# COURSE DETAIL

## TOPICS IN APPLIED MATHEMATICS: REINFORCEMENT LEARNING, SEARCH, AND TEST-TIME SCALING OF LARGE LANGUAGE MODELS

**Country**
Korea, South

**Host Institution**
Seoul National University

**Program(s)**
Seoul National University

**UCEAP Course Level**
Upper Division

**UCEAP Subject Area(s)**
Mathematics Computer Science

**UCEAP Course Number**
154

**UCEAP Course Suffix**

**UCEAP Official Title**
TOPICS IN APPLIED MATHEMATICS: REINFORCEMENT LEARNING, SEARCH, AND TEST-TIME SCALING OF LARGE LANGUAGE MODELS

**UCEAP Transcript Title**
REINFORCEMENT LRNG

**UCEAP Quarter Units**
4.50

**UCEAP Semester Units**
3.00

**Course Description**

This advanced topics course covers reinforcement learning, search, and test-time scaling of large language models that are expected to drive the next generation of AI systems.

Topics include: Basics of RL (Markov Decision Process and Policy evaluation), Basics RL (Imitation learning, Deep policy gradient methods), Basics of RL (Deep Q-Learning, Rainbow DQN); Symmetric alternating Markov games, Monte Carlo tree search, expert iteration, and AlphaGo; Imperfect information games, Counerfactural regret minimization, and Pluribus; NLP basics (RNN, beam search, tokenizers); NLP basics (Transformers, encoder-decoder architectures); Instruction fine-tuning, Scaling laws of LLM pre-training; Reinforcement learning with human feedback, direct policy optimization, Group Relative Policy Optimization (GRPO); Chain of thought, Process reward models, Prover-verifier games; In-context learning, Scaling LLM Test-Time Compute; DeepSeek-R1.

**Language(s) of Instruction**
English

**Host Institution Course Number**
3341.751

**Host Institution Course Title**
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**Host Institution Campus**

**Host Institution Faculty**

**Host Institution Degree**

**Host Institution Department**

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