

Session -II- Machine Learning in Medicine

Asst.Prof.Dr. Boran Şekeroğlu

Machine Learning in Health Informatics

- ▶ Ravi et al. (2017) classified and summarized the usage of Deep Learning approaches in Health Informatics as:
 - ▶ Bioinformatics:
 - ▶ Cancer diagnosis, gene selection/classification and variants, drug design...
 - ▶ inputs are gene expression, MicroRNA...
 - ▶ Deep Autoencoders, Deep Neural Networks
 - ▶ Medical Imaging:
 - ▶ 3D brain reconstruction, cells/Tissue classification, Tumour detection...
 - ▶ inputs are MRI, PET Scans, Endoscopy images, Microscopy, X-ray images
 - ▶ Convolutional Neural Networks, Deep Autoencoder, Deep Neural Network...



Machine Learning in Health Informatics

- ▶ Medical Informatics:
 - ▶ Prediction of disease, human-behaviour monitoring, data mining
 - ▶ inputs are electronic health records, big medical dataset, blood/lab tests
 - ▶ Deep Autoencoders, Convolutional Neural Network, Deep Neural Network...
- ▶ Public Health
 - ▶ Predicting demographic info, air pollutant prediction, infectious disease epidemics...
 - ▶ Social media data, mobile phone data, geo-tagged images, text messages
 - ▶ Deep Neural Network, Deep Autoencoders, Convolutional NN, Deep Belief Network



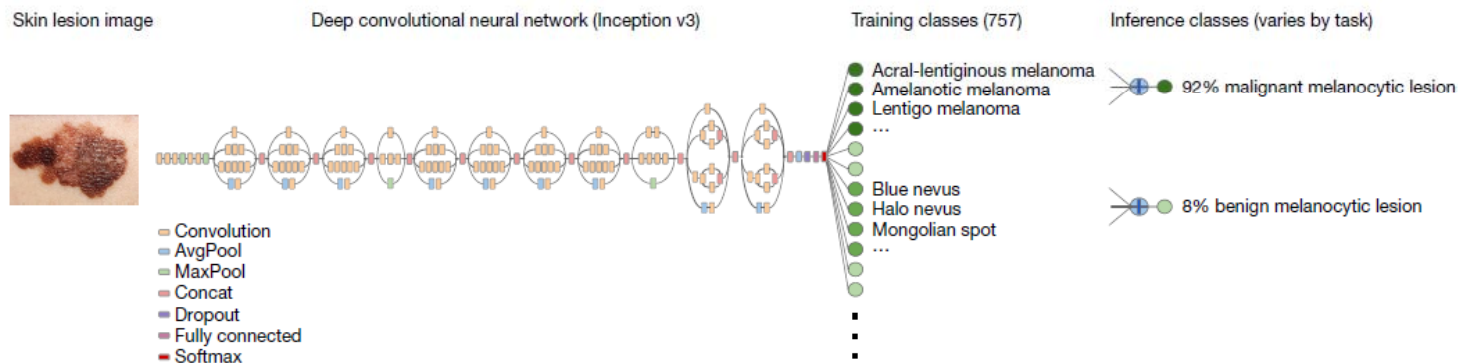
Ravi et al. ...

- ▶ “Nevertheless, the application of deep learning to health informatics raises a number of challenges that need to be resolved:
 - ▶ training a deep architecture requires an extensive amount of labeled data, which in the healthcare domain can be difficult to achieve.
 - ▶ deep learning requires extensive computational resources, without which training could become excessively time-consuming.
 - ▶ Eventually, deep learning models can be affected by convergence issues as well as over-fitting.”



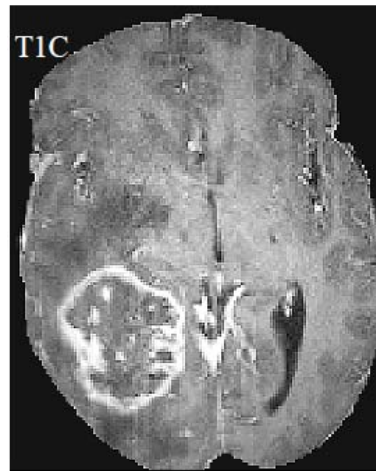
Specific Applications of Machine Learning in Medical Imaging

- ▶ **Esteva et al. (2017) – Nature**
 - ▶ Used Deep Convolutional Neural Networks to classify skin cancer.
 - ▶ Number of training + validation images: 127,463
 - ▶ Number of test images: 1942
 - ▶ Classification: 3 & 9 classes
 - ▶ In 3 classes: CNN → 72.1% Dermatologist(s) → 66.0%
 - ▶ In 9 classes: CNN → 55.4% Dermatologist(s) → 53.3%



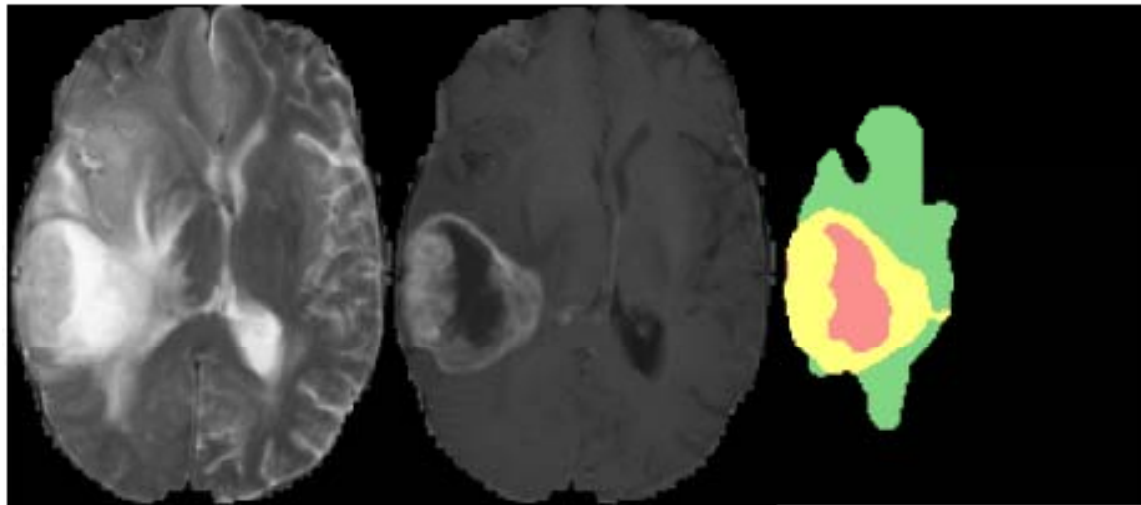
Specific Applications of Deep Learning in Medical Imaging

- ▶ **Havaei et al. (2016) – Medical Image Analysis**
 - ▶ Used modified Deep Convolutional Neural Networks to segment brain tumors.
 - ▶ BRATS2013 Dataset.
 - ▶ 5 labels: *non-tumor, necrosis, edema, non-enhancing tumor, enhancing tumor.*



Specific Applications of Deep Learning in Medical Imaging

- ▶ Havaei et al. (2016) – Medical Image Analysis



Specific Applications of Deep Learning in Medical Imaging

- ▶ **Guidi et al. (2014) – IEEE Journal of Biomedical and Health Informatics**
 - ▶ Clinical Decision Support System for Heart Failure Patient Assistance
 - ▶ Compared NN, SVM, Fuzzy system, Decision Trees and Random Forest.
 - ▶ The database consists 136 records of 90 patients.
 - ▶ Performed 2 experiments: severity assesment and type prediction
 - ▶ Random Forest for Severity Assesment and; Classification and Regression Tree (CART) for Type Prediction achieved highest results with 83.3% and 87.6% of accuracy respectively.



Specific Applications of Deep Learning in Medical Imaging

- ▶ Shimpi et al. (2017) – IEEE International Conference on Computing Methodologies and Communication
 - ▶ Classification of Cardiac Arrhythmia
 - ▶ UCI Machine Learning Repository Dataset – 472 patients with 279 attributes.
 - ▶ 13 labels (normally 16)
 - ▶ SVM, Logistic Regression, K-Nearest Neighbor and Random Forest Algorithm
 - ▶ Highest rates obtained by SVM, KNN, RF and LR respectively.



Specific Applications of Deep Learning in Medical Imaging

- ▶ Wen et al. (2018) – 15th Conference on Wavelet Active Media Technology and Inf. Processing
 - ▶ Compared 4 ML techniques for Prostate Cancer Survivability
 - ▶ k-Nearest Neighbors, Decision Tree, Naive Bayes, SVM, BPNN
 - ▶ Totally 348,300 cases
 - ▶ instances with missing values was deleted...
 - ▶ Finally, 329,466 cases...
 - ▶ 15 attributes, 1 output
 - ▶ Backpropagation achieved highest prediction rates.



Specific Applications of Deep Learning in Medical Imaging

- ▶ Sekeroglu & Emirzade (2018) – 3rd Int. W. on Pattern Recognition
 - ▶ Lung Cancer Detection and Segmentation
 - ▶ includes pre-processing...
 - ▶ Lung Image Database Consortium (LIDC) Database
 - ▶ SVM
 - ▶ 97.3% of Specificity & 92.0% of Sensitivity



Specific Applications of Deep Learning in Medical Imaging

- ▶ **Ting, Tan & Sim (April 2019)**
 - ▶ CNN for Breast Cancer Classification
 - ▶ Mammographic Image Analysis Society (MIAS) Database
 - ▶ 21 benign, 17 malignant, 183 normal cases
 - ▶ To assist experts...
 - ▶ Accuracy: 90.50%



Specific Applications of Deep Learning in Medical Imaging

- ▶ **Lin, Hu & Kong (May 2019)**
 - ▶ In-hospital mortality prediction with acute kidney injury
 - ▶ Random Forest, SVM, ANN
 - ▶ Medical Information Mart for Intensive Care (MIMIC) III Database
 - ▶ 19,044 patients
 - ▶ Accuracy of RF: 72.8%, followed by SVM and ANN respectively...



THANK YOU 😊

