



Adaptive Beamforming for future ITS

A neural network approach to antenna beam steering for mmWave Systems

Clifford Beta

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- multi-gigabit-per second communication

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- very low latency

- Autonomous driving



- Autonomous driving
- Immersive gaming



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- Virtual reality



Applications

- Autonomous driving
- Immersive gaming
- Virtual reality
- **Augmented reality**





Increased vehicular mobility

Need for constant beam
realignment.



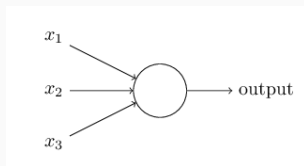
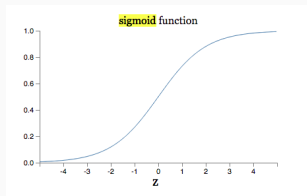
Neural networks have been proven to have the ability to compute any function, even

{Sequence prediction problems}

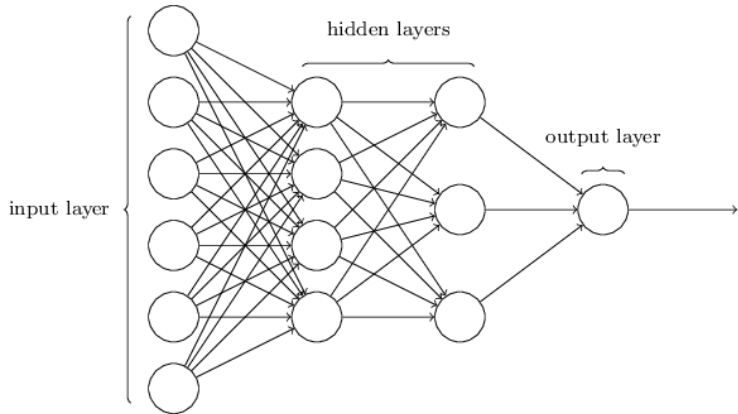
at which *LSTMs* shine ...

Neuron

$$\sigma(z) \equiv \frac{1}{1 + e^{-z}}$$

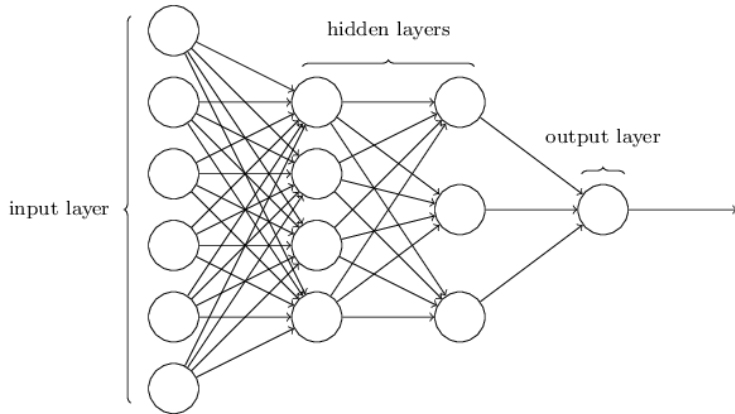


Neural Network



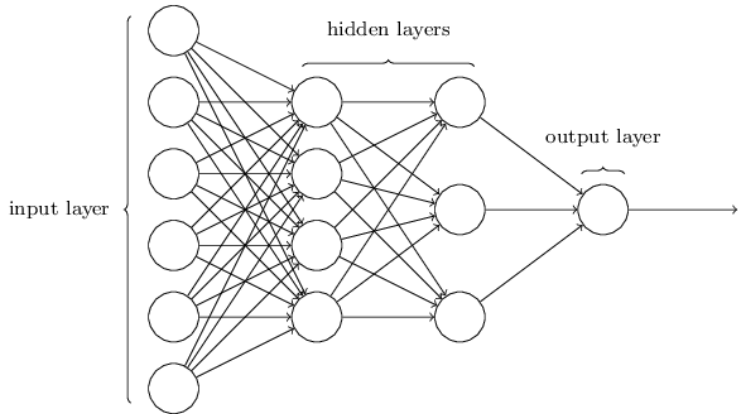
- Feed forward Neural Networks

Neural Network



- Feed forward Neural Networks
- Recurrent Neural Networks

Neural Network



- Feed forward Neural Networks
- Recurrent Neural Networks
 - Long short term memory RNN (LSTM)

Implementation

Model LSTM

Training data GPS co-ordinates

Testing

Verification

Beam forming algorithm - selection of an appropriate beam forming algorithm

Deployment

Higher SNR

Interference avoidance and rejection

Higher network efficiency

Questions?