
## FACULTY MENTOR

Pengtao Xie

## PROJECT TITLE

AutoSAM: Automated Prompting for the Segment Anything Model

## PROJECT DESCRIPTION

The Segment Anything Model (SAM) has demonstrated great success in semantic segmentation. However, to achieve high segmentation performance, it requires humans to provide meticulous prompts manually, which is very time-consuming and labor-intensive. To address this limitation, we will propose an automated prompting method based on three-level optimization that automatically generates prompts for an input image to achieve accurate segmentation without human involvement.

This project can accommodate both remote and in-person students.

## INTERNS NEEDED

- 3

## PREREQUISITES

- Familiar with deep learning.
- Familiar with PyTorch programming.


## FACULTY MENTOR

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## PROJECT TITLE

AutoMAE: Automatically Learning a Masking Strategy in Masked Autoencoder

## PROJECT DESCRIPTION

Masked auto-encoder has demonstrated great effectiveness in learning image representations. However, it masks image patches randomly without considering the fine-grained informativeness of individual patches, which hurts the quality of learned representations. To address this limitation, we propose a multi-level optimization-based method which automatically learns a masking network to generate image-specific masks.

This project can accommodate both remote and in-person students.

## INTERNS NEEDED

- 3

## PREREQUISITES

- Familiar with deep learning.
- Familiar with PyTorch programming.


## FACULTY MENTOR

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## PROJECT TITLE

Reduce Overfitting in Low-Rank Adaptation

## PROJECT DESCRIPTION

Low-rank adaptations (LoRA) are widely employed for fine-tuning large-scale pre-trained models in downstream tasks by learning low-rank incremental matrices. LoRA and its variants, such as AdaLoRA, train an entire low-rank incremental matrix on a single training dataset, which often leads to overfitting training data and inferior generalization on test data. To address this problem, we propose a bi-level optimization (BLO) based method for alleviating overfitting.

This project can accommodate both remote and in-person students.

## INTERNS NEEDED

- 3

## PREREQUISITES

- Familiar with deep learning.
- Familiar with PyTorch programming.


## FACULTY MENTOR

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## PROJECT TITLE

Automatically Tuning Matrix Ranks in Low-Rank Adaptation Based on Meta-Learning

## PROJECT DESCRIPTION

Large-scale pretraining followed by task-specific finetuning has achieved great success in various NLP tasks. Since finetuning all parameters of large pre-trained models poses substantial computational and memory challenges, several efficient finetuning methods have been developed. Among them, low-rank adaptation (LoRA), which finetunes low-rank incremental update matrices on top of frozen pre-trained weights, has proven particularly effective. Nonetheless, LoRA's uniform rank assignment across all layers, along with its reliance on an exhaustive search to find the best rank, leads to high computation costs and suboptimal finetuning performance. To address these limitations, we will propose a meta-learning-based framework for automatically identifying the optimal rank of each LoRA layer.

This project can accommodate both remote and in-person students.

## INTERNS NEEDED

- 3

## PREREQUISITES

- Familiar with deep learning.
- Familiar with PyTorch programming.


## FACULTY MENTOR

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## PROJECT TITLE

Information Augmentation for Text Classification Based on Automatically Prompting Large Language Models

## PROJECT DESCRIPTION

In many text classification tasks, the information contained in an input text is insufficient to predict the class label. To address this problem, we propose information augmentation, which analyzes the input text according to the classification task and uses the analysis results (referred to as augmented information) to train the classifier. Traditionally, this is infeasible to do due to the high costs of manually annotating complex augmented information. The recent success of large language models (LLMs) provides a unique opportunity to address this challenge. We propose a bi-level optimization-based method which automatically learns a task-specific prompt to guide LLMs to generate augmented information for texts in a classification task and use augmented information to train the classifier.

This project can accommodate both remote and in-person students.

## INTERNS NEEDED

- 3

## PREREQUISITES

- Familiar with deep learning.
- Familiar with PyTorch programming.