**Advanced Ad Targeting and Personalization on Social Networks: Syllabus**

Course Description:

This course delves into the cutting-edge of ad targeting and personalization on social networks using deep learning and network analysis. You'll explore real-world applications, delve into advanced algorithms, and learn to build and evaluate effective systems.

Prerequisites:

* Programming experience (Python preferred)
* Basic understanding of machine learning
* Familiarity with graph theory (optional)

Course Duration:

12 weeks (3 hours per week)

Learning Objectives:

* Understand the principles of effective ad targeting and personalization on social networks.
* Implement and analyze network analysis tools like NetworkX for representing and exploring social networks.
* Train and evaluate deep learning models for node embedding, such as node2vec.
* Build and apply Graph Convolutional Networks (GCNs) and other architectures for social network tasks.
* Implement Recurrent Neural Networks (RNNs) to capture sequential behavior patterns.
* Utilize autoencoders for user preference modeling and product/content recommendations.
* Consider ethical and privacy concerns of data-driven targeting and personalization.
* Evaluate and compare different techniques based on performance and real-world effectiveness.

Course Outline:

**Module 1: Introduction to Social Network Advertising and Personalization**

* Overview of social network advertising ecosystem
* Targeting strategies and personalization challenges
* Metrics and evaluation methods for success
* Case studies of successful social network ad campaigns

**Module 2: Graph Representation and Network Analysis with NetworkX**

* Network basics: nodes, edges, and graph properties
* Building and manipulating graphs with NetworkX
* Community detection and network centrality measures
* Feature engineering with network data

**Module 3: Node Embedding: Representing Users and Entities with node2vec**

* Concept of node embedding and dimensionality reduction
* node2vec algorithm: exploring neighborhood and homophily
* Learning node representations with node2vec and its variants
* Evaluating and using node embeddings for downstream tasks

**Module 4: Deep Learning for Social Networks: Graph Convolutional Networks (GCNs)**

* Introduction to GCNs: Architecture and message passing
* Learning node representations with GCN layers
* Applications of GCNs in social network analysis and ad targeting
* Case studies of successful GCN-based systems

**Module 5: Modeling User Behavior and Predicting Interactions with RNNs**

* Recurrent Neural Networks (RNNs) and LSTM networks
* Modeling user sequences and predicting future actions
* RNN applications in social network personalization and recommendation systems
* Techniques for handling long-term dependencies and vanishing gradients

**Module 6: Autoencoders and User Preference Modeling:**

* Autoencoders for encoding and decoding user preferences
* Collaborative filtering and matrix factorization techniques
* Combining autoencoders with other models for personalized recommendations
* Case studies of effective recommendation systems using autoencoders

**Module 7: Ethical and Privacy Considerations in Social Network Targeting and Personalization**

* Data privacy and user consent implications
* Bias mitigation and fair advertising practices
* Explainability and transparency in recommendation systems
* Responsible research and development in the field

**Module 8: Advanced Topics and Research Frontiers**

* Attention mechanisms and self-supervised learning for social networks
* Explainable AI and interpretable models for personalized experiences
* Multi-objective optimization and balancing competing goals
* Emerging trends and future directions in the field

Assessments:

* Programming assignments: Implement network analysis tools, deep learning models, and personalization algorithms.
* Case studies: Analyze real-world social network advertising campaigns and propose improvements.
* Research project: Investigate an advanced topic or develop a novel system for ad targeting or personalization.

Software Tools:

* Python programming language
* NetworkX library
* Deep learning frameworks (e.g., TensorFlow, PyTorch)
* Visualization tools (e.g., Gephi, Matplotlib)

Learning Resources:

* Research papers and blog posts on social network advertising and personalization
* Online courses and tutorials on deep learning and network analysis
* Datasets and benchmarks for social network analysis and advertising tasks
* Industry reports and case studies from leading technology companies