

# AI 3603 Artificial Intelligence:

## Homework 3: Segmentation

Adhere to the Code of Academic Integrity. You may discuss background issues and general strategies with others and seek help from course staff, but the implementations that you submit must be your own. In particular, you may discuss general ideas with others but you may not work out the detailed solutions with others. It is never OK for you to see or hear another student's code and it is never OK to copy code from published/Internet sources. Moss (Measure Of Software Similarity) will be used for determining the similarity of programs to detect plagiarism in the class (<https://theory.stanford.edu/~aiken/moss/>). If you encounter some difficulties or feel that you cannot complete the assignment on your own, discuss with your classmates in Discussion forum on Canvas, or seek help from the course staff. You can complete this homework **in the group of Final Project**. When submitting your assignment, follow the instructions summarized in Section 6 of this document.

## 1 Introduction

### 1.1 Description

In this homework, you will finetune the SAM model to segment the tumor area from the MRI images of brains. As shown in Fig.1, there are many MRI images of brain and their masks of tumor as groundtruth. Segment Anything Model (SAM) is a large model that can be used for image segmentation. But in this task, we need to fine-tune the model in specific areas of brain tumor segmentation. This homework will be implemented on the GPU server we provided.

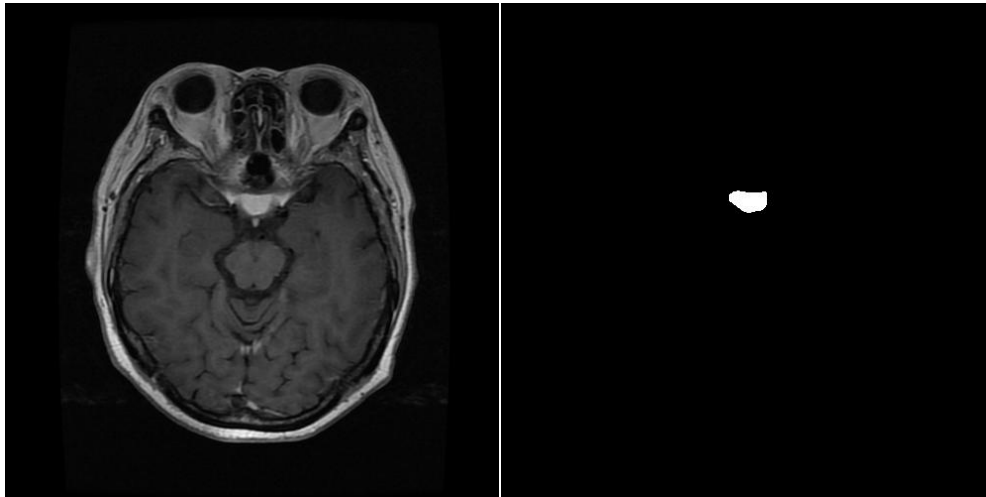


Figure 1: The MRI of brain and its mask

### 1.2 Provided File List

The provided files for this homework including:

- 0-The code for SAM: <https://github.com/facebookresearch/segment-anything>
- 1-SAM: The code for SAM fine-tune
- 2-MRI dataset: The MRI dataset
- 3-HW3\_Assignment.pdf: The introduction and description of homework 3.
- 4-Report Template: A template for report.

### 1.3 Submission File List

- H3\_code: Put the whole code you edited in one fold.
- HW3report.pdf: Report for homework 3.

## 2 Task 1: Prompt encoder of box[70points]

There are three types of sparse prompts: points, boxes, and text. In task 1, **You need to prompt the model in boxes**. The boxes are the envelope of the masks, and you can also write the code yourself to generate the boxes. You can find the code to prompt the model in box in the code for SAM fine-tune. You need to finetune the model on training dataset, and validate it on testing dataset.

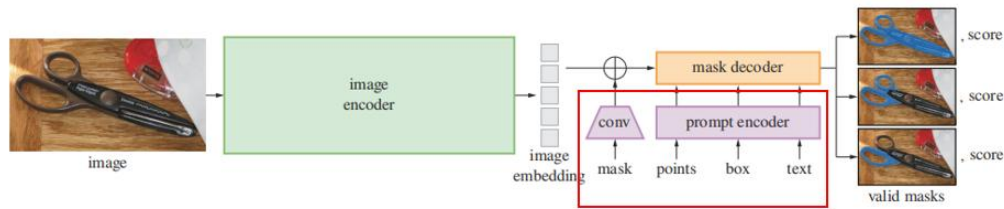


Figure 2: The prompt encoder of SAM

You should calculate the IOU to show the results of your tasks. You need to write codes to calculate the IOU of the masks we provided and your model predicted. IOU(Intersection over Union) is used to compare the similarity between the predicted output of the model and the real ground truth. The calculation formula for IOU of two areas A and B is as follows:

$$IOU = \frac{S(A \cap B)}{S(A \cup B)}$$

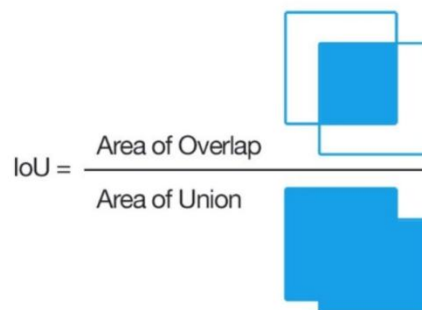


Figure 3: The IOU

Where  $S(A \cap B)$  means the the area of  $A \cap B$ , and  $S(A \cup B)$  means the the area of  $A \cup B$ .

## 3 Task 2: Prompt encoder of point[30points]

There are three types of sparse prompts: points, boxes, and text. In task 2, **You need to prompt the model in points**. Points are generated by masks. **Just one point should be generated for each image**. You need to write the code yourself to generate the points. You can also find the code to prompt the model in points in the code for SAM fine-tune. You need to finetune the model on training dataset, and validate it on testing dataset. You also need to calculate IOU to show your result.

## 4 Code and Report

Code:

Before editing your code, you need to use the following commands to configure the environment on the GPU server we provided:

**conda install numpy**

**conda install pandas**

**conda install scikit-image**

**conda install tqdm**

**pip install ipykernel --upgrade**

**pip install torch==2.0.1 torchvision==0.15.2 torchaudio==2.0.2 --index-url**

**<https://download.pytorch.org/whl/cu118>**

**conda install matplotlib**

**conda install monai**

For the task, you need to use **pre\_grey\_rgb2D.py** to preprocess your dataset. Then you need to edit **finetune\_and\_inference\_tutorial\_2D\_dataset.ipynb** to fine-tune the SAM model. You can follow the tips in **code annotation**.

Report:

Summarize the process and results of the homework, including but not limited to:

- The description of the implementation of SAM.
- The formulation and implementation of the prompt of SAM.
- The comparison between points and box of prompt.
- The description, formulation and implementation of your algorithm to improve IOU.

## 5 Discussion and Question

You are encouraged to discuss your ideas, and ask and answer questions about homework 3. A new post for this assignment “Homework 3 Discussion” is opened in the Discussion Forum on Canvas. If you encounter any difficulty with the assignment, try to post your problem for help. The classmates and the course staff will try to reply.

## 6 Submission Instructions

1. Zip **your whole edited code** and your report file **HW3report.pdf** to a zip file named as **HW3\_GroupID.zip** for a group. Write the GroupID in the name of zip file and all the names and student IDs on the cover of the report, and submit it **on the team leader's account**.
2. Upload the file to “Homework 3: Segmentation” on Canvas.