Learn-Design-Implement (LDI) Project [6 weeks]

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Project Objectives and ILOs

This project has multiple objectives as listed below. Although you will (in most cases) work as a team*, your work will be evaluated individually using rubrics based on these broad objectives and intended learning outcomes*. Therefore, you must understand the objectives and ILOs below.

Objectives

1. **Learn:** The first goal of this project is to teach you a deeper understanding of the ELEN90097 topics through "learning by doing" at your own pace. In this project, you will explore connections between these topics, their theoretical background, and how they are applied to practical problems.
2. **Design:** The second goal of the project is to teach you how to design engineering solutions using the methods you have learned, measure success, iterate designs, and explain your design choices based on what you have learned in ELEN90097.
3. **Implement:** The project's third goal is to encourage you to take initiative in your learning. Specifically, this means acquiring the necessary tools (data, software), scoping a feasible plan, and productively managing the time to implement your engineering solutions to realise your designs.
4. **Present**: The fourth goal of the project is to let you practice communicating what you have done and why using various methods, such as making a short presentation, answering questions about the project, and writing a proper project report.

Intended Learning Outcomes (ILOs)

- Learning the key concepts of the ELEN90097 subject and connections between these.
- Learning practical skills on how to implement engineering solutions and how to connect theory with practice.
- Learning how to design a solution, measure outcomes, iterate design as needed, make informed design choices, and provide engineering justifications for them.
- Acquiring *professional skills* such as project planning, time management, and teamwork.
- Learning to present your work in different formats and answer relevant questions.

Project Scope

- You are expected to use and emphasise the methods and topics covered in ELEN90097. The goal is to learn and practice these topics. Alternative solutions from beyond the scope of ELEN90097, irrelevant to the subject, will not get marks even if they work well in practice. *Please check with your lecturer when in doubt.*
- You are expected to take initiative. This is your project. You decide what to do and how as long as they are aligned with objectives and ILOs. We are happy to provide you with individualised support!
- The project application area is not that important; it is there for motivation and in alignment with your other interests. Groups doing a project in Area A are not advantaged or disadvantaged over Area B in any way.
- You are not expected to come up with novel or fully complete solutions to big problems. This is only a 6-week student learning project, not a capstone or MPhil/PhD thesis.
- You are encouraged to seek help from your demonstrators and instructor. **You must discuss the broad project plan with your demonstrator and/or instructor.**

Project Tasks and Suggested Timeline

Each project will have an overarching theme or area. *We will provide you with specific choices* as examples, but you are not bound by these. However, those who wish to work in an area of their liking should talk to the instructor before the project starts.

Given the limited time (6 weeks), you are expected to carefully scope your project following the recommendations below. **Priority should be given to learning**. This is not a capstone and the goal here is not achieving the big goal (e.g. creating a fully working autonomous driving solution). The goal is to learn/apply ELEN90097 topics as much as possible under the umbrella theme. A working solution does not guarantee and may not even lead to full marks.

Starting Point

Please see the project structure document and the baseline example provided.

Project Principles

- Students should learn and explain the inner workings of the methods they use in the projects. ELEN90097 lectures should be used as guidelines to judge the amount of detail and depth in this.
- Projects should clearly explain the *engineering design* process and how design objectives/constraints shape the problem formulations.
- Projects should compare/contrast approaches, and methods and discuss outcomes (metrics, solutions) using ELEN90097 knowledge.
- Self-proposed projects are welcome as long as the students intending to do them contact the instructor as early as possible. If you are late, then you have to work on a standard project. *As you can imagine, self-proposed projects often mean more work!*

Suggested Timeline

Week	Tasks	Achieve
before	• Choose a project and discuss it with the instructor and/or demonstrators	• The project was chosen by Week 1 of the project workshop.
1	• Setup relevant simulator or environment • Scoping and formulation of tasks following guidelines	• Setup and data generation completed • Initial project scoping: data set and problem definition
2	• Design your approach and system identification (SysID) problem formulation • Implement the initial solution • Plan your report	• Generate initial time series data • Initial system identification • Report skeleton (section headers)
3	• Design your approach and methodology • Continue documenting your progress	• Initial results • Some result graphs/tables within the report
4	• Database creation and storage of data. • Use SQL and alternatives to retrieve data • Initial statistical analysis	• Data storage, retrieval, and analysis • Report writing progress
5	• Iterate on data/problems/designs • Clarify the theory-practice connections • Enough results for the draft report	• Complete and submit a draft report
6	• Additional results from the implementation	• Ready for questions (oral exam) • Plans ready for completing the final report and presentation video

Project Deliverables

- By the end of Week 11 (see announcements on Canvas)
    - Draft report plus initial code
- During Week 12 (see announcements on Canvas)
    - Oral exam (in the form of a Q&A session)
- During the Final Exam period (see announcements on Canvas)
    - Full project report and project code
    - A brief recorded video presenting the project

Expected Deliverables

Here are basic guidelines regarding what is expected in the deliverables. *We will also create and disseminate specific rubrics in alignment with these expectations*.

- **Draft report**: around 4-5 pages per student excluding title, references, and table of contents. The full report structure as (sub)section headers should be included even if some sections are empty. *The goal is to structure your report properly and give you some feedback for the final report. It can be incomplete with content in some sections missing. Initial results/graphs/tables are encouraged. An introduction and overview of the project should be there.*
- **Initial project code**: this can be a work in progress but still should be structured and commented on to some extent. Code can be in the form of a Jupyter notebook with text sections briefly explaining it or a zip file containing Python scripts along with a brief README explaining which script is doing what. *This submission will allow us to provide you with feedback and suggestions.*

- **Final project report**: at most 10 pages per student including everything, i.e. 20 pages for a group of 2 and 30 pages for groups of 3. You should identify who has written which parts in section headers. The report should be written in clear language, present the project results, discuss ELEN90097 topics, and follow the best practices. A report structure and content suggestions will be provided.
- **Project video presentation (recorded)**: at most 5 minutes per project summarising the project's achievements. Note that if you are doing a project using one of the standard examples provided, there is no need to waste time on background information. Please focus on what you have done (achieved) as a group. As an example, you can build a narrative around Problem(s), Approach, Design, (theoretical) Analysis, and Outcomes.
- **Final project code:** this will be integral to the report and follow the same guidelines as the initial report. Projects without code will receive zero marks because we cannot verify what you say you have achieved!
- **Oral Examination:** approximately 3-5 minutes per student Q&A session led by the instructor. Students may bring their notes to facilitate the discussion. The examination will focus on the actual tasks, design, implementation, and results of the project rather than the overarching project area, especially if you use standard starter kits. Specific rubrics will be provided in Canvas.
- **Scaling for group size:** the default size of groups is 2. Everything including the *expectations* scales up with a multiplier of 1.5 for groups of 3 and scales down for a group of 1 student in those exceptional cases.

Suggested Report Structure

- Introduction (10-20% of page allocation)
    - Overview and background (especially relevant for self-proposed projects, otherwise keep short)
    - Project scope and tasks (important to clarify at a high level!)
- System Modelling and Identification Task (30-40% of page allocation)
    - System model formulation
    - Simulation and Identification process
    - Cross-validation with simulations [if possible]
    - Theory section: connect the theoretical background of the solution method used in the project – do not simply copy-paste slides!
    - Results and discussion
- Data Storage and Analysis Task (30-40% of page allocation)
    - Database design and implementation
    - Data set storage and retrieval of meaningful subsets of data
    - Statistical analysis of data
    - Theory section (explain the theoretical background of the solution method(s) used in the project)
    - Results and discussion
- Conclusion (10-20% of page allocation)
    - Reflection and broad discussion
    - Future directions that immediately follow from the project (e.g., tasks for which you did not have time)
- References
    - Practice best practices in this important area!

Special Remarks for PhD Students

If you are a PhD student and formally enrolled on the subject, you are:

1. Encouraged to work alone possibly within the standard project structure.
2. Alternatively, very welcome to design a project aligned with your PhD topics (as long as the project satisfies the principles described) and work on it alone. *Please contact the instructor as early as possible on this.*

Note that, these are for *fairness purposes* (a group with a PhD student has an unfair advantage). Moreover, only pass/fail matters for PhD students because they don't have a reported WAM/GPA in their studies.