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**Reframing the Frame Problem Problem**

The advent of modern computing has allowed for Artificial Intelligence (AI) to take the spotlight in the eyes of the mass media. More than ever, ‘novel’ solutions using some form of Deep Learning and Artificial Intelligence have appeared. For example, just recently, major graphics processing unit developer Nvidia released Deep Learning Super Sampling (DLSS) 3.0, an AI algorithm which generates entirely new frames in games to allow for an overall smoother feeling gameplay (Introducing NVIDIA DLSS 3, n.d.). However, as AI gets more generalized and more advanced, there is growing concern that AI may run headlong into the wall that is the frame problem. However, I posit that given techniques such as the default logic solution, the frame problem is a non-issue for AI in its current and near future forms.

To begin with, the frame problem, in the narrow sense, is as follows: trying to write a concise formula to “describe the effects of actions without having to write a large number of accompanying formulae that describe the mundane, obvious non-effects of those actions” (McCarthy & Hayes, 1969). A common example would be having red bucket in a house. Two rules are given, that colour of an object holds after painting it, and that the position holds after the movement. After a command to paint the bucket blue, it is followed by a command to move the bucket out of the house. Intuitively, one knows the bucket in the garden is still blue, but this is not explicitly linked in the axioms. As such, more axioms are required to link them together. As the number of variables rises, so to do the axioms.

In the wider sense, the epistemological frame problem is that, when given an artificial intelligence such as a robot, how does it know the limit the scope of prepositions that arise from an action? Given a real world scenario, for example getting a cup from the shelf, an AI robot would have many different datapoints regarding the facts of the surroundings, such as sunlight, temperature, sounds, the location of cup, etc. The problem arises in finding out which points are relevant and should be updated, such as if there is a spoon in the cup. (The Frame Problem. To differentiate it from the computational aspect, the key is how the robot could ever determine that it had successfully revised all its beliefs to match the consequences of its actions. (Stanford Encyclopaedia of Philosophy), 2016b).

The reason that the frame problem is an issue for AI research is therefore twofold. Firstly, resources and energy, while large, are finite. Therefore, there is a desire to compute axioms efficiently, allowing for AI to be placed in smaller, cheaper, and more portable hardware. Secondly, if the epistemological frame problem is unable to be resolved, then a true ‘Artificial Intelligence’ will be unable to be created, since the AI would be unable to judge by itself what should be ignored as a matter of ‘common sense’

On that note, I would be arguing largely against the narrow-minded problem, as in terms of the wider populace, AI has become a popular term to throw around, and has encroached on machine learning models. This will be further explained in the end, for better readability.

To combat the frame problem, many solutions have been proposed. One such example is the default logic solution, where rather than having all variables be linked together to form axioms which ‘hold’, one adopts the principle of ‘letting sleeping dogs lie’. By having an overarching axiom that states ‘that all variables hold unless otherwise specified’, linkages between independent variables can be removed. In Cognitive Wheels, The Frame Problem in AI, Dennet writes that “The demand for an efficient system of information storage is in part a space limitation, since our brains are not all that large, but more importantly it is a time limitation, for stored information that is not reliably accessible for use in the short real-time spans typically available to agents in the world is of no use at all.” By optimising out independent variables, the default logic solution reduces the time and space complexity. This can be effectively seen in a very common and relatively fast (to run) programming style, object-oriented programming, where attributes of objects do not change unless acted upon. Since in the wider world, when dealing with basic actions, a great many variables can be considered unnecessary intuitively (when building the AI), shrinking the number of variables and therefore linkages. Thus, this is effective in solving the narrow-minded frame problem to some extent.

However, when dealing with more complex issues, such as natural language processing, the amount of variables that are required are larger, due to the fact that even humans do not understand the true requirements to process natural language. With such ‘softer boundaries’, the frame problem would continue to exist, since different contexts affect the meaning of the language differently.

To solve this, however, one can train AI models to work in specific situations, with another AI model to overall govern when to use the specific ones. This division of labour is a common practice in many games to simulate enemies or computer controlled characters. For example, in Alien Isolation, the titular “Xenomorth” has 2 different main AI systems which work hand in hand. These are the director or ‘macro’ AI and the Alien or ‘micro AI’. The director guides the micro AI and gives it hints on where the player might be at, and tells it when to back off. Meanwhile, the micro AI (which in itself is a collection of smaller AI models) handles everything from moving limbs to actually sensing and hunting the player. (Thompson, 2017). By breaking up different aspects of a complicated issue, one is able to provide a semblance of intelligence.

That said, it is apparent this does not cover the epistemological aspects of the frame problem. However, in the current and short term future, I believe that this would not be a problem. As previously mentioned, current breakthroughs in what the wider public deems as AI, largely boil down to machine learning models. Even courses in the University of Waterloo that deal with AI, the syllabus provides an in depth look in machine learning models (VanBerlo, n.d.). Therefore, to a wider audience, AI is analogous to machine learning. Hence, the frame problem that a large number of AI engineers would be worried about, are the narrow-minded ones. AI models are still imperfect even it its narrow-minded form, and ultimately the illusion of intelligence is easier than actual true intelligence. As previously mentioned, many AI systems in games can be boiled down to decision trees, where one takes a counter action depending on variables hard coded into the game. However, when implemented correctly, they simulate a human mind shockingly well. For example, in Shadow of Mordor, orcs which were given advanced decision trees, as well as a large amount of voice acting and animation, created a memorial experience for players using the Nemsis system.

In conclusion, in the current and near future, the problem of the frame problem is largely a non issue. As humans push the boundaries of what can be modelled with a simplified model, and aim to pull back the curtain by separating true ‘Artifical Intelligence’, however, the epistemological aspects of the frame problem may rise up to be a greater issue in AI development.

Citations:

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