MIE498H1: Research Thesis 2025-2026

Supervisor	Samin Aref
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Number of Positions	1
Open to	Industrial Engineering students
Term Offered	Winter
Research Area	Operations Research
	Unsupervised machine learning, network clustering
Research Topic	Developing and solving integer programming models for network clustering problems

Project Description

Recently developed algorithms based on integer programming have been effective in solving network clustering problems. This includes the Bayan algorithm for modularity maximization and the Troika algorithm for clique partitioning. There are other closely related network clustering problems, such as correlation clustering, which can be tackled using a similar approach. This project involves developing an efficient IP-based algorithm that solves the network clustering problem to global optimality or approximates the optimal solution within a factor.

Relevant references:
1) Analyzing modularity maximization arxiv.org/abs/2310.10898
2) Bayan algorithm arxiv.org/abs/2209.04562
3) Troika algorithm arxiv.org/abs/2505.03573

Application Instructions	Students who would like to apply for taking MIE498 with Prof. Samin Aref on the above-mentioned project must complete these steps 2 months before the enrolment deadline for MIE498:
	1) Read the three reference papers (linked above) and deciding if the topic interests them and they have the required skills (mathematical modeling, python programming, integer optimization, algorithm development, github, version control) for conducting research in this area
	2) Send an email with a combined pdf file that contains their cv, unofficial transcript, and a paragraph on why they are the ideal student for this project. The paragraph must self-written without the use of any AI tools.

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