

AI Summer School 2024: Team Project

June 28, 2024

University of Pittsburgh

Introduction and Problem Statement

Total Knee Arthroplasty (TKA) is a surgical procedure that involves replacing a damaged knee joint with a prosthetic implant. Precise placement of the implant is critical for successful outcomes and optimal patient mobility. While AI has many applications in the field of medicine, one such area is in orthopedics, where object detection algorithms can assist in both pre-surgery planning and postoperative care.

In this team project, using synthetic knee radiographs, you will develop an AI localization system using YOLOv9 to automatically localize and also classify the knee joint area, both with and without TKA implants. This system aims to aid in both pre-surgery planning and postoperative care, enhancing the precision and effectiveness of TKA procedures.

Your Tasks:

1. Dataset Preparation

- a. Download the supplied dataset found on the GitHub repository and divide the images among your group.

GitHub Repo:

<https://github.com/pitthexai/AISummerSchoolinMedicalImagingInformatics>

- b. Annotate the images following the provided annotation guidelines using Labellmg, with following two classes: (1) NormalKneeAP, and (2) TkaKneeAP.

2. Data Conversion:

- a. Use Roboflow to convert your annotated images to YOLOv9 format. Follow the default configurations demonstrated during the hands-on session.

3. Model Training:

- a. Train a YOLOv9 detection model using your annotated images.
- b. Experiment with varying the learning rate and epochs.

4. Model Evaluation:

- a. Evaluate your model(s) using your validation set by calculating the average IoU
- b. If you have more than one model, choose the model that has the best performing IoU.

5. Model Testing and Performance:

- a. Generate bounding boxes for the test images using your model.
- b. Provide examples of the bounding box predictions with their confidence score.
- c. Calculate the average IoU of the test images for each class (KneeAP and TkaKneeAP)

6. Team Presentation:

- a. Create a team presentation in PowerPoint. It should include the following slides
 - Background (1-2 slides)
 - Dataset and Data Preparation (1-2 slides)
 - Methods (1-2 slides)
 - Results (1-3 slides)

*Note: If you have any questions or problems, then please feel free to ask Nick Littlefield and/or Dias Mashikov for help.