UNIVERSITY OF SOUTH FLORIDA

Defense of a Doctoral Dissertation

Towards High Performing and Reliable Deep Convolutional Neural Network Model for Typically Limited Medical Imaging Datasets

by

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For the Ph.D. degree in Computer Science and Engineering

Healthcare organizations are increasingly interested in how artificial intelligence (AI) can support better patient care while reducing costs and improving efficiencies. Deep learning is a subset of AI that is becoming transformative for healthcare. Deep learning offers fast and accurate data analysis. In this dissertation, we propose deep learning-based solutions to the problems of limited medical imaging datasets in (i) [illegible] and suggest novel systems for small magnetic resonance imaging (MRI) datasets based on ensembles of convolutional neural networks (CNNs). For COVID-19 diagnosis, we reveal one critical problem with CNN-based approaches for predicting COVID-19 from biased chest X-ray (CXR) imaging datasets: shortcut learning. Then, we experimentally suggest methods to mitigate this problem to build fair, reliable, robust, and transparent deep learning-based clinical decision support systems.

Examining Committee

Dr. Ismail Uysal, Ph.D., Chairperson
Prof. Lawrence Hall, Ph.D., Co-Major Professor
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Dr. Robert Gatenby, M.D.

Thursday October 13th, 2022
10:00 am
ENB 313

THE PUBLIC IS INVITED

Publications

1) K. Ben Ahmed, L. O. Hall, D. B. Goldgof and R. Fogarty, "Achieving Multisite Generalization for CNN-Based Disease Diagnosis Models by Mitigating Shortcut Learning," in IEEE Access, vol. 10, pp. 78726-78738, 2022, doi: 10.1109/ACCESS.2022.3193700
2) Ben Ahmed, K.; Hall, L.O.; Goldgof, D.B.; Gatenby, R., "Ensembles of Convolutional Neural Networks for Survival Time Estimation of High-Grade Glioma Patients from Multimodal MRI". Diagnostics 2022, 12, 345.
3) K. B. Ahmed, G. M. Goldgof, R. Paul, D. B. Goldgof and L. O. Hall, "Discovery of a Generalization Gap of Convolutional Neural Networks on COVID-19 X-Rays Classification," in IEEE Access, vol. 9, pp. 72970-72979, 2021, doi: 10.1109/ACCESS.2021.3079716
4) K. B. Ahmed, L. O. Hall, R. Liu, R. A. Gatenby and D. B. Goldgof, "Neuroimaging Based Survival Time Prediction of GBM Patients Using CNNs from Small Data," 2019 IEEE International Conference on Systems, Man and Cybernetics (SMC), 2019, pp. 3315-3321, doi: 10.1109/SMC.2019.8913929
5) Ahmed, Kaoutar B., Lawrence O. Hall, Dmitry B. Goldgof, Renhao Liu, and Robert A. Gatenby. "Fine-tuning convolutional deep features for MRI based brain tumor classification." In Medical Imaging 2017: Computer-Aided Diagnosis, vol. 10134, pp. 613-619. SPIE, 2017
6) Renhao Liu, L. O. Hall, D. B. Goldgof, Mu Zhou, R. A. Gatenby and K. B. Ahmed, "Exploring deep features from brain tumor magnetic resonance images via transfer learning," 2016 International Joint Conference on Neural Networks (IJCNN), 2016, pp. 2424-2430, doi: 10.1109/IJCNN.2016.7727204
7) R. Liu, L. O. Hall, K. W. Bowyer, D. B. Goldgof, R. Gatenby and K. Ben Ahmed, "Synthetic minority image over-sampling technique: How to improve AUC for glioblastoma patient survival pred