

Exam

UML for Embedded Systems – UMLEmb

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Authorized documents: lectures' slides, notes you've taken during lectures, lab sessions results.

For each question, the grading is provided. 1 additional point is given as a general appreciation, including written skills and readability.

Also, do not spend more than 30 minutes on question I since the modeling exercise is long to perform. At last, do think about making assumptions on the system to leverage the modeling work.

I. Understand of the course (5 points) ~30mn

- 1) Explain the use of abstract classes using an example of your own. (2 points)
- 2) Just assume you would have to conceive a system performing sorting algorithms on linked lists and arrays, those lists and arrays being themselves stored in trees (i.e. lists and arrays are stored at tree node level). Which object architecture would you use for that system, i.e. propose a class diagram for that system. (3 points).

II. Modeling exercise (14 points) ~90mn

The goal of this exercise is to model the **software system** of the energy manager of a hybrid vehicle. The time being short to perform that modeling, you may omit modeling details of your choice, but if you do so, clearly mentioned which ones you have decided to omit, and why. At last, do not forget to comment your diagrams, grading takes into account at the same level diagrams and related comments.

The energy manager of a hybrid vehicle is responsible first to load the battery when the car is in deceleration phase, and second to unload the battery – i.e. send power to electric engines located in wheels – when the latter is full: the battery is thus used to move the vehicle, until the battery level reaches a given discharge threshold (10% of load); also, in deceleration phase, the main engine is not turned off, but is rather put to a low rpm phase. If the vehicle needs more energy than the one provided only by electric engines, or by the regular engine, all engines are combined. At last, when the vehicle temporary stops (at a traffic light, for example) and if the battery charge is more than 10%, then, the regular engine is turned off and so only electric engines are used until the car reaches 30 km/h and as long as the battery is not fully discharged.

To simplify the system, we consider that 10mn of deceleration are enough to fully recharge the battery, and that a fully charged battery provides 5mn of electric-only propulsion.

1) Analysis ~60mn

- a) Make the use case diagram of this machine. (2 points)
- b) Make two scenarios, one for the nominal case, and one for a non-regular case. (2 points)
- c) Using the technique of "words in the text", propose a collection of classes and objects for this system. (2 points)
- d) Refine the two previously performed scenarios. (2 points)

2) Design ~40mn

- a) From your analysis diagrams, propose a class diagram containing class relations such as associations, aggregations and so on, and also multiplicity. (2 points)
- b) Perform the composite structure diagram of this system. Your diagram should model communication channels between system entities. (2 points)
- c) Make the state diagram of the most important / complex class of your system. (2 points)