

Motivation for the NeumenaMind Cognitive Engine DRAFT-Unfinished!

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Introduction

The purpose of this short essay is to introduce some of the basic underlying tenets for the use and application of the NeumenaMind Cognitive Engine (NMCE) in an entertainment product. It also provides a high-level road map for the future of the NeumenaMind-CE and its associated tools. This essay is written in a conversational tone and does not attempt to be an in-depth, rigorous treatment of any mentioned topic herein. This will follow in a further publication (either through a book or as a series of white-papers on the website).

The main impetus of NeumenaMind is the ability for a software product (which in this case is a computer game) to learn, retain and apply learnt knowledge to similar situations in the future. This is a tall order, as it implies that the AI engine has the ability to not only play the game, but it also has the ability to recognize situations, events, relationships, predict future events, predict without immediate action and the ability to not only recognize situations that are “sorta-like” a past event, but also, how-to eventually exploit the said situation.

Objective

The long-term objective of the NeumenaMind cognitive engine is the ability to create generalizations with the eventual ability to formulate analogies. Why is the ability to generalize a situation important to the development of a game? Grounded in the very practicality of the setting, we would no longer need to engineer specific rules to govern every current and eventual situation that may occur in a game. We would only need to engineer basic guidelines or more specifically, atomic actions that would get pieced together to formulate a response. A response could either be an immediate action, the generation of a thought, or the generation of an internal simulation. Another capability of a system that exhibits the ability to generalize, is that through the internal disparate representations of amalgamated components, the cognitive engine gains the ability to generate new conclusions from independent resources. This ability to essentially extract information from domains other than the currently experienced context is what will allow for, not only the ability to generalize, but the construction of the generalized concepts that eventually lead to the ability to analogize.

The motivation for writing the NeumenaMind-CE is also a very personal endeavor. How people approach and solve problems is obviously very different than how computers are engineered to solve those exact issues. The quickest route may then seem to be to duplicate or replicate every neuron, every bit of glial, every dendritic connection and the like from our brain onto a computer, but mother nature has had millions of evolutionary years selecting and repressing aspects of physiological structure. Even if we could simply replicate our brain's physiological makeup onto a computer – it still leaves open for debate whether our minds, our consciousness, would surface. While I'm not advocating the duplication of how the brain and the mind work (even if that were even possible on today's hardware), what I am

however advocating is that there are definitely some systems inside us, that may make the eventual ability for a machine to learn more reasonable if they were understood and modeled. In a subsequent publication I will lay the groundwork for duplication of a process similar to homeotic expression.

The general approach for NeumenaMind has been one of practicality. Evolution is if anything practical – if a specific feature is not needed, makes a species vulnerable, or is never required for survival – basically the lack of any type of reinforcement, then it is eventually suppressed. As William James stated in Psychology the human brain was not designed to think abstractly, it was constructed for survival in a specific environment. That means our brains are built as they are, as an embodied organism, structured as it currently is, for survival. Suppression within NeumenaMind comes at varying degrees – suppression within the short-term memory, suppression with long-term memory, and finally after enough time has passed, the temporal links that maintain an association to other older thoughts are eventually at a point that temporal decay removes them from the engine's very existence. Till that time occurs there is always the possibility that the older, albeit suppressed systems may eventually be reactivated (to some degree – temporal decay also effects systems that are reliant upon the core information and when pieces fall away, there is the possibility that NeumenaMind will only remember part of a suppressed feature).

The atomic elements of NeumenaMind are neuronal nodes, sets, polysets, engrams, and links of differing varieties (basic types such as spatial and temporal are supported as well as the more advanced types: similarity, associative, spatio-temporal, and containment). As should be expected some of the link types only occur at certain granularities. A system that reinforces “structural stabilization” is constantly at work – it is perhaps one of the most important systems in a distributed representation. Structural stabilization is auto poetic, in that while new information can be integrated, there are also mechanisms in place to maintain a stabilized structural representation thereby eliminating internal-external discontinuities.

There are several types of representation that can be used in a cognitive engine: direct representations, distributed representation and feature based representations. The simplest to implement and perhaps the most straightforward representation to explain is the direct representation. The direct representation is a one to one relation between an item (an entity, a relation, or really anything that is observed) and a single internal node of modeling. So if our cognitive engine sees a soldier in a field, internally that soldier will be modeled in one neuronal node. There is an obvious list of limitations with this representation; generalizations, concepts and analogy formation are crippled at best. This crippling is due to the fact that a single item needs to already have distinct generalizations and concepts built in about everything that it will ever have a possible interaction or relation with. Though a system like this is simple to understand due to the direct mapping of one item to one internal node, it also is not a suitable candidate for activation unit representation because for a cognitive engine we need to have the ability to generalize and formulate concepts - on our way to analogy creation. This is why the NeumenaMind-CE uses a distributed representation for it's internal modeling of memory.

For NeumenaMind to interact with the environment, to draw conclusions from the environment, to establish predictions, or even to generate predictive relations between entities in the world, it needs the ability to order its subjective output. This subjective output is termed a consequence. Its through the generation of consequences that NeumenaMind eventually generates either an internal or external action. But before NeumenaMind initiates an action, it needs to generate a consequence and that is execute through what can be described as “structural exploitation.” Structural exploitation first begins with the ability to recognize the environment. This initial step is termed as “structural recognition.” To generate a consequence that can be considered “valid”, there must be a step or a series of steps that

generate a condition that can be exploited. This exploitive condition, is used to generate and influence consequences.

As Wittgenstein stated in Philosophical Investigations ..”learning occurs through doing..”, and this is what NeumenaMind provides for; with specific tools that facilitate learning within certain contexts. It's however through the application of certain predefined components, that learning can occur through and thus the eventual mapping through the NeumenaMind association engine. This hindbrain functionality is characterized as the innate components, of the cognitive engine.

The Game: Master of the Empire (MOTE) - Express

Developing a cognitive engine with the immediate application of the technology into a product, is one of the best way's to validate your technology. And this is exactly how NeumenaMind is being developed. The engine is being developed such that it solves real-life issues within the context of a computer game called Master of the Empire: Express (see Figure 1). The game is a straightforward yet addictive strategy game where players produce and move tanks, infantrymen, panzertroopers around a randomly generated world. The points of contention are originally the resource fields and the cities themselves, but once violent interaction has occurred between the players, terrain will also serves as a restrictive and focusing element in the equation.



Figure 1: Master of the Empire: Express v0.1

MOTE:Express is an ideal environment to verify a cognitive engine. From game to game the environment is variable, the situations are variable, but the components that makeup the world are not - they are fixed. The ambiguity and uniqueness is generated by the interrelations of the context with the variable and static components. Contexts include determination of avenue of advances, retreat, massing of strength, determination of a potential invasion, zones of influence, as well as the applicable use of game rules in unprescribed moments. These and others lend themselves well to testing of a cognitive engine in a nontrivial, grounded scenario.

Summary

Norbert Wiener stated once that, “Every prediction is an operation on the past...” and it's the intricate understanding of that phrase that we realize that without the past, our AI's are making blind decisions.

There maybe guiding heuristics, but, the past lessons, regardless of how painfully learnt they were, are lost into the sands of time once the game shuts down. What NeumenaMind accomplishes is the carrying forth of learnt knowledge and the ability to reapply, learnt experiences in situations that are similar to past events.

Bibliography

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