The Notion of Semantic Simulation

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I am personally interested in LLMs and the problem of modeling human-like reasoning in general. Related to this is my interest in tackling in a coherent way the problem of modeling of semantic inferences. Specifically, I am looking into a semantic inference model based on semantic structures governed by equations of evolution. Let me expound on the latter. I believe that in order to model human-like reasoning we need to pose the problem of extracting semantic meaning and generating semantic inferences in a different way than the existing methods adopted in LLMs. That is – we will define a *semantic simulation* as a process in which appropriately defined laws are governing the evolution through time of semantic structures populating the *semantic space* (or *simulation space*). Here *semantic space* is defined as a metric space with *N* dimensions. The chosen metric in that space is *the semantic distance*. Let us assume that this semantic environment accepts textual input which is partitioned into *text quanta*. A *text quantum* represents a portion of the textual information with inherent semantic meaning. Each new set of quanta introduced to the environment will result in creating a new *semantic structure* in the metric space. Think of this structure as a collection of *semantic particles* in this space. This collection of particles evolves using some laws of attraction and conservation of certain quantities defined in that metric space. Each semantic particle has intrinsic properties which characterize it. One intrinsic property to every semantic particle is its *semantic mass*. Another intrinsic property to each semantic particle is its *semantic energy*. The propensity of semantic structures and particles to combine together in larger semantic structures is modeled via *semantic attractive / repulsive forces*. Introducing new structures (corresponding to new textual input in the environment) in this space will alter the position, the movement and the composition of the existing structures. The distance (the metric) between two structures in that space will correspond to their semantic similarity. The closer semantically are two structures the smaller the distance between their centers.

Reinforcement learning in this environment is implemented via the mediation of particle properties such the semantic energy of the particle. Specifically, the acquired semantic energy of a semantic particle depends on its past trajectory and past trajectories of other particles. In turn the current position and the future movement of the semantic particle will depend on its semantic mass and acquired semantic energy.

Inference in that space is done by recognizing patterns in the created structures and their trajectories. Matching the recognized patterns will lead to creating new structures. The inherent semantic properties of the newly created (inferred) structures will determine the motion and trajectories which in turn will influence the existing semantic structures. Hence semantic inference will alter the semantic distances and composition of the structures in proximity of the newly inferred structures altering the semantic meaning assigned to the points in the region of interest.

For the purpose of understanding and modeling Semantic Inference I define a new construct *Semantic Template* which is essential to the correct execution of Semantic Inference. More details on this simulation environment as well as key definitions and formulations can be found in the links below:

https://github.com/dimitarpg13/aiconcepts/blob/master/docs/ModelingAttractiveRepulsiveForcesInSemanticProperties.pdf
https://github.com/dimitarpg13/aiconcepts/blob/master/docs/ReinforcementMechanismInSemanticStructureModels.pdf
https://github.com/dimitarpg13/aiconcepts/blob/master/docs/SemanticTemplates.pdf
https://github.com/dimitarpg13/aiconcepts/blob/master/docs/PracticalExamplesUsingSemanticSimulationWithRL.pdf