Content

Course Code	Course Name	Semester	Theory	Practice	Lab	Credit	ECTS
INF 515	Graf Representation Learning	2	3	0	0	3	6

Prerequisites	
Admission Requirements	

Language of Instruction	English
Course Type	Elective
Course Level	Masters Degree
Objective	This course aims to teach the underlying theory and techniques for transforming graphs—used for data modeling in various fields—into numerical vectors through next-generation representation learning methods. It covers the subject in a broad spectrum, ranging from traditional spectral methods to contemporary Graph Neural Network (GNN) techniques. The primary objective is to equip students with the necessary tools to construct complex systems logic for data analysis and to select the appropriate representation learning technique to solve the problems they encounter.
Content	Introduction and Foundations of Graph Theory Traditional Graph Statistics and Kernel Methods Neighborhood Overlap and Spectral Methods Shallow Node Embeddings and Encoder-Decoder Framework Random Walk Methods and Knowledge Graphs Graph Neural Networks (GNN) and Message Passing Aggregation and Update Methods in GNN Architectures Midterm Exam Graph Pooling and Relation Prediction Applications Efficiency in GNN Applications and Node Sampling Spectral Graph Convolutions and Theoretical Motivations GNN Capacity and Graph Isomorphism Traditional and Deep Generative Graph Models Project Presentation
References	https://www.cs.mcgill.ca/~wlh/grl_book/files/GRL_Book.pdf http://web.stanford.edu/class/cs224w/

Theory Topics

Week	Weekly Contents
1	Introduction and Foundations of Graph Theory
2	Traditional Graph Statistics and Kernel Methods
3	Neighborhood Overlap and Spectral Methods
4	Shallow Node Embeddings and Encoder-Decoder Framework
5	Random Walk Methods and Knowledge Graphs
6	Graph Neural Networks (GNN) and Message Passing
7	Aggregation and Update Methods in GNN Architectures
8	Midterm Exam
9	Graph Pooling and Relation Prediction Applications
10	Efficiency in GNN Applications and Node Sampling

Week	Weekly Contents
11	Spectral Graph Convolutions and Theoretical Motivations
12	GNN Capacity and Graph Isomorphism
13	Traditional and Deep Generative Graph Models
14	Project Presentation