

CSCI 621 : DATABASE SYSTEM IMPLEMENTATION

NoSQL TERM PAPER - SIMPLEDB

IMPLEMENTATION AND WORKLOAD DISTRIBUTION

Group 6:

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About the application - Used_Cars app:

The application provides users to trade cars on an online platform. One can search for the car of his choice and add his car as a new listing. The front-end of the program is developed with HTML and CSS, the database is SimpleDB, and the back-end is flask. As we know SimpleDB is a product or the service provided by AWS, the application needs a specific python interface to run called boto.

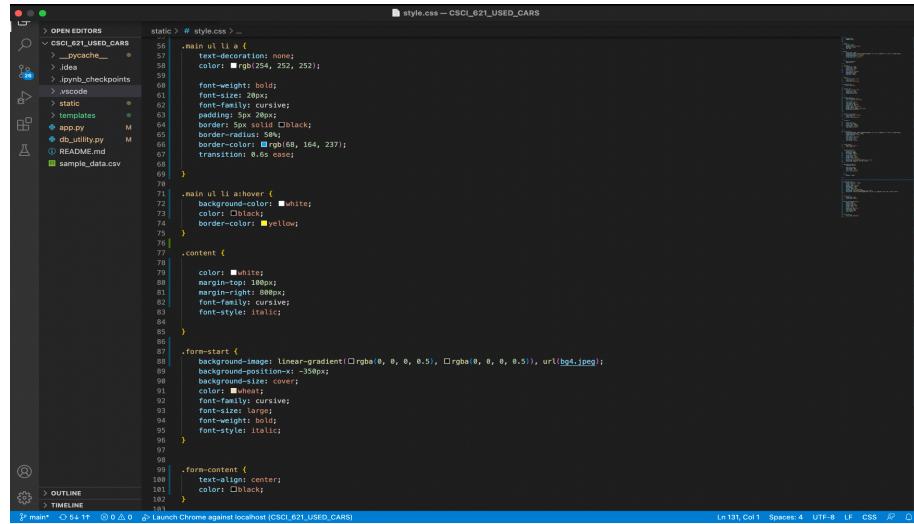
I. Front-end :

The front end consists of a few HTML web pages designed for different functions. The application has

- Home.html : It is the home page of the application. It is linked to style.css for styling. It has 2 navigation buttons -
 - View cars : Navigates to the ViewCar.html page
 - Sell my car : Navigates to sell my car section of the home page. This section consists of a single form with all the fields required in order to have a successful listing of the car. When the listing is successful, the application generates a unique 9 digit listing ID for the user with which he can retrieve his listing from the database. In order to have the successful listing, the user has to provide valid inputs such as VIN of length 17, Dealer Zip of 5 digits etc.



Figure:1-home.html



```

static > # style.css > ...
54 .main ul li {
55   text-decoration: none;
56   color: #rgb(254, 252, 252);
57 }
58 .main ul li a {
59   font-weight: bold;
60   font-size: 20px;
61   font-family: cursive;
62   padding: 10px 20px;
63   border: 2px solid #black;
64   border-radius: 50px;
65   border-color: #rgb(69, 164, 237);
66   transition: 0.5s ease;
67 }
68 }
69 }
70 .main ul li a:hover {
71   color: #white;
72   background-color: #black;
73   border-color: #yellow;
74 }
75 }
76 }
77 .content {
78 }
79 .content h1 {
80   color: #white;
81   margin-top: 100px;
82   margin-right: 80px;
83   font-family: cursive;
84   font-style: italic;
85 }
86 }
87 .form-start {
88   background-image: linear-gradient(#rgba(0, 0, 0, 0.5), #rgba(0, 0, 0, 0.5)), url(bg4.jpeg);
89   background-size: cover;
90   background-position: center;
91   color: #white;
92   font-family: cursive;
93   font-size: large;
94   font-weight: bold;
95   font-style: italic;
96 }
97 }
98 .form-content {
99   text-align: center;
100   color: #black;
101 }
102 }
103 }

```

Figure2: style.css

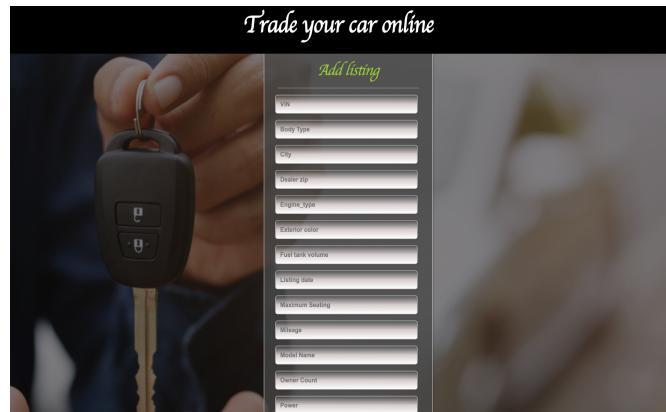


Figure 3: Sell my car section of home.html

- [viewCar.html](#): This is the second webpage which is styled using [style_viewCar.css](#). This page helps the user to look up the car according to the listing ID or model name of the car or according to his preferences. There are 4 forms for these respectively.

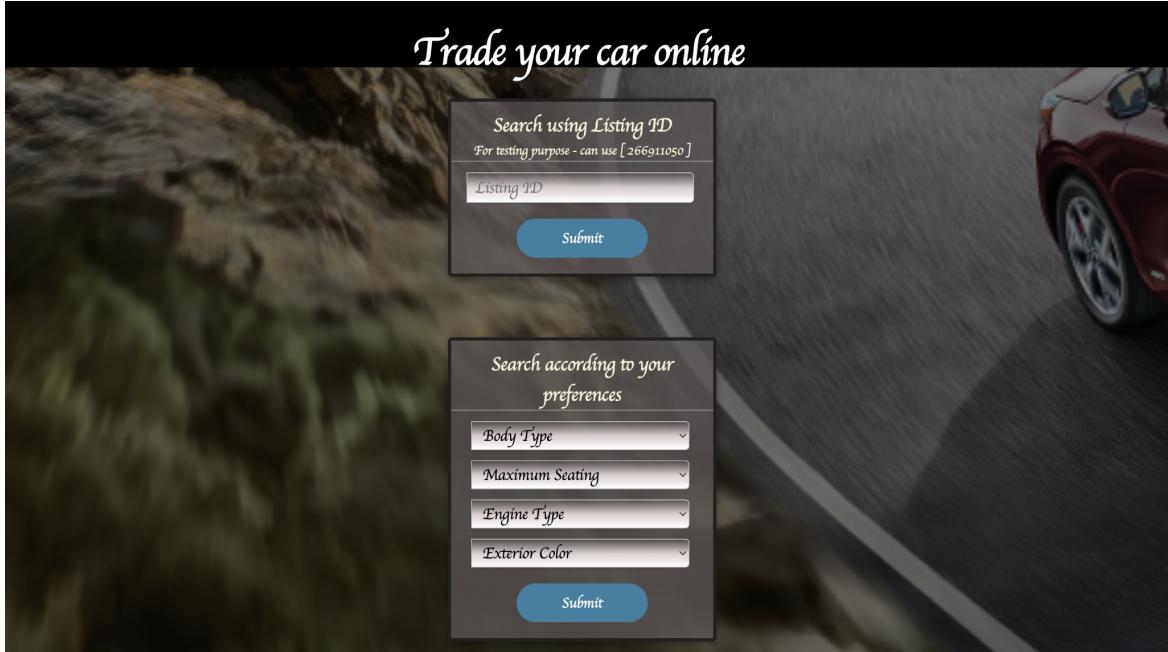


Figure 4

```

    Explorer: CSCI_621_USED_CARS
    viewCar.html U
    templates > viewCar.html > html > body > section#form_preferences.form_preferences > form > select#FuelType
    46   <section class="form_lid" id="form_listingId">
    47     <h4>Search using Listing ID</h4>
    48     <div class="input-block">
    49       <input type="text" name="listing_id" id="listing_id" placeholder="Listing ID" required />
    50     </div>
    51   </section>
    52
    53   <hr>
    54   <div class="input-block">
    55     <input type="submit" href="#carlist">Submit</button>
    56   </div>
    57 </section>
    58
    59   <hr>
    60   <div class="input-block">
    61     <input type="text" name="listing_id" id="listing_id" placeholder="Listing ID" required />
    62     <div class="input-block">
    63       <h4>Search according to your preferences</h4>
    64       <form action="form_preferences" method="post">
    65         <hr>
    66           <select name="Body Type" id="body_type" placeholder="Body Type" required>
    67             <option value="">Body Type</option>
    68             <option value="SUV">Crossover</option>
    69             <option value="Hatchback">Hatchback</option>
    70             <option value="Pickup Truck">Pickup Truck</option>
    71             <option value="Van">Van</option>
    72             <option value="Convertible">Convertible</option>
    73             <option value="Minivan">Minivan</option>
    74           </select>
    75           <select name="Maximum seating" id="Maximum_seating" placeholder="Maximum Seating" required>
    76             <option value="">Maximum Seating</option>
    77             <option value="2 seats">2</option>
    78             <option value="3 seats">3</option>
    79             <option value="4 seats">4</option>
    80             <option value="5 seats">5</option>
    81             <option value="6 seats">6</option>
    82             <option value="7 seats">7</option>
    83             <option value="8 seats">8</option>
    84             <option value="9 seats">9</option>
    85             <option value="10 seats">10</option>
    86           </select>
    87           <select name="Engine_type" id="engine_type" placeholder="Engine_type" required>
    88             <option value="">Engine Type</option>
    89             <option value="T4">I4</option>
    90             <option value="V6">V6</option>
    91             <option value="V6 Diesel">V6 Diesel</option>
    92           </select>
    93     </div>
  
```

Figure 5: viewCar.html

- formSubmissionStatus.html: This page turns up when the user adds a new listing with all the valid inputs as mentioned above. This page displays message along with the new unique 9 digit listing ID.



Figure 6: formSubmissionStatus.html

- Vtable.html: This page displays all the listings which match the filters applied/required by the user in one of the forms on viewCars.html page in table format.

The list goes here....																	
body_type	city	dealer_zip	engine_type	exterior_color	fuel_rank_volume	fuel_type	listed_date	listing_id	maximum_seating	mileage	model_name	owner_count	power	price	torque	transmission	year
Sedan	Bronx	10466	I4	Blue	12.4 gal	Gasoline	2020-06-04	273270595	5 seats	32894.0	Civic	1.0	158 hp @ 6,500 RPM	138 lb-ft @ 4,200 RPM	CVT	2017	
Sedan	Bay Shore	11706	I4	Dyno Blue Pearl	12.4 gal	Gasoline	2020-08-11	279002162	5 seats	30370.0	Civic	1.0	158 hp @ 6,500 RPM	138 lb-ft @ 4,200 RPM	CVT	2017	
Sedan	Bronx	10466	I4	White	13.2 gal	Gasoline	2020-07-15	276629949	5 seats	61444.0	Civic	2.0	143 hp @ 6,500 RPM	129 lb-ft @ 4,300 RPM	CVT	2015	
Sedan	Bay Shore	11706	I4	Taffeta White	13.2 gal	Gasoline	2020-08-30	280845134	5 seats	78271.0	Civic	1.0	140 hp @ 6,500 RPM	128 lb-ft @ 4,300 RPM	A	2012	
Sedan	Bohemia	11716	I4	Blue	12.4 gal	Gasoline	2020-08-06	278521462	5 seats	4715.0	Civic	1.0	158 hp @ 6,500 RPM	138 lb-ft @ 4,200 RPM	CVT	2019	
Sedan	Little Ferry	7643	I4	Blue	13.2 gal	Gasoline	2020-08-18	279617861	5 seats	122368.0	Civic	3.0	140 hp @ 6,300 RPM	128 lb-ft @ 4,300 RPM	A	2008	
							2020-09-						140 hp @	128 lb-ft @			

Figure 7

II. Flask :

It is the web framework that's being used in this application to render all the above explained HTML web pages in a web browser on localhost port 5000. It's being implemented on app.py python file.

- app.py: In this file, we have various functions for each different purpose. These functions can be bound to certain URL using route() provided by Flask. Also route() is used handle HTTP method i.e post method to access form data in this application. We also see each function rendering HTML templates using render_template method. Keeping app.py as a simple file, we have a handler file called db_utilities.py.

- db_utilities.py : In this file, we have implemented the available boto.sdb interface to connect with AWS's SimpleDB.

```
import boto.sdb
```

Figure 8

Also, in this file we have functions to

- validate the inputs which is necessary to have a successful listing

```
def validate_form_submitted_data(form_data):
    for key in form_data:
        if key in VALIDATION_FUNCTION_MAPPING:
            validation_function = VALIDATION_FUNCTION_MAPPING.get(key)
            if callable(validation_function):
                check, message = validation_function(form_data[key])
                if not check:
                    return FORM_FAILURE_MESSAGE.format(message)

    query = construct_insert_query(form_data)
    put_data_into_db(None, query)
    return FORM_SUCCESS_MESSAGE.format(query[form_data['vin']].get('listing_id'))
```

Figure 9

- generate random unique listing ID

```
def generate_listing_id():
    conn = get_connection()
    current_list_id = list(get_data_from_db(conn, NO_SQL_QUERY["LISTING_ID"]))
    return make_it_truly_random(current_list_id)

def make_it_truly_random(current_list_id):
    random_listing_id = random.randint(11111111, 99999999)
    if random_listing_id in current_list_id:
        make_it_truly_random(current_list_id)
    return random_listing_id
```

Figure 10

→ fetch the data from the database - designed to generate queries in the form
SELECT, FROM, WHERE.

```
def get_filtered_cars_details(filter_dictionary):
    conn = get_connection()
    query = NO_SQL_QUERY.get("CAR_LISTING")
    where_logic = "where "
    for key in filter_dictionary:
        current_filter = FILTER_LOGIC_PATTERN.format(HTML_NAME_MAPPING_TO_COL_NAME[key],
filter_dictionary.get(key))
        if where_logic == "where ":
            where_logic = where_logic + current_filter
        else:
            where_logic = where_logic + "and " + current_filter
    if where_logic != "where ":
        formatted_query = query + where_logic
    else:
        formatted_query = query
    data_iterator = get_data_from_db(conn, formatted_query)
    return list(data_iterator)
```

Figure 11

→ load the data to the database

```
def put_data_into_db(conn=None, js1=""):
    if conn is None:
        conn = get_connection()
    dom = conn.get_domain(DOMAIN_NAME)
    dom.batch_put_attributes(js1)
```

Figure 12

→ form a connection with the database - we can see boto.sdb being used in
order to connect with AWS.

```
def get_connection():
    conn = boto.sdb.connect_to_region(AWS_REGION, aws_access_key_id=ACCESS_KEY_ID,
aws_secret_access_key=ACCESS_KEY)
    return conn
```

Figure 13

III. Database :

SimpleDB is used as the AWS Service in our app on which around 20,000 data points have been uploaded for APP Demo which can be scaled up to 3 million data points which we have stored offline.

itemNa	body_t	city	dealer	engine	extero	fuel_ta	fuel_ty	listed_i	listing	main_s	maxim	mileag	model	owner	power	price	torque	transm	year
3M...	Sed...	Bay...	960	I4	Sno...	13...	Gas...	201...	244...	htt...	5 s...	204.0	MA...	nan	186...	236...	186...	A	201
3M...	Sed...	Bay...	960	I4	SO...	13...	Gas...	201...	244...	htt...	5 s...	12.0	MA...	nan	186...	236...	186...	A	201
3M...	Sed...	Bay...	960	I4	Sno...	13...	Gas...	201...	244...	htt...	5 s...	61.0	MA...	nan	186...	236...	186...	A	201
3M...	Sed...	Bay...	960	I4	SO...	13...	Gas...	201...	244...	htt...	5 s...	14.0	MA...	nan	186...	236...	186...	A	201
3M...	Sed...	Bay...	960	I4	Sno...	13...	Gas...	201...	244...	htt...	5 s...	17.0	MA...	nan	186...	236...	186...	A	201
JF1...	Sed...	Gu...	969	H4	None	15...	Gas...	201...	173...	nan	5 s...	nan	WR...	3.0	305...	469...	290...	M	201
SAL...	SU...	San...	922	I4	Nar...	17...	Gas...	202...	265...	htt...	7 s...	8.0	Dis...	nan	246...	465...	269...	A	202
SAL...	SU...	San...	922	I4	Eig...	17...	Gas...	202...	266...	htt...	7 s...	8.0	Dis...	nan	246...	512...	269...	A	202
SAL...	SU...	San...	922	I4	Nar...	17...	Gas...	202...	270...	htt...	7 s...	7.0	Dis...	nan	246...	488...	269...	A	202
SAL...	SU...	San...	922	I4	Bla...	17...	Gas...	201...	255...	htt...	7 s...	nan	Dis...	nan	246...	688...	269...	A	202
SAL...	SU...	San...	922	I4	San...	17...	Gas...	202...	263...	htt...	7 s...	8.0	Dis...	nan	246...	537...	269...	A	202
SAL...	SU...	San...	922	I4	Fire...	17...	Gas...	202...	267...	htt...	7 s...	6.0	Dis...	nan	246...	522...	269...	A	202
SAL...	SU...	San...	922	I4	Por...	17...	Gas...	202...	275...	htt...	7 s...	8.0	Dis...	nan	246...	545...	269...	A	202
SAL...	SU...	San...	922	V6	Eig...	23...	Gas...	202...	266...	htt...	7 s...	11.0	Dis...	nan	340...	674...	332...	A	202
SAL...	SU...	San...	922	V6	San...	23...	Gas...	202...	267...	htt...	7 s...	6.0	Dis...	nan	340...	689...	332...	A	202
SAL...	SU...	San...	922	I4	Kai...	16...	Gas...	202...	280...	htt...	5 s...	5.0	Ran...	nan	247...	687...	269...	A	202
SAL...	SU...	San...	922	I4	Kai...	16...	Gas...	202...	262...	htt...	5 s...	12.0	Ran...	nan	247...	669...	269...	A	202
SAL...	SU...	San...	922	I4	Fuji...	16...	Gas...	202...	275...	htt...	5 s...	11.0	Ran...	nan	247...	685...	269...	A	202
SAL...	SU...	San...	922	I4	Aru...	16...	Gas...	202...	266...	htt...	5 s...	20.0	Ran...	nan	247...	687...	269...	A	202
SAL...	SU...	San...	922	I4	Fire...	16...	Gas...	202...	279...	htt...	5 s...	7.0	Ran...	nan	247...	687...	269...	A	202
SAL...	SU...	San...	922	I4	Nar...	17...	Gas...	202...	268...	htt...	5 s...	22.0	Ran...	nan	246...	518...	269...	A	202
SAL...	SU...	San...	922	I4	Bla...	17...	Gas...	201...	238...	htt...	5 s...	254.0	Ran...	nan	296...	843...	295...	A	202
WB...	Sed...	Gu...	969	I6	Silver	15...	Gas...	201...	173...	htt...	5 s...	690...	3 S...	2.0	320...	589...	330...	A	201
ZA...	SU...	Sou...	7606	I6	WH...	22...	Gas...	202...	281...	htt...	4 s...	805...	X6	3.0	300...	209...	300...	A	201

Figure 14

→ SimpleDb data as seen using SDBNavigator before creating a Used_Cars_APP database with sample database for testing called UsedCars

```
Connection:
SDConnection:sdb.amazonaws.com
Getting All Domains
[Domain:UsedCars, Domain:test-domain]
Deleting Domain UsedCars
Getting All Domains
Creating Domain Used_Cars_APP:
[Domain:Used_Cars_APP, Domain:test-domain]
Inserting 1000 Values 25 datapoints batches
['BoxUsage', 'DomainMetadataResponse', 'DomainMetadataResult', 'RequestId', 'ResponseMetadata', '__class__', '__delattr__', '__dict__', '__dir__', '__doc__', '__eq__', '__format__', '__ge__', '__getattribute__', '__gt__', '__hash__', '__init__', '__init_subclass__', '__le__', '__lt__', '__module__', '__ne__', '__new__', '__reduce__', '__reduce_ex__', '__repr__', '__setattr__', '__sizeof__', '__str__', '__subclasshook__', '__weakref__', 'attr_name_count', 'attr_names_size', 'attr_value_count', 'attr_values_size', 'domain', 'endElement', 'item_count', 'item_names_size', 'startElement', 'timestamp']
No of Items in Domain Used_Cars_APP
1000
```

Figure 15

→ The python console while deleting a sample domain and making a new domain for uploading data for the application

itemNr	body_ty	city	dealer	engine	exterior	fuel_tar	fuel_typ	listed_d	listing_i	main_pi	maximu	mileage	model	owner	power	price	torque	transmi	year
SAL...	SUV...	San ...	922	I4	Narv...	17.7...	Gas...	202...	265...	http...	7 se...	8.0	Disc...	nan	246 ...	465...	269 ...	A	2020
JF1V...	Sedan	Gua...	969	H4	None	15.9...	Gas...	201...	173...	http...	5 se...	nan	WR...	3.0	305 ...	469...	290 ...	M	2016
SAL...	SUV...	San ...	922	V6	Eige...	23.5...	Gas...	202...	266...	http...	7 se...	11.0	Disc...	nan	340 ...	674...	332 ...	A	2020
SAL...	SUV...	San ...	922	I4	Narv...	17.7...	Gas...	202...	270...	http...	7 se...	7.0	Disc...	nan	246 ...	488...	269 ...	A	2020
SAL...	SUV...	San ...	922	I4	Kaik...	16.6...	Gas...	202...	262...	http...	5 se...	12.0	Ran...	nan	247 ...	669...	269 ...	A	2020
3MZ...	Sedan	Bay...	960	I4	SON...	13.2...	Gas...	201...	244...	http...	5 se...	14.0	MAZ...	nan	186 ...	236...	186 ...	A	2019
SAL...	SUV...	San ...	922	I4	Fuji ...	16.6...	Gas...	202...	275...	http...	5 se...	11.0	Ran...	nan	247 ...	685...	269 ...	A	2020
SAL...	SUV...	San ...	922	I4	Eige...	17.7...	Gas...	202...	266...	http...	7 se...	8.0	Disc...	nan	246 ...	512...	269 ...	A	2020
SAL...	SUV...	San ...	922	I4	Blan...	17.7...	Gas...	201...	238...	http...	5 se...	254.0	Ran...	nan	296 ...	843...	295 ...	A	2020
ZAR...	Coupe	Gua...	969	I4	Red	10.5...	Gas...	201...	171...	http...	2 se...	301.0	4C	2.0	237 ...	975...	258 ...	A	2015
SAL...	SUV...	San ...	922	I4	Narv...	17.7...	Gas...	202...	268...	http...	5 se...	22.0	Ran...	nan	246 ...	518...	269 ...	A	2020
WBA...	Sedan	Gua...	969	I6	Silver	15.8...	Gas...	201...	173...	http...	5 se...	690.0	3 Se...	2.0	320 ...	589...	330 ...	A	2016
SAL...	SUV...	San ...	922	I4	Arub...	16.6...	Gas...	202...	266...	http...	5 se...	20.0	Ran...	nan	247 ...	687...	269 ...	A	2020
3MZ...	Sedan	Bay...	960	I4	Sno...	13.2...	Gas...	201...	244...	http...	5 se...	204.0	MAZ...	nan	186 ...	236...	186 ...	A	2019
3MZ...	Sedan	Bay...	960	I4	Sno...	13.2...	Gas...	201...	244...	http...	5 se...	61.0	MAZ...	nan	186 ...	236...	186 ...	A	2019
SAL...	SUV...	San ...	922	I4	Fire...	17.7...	Gas...	202...	267...	http...	7 se...	6.0	Disc...	nan	246 ...	522...	269 ...	A	2020
SAL...	SUV...	San ...	922	I4	Fire...	16.6...	Gas...	202...	279...	http...	5 se...	7.0	Ran...	nan	247 ...	687...	269 ...	A	2020
SAL...	SUV...	San ...	922	I4	Kaik...	16.6...	Gas...	202...	280...	http...	5 se...	5.0	Ran...	nan	247 ...	687...	269 ...	A	2020
SAL...	SUV...	San ...	922	I4	Sant...	17.7...	Gas...	202...	263...	http...	7 se...	8.0	Disc...	nan	246 ...	537...	269 ...	A	2020
3MZ...	Sedan	Bay...	960	I4	Sno...	13.2...	Gas...	201...	244...	http...	5 se...	17.0	MAZ...	nan	186 ...	236...	186 ...	A	2019
3MZ...	Sedan	Bay...	960	I4	SON...	13.2...	Gas...	201...	244...	http...	5 se...	12.0	MAZ...	nan	186 ...	236...	186 ...	A	2019
SAL...	SUV...	San ...	922	I4	Port...	17.7...	Gas...	202...	275...	http...	7 se...	8.0	Disc...	nan	246 ...	545...	269 ...	A	2020
SAL...	SUV...	San ...	922	I4	Blan...	17.7...	Gas...	201...	255...	http...	7 se...	nan	Disc...	nan	246 ...	688...	269 ...	A	2020
SAL...	SUV...	San ...	922	V6	Sant...	23.5...	Gas...	202...	267...	http...	7 se...	6.0	Disc...	nan	340 ...	689...	332 ...	A	2020
SAL...	SUV	Car ...	922	V4	Name ...	17.7 ...	Gas ...	202 ...	270 ...	http ...	7 se ...	7.0	Disc	246 ...	545 ...	269 ...	A	2020

Figure 16

→ SimpleDb data as seen using SDBNavigator after creating a Used_Cars_App database

Exporting the data into SimpleDB through boto:

To export the data into the Amazon SimpleDB we used the boto package in python to export data to our SimpleDB as mentioned above. A brief about how the data gets loaded into the database system through this.

The below code gives an idea of how the connection of simpleDb is established using boto. We can also query the data using this package in python. An example is provided in the code below to understand how a query is written and processed by the same and the output is also provided giving us the result of that query. Here the pandas library is used to read through the csv file which contains our dataset.

```

Users > swetna > Desktop > 📁 Query.py > ...
1 import boto.sdb
2 import pandas as pd
3
4 # establishing connection
5 conn = boto.sdb.connect_to_region('us-east-1',
6 | | | | | aws_access_key_id='AKIAVL0Q2XR0MXG0YF4L',
7 | | | | | aws_secret_access_key='lB009aYvkXYFz2yrNugjaGkWCPx443kfQMa0jPcj')
8 print(conn)
9
10 # getting all domains of the used cars
11 domain = conn.get_domain('Used_Cars_APP')
12
13 # To create a domain in simpleDB
14 conn.create_domain('test-domain22')
15
16 # Adding data to SimpleDB via a csv file
17 df1=pd.read_csv('/Users/swetna/Desktop/Swetna.csv')
18 vin=df1["vin"]
19 df1.drop('vin', inplace=True, axis=1)
20
21
22 # Querying the data added to the domain
23 # (Demo to get all cars with body_type as Coupe, exterior color matching red and the price being lower than 98000)
24 query= 'select * from Used_Cars_APP Where body_type="Coupe" intersection exterior_color="Red" intersection price < "98000" limit 5'
25 rs = domain.select(query)
26 for j in rs:
27     print(j)
28
29
30 # Getting all domains and printing them
31 domains = conn.get_all_domains()
32 print(domains)
33
34 print(domains.item_count) #getting the number of domains created in SimpleDB
35

```

Figure17.1: Code for SimpleDB

```

$ python3 - % /usr/local/bin/python3 /Users/swetna/Desktop/Query.py
Search (⇧⌘F) : sdb.amazonaws.com
{'body_type': 'Coupe', 'city': 'Guaynabo', 'dealer_zip': '9691', 'engine_type': 'I4', 'exterior_color': 'Red', 'fuel_tank_volume': '10.5 gal', 'fuel_type': 'Gasoline', 'listed_date': '2017-04-06', 'listing_id': '171865107', 'main_picture_url': 'https://static.cargurus.com/images/forsale/2017/04/18/18/55/2015_alfa_romeo_4c-pic-5436617585836482578-152x114.jpeg', 'maximum_seating': '2 seats', 'mileage': '301.0', 'model_name': '4C', 'owner_count': '2.0', 'power': '237 hp @ 6,000 RPM', 'price': '97579.0', 'torque': '258 lb-ft @ 4,250 RPM', 'transmission': 'A', 'year': '2015'}
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{'body_type': 'Coupe', 'city': 'Teterboro', 'dealer_zip': '7608', 'engine_type': 'nan', 'exterior_color': 'Red', 'fuel_tank_volume': '19 gal', 'fuel_type': 'nan', 'listed_date': '2020-07-15', 'listing_id': '276650311', 'main_picture_url': 'https://static.cargurus.com/images/forsale/2020/07/15/08/15/2010_chevrolet_camaro-pic-3356414226829231610-152x114.jpeg', 'maximum_seating': '4 seats', 'mileage': '32084.0', 'model_name': 'Camaro', 'owner_count': '1.0', 'power': '400 hp @ 5,900 RPM', 'price': '23999.0', 'torque': '410 lb-ft @ 4,300 RPM', 'transmission': 'A', 'year': '2010'}
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[Domain:Used_Cars_APP, Domain:aarti-test, Domain:test-domain22]

```

Figure 17.2: Output of the code from Figure17.1