

## Recommender Systems (E018230)

**Course size** *(nominal values; actual values may depend on programme)*

**Credits 6.0**

**Study time 180 h**

**Course offerings and teaching methods in academic year 2024-2025**

A (semester 2)	English	Gent	lecture	0.0h
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**Lecturers in academic year 2024-2025**

De Pessemier, Toon	TW05	lecturer-in-charge
Martens, Luc	TW05	co-lecturer

**Offered in the following programmes in 2024-2025**

	<b>crdts</b>	<b>offering</b>
<a href="#">Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)</a>	6	A
<a href="#">Master of Science in Industrial Engineering and Operations Research(main subject Transport and Mobility Engineering)</a>	6	A
<a href="#">Master of Science in Computer Science Engineering</a>	6	A
<a href="#">Master of Science in Computer Science Engineering</a>	6	A
<a href="#">Master of Science in Industrial Engineering and Operations Research</a>	6	A

**Teaching languages**

English

**Keywords**

Personalization, profiling, self-learning systems, modelling user interests, data mining

**Position of the course**

Recommender systems are techniques and algorithms that generate content suggestions based on personal interests of the user. These systems are typically used to cope with the problem of information overload on many online services such as Amazon, Netflix and Facebook.

Research on recommender systems is a recent domain, originating from research on information retrieval, machine learning and data mining. As with search engines, information or content will be retrieved (information retrieval) and presented to the end user. Unlike search engines that use the entered search terms, recommender systems will select content based on personal interests. A recommender system will automatically learn these personal interests (machine learning) based on the user behavior such as interactions with the service and any feedback. Learning these personal preferences is performed using large amounts of historical data in which specific patterns are identified (data mining).

**Contents**

- Background and objectives of recommender systems for the various stakeholders (user, service provider)
- Input for recommender systems
  - Processing implicit and explicit feedback
  - Scaling and normalization of data
  - Data sparsity problems
  - Unary data vs. rating data
- Output of recommender systems
  - Predictions vs. recommendations
- Social aspects

- The filter bubble
- Privacy aspects
- Non-personalized recommender systems
  - Product-association rules
  - Popularity metrics
- Recommendation algorithms
  - Content-based recommender systems
    - Vector-Space model
    - Similarity metrics for content-based systems
    - Word2Vec
  - Collaborative filtering systems
    - Items-based vs. user-based
    - Collective intelligence
    - Similarity metrics for collaborative filtering
    - Cold start and scalability problems
    - Restricted Boltzmann machines
    - Trust networks
- Methods based on dimensionality reduction
  - Singular Value Decomposition
  - Funk SVD
- Advanced recommendation techniques
  - Algorithms based on social networking data
  - Rule-based systems and case-based reasoning
  - Algorithms based on trust and reputation of users
  - Combining algorithms in hybrid systems
  - Recommendations using neural networks
- Recommender systems in practice
  - Recommendation architectures
  - Implementation aspects
  - Optimizing calculations
  - Application domains
- Evaluation of recommender systems
  - Offline evaluation
    - Evaluation methodologies
    - Accuracy metrics
    - Decision-support metrics
    - Rank metrics
  - Online evaluation
    - User evaluation
    - A/B testing
  - Additional quality metrics
    - Serendipity
    - Diversity
    - Usefulness
    - Confidence
- Explaining recommendations (explanations)
  - Active learning for recommender systems
- Context-aware recommender systems
  - Context dimensions
  - Context generalization
  - Contextual pre-filtering, contextual post-filtering, contextual modelling
- Recommendations for groups
  - Aggregation of profiles vs. aggregation of recommendations
  - Aggregation methods
- Attacks on recommender systems
  - Attack strategies
- Dialog-based recommender systems
  - Interaction between user and recommender system
  - Expert-based systems

### **Initial competences**

Basic knowledge of math and programming

### **Final competences**

- 1 Modelling of user interests, interactions, and intentions.
- 2 Analysing and interpreting data originating from user interactions in the context of designing and developing a recommender system.
- 3 Designing a recommender system focused on a specific case.
- 4 Formulating an evaluation methodology in terms of the goals of the recommender system.
- 5 Reporting and critically evaluating the results of a recommender system.

#### **Conditions for credit contract**

Access to this course unit via a credit contract is determined after successful competences assessment

#### **Conditions for exam contract**

This course unit cannot be taken via an exam contract

#### **Teaching methods**

Lecture

#### **Extra information on the teaching methods**

- Lectures (hoorcolleges): teaching students the fundamentals of recommender systems.
- Independent work. Computer excercises: students gain practical knowledge about recommender systems by specific assignments.

#### **Study material**

Type: Slides

Name: slides theory supplemented with notes

Indicative price: Free or paid by faculty

Optional: no

Language : English

Number of Slides : 900

Oldest Usable Edition : 2023

Available on Ufora : Yes

Online Available : Yes

Available in the Library : No

Available through Student Association : No

Additional information: For the open book exam, students are asked to bring the printed slides

#### **References**

- Recommender Systems - An Introduction, D. Jannach, M. Zanker, A. Felfernig, and G. Friedrich.
- Recommender Systems Handbook Second Edition, F. Ricci, L. Rokach, and B. Shapira.

#### **Course content-related study coaching**

The teacher(s) or his assistant(s) will be available during and in between lectures and computer excercises for further explanation. The standard functionalities of the electronic learning platform will also be used.

#### **Assessment moments**

end-of-term and continuous assessment

#### **Examination methods in case of periodic assessment during the first examination period**

Written assessment

#### **Examination methods in case of periodic assessment during the second examination period**

Written assessment

#### **Examination methods in case of permanent assessment**

Assignment

#### **Possibilities of retake in case of permanent assessment**

examination during the second examination period is possible

#### **Extra information on the examination methods**

- Written exam: periodic evaluation, aimed at understanding and being able to apply the course material.
- Computer excercises: permanent evaluation, aimed at being able to apply the theory in practice. The students will implement some recommendation algorithms and evaluate and interpret the results. The focus is on applying the knowledge gained in the lectures in practice by implementing a recommender systems. The students will complete the full cycle of deploying a recommender system: problem analysis, design, development, evaluation, and

interpretation of results.

**Calculation of the examination mark**

- Written exam: 40%
- Independent Work. Computer exercises: 60%

**Facilities for Working Students**

Timing of the computer exercises can be changed for working students.