

Alternakraft Phase 1 Report

CS 6400 Database Systems and Concepts

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Team #08:

Yadhav Dahal, Thomas Gracie, Sheldon Greiling, William Todd Kirk, Garrison Winter

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Data Types

Households

| Attribute | Data type | Nullable |
|----------------------------|---------------|----------|
| Email | String | Not Null |
| Square Footage | Integer | Not Null |
| Household Type | String | Not Null |
| Public Utilities | List <String> | Not Null |
| Thermostat Setting Heating | Integer | Null |
| Thermostat Setting Cooling | Integer | Null |
| Postal Code | String | Not Null |

Postal Codes

| Attribute | Data type | Nullable |
|-------------|-----------|----------|
| Postal Code | String | Not Null |
| City | String | Not Null |
| State | String | Not Null |
| Latitude | Float | Not Null |
| Longitude | Float | Not Null |

Appliances

| Attribute | Data type | Nullable |
|--|---------------|----------|
| Sequential Order | Integer | Not Null |
| Manufacturer | String | Not Null |
| Model Name | String | Null |
| BTU Rating | Integer | Not Null |
| Appliance Type | String | Not Null |
| Fan Rotations per Minute (RPM) | Integer | Null |
| Method | List <String> | Null |
| Energy Efficiency Ratio (EER) | Float | Null |
| Energy Source (Heating/Cooling) | String | Null |
| Seasonal Energy Efficiency Rating (SEER) | Float | Null |
| Heating Seasonal Performance Factor (HSPF) | Float | Null |
| Tank Size | Integer | Null |
| Current Temperature Setting | Integer | Null |
| Energy Source (Water Heater) | String | Null |

Manufacturers

| Attribute | Data type | Nullable |
|--------------|-----------|--------------|
| Manufacturer | String | Not Nullable |

Power Generation

| Attribute | Data type | Nullable |
|--|-----------|----------|
| Sequential Order | Integer | Null |
| Generator Type | String | Null |
| Average Monthly Kilowatt Hours | Integer | Null |
| Battery Storage Capacity in Kilowatt Hours | Integer | Null |

Business Logic Constraints

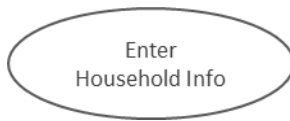
1. Household
 - a. The five-digit postal code must match a postal code already listed in the database.
 - b. The household email address must not already exist in the database.
 - c. The thermostat setting for heating must be specified if “No heat” is selected; otherwise, “No heat” may not be selected if a thermostat setting for heating is specified.
 - d. The thermostat setting for cooling must be specified if “No heat” is selected; otherwise, “No cooling” may not be selected if a thermostat setting for heating is specified.
2. Appliance
 - a. The manufacturer must match a manufacturer in the database.
 - b. There are additional business logic constraints which apply to some appliance types:
 - i. Air handler
 1. Air conditioner
 - a. The Energy efficiency ratio (EER) must be a decimal number (only up to the tenth decimal point).
 2. Heat pump
 - a. The Season energy efficiency rating (SEER) must be a decimal number (up to the tenth decimal point).
 - b. The Heating seasonal performance factor (HSPF) must be a decimal number (up to the tenth decimal point).
 - ii. Water heater
 1. The tank size must be a decimal value must be a decimal number (up to the tenth decimal point).
3. Power Generation
 - a. The household power generation must be collected if the household is “off-the-grid”. (A household that does not use any utilities is considered “off-the-grid”).
 - i. Otherwise, the user may skip this screen.
 - b. When viewing the summary, if the household is “off-the-grid” and all generators have been deleted, the user must add a power generator.

Task Decomposition and Abstract Code

Task #1 Enter Household Info:

Task Decomposition

- Task: 1 write of household for an email
- Lock types: Edit
- Enabling conditions: Called when the “Enter my household info” button is pressed
- Frequency: N/A
- Consistency: Not critical
- Subtasks: None



Abstract Code

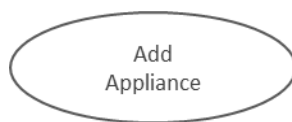
(Called from main menu, when enter household link is clicked)

1. Display household info from
2. When **Next button** is clicked, validate user inputs
 - email = must pass html5 email validation check
 - postal_code = must be of type text and maximum length 5
 - home_type = must be either house, apartment, townhome, condominium, modular home, or tiny home
 - square_footage = must be whole number
 - thermostat_setting_heating = must be whole number unless 'no heat' checkbox is checked
 - thermostat_setting_cooling = must be whole number unless 'no cooling' checkbox is checked
 - public_utilities = must be zero or more of these: Electric, Gas, Steam, Liquid Fuel
3. If validation fail:
 - Display appropriate error message
4. If validation check passed, attempt Database insertion
 - Display error if email already exists in Database
 - Display error if postal code is not in Database
 - Display error if any error occurs
 - Display 'add appliances form' upon successful insertion of household info

Task #2 Add Appliances:

Task Decomposition

- Task: 1 write of appliance for a household
- Lock types: Edit
- Enabling conditions: Called when click the next button on the Enter Household Info page or called when the “add another appliance” button is hit on the Appliances page
- Frequency: N/A
- Consistency: Not critical
- Subtasks: None



Abstract Code

(Called upon successful insertion of household details into the database or when ‘add another appliance’ is clicked from list appliance component)

1. Display ‘Add appliance form’ with single select component to select appliance type
2. When the value for appliance type selected, display following form fields:
 - Manufacturer
 - Model name
 - BTU Rating
3. If application type is ‘water heater’, display form fields to collect below information
 - Tank size
 - Temperature Setting
 - Energy source
4. If application type is ‘air handler’, display form fields to collect below information
 - Fan rotation per minute (RPM)
 - Heating and cooling method
5. For heating and cooling method:
 - If ‘air conditioner’ selected, display input field for Energy Efficiency ratio (EER)
 - If ‘heater’ selected, display input field for Energy Source
 - If ‘heat pump’ selected, display input field for SEER and HSPF
6. When **add button** is clicked, validate user inputs
 - manufacturer must be a string
 - model_name is optional, when entered it must be string
 - btu_rating must be a whole number

if appliance type selected is ‘water heater’:

- tank_size must be decimal value
- temperature can be null or whole number

- energy_source must be either electric, gas, fuel oil or heat pump

if appliance type selected is 'air handler' and

heating /cooling method is 'air conditioner':

- eer must be decimal number

heating /cooling method is 'heater':

- energy_source must be either electric, gas or thermosolar

heating /cooling method is 'heat pump'

- SEER and HSPF must be decimal values

7. If validation fail:

- Display appropriate error message

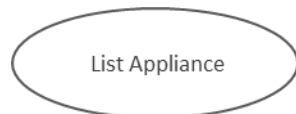
8. If validation check passed, attempt Database insertion

- Display error if any error occurs
- If database insertion successful, take user to 'list appliances component' (task #3)

Task #3 List Appliances:

Task Decomposition

- Task: 2 lookups of household and appliance for a household
- Lock types: Both read-only
- Enabling conditions: Called when the add appliance task is completed
- Frequency: Both have the same frequency
- Consistency: Not critical
- Subtasks: None



Abstract Code

(Called when a new appliance is successfully added)

1. Display all appliance that were recently added in tabular format,
2. provide option to delete appliance, add another appliance and go to next step
3. When **delete button** is clicked, take user to task #4
4. When 'add another appliance' link is clicked, take user to task #2
5. When **next button** is clicked display form to add power generation

Task #4 Delete Appliances:

Task Decomposition

Task: 1 write of appliance for a household

- Lock types: Edit
- Enabling conditions: Called when the delete button is pressed on the Appliances page
- Frequency: N/A
- Consistency: Not critical
- Subtasks: None



Abstract Code

(Called when delete button is clicked from 'List Appliance' component)

1. When **delete button** is clicked, attempt to delete appliance from the database
 - If deletion successful – Display success message and refresh appliance table
 - If deletion is unsuccessful – Display failure message

Task #5 Add Power Gen:

Task Decomposition

- Task: 1 write of Power Generator for a household
- Lock types: Edit
- Enabling conditions: Called when click the next button on the Appliances page or called when the "Add more power" button is hit on the Power Generator page
- Frequency: N/A
- Consistency: Not critical
- Subtasks: None



Abstract Code

(Called by clicking next button from list appliance component)

1. Display power generation form.

2. Provide option to add power generation information
3. Provide option to skip this task if household is on-the-grid
4. When **skip button** is clicked
 - Display submission complete message and a link to main menu
5. When **add button** is clicked, validate user inputs
 - type must be solar or wind-turbine
 - monthly_kwh must be whole number
 - storage_kwh must be optional, must be a whole number if provided
6. If validation fails, display appropriate error message.
7. If validation successful, attempt to add power generation information to the database
 - If insertion successful – take user to ‘Power Generation List’ component (task#6)
 - If insertion fails – Display appropriate message

Task #6 List Power Gen:

Task Decomposition

- Task: 2 lookups of household and Power Generator for a household
- Lock types: Both read-only
- Enabling conditions: Called when the add Power Gen task is completed
- Frequency: Both have the same frequency
- Consistency: Not critical
- Subtasks: None



Abstract Code

(Called upon successful insertion of new power generation method)

1. Display all recently added power generation in tabular format
2. provide option to delete, add more power and go to next step
3. When **delete button** is clicked, take user to Task #7
4. When ‘add more power’ link is clicked, take user to Task #5
5. When **next button** is clicked display submission complete message and a link to main menu

Task #7 Delate Power Gen:

Task Decomposition

- Task: 1 write of Power Generator for a household
- Lock types: Edit
- Enabling conditions: Called when the delete button is pressed on the Power Gen Page

- Frequency: N/A
- Consistency: Not critical
- Subtasks: None



Abstract Code

(Called when delete button is clicked from 'List power generation' component)

1. When **delete button** is clicked, attempt to delete power generation information from the database
 - If deletion successful – Display success message and refresh power generation table
 - If deletion is unsuccessful – Display appropriate failure message

Task #8 View Top25 Pop Manufg:

Task Decomposition

- Task: 1 lookup of all appliances
- Lock types: read-only
- Enabling conditions: Called when the "View Top25 Pop Manufg" button is pressed on the View Reports Page
- Frequency: N/A
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None



Abstract Code

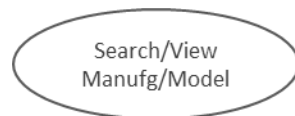
(Called when '25 top manufacturers' link is clicked from all reports page)

1. Calculate top 25 manufacturers based on number of appliances
2. Display result in tabular format, make the name of manufacturer clickable.
3. When the manufacturer name is clicked:
 - Calculate total number of appliances, categorized by appliance type for the given manufacturer
 - Display the result in tabular format
4. Provide options to go to main menu and all reports page

Task #9 Search/View Manufg/Model:

Task Decomposition

- Task: 2 lookups of all appliances and all manufactures
- Lock types: read-only
- Enabling conditions: Called when the user presses the submit button after entering a search string after pressing the “Search/View Manufg/Model” on the View Reports Page
- Frequency: Both have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None



Abstract Code

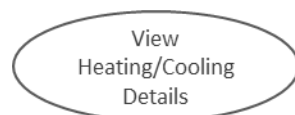
(Called when ‘Manufacturer / Modal search’ link is clicked from all reports page)

1. Provide input field for entering search string
2. When search string is entered:
 - Perform database search to find any manufacturer or model that match the provided string
 - Present result in tabular format. Highlight matched model/manufacturer
 - If no matching result found, inform the user

Task #10 View Heating/Cooling Details:

Task Decomposition

- Task: 2 lookups of all households and all appliances in each household
- Lock types: read-only
- Enabling conditions: Called when the user presses “View Heating/Cooling Details” on the View Reports Page
- Frequency: Both have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None



Abstract Code

(Called when 'view heating/cooling method detail' link is clicked from all reports page)

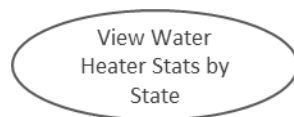
Display data in 3 different tables:

1. Air conditioners
 - Calculate the total number of air conditioners for each kind of household
 - Calculate air conditioners' average BTU, RPM, EER for each kind of household
 - Display above result in tabular format, order data by household type
2. Heaters
 - Calculate the total number of heaters for each kind of household
 - Compute Heaters' average BTU and RPM values for each kind of household
 - Determine the most widely used energy source for operating heaters for each type of household
 - Display above result in tabular format, order data by household type
3. Heat pumps
 - Calculate total number of heat pump for each kind of household
 - Calculate heat pump's average BTU, RPM, SEER and HSPF for each kind of household
 - Display above result in tabular format, order data by household type
4. Provide options to go to main menu and all reports page

Task #11 View Water Heater Stats by State:

Task Decomposition

- Task: 3 lookups of all households with all water heaters and postal codes in each household
- Lock types: read-only
- Enabling conditions: Called when the user presses "View Water Heater Stats by State" on the View Reports Page
- Frequency: All three have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None



Abstract Code

(Called when 'Water Heater Statistics' link is clicked from all reports page)

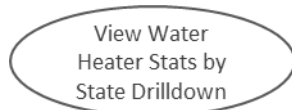
1. Water Heater statistics for each state
 - Calculate the average water heater tank
 - Calculate the average water heater BTU

- Calculate the average water heater temperature setting
 - Calculate the count of water heaters for which the temperature settings have been provided
 - Calculate the count of water heaters for which the temperature settings have not been provided
- Display above information in tabular format, make the state abbreviation clickable
2. Provide options to go to main menu and all reports page

Task #12 View Water Heater Stats by State Drilldown:

Task Decomposition

- Task: 3 lookups of all households with a Postal Code in state and all water heaters in each household
- Lock types: read-only
- Enabling conditions: Called when the user presses a state link on a row in the View Water Heater Stats by State Page
- Frequency: All three have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None



Abstract Code

(Called when state abbreviation is clicked from water heater statistics table(Task #11))

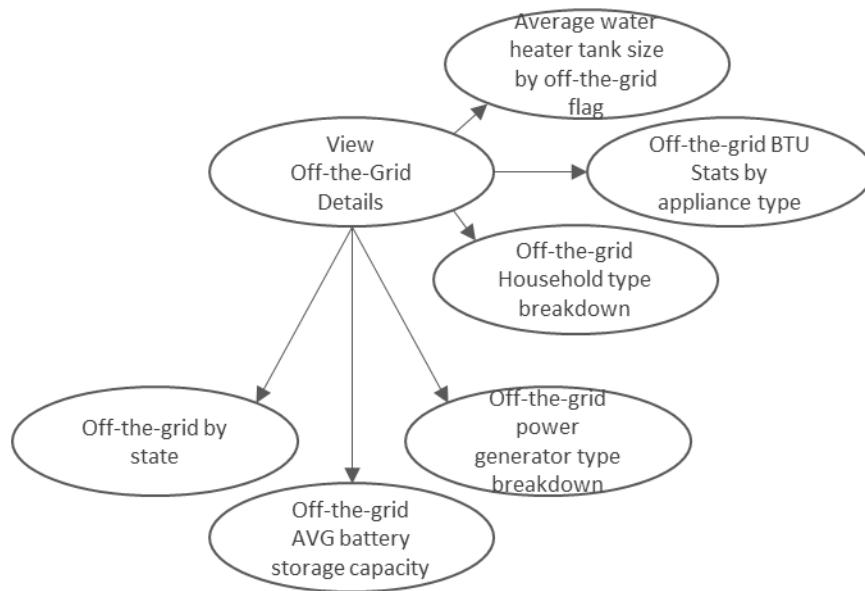
1. When the state abbreviation is clicked
 - Calculate the minimum water heater tank size for the selected state
 - Calculate the maximum water heater tank size for the selected state
 - Calculate the average water heater tank size for the selected state
 - Calculate the minimum temperature settings for the selected state
 - Calculate the average temperature settings for the selected state
 - Calculate the maximum temperature settings for the selected state
 - Display the above information in tabular format
2. Provide options to go to main menu and all reports page

Task #13 View Off-the-Grid Details:

Task Decomposition

- Task: Run all subtasks

- Lock types: read-only
- Enabling conditions: Called when the user presses “View Off-the-Grid Details” on the View Reports Page
- Frequency: All have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: Off-the-grid by state, Off-the-grid AVG battery storage capacity, Off-the-grid Power Generator type breakdown, Off-the-grid Household type breakdown, Average water heater tank size by off-the-grid flag, Off-the-grid BTU Stats by appliance type



Subtask #13.1 Top Off-the-grid by state:

Task Decomposition

- Task: 2 lookups of all off-the-grid households for every state
- Lock types: read-only
- Enabling conditions: Called by the View Off-the-Grid Details Mother task
- Frequency: All have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None

Subtask #13.2 Off-the-grid AVG battery storage capacity:

Task Decomposition

- Task: 2 lookups of batter storage of Power Generator for all off-the-grid households
- Lock types: read-only
- Enabling conditions: Called by the View Off-the-Grid Details Mother task
- Frequency: All have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None

Subtask #13.3 Off-the-grid Power Generator type breakdown:

Task Decomposition

- Task: 2 lookups of Power Generator type of Power Generator for all off-the-grid households
- Lock types: read-only
- Enabling conditions: Called by the View Off-the-Grid Details Mother task
- Frequency: All have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None

Subtask #13.4 Off-the-grid Household type breakdown:

Task Decomposition

- Task: 1 lookup household type for all off-the-grid households
- Lock types: read-only
- Enabling conditions: Called by the View Off-the-Grid Details Mother task
- Frequency: N/A
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None

Subtask #13.5 Average water heater tank size by off-the-grid flag:

Task Decomposition

- Task: 2 lookup all water heaters for each households
- Lock types: read-only
- Enabling conditions: Called by the View Off-the-Grid Details Mother task
- Frequency: Both have the same frequency

- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None

Subtask #13.6 Off-the-Grid BTU Stats by Appliance Type:

Task Decomposition

- Task: 2 lookup all appliances for each households
- Lock types: read-only
- Enabling conditions: Called by the View Off-the-Grid Details Mother task
- Frequency: Both have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None

Abstract Code

(Called when 'off-the-grid Household Dashboard' link is clicked from all reports page)

Display 5 different table, with data below –

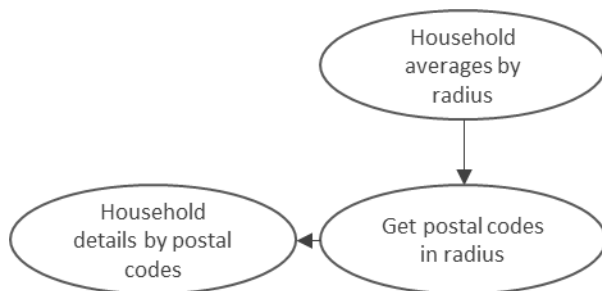
1. Table – 1
 - Determine the state with the most off-the-grid households and the count
 - Calculate the average battery storage capacity per battery, round it to a whole number
 - Display above data in single table
2. Table - 2
 - Calculate the proportion of power generation from each source for all off-the-grid households as a percentage.
 - Display the data in tabular format
3. Table – 3
 - Calculate total number of off-the-grid households grouped by household type
 - If a particular type of house does not have any off-the-grid household display 0
 - Display this data in tabular format
4. Table – 4
 - Calculate the average tank capacity of water heaters used in off-the-grid households
 - Calculate the average tank capacity of water heaters used in on-the-grid households
 - Display above data in tabular format
5. Table – 5
 - Calculate min, max and average BTU values for all off-the-grid households' appliances grouped by appliance type
 - If no data for specific appliance type, display zero
 - Display above data in tabular format

6. Provide option to go to main menu and all reports page

Task #14 Household Averages by Radius:

Task Decomposition

- Task: Run all subtasks
- Lock types: read-only
- Enabling conditions: Called when the user presses “Household averages by radius” on the View Reports Page
- Frequency: All have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: Get postal codes in radius, Household details by postal codes



Subtask #14.1 Get postal codes in radius:

Task Decomposition

- Task: 2 lookups of all households withing postal codes inside inputted radius
- Lock types: read-only
- Enabling conditions: Called by the Household averages by radius Mother task
- Frequency: Both have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: Household details by postal codes

Subtask #14.2 Household details by postal codes:

Task Decomposition

- Task: 5 lookups of household types for all returned households from the Get postal codes in radius task, Temperature Setting for all appliances for each household, all power generators for each household
- Lock types: read-only
- Enabling conditions: Called by the Get postal codes in radius mother task
- Frequency: Both have the same frequency
- Consistency: not critical even if appliances are being currently added or deleted
- Subtasks: None

Abstract Code

(Called when 'household Average by Radius' link is clicked from all reports page)

1. Provide users with 2 input fields one for postal code and one for radius and search button
2. When **search button** is clicked, validate the postal code and search radius
3. If user input is invalid, display appropriate message
4. Use the haversine formula to calculate the straight-line distance between the postal code's coordinates and the coordinates of other postal codes within the search radius.
5. Retrieve the household data for all postal codes within the calculated distance.
6. Calculate the following statistics for the retrieved household data:
 - Count the total number of households.
 - Count the number of households for each household type, displaying 0 if there are none for a particular type.
 - Calculate the average square footage of households as a whole number, rounded.
 - Calculate the average heating temperature as a decimal number rounded to tenths.
 - Calculate the average cooling temperature as a decimal number rounded to tenths.
 - Determine which public utilities are used, displayed in a single cell and separated by commas.
 - Count the number of "off-the-grid" homes.
 - Count the number of homes with power generation.
 - Determine the most common generation method for households with power generation.
 - Calculate the average monthly power generation per household as a whole number, rounded.
 - Count the number of households with battery storage.
 - Display above data in tabular format
7. Provide option to go back to main menu and all reports page