Methodology to read an AI paper

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Reading research papers in artificial intelligence is essential for practitioners and researchers in this constantly advancing field. They need to keep up with the state of the art models and technology. However, as noted by [1], reading research papers is a difficult task and can be time and energy consuming. This document proposes some best practices for reading research papers, which is inspired by our research work at Uncharted Technologies with some inspiration from [1]. This document has been written by William Clements[1] and I.

1 Objectives of reading a research paper

There are three reasons to be motivated to read a scientific article:

- *General knowledge*: Some fundamental papers in the field of artifical intelligence are part of the core knowledge expected of all practitioners in the field, as innovation often comes from combining these concepts. Examples of such fundamental papers include the DQN paper [2] and the GAN paper [3]. Some other papers, despite having a lesser impact, are worth reading as they may provide an introduction to some important aspect of artificial intelligence. Papers dealing with uncertainties in neural networks, generalization, or industrial use cases would fall into this category. An easy way to evaluate the a foundational paper is to look at the number of citations.
- *Creating or maintaining an expertise*: If you work in a company or conduct academic research, you are often expected to have an expertise in a certain branch of machine learning (computer vision, NLP, reinforcement learning for example). Then, you regularly have to read new papers in your area of expertise for staying up to date.
- *Unlocking a research question*: If you face a scientific problem in your work (let's say a prediction task in computer vision), and that you are stuck with a scientific problem relative to an other branch (let's say imbalanced dataset or noisy images), you may need to search for solutions developed in the academy/industry (GANs for example). As I said in the introduction, most innovations are made by combining different fields.

2 Methodology

This is the methodology I personally use when I am confronted with a research paper:

2.1 Should I read the paper?

1. **Read Title and Authors**. From this information, decide whether the article may fall into the three reasons mentioned above for reading a paper. To check if it is a General paper, we can check the number of citations and the date on Google Scholar.
2. **Read Abstract**. If this is uninformative then also read the **paragraph in the introduction in which the authors present their contributions**. I also sometimes read the **Section/subsection titles**. This should be enough to decide whether this paper falls in one of the three categories. If it does, then the paper is worth reading. Before continuing, you should mentally answer the following two questions:
    - Where does this paper fit into my current knowledge?
    - How will reading this paper be useful for me? Try and be specific.

This entire process takes me about 10 minutes.

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2.2 How should I read the paper?

If I passed the previous section, the paper is worth investigating further.

Preparation: To prepare for the next step, I usually go superficially through the article, re-read section and subsection headings, skim over the figures, and read the conclusion. This helps me understand how the paper is structured, and will help in reading it. This reading may also lead me to reassess my judgment of how the paper and its usefulness.

Define the objective: Now I have to decide how much of the paper I want to understand, from the general idea to a deep understanding of the concept. Obviously it is not possible to read all papers with the same degree of understanding. We noted 3 main objectives: **Getting a superficial idea** of the paper (problem tackled and some general ideas of how the authors did) ; A **More deepen understanding of the methodology used by the authors** ; **Working on this paper** (meaning having a strong understanding theoretically by reading the proofs or experimentally by reproducing the experiments).

Here are the steps I follow for the first two objectives (the last objective doesn't happen very often and depends on everyone in my opinion. I will briefly talk about it in a section below):

Skimming reading	**Good reading**
Read Related Work	Read the introduction and related work
Read first couple of sentences of each paragraph in the theory section	Read theory section
Read the discussion	Read the discussion
Look at the figures	Look at the figures
Read the algorithm	Read the algorithm
Don't read the experimental section	Skim Experiment section
	Examine references for relevant papers
About 15-20 minutes	**About 40-60 minutes**

Note that I usually don't spend much time on the experiment section as experiments are usually very good and often follow some standards (famous datasets (MNIST, CIFAR, Atari envirionment,... and typical benchmarks).

3 Archiving

Archiving the papers is extremely important for two reasons. First, it forces me to carefully think about the papers and how they fit into my knowledge base, thus improving my understanding of them. Second, archiving the papers with proper annotations means I can easily refresh my memory when needed. If I do not archive the papers, I easily forget them within a few months. To keep track of my readings I personally use **Mendeley**.

3.1 Information to archive

I try to archive papers with the following annotations:

- The problem the paper tries to solve, and how it solves it.
- A few notes containing salient points of the paper.
- A grade as to the importance and quality of the paper

4 Working on a paper

In some cases, one can be lead to use a research paper as the foundation on which to develop a new algorithm, either as part of a commercial solution or as a research project. This requires a much more careful reading than what was described earlier. In this much more careful reading, I take several notes, and I try to be able to mentally reproduce every step of the reasoning behind the paper and of the experiments that were completed. I also read the references very carefully.

5 Some Global knowledge papers everyone should have read (To be continued)

These are some fundamental papers worth reading in machine learning.

- LeCun, Y., Bengio, Y., & Hinton, G. (2015). **Deep learning**
- Goodfellow, I., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., ... & Bengio, Y. (2014). **Generative adversarial nets**
- Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., ... & Polosukhin, I.**Attention is all you need**
- Mnih, V., Kavukcuoglu, K., Silver, D., Rusu, A. A., Veness, J., Bellemare, M. G., ... & Petersen, S. **Human-level control through deep reinforcement learning**
- Mnih, V., Badia, A. P., Mirza, M., Graves, A., Lillicrap, T., Harley, T., ... & Kavukcuoglu, K. (2016, June). Asynchronous methods for deep reinforcement learning. In International conference on machine learning (pp. 1928-1937).
- Silver, D., Lever, G., Heess, N., Degris, T., Wierstra, D., & Riedmiller, M. (2014, June). Deterministic Policy Gradient Algorithms
- Bellemare, M. G., Dabney, W., & Munos, R. (2017, August). A distributional perspective on reinforcement learning. In Proceedings of the 34th International Conference on Machine Learning-Volume 70 (pp. 449-458). JMLR. org.
- Koren, Y., Bell, R., & Volinsky, C. **Matrix factorization techniques for recommender systems.**

References

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[2] V. Mnih, K. Kavukcuoglu, D. Silver, A. A. Rusu, J. Veness, M. G. Bellemare, A. Graves, M. Riedmiller, A. K. Fidjeland, G. Ostrovski, *et al.*, "Human-level control through deep reinforcement learning," *Nature*, vol. 518, no. 7540, p. 529, 2015.

[3] I. Goodfellow, J. Pouget-Abadie, M. Mirza, B. Xu, D. Warde-Farley, S. Ozair, A. Courville, and Y. Bengio, "Generative adversarial nets," in *Advances in neural information processing systems*, pp. 2672–2680, 2014.