

Data 606 - Literature Study

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Project 1- Real-Time Automated Data Pipeline for Advertising

Introduction

Our research focuses on optimizing ad performance by improving the interaction between creative elements and ad placements using machine learning and data-driven approaches.

Through our literature search, we explored existing models that leverage **natural language processing (NLP) and computational advertising techniques** to enhance ad targeting and conversion prediction.

Real-Time Automated Data Pipeline for Advertising

LLM-Infused Approach for Optimized CTR Prediction

 Paper: [ArXiv:2412.06860](https://arxiv.org/abs/2412.06860)

♦ Main Idea:

- Utilizes Large Language Models (LLMs) to extract semantic insights for **enhanced Click-Through Rate (CTR) prediction**, balancing effectiveness with computational efficiency in real-world advertising.
- This process is achieved by using **user level and product level implicit and explicit information** such as product's target audience and user interests. They have noticed an improvement in F1 score using this approach.

♦ Key Contribution to Our Project:

- **Helps answer:** How can NLP-driven models improve ad creative and placement interaction?
- **Big Picture:** Capturing semantic relationships in ad creatives can lead to more **effective ad targeting**.
- **Connection:** We can integrate **semantic analysis using NLP** to refine creative–placement matching, optimizing conversions without relying on user-level tracking.

Real-Time Automated Data Pipeline for Advertising

Introduction to Computational Advertising Research Methodology

 Paper: [*Journal of Advertising*, 2024](#)

♦ Main Idea:

- This paper discusses the application of computational social science methodologies to advertising, emphasizing the collection and analysis of large-scale data to address advertising challenges.
- This research Includes ad content research, frameworks for assessing advertising data, and AI generated ad creatives.

♦ Key Contribution to Our Project:

- **Helps answer:** What computational methods can enhance the analysis of creative–placement synergies?
- **Big Picture:** Employing computational techniques allows for a deeper understanding of advertising dynamics.
- **Connection:** By adopting computational advertising research methodologies, we can systematically analyze and optimize the pairing of creative elements with ad placements to improve conversion metrics.

Real-Time Automated Data Pipeline for Advertising

Smart Advertisement for Maximal Clicks in Online Social Networks Without User Data

 Paper: [ArXiv:1911.02061](https://arxiv.org/abs/1911.02061)

♦ Main Idea:

Develops a method to predict Click-Through Rates (CTR) by analyzing advertisement content using Natural Language Processing (NLP) to extract key concepts, termed "conceptual nodes." The study employs machine learning models to optimize ad content without relying on user-specific data.

♦ Key Contribution to Our Project:

- **Helps answer:** How can we optimize ad performance without user-level data?
- **Big Picture:** Utilizing NLP and machine learning enables effective ad optimization while respecting user privacy.
- **Connection:** We can apply similar NLP techniques to analyze and enhance the synergy between creative elements and ad placements, improving conversion metrics without the need for personal user data.

Idea 2- AI-Driven Predictive Model for Highway Deterioration Forecasting

Problem statement

- Road infrastructure deteriorates over time due to heavy usage, particularly from freight traffic, leading to costly repairs, safety hazards, and disruptions. However, current maintenance approaches are often reactive, addressing damage only after it occurs. The challenge lies in predicting road deterioration in advance to enable proactive maintenance, reduce unexpected failures, and optimize resource allocation.

Project 2- Predictive Model for Highway Deterioration Forecasting

Introduction

Our research focuses on **predicting pavement deterioration** using machine learning and data-driven approaches. Through our literature search, we explored **existing datasets** and **methodologies** that utilizes different **pavement performance** and other influencing factors that helps for **predictive maintenance** and **optimization**.

Predictive Model for Highway Deterioration Forecasting

Data Fusion for Pavement Performance Prediction

- ♦ **Main Idea:**

- This study proposes an **International Roughness Index (IRI)** prediction model utilizing the **Random Forest Regression**.
- By analyzing multiple features, including traffic loads and environmental factors, the model aims to accurately forecast pavement surface roughness by using HPMS dataset.

- ♦ **Key Contribution to Our Project:**

- **Helps Answer:** How does incorporating diverse datasets, such as traffic and environmental data, enhance predictive accuracy?

- **Big Picture:** The successful application of the Random Forest algorithm in this study encourages us to explore ensemble learning methods for our predictive models.

- **Connection:** Just like the paper we are integrating two datasets HPMS(Highway Performance Monitoring System) and FAF(Freight analysis Framework) to predict pavement deterioration.

Predictive Model for Highway Deterioration Forecasting

A Deep Reinforcement Learning Model for Predictive Maintenance Planning of Road Assets

- ♦ **Main Idea:**

Proposes a **Reinforcement Learning (RL) framework** integrating **Life Cycle Cost Analysis (LCCA)** and **Life Cycle Assessment (LCA)** to optimize pavement maintenance. The model determines the best maintenance timing and type based on Long Term Pavement Performance(**LTPP**) **data**, considering pavement structures and environmental factors

- ♦ **Key Contribution to Our Project:**

- Helps Answer:** How does the effectiveness of LTPP data in predictive modeling support our decision to incorporate it alongside HPMS and FAF data?

- Big Picture:** Demonstrates how leveraging **LTPP indicators** like **Road Structure Features such as Pavement age, thickness, climate & environmental factors** enables the development of a **data-driven ML model** for more accurate highway deterioration forecasting.

- Connection:** Integrating Long Term Pavement Performance(**LTPP**) with Freight Analysis Framework(FAF) and Highway Performance Monitoring System(HPMS) can retrieve new insights which may help in predicting road deterioration

Predictive Model for Highway Deterioration Forecasting

Multi-Types of Flexible Pavement Deterioration Prediction Models

- ◆ **Main Idea:**

Uses Machine Learning and other models such as probabilistic and Deterministic models to analyze **traffic loads & environmental effects** on pavement deterioration by using LTPP.

- ◆ **Key Contribution to Our Project:**

- Helps answer:** How can integrating multiple modeling techniques improve the accuracy of pavement deterioration forecasting?

- Big Picture:** Reinforces the importance of using **traffic loads and environmental factors** in predictive maintenance strategies.

- Connection:** Guides us to adopt **machine learning techniques** for finding pavement condition forecasting.

REFERENCES

Project 1

1. [Balancing Efficiency and Effectiveness: An LLM-Infused Approach for Optimized CTR Prediction Guoxiao Zhang, Yi Wei, Yadong Zhang, Huajian Feng, Qiang Liu](#)
2. [Introduction to Computational Advertising Research Methodology Themed Issue Jisu HuhORCID,Michelle R. NelsonORCID &Cristel Antonia RussellORCID](#)
3. [Smart Advertisement for Maximal Clicks in Online Social Networks Without User Data Nathaniel Hudson , Hana Khamfroush, Brent Harrison, and Adam Craig](#)

Project 2

1. [A deep reinforcement learning model for predictive maintenance planning of road assets: Integrating LCA and LCCA Moein Latifi, Fateme Golivand Darvishvand, Omid Khandel, Mobin Latifi Nowsoud](#)
2. [Evaluation of pavement surface roughness performance under multi-features conditions based on optimized random forest Yuanjiao Hu; Zhaoyun Sun; Lili Pei; Wei Li; Yingying Li](#)
3. [Multi-Types of Flexible Pavement Deterioration Prediction Models Maher Mahmood; Mujib Rahman; Senthana Mathavan](#)

THANK YOU