Deep Learning for Medical Imaging: A Recipe for Success

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Background/Problem Being Solved

Medical image analysis is a fascinating and fast-moving field that was further re-energized with the emergence of deep learning (DL) approaches to many clinically relevant problems.

Many well-intentioned researchers in this field follow a simple recipe that starts with learning the basics of Python and a DL framework of choice; getting a publicly available dataset; applying transfer learning using a popular pretrained DL model; tweaking parameters, hyperparameters, etc. to improve results; and stop upon reach a goal (e.g., good enough AUC or accuracy).

Intervention(s)

We propose a better recipe, which essentially consists of the following eight steps:

1. Identify opportunities: There are numerous combinations of anatomies, pathologies, image modalities, and tasks (segmentation, detection, classification) that might still benefit from DL approaches to help solve specialized problems.
2. Search the literature: Survey papers help get a perspective of the field and maybe narrow down to a subset of problems of interest. Beware that there has been so much work in this space that there are now systematic meta-reviews of published survey papers.
3. Select the best tools for the job: Don't stop at general-purpose frameworks, such as TensorFlow or PyTorch. Look also for specialized ones, such as MONAI.
4. Build strong partnerships: Most problems are large and complex and require multidisciplinary teams with different skill sets. Partner with subject matter experts that offer a chance to solve meaningful problems using real data.

5. Document code, data, and model: Best practices for dataset and model documentation help increase transparency, improve communication, and prevent errors at crucial stages in the development lifecycle.
6. Enter challenges and competitions: There are hundreds of medical imaging challenges promoted by leading groups, sites, and professional societies such as SIIM and RSNA. Participating in some of them provides valuable learning opportunities that might not be found elsewhere.
7. Publish your work: Share your results and findings with the professional community. Be prepared to ensure that your work meets the requirements from leading journals' checklists.
8. Go beyond the code: Medical imaging is a small part of the whole ecosystem for clinical practice. Once you have successful foundational research, move further into the path to commercialization.

Barriers/Challenges

There is a widely spread misperception that, once a model trained and tested in a research lab reaches acceptable performance metrics, the work is done and fame and fortune await. Alas, this is just the beginning.

Outcome

Following the suggested recipe should allow researchers to turn promising research endeavors into concrete and necessary steps towards building actual DL solutions that can be successful in realistic clinical settings.

Conclusion/Statement of Impact

The suggested recipe should help medical imaging researchers to build, document, and test solutions using the best tools, partners, and outlets for dissemination of their successes.

Lessons Learned

Building successful DL medical imaging applications requires much more than following the traditional DL workflow and producing promising research prototypes.

Keywords

Artificial Intelligence; Emerging Technologies; Imaging Research

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