Phase 1 Report | CS 6400 - Spring 2023 | **Team 021**

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Data Types:

Household

Attribute	Data Type	Nullable
Email	String	Not Null
Type	String	Not Null
Square Footage	Integer	Not Null
Thermostat Setting Heating	Integer	Null
Thermostat Setting Cooling	Integer	Null

On-Grid Household

Attribute	Data Type	Nullable
Utilities	List <String>	Not Null

Off-Grid Household

Attribute	Data Type	Nullable

Appliances

Attribute	Data Type	Nullable
Order Entered	Integer	Not Null
BTU Rating	Integer	Not Null
Model Name	String	Null
Type	String	Not Null

Water heater

Attribute	Data Type	Nullable
Energy Source	String	Not Null
Current Temperature	Integer	Null
Capacity	Double	Not Null

Heating/Cooling Method

Attribute	Data Type	Nullable
Order Entered	Integer	Not Null
Method	String	Not Null

Heat Pump

Attribute	Data Type	Nullable
HSPF	Double	Not Null
SEER	Double	Not Null

Air Conditioner

Attribute	Data Type	Nullable
EER	Double	Not Null

Heater

Attribute	Data Type	Nullable
Energy Source	String	Not Null

Manufacturer

Attribute	Data Type	Nullable
Name	String	Not Null

Power Generation

Attribute	Data Type	Nullable
Order Entered	Integer	Not Null
Type	String	Not Null
Avg. Mo. Kilo. Hours	Integer	Not Null
Capacity	Integer	Null

Location

Attribute	Data Type	Nullable
Postal Code	String	Not Null
City	String	Not Null
State	String	Not Null
Latitude	Double	Not Null
Longitude	Double	Not Null

Business Logic Constraints

General

- The SQL used to generate reports will be case-insensitive.
- "Dropdown" user-inputs all require one of the supplied values to be selected.

Household

Thermostat setting for heating

- Required unless the user checks 'No heat'.
- If the user does not check 'No heat', an Appliance must be added that supports the Heater or Heat Pump Heating/Cooling Method. A message should be shown to the user notifying them of this requirement.
- If a user deletes all Appliances with Heater or Heat Pump Heating/Cooling Methods from the Appliance List page, they should not be allowed to continue. The 'Next' button should be disabled, a notification should be displayed that they must return to the Add Appliance page, and a link to redirect them to that page should be present.

Thermostat setting for cooling

- Required unless the user checks 'No cooling'.
- If the user does not check 'No cooling', an Appliance must be added that supports the Air Conditioner Heating/Cooling Method. A message should be shown to the user notifying them of this requirement.
- If a user deletes all Appliances with the Air Conditioner Heating/Cooling Method from the Appliance List page, they should not be allowed to continue. The 'Next' button should be disabled, a notification should be displayed that they must return to the Add Appliance page, and a link to redirect them to that page should be present.
- The user supplied value for Email must pass a standard formatting validation.
    - EX: Contain '@', have a valid domain name, have a valid username, etc.
- Square Footage cannot be negative.

Appliance

- A utility will keep track of the Integer value for the next Appliance #, starting from 1 and incrementing by 1 with each added Appliance. Deleting an Appliance does not affect this value.

Postal Code

- Improperly formatted user supplied Postal Codes result in an error message on form submission, no data persistence, and redirection to the rejected form.
    - EX: "Please enter a valid, 5-digit United States Postal Code."
- Properly formatted user supplied Postal Codes that are not in our validation table result in an error message on form submission, no data persistence, and redirection to the rejected form.
    - EX: "Sorry, that Postal Code is not in our database."
- User supplied Postal Codes that match our validation table result in no errors on form submission, data persistence, and redirection to the next form.

Water Heater

- Capacity cannot be negative.

Air Handler

- Can have at most one of each type of heating/cooling method.

Power Generation

- A utility will keep track of the Integer value for the next Power Generator #, starting from 1 and incrementing by 1 with each added Power Generator. Deleting a Power Generator does not affect this value.
- If NOT NULL, Capacity cannot be negative.

Task Decomposition with Abstract Code

Main Menu

Task Decomp

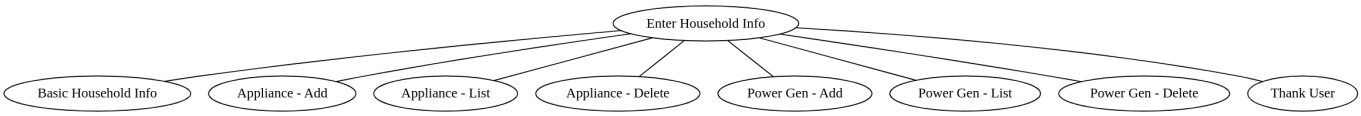
- Lock Types: None
- Number of Locks: 0
- Enabling Conditions: None
- Frequency: Around 500 per day
- Consistency (ACID): Not critical, order is not critical.
- Subtasks: Mother task not needed. No decomposition needed.

Abstract Code

- Show **"Enter My Household Info"** and **"View Reports/Query data"** links.
- Upon:
  - **Enter My Household Info** - Jump to **Enter My Household Info** task.
  - **View Reports/Query data** - Jump to **View Reports** task.

Enter My Household Info

Task Decomposition



- Enabling Conditions: None
- Frequency: Around 100 per day
- Subtasks:

  Mother Task for the following sequence:

  - **Basic Household Info**
  - **Appliance - Add**
  - **Appliance - List**
  - **Appliance - Delete**
  - **Power Generator - Add**
  - **Power Generator - List**
  - **Power Generator - Delete**
  - **Thank User**

Basic Household Info

Task Decomp:

- Lock Types:

    - Write on Household
    - Read on Location
- Number of Locks: 2
- Enabling Conditions: Clicking "Enter my household info" on Main menu
- Frequency: Around 100/day
- Consistency (ACID):

Abstract Code

- If User clicks on Next from Basic Household Info screen:
    - Validate email:
        - If Email already exists in database, display a warning that email is already found, pick a new email. Disable next button until new email entered.
    - Validate Zip Code:
        - Check if Zip + City + State combo the user entered exists in Location. If not, display a warning that the zip code + city entered is invalid. Disable next button until new Zip or City or State entered.
    - Validate the required fields are filled in:
        - Type, Square Footage
    - If no value is entered for *Thermostat Setting Heating*, validate the user checked the "No Heat" box.
    - If no value is entered for *Thermostat Setting Cooling*, validate the user checked the "No Cooling" box.
    - If any validation checks fail, present the user an error message saying what's missing.
    - If all validation checks successful, insert data in the database, then go to the **Appliance - Add** task.

Appliance - Add

Task Decomp:

- Lock Types:
    - Write on: Appliance, Heating/Cooling Method, Heat Pump, Air Conditioner, Heater
    - Read on Manufacturer
- Number of Locks: Several
- Enabling Conditions: User has completed **Basic Household Info** task.
- Frequency: Around 100 per day
- Consistency (ACID): Must be done after **Basic Household Info** task, otherwise order not important.
- Subtasks: None

Abstract Code

- User selects an Appliance Type from a drop-down (Air Handler or Water Heater)
    - If user selects Air Handler, display the Air Handler fields:
        - Manufacturer, Model Name, EER, Energy Source, and Method (a multi-select allowing Air Conditioner, Heater, and/or Heat Pump)
        - Manufacturer will be a dropdown list of manufacturers who make Air Handlers.
        - If user selects Air Conditioner method:

            - Add input for EER
        - If user selects Heater:
            - Add input for Energy Source
        - If user selects Heat Pump:
            - Add inputs for HSPF and SEER
    - If user selects Water Heater, display Water Heater fields:
        - Energy Source, Current Temperature, Capacity
    - If user hits Add:
        - Validate the required fields are filled in
        - Validate data types match:
            - HSPF, SEER, EER, Capacity are numbers, decimals allowed
            - BTU, Current Temperature are numbers, round to whole number when saving.
        - Insert to the database. Run **Appliance - List**

Appliance - List

Task Decomp:

- Lock Types: Read on Appliance
- Number of Locks: 1
- Enabling Conditions: User completed **Appliance - Add** task.
- Frequency: Around 100 per day
- Consistency (ACID): Done after appliances added.
- Subtasks: None

Abstract Code

- Read household's appliances using household email.
- If list is empty, run **Appliances - Add** (user must have deleted last appliance)
- Display:
    - List of appliances that are not Deleted.
    - Button to delete each appliance
    - Button to Add Another Appliance
    - Button saying Next.
- If user hits Add Another Appliance, run **Appliances - Add**.
- If user hits Delete, run **Appliances - Delete**
- If user hits Next, run **Power Generation - Add**.

Appliance - Delete

Task Decomp:

- Lock Types: Write on Appliance
- Number of Locks: 1
- Enabling Conditions: At least 1 appliance exists for that household.
- Frequency: Rare - 3 per day
- Consistency (ACID): Not critical
- Subtasks: None

Abstract Code

- Delete the selected appliance.
- Run **Appliances - List**

Power Generator - Add

Task Decomp:

- Lock Types: Write on Power Generator
- Number of Locks: 1
- Enabling Conditions: User clicks next on **Appliance - List**
- Frequency: Around 100 per day
- Consistency (ACID): Not critical
- Subtasks: None

Abstract Code

- Display:
    - Inputs for Type, Monthly kWh, Capacity,
    - If household is not off-grid, display skip button.
    - Display add button
- If user hits Add:
    - Validate required fields are filled in
    - Validate Monthly kWh and Capacity are numbers. Round to whole number when saving.
    - If above validation checks are successful:
        - Insert to database.
        - Run **Power Generator - List**
    - Else display a data validation error and disable Add button until a change to a user-input is made
- If user hits skip button, run **Thank User**

Power Generator - List

Task Decomp:

- Lock Types: Read on Power Generator
- Number of Locks: 1
- Enabling Conditions: Household has been entered, at least 1 Power Generator has been added
- Frequency: Around 100 per day
- Consistency (ACID): Done after power generation completed.
- Subtasks: None

Abstract Code:

- Read a household's power generators by email.
- Display:
    - List of Power Generator that is not Deleted
    - Button saying "Add More Power"
    - Button saying "Finish"

    - Button saying "Delete" for each Power Generator listed
- If user hits "Add More Power", run **Power Generator - Add**
- If user hits "Delete", run **Power Generator - Delete**
- If user hits "Finish", validate at least 1 power generator exists OR household is on-grid, then run **Thank User**
- If 0 power generators exist and household is off-grid, run **Power Generator - Add**.

Power Generator - Delete

Task Decomp:

- Lock Types: Write on Power Generator
- Number of Locks: 1
- Enabling Conditions: At least 1 power generation exists for that household.
- Frequency: Rare - 3 per day
- Consistency (ACID): Not critical
- Subtasks: None

Abstract Code

- Delete the selected Power Generator
- Run **Power Generator - List**

Thank User

Task Decomp:

- Lock Types: None
- Number of Locks: 0
- Enabling Conditions: User finishes adding or skipped power generation
- Frequency: Around 100 per day
- Consistency (ACID): Not critical
- Subtasks: None

Abstract Code

- Display a message thanking the user, and a link to the main menu. When clicked, run **Main Menu**

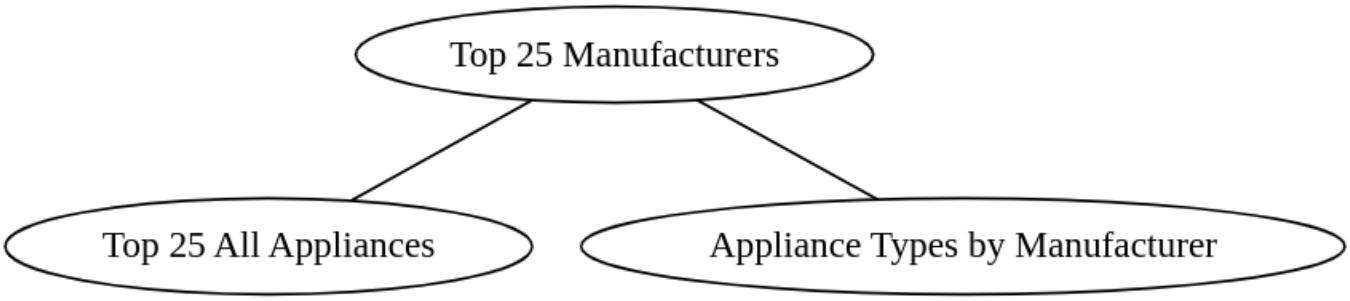
View Reports

Abstract Code:

- Display links for:
    - Top 25 popular manufacturers.
    - Manufacturer/model search
    - Heating/cooling method details

    - Water heater statistics by state
    - Off-the-grid household dashboard
    - Household averages by radius*
- Clicking each link should go to the respective report task

Top 25 Popular Manufacturers



Task Decomp:

- Lock Types: Read on Manufacturer, Appliance
- Number of Locks: 2
- Enabling Conditions: Clicking link from **View Reports**
- Frequency: 50 per day
- Consistency (ACID): Not critical
- Subtasks:
    - Top 25 All Appliances
    - Appliance Types by Manufacturer

Abstract Code:

- Query Appliance and Manufacturer to Get a count of Appliances grouped by Manufacturer *Name*. Sort by number of appliances descending, keep the top 25.
- If user clicks on a manufacturer, query the Appliance entity grouped by the *Type* attribute to get a count of appliances by type for that Manufacturer *Name*. Display a drilldown table with that company's name as the title and columns for each type.

Manufacturer/Model Search

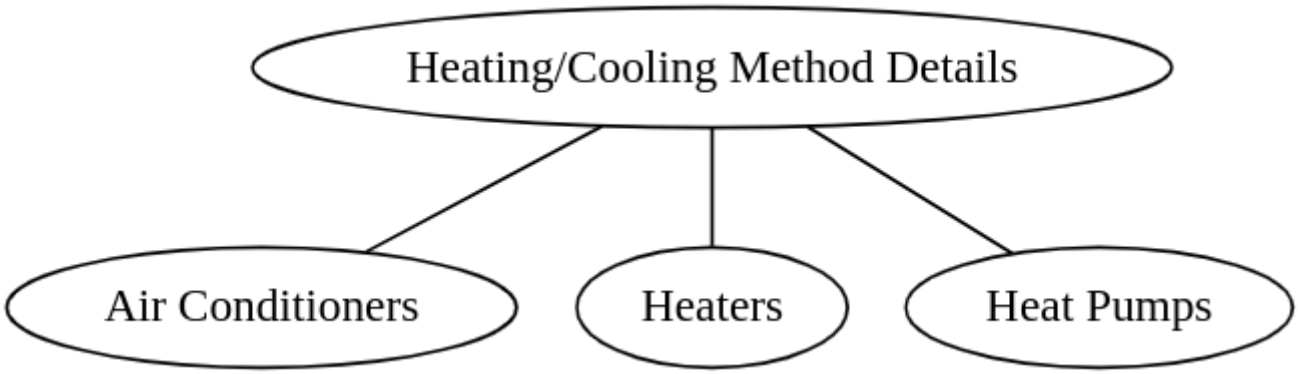
Task Decomp:

- Lock Types: Read on Manufacturer, Appliance
- Number of Locks: 2
- Enabling Conditions: Clicking link from **View Reports**
- Frequency: 50 per day
- Consistency (ACID): Not critical
- Subtasks: None

Abstract Code:

- If a user hits the "Search" button:
    - If there are no characters in the search text input, display a warning to the user.
    - If there are characters, query Manufacturer *Name* and Appliance *Model Name*. Display a table with all distinct models (and their manufacturer) where either the model or manufacturer name matched the search query.
    - Results should be ordered by manufacturer name (ascending), then model name (ascending).
    - Highlight matching strings in green.

Heating/Cooling Method Details



Task Decomp:

- Lock Types: Read on Appliance, Heater, Air Conditioner, Heat pump
- Number of Locks: 4
- Enabling Conditions: Clicking link from **View Reports**
- Frequency: 50 per day
- Consistency (ACID): Not critical
- Subtasks (no specific order required):
    - Air Conditioners
    - Heaters
    - Heat Pumps

Abstract Code:

- Query **Air Conditioner** grouped by **Household** *Type* (found via tracing identifying relationships from Air Conditioner to Household), returning a count of Air Conditioners, average BTU (rounded to whole number) and average EER (rounded to 0.1).
- Query **Heater** grouped by **Household** *Type* (found via tracing identifying relationships from Air Conditioner to Household), returning a count of Heaters, average *BTU* (rounded to whole number), and most common **Heater** *Energy Source* for each **Household** *Type*.
- Query **Heat Pump** grouped by **Household** *Type* (found via tracing identifying relationships from Air Conditioner to Household), returning a count of Heat Pumps, average *BTU* (rounded to whole number), and average SEER and HSPF (rounded to 0.1).
- Group by **Household** *Type* so that all results are in a single table with 1 column for each measure.

Water Heater Statistics By State

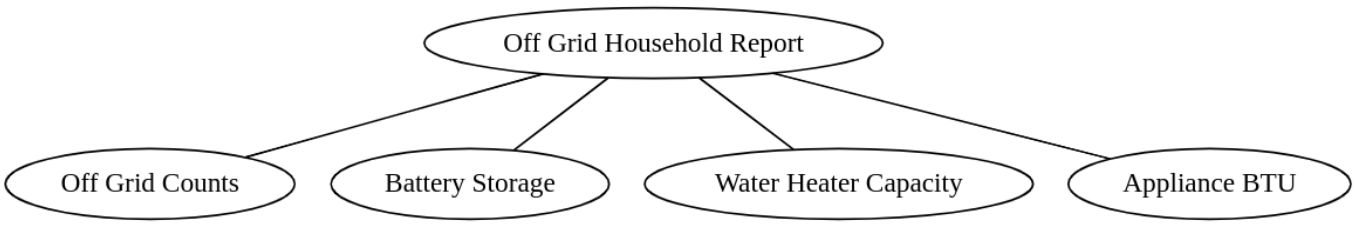
Task Decomp:

- Lock Types: Read on Water Heater, Appliance, Location, Household
- Number of Locks: 4
- Enabling Conditions: Clicking link from **View Reports**
- Frequency: 50 per day
- Consistency (ACID): Not critical
- Subtasks: None

Abstract Code:

- Query **Location**, **Water Heater**, **Appliance**, **Household**, group by *State*, return:
    - Average *BTU* (from **Appliance**, round to whole number)
    - Average water heater *Capacity* (round to whole number)
    - Average *Current Temperature* (round to 0.1)
    - Count of All Water Heaters
    - Count of Water Heaters that have a **Current Temperature** recorded
    - Count of Water Heaters that do not have a **Current Temperature** recorded
    - If there are no results for any of the counts, display 0.
- Sort results by State abbreviation, ascending, and display. Each State should be a link.
- If a user clicks on a State link:
    - Query **Water Heater**, **Location**, **Household**, **Appliance**, filter by the State clicked on and grouped by *Energy Source*, return:
        - Min, Avg, Max of *Capacity*, rounded to whole number
        - Min, Avg, Max of *Current Temperature*, rounded to 0.1.
        - Order by *Energy Source* ascending and display results.

Off-the-grid Household Dashboard



Task Decomp:

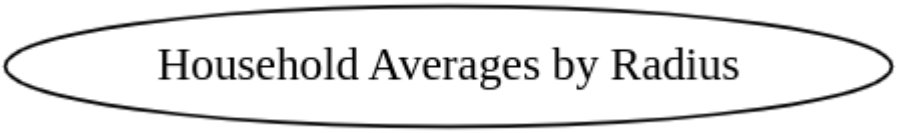
- Lock Types: Read on Location, Off-Grid Household, On-Grid Household, Power-Generator, Water Heater, Appliance
- Number of Locks: 6
- Enabling Conditions: Clicking link from **View Reports**
- Frequency: 50 per day
- Consistency (ACID): Not critical
- Subtasks:

    - Off-grid counts
    - Battery Storage
    - Water Heater Capacity
    - Appliance BTU

Abstract Code:

- Query **Location** and **Off-Grid Household** grouped by State, return the State with the most Off-Grid Households and the count of Households for that state.
- Query **Off-Grid Household**, **Power-Generator**, filter for Off-Grid Households, return:
    - The avg *Capacity* (round to whole number).
    - The percentage of each *Type* (round to 0.1).
- Query **Off-Grid Household**, **Water Heater**, filter for Off-Grid Households, return avg *Capacity* (round to 0.1). Do the same again but replace Off-Grid with **On-Grid Household**. Combine the results into 1 table.
- Query **Off-Grid Household**, **Appliance**, filter for Off-Grid Households, Group By Appliance *Type*, return the min, avg, max *BTU* (round to whole number).

Household averages by radius



Task Decomp:

- Lock Types: Read on Location, Household, Off-Grid Household, On-Grid Household, Power-Generator
- Number of Locks: 5
- Enabling Conditions: Clicking link from **View Reports**
- Frequency: 50 per day
- Consistency (ACID): Not critical
- Subtasks: None

Abstract Code:

- If user hits "Search" button:
    - Validate Postal Code exists in **Location**. If it doesn't, display a warning and stop.
- Query **Location** to return all postal codes within the user-selected distance of the user-input Postal Code.
    - For each row in Location:
        - Convert each Longitude and Latitude to Radians
        - Get Delta Lat and Delta Lon by subtracting the row's Lat/Lon from the Lat/Lon for the Postal Code the user entered.
        - Calculate "a" as:
            - $sin^2(\Delta lat/2) + cos(lat2) * sin^2(\Delta lon/2$
        - Calculate "c" as:
            - $2 * atan2(\sqrt{a}, \sqrt{1-a})$
        - Finally, the distance is $R * c$, where R is the radius of Earth.

- Return the Zip Codes where distance is less than or equal to the user selected max distance.
- Query **Household**, filter for *Postal Code* from the previous query. Return:
  - Count of households
  - Count of households grouped by Type
  - Avg square footage (round to whole number)
  - Avg *Thermostat Setting Heating* (round to 0.1)
  - Avg *Thermostat Setting Cooling* (round to 0.1)
- Query **On-Grid Household**, filter for *Postal Code* in distance query. Return:
  - Which public utilities are used (single cell, separated by commas). Append to results.
- Query **Off-Grid Household**, filter for *Postal Code* in distance query. Return:
  - Count of off-the-grid households. Append to results.
- Query **Power Generator**, **Household**, filter for *Postal Code* in distance query. Return:
  - Count of households with power generation
  - Most common power generation method
  - Avg monthly power generation (rounded whole number)
  - Count of households with battery storage