MIRADA
The Imaging Software People

FAQ on Deep Learning Contouring

Q. What is Deep Learning Contouring (DLC)?

A. Deep Learning Contouring is a method for auto-contouring organs-at-risk and other standard anatomical structures using deep learning. The system is trained to imitate human contouring performance based on hundreds of training cases, and has been found to generate contours with greater clinical acceptance than previous auto-contouring methods.

Q. What is deep learning?

A. "Deep learning" refers to a set methods within the broader field of machine learning and artificial intelligence that use a particular type of rich and complex model when training a system to perform particular tasks.

Q. What is meant by training?

A. Think of the model as a large machine with very many dials that can be adjusted. These represent the *parameters* of the model. Training is the process of 'tweaking' these parameters, i.e. the task of finding just the right combination of settings for the dials to get the machine (model) to behave as we would like. This process can also be described as learning, or optimizing, the parameters. Training usually needs to be carried out using a big data set where the correct response or behaviour of the model for each example in the set is known.

Q. What are neural networks?

A. Neural networks or 'nets' are one of the rich models that deep learning can use. Their design was inspired by the way that neurons in the brain pass signals around through a highly complex set of interconnections (hence the term network). Computer scientists first developed simple neural nets in the 1950s, with (artificial) neurons arranged in 'layers' that connected to each other. Nowadays, neural networks can have a very large number of layers, hence the term 'deep'. It is this depth that makes neural networks very expressive and capable of modelling highly complex data.

Q. Where does 'big data' fit in?

A. The large number of parameters (dials) in a deep network means that many examples are needed to train it. In the last decade or so, large data sets have become more widely available and this has made it easier to train the complex and data-hungry deep networks. In other words, big data has made deep learning possible, although it should be noted that other kinds of machine learning models have also benefited from large data sets.

Q. Why are GPUs important in deep learning?

A. Apart from the availability of big data and computers with sufficient memory to store it, technological advances such as the introduction of affordable graphics processing units (GPUs) have made it possible for users of standard desktop machines to train and apply deep learning models. While deep neural networks have very many parameters, training them can be parallelized, i.e. we can optimize different parameters independently and simultaneously. GPUs are designed to carry out these kinds of parallel operations and can therefore greatly accelerate the process of training deep learning systems.

Q. How does all this relate to AI?

A. Artificial Intelligence is an area of research at the point where Computer Science and Philosophy meet. It is concerned with trying to define intelligence and create it in machines. AI researchers have used a variety of different models and tools try to address their questions, and neural networks are just one of these. The complexity and richness of deep networks means that they are currently a popular choice for AI research but another approach may well be developed and replace them.

Q. So is DLC a form artificial intelligence?

A. Mirada's aim in developing DLC was to advance auto-contouring to a level that matches human contouring performance. In this sense, DLC might be considered a form of AI. For that reason, we have designed and implemented a modified form of the Turing Test (a classical test of AI) to evaluate its performance. However, DLC is *not* intelligent in the way that humans are, and cannot adapt/learn without explicit training. Instead, it imitates human performance in the task it was trained for, and is better described as machine learning.

Mirada Medical Ltd. Oxford Centre for Innovation, New Road, Oxford, OX1 1BY| +44 (0)1865 261410 | enquiries@mirada-medical.com.

mm7115-0