

**Module Description, available in: EN**

## *Multimodal Recommendation Systems and Complex Networks*

**General Information****Number of ECTS Credits**

3

**Module code**

TSM\_DataAnaCla

**Valid for academic year**

2024-25

**Last modification**

2023-10-20

**Coordinator of the module**

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**Explanations regarding the language definitions for each location:**

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Lausanne			Lugano	Zurich		
<b>Instruction</b>				X E 100%			
<b>Documentation</b>				X E 100%			
<b>Examination</b>				X E 100%			

**Module Category**

TSM Technical scientific module

**Lessons**

2 lecture periods and 1 tutorial period per week

**Entry level competences****Prerequisites, previous knowledge**

- Machine Learning and Data Mining,
- Python programming
- basic calculus, linear algebra and statistics concepts

**Brief course description of module objectives and content**

The module will address the theoretical aspects behind the realisation of Recommendation Systems and will allow students to practice over different

use case scenarios. In particular it will address the following RecSys approaches:

- Traditional and Machine Learning based recommendation
- Deep Learning based recommendation
- Complex networks based recommendation.

## Aims, content, methods

### Learning objectives and acquired competencies

Students understand the theoretical aspects behind the realization of Recommendation Systems and they will learn how to build them over different use case scenarios.

They will learn how recommendation systems work, focusing on three different approaches:

- Traditional and Machine Learning based recommendation
- Deep Learning based recommendation
- Complex networks based recommendation.

They will learn how to deal with classical recommendation challenges like imbalanced data set problems, cold-start problems, and long tail problems. Additionally they will learn how to evaluate recommendation systems.

They will learn how to deal with complex networks and how to exploit network extracted information to enhance recommendation solutions.

Finally they will learn how to build multimodal recommendation systems exploiting social networks metrics and dynamics in order to deal with content spread and users engagement.

They know the current research directions within these domains.

They can reuse the material acquired in this course in their own working environment and apply them to solve their specific problems

### Contents of module with emphasis on teaching content

The content of the module includes 3 main topics:

Complex Networks:

- Network Elements (Handling Networks in Code, Density and Sparsity, Subnetworks, Degree, Multilayer and Temporal Networks, Network Representations)
- Network measures (Hubs, Centrality Measures, Centrality Distributions, The Friendship Paradox, Ultra-Small Worlds, Robustness, Core Decomposition, Transitivity, Similarity)
- Network models (Lattice, Random Networks, Small Worlds, Configuration Model, Preferential Attachment, Other Preferential Models)
- Community Detection
- Dynamic models (Ideas, Information, Influence, Epidemic Spreading, Opinion Dynamics, Search)
- Social Media as Networks (es. Twitter, Facebook and Reddit)

Recommendation Systems:

- Traditional and Machine Learning based Recommendation Systems (Collaborative Filtering, Content Based, Knowledge Based, Hybrid)
- Deep Learning based Recommendation Systems
- Reinforcement Learning based Recommendation Systems
- Evaluation of Recommendation Systems
- Handling challenges in Recommendation Systems (imbalanced data set problems, cold-start problems, long tail problems)

Multimodal Systems for Recommendation:

- Complex Networks/Social Networks integration
- Use case: Recommendation Systems for Social Networks content spread and users engagement.

### Teaching and learning methods

Problem based learning. During the lesson the lecturer will introduce real world problems and the class will try to solve them together.

The lecturer will support the problem solving process, introducing new concepts and tools, as required.

Practical work will complement the theory, so that students can put in practice the studied arguments.

#### Literature

Lecture slides, references to internet resources and books

## Assessment

#### Certification requirements

Module uses certification requirements

#### Certification requirements for final examinations (conditions for attestation)

The successful delivery of solved practical projects is a condition for entering the examination, and will contribute to the final mark.

#### Basic principle for exams

**As a rule, all the standard final exams for modules and also all resit exams are to be in written form**

#### Standard final exam for a module and written resit exam

Kind of exam

written

Duration of exam

120 minutes

Permissible aids

No aids permitted

#### Special case: Resit exam as oral exam

Kind of exam

oral

Duration of exam

30 minutes

Permissible aids

No aids permitted