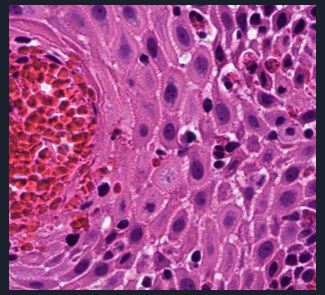
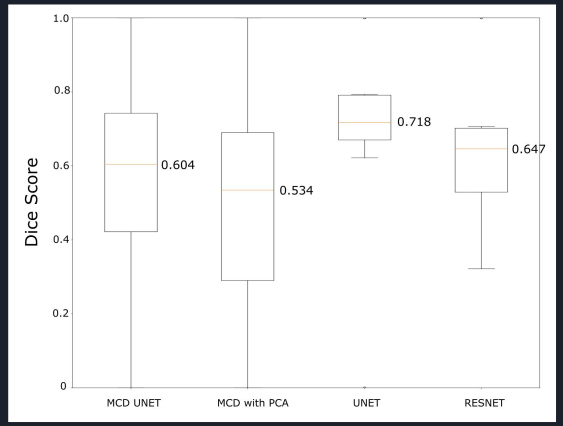
ML Systems for Computer Vision

Kevin Lin
Jason Wang

Computer Vision in Medical Imaging



- Image Classification and Segmentation performed on Eosinophilic Esophagitis (EoE) to assist UVA Medical Center Pathologist in diagnosis
  - >15 eosinophils in Whole Slide Image (WSI) = Patient has EoE
  - All Patient Information scrubbed (no privacy concerns)
- Advanced Deep Learning methods applied to explore uncertainty and improve performance
  - UNet with and without Monte Carlo Dropout
  - PCA Methods
  - nnUnet
  - ResNet-50
- Dice Score used as performance metric
  - Accuracy can be 99% but the 1% could be important!!
- Brief exploration using R-CNNs

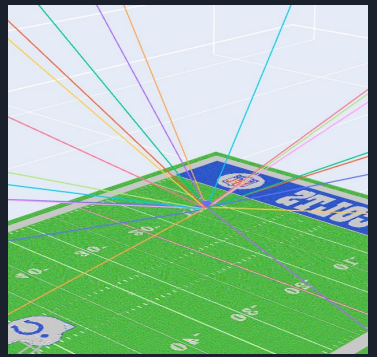


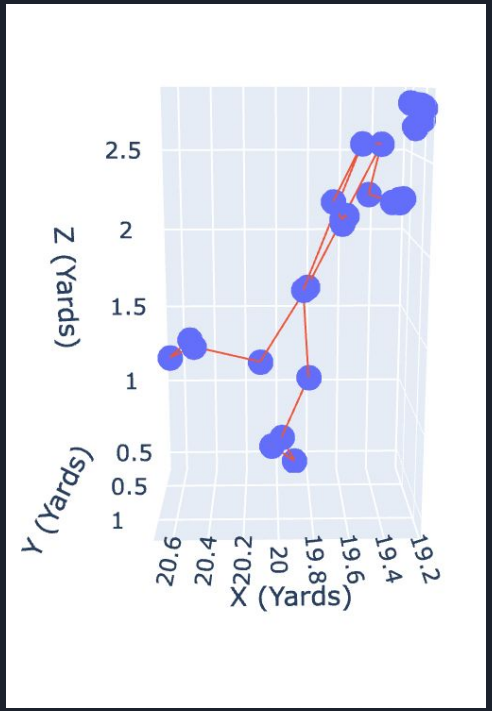
Takeaways

- Rise in Domain Adaptation Methods
  - Why retrain existing models? -> Surprisingly good performance
  - “Bad models with good parameter estimates are better than good models with bad parameter estimates” - Dr. Brown, Bayesian Learning Fall 2021
- Potential for Computer Vision to identify regions of interest in medical imaging
  - Identifying eosinophils is currently a manual process of counting frame by frame!!
  - Can also provide further insight into “groupings” of eosinophils
  - Adding bayesian inference to performance measures can capture uncertainty -> more information about what computer vision models are doing and where they under/overperform
  - Goal: Apply object detection model to EoE dataset and assess viability of approach. Find optimal combination of ML System parameters.
- Large amount of Risk!
  - Faulty or biased algorithms can impact thousands of patients
  - Constant contact with UVA medical pathologists to vector and adjust approach

Transforming Sports with Computer Vision

- Aim is to **reduce the number of injuries** in the NFL by analyzing body pose movement of players
- Used **38 cameras** located around stadiums to reconstruct 3D pose
- Utilized many traditional Computer Vision techniques:
  - Stereo Camera Calibration
  - Bundle Adjustment
  - Homography Transformations
- However Deep Learning is having a tremendous impact as well
  - 2D and 3D Pose Estimation
  - Object Detection and Tracking





Future of Computer Vision in Sports

- We are starting to see an extraordinary number of Startups enter this field
  - Sports such as football are getting safer with the use of Computer Vision to analyze the movement of athletes and trying to reduce risky plays
  - The optimization of players is also a huge market as AI can inform players what the best course of action is, potentially changing the way games are played (similar to AlphaGo)
- All these applications require efficient and lightweight ML systems to utilize this technology in real time
- We could look into the scalability of these camera systems
  - Number of Cameras
  - Edge Devices
  - Frames per Second

Questions