Systems Modeling and Cognitive Audits for Hypercert Ecosystems

Active Inference Institute (https://www.activeinference.org/)

Problem and solution

- On August 24th 2022, Holke Brammer of Protocol Labs released a blog "Hypercerts: A new primitive for public goods funding" describing how "Hypercerts" could be used for Decentralized Science (DeSci).
- With collaborators at the Active Inference Institute, we have been developing frameworks and tools for applied Active Inference, in the context of Remote Teams & DeSci, specifically highlighting the intersection of Active Inference and Systems Engineering as realized in our open source package Active Blockference.
- Our 2022 DeSci paper introduced an Active Entity Ontology for Science (AEOS), which describes how entities of different types develop and interact within and across system scales (e.g. two people communicating, within a DAO that scaffolds scientific peer review, that is paid via funding from a research agency).
- **We aim to develop the Hypercert ecosystem towards flexibility, utility, and maturity by creating an AEOS specification, and Active Blockference implementation, for Hypercerts.**
- We aim to develop the tooling, use cases (case studies), and educational resources that enable a **cognitive audit of Hypercert protocols**. The addition of this cognitive layer into the Hypercert development stack will facilitate trust and reliability, thus maximizing the value of projects.
- This AEOS implementation would enable anticipatory design and realtime analysis of Hypercert ecosystems, at the granularity required for high-reliability systems design. **Such an implementation may build on intuition, by demonstrating areas where Hypercerts may be superior to other funding mechanisms**, as well as areas where it may not be effective.

We can consider the Problem being addressed, in terms of some of the limitations of current practice in two areas: 1) How funding is done today in DeSci, and 2) How DeSci systems design is done:

1. How is funding done today in DeSci:
    a. Funding is accomplished (that is, where it is accomplished) by various uncoordinated modalities including: self-funding, selling of speculative fungible or non-fungible assets, philanthropy, research grants from legacy

institution, etc. — this is an area that the Hypercert (and Impact Certificate concept more broadly) seeks to address.
   b. Hence we are interested in developing the rigor and efficacy of the Hypercert concept, to increase the probability that it can be used successfully.
2. How DeSci systems design is done:
   a. Systems are often communicated with ad hoc flowcharts with heterogeneous or partially-specified types of nodes and edges (**informal ontologies**).
   b. Systems are often communicated and coordinated via blog posts, social media, conferences (**no standard means of communication**).
   c. Lack of shared standards for communication and versioning on systems design (**lack of engineering-grade standards**)
   d. Systems design is often at the level of populations, or types, of things. This may be too coarse-grained to deal with the kind of data which exists in Web2 and Web3 ecosystems - these data can describe single specific actions, taken by particular entities. We suggest that agent-based methods are essential to move design considerations from the bulk or mean-field approach, towards the granularity which design & realtime analysis demand (**lack of entity-based modeling**)

Related work

- We have been interested to apply Active Inference to the setting of Web3, DeFi, and Decentralized Science (DeSci) for some time now, resulting in our paper from March 2022: "An Active Inference Ontology for Decentralized Science: from Situated Sensemaking to the Epistemic Commons". In this paper we provided an overview and contextualization of Decentralized Science, and introduced the AEOS framework which this grant will develop upon.
- We are working closely with the cadCAD development team, and using their platform BlockScienceLabs. Additionally we are connected/collaborating with several relevant groups in Web3 (such as Kernel Community), the DeSci space such as OpSci (via project participants Jakub and Shady).
- Currently, Active Blockference simulates the cognitive processes and goal-directed behavior of a single-agent. Our goal is to expand this simulation into a multi-agent model, in order to explore the cognition and behavior of Hypercert ecosystems. As a multi-agent simulation, Active Blockference would facilitate the rigorous analysis of consensus protocols and Web3 communities prior to deployment. It can serve as a sandbox where we explore cognitive, micro-economic, behavioral, and decision-making processes.

Relation to PL's research activities

- As of August 2022, the blog post described that "We want to build the foundations for hypercerts and support 3+ impact economies in the next 12 months" - so we believe that this project and grant are within the temporal and attentional window of Protocol Labs.
    - In terms of active research groups at Protocol Labs, wherever the Hypercerts are being developed, would be relevant. Perhaps this is with the CryptoEconLab, Cryptonet, Network Good, Network Research, or Research Acceleration areas.
- Adapting the Hypercert concept to an Active Inference entity ontology will provide a direct link to the work done on AEOS and create affordances for computational models of systems using Hypercerts as their funding mechanism.
- Whatever the final NFT specification of the Hypercert, holistic consideration of the Hypercert ecosystem will require systematic and rigorous cognitive modeling (e.g. Priors, Preferences, Expectations, Affordances), integrated with state of the art tokenomic simulations (e.g. with cadCAD).
- The creation of a formal ontology partitioning the system in question into entity types, affordances, and system dynamics is clearly advantageous over coarse-grained structural descriptions of a novel system without clear definitions of its subparts or any link to simulations, real-world applications, and other research initiatives in the space.

Impact

- We aim to provide a rigorous analysis of various Hypercert-related funding mechanisms and how they may be used by both existing and emerging communities along with a set of tools for creating entity diagrams and develop simulations tailored to the needs of the researcher. Many communities in the Web3 space are increasingly interested in formalizing their approach to community-design, token engineering, and overall value creation, so these open source tools would be impactful and relevant.
- Having an entity-based modeling and representation of Hypercert ecosystems, could have various benefits such as: Regulatory compliance, evaluation of proposed and actual designs, prevention of various kinds of system abuse and failure.

Research Strategy

- As Hypercerts are in active development at Protocol Labs and beyond, with multiple concurrent teams, we do not have a completely-specified research strategy.

- We will initially engage in a series of informative interviews with Protocol Labs and Hypercert developers, and stakeholders, to understand the landscape which we will be then developing in.
- Following this stage of informative interviews, we will pursue the following development Milestones.
- Note: all Milestone Deliverables, Budgets, and Descriptions are tentative. We are open to further discussions with Protocol Labs, to hone this proposal into a form that is most preferable for you.

Milestones

Milestone 1: Entity Model Construction

Date: Within 4 months of funding beginning.

Budget: $20,000

Deliverables:

- Active Blockference models for the relevant Hypercert ecosystem active entities
- Active Blockference models for the relevant Hypercert ecosystem informational entities

Milestone 2: Ecosystem Composability Functionality

Date: From 3-6 months after funding beginning

Budget: $20,000

Deliverables:

- Active Blockference templates and constructors for Hypercert ecosystems

Milestone 3: Ecosystem Composability Functionality

Date: From 5-10 months after funding beginning

Budget: $20,000

Deliverables:

- Composable, executable simulations (e.g. design studio, or SCADA-like) for Hypercert ecosystems (can be novel/plausible systems, or case studies / digital twins).

- Compose comparable simulations of traditional, DeSci, and Hypercert funding models that demonstrate advantages and opportunities for improvement for Hypercerts.

What are the risks of our Research Strategy?

- There is no certainty that the development of an entity ontology for systems using hypercerts will yield results in favor of the hypercert mechanism.
- Hypercert markets in and of themselves, may present secondary risks, for example related to cascading market effects, and psychological/social effects of this kind of financialization of research.