Congress of Neurological Surgeons

Data Science and Image Analysis for the Neurosurgeon
June 10, 2021 - June 17, 2021 - June 24, 2021

Course Directors and Planners:
Dr. Mohamad Bydon
Dr. Matt Pease
Dr. Daniel Donoho

Faculty:
Stephane Doyen, Oliver Gevaert, Eric Oermann, Yvonne Lui, Tim Smith, Jason Davies

Course Description:
Data science techniques are becoming commonplace throughout neurosurgery in research studies, clinical trials, and operating room technology. This course is designed for neurosurgeons with an academic or leadership focus who will use data science in their research or hospital administrative duties. We will provide an overview of various types of data science techniques, with a focus on image analysis with artificial intelligence. The course is suitable for those who do not know how to code or model build themselves and is not designed to teach coding. The aim is to teach neurosurgeons how data science is applied in neurosurgery, to successfully collaborate with data science researchers, and to understand how artificial intelligence is incorporated in image analysis.

Course Learning Objectives:
- Organize your data collection in an efficient way to be analyzed by data science techniques
- Describe the strengths and weaknesses of various data science modeling techniques such as neural networks, principle component analysis, and clustering techniques
- Build a research project centered on utilizing AI imaging analysis techniques

Agenda

June 10, 2021

Learning Objectives:

- Describe the strengths and weaknesses of regression, classification, and clustering algorithms and explain how a neural network is built and tested
- Identify how researchers are developing explainable neural network models and why black box models are problematic in-patient care settings
- Describe two data science methods used in imaging analysis and identify two strengths and weaknesses of 3D-CNN imaging approaches

6:00 – 7:00 pm
Overview of Data Science, Machine Learning, and Neural Networks for Model Building
Stephane Doyen, PhD

7:00 – 8:00 pm
Machine Learning in Medical Imaging Analysis
Oliver Gevaert, PhD

8:00 – 8:30 pm
Question and Answer

June 17, 2021

Learning Objectives:

- Describe how features from imaging (shape, intensity, texture, etc.) can be used to develop large feature sets that can predict tumor genetics or patient outcomes
- Describe the differences between a 3D-CNN model for image analysis and a radiomic model
- Identify two clinical barriers to radiomics in a clinical setting
- Describe how radiologists are using computer-aided diagnosis to change the radiology workflow and identify one area where a 3D-CNN model has the potential to improve upon a radiologist's or neurosurgeon's diagnostic ability
- Describe the process for pre-processing imaging in data science studies and how to minimize the effort for organizing/pre-processing data
- Explain two ways that longitudinal cranial or spinal imaging can be used in data science studies
- Identify how to overcome common IRB challenges in data science

6:00 – 6:45 pm
Radiomics
Eric Oermann, MD

6:45 – 7:30 pm
Artificial Intelligence in Medical Imaging Diagnosis
Yvonne Lui, MD

7:30 – 8:15 pm
Collecting Data for an Imaging Study
Tim Smith, MD, PhD

8:15 – 8:30 pm
Question and Answer

June 24, 2021

Learning Objectives:

- Describe how different data science algorithms can be used depending on data format and clinical questions
- Interpret the results of a neural networked based experiment
- Describe two challenges in implementing data science techniques in a real world setting and identify two ways in which AI in image analysis is being used in neurosurgery
- Describe how connectivity features derived from imaging (rs-fMRI, DTI, MEG, etc.) can be used to develop feature sets that can predict neurological disease progression and therapeutic response
- Describe the ethical issues with using quantitative image analysis for patient prognosis

6:00 – 7:00 pm
AI in Imaging for a Neurosurgeon
Jason Davies, MD, PhD

7:00 – 8:30 pm
Breakout Session: Develop a Data Science Modeling Project

Please note: All faculty are subject to change