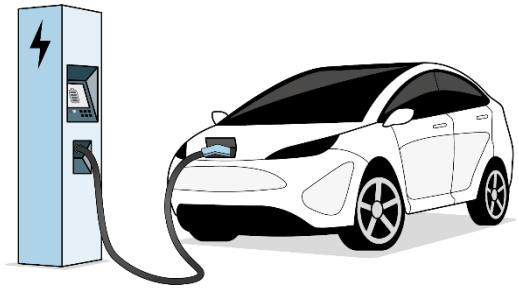
Task 1: software design and development

EVcharge is a company that runs an electric vehicle charging network. It requires a program to provide users with a summary of their journey, and to calculate the cost for using the charging network.

Program analysis
At the end of the journey, details are submitted to EVcharge to calculate the final cost.

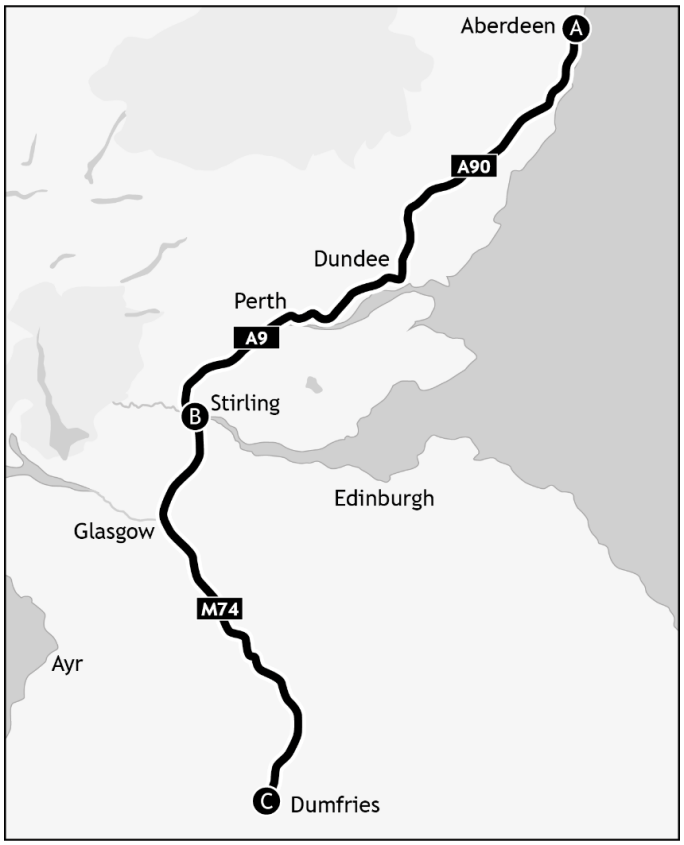
Inputs

- The vehicle mileage at the start of the journey.
- The number of charging stations visited.
- A valid kilowatt (kW) rating for each charging station (7kW, 22kW or 50kW).
- The vehicle mileage at each charging station.



For example, if making the journey from Aberdeen to Dumfries via Stirling (shown in the diagram below), the user would enter:

- the vehicle mileage at the start of the journey (A)
- that two charging stations were visited (B and C)
- the kW rating of each of the two charging stations
- the vehicle mileage at each of the two charging stations (B and C)



Process

- Calculate the number of miles travelled in each stage of the journey.
- Calculate the cost of each stage of the journey using the number of miles travelled and the cost per mile, based on the kW rating of the charging station as shown below:
  - 7kW = £0 per mile
  - 22kW = £0.005 per mile
  - 50kW = £0.01 per mile
- Calculate the total number of miles travelled from the start to the end of the journey.
- Calculate the total cost for the journey.

Outputs

- The total number of miles travelled.
- The cost (£) of each stage of the journey.
- The total cost (£) rounded to two decimal places.

Assumption(s)

- The user will complete the journey using no more than 10 charging stations.

Task 1: software design and development (part A)

1a Input validation is used to check that a valid kW rating has been entered for a charging station.

Using the information provided in the program analysis, design how this process could be carried out. You can use a flowchart, structure diagram or pseudocode design.

(3 marks)

1 mark each for:

- Input inside loop
- Conditional loop used
- Correct loop conditions

Example Answer

1. Get kW value from user
2. Conditional loop while kW NOT (= 7 or = 22 or = 50) THEN
3. Ask for kW value to re-entered as invalid
4. End loop when kW value = 7 or = 22 or = 50

- Check your answers carefully, as you cannot return to part A after you hand it in.
- When you are ready, hand part A to your teacher or lecturer and collect part B.

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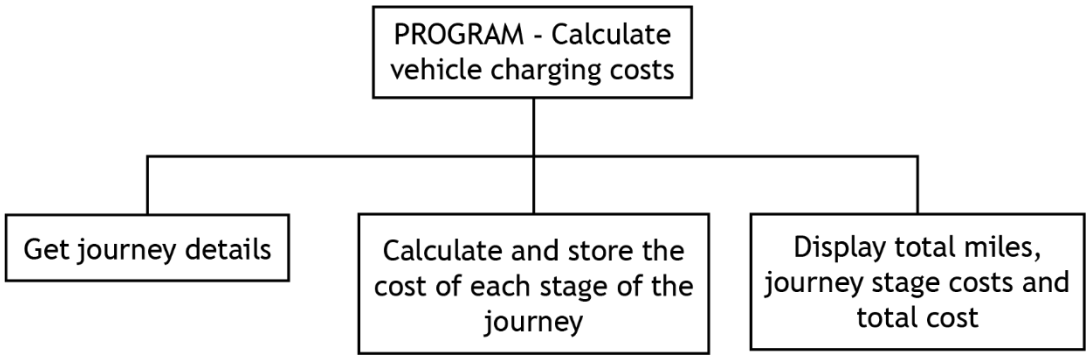
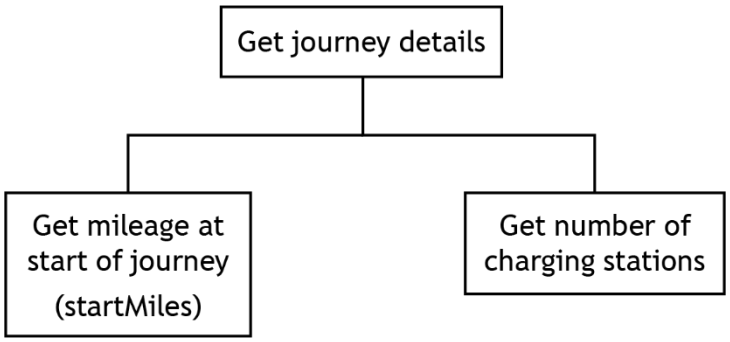
Task 1: software design and development (part B)

Program design (structure diagram)

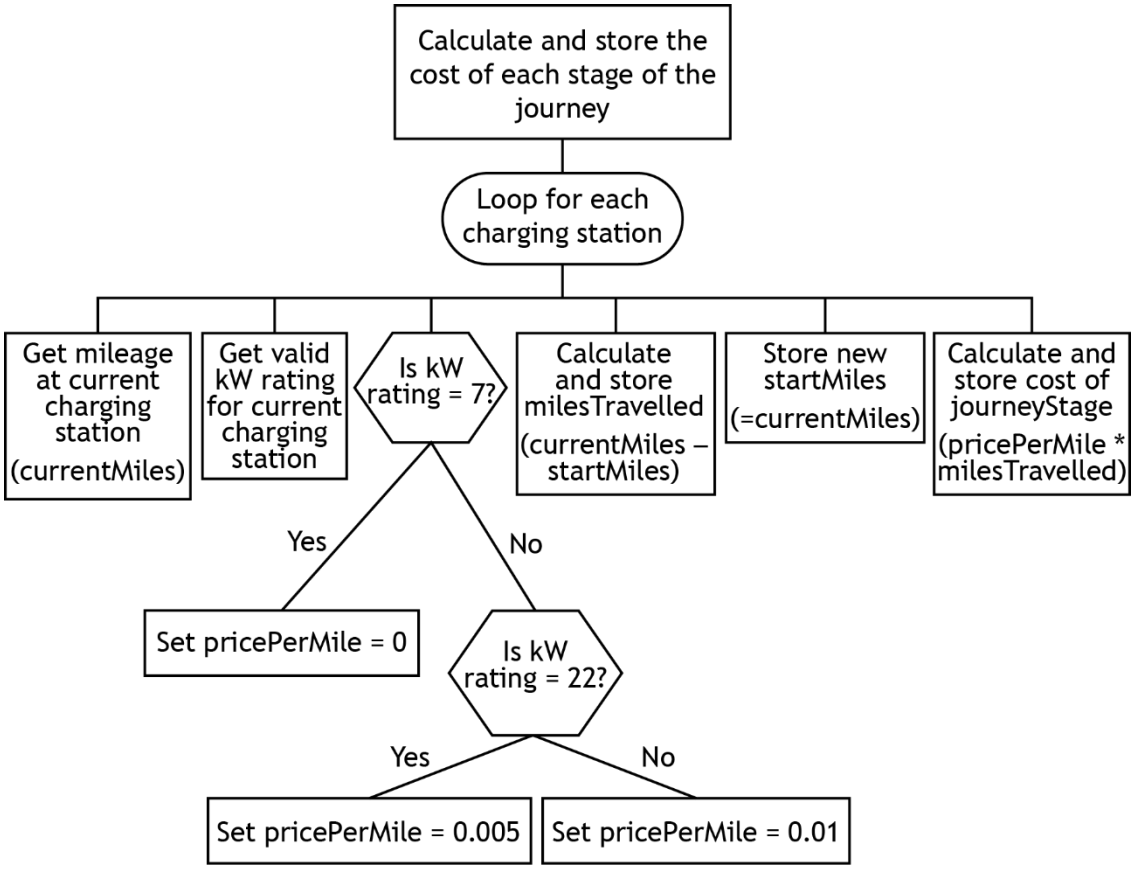
Main steps



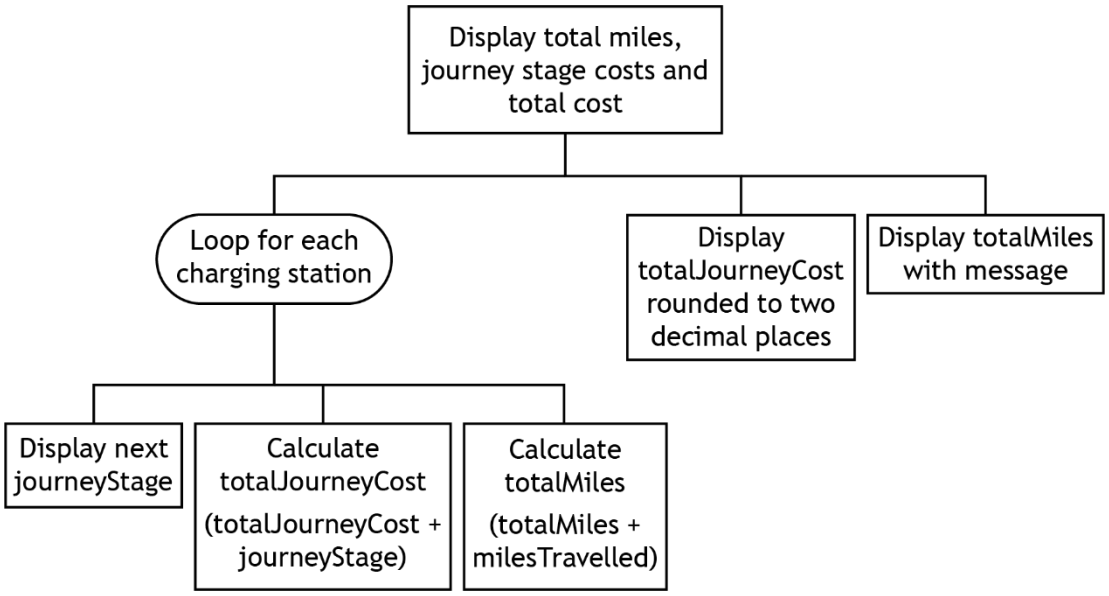
Refinement of 'Get journey details'



Refinement of 'Calculate and store the cost of each stage of the journey'



Refinement of 'Display total miles, journey stage costs and total cost'



1b Using the program analysis and the design, implement the program in a language of your choice.

Ensure the program matches the structure diagram given.

(15 marks)

Print evidence of your program code.

Trinket link to view completed code
https://trinket.io/python/7f1475401c

1c(i) Your program should be tested to ensure it produces the correct output.

Use the test data provided below to check that your program produces the correct output.

Type of test	User input	Expected output	Actual output
Normal	Miles at start **1200** **2** charge stations visited **Charge station 1** ♦ 1320 miles ♦ 22kW **Charge station 2** ♦ 1411 miles ♦ 50kW	Journey stage 1 cost = **0.60** Journey stage 2 cost = **0.91** Total cost = **1.51** Total miles = **211**	Attach printouts of inputs and outputs as evidence

Print evidence of the test showing inputs and outputs.

(1 mark)

```
Enter mileage at start of journey:  1200
How many charging stations are on your journey:  2
Enter miles at station 1:  1320
Enter KW Rating for each station 7, 22 or 50:  22
Enter miles at station 2:  1411
Enter KW Rating for each station 7, 22 or 50:  50
Journey Stage Cost 1: 0.6
Journey Stage Cost 2: 0.91
Total Journey Cost: 1.51
Total Miles Travelled: 211
```

(ii) In the test data below, the mileage entered at Charge station 2 is not correct.

Complete the test table below — this will show that the program is not fit for purpose.

(2 marks)

Test data	Expected results
Miles at start **18000** **2** charge stations visited **Charge station 1** ♦ 18350 miles ♦ 7kW **Charge station 2** ♦ 17800 miles ♦ 50kW	Journey stage 1 cost = 0 Journey stage 2 cost = -5.5 Total cost = -5.5 Total miles = -200

(iii) With reference to the test data above, describe how to make the program fit for purpose.

(1 mark)

Input validation would be needed to ensure that the next charging station (charging station 2) mileage cannot be less than the previous charging station value (charging station 1)
The user should be asked to re-enter if this was the case until they enter a value greater than the previous mileage recorded.

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1d With reference to your code, evaluate your program by commenting on the following:

Efficiency of your program code **(1 mark)** Efficiency examples could include comparison of: • array vs multiple variables • nested ifs vs individual ifs • use of a loop vs replication of code
Robustness of your completed program **(1 mark)** Robust examples might refer to: • input validation of kw rating. Program can handle normal, extreme, exceptional test data for kW • lack of validation for other inputs e.g. current mileage potentially being incorrect.

Readability of your code	**(1 mark)**
Evaluation of readability must contain an element of evaluation rather than simple statements of terms. For example “I have used white space to highlight structures in my program” not “I have used white space”. The candidate’s code must also show evidence of this for a mark to be awarded.	

Candidate name_____ Candidate number_____