

Regarding Machine Learning and ART Models

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Before learning about ART Models, I read about the stability-plasticity dilemma. In my view, machine learning models function similarly to the human brain: it depends on age and requires plasticity for receiving new knowledge, but also stability to prevent previously acquired knowledge from being forgotten. ART Models may help solve this dilemma by helping the models learn new information while retaining previous ones.

After reading your research articles and some selected literatures regarding ART, I have learnt more about how machine learning and its paradigms can be used in a variety of applications. In particular, I became familiarised with ART models, from original ART Models (e.g. the discrete ART1, continuous ART2, Fuzzy ART, etc.) that are based on the principles of unsupervised learning, to its generalisation of creating Fusion ART Models that learns from multiple pattern channels instead of one and uses several machine learning paradigms (unsupervised, supervised, reinforcement, multimodal, etc.). The study is interesting because we are developing models that learn and retain information, and then use it for recognition and prediction as though the model has a brain of its own.

Moreover, what is particularly interesting is that Fusion ART models use multiple pattern channels, and the pattern channels will always have an input with all input vectors initialised to 1s, which ensures that Fusion ART Models will be able to process as intended. Another algorithm derived from Fusion ART, FALCON, is intriguing in terms of its applications, and how its efficiency/success rate increases with each simulation. I have also taken a read at Professor Carpenter's article titled "Adaptive Resonance Theory", which provides an introduction of ART's search cycle, process and how they can learn from experience. As I see it, I believe I can use my existing knowledge of machine learning paradigms to research more about ART and its applications.

There are notable advantages and disadvantages worth discussing as well. For instance, although ART Models are effective in developing bots that learn information, the weight vector should not be changed significantly upon each iteration. Otherwise, the model would forget previously acquired information and would have to be retrained. This would defeat the purpose of solving the stability-plasticity dilemma. Further research would suggest examining the most optimised change in weight vectors.

What intrigues me the most is how these models can be applied. As an avid gamer, I find it fascinating how TD-FALCON, a class of FALCON and an instance of Fusion ART, can be used to develop bots in video games. The algorithm itself does remind me of the principle of Markov processes, where states are updated after each iteration. For instance, your article mentioned how bots can be developed in Unreal Tournament while assessing their performance through their actions, such as killing an opponent, increasing its health or collecting a new weapon by implementing a game score. Through various simulation trials, the bot can be seen to perform better in terms of game score by learning from previous trials, especially when implementing combinatorial operations.

It is intriguing how these models can be trained using simulation to perform better. This is reminiscent of my interest in AlphaZero, a computer program that learns strategies in Chess and Shogi, which sparked interest from both expert players and the general populace. Implementing this bot within the video gaming field would prove beneficial for gamers who would like to challenge themselves by playing against bots that perform better with every game, or people who would like to play against bots with various difficulties. Another implementation I find interesting is TD-FALCON's use in developing autonomous vehicles, particularly for navigation and mine avoidance. With better performance the more trials it has, the model can ultimately be used to implement self-driving vehicles for consumer use.

Moving forward, I think there are many areas that we can research further using ART Models as the underlying theory. One instance is that we could extend TD-FALCON's application to strategy and board games. The models can learn from players' behaviour from previous games. This is innovative in the sense that such a game would prompt players to develop new strategies to beat the game. Moreover, we could develop models for the same field but with more optimised parameters. As efficient ART Models are about finding the balance between stability and plasticity, we could explore better weight vectors and vigilance parameters. For instance, as a high vigilance produces more specific memories and lower vigilance produces more general memories, a model would learn faster and perform better with a better tuned vigilance parameter.

I believe my programming skills could contribute to your research, from retrieving and filtering datasets, to assisting you in developing machine learning models for a variety of applications. I would also love to help by suggesting fields in which such models can be implemented. Thanks to my skillset and motivation for this research topic, with the appropriate training, I believe I can assist you in developing ART models with any programming language required. My main programming language is Python, but I am willing to learn and work with Java or front-end languages, as mentioned in our interview, if required.

All in all, I am excited to explore how ART models can be used in computer science, especially in games and simulations. Hence, I would love to have the opportunity in contributing to your research.