Final Report on Teaching Grant: Graph Theory Course (STÆ520M)

The aim of the teaching grant was to *develop innovative teaching methods for the course Graph Theory (STÆ520M), and to provide students with new, up-to-date material.* In particular, the goals were to incorporate connections to the rapidly growing research area of real-world networks, and to develop a framework for the computer implementation of graph-theoretic algorithms.

Together with Atli Fannar Franklín, we developed the proposed teaching materials and taught the course in 2024 accordingly. A key innovation was the introduction of two distinct learning paths: a traditional, mathematically focused direction and a new, computer-based direction. Students were able to choose between these options. Those who selected the computer-based path had dedicated exercise sessions, homework assignments, and exam components tailored to algorithms and programming.

This innovation aimed to make the course more accessible and relevant for students outside the mathematics department, such as those in computer science and software engineering. Another major goal was to provide updated and improved study material, addressing limitations in the previously used textbook, and to introduce elements of *Network Science* into the curriculum. Network Science is a natural and applied extension of Graph Theory, with relevance across disciplines such as sociology, finance, and chemistry.

Key outcomes of the project include:

- A draft version of a new textbook covering the mathematical foundations of Graph Theory.
- A new set of notes focusing on the algorithmic and computational aspects of Graph Theory, with an emphasis on coding and implementation.
- A comprehensive collection of exercises for both tracks, including homework problems, practice sets, and a problem bank for future exams.
- A dedicated note on Network Science, along with application-focused materials and tools for computer-based experimentation with networks.

The project successfully achieved its main objectives. It enhanced the learning experience by aligning the course content more closely with student interests and academic backgrounds. It also introduced a more interdisciplinary approach to teaching Graph Theory and placed greater emphasis on digital teaching methods, in line with the University of Iceland's strategic priorities.