NHH

HOME EXAMINATION
FOR14

Fall, 2023

Date: December 1, 2023

Time: 08:00 – 16:00

Number of hours: 8

THE HOME EXAMINATION SHOULD BE SUBMITTED IN WISEFLOW

You can find information on how to submit your paper here:
https://www.nhh.no/en/for-students/examinations/home-exams-and-assignments/

Your candidate number will be announced on StudentWeb. The candidate number should be noted on all pages (not your name or student number). In case of group examinations, the candidate numbers of all group members should be noted.

Collaboration between individuals or groups on submission preparation, as well as exchange of self-produced materials between individuals or groups is prohibited. The answer paper must consist of individual's or the group's own assessments and analysis. All communication during the home exam is considered cheating. All submitted assignments are processed in Ouriginal, a plagiarism control system used by NHH.

SUPPLEMENTARY REGULATIONS FOR HOME EXAMINATIONS

You can find supplementary regulations under the headline “Regulations”

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Find more information under chapter 4.0 in the Supplementary provisions to the regulations for fulltime study programmes

Number of pages, including front page: *4*

Number of attachments: *4*

Car sharing reservations scheduling problem

The car sharing company is happy with the results seen so far with the prototypes presented for the evaluation phase for the improvements of the reservation system. After some tests with the current version of the prototype they are interested in enhancing it with more detail and flexibility. They have the following requirements:

- They want to know the time that is unusable with any given reservation schedule. In other words, if the difference between the ending time of a reservation and the starting time for the next one is less than half an hour, that time spam is considered lost. They want a report for each car of the total unusable time in hours for any given schedule.
- They want to know the idle time for a car. In this case if the difference between the ending time of a reservation and the starting time for the next one is more than half an hour that is consider idle time. They want a report for each car of the total idle time in hours for any given schedule.
- They want to know the time wasted due to short reservations. In other words, if the difference between starting time and ending time for some reservations is less than half an hour that time is considered wasted for the car. They want a report for each car of the wasted time for any given schedule.
- They want to know the total productive time for a car. Specifically, if a reservation is longer than half an hour that is considered productive time for a car. They want a report for each car of the productive time for any given schedule.
- They also want a report of the overall unusable time, idle time, wasted time, and productive time for the whole car fleet for any given reservation.

The car sharing company wants to enhance the handling of the schedule. In the previous rounds, the data provided had already identified a subset of cars that were interchangeable. Now, they want to change the criteria for creating interchangeable subsets. A subset of cars is considered interchangeable among them when all of them have the same number of seats. In other words, any car in the subset would be suitable to fulfill a customer's requirements for a car with the same level of satisfaction.

The car sharing company sees great potential for maintainability and development of the last Object Oriented Programming (OOP) approach they saw. This time, thinking of future development, they want to be able to create object of four types:

- Schedule: For the schedule they want to have a reshuffling capability aiming to improve the indicators of unusable, idle, wasted, and productive time[1] . They want a report of those times and a comparison of how a reshuffling would affect the quality of the current schedule. Keep in mind that the current schedule should not be lost when the reshuffling option is used for evaluation.

[1] Here the reshuffling aims to achieve and improvement in utilization in the same way it was described in assignment 1.

In other words, the reshuffling option should not mutate the schedule object. However, it should return the resulting schedule possibility for evaluation purposes.

- Reservation: Reservations should keep track of the current reservation information. They want to keep track if the reshuffling operation results in a change of car_id. The purpose of this tracking is a future development plan to calculate the impact of that change for the client. They also want to be able to map each object to the row in the file trips.csv where they are defined. The file is described later in this document.
- Fleet: They want to use this to encapsulate the information about the cars fleet. They want to be able to create cars subsets. A particularly interesting feature is the category of the car which is used in the reshuffling process to identify cars that are interchangeable.
- Car: This type is for encapsulating the information of each car. They want to use it for keeping track of the performance of each car when it comes to unusable, idle, wasted, and productive times for each. They also want to be capable of listing the specific schedule of each car for comparison purposes. Additionally, they want to be able to map each car to the row in the file car.csv in which they are defined. Finally, they want to record the name of the model, the name of the category, and the number of seats.

The company has provided the following data:

- File car.csv: It provides details about the cars in the fleet. It has the fields car_id, model_id, location_id, car_number, and icon_url.
- File car_category.csv: It provides the definition of the different car categories. It has the fields category_id, and category_name.
- File model.csv: It provides the category classification and number of seats for the models of cars that are available in the fleet. It has the fields model_id, model_name, category_id, and seats.
- File trips.csv: It has the trip_id, driven_km, start_ts (starting of the reservation), ends_ts (ending of the reservation), and car_id.

Keep in mind that the csv use a semicolon (;) as a separator.

Task

You must provide a report and implementation files to respond to the requirements of the car sharing company. All the code must be delivered in py files as part of this assignment.

For the assessment of the submission, we will consider the following aspects:

1. (15 pts max) Report on the analysis and specification of your solution. Here it is required for you to include any assumptions or implementation decisions you made. It is not enough to repeat the problem statement. We want to have your interpretation of the problem and it must match what you deliver.

Additionally, you must provide a clear description of the design of your classes explicitly showing what is the data representation and the public interface.

2. (10 pts max) The pseudocode for the critical functions and methods of your code. In other words, we want the procedures that are core for your application to work and deliver the main tasks. This must be implementable and match the code delivered. If that is not the case, no points will be granted.
3. (30 pts max) An implementation in Python. If you decide not to use OOP keep in mind that the 15 points assigned to that criterion will not be granted.
4. (15 pts max) Documentation for the Python code. All classes, methods, and functions must have documentation explaining what they do and an explicit and clear explanation of the arguments that a user must provide and the returned values.
5. (15 pts max) The program runs and provides:
    a. A reshuffling result (10/15).
    b. A meaningful report (9/15).
6. (15 pts max) A collection of classes for modeling the four types of objects requested. We will assess that the classes do have a role in the implementation. Declared classes that do not have a role in the implementation will be disregarded.

To keep in mind for the delivery

- Notice that the points assigned to each bullet in the previous list are the max attainable and the final score will depend on the assessment of each element. This means that just the existence of the element will not ensure the max points.
- The reports for the numerals 1 and 2 must be a pdf file, do not include these in the python code, if you do 25 points will be deducted.
- For the code, you must submit one or several ".py" files with the python code. Just pasting the code on a pdf file without any py files will be considered a failure to submit the code and 30 points will be deducted immediately.
- You may reuse any code you have from previous assignments. However, the use of code from any other source is not allowed and it will be considered cheating. The submission's work must be original and fully developed by the members of the group.
- There is no ban on using Generative AI such as ChatGPT or Bard to help you with the code. However, if you use it, you are responsible for explicitly stating the queries you send and how much of the code in the implementation is not yours but the Generative AI assistant. Also, how you modified and adapted the code for your implementation. If it is found that you used Generative AI for your implementation without being declared it will be considered academic dishonesty and it will be reported.
- Be sure to familiarize yourself with the guidelines for home exams in https://www.nhh.no/en/for-students/examinations/home-exams-and-assignments