Alexandria University
Faculty of Engineering
Electrical and Electronics Engineering Department
Fall semester, 2020/2021

جامعة الإسكندرية
كلية الهندسة
قسم الهندسة الكهربية
الفصل الدراسى الأول, 2021/2020

EEC 494 - OPTIMIZATION

Project

In the EEC 494 project, you will use convex optimization to study and solve an engineering problem that exists in any field of the electrical engineering domain that might interest you. Specifically, the goal of this project is to focus on any area of study that interests you, and pick an engineering problem which is solved in the literature using convex optimization tools. Here is how you can approach the project.

Step 1 – Form a group. The project is group-based. The group should consist of 5-7 members. You will need to submit the list of group members by the appropriate deadline (see deadlines below). You should submit the names of the group members using the link below. Note that you can submit the group members **only once**, so make sure that your group is finalized before submitting the names.

https://forms.office.com/r/CYVmGuGX3p

Step 2 – Select a paper in your field of study. You can do the project in any area of focus that you and your group feel comfortable with (e.g., communications, electronic designs, embedded systems, software development, machine learning, biomedical engineering). In this area of study, select a paper which discusses an engineering problem that is modeled and solved using convex optimization tools. This paper will be the core of your project. The group should inform the professor about the paper that they selected to get an approval – the approval is needed to ensure that the selected paper contains enough material that the group can use for the project. Since there is a chance that the paper that you select may not be suitable and thus not approved, make sure to select the paper early enough to give your self sometime for re-selection if needed before the paper selection deadline (see deadlines below).

Step 3 – Read and understand the paper. This is the main project work. You will need to understand the problem discussed in the paper and the proposed solutions. The following are guidelines to help you with the paper.

1. **What is the engineering problem that the paper is trying to solve?** Try to understand precisely what the engineering problem is that the paper is trying to address. This understanding has to be very precise. For example, it is not enough to say “the paper is trying to make the communication system

better". Instead, your understanding should be something like "the paper is trying to find the optimal power allocation which maximizes the total throughput in the presence of interference". Keep in mind the following aspects when understanding the problem: 1) what is the problem at hand, 2) why is it challenging to solve this problem, 3) what are the constraints imposed on the system, 4) what are the parameters/tools that you can use to solve the problem.

2. **How is the problem modeled as an optimization problem?** Based on your clear understanding in 1 you should understand how this problem is modeled as an optimization problem. You should understand how the optimization variables, objective function and constraints are related to the problem.
3. **Find a solution to the problem numerically using CVX.** Once you understand the problem, try to use CVX to come up with a numerical solution to the problem, even for a very small version of the problem. In this step, you will naturally need to put a lot of numerical values to the constants in the problem. Typically, papers with optimization-based problems contain sections with "numerical evaluations" or "experiments" which contain suggested numerical values to use. You can consider these values in your solution. Please see below for material on how to use CVX.
4. **Understand the solution that the paper proposes to solve the optimization problem.** Typically, the paper will contain some form of a solution to the optimization problem. This solution can be in the form 1) an analytical expression, 2) an algorithm to solve the problem, 3) other sub-problems that can be solved to arrive at a solution to the original problem, and others. You will need to clearly understand that solution.

Outcome of the project

The main outcome of the project should be a presentation that the group members will present to the professor. This presentation should cover all the aspects that they understood and investigated, possibly including some or all of the aspects mentioned above. The presentation should be for **15 minutes at most!.**

Grading

The grading of the project will be mainly based on the presentation. The project will be for a total of **10 marks**. Typically, the grading of the project is lenient (you can very easily get 8/10 if you do average effort). However, the last two points require that you show reasonably good effort. There will be (very generous) bonus for groups that do exceptionally well in the presentation.

Alexandria University
Faculty of Engineering
Electrical and Electronics Engineering Department
Fall semester, 2020/2021

جامعة الإسكندرية
كلية الهندسة
قسم الهندسة الكهربية
الفصل الدراسى الأول, 2021/2020

Material for learning CVX

CVX is a software tool used for solving convex optimization problems. There are two versions of CVX in both MATLAB and Python. The material for learning CVX are readily available on the internet and can be easily found. Some material for CVX are uploaded on the class Teams (link here). This material should be enough to use the tool in this project.

Presentation times

Presentations will occur from 17/5 to 21/5. Each group will be allocated a 20-minute slot. The selection of slots will be done after group formation. Please contact the professor if you would like to change the presentation times at earlier/later dates.

Deadlines

- Team formation: 28/4/2023
- Paper selection: 5/52023
- Presentation: 17/5/2023 – 21/5/2023

Contact us if you have questions

	Contact Information
Eng. Sarah Hassan	**Email:** sarahabdelsalam@alexu.edu.eg
Dr. Mohammed Karmoose	**Email:** mkarmoose@alexu.edu.eg