**Incentivizing agent-based modeling with respect to adaptive learning**

**Abstract**

Many domains outside of cognitive science as well as AI and machine learning have no grounding in the viability of agent-based models. Purpose of this manuscript is to explore a motivated direction for considering agent-based modeling across varying fields of study. A surface understanding of exploring philosophy of science talking points pertaining to integrity pertaining to the prospects of humanity are also addressed. This manuscript is a broad scope critique on considering understanding the role of agent-based modeling and how such modeling can motivate expanding our capacity of developing technology and potential glimpsing toward ethical considerations.

**Motivating agent-based modeling with respect to adaptation**

Adaptive autonomic dynamics are becoming increasingly more associated with what philosophy of science communities in particular as well as increasingly more of those among the academic institutions and research focused industry-based enterprises as the fundamental reinforcement constraints of biological organisms. Of interest to communities abroad largely revolves around the exploratory and problem solving potential of agent-based modeling insights and how they impact the improvement and development of technologies at scale largely centered around AI and Machine Learning. Largely of interest pertaining to the postulations made in this manuscript, concerns the scope of agential dynamics pertaining to understanding adaptive learning dynamics crucial to human behavior with respect to persisting fitness constraints. Adaptive learning dynamics considers the capabilities of us as humans individually and most especially cooperatively reinforce our fitness for better or worse with respect to complexity of stimuli-response dynamics responsible for understanding survivability constraints and goal-feasibility leverage constraints. Understanding the nested dynamics of individual as well as group fitness actions as cost of those actions enables a capacity to develop compositional models to explain and predict complex relationships of circumstantial behavior among individual and group contexts. Adaptive potential pertaining to individual as well as group fitness actions and costs of those actions are responsible for mitigating these constraints with respect to gamification dynamics regarding the individual with respect to environment as well as individuals with respect to each other among groups with respect to environment yields game theoretic modeling postulations.

Before discussing agential systems from first principles, perhaps it is necessary to address that the scope of focus regarding human behavior in this manuscript is not mutually exclusive to appreciable insights to inspire innovation most especially regarding AI and Machine Learning. Agent-based modeling enables not only the potential for better understanding human behavior, but also deriving means to deal with broad and acute constraints regarding scaling of the free market ecosystem with respect to a sustainable population and thriving economy. More directly, agent-based modeling becomes necessary for scaling technology for broad use-cases that associate some fashion with stability of the free market ecosystem and a thriving economy. Furthermore a broader and deeper scope of exploratory and problem solving capacities can be facilitated through agent-based modeling by describing phenomena as well as constructing system architectures to augment technological capacities that serve as extended cognition capacities for the groups and individuals associated with them to exploit those capacities. Exploiting those capacities however can be costly with respect to how sufficiently coordinated groups of individuals leverage resources with respect to constraints of utilizing those resources at the expense of a habitable ecosystem in which all agents are existentially bound to. Such perspective on motivations for investigating human behavior along with insights into AI and Machine Learning additionally considers reframing of the Gaia Hypothesis.

**Agential systems with respect to human behavior and systems as well as behavioral analysis**

Agential systems are also known as autonomous systems. These systems manifest degrees and compositional traits of functioning that are associated with some physiologically restricted capacity of agency. While the scope of examining the dynamics of agency largely pertains to human behavior as the realization of our multi-agent system of interest, it is best to derive single as opposed to multi-agent systems for those with lacking understanding of the dynamics at play. There can be many other realizations of other kinds of agents rather than addressing human behavior more directly. That is not to say there is no reason to explore the dynamics of other types of agential systems, but that is broadly too much content to cover in this manuscript and quite verbose. Such systems have the capacity of compositional hierarchical decision-making dynamics which correspond to Daniel Kahneman’s System 1 and System 2 modeling of decision-making behavior. Jonathan Haidt’s The Rider and The Elephant model complements the load balancing capabilities of System 1 and System 2 modeling while providing insights into complementary heterarchical dynamics. Realizable systems that are inspired by agents through their capacity to instantiate traits of agency although lack enough traits to realize actual agency are known as agentic models or agentic systems among the AI and Machine Learning community.

Primarily agential systems are of two types; single agent and multi-agent based. Single agents as understood through the intricacies of biological organisms, exhibit fewer degrees of freedom of agency to interact with their environment and lack cognitive capacities necessary for self-reflection faculties displayed by humans. As multi-agent systems, we humans are composed of many single unit cells as singular agents coordinating with each other to maintain organ systems that maintain our being as a whole functioning organismal ecosystem. Additionally these multi-agent capabilities yield the collective coordinated capacity of agents to give rise to our self-reflection capabilities needed to reliably harness our decision-making potential. Even more contingent to those self-reflection capabilities as we compare ourselves to other varieties of multi-agent and single agent systems… realizing that we are one of few varieties of multi-agent systems with such cognitive capacities of self-reflection. Let alone we are among the few who are able to contemplate our own existence in the first place.

Many philosophically deep analogies can be made about systems that harness the capacity to be aware of themselves. Aware of themselves potentially to such a degree of sophistication to realize the bizarre yet bewilderingly phenomenal aesthetic representation of the universe which comes along with the potential appreciation of it existing in the first place. Such profound philosophical fluff is inconceivable without the cultural dynamism of language structure pertaining to the prospective capabilities of human societies at large. Humanity seems to have deemed itself to become an apexing superorganism within the ecosystem in which it is existentially bound to and co-inhabits with other species of agents varying between varieties of single agent and multi-agent based systems. Such an achievement of humanity for better or worse can lead to its continued thriving as a superorganism, a controversially declarative second force of nature if you will… while also being capable of poorly coordinating itself with respect to its ecosystem and other co-inhabiting agents leading to the annihilation of itself as an entire species.

Such implications lead to the profound appreciation of decision-making dynamics pertaining to the symbiotic and synthbiotic coordination potential of agents. Single agent systems exhibit marginally simplistic decision-making faculties at scale as opposed to their multi-agent counterparts. It is hard to argue whether the amoeba on an agar plate in some lab exhibits more agency than a dandelion outside my apartment. Perhaps their agency operates at different timescales and different niches of function regarding their role within the ecosystem they are existentially co-inhabiting. A profound implication can be made regarding human agency pertaining to the role of humans to be proportionally biblical in terms of generalizing their role as stewards among the ecosystem in which they are existentially bound to co-inhabiting with other varieties of agents.

As briefly mentioned, agency is exhibited at multiple time scales and diverse niches of function with respect to the agent in question. Clearly we are considering the model agent of interest to be our multi-agent system of interest, us humans. Physiologically bounded cognitive capacities resemble the varying dynamics of agency that are enabled over-time. These varying dynamics of agency furthermore enable the agent’s continued existence in some constrained fashion relevant to the agent’s role within the ecosystem it is existentially bound to and co-inhabits with other agents with diverse roles. All agency is bound to stimuli-response dynamical mechanisms regarding an agent’s capacity to interact with its environment and other agents. Agents exploit intention and motivation to preserve their existence and optimize their capacity to leverage eventual degradation of agency.

A first principles approach to understanding embodied cognition as appropriated to the degrees of agency of arbitrary agents

As with classical systems, we have to consider the fundamental input-output and circuitry in which the overall agential system behaves by reducing to fundamental operations and functions that yield more complex compositional intricacies. These compositional intricacies vary among each other but are crucial to the anatomy and adaptive physiological capacities of an arbitrary agent to sustain itself for an existentially finite yet persistent amount of time. Compositional nesting of circuitry in which input-output dynamics are facilitated correspond to stimuli-response mechanisms associated with sensory and actuator based operations and functions. Sensors are bombarded with stimuli that are externally associated with the singular sensor in question. Actuators respond to loads of sensor signaling associated with the singular actuator in question.

Generally there exists a variational spectrum of coupling to associated pairings of sensors and actuators with respect to processing stimuli-response loads. Degrees of agency pertaining to an arbitrary agent’s overall agency is contingent upon the complexity of these couplings and their nested hierarchical as well as heterarchical processing associations. Granted the reading audience on average probably has no idea what I mean by heterarchical processing, a sigh of relief ensues considering the prioritization of hierarchical processing associated with compositional nesting dynamics of coupling associations between pairings of sensors and actuators. A function is a composition of operations associated with processing loads. Compositions of functions must exist in which nesting of functionals as operations are embedded with semi-finitely combinatorially reducible operations of associated couplings. Heterarchical processing complicates the matter in which there may exist quasi-enumerable combinations contextually associated with an agent’s fitness and the integrity of compositional intricacies for said agent to sustain its existence until graceful degradation of degrees of agency hits its limits.

Couplings consider that all compositionally nested combinations of sensors and actuators involved have dynamical contextual limitations with regard to their distributed load processing of inputs to outputs impacting the integrity of the agential system in question with respect to its localized and non-localized existential embedding pertaining to the role of the agent with respect to the ecosystem. Heterarchical processing concerns the tuning dynamics of couplings with respect to the integrity of an arbitrary agent with respect to prioritizing input stimulus to output response signaling payloads. Semi-finite reductions of behavior then pertain to the contextually quasi-enumerable combinatorial bounding of localized and non-localized capabilities in which agents interact with their surrounding ecosystem as well as other agents. All these complex intricacies of compositional nesting combinations of sensors and actuators have the potential to give way to emergent, generative processing feedforward and feedback dynamics along with their causal associations relating to affective processing loads.

Affective processing loads motivate the very nature of embodiment, sometimes better known as embodied cognition, referring to the range of interactive potential possibilities of high-ordering relational based compositional nestings of said couplings of sensors and actuators. Stimuli get fed to sensors which then are fed to actuators. Coupling denotes that there are dynamical variations in which structural associated pairings of sensors correspond with some associated pairings of actuators. Neural and glial cell dynamics provide some of the more intuitive examples of these couplings. Neurons have dendrites as sensors and axons as actuators, while glial cells are support structures that mitigate temporal scaling dynamics of synaptic networks of associating neural and glial cells with hierarchical and heterarchical coordination of load processing. This load processing in essence is cognitive, meaning that it considers the intricacy based compositional nesting constraints that can handle inputs and outputs of stimuli and response to stimuli, enabling an agent’s decision making capacities to be facilitated in order for it to optimize its fitness leverage overtime.

Optimizing and sustaining fitness to a sufficient degree depends on an agent’s capacity to utilize its complex intricacies of sensor and actuator mechanics within a coherent bounds of dynamical degrees of freedom to interact with its environment and maintain a satisfactory optimal dynamical state of persisting existence in the first place. This capacity of self-regulation regards an agent to coordinate its integral whole referring to compositional nesting combinatorial partitions of associated sensors and actuators that associate with some combinatorial chaining of complex molecular interactions. Such self-regulation deliberately refers to an agent’s capacity to regulate itself within what is known as a non-equilibrium steady state or transitions of states thereof until the agent no longer can regulate itself and thus ceases to exist. Consider for example how cellular respiration takes place for optimizing the throughput of rudimentary cell functions, in which a variation of organelles and their cytoskeletal microtubule interactions function to maintain a cell’s integrity as associated complex intricacies of sensor and actuator mechanics regulating the cell itself as a unit agent.

Phenomenal yet profound implications are inspired by the cellular respiration cycle contingent on how biological organisms as agents sustain a coherent non-equilibrium steady state so the agent itself does not cease to exist. Parallel yet distributed processing of non-equilibrium steady states yielding a larger whole of interacting unit agents of a multi-agent system actively sustain a coherent boundary of existentially optimizable integrity of a more whole functioning agential system. While there indeed exist many biologically derived agential systems that function as singular agents, understanding how unit agents cooperatively engage with each other in order to sustain a more holistic agential system as referred to as a multi-agent system is of utmost relevance, considering relating to human capacities from the get go. Cellular respiration thus provides the most flushed out realizable example fundamental to how an agential system self-regulates. That is, cellular respiration is an extraordinary example of the utility of resource leverage dynamics in which agents facilitate their agency. More simply, a system needs to harness energy in some fashion in order to offset operation and function costs pertaining to all possible causally associated behaviors facilitated by all existing couplings of sensor and actuator pairings. As the popular saying among the economics and cognitive science communities denotes, there is no free lunch.

Metabolic processing considers the dynamical means in which operations and functions of partitioned pairings of sensors to actuators leverage the cost of managing integrity overtime for some arbitrary agent. Agents must in some adaptive dynamical procedural fashion facilitate a means to exploit compatible resources in its localizable direct environment as energy potential for self-regulation efforts derived by associated compositional nesting structures of coupled sensor and actuator dynamics. Metabolism therefore represents power source distribution constraints of agents. Metabolic processing demands of load processing of stimuli-response mechanisms of said compositional nesting of coupled pairing structures of sensors and actuators is contingent on the fact that operations and functions of an agent’s agential dynamics are never in an idle state.

Classical systems we associate to be electrically engineered computerized mechanical systems or non-electrical mechanical systems on the other hand exhibit idle states halting on prompted inputs associated with some output. Agents must feed prompted inputs in order to break classical systems from idleness. Agents themselves never experience idleness, as all their compositional nesting pairings of sensor and actuator structures are in a self-persisting active engagement loop of feedforward and feedback processing of stimuli-response mechanism payloads. A potential issue with agents poses a rather interesting dilemma relatable to the halting problem of classical systems, which considers dealing with degrees of uncertainty in which feedforward and feedback processing of stimuli-response mechanism payloads end up deceiving the agent’s fitness capacities. Such deception in the worst case can lead to an agent’s compromise of its agency as well as its own existence.

Motivating agential mechanics for deriving coupled sensor to actuator dynamics

There are a number of different directions of abstraction to consider to elaborate on the mechanics of these compositionally nested combinations of sensors and actuators of which sustain the integrity of some arbitrary agent with respect to its role in the ecosystem. We will focus on the more fundamental mechanics here which may aid in inspiring philosophy of physics debates pertaining towards insights into the standard model. Such insights may even consider perspective nuance towards the incompatibility dilemma of gravitational mechanics with respect to quantum mechanics and relativity as applied to biophysical interactions of protein dynamics influencing degrees of sensor and actuator mechanics postulated here useful for the intersection of semi-classical field theories as well as quantum field theories. These insights are emphasized through exploring deep temporal inference as associated with temporal complexity. In other words, there is reason to explore more high-order interactions pertaining to compositional nesting regarding temporal depth of interactions that occur in the fabric of space-time, especially given the intricacies of protein interactions necessary for existing biologically derived agential systems to exist in the first place.

Protein interactions pertaining to biologically derived agents consider the majority of operations, functions, and functionals responsible for mitigating both sensor and actuator dynamics of an arbitrary agent’s agency. For now it is unfortunately more speculative to derive such operations, functions, and functionals more directly as well as reliably for synthetic agents. Let alone, there exists much controversy around the speculation of whether or not truly synthetic agents could exist outside of biologically sampled clusters of organoids and isolated cells being conditioned to become xenobots as well as other variations of biobots.

The Anthropic principle remains to be one of the most alluring of arenas, largely most alluring to theoretical physicists and philosophers of physics as well as philosophers of biology. Even theologians may find the Anthropic principle interesting because it could explain what most religions deem to get humans closer to understanding God. Motivating a cognitive theology lens, arguably the intricacies of arbitrary human-like agents being able to envelope symbiotic co-inhabitable coherence as conscience-aware agents that separates us from the rest of the species on the planet due to unique natural language capacities responsible for the sophisticated coordination of human social structure cohesion itself. That is, we consider non-human biological species to only be capable of proto-language faculties as opposed to natural language unique to humans. Completely being underappreciated here is the cosmological moment of deep temporal complexity in which life itself became a possibility within the existing configurable yet controversially incomplete ontology of the universe as modeled under the standard model. For if the ontology of the universe were complete then why has the physics community largely considered it to be expanding at a nonlinear accelerating rate and to which generalizable projective structure thereof is it expanding in terms of its dynamical form? At this point we may be slipping away from why the Anthropic principle is interesting for deriving agential mechanics. We must ask ourselves… What makes agency itself possible in such an arbitrary universe thereof? One perhaps cannot get much closer to deriving first principles of agential mechanics.

Alas the abiogenesis problem is a potentially controversial path of exploration in terms of deriving the mechanisms of agency (and it may very well be the only path for refining as well as deriving such first principles understandings of agential mechanics; whether or not it is solvable may not matter). For what problem is more perfect than figuring out how to have material interactions yield a compositional integral whole of some kind of emergent meta-material structuring of meta-material based interactions isolated in some arbitrary configurably compatible orientation and localization within the fabric of space-time itself with respect to feasible confinement-based reaction conditions? No way have these metabolic-materials themselves always existed without being composed of some reaction-based derivation of complex molecular base materials that themselves are composed of isolated component interacting parts that alone cannot be metabolic-materials. Yet the base functionality of such metabolic-materials yields the coupling dynamical pairings of sensors and actuators that make some arbitrary semblance of agency possible in the first place. While sensors and actuators of classical circuit models themselves are not required to be configured as metabolic-materials, the integral capacities of such circuits fail to exhibit functions and operations of agency thereof.

Some befuddled readers may be thinking… “What about quantum circuits?” With classical circuits we generally consider the realm of binary logic operations. However, quantum circuits extend these binary operations to superimposed bitwise operations. Even more controversially speaking, one ought to question the true quantum nature of quantum circuits, outside of being inspired by pairwise entanglement as well as super-positioned quantities imposing sub-atomic structurings of fermionic and bosonic pairing reactions. Although this is also underappreciated and misunderstood, largely due to the supposed nature of incompatibility of quantifying gravitation between scales in respect to quantum and relativistic mechanics. Any facilitated interaction between feasible metabolic-materials as defined within the previous paragraph, denotes that such meta-material interactions yield gravitational manipulation properties that make the mechanics of agency possible between the micro and macro scales of arbitrary material interactions within an arbitrary universe thereof without violating any physical laws.

Aforementioned generalizations regarding entanglement of and superimposed bitwise operations of quantum circuit architectures (at least as they exist currently), do not account for the operations, functions, and functionals of derivable mechanics of affective processing capacities of agents. This brings us back to coupling two key models… Daniel Kahneman’s System 1 vs. System 2 as well as Jonathan Haidt’s The Rider and The Elephant. Such a coupled modeling paradigm requires more extensive use of logic systems outside of existing quantum circuit architectures as well as classical circuit architectures, in order to more appropriately model the mechanics of agents from the get go (even when considering the curse of dimensionality dilemma which is rigorously relatable to Godel’s first incompleteness theorem with regard to the inconsistency of axiomatic systems and furthermore relates to ontological incompleteness issues already mentioned… however do not confuse Godel’s theorems to be completely applicable to these cases).

Readers may be a bit confused about the complementation of Haidt’s The Rider and The Elephant model due to lack of existing elaboration thus far in terms of how it pairs intricately and effectively with Kahneman’s System 1 (automated processing of tasks that agents have trivialized their training for) vs System 2 (non-trivial tasks requiring critical thinking and problem solving). One can only imagine an elephant going rampant in some arbitrary third-world village, where the accountable rider thereof bears responsibility for the elephant’s mutually assured destruction in the moment onward. The elephant represents the reactive visceral potential of the rider’s attentional capacity to guide the elephant along a dynamical landscape. The rider furthermore is the seat of perceptual conscience-based evaluations in which the elephant represents the constant load balancing of stimuli-response dynamics unfolding in real time.

Before unpacking the extensive use of logic systems necessary, let us consider talking about time-scaling complexities of compositionally nested hierarchical and heterarchical dynamics pertaining to the non-equilibrium steady state integration of agency derivable from aforementioned coupling dynamics of sensor to actuator circuit base pairings. Recall that agential mechanics require temporal depth, in a way that seems quite rare throughout the vastness of the cosmos (black holes are perhaps far more abundant than life itself, which arguably also exhibit vast temporal depth not comparable to all other interactions in the known universe, other than interactions involving black holes themselves, or the potential of the birth and death of star clusters associated with them). Considering agents, mechanics influence each other from the top-down and bottom-up interactions regarding time-scaling intricacies of compositionally nested hierarchical and heterarchical structuring of sensor to actuator couplings. Top-down considers the integrative whole of decision-making capacities which can fatalistically pre-emptively influence bottom-up metabolic processing capacities (although the visceral processing of bottom-up dynamics enable the optimal regularity of top-down dynamics). Meso layers, being the in-between layers of top-down and bottom-up facilitation, comprise of regionally clustered system interactions pertaining to partial functioning that contributes to regulating the integrative whole of agents.

Binary operational logic systems consider the realm of binary operations and the potential of derivable functions of extended cognitive utility. That is, all possible nesting combinations of functionals realizable by binary sequences, which cannot address the necessary interpolative functional nesting of additional necessary modal parameters of computation required of agency (aside from some agentic baseline computations via existing agent-based models that have been successfully deployed commercially as well as accessible to the public domain). Limitations of binary sequence operations only address many behaviors in which one can use binary sequences to compute classical Newtonian behavior (albeit to a very limited precise degree proportional to the amount of compute available given hardware and energy budget constraints). Many remarks have been made about binary encoding schemes in which architectures are framed upon have excessive computational costs that are economically as well as ecologically problematic, regarding existing circuit modeling schemes available for commercial and public domain access. A critical limitation of binary operations is the restriction to subsets of but not the entirety of dense Euclidean space (that is, approximations of digits, not complete representations of irrational numbers and other numbers in which their exact representation can only be approximated to a precision number of digits). Therefore, extended non-classical logic systems are intractable and irreducible to represent in binary, some of which cannot possibly have an approximation of a numeric representation (consider complex numbers instead of real numbers) under binary encoding schemes. Although it is argued that regardless whether or not it is possible for us humans to build such computers or systems which extend beyond binary operations, while also more appropriately handling contexts of intractability and irreducibility of digit or analog representations of numbers and their operator behaviors intuitive to a non-classical logic system or combination of interacting systems thereof.

Seemingly one must consider with strict confidence whether or not metabolic systems are understood from first principles… a problematic setback among the biological sciences and perhaps the progression of scientific methodology and human reasoning going forward. Too bad humans cannot be so clever as to hope to map out metabolic behavior using non-classical operational derivations alone. As if swimming through the vastness of a non-classical ocean of systems abstraction can be ever more intimidating for such a task. Given that information on metabolism is largely anatomically understood from the biological perspective, one contingency toward understanding the abstraction of metabolism would be to consider conditional, causally associated contexts in which it is possible to derive metabolic operations.

Two means of abstraction can be entailed for considering causal set associations, in which we may be able to consider Fay Dowker’s causal set theoretic approach to derive. On the one hand, agents must conduct uniform exploratory navigation (also known as novelty search), making use of their combinatorial modal limitations of integrative baseline sensory and actuating based stimuli-response mechanistic processing capacities. On the other hand, anything an agent can identify becomes a pattern-matching mechanism exploited by novelty search both initially and in a mitigative manner. These two means of abstraction, novelty search and pattern matching, pave a foundation for deriving causal set associations of metabolic operational mechanics of agents. Deeper layers of metabolic function can be depicted by considering soft matter (a subset of condensed matter) quasiparticle structuring of meso-layer interactions of connectome dynamics (in terms of considering trans-regional synaptic networking of neural and glial clusters from the top-down regarding their neuromodulatory allostatic potential). Once again, we limit our scope of study in particular for generalizing multi-agent system based human-like agential mechanics instead of the mechanics that are derivable for all other agents (simply because such conversation is excessively verbose for the majority reading audience and extends beyond what is contextually relevant for this manuscript).

Parr et. al’s Active Inference text elaborates very well philosophically and psychologically regarding the Free Energy Principle being a meta-layering framework for understanding the unraveling potential of agential behavior (it helps us understand the possibilities of outcomes of behavior motivating Bayesian mechanics framing yet does not derive the rigorous physics of agents themselves). Let us not forget that a large number of mathematicians and physicists around the world still scoff at Stephan Wolfram’s attempt at deriving a meta-mathematics capable of computationally explaining all possibly knowable interactions pertaining to the universe in a more formally complete manner (one ought to question if this is just more rigorously necessary complementation of improving the utility of transdisciplinary scientific methodology or complicate meaningful investigative insights into the limits of understanding pertaining to human perception). Nothing can honestly be perceivable or understandable beyond human perception, as understood by modern culture and how cultures themselves shape human perception for better or worse for humanity’s sake due to the amalgamation of consensus narratives thereof (one can appreciate Lisa Feldman Barrett’s take on consensus with respect to relational realism). That is, our understanding of the world around us and everything thereof is formed by anthropocentric biasing… that which is most impactful to shaping the possibilities for human imagination among individuals and groups as interacting agents, with existential gamifying ramifications at stake.

Agential systems as opposed to agentic systems

From the outset of machine learning and artificial intelligence enthusiasts, there seems to be radical perspective shifting and debates amongst the capacity towards synthetically derived autonomous functions and the hybridization of systems architecture limitations. Controversially perhaps there have been quite few singular moments of human history in which economics at scale can play out in favor of humanitarian standards of wellbeing or work against such a means rather obliviously on a species level. Humanitarian efforts are hopeless without symbiotic coherence regarding the fragmentation of human societies concerning existential conflict resolution. Such existential conflict resolution is pertinent to humanity more holistically realizing holding itself accountable to its actionable impact on surrounding ecosystem ecologies that in large part undermine the importance of other species of agents that regulate ecosystem habitation. Alas, going off a rant pertaining to humanitarianism and its relevance to a sustainable humanity is outside the scope of this manuscript and is likewise contingent to deep philosophical jargoning (which is not necessarily useless but probably less concerning to the venture capitalists reading such jargon, as they can just look terms up on the internet anyway like everyone else). One ought to wrap their head around systems of agency as opposed to systems that replicate traits of agency but fail at grasping a true sense of autonomic functioning.

Truly autonomous systems so far are systems with no synthetically (human) derived hard restrictions on the capacity of autonomic function relational to the context in which such systems are engineered to perform a particularly complicated contextualized series of nested tasks. Such a proposition of contrasting differences between systems is albeit slightly contrived, largely because true autonomy among agents as organisms becomes confined to eco-niches. Eco-niches do indeed provide boundaries of restricted function pertaining to autonomic function with relation to context, being contingent on the phylogenetic (nature) as opposed to phenotypic (nurture) divergence of the agent in question with respect to the surrounding ecosystem it’s existentially embedded in. The guiding capacity of phylogenetic as opposed to phenotypic behavior of agents rests upon exploratory and pattern-matching based operational baseline behaviors (if this was not made clear earlier, this regards the baseline operations of autonomy and in particular, metabolism as well). Such operationalized complicated series of nested tasks are largely framed upon variational functionals (in the case of biological organisms as agents as opposed to agentic systems, extensively variational complex functionals) which contain variational objects, some of which primitive operations are derivable in classical computation (consider binary sequence operations) exists as a subset (such a subset however clearly lacks variation compared to more varied agent-based or agentic behavior).

Such postulations motivate the drive to explore the potential world of operations consisting of variational functional evaluations pertaining to agential as opposed to agentic behavior. Our conventional, commercialized computer systems work to interface some series of inputs for some expected series of outputs to be fed back from the interfacing system in question. Interfaced inputs are encoded in an embedded format, with sequential and modal symbolic notation to signify prioritization of which means to evaluate interfaced inputs for a contextually optimized expected series of outputs. Nitpicky readers with engineering background may be wondering about sequences as opposed to series of inputs to outputs (a sequence shall be denoted as a subset of a series). Furthermore such abstraction of sequences and series of task evaluation considers locality and non-locality of operationalized dynamics contingent on the fabrication of relational procedural generation of inputs to outputs. The most primitive operations of read and write then extend to composite nested coupling pairings of sensor to actuator components that enable the possibility of such operations to be performed as feedforward and feedback series of inputs to outputs (this allows us to abstractly derive molecular motor dynamics of agential systems, which do not quite exist for agentic systems).

Traditional formality regarding computer system interactions of read and write operations are fundamental to the integrity and bounded limitations of interactions pertaining input to output specifications, largely considering classical commercialized computation. However, these computations are not encoded by variational functional objects, as they are encoded by more primitive functional objects that decompose into binary operations (perhaps one can argue this is a restricted variational functional object of its own kind). These functional objects from a software perspective, are virtually projected by their complementary hardware parts capable of procedural generation of processed inputs to outputs compatible with silicon chip architectures with hard-wired electrical circuit components. Agential systems are wet-wired with molecular motor circuitry that are bound to stimuli-response interactions between continuous existentially adaptive capacity regulating the multi-modal means of internalizing (perceiving, sensor-based) processing of stimuli and externalizing (acting, actuator-based) responses to stimuli. Feedforward-feedback looping of circuits being restricted to binary operations, surmise problems with memory allocation and retrieval processing at scale, especially regarding server load balancing with respect to how many sessions for clients can be instantiated both efficiently and resiliently. Not to mention the limitation of such binary operations curtails the capabilities for which such systems can interface input to output series of tasks in relation to how agential systems interface the world around them. Affective processing, for instance, is beyond the coherent processing scope for binary operation based systems if we recall the coupled model of Kahneman and Haidt from earlier.

Generative AI applications have spawned a new kind of potential for systems design compatible with existing silicon chip architectures. Perhaps not so controversial, being that Generative AI models like most beloved ChatGPT have agentic capabilities but are themselves not agents. Largely, current understanding of computer programs entails that the functional capabilities of the program to be executed as a process is encoded with a modal user interface alongside generally popular GUI (graphical user interface). Users are able to interact with such a system by signifying commands to be executed through a modal (primarily text and or voice based) input layer or by navigating a GUI, or series of either in combination as contextually appropriate. Problematically, some systems are more intuitive for use as opposed to others especially when there is multi-threaded series task evaluation potential to be considered based on the complicated steps involved for completing a composite series of associated multi-threaded tasks. Consider the use of a spreadsheet application, word processing application, or text-messaging system to function as a standalone (such a system need not be agentic in order to be meaningful for the user’s intentions). However, for a system to be agentic, it must have meaningful specifications in terms of its functional capabilities that address use-cases where each user intentionally demands to interface a modal and or GUI layer which then fulfills such a means to execute a sufficiently complicated composite series of associated multi-threaded tasks (other than ChatGPT, more examples consider services like Perplexity AI, Julius AI, as well as GitHub Copilot). Specifications of services that provide such functionality of composite series of multi-threaded tasks largely rely on transformer architecture-based models. Agentic systems therefore can manifest an illusion almost as if another human or group of humans are otherwise performing the series of tasks themselves.

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