

OPPONENT'S EVALUATION OF THE MASTER'S THESIS

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Opponent: Assoc. Prof. Martin Kotyrba,
Ph.D.

Study program: **Information Technologies**
Specialization: **Software Engineering**
Academic year: **2024/2025**

Master's Thesis topic: **Personalized Cloud Recommendations**

The thesis outlines a thorough elaboration of a personalized cloud recommendation system by proposing and partially implementing a hybrid machine learning approach. The structure, as indicated by the Table of Contents, moves logically from a literature review and theoretical background to practical implementation and future directions. The practical section details data collection, preprocessing, the core ML methods (clustering and classification), system architecture, and integration. The discussion of obtaining data from various public sources and cloud providers demonstrates practical data handling considerations.

The validity of the approach is supported by existing research in the field. The thesis correctly identifies the use of clustering and classification as established techniques for recommendation systems and their applicability to cloud environments. The selected algorithms (K-Means, DBSCAN, Decision Trees, Random Forest) and libraries (Weka, Smile) are standard tools in machine learning, lending credibility to the technical choices. The objective to enhance accuracy, scalability, and efficiency is a valid research goal in this domain. The thesis explicitly aims to address difficulties in existing recommendation systems, such as managing the volume and diversity of data, real-time processing needs, personalization challenges, data sparsity, and cold start problems within dynamic cloud environments. The proposed hybrid approach leveraging cloud usage footprints is presented as a method to overcome some of these challenges by segmenting users and predicting suitable resources.

The level of the concepts resolved is appropriate for a Master's thesis. The core ML algorithms (K-Means, DBSCAN, Decision Trees, Random Forest) are fundamental supervised and unsupervised techniques. The application of these algorithms to cloud usage data for segmentation and prediction demonstrates a practical understanding of how to apply standard ML concepts to a real-world problem. The discussion of system architecture, data flow, and integration with technologies like MongoDB and the Spring Framework indicates a solid understanding of how to build a functional system around these ML models. While advanced concepts such as Ranking, Reinforcement Learning, and Large Language Models are discussed, they are correctly framed as future directions and not fully resolved implementations within the scope of this specific work.

The level of the thesis topic is highly relevant and timely. Personalized cloud recommendation is a significant area of research and practical application given the complexity and scale of modern cloud services. It is a suitable topic for a Master's thesis, requiring a blend of theoretical knowledge in cloud computing and machine learning, as well as practical system design and implementation skills.

Based on the provided excerpts, the formal aspects appear generally well-structured, following a standard academic thesis format with clear sections and appropriate use of citations. Citations are consistently presented using bracketed numbers [i] or [i, j].

Questions relating to the defence of the thesis

1. Could you explain in more detail the process and rationale behind selecting the specific parameters for K-Means ($k=3$) and DBSCAN (min points=5, epsilon=10.0)? How sensitive are the clustering results to these parameters, and were alternative values or parameter tuning methods explored?
2. Considering scalability is a key objective, beyond leveraging MongoDB's sharding, how is the system designed to handle a massive increase in incoming real-time usage data for classification and frequent model retraining as user behavior evolves?

Overall, the submitted thesis, based on the provided excerpts, appears to be a well-structured and relevant piece of work addressing a practical problem in cloud computing using machine learning. The topic is highly current, and the chosen hybrid approach is a valid and reasonable method for personalized recommendations. The theoretical foundation seems adequate, and the practical implementation section provides sufficient detail to understand the core components and their integration. The use of standard, well-understood ML algorithms and established technologies like MongoDB and Spring demonstrates competent technical skills.

The thesis successfully outlines a clear data processing and recommendation pipeline. It identifies important challenges in the field and proposes a system designed to address some of them, particularly concerning personalization based on usage patterns. The inclusion of a detailed future directions section showcases an awareness of advanced techniques and the potential for the system's evolution towards greater autonomy and intelligence, including the exciting prospect of integrating LLMs for automation.

However, the work demonstrates a solid understanding of the problem domain and the application of machine learning techniques. The proposed hybrid approach is sound, and the system architecture is thoughtfully designed. It represents a significant effort in building a data-driven recommendation engine.

Evaluation of the thesis:

Overall evaluation of the thesis:

The Opponent shall grant a mark according to the ECTS classification scale:

A – Excellent, B – Very Good, C – Good, D – Satisfactory, E – Sufficient, F – Insufficient

An “F” grade also means “I do not recommend the thesis for defence.”

I recommend this thesis to be defended and suggest the following evaluation:

B - Very Good

In the case of an evaluation grade of “F – Insufficient”, please supply the main shortages and reasons for this assessment.

Date: 04.06.2025

Thesis Opponent's Signature: