

IMPERIAL

Department of Mathematics

Deep Reinforcement Learning for Ad Personalization

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The work contained in this thesis is my own work unless otherwise stated.

Signed: Martin Batěk

Date: 17 July 2024

Abstract

ABSTRACT GOES HERE

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1 Introduction

The global digital advertising market is worth approximately \$602 billion today. Due to the increasing rate of online participation since the COVID-19 pandemic, this number has been rapidly increasing and is expected to reach \$871 billion by the end of 2027 (eMarketer, 2023). Many of the major Ad platforms such as Google, Facebook and Amazon operate on a cost-per-user-engagement pricing model, which usually means that advertisers get charged for every time a user clicks on an advertisement. This means that these platforms are incentivized to make sure that the content shown to each user is as relevant as possible in order to maximize the number of clicks in the long term. Attaining accurate Click-Through Rate (CTR) prediction is a necessary first step for Ad personalization, which is why study of CTR prediction methods have been an extremely active part of Machine Learning research over the past through years.

Initially, shallow prediction methods such as Logistic Regression, Factorization Machines (Rendle, 2010) and Field-Aware Factorization Machines (Juan et al., 2016) have been used for CTR prediction. However, these methods have often been shown to be unable to capture the higher order feature interactions in the sparse multi-value categorical Ad Marketplace datasets (Zhang et al., 2021). Since then, Deep Learning methods have been shown to show superior predictive ability on these datasets. The focus of my research project is therefore to explore the merits of different Deep Learning architectures for click-through rate prediction.

Paragraph about Reinforcement Learning and how it can be used for Ad Personalization.

Paragraph about the structure of the thesis.

2 Background

Background chapter.

2.1 Problem Statement

Section content goes here.

2.2 Literatiure Review

2.2.1 Deep CTR Prediction

2.2.2 Deep Reinforcement Learning

3 Deep CTR model Evaluation

3.1 Model Selection Methodology

3.2 Model Summaries

3.2.1 Shallow Models

Logistic Regression

Factorization Machines

3.2.2 Deep Models

Factorization Supported Neural Networks

Product Based Neural Networks

Wide & Deep Learning

DeepFM

Feature Generation by Convolutional Neural Network

Automatic Feature Interaction Learning

3.3 Benchmark Datasets and Exploratory Data Analysis

3.4 Model Evaluation

3.5 Deep CTR Model Results

4 Deep Reinforcement Learning for Ad Personalization

4.1 DeepCTR-RL Framework

4.2 Experiment Setup

4.3 Results

5 Discussion

Discussion goes here.

6 Conclusion

Conclusion goes here.

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