COSC3106 Python Programming Studio
Semester 1 Flex - 2025
‘Investigating Australian Climate Change’
Studio Project Requirements Document

1. Overview

This document outlines the tasks for the "Anthropomorphic Climate Change" social challenge. You can think of this document as the **product idea** from the UCD perspective, and the **case study** from the database perspective.

1.1. Challenge: Investigating Australian Climate Change

According to the World Meteorological Organization, climate change is a term used to describe changes in climate that can be identified by changes in the average or variability of climate properties over an extended period of time. The reasons for climate change are complex. Some climate change may be due to internal or external processes such as changes in the solar cycle or volcanic eruptions.

For example, the year 1816 was famously described as "the year without a summer" due to the eruption of Mt Tambora in Indonesia which causes significant crop failures in the northern hemisphere. Anthropomorphic climate change is also known as Human-Induced climate change. Anthropomorphic Climate Change occurs when human actions have an effect on climate trends. Examples of human actions include:

- Burning fossil fuels
- Deforestation
- Land Use Change
- Livestock Management
- Fertilisation of Soil
- Waste Management
- Industrial Processes

Human induced climate change has resulted in accelerated changes in several climate metrics including increased temperatures, melting of Antarctic ice shelfs, glacial retreat, and an increase in extreme weather events. Signifiers of climate change include increased minimum and maximum temperatures over time, increased rainfall as more water enters the atmosphere, increased humidity, as well as new extremes in various climate measurements.

Using the Bureau of Meteorology data, your challenge is to develop a web-application to help various key parties including the general-public, corporations and policy makers to explore unbiased information on climate change over an extended period (1970 – 2020). You will need to:

- Present this information in an informative, respectful, and unbiased manner.
- Cater for a diverse range of users who are seeking to become more informed on this topic.
- Provide diverse types of information on functionality, including both high-level summaries, and enabling an in-depth analysis of the data.

By using your website, users should be able to become well-informed about anthropomorphic climate change in the Australian context.

1.2. Notes on the provided data sets

You have been provided with data sets that relate to climate data measured from the Australian Bureau of Meteorology's weather stations located all over Australia and its Antarctic and external territories. Most weather stations have rainfall, and temperature data from January 1st 1970 to 31st December 2020. The column headings have been simplified to help you load the information into your database. You have also been provided with information about the climate station locations, including their Latitude and Longitude, LGA (Local Geographic Area) – where available, and the state /territory / region where the weather station is located. If in doubt you can put the digital

Latitude and Longitude into Google Maps to see the exact location of the weather station. The database provided has a datetime table which can aggregate the data by day, week, month, quarter, half year, year, half decade and decade.

1.3. Notes on examples provided in this specification

Sample data in this report is for illustration purposes only and does not reflect the actual data or figures in your dataset. You should use these examples as guides whilst you develop a set of features for your identified target groups. There must be a clear distinction between the tasks you implement in sub-tasks A & B.

2. Project Level Details (Web-App's Pages)

This section details the functional requirements of the web-app, organised into 6 pages. Each student will create three pages. Each page corresponds to a sub-task within a level. Each level corresponds an increasing level of complexity. E.g. Student A will complete Sub-Task A tasks of levels 1, 2 and 3. Student B will complete Sub-Task B tasks of levels 1, 2 and 3.

NOTE: For the level 1 tasks you may create the required tables in the database to hold the information you require and use a simple SQL query to obtain this information when the page is requested. IMPORTANT: this approach is not suitable for levels 2 & 3 where all data must be dynamically and efficiently retrieved using SQL statements that you have efficiently crafted.

2.1 Level 1 - “Big Picture” Content

Level 1 sub-tasks capture the attention of the users and show how to use your website. It is up to you to decide the best way to show the users the required information, that is, complete the UCD.

Sub Task A: Landing Page

- Capture the attention of all users of your website.
- Highlight the topics targeted by your website.
- Present a snapshot of the data covered by your website.
  You should present 4 facts that are of interest to your selected user groups.

  For example:
  - The year range (first and last year) for available data
  - Identify the weather station that has the lowest recorded temperature in the dataset.
  - Identify the weather station that has the highest recorded rainfall measurement in the dataset.
  - Identify the region with the most weather stations.
  - Other facts that are of particular interest to your selected user groups.

- List all attributes and descriptions using a “natural language” label.
  These must be stored in and retrieved from your database based on the provided description.csv file in BOM_DATA.ZIP.

Sub-Task B: Mission Statement

This presents the overall purpose of your website. This should:

- Present your perspective on how your website addresses the social-challenge.
- Describe how your site can be used.
- Present the Personas that your website targets. **These must be stored in and retrieved from your database.**
- List the names and student numbers of all team members. **These must be stored in and retrieved from your database.**

2.2 Level 2 - "Shallow Glance" of the data

Level 2 sub-tasks explore the issue of climate change for various geographic locations, climate metrics and time periods. You should carefully consider your UX/UI designs and the ER model. The sub-tasks include UX/UI design and ERM design challenges.

In this level you must demonstrate the ability to select, filter, sort, join and aggregate data using efficiently written SQL.

Any data anomalies such as missing data, duplicate data etc must be identified and handled appropriately.
For example, you might average values for duplicate rows that have inconsistent data.

Sub-Task A: Focused view of climate change by Weather Station

Present information about the climate for user selected States.

- Allow the user to select any **ONE** from all the available States.
- Allow the user to select a **start latitude and an end latitude**
- Allow the user to select a specific climate metric.
- Provide a facility to sort the data on any of the resultant columns.

For example, you might display two tables for your user:

- **Table 1:**
  For the selected State display the weather station details for all the stations in the selected state between the specified latitudes.

  For example, W.A between latitude -17.00 and –20.00.

Western Australia

Site	Name	Region	Latitude
3003	Broome Airport	Broome	-17.95
3032	Derby Aero	Derby West Kimberley	-17.37
4019	Mandora	Broome	-19.74

- **Table 2:**
  Allow the user to summarise the data and combine information from more than one table.
  For example, the number of weather stations in a region and the average maximum temperature of the region.

  Western Australia

Region	Number Weather Stations	Average Max Temperature
Broome	2	27.2
Derby West Kimberley	1	23.1

Sub-Task B: Focused view of Climate Change by Climate Metric

Present information about climate changes for specific climate metric measurement across all states and regions.

- Allow the user to select any **ONE** from all available climate metrics.
- Allow the user to select a range of station id's
- Allow the user to select a **start date and end date**
- For the selected metric display the daily value for the selected metric for all the stations with the ability to filter and sort on any of the resultant columns.

  For example, station IDs range 3000 - 4000 between the dates 01/01/1970 - 03/01/1970 looking at precipitation totals, sorted by station ID.

Station Id	Date	Precipitation (mm)
3003	01/01/1970	15
3003	02/01/1970	14
3003	03/01/1970	10
4019	01/01/1970	15
4019	02/01/1970	12
4019	03/01/1970	11

- **Allow the user to summarise the data by combining information from more than one table.**
  For example: the total value for precipitation for a State
  May 2005

State	Precipitation Total (mm)
W.A.	38
VIC	77

2.3 Level 3 - “Deep-dive” of the data

Level 3 sub-tasks explore a deeper view of the issue of climate change for various states territories & regions, climate metrics.

In this level you must demonstrate the ability to use the results of one query to find another sub-dataset.

You should carefully consider your UX/UI designs and the ER model. These sub-tasks include complex UX/UI design and ERM design challenges. For top-marks you will need to take a very well-considered approach.

Write an efficient SQL query that:

- Retrieves only the required data.
- Uses JOINs and column selection to work in a single query if possible.
- Performs sorting based on similarity using SQL.
- Avoids post-processing of data using Python where it can be handled through careful crafting of the SQL query.
- Sorts results by a user selected criterion.
- Note that this is a challenge in making suitable SQL queries.

Sub-Task A: Identify weather station locations with similar change in metric percentages

In this task, enable your users to analyse weather stations that have changed over time to identify which ones show **similar rates of change**.

Note the primary focus for this sub task is identifying similar weather stations via the use of metrics.

Your user should be able to:

- Select multiple time periods
  (e.g. specific date ranges or aggregated time periods such as quarters, half decades etc).
- Choose a reference weather station (e.g. Melbourne Airport).
- Choose the number of weather stations to find.

  For Example:
  The user wants to find the two most similar weather stations to Melbourne Airport based on average temperature, and a time range from 2005 to 2015, grouped into two half-decade periods (2005–2009 and 2010–2015).

  The system calculates how much each climate metric changed across the two time periods and compares them to other weather stations that have a similar rate of change on a second climate metric.

Weather Station	Average Temp (2005–2009)	Average Temp (2010–2015)	% Change	Difference from Melbourne Airport
Melbourne Airport	22.5 °C	22.7 °C	+0.88%	0.0% (selected)
Ballarat	17.2 °C	17.6 °C	+0.23%	-0.65%
Bendigo	16.9 °C	17.0 °C	+0.59%	-0.29%

Sub-Task B: Exploring Climate Metrics Similarities

In this task, enable your users to explore how different **climate metrics** (e.g. Precipitation, Max Temperature, Sunshine) have changed over time to identify which ones show **similar rates of change**.

Note the primary focus for this sub task is identifying and correlating similar climate metrics.

Your user should be able to:

- Select multiple time periods
  (e.g. specific date ranges or aggregated time periods such as quarters, half decades etc).
- Choose a reference climate metric (e.g. Precipitation).
- Choose the number of climate metrics to find.

For Example:

The user selects precipitation between 2005 to 2015, grouped into two half-decade periods (2005–2009 and 2010–2015).

They ask the system to find the **most similar climate metrics** based on **percentage rate of change**.

The system calculates how much each climate metric changed across the two time periods and compares them to Precipitation's rate of change.

Metric Name	**Total (2005–2009)**	**Total (2010–2015)**	**% Change**	**Difference from Precipitation (%)**
Precipitation	4250 mm	4370 mm	+2.80%	0.0% (selected)
Evaporation	7100 mm	7125 mm	+0.35%	-2.45%
Average Temp	22.5 °C	22.9 °C	+1.77%	-1.03%
Sunshine	19,300 hrs	19,415 hrs	+0.59%	-2.21%
Cloud Cover	3250 oktas	3200 oktas	-1.50%	-1.30%