Independent Study Proposal

# Paper Title

“A Review of the Impact of Deep Learning in Practical Contemporary and Near-Future Applications in the 21st Century”

# Aim

To research and study the current applications, techniques and implementations of deep learning used in the current day. This paper will focus primarily on extant or near future applications, looking to summarise the current progress in using deep learning as a tool for real scientific, medical, commercial and industrial use. Attention will be primarily paid to areas that have widespread applications or strong potential for marketing to a global market. The primary goal of the paper will be to assess what future innovations and changes we can expect to see in the 21st century from deep learning, specifically significant changes that will impact the average person’s life.

# Plan of Work

1. Research and collect sources of information on deep learning from journals, conference proceedings and other current academic sources
2. Obtain approval on the proposal given.
3. Write an initial draft for an introduction to the general topic of deep learning and the methods of information gathering
4. Summarise current material gathered and obtain initial conclusions, completing the 1st draft
5. Further research and gathering of sources into areas of interest and aspects that are discussed but require more detail. Make changes according to feedback on 1st draft
6. Summarise new sources and integrate new information into a more detailed and comprehensive summary
7. Form final conclusions from summary of the topic, concluding with results of study, completing a 2nd draft
8. Revise paper for a 3rd draft, using any feedback I may have obtained
9. Final proofread and hand-in

# Structure

* Introduction
* Methods
* Scientific Applications
* Medical Applications
* Commercial Applications
* Conclusions
* References

# Useful References

Erdmann, M., Glombitza, J. and Walz, D. (2018). A deep learning-based reconstruction of cosmic ray-induced air showers. *Astroparticle Physics*, 97, pp.46-53.

Huval, B., Wang, T., Tandon, S., Kiske, J., Song, W., Pazhayampallil, J., Andriluka, M., Rajpurkar, P., Migimatsu, T., Cheng-Yue, R. and Mujica, F., 2015. An empirical evaluation of deep learning on highway driving. *arXiv preprint arXiv:1504.01716*.

Litjens, G., Kooi, T., Bejnordi, B., Setio, A., Ciompi, F., Ghafoorian, M., van der Laak, J., van Ginneken, B. and Sánchez, C. (2017). A survey on deep learning in medical image analysis. *Medical Image Analysis*, 42, pp.60-88.

Najafabadi, M., Villanustre, F., Khoshgoftaar, T., Seliya, N., Wald, R. and Muharemagic, E. (2015). Deep learning applications and challenges in big data analytics. *Journal of Big Data*, [online] 2(1). Available at: https://journalofbigdata.springeropen.com/track/pdf/10.1186/s40537-014-0007-7?site=journalofbigdata.springeropen.com [Accessed 24 Jan. 2018].

Yuan, X., He, P., Zhu, Q., Bhat, R.R. and Li, X., 2017. Adversarial Examples: Attacks and Defenses for Deep Learning. *arXiv preprint arXiv:1712.07107*.

Zhang, Z., He, Q., Gao, J. and Ni, M. (2018). A deep learning approach for detecting traffic accidents from social media data. *Transportation Research Part C: Emerging Technologies*, 86, pp.580-596.

Appendix (Initial Draft Work)

# Introduction

Deep learning is a type of neural network based machine learning that involves using a set of multiple hidden layers, typically at least 6-10, of nonlinear processing units for feature extraction and data transformation. Each layer composed of *n* number of nodes feeds the next with connections made between each layer’s nodes to the next. The great number of connections made between nodes means exponential increases in complexity when expanding the number of layers and/or nodes. This makes deep learning, as a highly complex model of neural network, very computationally expensive when compared to traditional algorithms. A large proportion of the computational power used will not necessarily be used within the calculations performed on a prepared network but the training of a network, the length of which is directly tied to the number of connections within a network.

Learning can be supervised, semi-supervised or unsupervised. Supervised learning consists of teaching a network to recognise patterns based on learning the values of pairs of input and output values fed to the system. The network will adjust to these values, called a training set, to prepare it for receiving novel data. In theory a trained network will be able to adjust itself to recognise novel data presented to it and accurately calculate the correct result intended by the training process. Semi-supervised learning is a technique in which unlabelled data is mixed with the training data, which can improve the learning accuracy of a network. A problem with supervised learning is that often a network may be trained too specifically towards training data. In contrast, unsupervised learning does not have predicted accuracy due to the lack of concrete examples from which the network can learn. However a network will still be able to detect and learn patterns and similarities between data sets available to it.

# Initial More a Narrative than 1st Draft Methodology

An initial search performed on the University of South Wales Library portal, looking for articles associated with deep learning. For this purpose, I used multiple searches using the additional key words of “medical”, “scientific”, “commercial”, “industrial” and “applications”. An initial selection process involved picking articles and conference proceedings based on their relevance to deep learning. From here I went into each article and downloaded a PDF copy where available and any associated articles I could find that were presented on the website. I found a large quantity of articles available, particularly on the website “ScienceDirect” and downloaded a few dozen linked articles. Going further, I searched directly on the ScienceDirect website for articles on deep learning and found many. I then followed this up with a set of searches on google scholar, JSTOR, arXiv and Jurn. JSTOR unfortunately has a paywall preventing me from using that source but I obtained many useful articles from google and Jurn. Of note several of these journal search engines linked to each other and my searching involved going back and forth between different websites. This initial data gathering was to find a great deal of material on the subject I am covering, followed by a later culling of inappropriate or poor sources.

My initial gathering of articles en masse without appreciable quality control yielded 93 articles of interest about deep learning. All articles gathered mention deep learning within the title or the abstract. I will cull this greatly through a skim read of the article to determine the suitability of each article to this review paper. Approximately 30 articles were carefully picked out one by one in a manual fashion. The remainder were collected through links to associated papers.