



CODATA – RDA

**Data
Schools**

Artificial Neural Networks 2 : Recent Developments

Roger Barlow Roger.Barlow@hud.ac.uk

New Material - beyond the course

1. GPUs
2. Big Data
3. Deep Learning
4. Face recognition

GPUs - Graphical Processing Units



Top end CPU (e.g. Intel i9) has 10 cores - can run 10 processes in parallel

Top end GPU (e.g. Nvidia TESLA V100) has 5120 cores - can run 5120 processes in parallel

5120 cores: 80 units of 64 cores all doing the same thing in shared memory

Historically driven by graphics for gaming: ray tracing, shading etc. for many objects

Parallelism - not suitable for programs involving branching

Memory caching only basic - best suited to intensive computations

CUDA programming language - extension of C/C++ (R for GPUs is also available)

ANNs tick all the boxes - get massive increase in speed

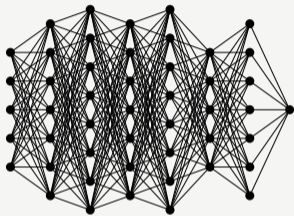


It's BIG! terabytes to petabytes

It's VARIED. Inhomogeneous. Collections of different types of data

- ▶ Weather/climate science data
- ▶ Astronomy: Sloan Digital Sky Survey. Multi-messenger (optical, IR, Radio, X-ray...)
- ▶ Genome data
- ▶ Government data - from the census and other records
- ▶ Data large organisations get from their activities
- ▶ Data generated by the internet

Lots of large datasets out there suitable for ANN training and analysis



Back propagation doesn't work well for more than a few layers

A weight in a late layer affects the result and is rewarded or punished accordingly - OK

A weight in an early layer affects the result through many different paths, some good some bad, and rewards/punishments tend to wash out

Instead: Encourage early layers to pick out *features* - maximise spread of outputs

Then use supervised backpropagation learning in later layers

Use this to recognise useful features and prune useless ones

Needs enormous training samples and superfast computers - which we have

Very powerful and enables many new applications

Face recognition

What's not to like? It lets your phone recognise you

Humans very good at this - *Fusiform Gyrus* in the brain devoted to it

Tough problem for AI techniques - early methods had very low accuracy

Now progress! 'DeepFace' and other techniques using deep Neural Nets

Banned in San Francisco, Boston etc.

IBM, Microsoft, Amazon won't sell to police



- ▶ Can be inaccurate. You look like a criminal and get arrested. **Fix: improve the technology**
- ▶ Can be accurate but incorrectly applied. You walk past a bank the day before a robbery and get hauled in as a suspect. **Fix: educate the cops**
- ▶ Can be accurate and correctly applied but misused. You take part in a peaceful demonstration. The regime locks you up. **Fix: none**

Summary and future talk



1. You learnt what an ANN was and you set one up and used it
2. Deep learning adds to their power- helped by Big Data and powerful GPUs. But there is a dark side.
3. Tips on teaching your own course