Care Taker ☐ Admin
Philip Tang	Philip Tang	☑ Pet Owner ☑ Care Taker ☐ Admin
Bryan Lim	Bryan Lim	☑ Pet Owner ☐ Care Taker ☐ Admin

3. Database Schema (ER Model, Create Table Queries)




```
create table users
(
   username      varchar(50) not null
       constraint users_pkey
           primary key,
   display_name  varchar(50) not null,
   password_hash varchar(64) not null,
   salt          varchar(16)
);

create table pcs_administrators
(
   username varchar(50) not null
       constraint
pcs_administrators_pkey
           primary key
       constraint
pcs_administrators_username_fkey
           references users
           on delete cascade
);
```

```
create table bids
(
   pet_owner     varchar(50)   not null
       constraint bids_pet_owner_fkey
           references pet_owners
           on delete cascade,
   care_taker    varchar(50)   not null
       constraint bids_care_taker_fkey
           references care_takers
           on delete cascade,
   pet_name      varchar(50)   not
null,
   transfer_mode varchar(50)   not
null,
   start_date    date          not
null,
   end_date      date          not
null,
   daily_price   numeric(4, 2) not null
       constraint
bids_daily_price_check
```

```
create table pet_owners
(
   username varchar(50) not null
       constraint pet_owners_pkey
           primary key
       constraint
pet_owners_username_fkey
           references users
           on delete cascade,
   area     varchar(50)
);

create table care_takers
(
   username      varchar(50) not null
       constraint care_takers_pkey
           primary key
       constraint
care_takers_username_fkey
           references users
           on delete cascade,
   employee_type varchar(50) not null,
   area          varchar(50),
   avg_rating    double precision
);

create table base_prices
(
   pet_type varchar(50)   not null
       constraint base_prices_pkey
           primary key,
   price    numeric(4, 2) not null
       constraint
base_prices_price_check
           check (price > (0)::numeric)
);

create table pets
(
   username    varchar(50) not null
       constraint pets_username_fkey
           references pet_owners
           on delete cascade,
   pet_name    varchar(50) not null,
   pet_type    varchar(50) not null
           check (daily_price >
(0)::numeric),
   selected      boolean,
   paid          boolean,
   payment_type  varchar,
   rating        integer,
   review        varchar(200),
   constraint bids_pkey
       primary key (pet_owner,
care_taker, pet_name, start_date,
end_date),
   constraint
bids_pet_owner_pet_name_fkey
       foreign key (pet_owner,
pet_name) references pets
           on delete cascade,
   constraint bids_check
       check (end_date >= start_date),
   constraint bids_check1
       check ((((rating >= 0) AND
(rating <= 5)) OR rating IS NULL)),
);

create table prices
(
   care_taker varchar(50)   not null
       constraint
prices_care_taker_fkey
           references care_takers
           on delete cascade,
   pet_type   varchar(50)   not null
       constraint prices_pet_type_fkey
           references base_prices
           on delete cascade,
   price      numeric(4, 2) not null
       constraint prices_price_check
           check (price >
(0)::numeric),
   constraint prices_pkey
       primary key (care_taker,
pet_type)
);



create table leaves
```

```
        constraint pets_pet_type_fkey
            references base_prices
            on delete cascade,
   special_req varchar(50),
   constraint pets_pkey
        primary key (username, pet_name)
);
create table availabilities
(
   care_taker varchar(50) not null
        constraint
availablilities_care_taker_fkey
            references care_takers
            on delete cascade,
   start_date date        not null,
   end_date   date        not null,
   constraint availablilities_check
        check (end_date >= start_date)
);
```

```
(
   care_taker varchar(50) not null
        constraint
leaves_care_taker_fkey
            references care_takers
            on delete cascade,
   start_date date        not null,
   end_date   date        not null,
   constraint leaves_check
        check (end_date >= start_date)
);
```

4. Constraints

- Users have to belong to either Admin, Pet Owners or Caretakers (Covering constraint). Users can belong to multiple groups (Overlapping Constraint).
- Price_List of Care_Takers will record down the available pet types the Caretakers are capable of handling.
- Part-time Caretakers can add pet_type and price into his prices table only if the pet_type exists in the base_prices table and the price entered is higher or equal to the price stated in the base_prices table
- Full-time Caretakers can only add pet_type into price_list as the prices will be auto generated by the system.
- Part-time Caretakers can specify their own availability for the current year + the next year.
- Full-time Caretakers have to specify their leaves for the current year + the next year and are available when they are not on leave.
- Caretakers avg_rating will be between 0 and 5
- Part-time Caretakers can take care of up to 2 pets in a day if his avg_rating <4. If avg_rating >= 4, he can take care of up to 5 pets in a day.
- Full-time Caretakers can take care of up to 5 pets in a day

- Part-time caretakers can only accept bids if the dates of the bids are within the dates in availabilities.
- Pet Owners can only pay for bids when they have been selected
- Pet Owners can only make review and rating for bids when they have been completed
- Pet Owners will be able to search Caretakers based on pet_type and min price and max price
- Existence of Pets(weak entity) depends on the existence of Pet_Owners(owning entity)
- Existence and identity of Prices(weak entity) depends on the existence of Care_Takers(owning entity)
- Existence and identity of Availability(weak entity) depends on the existence of Care_Takers(owning entity)
- Existence and identity of Leave(weak entity) depends on the existence of Care_Takers(owning entity)
- Care_Takers cannot bid or rate themselves

5. 3NF/BNF Analysis

5.1. Representing SQL schema into Functional Dependencies and R

R = (u1, u2, u3, u4, pa1, po1, ct1, bp1, p1, p2, p3, b1, b2, b3, b4, b5, b6, b7, b8, b9, pr1, av1, av2, lv1, lv2)
F = {u1->u2u3u4, pa1->u2u3u4, po1->u2u3u4, ct1->u2u3u4, p2->bp1, u1p1->p2p3, po1ct1p1b2b3->b1b4b5b6b7b8b9, ct1p2->pr1}

Relation Fragment: SQL Table	Functional Dependency
<R1(u1, u2, u3, u4): Users> <u>username:</u> u1 display_name: u2 password_hash: u3 salt: u4	u1->u2u3u4 (superkey)
<R2(pa1): PCA_Administrators <u>username :</u> pa1	pa1->u2u3u4 (superkey)
<R3(po1): Pet_Owners> <u>username</u>: po1	po1->u2u3u4 (superkey)
<R4(ct1): Care_Takers> <u>username</u>: ct1	ct1->u2u3u4 (superkey)
<R5(p2, bp1): Base_Prices>	p2->bp1 (superkey)

pet_type : p2 price : bp1	
<R6(u1, p1, p2, p3): Pets> username: u1 pet_name: p1 pet_type: p2 special_req: p3	u1p1->p2p3 (superkey)
<R7(po1, ct1, p1, b1, b2, b3, b4, b5, b6, b7, b8, b9): Bids> pet_owner : po1 care_taker: ct1 pet_name: p1 transfer_mode: b1 start_date: b2 end_date: b3 daily_price: b4 selected: b5 paid: b6 payment_type: b7 rating: b8 review: b9	po1ct1p1b2b3->b1b4b5b6b7b8b9 (superkey)
<R8(ct1, p2, pr1): Prices> care_taker : ct1 pet_type : p2 price: pr1	ct1p2->pr1 (superkey)
<R9(ct1, av1, av2): Availabilities> care_taker: ct1 start_date: av1 end_date: av2	N/A
<R10(ct1, lv1, lv2): Leaves> care_taker: ct1 start_date: lv1 end_date: lv2	N/A

*<R9 Availabilities> and <R10 Leaves> do not have a key thus they are not captured in the functional dependency for our analysis.
The rest of the tables are in BCNF as the LHS of their functional dependencies all contain a super key.

6. 4 Non-trivial/interesting triggers

1) calculates average of ratings of caretakers in table bids of and updates the avg_rating in table care_takers (refer to the SQL snippet below)

```
CREATE OR REPLACE FUNCTION calculate_avg() RETURNS TRIGGER AS
$$ BEGIN
UPDATE care_takers SET avg_rating = (SELECT AVG(rating) FROM bids WHERE
bids.care_taker = care_takers.username); RETURN NEW; END; $$ LANGUAGE plpgsql;

CREATE TRIGGER calculate_avg_trigger AFTER INSERT OR UPDATE
    ON bids FOR EACH ROW
    EXECUTE PROCEDURE calculate_avg();
```

2) When bid by any Pet Owner, a full-time Caretaker will always accept the job immediately if possible

```
CREATE OR REPLACE FUNCTION accept_job() RETURNS TRIGGER AS
$$ BEGIN
UPDATE bids SET selected = true
WHERE EXISTS
    (SELECT care_takers.username
     FROM care_takers
     WHERE care_takers.username = new.care_taker
     AND care_takers.employee_type = 'full-time')
AND EXISTS
   (SELECT *
    FROM availabilities
    WHERE availabilities.care_taker= new.care_taker
    AND new.start_date>= availabilities.start_date
    AND new.end_date<= availabilities.end_date)
AND new.daily_price>=
   (SELECT price
    FROM prices
    WHERE new.care_taker = prices.care_taker
    AND prices.pet_type = (SELECT pets.pet_type
                           FROM pets
                           WHERE pets.username = new.pet_owner
                           AND pets.pet_name = new.pet_name));
RETURN NEW;
END; $$ LANGUAGE plpgsql;


CREATE TRIGGER po_bid BEFORE INSERT
    ON bids FOR EACH ROW
    EXECUTE PROCEDURE accept_job();
```

3) If a full-time caretaker applies for leave, their availability will automatically be set to not available for the range of the dates of the leave.

```
CREATE OR REPLACE FUNCTION take_leave() RETURNS TRIGGER AS
$$ BEGIN
INSERT INTO availabilities
SELECT new.care_taker,availabilities.start_date,new.start_date - INTERVAL '1 day'
FROM availabilities
WHERE new.care_taker = availabilities.care_taker
AND availabilities.start_date<=new.start_date
AND availabilities.end_date>= new.end_date;
INSERT INTO availabilities
SELECT new.care_taker,new.end_date+ INTERVAL '1 day'
,availabilities.end_date
FROM availabilities
WHERE new.care_taker = availabilities.care_taker
AND availabilities.start_date<=new.start_date
AND availabilities.end_date>= new.end_date;
DELETE FROM availabilities
WHERE new.care_taker = availabilities.care_taker
AND availabilities.start_date<=new.start_date
AND availabilities.end_date>= new.end_date;

RETURN NEW;
END; $$ LANGUAGE plpgsql;

CREATE TRIGGER ct_take_leave AFTER INSERT
    ON leaves FOR EACH ROW
    EXECUTE PROCEDURE take_leave();
```

7. 3 Most Complex SQL Queries

1) Table with average price by pet type and area among care-takers, joining with base price table for comparison

```
SELECT a.pet_type, area, average_price, price AS base_price,
      CASE WHEN price <= average_price THEN 1 ELSE 0 END AS ishigh
FROM base_prices b LEFT JOIN
   (
       SELECT pet_type AS pet_type, area, ROUND(AVG(p.price)::NUMERIC,2) AS
average_price
       FROM prices p, care_takers c
       GROUP BY pet_type, area
   ) a ON a.pet_type = b.pet_type;
```

2) Updating of avg_rating using given input of care_taker rounded to 2d.p.

```sql
WITH rating_CTE (care_taker, ave)
AS (
SELECT care_taker, ROUND (AVG(rating),2) as ave
FROM (
SELECT care_taker, rating FROM bids WHERE rating is not NULL
)T1
GROUP BY care_taker
HAVING care_taker = '$1'
)

UPDATE care_takers
SET avg_rating = (SELECT ave FROM rating_CTE)
WHERE username = (SELECT care_taker FROM rating_CTE)
```

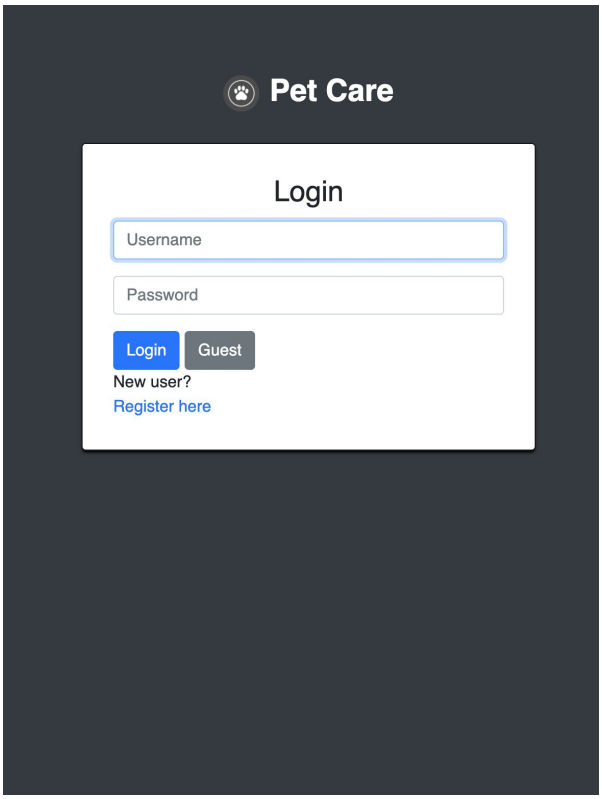
3) Selecting user information from pcs-admin, care-taker and owners table and determine which user type the user belongs to (CareTaker/PCS Admin/Pet Owner)

```sql
SELECT users.username, users.display_name, pet_owners.username as is_owner,
care_takers.username as is_care_taker, pcs_administrators.username as is_admin
FROM users left join pcs_administrators on users.username =
pcs_administrators.username
left join pet_owners on users.username = pet_owners.username
left join care_takers on users.username = care_takers.username
```

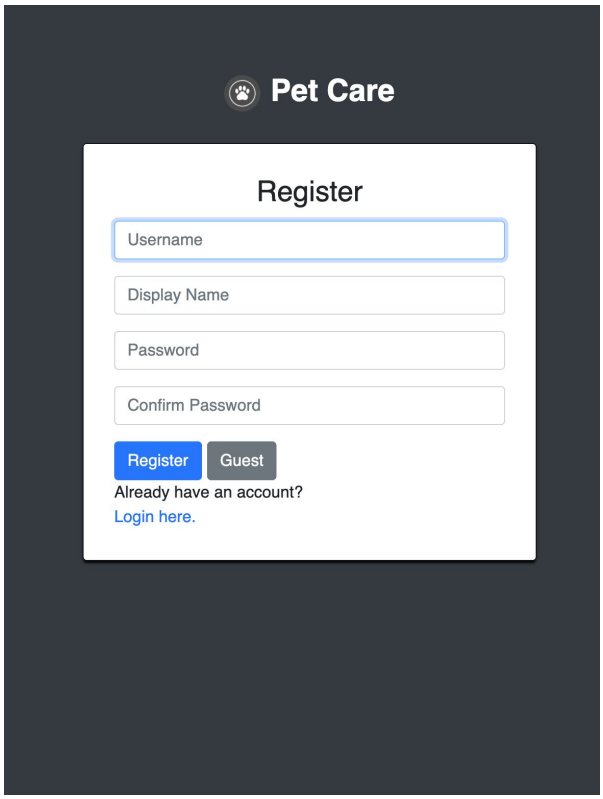
8. Specification of frameworks used in project

- Front End: CreateReactApp
- Back End: NodeJS (Express)
- Project Module Management: Yarn
- Deployment: private server
- Database Engine: Postgres-SQL (v12)

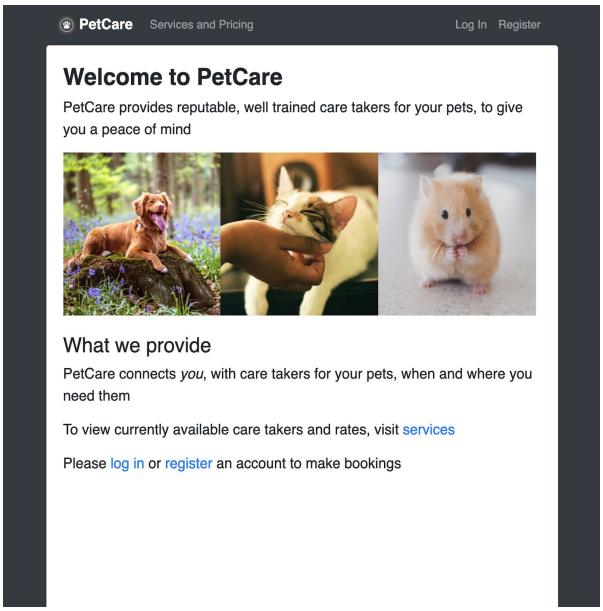
9. Screenshots of application



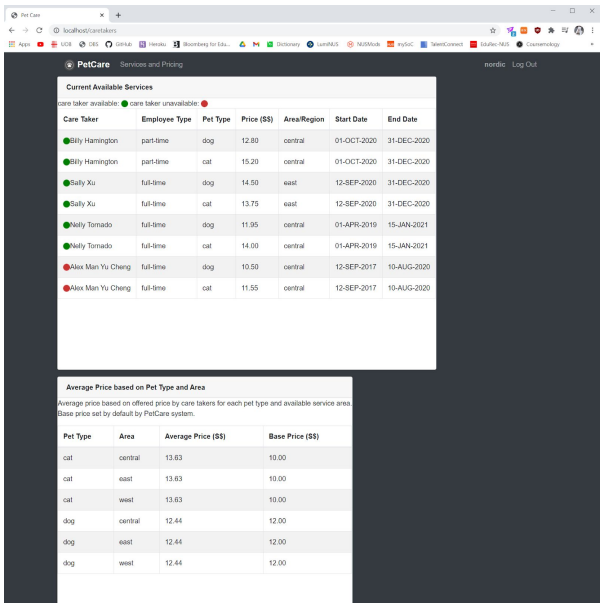
<Login Page>



<Registration Page>



<Main Homepage>



<Services and Pricing Page>

10. Project Summary

The overall project was a fantastic challenge and offered many learning opportunities as we worked on it, as the entire application design had to be built up from scratch, including the schema design, constraints, front and back end web application development. However, the components of the project allowed our team members to better understand about the basic knowledge of application development with relational database implementation.

We had to revise our schema design a few times as we discovered additional constraints that we wanted to include to better reflect the business processes of PetCare. Also, along the way, we discovered certain flaws about our original schema design and thus we needed to fix these flaws and re-create our schema design. From this, we learned that having a clear initial design in the form of an understandable ER diagram was critical to designing a properly working schema which could reflect our business needs.

When designing the triggers, the syntax found online was relatively different from the ones found in the lectures thus we had to reconcile these differences and test our triggers repeatedly until they worked properly. BCNF vs 3NF analysis of our tables was relatively difficult as we were unclear about the concepts and had to clarify them during tutorial and consultations. However, this analysis helped us gain insight about properly designing our schema such that redundancy is minimised.

This project also expanded our horizons as it not just taught us about database design and implementation, it reached beyond and required us to pick up news skills by self-learning along the way, such as HTML and javascript. It helped us learn the importance and tight knit integration of interactive applications and database systems, how they work together, and how a DBMS can allow a developer to easily manage a large amount of data.