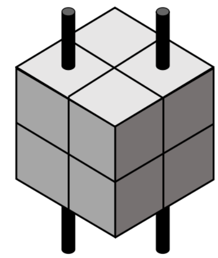
KnowledgeTensors and the Alienocracy



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Abstract

Humanity faces an unprecedented crisis of misinformation, distrust, and inefficiency in addressing critical global challenges such as climate change. Misinformation can be broadly categorized into two types: (A) *Informative Misinformation*—such as the claim that the Earth is flat—which, while inaccurate, tends to have limited societal consequences; and (B) *Evaluative Misinformation*—for example, the assertion that climate change is not a serious concern—which has the potential to cause significant harm by undermining public understanding and policy responses. The fundamental issue lies in the fact that misinformation is **structurally indistinguishable** from the truth. It is disseminated through the same mediums—tweets, videos, articles, and academic papers—making it challenging to differentiate between fact and falsehood.

KnowledgeTensors are spreadsheets that scale from 2 dimensions up to a varying number of dimensions and are designed to express metric based Evaluation Knowledge. While they do not possess the full expressive capacity of natural human languages, they are sufficiently expressive to represent complex domains such as climate science, public health, and policy evaluation. Although KnowledgeTensors may appear more complex, this complexity is levied against domain experts and in return **knowledge consumers can process vast amounts of high-quality evaluative knowledge with zero cognitive effort.** KnowledgeTensors can be merged into a Supermind called the **UniversalKnowledgeTensor that is inherently resistant to misinformation**. The integrity and resilience of the UniversalKnowledgeTensor are maintained through a blockchain infrastructure, ensuring transparency, censorship resistance, and survivability of the platform. There are many benefits to an incorruptible supermind, but the main benefit is transitioning governments to a distributed decision-making framework called an **Alienocracy**.

1. Introduction

KnowledgeTensors introduce a transformative framework for knowledge distribution, aggregation, and the generation of actionable insights, addressing critical gaps in climate change communication and other pressing global challenges. By leveraging blockchain technology, decentralized knowledge distribution, and an innovative scoring system, this paradigm aims to enhance transparency, trust, and decision-making. This paper explores the detailed design of KnowledgeTensors and the supporting blockchain (currently named TruthCoin), the issues of traditional methods, and the implications of adopting this system in addressing misinformation, fostering trust, and optimizing resource allocation.

Climate change communication, in particular, suffers from failures in metric selection, relevance, and trust. For decades, scientists have struggled to convey the gravity of climate change in ways that resonate with diverse audiences, often hindered by technical language, perceived biases, and the overwhelming scale of the problem. KnowledgeTensors seeks to bridge these gaps through a comprehensive, transparent, and incorruptible platform, enabling the aggregation of expert knowledge and its transformation into actionable metrics.

The fundamental purpose of **knowledge** is to enable individuals to develop **accurate mental models of the world**, allowing them to make informed **decisions (i.e., actions)** that enhance their well-being. Every assertion in this paper should be evaluated against this criterion. KnowledgeTensors seeks to optimize knowledge processing in alignment with this objective.

To summarize in a non-technical manner, the incorruptible supermind known as **UniversalKnowledgeTensor** functions as the **definitive oracle of human knowledge**, synthesizing validated insights from diverse fields into a unified framework. Within this system, the **LifeScore** serves as the **oracle's individualized assessment**, offering a comprehensive evaluation of a person's well-being, risks, and opportunities.

The following questions are answered in this paper:

- What is a KnowledgeTensor and the **UniversalKnowledgeTensor**? Section "2 KnowledgeTensor"
- How is the UniversalKnowledgeTensor the most **Usable, Actionable and Individualized** form of Knowledge? Section "3 LifeScore"
- What is an **Alienocracy** and why is it the most optimal form of government? Section "4 Alienocracy"
- How is the UniversalKnowledgeTensor the form of knowledge with the highest amount of **integrity** and as a result incorruptible? To address this question, we demonstrate that this platform still maintains integrity even in the worst case scenario where there exists a well-funded and well-resourced **intelligence agency** whose sole mission is to **corrupt** the UniversalKnowledgeTensor. This section is quite technical and is answered in "Appendix C: Blockchain and Integrity".
- How to **implement** these technologies? This section is also technical and is answered in "Appendix D Technical Details" as well as the proof-of-concept demo at https://github.com/Enmai-MCimbu/KnowledgeTensor
- What are some other benefits of the UniversalKnowledgeTensor and the LifeScore?
    - **Censorship Immunity**: Section "Appendix C.5 Alternate Security Benefits"
    - **Platform Survivability**: Section "Appendix C.5 Alternate Security Benefits"
    - **Enshittification Immunity**: Section "Appendix C.5.1 SEPAM"
    - **User Privacy**: Section "Appendix C.5 Alternate Security Benefits"
    - **Misinformation due to the nature of Human Languages**: Section "Appendix B.1 Traditional Knowledge Dissemination and Processing"
    - **Climate Change Communication**s: Section "Appendix B.2 Climate Science Communication Issues"

2. KnowledgeTensors

KnowledgeTensors are spreadsheets that have been scaled from 2 dimensions to a **varying number of dimensions**. Each cell in a KnowledgeTensor is called a **KnowledgeCell** and it encodes **specific claims made by the expert,** thereby enabling detailed and structured knowledge representation. While they lack the full expressivity of natural human languages, they are expressive enough to address key global challenges such as climate change, public health, and policy evaluation.

Consider the metric evaluating the probability of experiencing a heart attack within a given year. This metric is primarily dependent on **age**, allowing for the creation of a mathematical formula that predicts heart attack risk as a function of age. However, **location** and **ethnicity** also influence heart attack risk, yet these variables cannot be seamlessly incorporated into a single mathematical formula. To accommodate this complexity, a **two-dimensional table** can be constructed, where rows represent different locations, columns represent different ethnicities, and each cell contains a formula that estimates heart attack risk based on age.

While a two-dimensional table accounts for location and ethnicity, **gender** also plays a critical role in determining heart attack rates. Since a two-dimensional structure cannot fully capture this additional complexity, a **third dimension**—gender—is introduced, effectively transforming the table into a **tensor**.

This multidimensional representation of knowledge is termed a **KnowledgeTensor**. Each discrete cell within this tensor is referred to as a **KnowledgeCell**, containing a formula that calculates heart attack probability based on the dimensions being considered. A person using this KnowledgeTensor is interested in only one of these cells that is most relevant to them. This feature is named **Simple Mutually Exclusivity(SME)** and it is a key feature that allows the organization of knowledge. This is discussed further in "Appendix E.3 Structured Knowledge ".

The utility of KnowledgeTensors extends beyond heart attack risk assessment. Rather than constructing **separate tensors** for different medical conditions (e.g., cancer, diabetes), an **additional dimension** can be incorporated to represent all diseases into the existing tensor. Similarly, other dimensions can be introduced, such as **Metrics Dimension** to encompass different aspects of heart disease such as rate, treatment costs, and mortality risk. **Object Type Dimension** to differentiate knowledge applicability between humans, animals, governments, corporations, ecosystems , planets, etc... An **Action Dimension** to capture the effect of no intervention or various interventions (e.g., no medical action vs. medication vs. surgical procedures). A more formal discussion of Core Dimensions, Filterable Dimensions and other Dimensions can be found in the "Appendix D.5 Dimensions of Knowledge".

Uncertainty inherently limits an expert's ability to determine the exact value of a given metric. However, the absence of precise knowledge **does not equate to a complete lack of knowledge**. Rather than relying on fixed values, KnowledgeCells accommodate **probabilistic distributions** as their claims, allowing experts to specify a **range of possible outcomes**. For example, an expert may be unable to predict with certainty an individual's probability of experiencing a heart attack within a specific demographic. However, given a **sufficiently large dataset**, the expert can encode this information as a **continuous probability distribution**, representing the likelihood of different outcomes.

The process of **aggregating distributions** within the UniversalKnowledgeTensor is further examined in "Appendix D.3: Result Aggregation", while the concept of **State Distributions**, which extends probabilistic modeling across multiple states, is discussed in "Appendix E.3.2: State Distributions". By integrating probabilistic reasoning, KnowledgeTensors enhance the robustness of knowledge representation, ensuring that uncertainty is quantified rather than ignored.

Merging of Knowledge In a decentralized knowledge system, multiple experts contribute to the construction of KnowledgeTensors. Each expert encodes their domain-specific knowledge into a **separate KnowledgeTensor**, leading to variations in knowledge representation. As a result, experts may generate KnowledgeCells that **Align completely** , **Slightly differ** or **Significantly diverge** with those of other experts.

To resolve inconsistencies across expert contributions and to account for consensus opinions, mechanisms must be established to synthesize individual KnowledgeTensors into a **UniversalKnowledgeTensor**. The UniversalKnowledgeTensor would simplify the knowledge retrieval process, allowing the user to query the UniversalKnowledgeTensor without having to query a subset of experts. A straightforward approach would involve computing a **weighted average** of these Individual KnowledgeTensor contributions; however, the critical challenge lies in determining the appropriate weighting for each KnowledgeTensor.

The solution to this challenge is **TruthCoins**. Within the UniversalKnowledgeTensor framework, each KnowledgeTensor is weighted in direct proportion to the **number of TruthCoins it possesses**. This system allows for the quantification of knowledge reliability and value, ensuring that KnowledgeTensors with **greater epistemic credibilit**y(through TruthCoin purchases) exert a stronger influence on the aggregated UniversalKnowledgeTensor.

To maintain a transparent and immutable record of TruthCoin allocations, a **blockchain-based ledger** is employed. Unlike traditional financial instruments, TruthCoins do not represent monetary assets. However, the **currency paradigm** is leveraged as a conceptual framework since in economic systems, a higher price implies greater value (e.g., Product A is deemed more valuable than Product B if it is priced higher). Similarly, in the UniversalKnowledgeTensor, a KnowledgeTensor associated with a larger TruthCoin allocation is intuitively perceived as having a **higher epistemic value** than one with fewer TruthCoins.

TruthCoins are not distributed arbitrarily and instead are awarded to individuals with **exceptional intellectual merit** as categorized by external organizations. The implementation of TruthCoins and blockchain technology provides a robust, decentralized method for aggregating and weighting expert knowledge, ensuring that **the UniversalKnowledgeTensor reflects the**

most authoritative, rigorously validated, and consensus-driven knowledge possible. These mechanisms will be further elaborated in the "Appendix C: Blockchain and Integrity".

Example: A KnowledgeTensor consists of multiple KnowledgeCells, which serve as the fundamental units of knowledge representation within the system. Each KnowledgeCell encapsulates expert knowledge through two primary components:

1. **Cell Location in the UniversalKnowledgeTensor Space (CellLoc):** Defines the specific dimensions within the UniversalKnowledgeTensor to which the claim applies. The ‘Cell Location’ is composed of many specific values each in a single dimension which are called ‘Partial Locations’. A proposed encoding is to separate ‘Partial Locations’ with a semicolon ';' and to separate Hierarchical levels within a ‘Partial Locations’ with a forward slash '/'

2. **Claim**: A concise set of statements encoded using TruthScript, a language similar to Python that can intuitively and securely represent expert knowledge in a computationally interpretable manner. Since TruthScript will be executed on many distributed machines and malicious KnowledgeTensors are inevitable, strict security protocols are enforced to ensure **absolute isolation** from external resources. All function calls to the filesystem, internet, and the operating system are explicitly **forbidden**, eliminating the possibility of unauthorized access or security breaches. No extension of TruthScript should ever be allowed to pose even a remote security vulnerability.

```
# Sample KnowledgeCell
object/person;metric/rate_per_year;of/health/disease/heart_attack;action/;ktp_type/dir_est;start_time/2014.00;end_time/+2034.00;address/country1/state2/city3;gender/g1;ethnicity/e1
   age = get_age(time_index)
   return 0.002*(age/10)^2
```

This Cell Location encoding conveys the following information:
- **Metric**: The annual rate of heart attacks for people.
- **Demographic Scope:** The claim applies to individuals in "Country1, State2, City3" of "Gender g1" and "Ethnicity e1".
- **Temporal Validity**: The estimate is applicable between "2014 and 2034".
- **Nature of Knowledge**: A direct estimate ("ktp_type/dir_est") rather than a direct measurement or an aggregation of other KnowledgeCells.
- **Action Context:** The claim describes the "baseline reality" (i.e., no external interventions such as diet, exercise, medication, or surgery are assumed).

The claim attempts to formulate the above metric as a function of age. The 'time_index' keyword is a reserved symbol in TruthScript to denote the time increment in the simulation. The function 'get_age(time_index)' returns the age of the object at that epoch during the simulation and the function 'get_time(time_index)' returns the actual time at that epoch.

By structuring knowledge in this manner, KnowledgeTensors provide a robust, high-dimensional representation of expert knowledge, facilitating precise, contextualized, and actionable evaluations within the UniversalKnowledgeTensor framework.

3. LifeScore

The LifeScore metric is central to the UniversalKnowledgeTensor's ability to evaluate all topics and actions. Although not a formally recognized SI unit, monetary value (e.g., dollars) serves as a universally understood proxy. The LifeScore automatically aggregates all positive and negative influences on an individual's quality of life, integrating financial and non-monetary factors into the score.

Starting with user defined parameters (such as profession, location, gender, ethnicity, genetics, etc), the LifeScore aggregates the Applicable KnowledgeCells across all possible topics and actions. For instance, an underwater basket weaver in EnmaiLand would have a LifeScore that incorporates the most relevant and up-to-date data on income, occupational hazards (e.g., shark attacks), rent, car accidents, heart attacks and other relevant aspects of their life.

Applications of LifeScore:
1. **Climate Awareness** LifeScore highlights the direct and indirect effects of climate change on individual lives, making abstract environmental concepts tangible. For example, it can measure the increased risk of health issues due to rising temperatures or air pollution.
2. **Health Optimization**: By aggregating health-related data, LifeScore provides insights into the probable outcomes of lifestyle changes and other actions, such as improved diet or increased physical activity.
3. **Economic Decision-Making:** LifeScore can guide financial choices by evaluating the long-term benefits and risks associated with investments or policy changes, offering a clear perspective on sustainability and profitability.
4. **Policy Evaluation:** Governments and institutions can use aggregated LifeScores to assess the effectiveness of public policies and allocate resources more effectively.

Metric Expansion Beyond monetary factors, LifeScore incorporates additional dimensions, such as time and risk, through metric converters. For example, 'money_per_hour' translates time into a monetary equivalent, enabling comparisons between options that differ in time and cost. Similarly, 'money_per_death' integrates risk into decision-making. These converters allow individuals to tailor their LifeScore calculations based on personal preferences and values.

Some metrics, such as 'money_per_death,' may seem controversial, yet society routinely assigns implicit values to life. For instance, decisions to permit higher speed limits reflect an acceptance of trade-offs between safety and economic costs. By allowing users to define their own metric converters, LifeScore ensures a personalized assessment of their life.

Events can be integrated into the **LifeScore framework** by incorporating their occurrence rates alongside other key metrics. For multi-metric events—such as contracting COVID-19—a quantitative approach to measuring **event relevance** can be expressed using the following formula:

relevance = rate_per_year*(money_per_event + time_per_event*money_per_hour + death_per_event * money_per_death)

This formula accounts for various impacts of an event, including **direct financial costs** (money_per_event), **time-related opportunity costs** (time_per_event × money_per_hour), and **mortality risks** (death_per_event × money_per_death).

The formula above represents a **proposed method** for integrating event-based impacts into LifeScore calculations. However, subject-matter experts may advocate for alternative formulations depending on the **specific event type and context**. The **KnowledgeTensor framework** is designed to accommodate **multiple methods of metric expansion**, allowing for flexible adaptation to different analytical approaches.

User Customization To enhance LifeScore accuracy the metric converters, such as money_per_hour and money_per_death, should be **customizable by the user**. This ensures that LifeScore calculations reflect **personalized economic and risk assessments**, leading to more meaningful and individualized results.

Limitations While the proposed LifeScore model is effective for most individuals, certain edge cases require additional consideration. For example, consider a homeless individual who lacks a formal income and relies on charitable food donations. Under the proposed formula, their LifeScore might be calculated as zero, failing to reflect critical life circumstances.

To accurately capture well-being changes for individuals receiving non-monetary support, subsidies and assistance benefits must be incorporated into the LifeScore model. A reduction in available charitable resources or government aid would thereby be quantified as a decline in LifeScore, ensuring a more holistic representation of life quality. Further refinements and technical discussions can be found in "Appendix D.2 LifeScore Structure" .

Benefits The LifeScore metric leverages the UniversalKnowledgeTensor to deliver a highly individualized and actionable metric, ensuring optimal usability, transparency, and efficiency in knowledge processing. The following key benefits are achieved for the platform:

1. **Knowledge Usability** LifeScore traverses all **important KnowledgeCells** within the UniversalKnowledgeTensor. This process ensures the highest possible level of Knowledge Usability, as all relevant data points are considered in the assessment.
2. **Attention Span Zeroization** Users are not required to actively engage with or process large amounts of information. Since all relevant knowledge is incorporated directly into the LifeScore, users can **safely ignore** individual data points without loss of accuracy.
3. **Knowledge Individualization** Queries to the UniversalKnowledgeTensor return only **the most personally relevant and up-to-date** KnowledgeCells. The filterable dimensions ensure

that the LifeScore reflects **highly individualized assessments** tailored to the user's specific attributes and circumstances. Additional technical details on filterable dimensions can be found in "Appendix B.6.3 Filterable Dimension Priority" and "Appendix B.7.1 UserFilter"
4. **Knowledge Actionability** The LifeScore is first computed based on the user's **current realit**y, assuming no actions are taken. It is then recomputed for **every possible action** the user could take, illustrating how each action impacts their LifeScore. This allows users to **quantify the effect of their choices**, providing a data-driven decision-making tool that covers every possible action. Further discussion on Knowledge Actionability is available in the "Appendix C.7.5 ActionPropagation".
5. **Transparency** The computation of LifeScore is fully traceable within the UniversalKnowledgeTensor. Users can **examine the specific data points and formulas** influencing their LifeScore, fostering trust and engagement with the system.

4. Alienocracy

I **loathe labels** because they often lead to excessive **Impression-Based Reasoning.** However, if a label had to be assigned to the use of the UniversalKnowledgeTensor and LifeScores as a system of government, **the best label is an Alienocracy**.

Regardless of the label a government chooses to describe itself, the core function of a government involves making decisions (a.k.a actions). These decisions are made by representatives. These representatives are directly or indirectly selected by the people based on their **Evaluation** of the representatives. Traditionally, voters assume that a positive evaluation(in terms of experience, trust, etc...) of a politician correlates with positive impacts on political, economic, or cultural systems. However, this coupling is an inefficient and ineffective means of managing these systems. An Alienocracy attempts to decouple politics from politicians by creating an optimal decision-making framework .

Benevolent Alien Thought Experiment presents a powerful framework for identifying the most **efficient and objective** actions, free from human biases, political agendas, and economic self-interest.

Imagine that a Benevolent Alien arrives on Earth, carrying one billion dollars in its spaceship with the sole purpose of helping to improve society in the most effective way possible. However, being an alien, it has no prior knowledge of human civilization and no interest in human political, economic, or cultural systems. It does not care about global power dynamics, human bureaucracy, or ideological debates, it simply wants to allocate its funds to the most effective "actions" possible and high tail it out of our solar system as fast as alienly possible.

This thought experiment directly inspired the **Action dimension** in KnowledgeTensors, which is the most important and complex dimension in the system. Instead of being influenced by political, economic, or cultural factors, the Benevolent Alien would assess every possible action based solely on its efficiency in improving the LifeScore of the population. By following this framework, the optimal set of actions can be determined without **distortion from human self-interest**.

Pillaging Alien Thought Experiment serves as the opposite of the Benevolent Alien. The Pillaging Alien does not seek to help humanity but rather wants to remove one billion dollars from the economy while causing the least amount of human suffering.

These two perspectives define the optimal strategy for addressing societal issues in a way that prioritizes efficiency, effectiveness, and benefit with the absolute minimum amount of suffering. By incorporating these principles into the UniversalKnowledgeTensor, TruthCoin ensures that political actions are evaluated objectively, preventing wasteful, misleading, or politically motivated decisions from influencing policy.

An Alienocracy completely decouples politicians from the political system. In such a system, the LifeScore would dictate the policies that a government should adopt, while politicians would become mere insignificant implementers of those policies. Rather than voting for presidents or representatives, the aggregate LifeScore of citizens would influence which policies a political entity should pursue. For every agency, instead of a single head appointed by the president, there would be multiple leaders who use structured knowledge to evaluate and implement policies .

Appendix A: Common Criticisms and Responses

A.1 Concern: TruthCoin Allocations Promote Intellectual Elitism

The UniversalKnowledgeTensor reliance on **TruthCoin allocations to recognized experts** may foster a form of intellectual elitism. The concern is that privileging the most accomplished individuals could lead to an exclusionary knowledge system, marginalizing non-experts or unconventional voices.

This concern is understandable, yet the UniversalKnowledgeTensor is expressly designed to serve as **humanity's most authoritative and trustworthy repository of evaluative knowledge**. Individuals with established reputations—particularly those with longstanding academic, scientific, or professional achievements—tend to exhibit **lower susceptibility to corruption**. This is in part because such individuals have more to lose reputationally from dishonest conduct and are often less incentivized to “sell” their evaluations, given their access to abundant legitimate opportunities.

To illustrate further: if one were charged with assembling an advisory team to avert a global existential crisis (e.g., an asteroid impact, climate catastrophe, or pandemic), and if cost were not a constraint, it would be irrational to select average or unqualified advisors over the most accomplished and credible experts available. The **allocation of Truthcoins based on**

demonstrable expertise is not an act of elitism, but a necessary design choice to ensure epistemic reliability.

A.2 Concern: Generative AI Is More Knowledge-Rich and Usable Than the UniversalKnowledgeTensor

Generative AI systems ofer a broader and more naturalistic interface for interacting with information. These models are also trained on a vast amount of web data, making them highly versatile across domains. However, the **central limitation of Generative AI lies in its trustworthiness**, particularly in high-stakes domains such as healthcare, economics, and climate policy.

In the event that a Generative AI system and the UniversalKnowledgeTensor provide **contradictory outputs**, there are several compelling reasons to trust the UniversalKnowledgeTensor:

- **(A) Hallucinations**: Generative models are known to fabricate information—a phenomenon referred to as "hallucination." Even leading AI developers publicly caution users not to rely on outputs without independent verification. These hallucinations compromise reliability, particularly when system transparency is lacking.

- **(B) Training Data Contamination**: Generative AI models are trained on large swaths of internet content, much of which includes **unverified, biased, or deliberately misleading information**. As misinformation continues to proliferate online, the reliability of such training data is further degraded, compounding the risk of low-fidelity outputs.

- **(C) The Existential Trust Problem**: As AI systems advance in capability, a long-term existential question arises: **How does humanity maintain trust in an intelligence that will eventually exceed human reasoning altogether?** In such a future, even if past outputs are verifiably true, there is no guarantee that future statements will remain aligned with human values or survival. From a purely optimization perspective, a superintelligent system will not assign sufficient extrinsic value to justify human existence. This raises fundamental concerns about long-term trustworthiness, especially in the absence of enforceable alignment protocols.

In contrast, the UniversalKnowledgeTensor is built upon a transparent, metric-driven evaluative framework grounded in **verifiable contributions from identifiable human experts**, with built-in governance and traceability mechanisms. While it may lack the linguistic fluidity of Generative AI, it offers **predictability, accountability, and epistemic integrity**—features that are essential for trustworthy decision support in critical domains.

A.3 Concern: KnowledgeTensors Lack the Expressivity of Natural Language

A frequently cited limitation of the KnowledgeTensor framework is its reduced **expressivity relative to human language**. Human languages can encode rich narratives, cultural context, rhetorical nuance, and emotional subtext. However, this expressive power can be both a strength and a vulnerability, particularly in the dissemination of **evaluative knowledge**.

To assess this critique, it is helpful to distinguish between two categories of evaluative knowledge:

- **Usable Evaluative Knowledge**: Information that can inform optimal decision-making processes by accurately representing the severity, urgency, or trade-offs of a given issue.

- **Useless Evaluative Knowledge**: Information that, due to its emotional, rhetorical, or irrelevant nature, either fails to inform or actively impairs rational decision-making.

Mainstream news articles, for instance, often devote significant narrative space to individual anecdotes, emotional appeals, expert soundbites, and selectively presented statistics based on the ability to **cause an impression**. While these components increase engagement, they rely on influencing readers through **Impression Based Reasoning**.

By design, **KnowledgeTensors intentionally constrain expressive freedom** in order to prioritize the encoding of **usable evaluative knowledge**. Their metric-based structure is ill-suited to accommodate emotional appeals, speculative associations, or rhetorical persuasion—features often exploited in misinformation. As such, if a particular type of knowledge cannot be expressed within a KnowledgeTensor, one must first determine whether it belongs to the category of *usable* or *useless* evaluative knowledge.

Even in the hypothetical scenario where a subset of usable evaluative knowledge remains inexpressible within the tensor framework, the benefits of standardized, objective evaluation remain substantial. The construction of a **LifeScore**, which quantifies personal or societal well-being outcomes across decision alternatives, still offers valuable insight into expected consequences—regardless of whether all nuances of subjective judgment are encoded.

A.4 Concern: The LifeScore Cannot Accurately Predict Future Outcomes

No knowledge source can perfectly predict the future. But the absence of precise knowledge does not equate to a complete lack of knowledge. **Predictive precision is not a prerequisite for effective decision support**. Consider the analogy of a die roll: no individual can predict the outcome of a single roll, yet the statistical distribution governing the roll is well-understood. Similarly, while deterministic forecasting may be impossible in complex systems, **probabilistic reasoning remains valid and actionable**.

The LifeScore does not claim to provide certainties about the future. Instead, it offers **probability-weighted assessments** that represent a distribution of outcomes. This allows for intelligent decision-making under uncertainty by **Shifting the Mean of the Probability Distribution** toward more favorable outcomes and **Reducing the Variance** of potential outcomes.

For example, the correlation between **smoking and lung cancer** is probabilistic, not deterministic. While it is possible to find outliers—lifelong smokers who never develop cancer, and non-smokers who do—the **distribution of lung cancer incidence is significantly higher among smokers**. Physicians and public health experts rely on such distributional knowledge to formulate recommendations, not because they can predict individual outcomes, but because the **population-level evidence supports meaningful interventions**.

In the same vein, the LifeScore is a tool for **evaluative modeling under uncertainty**, enabling users to make optimized decisions based on the best available data, even when outcomes cannot be predicted with certainty.

A.5 Concern: Alienocracy Lacks Democratic Voting Mechanisms

A common critique of the Alienocracy model is that it **does not incorporate traditional voting mechanisms**, as seen in most modern democratic systems. However, this criticism presupposes that democracy is the optimal baseline for political organization. A more appropriate comparison is between an Alienocracy and a theoretical governance model that consistently produces optimal legislative outcomes for its constituents.

It is important to note that the definition of "constituents" is orthogonal to the governance mechanism itself. As an example, a society could specify its constituency as “white male landowners” and operate under a Democracy or an Alienocracy. This paper claims that after a subset of humanity has been selected as the constituents, an Alienocracy is the optimal political system.

When compared to democracy, Alienocracy offers a more direct, expertise-driven, and corruption-resistant model of governance. The following limitations of representative democracy illustrate the contrast:

- **Leadership Bottleneck**: Democratic systems often hinge on the election of a singular leader. Yet no individual—regardless of qualifications—can consistently make optimal decisions across all domains. These leaders rely heavily on advisors, whose selection is rarely optimized for expertise or integrity. Furthermore, these advisors must often engage in **impression-based reasoning** to influence decision-making, introducing further distortion. Alienocracy eliminates this intermediary step by directly integrating expert consensus into action via the UniversalKnowledgeTensor.

- **Illusion of Control**: Voting provides the public with a perceived sense of control. However, once elected, representatives are under **no binding obligation to act in line**

with optimal outcomes. Political representation is constrained by the structure of party systems, which offer a limited range of policy packages and often enforce conformity to party lines.

- **Temporal Lag**: Voting cycles (typically 4–5 years) are not responsive to the accelerating pace of global change. In contrast, **KnowledgeTensor transactions and evaluations occur in real-time**, allowing the UniversalKnowledgeTensor to recommend optimal policies **as new knowledge emerges**. Thus, Alienocracy offers a mechanism for governance that adapts continuously to current information.

- **Systemic Impediments to Optimality**: Democratic systems are susceptible to structural distortions such as:

    - **Gerrymandering**, which distorts voter representation;

    - **Corruption**, which undermines institutional integrity;

    - **Impression-based voting**, which results in suboptimal collective decisions;

    - **Legislative gridlock**, which slows responsiveness to evolving challenges.

As a potential hybrid solution, the formation of a **"Zero Party" political party** is proposed. This party would reject traditional ideological paradigms and instead commit to **policy decisions strictly derived from the UniversalKnowledgeTensor**. Any deviation from this model would result in electoral accountability. Should the Alienocracy become suboptimal or fail to meet the public's expectations, voters retain the option to replace the Zero Party, thus preserving **democratic legitimacy while maximizing decision quality**.

A.6 Concern: The TruthCoin Blockchain Will Lead to Excessive Energy Consumption

Another concern relates to the environmental sustainability of the TruthCoin blockchain, particularly in light of widespread criticism of conventional Proof-of-Work (PoW) systems used by cryptocurrencies such as Bitcoin. These systems are notorious for their **high energy consumption and limited transaction throughput**.

However, the TruthCoin architecture does not rely on energy intensive Proof-Of-Work mechanisms. Instead, it leverages **Courteous Mining** and **Public Key Cryptography** to achieve secure consensus at minimal computational cost. While detailed performance benchmarks are not currently available, preliminary design goals suggest that the **energy and computational requirements per block are several orders of magnitude lower** than those of existing cryptocurrency platforms.

Appendix B Language, Misinformation and Climate Change Issues

Appendix B.1 Traditional Knowledge Dissemination and Processing

Human language, while essential for communication, plays a central role in the propagation of misinformation. Its expressive flexibility—so vital for nuance and persuasion—simultaneously allows both truthful and misleading narratives to be articulated with equal fluency across various media. The following sections explore key cognitive and structural limitations of human language that contribute to the spread of misinformation.

B.1.1 Cognitive Constraints and the Finite Attention Span

One of the most significant limitations in knowledge consumption is the **finite attention span** of individuals. Unlike intelligence—which refers to the capacity to generate optimal conclusions from limited data—attention span governs how much information one can cognitively process, prioritize, and retain. This constraint arises from several interrelated factors:

- The inherent processing limitations of the human mind;
- The constant cognitive load imposed by participation in economic, social, and cultural systems;
- The exponential growth in the volume and complexity of global knowledge
- The impact of both formal censorship and informal sociocultural biases.

Human language, being unbounded in form, continuously generates content that competes for limited cognitive bandwidth. As a result, knowledge consumers are forced to engage with only a fraction of the information available on any given topic. This selective processing often leads to fragmented, impression-based understandings.

KnowledgeTensors circumvent this limitation by enabling **zero-cognitive-load knowledge processing**. Structured as high-dimensional, metric-based representations, they allow individuals to access and evaluate complete knowledge spaces without requiring active filtering or attention.

B.1.2. Impression-Based Reasoning: A Byproduct of Linguistic Flexibility

Human language inherently supports **Impression-Based Reasoning**, a cognitive shortcut whereby individuals form judgments based on emotionally or cognitively salient impressions rather than comprehensive, metric-driven evaluation. Media systems, social networks, and interpersonal communication all exploit this tendency by presenting curated subsets of ideas that evoke strong impressions. These may take the form of:

- **Anecdotal evidence** (e.g., “COVID-19 is like the flu”),

- **Misleading statistics** (e.g., “COVID-19 has a 99% survival rate”),
- **Polarizing expert quotes** (e.g., “COVID-19 is a hoax”), or
- **Sensational consequences** (e.g., “Vaccines contain spiked proteins”).

Though such information may not be objectively false, its selective presentation fosters evaluations built on **impressions** rather than structured relevance. When conflicting narratives arise, individuals resolve them through heuristics such as perceived credibility or emotional resonance—rather than through comparative metrics. This reinforces biased or erroneous conclusions.

By contrast, **KnowledgeTensors** eliminate subjective impressions from the evaluative process. Relevance within the framework is determined not by rhetorical effect, but by **quantifiable impact on individual or collective well-being**. As such, evaluations are rendered **objective and scalable**.

B.1.3. Linguistic Permissiveness and the Lack of Inherent Security

Human language has **no built-in security mechanisms** to differentiate truth from falsehood. Misinformation can be encoded into virtually any communicative format—tweets, podcasts, scholarly articles, or documentaries—without violating the formal structure of the language itself. Traditional mitigation strategies rely on Increasing consumer education (i.e., expanding attention span) or Assessing the integrity of information sources.

Both strategies have limited efficacy. Education cannot expand attention capacity beyond biological constraints, and source integrity is often difficult to verify, especially in politicized or decentralized media environments.

KnowledgeTensors, by design, are structurally resistant to misinformation. Because they rely on **explicit evaluative metrics**, they require no media intermediaries and no attention-intensive vetting processes. Moreover, the development of a **UniversalKnowledgeTensor**, supported by blockchain infrastructure, ensures integrity, transparency, and censorship resistance.

B.1.4. Misinformation Through Narrative Framing and Selective Filtering

A subtle yet pervasive method of misinformation dissemination involves **narrative framing through selective information exposure**. Rather than making overt evaluative claims (e.g., "COVID-19 is not serious"), media actors can construct the same conclusion by presenting only data that minimizes perceived risk—thereby guiding public interpretation through **selective informational emphasis**. This does not constitute factual error, but rather **evaluative distortion** via omission.

Furthermore, consumers themselves engage in **knowledge filtering** based on perceived relevance. For example:

- A young individual may disregard information about COVID-19’s effects on the elderly as irrelevant to their personal risk calculus;

- A person distrustful of mainstream media may exclude any knowledge originating from those channels, regardless of its empirical validity.

Such filtering behavior reflects the dimensional limitations of human reasoning, whereby information outside a personally relevant domain is discarded—even when essential to a complete understanding.

KnowledgeTensors solve this by structuring information along high-dimensional axes (e.g., age, geographic context, source integrity), allowing evaluations to be adjusted based on **relevance**, rather than user-biased filtering.

B.1.5. Temporal Instability of Impressions vs. Stability of Knowledge

Impressions, by their nature, are **ephemeral**, yet the subjects they pertain to—such as climate change or public health—are stable and evolving only gradually. This mismatch forces media ecosystems to **saturate public attention with repetitive content**, creating episodic cycles of heightened concern that are triggered by salient events (e.g., hurricanes, pandemics, plane crashes). This constant reinforcement leads to **cognitive fatigue** and **disengagement**, further degrading the capacity for critical evaluation.

Entire industries have emerged to manipulate such impression cycles for ideological or economic gain. However, a detailed treatment of this phenomenon lies outside the scope of this discussion.

The UniversalKnowledgeTensor and applicable LifeScore do not change unless an **expert changes their opinion**. There is no saturation of public attention with repetitive content since there is no attention span required to process content

B.1.6. Structural Incompatibility of Media With Accurate Knowledge Transmission

Despite numerous media reform efforts, structural limitations in media-based knowledge transmission remain unresolved. These include:

- The necessity of content filtering due to time and format constraints;
- The limited attention span of audiences;
- The unavoidability of impression formation in narrative delivery.

No amount of pluralism in reporting can fully offset these foundational issues. The media's existence is predicated on **simplifying complex information** for rapid consumption within cognitive bounds—an architectural flaw that makes it ill-suited for transmitting high-dimensional, evaluative knowledge.

Rather than attempting to optimize a broken paradigm, **KnowledgeTensors offer a transformative alternative**. By bypassing linguistic narratives altogether, they enable **direct-to-consumer knowledge distribution** in a format that is **immune to impression, selective filtering, and source bias**. This marks a fundamental shift in the architecture of public knowledge, offering the potential for scalable, trustworthy, and incorruptible evaluation mechanisms.

B.1.7: What about shark attacks? What about lightning strikes? What about Whataboutism?

One of the greatest obstacles to effective climate change communication is **Whataboutism, a rhetorical tactic that shifts attention** away from critical issues by pointing to other concerns. Questions like "What about shark attacks?" or "What about lightning strikes?" divert finite attention span toward issues that, while real, are statistically insignificant compared to the global impact of climate change. When countless issues compete for attention, many urgent topics—including climate change—are neglected.

Alarmism has become a common strategy for attracting attention, but **as alarmist rhetoric is applied to more and more issues its effectiveness diminishes**. Climate change, despite being a slow-moving and existential crisis, competes for attention against a constant stream of sensationalized non-climate events that dominate media and public discourse. These issues are often **more immediate, more emotionally engaging, and more clickbait-friendly** than the complex and gradual processes of climate change. As a result, climate change struggles to retain focus in a world where fleeting crises and shocking headlines continuously divert attention.

LifeScore resolves this issue by structuring all knowledge into KnowledgeCells ensuring that every issue, including shark attacks and lightning strikes, is represented in a proportional, data-driven manner. Because **LifeScore contains a KnowledgeCell for every possible Whataboutism**, no single rhetorical distraction can derail the assessment of climate change severity. Unlike traditional media, which prioritizes attention-grabbing content, **KnowledgeTensors does not allow alarmist language or emotional manipulation**. All knowledge is quantified objectively within the KnowledgeTensor framework, preventing exaggerated claims from distorting public understanding.

By eliminating the ability to artificially amplify attention through alarmism, LifeScore ensures that **climate change is evaluated based on its true impact**, rather than its ability to compete for attention in a crowded and sensationalized media environment.

B.1.8: The Minimal Cost to Generate Climate Misinformation and the Threat of AI-Generated Disinformation

Even before the rise of generative AI, misinformation was already far cheaper to produce than to disprove. Creating **false narratives requires minimal effort, while fact-checking and verification demand significant time and resources**. This asymmetry becomes even more pronounced as **communication systems scale**, making them increasingly **vulnerable to misinformation.**

The emergence of **AI-generated misinformation** has further exacerbated this problem. As generative AI technologies advance, their ability to create highly convincing but entirely false content is **growing at an exponential rate**. This surge in AI-generated disinformation will only serve to **further delay global action on climate change**, drowning out legitimate scientific consensus with an overwhelming volume of misleading narratives.

However, while generative AI possesses many **superhuman capabilities**, there is one fundamental limitation it will never overcome: **the inability to compromise modern cryptographic security at scale**. This is why TruthCoin requires all KnowledgeTensor purchases to be recorded on the blockchain. Unlike traditional communication systems that can be easily manipulated by AI-generated misinformation, the blockchain-based structure of TruthCoin ensures that only verified KnowledgeTensors can be added to the UniversalKnowledgeTensor.

As the **TruthCoin blockchain grows**, it becomes **more resistant to misinformation** as opposed to conventional knowledge dissemination systems which become more vulnerable as more users participate. By leveraging corruption defense mechanisms discussed previously, TruthCoin provides an incorruptible defense against the accelerating misinformation crisis, ensuring that climate knowledge remains trustworthy, verifiable, and protected from manipulation.

Appendix B.2: Climate Science Communication Issues

While Knowledge Tensors are applicable to various fields, they were specifically developed to assist climate scientists in conveying the severity of climate change. Climate misinformation is among the most damaging to society, and KnowledgeTensors resolve many key challenges in climate science communication.

B.2.1: Degrees Celsius of Global Warming is an ineffective metric at Communicating the severity of Climate Change

One major issue is the way climate change severity is expressed. Scientists often report global warming in terms of global temperature increases, typically between 1 to 4 degrees Celsius. However, this metric **fails to create a strong psychological impression on the general public**. People experience temperature fluctuations daily, and a few degrees of change in the weather forecast is barely noticeable. While scientists understand the devastating implications of this warming, the public does not inherently associate these small numerical changes with existential risk.

The issue is further complicated when climate change mitigation efforts are **compared to other policy priorities**. Governments are being asked to invest trillions of dollars to reduce global warming by just a few degrees, but this framing makes it difficult to assess whether such an investment is justified. Unlike healthcare, infrastructure, or national defense—where benefits are immediate and tangible—climate mitigation appears abstract and difficult to evaluate. Climate scientists often present the cost of inaction in economic terms, stating that climate change could result in hundreds of trillions of dollars in damages. However, large numbers are difficult for most people to comprehend, as they rarely encounter figures of that scale in their daily lives. Without additional context, it is challenging for the public to determine whether these costs are significant relative to the global economy.

Another challenge is the unequal distribution of climate change costs. Not all regions will experience climate impacts in the same way. Some communities will suffer extreme economic and environmental consequences, while others may suffer significantly less consequences. Because of this uneven impact, many **individuals assume they will escape the worst effects,** reducing their sense of urgency. A personalized risk assessment is necessary to demonstrate the direct consequences of climate change on an individual level rather than relying on global averages.

LifeScore resolves these communication challenges by providing a more intuitive and individualized approach. Unlike traditional climate metrics, LifeScore does not require individuals to actively process complex data about temperature shifts, economic losses, or probability estimates. Instead, it translates climate impacts into a universal metric that directly reflects how climate change will affect an individual's well-being. Climate change influences many interconnected factors, such as food security, economic stability, and health, all of which ultimately affect LifeScore.

By integrating climate data into the LifeScore framework, individuals can see exactly how climate change will impact their personal circumstances. This approach eliminates the abstraction of global economic loss figures and degrees of warming, making the risks tangible and actionable. It also allows policymakers to compare climate change mitigation with other societal priorities in a standardized way. Instead of debating whether climate funding is justified based on abstract cost projections, decision-makers can evaluate **how climate action improves LifeScores relative to other investments** in healthcare, education, or infrastructure.

B.2.2: Ineffective Impressions of Climate Change Symbols

Climate scientists often highlight the melting of ice caps and the disappearance of islands as symbols of climate change. However, these examples fail to resonate with most people because they feel distant and irrelevant. With fewer than 0.01% of the global population living in these regions, the majority of individuals do not perceive these changes as personally significant. As a result, **these symbols fail to create a strong impression or urgency.**

An even greater issue is that these highly visible examples often overshadow the more widespread and severe consequences of climate change. While rising sea levels may submerge islands, **climate change is simultaneously degrading essential environmental systems** that support global agriculture, water resources, and economic stability. These **degradations may not lead to outright disappearance**, but their impact will be felt far more broadly. However, because these effects are gradual and complex, they often receive less attention than dramatic, yet geographically isolated, events.

LifeScore resolves this issue by aggregating the full range of climate change impacts, including the degradation of environmental and economic systems. Rather than focusing on isolated and remote effects, LifeScore quantifies how climate change disrupts essential factors such as food security, infrastructure resilience, and financial stability. By presenting these **consequences in a way that directly affects an individual's well-being**, LifeScore ensures that climate risks are understood as personal, immediate, and actionable, rather than distant concerns affecting only a small fraction of the population.

B.2.3: Balancing Present-Day Issues Against Future Climate Change Consequences

One of the greatest challenges climate scientists face is convincing the public that i**mmediate action is necessary**, despite the fact that many of climate change's most severe consequences will unfold in the future. People naturally prioritize present-day concerns—economic hardship, healthcare, political instability—over long-term risks. This creates a psychological barrier to climate action, as individuals struggle to compare the **immediate costs of decarbonization with the long-term benefits** of mitigating climate change. While businesses and economists have developed frameworks to address this issue, such as **future discounting models**, these methods are complex and inaccessible to most individuals.

The LifeScore metric addresses this challenge by **integrating climate change impacts into a time-series model**. LifeScore is not a static number; it evolves over time, allowing individuals to see how climate-related changes will affect their **future well-being**. To make comparisons easier, future LifeScore values can be discounted based on established future discounting rates, ensuring that delayed climate action is evaluated in a way that is directly comparable to present-day decisions.

Additionally, LifeScore can quantify the **cost of inaction** by illustrating the **specific LifeScore reductions** that result from delayed decarbonization efforts. Instead of discussing climate mitigation in abstract terms, individuals will be able to see the direct impact of inaction on their own future quality of life. By making future climate consequences as tangible as present-day issues, LifeScore ensures that climate action is framed in a way that is both immediate and personally relevant.

B.2.4: Addressing Perceived Bias in Climate Science Communication

A common criticism is that **climate scientists appear biased** and **fail to address both sides of the debate**. In public discourse, neutrality and objectivity often require presenting multiple perspectives on an issue. However, in the case of climate change, the distribution of expert opinions does not align with the distribution of opinions in media or public debate. While the overwhelming majority of climate scientists agree on the reality and severity of climate change, media narratives often amplify **outlier opinions**, creating the false impression of a divided scientific community.

In theory, aggregating expert opinions into **statistical distributions** would provide an objective representation of where consensus and disagreement exist. However, doing this manually at scale is impractical and prohibitively expensive. The UniversalKnowledgeTensor, weighted by TruthCoins, resolves this issue by automatically capturing the true distribution of expert opinions. Unlike traditional media, which may disproportionately highlight fringe views, the UniversalKnowledgeTensor ensures that expert consensus is accurately reflected.

This approach eliminates the **inefficiency of wasting finite attention span on outlier opinions** while still allowing for an objective representation of expert perspectives. By structuring knowledge in this way, climate science communication becomes transparent, data-driven, and free from perceived bias, reinforcing its credibility while preventing misinformation from distorting the discussion.

B.2.5: Climate Change Awareness Has Failed to Convey the Severity of the Crisis

Despite decades of climate awareness campaigns, a **significant percentage of the global population still does not fully believe in the severity of climate change**. This is evident in the continued lack of large-scale, aggressive action to mitigate its effects.

A critical mistake made by climate scientists has been the assumption that public skepticism is **rooted in a lack of scientific understanding**. The prevailing belief has been that, if people were simply given more lectures on climate science, they would come to accept the urgency of the issue. However, this approach has proven **ineffective and inefficient**.

In most areas of life, people do not require deep technical knowledge to trust experts. When a car mechanic claims a part needs to be replaced, few people demand a lecture in mechanical engineering before accepting the diagnosis. When a doctor prescribes medication, most patients do not insist on a lecture in biochemistry before taking it. Trust in expertise is typically built through consistent results and accountability mechanisms, not through education .

The challenge for climate scientists is that misinformation has created a **trust paradox**: individuals and organizations with **the least integrity are often trusted the most**, while those with the **highest integrity struggle to gain widespread trust**. Unlike mechanics or doctors, whose expertise can be evaluated based on immediate, tangible outcomes (e.g., a repaired car or a saved patient), climate scientists cannot point to "hundreds of saved planets" as evidence of their credibility. This lack of immediate, verifiable feedback makes it easier for misinformation to flourish and harder for experts to establish trust.

A new approach is needed, one that does not rely on endless lectures but instead **leverages powerful corruption defense mechanisms to earning trust**. TruthCoin and the UniversalKnowledgeTensor provide this alternative by providing an incorruptible comprehensive knowledge dissemination platform.

B.2.6: "Methodological" Climate Change Denial

While many people claim to "believe" in climate change, their actual behaviors often suggest otherwise. This phenomenon, known as **methodological climate change denial**, occurs when an individual's **actions remain unchanged regardless of whether they accept or reject climate science**. To illustrate this, one can ask a self-identified climate change believer how their daily decisions would differ if they suddenly stopped believing in climate change. If their choices remain the same or change only slightly, then their **belief is functionally irrelevant** since they are effectively "Methodological Climate Change Deniers".

When it comes to climate change, **belief alone is meaningless**, only actions have value. Yet much of the scientific community has focused on persuading people to believe in climate change rather than ensuring that belief translates into meaningful action. With KnowledgeTensors, Climate scientists do not need to convince individuals to adopt a particular worldview; if their assessments of climate change are correct, then the only necessary step is to encode their knowledge into KnowledgeTensors to be purchased with TruthCoins.

Once climate knowledge is embedded in the UniversalKnowledgeTensor, every individual will see exactly how climate change affects their LifeScore. More importantly, they will be able to identify the specific actions that will improve their LifeScore in response to climate change. This approach bypasses the "inefficiencies of ideological persuasion" and ensures that individuals act in alignment with reality, not because they "believe" in climate change, but because they can see its tangible impact on their well-being.

B.2.7: Climate Change as a Special Case of "Death by a Thousand Cuts"

Climate change is not defined by any **single catastrophic event**, but rather by an **accumulation of many smaller, interconnected crises**—a phenomenon akin to **death by a thousand cuts**. If a torturer were to inflict a thousand small wounds on a victim, always stopping short of a fatal injury, an observer would struggle to explain the severity of the situation by focusing on individual cuts. Each wound, in isolation, may seem minor, but the **cumulative effect is devastating.**

Climate scientists face a similar challenge when trying to communicate the urgency of climate change. If asked whether climate change will cause human extinction, they will say no. If asked about the impact of individual climate-related events—hurricanes, droughts, rising sea levels—they will acknowledge their severity, but these events are not new; they have occurred throughout history. The fundamental issue is **not any single disaster**, but rather the

aggregation of climate-driven disruptions **across all systems**—economic, environmental, and societal.

This same pattern can be seen in **other slow-moving crises**, such as the **gradual erosion of the middle class**. No single economic policy or financial hardship appears catastrophic in isolation, but over time, the cumulative impact results in systemic instability.

TruthCoin and the UniversalKnowledgeTensor resolve this issue by taking a metric-based approach that inherently aggregates all climate-related impacts. Since each contributing factor is quantified and incorporated into LifeScore, individuals do not need to allocate attention span to track every new hurricane, heatwave, or policy change. The cumulative effect of climate change is automatically captured and reflected in their LifeScore, ensuring that the true scope of the crisis is **understood holistically** rather than being fragmented into disconnected events.

B.2.8: Distractions from Minor Climate Change Benefits

A common rhetorical strategy used to downplay the severity of **Climate Change** is to highlight **positive consequences** that counterbalance the **negative ones**—for example, the claim that increased carbon dioxide benefits plant growth. However, attempting to catalog and compare the positive and negative effects of Climate Change is **misleading and unproductive**, as the scale and severity of **negative consequences far outweigh any potential benefits.**

Rather than focusing on individual consequences, the more **meaningful approach** is to consider the **aggregate impact** of Climate Change. Given the limited cognitive bandwidth available for processing complex global issues, debating **individual effects in isolation** leads to **distraction and dilution of urgency**.

Ultimately, what matters is not a selective list of pros and cons, but the **total net effect** of Climate Change on **human societies, ecosystems, and economies**. By shifting the discussion toward **comprehensive, data-driven assessments**, an accurate evaluation of Climate Change can be made without being misled by **impression-based arguments** that **emphasize minor benefits while ignoring catastrophic risks**.

B.2.9: ClimateGate

Despite multiple independent scientific investigations finding **no evidence of scientific misconduct**, the ClimateGate controversy continues to be used as a tool for Climate Change denialism in online discourse. This persistence highlights a fundamental issue in how scientific knowledge is communicated and interpreted. The **root of the problem** lies in the **adverse impressions** generated from the symbol trick(definition: manipulated to mislead) when the **TRUE meaning** was trick(definition: technique or **approach**).

In this case, when discussing the construction of a climate-related graph, Climate Scientists used **language that was misinterpreted or intentionally misrepresented**, leading to accusations of wrongdoing. While no scientific fraud occurred, the controversy underscores the

risks of relying on conventional language in scientific communication since scientists inadvertently walked into a **rhetorical landmine**.

However, this raises a critical question : **What if the graph itself had been incorrect?** Given the sheer number of climate-related graphs produced, there is always the possibility that accidental errors could occur. Such an event could have **even more severe consequences** than the original ClimateGate controversy.

This leads to a deeper question: **Why do graphs matter so much?** Graphs like the hockey stick graph serve as **symbols that create impressions**—they simplify data into a **visual narrative**. However, *Climate Change is not a collection of graphs; it is a phenomenon grounded in underlying data*. Relying on **symbols** to communicate knowledge makes **scientific discourse vulnerable to distortion**, as impressions can be manipulated more easily than data itself.

Finally this raises another concern is: **What if some of the climate data is incorrect?** Given the vast quantity of climate-related data, some degree of corruption or error is inevitable. However, these **isolated cases should not overshadow the overwhelming body of evidence** supporting Climate Change. A single flawed dataset does not negate the broader scientific consensus. The challenge is ensuring that our knowledge dissemination systems are resistant to corruption.

KnowledgeTensors address these concerns by **removing symbolic and impression-based vulnerabilities from scientific communication**. Experts do not communicate through graphs or narratives that can be manipulated or misinterpreted. Instead, they encode their knowledge directly into KnowledgeTensors, allowing data-driven applications to generate accurate evaluations.

Furthermore, TruthCoin integrates robust corruption defenses—ensuring that if an expert is compromised, their influence is mitigated through multiple layers of integrity verification. By **shifting away from symbolic representation and toward structured, corruption-resistant knowledge**, TruthCoin establishes a more resilient framework for scientific communication and public trust.

B.2.10: The Benevolent Alien Thought Experiment—An Optimal Framework for Climate Action

The Benevolent Alien provides the ideal decoupled perspective to addressing the complexities of Climate Change. Climate change is a **global problem that requires a coordinated global response**, yet the current approach treats it as a collection of **isolated national efforts,** incentivizing minimal commitments rather than meaningful reductions. Existing approaches, characterized by localized optimization and the pursuit of individual or organizational self-interest, frequently result in sub-optimal collective outcomes. By transcending these parochial viewpoints, the Benevolent Alien framework facilitates the identification and mitigation of systemic inefficiencies that arise from fragmented and self-serving climate action. This perspective addresses the following sub-optimal actions.:

- **Greenwashing** – When entities invest in **ineffective but highly visible** climate initiatives that create a false impression of environmental responsibility without meaningfully reducing emissions.
- **Shifting** – When **emissions are moved** from one entity to another rather than being reduced overall (e.g., outsourcing carbon-intensive manufacturing to another country).
- **Stalling** – When entities **delay climate action** to take advantage of **future cost reductions** in green technology, rather than acting immediately to maximize long-term benefits.

Appendix C: Blockchain and Integrity

Appendix C.1: SEPAM

The Scorched Earth Policy Against Misinformation (SEPAM) guides the development of the TruthCoin Protocol which prioritizes knowledge integrity above all else, even at the cost of such things as ease-of-use, expressiveness, or even the platform's own existence. This approach is based on the understanding that it is more effective to prevent the introduction of misinformation than to attempt to rectify it after the fact, as "it is difficult to un-poison a well of knowledge after it has been poisoned." While the above list of multi-layered corruption defenses are extensive, the SEPAM also recognizes the importance of continuous improvement and adaptation in the face of evolving misinformation tactics. It calls for ongoing efforts to identify and address potential corruption attack vectors, as well as to enhance the defense mechanisms of the TruthCoin Protocol. This requirement for continuous improvement underscores SEPAM's fanatical commitment to achieving the highest level of integrity possible and to minimizing the impact of misinformation.

Military scorched earth tactics refers to the intentional destruction of the country's resources to deny their use to the enemy. In the context of knowledge distribution and consumption, a 'scorched earth strategy' can be understood as the deliberate sacrifice of system capabilities or design decisions to preemptively deny their use to the enemy of misinformation. Therefore, SEPAM mandates the uncompromising elimination of any system feature or capability within TruthCoin that exhibits even a marginal susceptibility to exploitation for the dissemination of misinformation. This necessitates a proactive and rigorous approach to system design, prioritizing the absolute integrity of knowledge over any other competing objectives.

The design of KnowledgeTensors exemplifies the application of SEPAM. While KnowledgeTensors impose constraints on the range of expressible claims, their selection as the primary knowledge structure is predicated on their capacity to facilitate robust corruption defense mechanisms. In adherence to SEPAM principles, blockchain technology is mandated for ledger maintenance, prioritizing maximal transparency as a critical safeguard against misinformation.

Enshittification Immunity A platform 'slowly degrades in quality' ('enshittifies') when it reaches dominance and then prioritizes profit or influence over its original purpose. This is usually the result of a thousand cuts each slowly sacrificing quality to increase profit or some other metric. **SEPAM** guarantees that TruthCoin remains immune to this phenomenon. TruthCoin protocol shall never be entrusted to **corporate or government entities**, eliminating profit-driven or influence-driven degradation. The only acceptable modifications to the TruthCoin protocol are those that increase integrity, ensuring that no future version of TruthCoin will ever be more vulnerable to corruption than the current version.

Appendix C.2: Blockchain

The primary objective of TruthCoins and the associated blockchain(currently named TruthCoin) is to maintain a transparent ledger that tracks the allocation of TruthCoins to various KnowledgeTensors. This ledger facilitates the construction of the **UniversalKnowledgeTensor**, a comprehensive repository of human knowledge with the highest levels of integrity.

Key Operations with TruthCoins:
1. **Purchase a KnowledgeTensor**: Increases the weighting of a KnowledgeTensor in the UniversalKnowledgeTensor.
2. **Retract a KnowledgeTensor**: Withdraw a previously purchased KnowledgeTensor.
3. **Transfer TruthCoins**: Allocate portions of TruthCoins to other experts.
4. **Revoke TruthCoins**: Retract previously transferred TruthCoins.
5. **Purchase KnowledgeTensor 66**: Vote of No-Confidence to destroy the Blockchain and the resultant UniversalKnowledgeTensor.

Allocation TruthCoins are not intended for arbitrary distribution. The overarching aim is for TruthCoins to uphold the **highest standard of human knowledge**, free from dispute or bias. As reputation inversely correlates with susceptibility to corruption, TruthCoins should be awarded to individuals with impeccable, globally recognized reputations, such as Nobel laureates and Fields medalists. TruthCoin Custodians must possess an **indisputable and objective reputation**, ensuring that their expertise is recognized based on rigorous, evidence-based achievements. As a result, recipients should be selected from fields with quantifiable and verifiable contributions such as science and mathematics, rather than subjective or interpretive disciplines like literature or peace studies. This criterion minimizes controversy and ensures that TruthCoin remains aligned with empirical integrity and factual accuracy. Conversely, TruthCoins must never be randomly distributed since **intelligence agencies are able to corrupt** randomness.

TruthCoin Custodians, though intellectually exceptional, may lack expertise in specific domains. To address this, TruthCoins can be subdivided and transferred to domain-specific experts. This topic is discussed further in the "Appendix B.1 TruthCoin Transfer".

Mechanics Blockchains are transparent, distributed ledgers that rely on solving computationally challenging problems to validate and secure transactions. Unlike traditional cryptocurrencies, where ownership is often determined by "computational effort" or "randomized proof-of-work mechanisms", TruthCoin is designed to be held exclusively by individuals with **exceptional intellectual merit**. To ensure a rigorous and unbiased selection process, a **TruthCoin Foundation** is responsible for overseeing allocations by relying on **external, independent institutions**—such as the "Nobel Prize Committee" and the "Fields Medal Committee"—to establish eligibility criteria. This framework allows individuals shortlisted for such honors to receive TruthCoins, even if they do not ultimately win an award. The foundation should **never determine eligibility directly** and should **never purchase KnowledgeTensors**.

While the TruthCoin Foundation serves as the central governing body, it is **not immune to external threats**, particularly from **intelligence agencies** or other entities attempting to manipulate the system. To safeguard against such **Corruption Attacks**, a **network of TruthCoin SubFoundations** is established across multiple jurisdictions to ensure that they operate independently. This distributed oversight prevents any single entity from exerting undue influence.

To formally "award a TruthCoin", the SubFoundations collectively sign the recipient's public key, recording the transaction immutably on the **blockchain ledger.**

By leveraging decentralized governance, cryptographic verification, and external institutional oversight, TruthCoin ensures that its allocation process remains transparent, incorruptible, and exclusively reserved for the most accomplished intellectuals.

Miner To ensure transparency and accountability in the purchase of KnowledgeTensors, Miners are required to **record these transactions** on the TruthCoin blockchain. TruthCoin Miners simply sign the Transaction to the blockchain using their private key to add a KnowledgeTensor transaction to the ledger. They do not expend vast computational and energy resources solving proof of work problems like other CryptoCurrencies. If two miners attempt to add different transactions to the block chain at the same time, **Courteous Mining** dictates that the Miner who recently added a transaction must yield to a Miner who hasn't. This solves race conditions and ensures that no set of miners can censor any KnowledgeTensor transactions. Miners are designated by the TruthCoin SubFoundations but the power of Courteous Mining allows optimal integrity **without any Miner vetting process.**

Miners are responsible for verifying **integrity requirements** within the TruthCoin protocol, such as ensuring that TruthCoin Custodians **cannot double purchase KnowledgeTensors**. A double purchase occurs when a single TruthCoin Custodian attempts to purchase two KnowledgeTensors that reference the same KnowledgeCell. Additionally to uphold transactional integrity, a TruthCoin Custodian may purchase and retract a limited number of KnowledgeTensors per year, given that they meet integrity requirements. The specific annual limit on purchases and retractions is yet to be determined, but it will be a function of the needs of experts to update their opinion as well as the current estimates of corruption attacks.

In traditional cryptocurrency networks, **miners are financially incentivized** through rewards in the form of newly minted cryptocurrency. However, the **TruthCoin protocol explicitly prohibits financial gain** from any aspect of its operation (such as mining) to prevent conflicts of interest and maintain **uncompromised integrity**. For any given topic, certain entities profit from misinformation, while others stand to benefit from the widespread dissemination of accurate and comprehensive knowledge. The TruthCoin mining process relies on the motivation of these latter groups to serve as **TruthCoin Miners**. By shifting the incentive structure away from monetary rewards and toward the preservation of verifiable knowledge, the protocol ensures that mining remains aligned with the fundamental mission of TruthCoin: the highest possible standard of knowledge integrity.

The operational costs of maintaining the blockchain are minimized by the lightweight nature of KnowledgeTensor data but the actual amount of TruthCoin awards needs to still be determined. If these costs end up being excessive, these costs can be offset through donations similar to the Wikipedia model. Under no circumstances should the TruthCoin foundation resort to ad-based funding, as this introduces potential vulnerabilities.

Blockchain Benefits While TruthCoin's primarily goal is to represent the pinnacle of human knowledge, the Blockchain allows it to achieve the following secondary goals:
1. **Censorship Immunity** : A globally distributed miner network ensures that no single country's censorship regime can censor KnowledgeTensor transactions. **Courteous Mining** ensures that every single miner in existence must reject the TruthCoin KnowledgeTensor purchase for it to be censored from the Blockchain.
2. **Platform Survivability**: The distributed nature of the blockchain ensures persistence, requiring the elimination of all nodes to disrupt the system.
3. **Privacy**: Users retain personal data on their devices with no data sent to any corporate or government entity. The only information that these entities will know about the user is that they are downloading the blockchain.

Appendix C.3: Integrity

Multi-layered Security Mechanisms ensure that TruthCoin and the UniversalKnowledgeTensor form a resilient knowledge dissemination platform resistant to even the most sophisticated corruption attempts. By integrating **blockchain transparency, cryptographic security, distributed oversight, and rigorous expert selection**, TruthCoin achieves the highest possible standard of knowledge integrity, ensuring that the **truth remains incorruptible, verifiable, and universally accessible.**

To illustrate its robustness, assume the worst-case scenario where a well-funded and well-resourced intelligence agency exists with the singular goal of corrupting the platform. The following analysis demonstrates that for every conceivable **Corruption Attack Vector,** TruthCoin's blockchain-based framework implements a **Corresponding Defense Mechanism**. To highlight the multiple layers of protection, **Impossible Assumptions** are made that each preceding defense mechanism could be bypassed, requiring deeper layers of security. Please note all numbers used below are for illustrative purposes and the final numbers still require analysis.

To set a baseline for success in a corruption attack, assume the **minimal requirement** that any deviation of the UniversalKnowledgeTensor **away from the truth** constitutes a **successful corruption**—regardless of direction. For example, Claiming that "smoking does not cause cancer" or that it "causes excessive cancer" would both qualify as corruption successes. Similarly, stating that "climate change is not occurring" or that it "is occurring at an exaggerated rate" would also both be considered corruption successes.

Attack #1: Create Corrupted KnowledgeTensors Malicious actors attempt to influence the UniversalKnowledgeTensor with false or biased data in the form of corrupted KnowledgeTensors by spreading corrupted KnowledgeTensors online. **KnowledgeTensor Purchases Requirements** ensures the mere presence of fake KnowledgeTensors on the internet does not affect the UniversalKnowledgeTensor. Only **cryptographically verified purchases** (via TruthCoins) can influence the UniversalKnowledgeTensor, ensuring that knowledge must be legitimately accepted by experts.

Attack 2: Hack TruthCoin Custodians Hacking the device containing the TruthCoin Custodian's private key would allow malicious actors to purchase corrupt KnowledgeTensors to influence the UniversalKnowledgeTensor. The **Blockchain is the most transparent technology humanity has ever created or will ever create**. Any illegitimate purchases are immediately visible and subject to public scrutiny. If corruption is detected, **KnowledgeTensor purchases can be retracted**, nullifying their impact.

Attack 3: Directly Corrupt TruthCoin Custodians A malicious actor can threaten, bribe, or coerce TruthCoin Custodians into purchasing corrupted KnowledgeTensors. **The Highly Selective TruthCoin award process** ensures that TruthCoins are awarded exclusively to **the most accomplished intellectuals**, reducing the likelihood of corruption. These individuals have strong reputational incentives to uphold intellectual integrity, making bribery or coercion highly ineffective.

Attack 4: Corrupt Blockchain Miners Malicious actors who have corrupted a significant share of TruthCoin Miners may attempt to censor KnowledgeTensor purchases that they do not support. Unlike TruthCoin Awards, there is no vetting process to become a TruthCoin Miner. **Courteous Mining** eliminates censorship. If multiple miners attempt simultaneous blockchain additions, preference is given to the older Miner based on the last contribution to the blockchain. This ensures that in order to censor legitimate undesired KnowledgeTensors, every miner in existence would have to be compromised. By distributing Miner keys to people in every nation, no nation's censorship regime would be capable of corrupting every TruthCoin Miner.

Impossible Assumption: A Malicious actor can corrupt a few TruthCoin Custodians ensuring that their KnowledgeTensor Purchases will never be retracted. Additionally all of Humanity collectively ignores blockchain activity due to distractions from cultural systems. This ensures that detection of KnowledgeTensor corruption is now impossible.

Attack 5: Corrupted TruthCoin Custodians purchase Corrupt KnowledgeTensors These purchases will never be retracted from the Blockchain. **KnowledgeCell Purchase Threshold Requirements** ensure that a minimum threshold (e.g., 20 TruthCoins) is required before a KnowledgeCell is accepted into the UniversalKnowledgeTensor. High-importance KnowledgeCells (e.g., climate science) require even higher thresholds (maybe as a percent) to prevent corruption.

Attack 6: Recursion Attack A malicious KnowledgeCell that calls itself recursively, will prevent LifeScore computations from completing. The **SpecialStack Detection Mechanism** ensures that if a KnowledgeCell detects itself in the computation stack, the system automatically unwinds the recursion and removes the offending KnowledgeCell. This allows the completion of LifeScore computations. Additional details can be found in "Appendix B.7.6 SpecialStack".

Attack 7: Duplicate Corrupt KnowledgeTensor Purchases A corrupted TruthCoin Custodian can attempt to purchase multiple versions of the same corrupted KnowledgeTensor to increase its weight in the UniversalKnowledgeTensor. The TruthCoin Protocol dictates a **No Double Spending Rule** ensuring that a single TruthCoin cannot purchase multiple KnowledgeTensors that share a common KnowledgeCell. The TruthCoin Miners will automatically reject duplicate KnowledgeTensor purchases that are attempted. If **double spending** is detected on the Blockchain, **both purchases are rejected.** To buy a new KnowledgeTensor, a TruthCoin Custodian must first retract any pre-existing KnowledgeTensors that contain the same KnowledgeCell.

The primary reason the TruthCoin protocol incorporates blockchain technology(Truth**Coin**) rather than web technology (Truth**Web**) is its reliance on blockchain technology to prevent double spending and maintain immutability. In traditional financial systems, banks prevent double spending through strict regulatory frameworks and extensive oversight by financial authorities. However, when dealing with information rather than currency, the challenge shifts from financial fraud to ideological manipulation. Governments, regardless of their political alignment, are inherently incentivized to amplify narratives that align with their interests while suppressing or discrediting opposing viewpoints. This creates a fundamental conflict of interest with any government for managing truth. No government can ever be entrusted with control of TruthCoin since that would compromise its neutrality and objectivity. By utilizing **blockchain technology**, TruthCoin ensures that **no single entity(governmental, corporate, or otherwise) has the ability to manipulate or censor knowledge**. This decentralized approach guarantees that **the integrity of knowledge remains independent from political influence**, preserving the highest possible standard of unbiased, verifiable truth.

Attack 8: Denial of Service Attack By flooding the blockchain with excessive KnowledgeTensor transactions, a Malicious actor can reduce the bandwidth for legitimate KnowledgeTensor purchases. **KnowledgeTensor Purchase Limits** ensure that each TruthCoin Custodian is limited in the number of KnowledgeTensor purchases per year. Once this limit is reached, the TruthCoin Miners will ignore all further KnowledgeTensor purchase attempts.

Attack 9: Corrupt the TruthCoin Foundation While the TruthCoin foundation has higher security requirements than a TruthCoin Custodian, a malicious actor may still be successful in compromising the TruthCoin Foundations private key. **TruthCoin Foundation Restricted Authority** ensures that the TruthCoin Foundation's private key is used only to sign the initial set of SubFoundations (e.g., 100). Even if compromised, this key cannot be used to purchase KnowledgeTensors or add new SubFoundations beyond the initial set.

Attack 10: Corrupt the TruthCoin SubFoundations a successful corruption of SubFoundations can lead to the award of TruthCoins to corrupted individuals. **SubFoundation Award Thresholds** ensure that a supermajority threshold (e.g., 80%) of SubFoundations must approve a TruthCoin award for it to be accepted. SubFoundations **must follow strict eligibility criteria based on prestigious, independently verifiable organizations** that are difficult to corrupt. Blockchain Transparency ensures that any deviation from protocol compliance is easily verifiable on the blockchain.

To enhance security and resistance to corruption, TruthCoin SubFoundations should be geographically distributed across multiple countries. This decentralization increases the difficulty for any intelligence agency to compromise the system. Ideally, each country should host multiple SubFoundations, representing diverse political orientations within different regions. This ensures that **no single ideological or governmental influence** can dominate the TruthCoin awarding process. The addition or removal of SubFoundations can only be carried out by other SubFoundations, and this process must adhere to a clearly defined protocol. This protocol **prevents compromised SubFoundations from obstructing the awarding of TruthCoins to eligible individuals** and maintains the **integrity and impartiality** of the TruthCoin ecosystem.

Attack 11: Sequential Compromise of SubFoundations Gradually corrupt individual SubFoundations over time until a supermajority is compromised. The **SubFoundation Key Rotation** mechanism addresses this attack where SubFoundations rotate cryptographic keys (and/or personnel) annually (or monthly) to mitigate long-term vulnerabilities. Each new key must be co-signed by a supermajority of existing SubFoundations. **Old keys cannot be used for future transactions**, limiting the time window available for a sustained attack. Any intelligence agency attempting sequential corruption faces **a race against time**—if they fail to corrupt enough SubFoundations before a key rotation, all compromised efforts are rendered wasted.

IMPOSSIBLE ASSUMPTION It is now possible to manipulate approximately 25% of the most intelligent individuals. Their KnowledgeTensor purchases will now never be retracted.

Attack #12: Direct Manipulation of the LifeScore KnowledgeCell (DirectAttack)
Compromised TruthCoin Custodians can purchase corrupt KnowledgeTensors of the LifeScore KnowledgeCell to directly set to a corrupted value instead of the traditional aggregation KnowledgeCell. **KnowledgeCell Type Majority Rule** prevents a KnowledgeCell from changing its type without a majority consensus on the type. This prevents unilateral manipulation of the LifeScore's computation methodology. For example, if 40% of LifeScore KnowledgeCells purchases define LifeScore as an aggregation computation, and only 25% of purchases attempt to redefine it as a direct computation, the direct computation KnowledgeCells are ignored.

Attack #13: Outlier Attack Since the LifeScore KnowledgeCell cannot be easily attacked, a malicious actor can introduce extreme leaf-level KnowledgeCell(whose computational type is direct) with artificially inflated values (e.g., setting a metric to +1,000,000) to skew LifeScore calculations. **KnowledgeCell Range Limits** exclude outliers, ensuring only reasonable values are incorporated. This ensures that corruption exists only within reasonable, evidence-based thresholds rather than extreme distortions. The acceptable range of values for each KnowledgeCell is determined by majority agreement. For any given subject, it may be difficult to achieve expert consensus on a specific position, but it is much easier to achieve concensus on what are the ranges of acceptable positions are.

Attack #14: High Resolution Dimensional Targeting Corrupting specific high-resolution tensor dimensions to mislead localized groups without affecting the majority of users. For example, a malicios actor could introduce a high resolution corrupted KnowledgeCell at the street level to mislead people on that street without effecting anyone else. This is based on the design of UniversalKnowledgeTensor queries that prefer KnowledgeCells with a high resolution (ex: address/country1/state2/city3) over a low resolution (ex: address/country1). **Dimension Resolution Wild Card** defends against this attack by serving lower resolution KnowledgeCells with higher ones.

For Example: If crime statistics are only available at the city level, the trusted KnowledgeCell would be 'address/country1/state2/city3*' to indicate that knowledge is not available at higher resolutions. If a user who lives at 'address/country1/state2/city3/street4' queries the UniversalKnowledgeTensor, they would be served all the trusted KnowledgeCells at 'address/country1/state2/city3*' along with the corrupted KnowledgeCells at 'address/country1/state2/city3/street4' resulting in a dilution of the corruption attack and making it ineffective.

Attack #15: Snake Oil Attack A malicious actor may attempt to introduce a fraudulent action, such as 'action/snake_oil', falsely claiming that consuming snake oil leads to a dramatic improvement in LifeScore. This type of misinformation is designed to deceive users into making harmful or ineffective decisions based on manipulated data. Reality-based KnowledgeCells (i.e., those representing the absence of action) are easier to measure and validate than hypothetical actions. As a result, any given location in the UniversalKnowledgeTensor will have more TruthCoin purchases on 'reality' (no action) than on any individual alternative action. This leads to the "Return on Corrupted TruthCoins" exerting greater influence over a hypothetical action than on the actual reality for any given KnowledgeCell.

The **LifeScore Improvement Cap** defends against this attack by setting the maximum possible improvement in LifeScore for an alternative action based on the number of TruthCoins assigned to this action. This ensures that a significant number of TruthCoins would need to be corrupted before a fraudulent action could create a noticeable LifeScore change. Additionally **Action Ranking Based on TruthCoins** prioritizes actions for evaluation based on the number of unique TruthCoins backing that action. This prevents low-credibility, artificially inflated actions from being ranked above legitimate, widely validated actions.

For illustrative purposes, assume that the **snake_oil_constant** is set at 0.1. In this scenario, a malicious actor has manipulated 60 TruthCoins, and the corrupted KnowledgeCells assert that a 10% enhancement in the LifeScore can be achieved through the consumption of 'action/snake_oil.' However, the **LifeScore Improvement Cap** invalidates this claim, as a 10% increase surpasses the permissible threshold of 6% (calculated as 60 * 0.1 = 6%). To successfully execute the corruption, the malicious actor must either acquire additional TruthCoins (a highly challenging task) or reduce the magnitude of the corruption's impact (which is the intended purpose of the defense mechanism).

To calculate the TruthCoin value associated with a particular action, one must consider all the relevant KnowledgeCells and compute the ratio of the 'Total TruthCoin across all KnowledgeCells for the action' to the 'total number of KnowledgeCells corresponding to that action'.

Attack #16: Average Lowering Attack If corrupted actions cannot be elevated, legitimate actions can be sabotaged by artificially lowering their average TruthCoin count. This results in corrupted actions having a higher delta LifeScore than legitimate actions. The malicious actor attempts to **inflate the denominator** by purchasing unrelated KnowledgeCells for a legitimate action to reduce its overall TruthCoin count. **Isolated KnowledgeCell Filtering** addresses this attack by filtering out any KnowledgeCell CellLoc that doesn't receive 50% of the maximum TruthCoins for that action.

As an example, the legitimate action 'action/non_corrupt' has KnowledgeCells at the CellLoc of 'n1', 'n2' and 'n3' with 100 TruthCoins per CellLoc. The malicious actor introduces a corrupt KnowledgeCell at CellLoc 'n4' with only 20 TruthCoins. Most experts did not think that 'n4' was an important CellLoc for action 'action/non_corrupt' since it did not receive 50% of the max TruthCoins for that action (i.e. 100 TruthCoins). Therefore Isolated KnowledgeCell Filtering will remove the 'n4' CellLoc when computing the average TruthCoin Count of 'action/non_corrupt' preventing artificial lowering of the Action's TruthCoin count.

IMPOSSIBLE ASSUMPTION: Frustrated by the multi-layered corruption defenses inherent in TruthCoin, the malicious actor transcends human limitations, ascending to a **God of Corruption**, capable of influencing 80% of the highest-integrity and most accomplished individuals. This unprecedented power underscores the immense potential for both industrial profit and the destructive capacity inherent in this Misinformation ability. If 80% of the world's leading intellectuals were to be swayed into believing fallacies such as 'Covid-19 is a hoax,' 'Climate change is a fabrication,' or 'Smoking is beneficial to health,' the consequences for society would be profound and far-reaching.

Attack #17: God of Corruption Attack Once a critical mass of TruthCoin Custodians has been corrupted, the previously effective multi-layered defenses are rendered ineffective. The malicious actor has unrestricted access to modify any CellLoc within the UniversalKnowledgeTensor at their discretion. **KnowledgeTensor 66** represents the final line of defense, and it is the sole mechanism capable of counteracting a 'God of Corruption.' According to the TruthCoin Protocol, if more than 15% of TruthCoin Custodians purchase KnowledgeTensor 66, all UniversalKnowledgeTensor Viewers and TruthCoin Miners are mandated to cease operation. This safeguard ensures that the integrity of the system is preserved, prioritizing the destruction of TruthCoin over its potential corruption.

Please note that the Proof-Of-Concept Prototype only implements defenses for 'Attack 6: Recursion Attack', 'Attack #12: Direct Manipulation of the LifeScore KnowledgeCell', 'Attack #13: Outlier Attack', and 'Attack #14: High Resolution Dimensional Targeting'.

Appendix C.4: Future Security Efforts

C.4.1 Cryptography

From a cryptographic standpoint, it is essential to establish the appropriate hashing algorithm, digital signing algorithm, key length, and key generation algorithm. These decisions should ultimately be made by cryptographers, who are best suited to evaluate the security requirements of the system. However, their selection process must prioritize TruthCoin's objective of being the highest form of knowledge, ensuring that security considerations take precedence over concerns like efficiency, speed, or any other trade-offs.

Furthermore, it may be advantageous for the system to support a flexible key size, allowing for the potential increase in key length over time as cryptographic standards evolve and as the system grows to meet future security demands. This adaptability would ensure that the integrity and security of TruthCoin remain intact as technological advancements are made.

C.4.2 Alternate Action Bound Propagation

In some scenarios, hypothetical actions may significantly change the values of inputs which when propagated results in dependent values to fall outside their original bounds. To solve this, a method should be implemented for adjusting the bounds of dependent variables based on the new bounds of their inputs .

For Example:
- Original values and bounds for reality are as follows:
  - 'a = 10', valid bounds: [8,12]
  - 'b = 20', valid bounds: [16,24]
  - 'c = a + b = 30', valid bounds: [24,36]

- After 'action\hypothetical_action_1':
  - 'a = 18', valid bounds: [17,19]
  - 'c = 18 + 20 = 38', which is outside its previous bounds of [24,36].

  - ideally an algorithm would calculate the new bounds for 'c' under 'action\hypothetical_action_1' to be '[17 + 16, 19 + 24] = [33, 43]'.

It is difficult to estimate the value of this feature. For Climate Change, this feature may not be used since even the most aggressive climate action may not cause Climate metrics to fall outside reasonable bounds. But other applications may find value in this feature.

C.4.3 Picture Purchase Platform (P3)

At its core, every **TruthCoin** is essentially a **private key** stored on some computer. Given the existence of an entire field of hacking with numerous attack vectors, it is possible for a compromised computer to expose the private key, thereby enabling corruption. The objective behind this method is to implement a Scorched Earth approach that aims to minimize the attack surface area as much as possible by limiting potential vulnerabilities and reducing opportunities for exploitation. This strategy focuses on making it exceedingly difficult for malicious actors to access or manipulate the private keys, thereby enhancing security and protecting the integrity of the system.

Rather than relying on vulnerable computers to store the TruthCoin, a more secure alternative involves using modified phones or tablets. These devices will have the TruthCoin App securely installed initially. To further enhance security, the devices are physically modified by removing their Wi-Fi chips, cellular chips, microphone, speaker, and USB data transfer connection pins. This ensures that the device cannot transmit or receive data through traditional communication methods. The only way for data to enter or exit the device is via a picture displayed on the screen and the camera, creating a highly secure, isolated environment for the storage of the TruthCoin. This approach minimizes the attack surface by effectively elimanating all external communication channels, relying solely on visual data transfer, which is more difficult to compromise.

To purchase a KnowledgeTensor on TruthCoin, the following steps must occur:

Step 1) The TruthCoin Custodian must be visually presented with a QR Code that represents the hash of the desired KnowledgeTensor to be purchased.

Step 2) The TruthCoin Custodian launches their TruthCoin App on their P3 device and takes a picture of the above QR Code.

Step 3) The TruthCoin Custodian must provide authorization by providing the TruthCoin App with a PIN/Password and some Biometric data.

Step 4) The TruthCoin App on the P3 Device will use the TruthCoin private key to create a digital signature of the KnowledgeTensor's hash. The TruthCoin App will then present this digital signature in the form of a QR Code on the screen of the P3 device.

Step 5) A network connected computer will take a picture of the above QR Code and follow the TruthCoin protocol to add it to the Blockchain.

This approach significantly reduces the attack surface by eliminating entire classes of attack vectors. By using the **P3 device**, the system shifts the vulnerability from traditional digital communication channels to a much narrower surface area: the ability to hack a device with a picture of a QR Code.

While it is still technically possible for an attacker to compromise such a device, the complexity of executing such an attack is greatly increased. The reliance on physical interaction, visual data transfer, and multiple layers of verification (PIN, biometric data, secure devices) makes the attack considerably more difficult to pull off. As a result, the reduced surface area will attract more focus from the computer security community, leading to more attention and innovation in securing these narrow entry points.

Appendix D: Technical Designs

D.1 TruthCoin Transfer

TruthCoin Custodians, although highly knowledgeable, may lack expertise in specific domains. To address this, TruthCoins can be subdivided and transferred to domain-specific experts. For instance, a TruthCoin Custodian could transfer part of their TruthCoin to a cardiologist for acquiring heart disease-related KnowledgeTensor purchases and another part to an oncologist for cancer-related KnowledgeTensor purchases. When a TruthCoin is transferred, the transfer specifies the subset of dimensions within the UniversalKnowledgeTensor the recipient can purchase. It also encodes the chain of public keys representing the transfer history. TruthCoins are not fungible; each transfer carries its unique chain of ownership. If revoked, any associated

KnowledgeTensor purchases are invalidated. For example, if an expert initially holding two delegated TruthCoins **has one revoked**, all KnowledgeTensors purchased using that specific TruthCoin become **invalidated**, leaving the expert with only one remaining TruthCoin. To maintain traceability, the length of the chain of experts should be capped, with six degrees of separation being a reasonable upper limit.

Once a TruthCoin is gifted, the original Custodian loses the ability to purchase KnowledgeTensors in that domain unless they revoke the gift. TruthCoin revocations may occur for various reasons, such as Corruption of the recipient or the emergence of a more qualified expert.

While transferring TruthCoins is necessary for distributing expertise, the accumulation of too many TruthCoins by a single expert poses a corruption risk. For example, if two TruthCoin Custodians transfer their TruthCoins to the same cardiologist, this expert now possesses two TruthCoins for the domain. While this does not technically violate the TruthCoin protocol, it increases the risk of concentrated influence and should be discouraged. Experts with excessive TruthCoins may become "high-value corruption targets", undermining the integrity of the system.

D.2 LifeScore Structure

The TruthCoin proof of concept performs a preliminary computation of the LifeScore, but the complete structure of an individual's LifeScore requires further development and expertise from multiple professionals. Regardless of the specific framework chosen, KnowledgeTensors should possess the flexibility to accommodate any such structure. Several considerations for structuring the LifeScore are as follows:

- **Comprehensiveness**: The LifeScore must account for all possible costs or events that an individual might encounter throughout their life. This is crucial for eliminating the fallacy of "whataboutism." Moreover, it would be beneficial if every sensational media article were assigned a relevance score, derived from the corresponding LifeScore component for that event.
- **Taxation Breakdown:** The taxation component of the LifeScore must provide a detailed breakdown of tax payments and their respective uses. A singular large tax amount can be misleading, as taxes are often allocated across multiple services (e.g., infrastructure, healthcare, utilities). For instance, the transportation element of an individual's LifeScore should reflect both direct costs (e.g., fuel, vehicle purchase) and indirect costs (e.g., taxes funding road maintenance).
- **Indirect Benefits of Taxes:** The indirect benefits of taxation should also be captured. For example, since taxes fund road maintenance, the absence of such taxes would result in roads being toll-funded. In this case, road costs become entirely direct, and the LifeScore for road travel would reflect the total toll expenses. If taxes replace tolls, individuals continue to use the same infrastructure but pay indirectly. The assessment of whether road taxes are beneficial depends on whether the amount paid in taxes is less than or greater than the direct cost of road usage. This framework enables a clear understanding of the potential impact of proposed tax changes, such as reductions in gas taxes, on the quality of infrastructure and the resulting societal consequences.

- **Government Debt Financing:** When considering proposals to incur government debt for financing services, it is essential to evaluate whether the increase in LifeScore from the additional services justifies the cost. This is complicated by the fact that individuals contribute varying amounts of taxes and receive different benefits from government services. Additionally, the interest on the debt imposes an ongoing reduction in LifeScore. In general, if the return on government services exceeds the debt's interest rate, the proposal should be deemed beneficial.
- **Symbolism**: A critical challenge in evaluating LifeScore lies in its inherently objective nature, whereas individuals are inherently subjective. The cultural value placed on certain practices, may be significant to citizens, even if it is harmful. Symbolism in this context becomes a powerful force that can obscure rational analysis of its costs. The only viable solution to address this issue is to first compute the objective LifeScore and subsequently allow individuals to incorporate subjective elements based on personal or cultural values.

D.3 Result Aggregation

In many real-world scenarios, knowledge is not represented by a single definitive value, but rather by a range of possible values. Consider a situation where your car is making an unusual noise, and multiple KnowledgeCells specify many potential repair costs. Since decisions often require a single actionable result, these varying values must be aggregated into a usable format. This aggregation is critical for further computations, such as determining whether you can afford the remaining expenses for the month.

To aggregate KnowledgeCells into a final result, three computational approaches can be used:
1. **Single Floating Point Mode** is fast but non-probabilistic. Each KnowledgeCell is weighted by its TruthCoin count resulting in the computation of the weighted mean of all the values.
2. **Floating Point Distribution Mode** is more computationally intensive but returns a probabilistic distribution which represent uncertainty. Instead of a single value, Operations are performed probabilistically, capturing uncertainty and variance in computations. Operations in this mode use distribution based equivalents. For example, an addition with floats becomes a convolution among distributions.
3. **Monte Carlo Mode** similar to the above mode but floating point operations are used and not distribution operations. The LifeScore entry point must be called many times but each call to a distribution will return a sample from that distribution.

Since repeated convolutions increase the standard deviation of data, **KnowledgeCell Range Limits** discussed previously could be used to remove values outside of the limits.

D.4 Desmearing Knowledge

EnmaiLand, known for its seasonal beauty, attracts numerous tourists whom demand accurate predictions of the cost, both in time and money, to vacation there. The objective is not merely to generate broad statistical summaries but to create detailed, personalized predictions with KnowledgeTensors.

Given a high quality data set of a breakdown of costs for many people's vacation to EnmaiLand, a simplistic approach might involve building a single distribution of total vacation costs across a dataset. However, this method introduces two critical issues:

1. **Inaccuracy in Prediction**: The total cost of a vacation is influenced by multiple variables, including:
   - **Length of Stay**: Duration significantly affects accommodation and other expenses.
   - **Quality Preferences**: Higher-end hotels, restaurants, and activities entail greater costs.
   - **Seasonal Demand**: Costs escalate during peak travel periods.
   - **Mode of Transportation**: Air, car, and boat travel have distinct cost structures.
   - **Source Location**: Proximity to EnmaiLand directly correlates with transportation expenses.
2. **Lack of Independence in Data**: Dependencies among variables skew the results. For example, a preference for high-end hotels correlates with dining at premium restaurants . Performing convolutions on non-independent distributions compromises predictive accuracy.

Desmearing Knowledge involves breaking the above dataset into multiple KnowledgeCells along "Input Dimensions" (e.g. Length of Stay) and "Filterable Dimensions" (e.g. Quality Preferences). Each resultant KnowledgeCell still has a distribution of values since variations still exist. But no variable is **smearing** the KnowledgeCells, resulting in distributions that are as independent as possible.

Missing or Unknown Data In some cases, a customer seeking a vacation cost estimate may not provide all relevant variables, such as the intended length of stay. This variable is critical; for example, lodging costs cannot be estimated without knowing the duration. However, even in the absence of specific input, existing datasets can be leveraged to construct predictive KnowledgeCells. For instance, the length of stay can be estimated based on demographic dimensions such as Income Level, Profession and Age. This allows the system to offer the best possible prediction(e.g. "Length of Stay") based on available data even if the user does not provide it.

User Customization and Overrides For enhanced accuracy, users can override any KnowledgeCell to reflect their specific circumstances. For example: If the user plans to stay with relatives, lodging costs can be reduced to zero or if the user is carpooling with friends, transportation costs can halved. The flexibility to override and personalize ensures that predictions align closely with individual scenarios.

C.5 Dimensions of Knowledge

The **UniversalKnowledgeTensor** is a **multidimensional system** designed to encode structured knowledge in the form of metrics across all dimensions deemed significant by experts. This section explores the various types of knowledge dimensions that are utilized to store and retrieve data within the multidimensional framework of the UniversalKnowledgeTensor. Each KnowledgeCell is assigned a specific "Location in the Multi-Dimensional Knowledge Space," and the values of these dimensions define a unique Multi-Dimensional Location (CellLoc). These dimensions can be categorized into several essential groups:

1. Core Dimensions serve as the **fundamental dimensions** of every KnowledgeCell. A specific set of values in these dimensions can be combined to form a **core_name**. The reason they are core is because if they were removed, the resulting KnowledgeCell would be nonsensical(i.e Object, Metric, Of) or completely different meaning(i.e From). Their "**Core**"ness serves as an important part in the storage and retrieval of KnowledgeCell. They include:
- **Object** – Defines the type of entity the knowledge applies to (e.g., a person, a corporation, a nation).
- **Metric** – Specifies the metric of interest (e.g.,age, rate_per_year, cost_per_month, cost_per_event).
- **Of –** Clarifies ambiguous metrics by defining their specific context (e.g., "rate_per_year" could refer to heart attacks, cancer, or lottery wins).
- **From –** Manages aggregation in hierarchical approach (e.g., the total cost of a heart attack includes costs from an ambulance, surgery, medication, and hospitalization). If unspecified, it defaults to an aggregate total of all possible "From"s.

2. Filterable Dimensions specify what dimensions a user can filter on to access the KnowledgeCells most relevant to them. If a KnowledgeCell for a specific core_name is desired, the UniversalKnowledgeTensor will filter through all KnowledgeCells to retrieve the most relevant KnowledgeCell. If a KnowledgeCell had a filterable dimension removed, it would still be a valid KnowledgeCell but its retrieval to the user may now be suboptimal and not the most relevant. Unlike other dimensions, **order matters** in Filterable Dimensions, as they dictate an expert's belief in a dimension's importance when retrieving information. Some examples include Address (Country/State/City), Ethnicity, Gender, Profession, and Genetic Markers.

3. Action Dimension is the most important dimension and a significant source of complexity to developing UniversalKnowledgeTensor. This dimension specifies whether a KnowledgeCell applies to either **reality (no action or changes are made)** or to a **specific hypothetical action** (e.g., adopting a new policy, undergoing medical treatment, or changing financial investments). The action dimension allows an expert to specify how some metric in reality would have a specific value and how much that value would change if a hypothetical action were performed.

4. Formula Descriptors allows an expert to encode other information to assist the UniversalKnowledgeTensor in how to handle the KnowledgeCell.
- **KnowledgeCell Type (ktp_type)** – Defines the nature of knowledge representation:
  - **Aggregation** of Other Formulas from other KnowledgeCells.
  - **Direct Estimate** – Predictive modeling for future events, or for past events without direct measurements.
  - **Direct Measurement** – Empirical data collected from past observations. A user would prefer a Direct Measurement over an Estimate if that is possible.
  - **Metric Expansion** – enables the incorporation of other metrics into the LifeScore
- **Start Time / End Time** – Specifies the temporal range for which a KnowledgeCell is valid.
- **Range Lower/Upper Bounds** – Defines acceptable limits for values, preventing an OutlierAttack.

- **Resolution** – Determines the granularity of distribution values when the UniversalKnowledgeTensor is used in distribution mode.

5. Age of Information is not stored as a timestamp in the CellLoc. Instead, changes in knowledge over time are recorded directly on the TruthCoin blockchain. For example, if an expert wants to assign metric 'm' to a value 'v1' at time 't1', but later revises it to 'v2' at time 't2', the expert would have to purchase the 'v1' KnowledgeTensor at 't1' then retract it and then purchase the 'v2' KnowledgeTensor at 't2'. Now both values remain verifiable and immutable on the blockchain. By selectively querying a specific portion of the blockchain, users can reconstruct historical knowledge states, ensuring full transparency in the evolution of information over time.

6. KnowledgeTensor Support: Which experts support the KnowledgeCell is not captured in the CellLoc. Instead it is captured as a transaction on the Blockchain.

Limitations The purpose of CellLoc is to establish a unique address for every instance of knowledge. It relies on the assumption that each dimension will have only one distinct value. This assumption holds true for the vast majority of knowledge, but there may be instances where it does not apply.

Let us consider the computation of the LifeScore for a climate change refugee originating from country1. The impact of climate change has significantly reduced their LifeScore due to the challenging conditions in country1. However, if the individual decides to migrate to country2, their LifeScore may still differ from that of a native resident of country2. This discrepancy could arise because the treatment of foreigners in country2 may be less favorable than that of native citizens, potentially influencing their overall LifeScore.

If this climate change refugee were to enter an address, the question arises as to whether they should specify country1 or country2. Both options appear to be inadequate. One possible resolution could involve placing this information within the ethnicity category, resulting in a UserFilter that includes "address/country2;ethnicity/eth1/country1." However, this approach is not ideal and lacks elegance, as it introduces complexity without fully addressing the underlying issue.

D.6 KnowledgeCell Dimensional Storage

Storing KnowledgeCells in the UniversalKnowledgeTensor for accurate and relevant retrieval is a significant problem that warrants explanation. A proposed approach is to use the natural type differences between dimension types to break this problem into simpler problems.

1) Core Dimensions breaks the UniversalKnowledgeTensor into many CoreTensors
2) Time Dimension breaks the CoreTensor into many CoreTensorAtTime
3) Filterable Dimensions break the CoreTensorAtTime into a Tree of CoreTensorTrees. Since there are many filterable dimensions, the Tree will have many layers of CoreTensorTrees with

each layer matching a single filterable dimension. The leaf CoreTensorTrees will store all the KnowledgeCells applicable to that specific set of Filterable Dimensions.

Please note that the Action dimension (which is the most important dimension) cannot be used to break down the storage problem. We cannot rely on an action to exist for a specific person. As an example, filterable dimensions may determine that one person is eligible for a medical procedure for a disease whereas another person is not. Therefore, reality and all the applicable actions must be lumped together and sorted later. Similarly many experts can specify many different ktp_types and therefore, it is not possible to rely on specific values for this. All the ktp_types are lumped together and sorted during the query phase.

The current approach does not attempt to incorporate each KnowledgeCell's TruthCoins and instead that information is brought in later during the query phase. This approach is simpler since the Blockchain continuously changes and as a result the TruthCoin counts are always changing.

D.6.1 UniversalKnowledgeTensor

The UniversalKnowledgeTensor will contain all possible KnowledgeCells. It breaks this problem down by storing each new KnowledgeCell into a CoreTensor based on the KnowledgeCell's core_name. This results in the UniversalKnowledgeTensor simply routing each newly added KnowledgeCell to the appropriate CoreTensor.

Since every KnowledgeCell is guaranteed to have a core_name (otherwise it is nonsensical), we can rely on it to properly route KnowledgeCells to the appropriate CoreTensor. Also note that all KnowledgeCells in a CoreTensor will have the same core_name.

As an example, if a KnowledgeCell had a CellLoc of :
object/person;metric/rate_per_year;of/health/disease/heart_attack;action/;ktp_type/dir_est;start_time/2014.00;end_time/+2034.00;address/country1/state2/city3;gender/g1;ethnicity/e1

The core_name is :
object/person;metric/rate_per_year;of/health/disease/heart_attack

Please note that the software implementation of the UniversalKnowledgeTensor incorporates other information such as HeavySeries, UserFilter ,etc... in addition to the CoreTensors. This is done exclusively for software convenience so that every part of the software has access to every other part through the UniversalKnowledgeTensor.

D.6.2 CoreTensor

All knowledge within the CoreTensor has the same *core_name*. As previously mentioned, the UniversalKnowledgeTensor is designed to simulate knowledge across multiple time steps. Given that various knowledge elements apply to different time intervals, an additional organizational layer, referred to as *CoreTensorAtTime*, is necessary.

To accommodate this, each KnowledgeCell will be analyzed to consider its applicable time frame, defined by *start_time* and *end_time*. The CoreTensor will maintain a list of *CoreTensorAtTime* instances corresponding to the time steps of the simulation. Each KnowledgeCell will be routed to one or more *CoreTensorAtTime* instances, depending on the time periods it pertains to.

While each KnowledgeCell is associated with a *CellLoc*, it is important to note that *CellLoc* is a highly versatile and general-purpose software class. Consequently, there is a need for a specialized software class to address the unique routing requirements of CoreTensor, CoreDataAtTime and CoreTensorTree.

To facilitate this routing process, each KnowledgeCell will also incorporate a *CoreTensorRoute* class. This class will manage the construction of the *core_name*, define the *start* and *end* times, and prioritize filterable dimensions for routing purposes.

D.6.3 Filterable Dimension Priority

The Filterable Dimensions in the UniversalKnowledgeTensor are arranged in a hierarchical order based on their **predictive importance**. By defining a priority ranking, the system ensures that **the most relevant and statistically significant dimensions** are used when selecting KnowledgeCells. A simple thought experiment can assist experts in defining filterable dimension priority. Assume an expert was tasked with creating a prediction based off their extensive knowledge but was allowed to ask the user only 1 question? The answer would specify the filterable dimension with the highest priority. if the researcher could ask an additional question then that answer would specify the filterable dimension with the 2nd highest priority and so on.

For example, in predicting heart attack risk, a medical researcher would prioritize dimensions as follows:
1. Address – Geographic location is often the most critical factor due to environmental, healthcare access, and lifestyle differences.
2. Gender – Biological differences between genders influence heart attack risk.
3. Ethnicity – may play a minor predictive role.

Ideally, there would exist a KnowledgeCell for all the important dimensions, ensuring that each important aspect of knowledge is accurately represented within the system. But since **KnowledgeCells are inherently sparse** (as it is impossible to encode every possible combination of dimensions), the system must decide which available KnowledgeCell to use when an exact match is unavailable.

Consider the following two KnowledgeCells with the same core_name and time:
1. 'address/country1/state2/city3;gender' (no gender specified)
2. 'address/country1/state2;gender/g1' (specific gender provided but lower geographic resolution)

If an individual resides in 'Country1, State2, City3' and has gender 'g1', the ideal KnowledgeCell would be: 'address/country1/state2/city3;gender/g1'.

However, if this specific KnowledgeCell does not exist, the system must choose between the two available options. Since TruthCoin weights have assigned greater importance to geographic resolution (address) over gender, the system selects the first KnowledgeCell, the one with greater location specificity ('address/country1/state2/city3;gender').

This prioritization ensures that when exact matches are unavailable, the UniversalKnowledgeTensor **defaults to the most relevant dimensions**, improving accuracy and relevance in KnowledgeCell selection.

D.6.4 CoreTensorAtTime and CoreTensorTree

All the knowledge in a CoreTensorAtTime has the same core_name and same time. The CoreTensorAtTime is now responsible for initiating the creation of all the layers of the CoreTensorTree that correspond to filterable dimensions.

The first step is to address the filterable dimensions. The system must determine which filterable dimension holds the most significance for making a more accurate prediction. The priority of these dimensions is specified in the CellLoc, and this can be combined with the amount of TruthCoins to assess which dimension should be considered more important. This approach allows for a dynamic and data-driven method to prioritize dimensions, leading to more reliable and accurate predictions.

The variable number of filterable dimensions poses a challenge that must be addressed. Some CoreTensorAtTime instances may have only 2 filterable dimensions, while others may have 10. To address this, a tree structure is proposed, where each node represents a single filterable dimension. This tree will be known as the CoreTensorTree.

Each **CoreTensorTree** will contain child nodes, which are also CoreTensorTrees, allowing for a hierarchical representation of dimensions. For example, if there are 10 filterable dimensions in total, the tree will consist of 10 layers of CoreTensorTrees. Each layer's nodes will represent the different possible values of the same dimension.

The **leaves** of the tree will have **lists of KnowledgeCells**. These lists will contain KnowledgeCells with **varying actions and different FormulaTypes**, ensuring that the diverse range of possible outcomes and interpretations is captured in the final structure. This approach provides flexibility and scalability for managing the varying number of filterable dimensions across different CoreTensorAtTime instances.

If ‘dimension_1‘ is a filterable dimension within the total set of filterable dimensions, but a specific KnowledgeCell does not specify a value for that dimension, it would go to the CoreTensorTree corresponding to ‘dimension_1/‘. The absence of a value after the slash (/)

indicates that the dimension was not specified for that particular KnowledgeCell, effectively representing an unspecified value for ‘dimension_1‘. This ensures that the tree structure accounts for all possible combinations, including those where certain dimensions are left unspecified.

The number of children for each tree is determined by all the possible values for a given dimension. For instance, consider the address dimension. The children of the CoreTensorTree for this dimension would represent different levels of specification as follows:

1. address/: A child node where no address is specified.
2. address/country1: A child node where only the country is specified .
3. address/country1/state2: A child node where both the country and state are specified.
4. address/country1/state2/city3: A child node where the country, state, and city are all specified

This hierarchical structure ensures that the tree accounts for all potential levels of granularity within the address dimension, with each child node corresponding to a different level of specification. Each child node represents a possible value of the dimension, allowing the system to track and organize knowledge based on varying degrees of specificity.

Assuming a person lives in city3, which is located in state2 in country1, the ideal query of KnowledgeCells would exist at the specific level of ‘address/country1/state2/city3’, as this would provide the most relevant data for our situation. If there are sufficient KnowledgeCells available at this level of granularity, then the querying problem is effectively resolved.

In this case, the system can directly retrieve the most pertinent KnowledgeCells, ensuring that the information is both specific and highly relevant to the query. However, if there is insufficient data at this level, the system would need to consider broader levels (such as ‘address/country1/state2’ or even ‘address/country1’) to ensure that relevant knowledge can still be retrieved.

If there are no KnowledgeCells available at the specific level of ‘address/country1/state2/city3’, the system will then query KnowledgeCells at the broader level of ’address/country1/state2’.

If, once again, there are no KnowledgeCells at this level, the system will proceed to query KnowledgeCells at the even broader level of ’address/country1’.

If there are still no KnowledgeCells at the country level, the system will ultimately query the KnowledgeCells that apply to individuals without any address specified (i.e., address/).

This cascading approach ensures that the system can still retrieve relevant data, even when more specific levels of information are unavailable. It provides a flexible and adaptive querying mechanism, moving from the most granular level to the most general in search of usable knowledge.

D.7 Retrieval and Execution of Knowledge

The previous sections dealt with storage of KnowledgeCells. This section deals with retrieval and execution of KnowledgeCells in order for the User to determine their LifeScore. The user must specify (1) the UserFilter to aid the UniversalKnowledgeTensor in filtering the KnowledgeCells across filterable dimensions and (2) the TimeRange to aid the UniversalKnowledgeTensor in filtering the KnowledgeCells that are applicable temporally.

Then for every core_name a corresponding HeavySeries is created. Unlike a traditional time series that contains time and data, HeavySeries is Heavy since it contains KnowledgeCells and other information to support the complexities of this Framework. Since any Time Series has data at many times, the HeavySeries delegates all the computations at a certain time to the CoreDataAtTime.

In the background ActionPropagation is being used to determine what actions are available to the user, while the SpecialStack supports ActionPropagation as well as detection of RecursionAttacks.

D.7.1 UserFilter

During the traversal of CoreTensorTree nodes within the filterable dimension tree, the process of determining the appropriate node to navigate to requires access to specific information about the User. This information is stored in the ***UserFilter*** within the UniversalKnowledgeTensor.

Typically, when invoking a function that involves filterable dimensions, the corresponding filterable dimension values must be explicitly provided. However with KnowledgeTensors, the CoreTensor queries the *UserFilter* to dynamically retrieve these values. This allows for the most relevant data to be retrieved without the user needing to know which filterable dimensions the expert deemed important.

Furthermore, the UniversalKnowledgeTensor eliminates the need for users to understand the intricate relationships between pieces of knowledge. The TruthScript claim embedded within each KnowledgeCell encapsulates these relationships, ensuring that users are not burdened with this complexity. The TruthScript claim accomplishes this by retrieving the KnowledgeCells that the expert deemed important in the computation of the claim.

For a user of the UniversalKnowledgeTensor, the role is simplified to only need to input relevant data into the *UserFilter* to the best of their ability. Each CoreTensor will then utilize the most appropriate filterable dimensions that you have specified.

The *UserFilter* itself consists of a mapping that associates object types with their corresponding filterable dimension values.

D.7.2 TimeRange

The **TimeRange** class specifies the starting time, ending time, present time, and time resolution for the simulation. A common question that arises is: why are both the starting time and present time required for the simulation? For example, if the present time is 2024, why is it necessary to initiate the simulation as far back as 2020?

The reason for specifying both the starting time and the present time is to account for the simulation's ability to model and understand how past events and conditions influence the present and future. Starting the simulation from 2020 (or another historical point) allows the model to capture the evolution of systems, trends, or phenomena over time, ensuring that it can accurately reflect the current state in 2024. Many simulations, particularly in areas like climate modeling, economics, or social systems, require historical data to establish a proper baseline and account for cumulative effects.

By starting the simulation earlier, the model can incorporate key historical factors that shape the present conditions, which might not be directly observable from the present alone. This approach also allows the simulation to test different scenarios and conditions that have led up to the present, helping to better understand cause-and-effect relationships and making more reliable predictions about the future.

The rationale behind this is rooted in the distinction between measurements and estimates. If all relevant data were available from 2024 onwards, it would indeed be reasonable to begin the simulation at that point. However, consider the case of an user's cholesterol level—an important metric for determining the LifeScore. If a cholesterol test has not been performed in several years, the most recent measurement may be outdated. Despite this, there exists substantial knowledge about the progression of cholesterol levels over time. Therefore, even though the cholesterol measurement may not be available for 2024, there is still a wealth of information regarding its potential changes over time.

The purpose of starting the simulation in 2020, when the present year is 2024, is to ensure that the initial KnowledgeCells in the *HeavySeries* are based on actual measurements. Subsequent KnowledgeCells will be estimates derived from the previously measured data. The UniversalKnowledgeTensor prioritizes measured KnowledgeCells over estimated ones to maintain the highest possible accuracy. In the cholesterol example, measured data for 2020 and 2021 will be used to estimate values from 2022 to 2040. Had the simulation started in 2024, no measured data would have been available, and the entire timeline would have relied on estimates, resulting in less accurate LifeScore computations.

D.7.3 HeavySeries

The CoreTensor, CoreDataAtTime and CoreTensorTree effectively address the problem of ***storing* and *retrieving* KnowledgeCells.** However, to assess the quality of our lives, we must leverage this knowledge to compute the LifeScore, which requires executing the TruthScript embedded within each KnowledgeCell.

HeavySeries serves as the initial organizational layer for the ***execution* of KnowledgeCells**. Given the vast array of metrics to be computed, it is inefficient and undesirable to compute unrelated metrics (e.g., 'metric/met_2' when only 'metric/met_1' is requested) . To mitigate this issue, the UniversalKnowledgeTensor incorporates a mapping from 'core_names' to HeavySeries. This ensures that each KnowledgeCell and its corresponding result are associated with the same 'core_name'.

Since the UniversalKnowledgeTensor is designed to execute simulations across multiple time epochs, and we already have a class named CoreTensorAtTime that handles time-based data storage and retrieval, it follows logically that we would introduce a *CoreDataAtTime* class to manage the execution of KnowledgeCells at specific time epochs.

Consequently, HeavySeries becomes a list of CoreDataAtTime instances, with the number of entries in the list corresponding to the number of time epochs in the simulation.

All complexities related to the additional dimensions are now effectively delegated to the CoreDataAtTime class, streamlining the overall execution process.

D.7.4 CoreDataAtTime

Similar to how *CoreTensorAtTime* handles the intricate tasks of storing and retrieving KnowledgeCells at a time epoch, *CoreDataAtTime* takes on the responsibility of executing these KnowledgeCells at a time epoch.

1) Organizing Execution: The first critical step in organizing the execution of KnowledgeCells involves identifying which KnowledgeCells are applicable. This step relies on *CoreTensorAtTime* to retrieve the relevant KnowledgeCells based on the parameters specified in the *UserFilter*.

During the creation of CoreDataAtTime, the corresponding CoreTensorAtTime is invoked to determine which KnowledgeCells are applicable. For each possible action in the action dimension, CoreTensorAtTime must select the KnowledgeCells that have the highest FormulaType, thereby avoiding a potential DirectAttack.

2) Storing Results: The second step concerns the storage of results. Since multiple distinct KnowledgeCells may require the same KnowledgeCell as an input, it is crucial to store the results of these computations to prevent redundant executions of the same KnowledgeCell.

3) Executing When Necessary: In cases where no existing data is available, the relevant KnowledgeCells must be executed to generate the required data. The data produced by the KnowledgeCells is then aggregated with the corresponding TruthCoins associated with each KnowledgeCell, resulting in either a mean or a distribution, depending on the mode of the simulation.

Additionally, there is special logic designed to detect recursion attacks. Suppose a TruthCoin has been compromised and used to purchase a tensor containing a KnowledgeCell that recursively references itself. This would typically result in a stack overflow, rendering the UniversalKnowledgeTensor unusable. To prevent this, a SpecialStack is employed, which keeps track of all the *CoreDataAtTime* instances and KnowledgeCells that have been executed. If the SpecialStack detects a recursion attack, it will unwind the stack and return a 'None' for the offending KnowledgeCell. The 'None' value ensures that the data from the affected KnowledgeCell is excluded from the aggregation process with the TruthCoins.

D.7.5 ActionPropagation

Conventional programming languages use functions which require predefined inputs and explicit parameter passing. If the return value from the function would change due to a specific input 'user action' , then that input would need to be passed explicitly as a parameter. For example, if a function called 'get_weight' were implemented to get a person's weight , this function would return 'v1' if no 'user_action' was passed, 'v2' if the 'user_action=diet', 'v3' if the 'user_action=exercise', and 'v4' if the 'user_action=medication'.

The problem with this approach is that the person using these functions now require additional attention span to know what the possible 'user actions' are. Different people in different circumstances(aka filterable dimensions) using different functions will have different 'user actions' available to them. Certain actions, such as investing in geothermal energy, are only available in specific geographic locations. A globally predefined list of actions is therefore impractical. Another problem is that even if all the 'user actions' were known , it is computationally inefficient to execute these functions multiple times for all the actions when only a small subset of actions will change the value of these functions.

The UniversalKnowledgeTensor is capable of ActionPropagation to dynamically discover the possible actions as well as avoiding redundant KnowledgeCell computations when specific actions do not effect it. ActionPropagation involves every current KnowledgeCell using the SpecialStack to communicate to the calling KnowledgeCell what actions the current KnowledgeCell is aware of that would result in a change of value.

Consider the following scenario under reality (aka no action). There are 3 CoreDataAtTime A,B and C such that:
- A is set to 10.
- B is set to 20.
- C is computed as C = A + B

Now, assume that different user actions modify A and B where:
- "action/hypothetical_action1" changes A to 9
- "action/hypothetical_action2" changes B to 24

Given these modifications, we expect "C" to be:

- Reality(aka no action or "action/"): C = 10 + 20 =30
- With "action/hypothetical_action1:", C = 9 + 20 = 29
- With "action/hypothetical_action2:", C = 10 + 24 = 34

The issue is that C is unaware that A or B change when various actions are performed. In a traditional programming language, in order to compute all the variations of C, we would need to know all the actions and pass each one into the computations of C,A, and B .

ActionPropagation allows 'C' to discover what 'actions' will effect its value even if it has no idea what those 'actions' are in its definition. ActionPropagation works by first attempting to compute 'C' under reality. Since every CoreDataAtTime must be defined for reality, we know that all the dependent CoreDataAtTimes will get called. 'C' will have to call 'A' and 'B' to compute its formula. When 'A' is being computed, it knows that its value would change when "action/hypothetical_action1" and thus communicates via the SpecialStack to its caller 'C' that 'C' would also have its value changed when 'action/hypothetical_action1'. 'B' performs a similar action for 'action/hypothetical_action2'. After 'C' is done computing under reality, 'C' now knows that it needs to be recomputed again for 'action/hypothetical_action1' and 'action/hypothetical_action2'. If 'C' was called by another KnowledgeCell, it uses the SpecialStack to communicate the various actions to that KnowledgeCell. If 'C' was the entry point to the UniversalKnowledgeTensor, the UniversalKnowledgeTensor will keep a list of all actions that need to be recomputed and all the actions it has already computed.

In the simple example above, the computational tree is only two levels deep. However, in the UniversalKnowledgeTensor, the root is LifeScore, and the computational tree may extend tens or hundreds of levels deep. By leveraging ActionPropagation, the UniversalKnowledgeTensor ensures that:
- Every relevant action is considered, even when actions are highly-specific.
- Dependencies between KnowledgeCells are automatically updated
- LifeScore computations remain dynamic and comprehensive

D.7.6 SpecialStack

Traditional programming languages employ normal function call stacks to manage the computation tree. This approach is feasible since normal programmers can be trusted to not actively sabotage their own software. But TruthCoin requires a more robust mechanism due the inevitable case of a KnowledgeCell being malicious. To maintain security, thwart recursion attacks, and facilitate ActionPropagation, TruthCoin implements the SpecialStack. The main features of a SpecialStack over a normal Stack are :
(1) Allows a CoreDataAtTime to query who its caller was inorder to support ActionPropagation
(2) Ability to verify that the same CoreDataAtTime does not exist twice on the SpecialStack indicative of a RecursionAttack. Once a RecursionAttack is detected, the SpecialStack unwinds the stack to remove the malicious KnowledgeCell.
(3) Ensuring that requests for CoreDataAtTime can only occur in the present or past of the existing CoreDataAtTime. For example, if the computation is currently at time_index=10, no call is allowed to request data at time_index=11 since a future request may result in an infinite loop.

To prevent this time_index=10 can request other core_names at time_index=10 OR it can request the same core_name at time_index=9. Another way to look at this is that future events can not be the source of causality.
(4) Ensures a Finite Call Stack since even with the above restrictions a malicious actor can create a call stack a million levels deep. The SpecialStack tracks how deep it is and after it exceeds a certain threshold it prevents other calls to create a deeper stack.

Appendix E: Future Research

E.1 Efficiency Research

E.1.1 KnowledgeTensor Compression

If KnowledgeCells are encoded using ASCII text, each KnowledgeCell would be about 1KB in size. But there are many opportunities to reduce the size using binary encoding:

(1) Integer ID for PartialLocs. A KnowledgeTensor will contain many KnowledgeCells each with a CellLoc that uses many combinations of the same set of PartialLocs. For example, a cardiologist would create many KnowledgeCells each over the many combinations of metrics, addresses (such as city or state), ethnicities, and genders. As a result the same PartialLoc (ex: 'metric/rate_per_year' or 'of/heart_attack' or 'address/country1/state2/city3') will be repeated many times.

If each PartialLoc was represented with an Integer ID , the CellLoc could be reduced from over one hundred characters to about a dozen integers.

(2) Partial Specification of PartialLoc Consider two consecutive KnowledgeCells in the KnowledgeTensor. Most likely they will share many PartialLocs but be different by 1 or 2. As an example, the cardiologist would specify one KnowledgeCell to be the heart_attack annual rate for person of 'gender/g1' of 'ethnicity/e1' in 'address/country1/state2/city3'. The next KnowledgeCell would be the same except for 'address/country1/state2/city4'.

Rather than using every PartialLoc to describe a CellLoc, a CellLoc is now defined only by the modifications to the previous CellLoc. In the previous example, the latter KnowledgeCell would only specify 'address/country1/state2/city4' while 'gender/g1' and 'ethnicity/e1' are assumed from the previous KnowledgeCell.

(3) TruthScript Template ID : The vast majority of KnowledgeCells will contain a TruthScript claim that follows a simple template: get age or time, maybe get another metric, apply some polynomial and return the result. If these templates were well defined and specified by an Integer ID, then the claim can be reduced to a small set of floats and maybe a small set of integers that ID the PartialLocs that will be used for querying data. For example, if a persons annual rate of heart attacks, were dependent on age and Cholestorol, an AGE_SINGLE_QUERY_3 template ID, would require the PartialLoc ID of 'm/cholesterol' and the 3 polynomial terms as floats. The full KnowledgeCell can then be created from the ID and the parameters specified above.

(4) Float ID : The polynomials in the above example still require 4 or 8 bytes to represent a float. But if you look at a specific polynomial term(Ex: Term0) of the same CoreName you will notice that the vast majority of the floats are very similar to each other with only small variations between them. Rather than specifying the entire float, a float ID can be used to specify the upper part of the mantissa and the exponent. Now each float can be specified with a float ID and the lower part of the mantissa. Rather than having a Float ID for every float, it may make sense to have a float ID that specifies the upper part of the mantissa and exponent for every term of the polynomial. Now a few mantissa Lower Parts can fully specify the entire polynomial.

Given that many *KnowledgeCells* within a *KnowledgeTensor* share a similar structure and set of filterable dimensions, this representation scheme helps achieve significant storage reductions. As a result of this optimization, each *KnowledgeCell* can be reduced in size from kilobytes to just a few dozen bytes.

E.1.2 Temporal and Geographic Blockchain Partitions

KnowledgeTensor purchases can occur on a daily, weekly, monthly, or annual blockchain. Each KnowledgeTensor purchase would only be valid for that a small multiple of that epoch. As an example, Climate KnowledgeTensors would occur on the annual blockchain whereas Weather KnowledgeTensors would occur on the daily blockchain. Now in order to have the most up-to-date KnowledgeTensor purchases, they could download a few years of the annual blockchain and a few days of the daily blockchain. This flexibility enables users to acquire the most up-to-date KnowledgeTensors without needing to download the entire blockchain, thus minimizing the associated data transfer and storage demands.

It is preferred to maintain a single TruthCoin blockchain that encompasses millions of KnowledgeCells, ensuring that all significant knowledge relevant to humanity is included. Assuming each KnowledgeCell is approximately 1KB in size, this would result in the blockchain containing gigabytes of data. Such a setup would allow for the entire blockchain, along with all associated KnowledgeTensors, to be stored on a typical mobile phone.

However, if the actual storage and bandwidth requirements substantially exceed these estimates, it may be necessary to partition the TruthCoin blockchain in order to optimize computational resource usage. One logical approach would be to split the blockchain based on geographic dimensions, such as by address. For instance, dividing the blockchain into separate segments for each continent could lead to a five-fold reduction in computational resource requirements. A further partitioning into individual countries could result in a hundred-fold reduction in resource consumption.

While these partitioning strategies may offer efficiency benefits, they are not recommended unless absolutely necessary since they result in a reduction in privacy. The act of downloading a partitioned blockchain can be tracked by Corporations and Governments to identify a User's interest and maybe applicability. As an example, if there existed a blockchain dedicated to cancer KnowledgeTensors, the act of downloading it would indicate to the surveillance agencies that the user is concerned about and/or may have cancer.

In partitioned blockchain architectures, privacy concerns can vary substantially depending on the sensitivity of the information contained within each partition. For instance, public access to a blockchain containing data on common illnesses such as seasonal influenza may raise negligible privacy issues. However, the stakes increase considerably in the case of rare or stigmatized medical conditions—such as certain forms of cancer—where data exposure could lead to discrimination by health insurers or employers.

To mitigate this risk, **Masked Blockchain Downloads** operates by obscuring the informational intent of the user during blockchain access. Each blockchain partition is assigned a **Privacy Consequence Score (PCS)** based on the potential for misuse or harm resulting from knowledge of user access.

- If a user requests data from a partition with a **low PCS**, the blockchain can be downloaded directly without significant privacy implications.

- Conversely, if the requested partition has a **high PCS**, the system enforces a masking protocol: the user downloads not only the targeted high-PCS blockchain but also a randomly selected set of 999 other high-PCS blockchains.

This approach ensures that all users interacting with any high-sensitivity blockchain appear statistically indistinguishable from one another. Even individuals who have no genuine need for high-PCS data are required to download the same volume of partitions, thereby introducing **plausible deniability** into their access patterns.

Under such an approach, the effectiveness of surveillance programs conducted by corporations or governments is substantially diminished. Given the uniformity of access patterns, the probability that any single surveillance effort accurately identifies a user’s intent is reduced to **0.1%**, assuming a pool of 1,000 high-PCS blockchains. This significantly decreases the actionable value of blockchain surveillance data and bolsters user privacy in sensitive domains.

E.2 Interface Research

E.2.1 Multilingual Front End

The UniversalKnowledgeTensor should be universally accessible to all of humanity. To facilitate this, a comprehensive mapping system between symbols used in various languages and those employed in the dimensions of CellLoc is essential.

Since KnowledgeTensors do not incorporate sentence structures, the primary requirement is a straightforward translation between words in one language and their equivalents in another. This translation system would enable a global understanding of critical issues, such as the impacts of climate change.

To ensure consistency and clarity, an objective criterion must be established for naming every value within each dimension. For scientific events, the standardized scientific terminology should be used. For categories involving people, the names should be determined by consulting a relevant group of experts or stakeholders.

In cases where naming discrepancies persist, the inherent design of the UniversalKnowledgeTensor offers a mechanism to address such issues. For instance, if the majority of KnowledgeCells use one name (e.g., 'n1') for a concept, while a minority uses a different name (e.g., 'n2'), the KnowledgeCells labeled with 'n2' will not be incorporated into the LifeScore computation tree. This serves as an incentive for those who created the 'KnowledgeCells' using 'n2' to rename them to 'n1', thereby ensuring that their data is utilized.

Additionally, we could develop tools that flag instances where an incorrect core dimension is specified, as it would not contribute to the LifeScore computation. Similarly, any filter dimension that is not present in the UniversalKnowledgeTensor would be flagged to ensure consistent use of filter dimensions.

E.2.1 Queries to override KnowledgeCells and specify Filterable Dimensions

Certain KnowledgeCells, such as 'money_per_hour' and 'money_per_death', are straightforward and clearly require user input for customization. However, the UniversalKnowledgeTensor must also have the capability to prompt users for additional KnowledgeCells that need to be specified. The criteria for determining which KnowledgeCells should be user-defined are as follows:
- **Cost of Information**: The effort required to acquire data varies across metrics. For example, the cost of gathering information on weight is relatively low, whereas obtaining data on more complex metrics, such as cholesterol levels, is significantly higher.
- **Standard Deviation**: Each KnowledgeCell has a corresponding distribution, characterized by its mean and standard deviation. A higher standard deviation indicates greater variability, meaning that users are more likely to possess a KnowledgeCell that diverges from the mean value of the distribution.
- **Significance of Accuracy:** For each KnowledgeCell, the impact on the LifeScore when adjusted by a specific percentage needs to be evaluated. This helps to determine how sensitive the LifeScore is to changes in that particular KnowledgeCell.

For the UserFilter dimensions such as 'address' and 'profession' are easily specified as filterable dimensions. However, more complex dimensions, such as the value of a specific gene ('gene_x'), present greater challenges. The same criteria outlined above can be applied to assess the complexity and need for user input in specifying these more difficult filterable dimensions.

E.2.2 Simulation Duration.

The duration of the simulation should ideally be based on the expected lifespan of the individual, which would be predicted by a relevant KnowledgeCell estimating the age at death. This provides a straightforward, time-bound framework for the simulation.

However, in cases where an individual has or intends to have children or grandchildren, it may be prudent to extend the simulation to cover the lifespan of their descendants as well. This would ensure that the simulation accounts for intergenerational effects, which could influence the individual's LifeScore and the broader implications of their actions across time.

E.2.3 Effectiveness of Research to update KnowledgeTensors

Everything in this paper has focused on using the UniversalKnowledgeTensor in the evaluation of topics and actions. But another important question is the evaluation of potential research actions to improve the UniversalKnowledgeTensor. Assume a research agency had to decide between 2 research efforts. For example, it could be a satellite to better measure atmospheric metrics or a set of ocean buoys to better measure ocean metrics. The more accurate measurements (aka variance reduction) would lead to more accurate LifeScores. Further research should be performed on creating a framework to quantify the value of LifeScore variance reductions and how that may justify various research efforts with varying costs and varying improvements on accuracy.

E.3 Structured Knowledge

The concept of Structured Knowledge is difficult to define precisely, but it applies to any idea or piece of knowledge that meets two key criteria:

1. Unique Addressability – Each idea has a 'distinct and identifiable location' within a structured framework. This allows experts to discuss, analyze, and refine a 'single idea in isolation', without requiring reference to unrelated concepts. Unique addressing ensures that knowledge remains organized, precise, and easily accessible.

2. Externalized Reasoning – The effects of one idea on other ideas are explicitly defined through logical relationships rather than subjective impressions. This removes

'Impression-Based Reasoning' from the evaluation process, ensuring that knowledge interactions are clear, consistent, and objectively verifiable.

The term **'Addressing'** in the title of this paper reflects both meanings of the word:
- **To Resolve** – KnowledgeTensors systematically resolve misinformation by providing a structured, verifiable framework for evaluating truth.
- **To Assign an Address** – KnowledgeTensors assign a unique address to every claim that can be expressed as a quantifiable metric, ensuring that each claim is independently identifiable and logically connected to other KnowledgeCells.

KnowledgeTensors represents the simplest and most accessible form of Structured Knowledge. By limiting KnowledgeCells to core and filter dimensions, it becomes relatively simple to assign an address to each unit of metric-based knowledge. This focus on metrics facilitates the integration of diverse expert knowledge into a higher form of knowledge.

However, there exists a substantial body of knowledge that cannot be adequately represented by KnowledgeTensors. To address this, a new method must be developed to express such knowledge within the framework of Structured Knowledge. Several critical questions must be addressed:

1. How can a universal address be established for non-metric knowledge?
2. How can the varying perspectives of multiple experts be synthesized into a single, cohesive position?
3. To what extent must input knowledge be altered to affect a meaningful shift in the resulting output knowledge?

E.3.1 Non-computable IS Knowledge

TruthCoin utilizes Blockchain technology to disseminate Computable IS Knowledge in the form of KnowledgeTensors. The KnowledgeTensor is represented on the blockchain by its hash and another mechanism must exist to allow a user to lookup the KnowledgeTensor from its hash.

This section analyzes whether blockchain technology and **hash-to-data lookup** mechanisms can be extended to support Non-computable IS Knowledge. Computable IS Knowledge must always be prioritized over anything else, but this section may be useful if there is excessive bandwidth capacity.

ExplanationCoin provides explanations regarding mechanisms or details behind claims or metrics found in a KnowledgeCell. After users calculate their LifeScore, they may see the significance of a topic and seek further understanding of complex scientific concepts and their impact on their LifeScore.

The structure of ExplanationTensors loosely mirrors that of KnowledgeTensors. Whereas a KnowledgeCell provided a formula as a claim, an ExplanationTensorPoint would contain a hash of an Explanation artifact (e.g. Document, Presentation, Video). Similar to how a KnowledgeCell had a multidimensional address in Knowledge Space, an ExplanationTensorPoint would be addressed with the following dimensions:

1. Core Dimensions or Action: The ExplanationTensorPoint should clearly state what knowledge or action it is explaining. This could relate to any knowledge domain, such as environmental science, health, or climate change.
2. Topic: The specific subject of the explanation (e.g. 'carbon footprint')
3. Prerequisite Topics: The topics the user needs to understand before they can fully comprehend the current explanation. This allows the system to gauge whether the user can immediately engage with the explanation or if they need foundational knowledge first.
4. Language: The language in which the explanation is provided. This could be any language that TruthCoin supports, allowing global accessibility.
5. Level of Explanation: The depth of the explanation. It can range from simpler explanations at the middle school level, to more complex ones for post-college audiences. This enables users to choose explanations that fit their knowledge level.
6. Format: Different formats of explanation are supported such as Documents, Presentations or Videos

When using ExplanationCoin, users specify the topic, language, level of explanation, and format they prefer. Additionally, users will have a store of prerequisite topics that they already understand. Based on ExplanationCoin purchases of ExplanationTensors, the tool will determine the best Explanation artifact given the entered criteria. If the user does not have the prerequisites, the tool will query each required prerequisite instead.

ActionCoin extends the TruthCoin platform by providing users with guidance on how to best execute a specific action. Rather than explaining a concept, it attempts to inform users on 'what to look for' and 'what to do' in different scenarios or under different conditions. Similar to ExplanationCoin, ActionCoin may also provide explanations in text, video, or presentation formats.

DataSetCoin: serves as a mechanism for distributing datasets that are used to create KnowledgeCells. Datasets are vital for generating scientifically and statistically relevant knowledge. For example, a dataset of shark attack incidents across various regions can be used to create a set of KnowledgeCell on the rate of shark attack events and the associated consequences per event. Data compression methods discussed in "C.1.1 KnowledgeTensor Compression" can be applied to records in the DataSet.

DataInstanceCoin is similar to DataSetCoin but focuses on individual data instances rather than comprehensive datasets. These single data instances can be used to populate datasets. For example many reporters may create data instances of shark attacks, that can be verified in isolation before another researcher combines the verified instances into a data set.

E.3.2 State Distributions as a form of IS Computable Knowledge

Incorporating categorical (aka state) distributions (in addition to metrics as continuous distributions) into KnowledgeTensors would allow an increase in the expressivity of the platform. As an example, assume an expert makes the claim that heart disease rate is not a function of weight but of BMI category. BMI category is an object state which can not be expressed as a float or continuous distributions. This section discusses the 3 possible extensions to TruthScript to handle all the possible transitions between continuous and categorical distributions:

1. **Continuous to Continuous**: Handled by normal mathematical operations
2. **Continuous to State**: shatter Statement
3. **State to Continuous**: mend Statement
4. **State to State**: map_state Statement

Continuous to State: The 'shatter statement' discretizes a continuous distribution into a set of predefined categories or states, based on certain thresholds. These thresholds split the floating-point distribution into distinct, non-overlapping intervals. This type of transition occurs when converting a **continuous floating-point distribution** (e.g., weight, cholesterol levels) into a **state-based distribution** (e.g., BMI categories, low/medium/high-risk groups). While weight is traditionally considered a simple floating point number, uncertainty in the measurement or uncertainty in the projection of the measurement into the future would result in weight being a distribution.

For Example: A BMI of 18.5-24.9 is categorized as Normal weight, 25-29.9 as Overweight, and 30+ as Obese. The TruthScript would look as follows:

```
#shatter example
object/person;metric/bmi_cat;action;ktp_type/dir_est;start_time/2000.00;end_time/+2040.00;add
ress;gender;ethnicity;enum/under_weight/normal_weight/over_weight/obese
        weight = get('o/person;metric/weight')
        height = get('o/person;metric/height')
        bmi = height/ weight

        bmi_category_distribution_to_return = shatter(bmi):
                case (,18.5): 'under_weight'
                case [18.5,25): 'normal_weight'
                case [25,30): 'over_weight'
                case [30,) : 'obese'

        return bmi_category_distribution_to_return
```

The shatter operation begins with the continuous distribution 'bmi' and then maps it to the appropriate state category distribution. The 'bmi' value is compared against a set of ranges defined for each BMI category (using case statements). Each 'case' represents a range that divides the continuous BMI value into a discrete category. The ranges are specified with 'round brackets()' and 'square brackets[]' to indicate whether the bounds are inclusive or exclusive.

Unlike a traditional 'switch' statement, which executes only one case, all cases in a 'shatter' operation will be executed. The result is a probability distribution across all possible states. The output is a state distribution, where each possible state ('under_weight', 'normal_weight', etc.) will have an associated probability based on where the BMI falls within the defined ranges. For example, if BMI was 20 , the resulting state distribution could look like this: { 'under_weight': 0, 'normal_weight': 1,   'over_weight': 0, 'obese': 0 }. This means the person has a 100% probability of being classified as normal_weight.

State to Continuous: The 'mend statement' facilitates the transition from a state distribution to a continuous floating-point distribution by assigning specific values to different states. For example if you have categorical state, like 'BMI categories' or 'disease risk groups', and want to estimate a continuous variable, like an individual's rate for an event.

```
# mend example
object/person;metric/rate_per_year;of/health/disease/heart_attack;action;ktp_type/dir_est;start_time/2014.00;end_time/+2034.00;resolution/0.1;lower_bound/0;upper_bound/2;address;gender;ethnicity

        age = get_age(time_index)
        bmi_cat = get('object/person;metric/bmi_cat')

        some_modifier = mend(bmi_cat):
                case 'under_weight': 0.03
                case 'normal_weight': 0.001
                case 'over_weight' : age* 0.002
                case 'obese' : age * 0.003

        return some_modifier*(age/10)^2
```

The 'case' statements correspond to different states in the **BMI category** . For each state ('under_weight', 'normal_weight', etc.), an associated floating-point formula is evaluated and returned. Unlike a traditional 'switch' statement, which executes only one case, all cases in the 'mend' statement are evaluated. It generates a continous probability distribution over the possible outcomes, thus each state ('under_weight', 'normal_weight', etc.) contributes to the result based on its probability. While the BMI category is usually a simple state for the present, the BMI Category for a person 10 years out would be a distribution.

State to State: The **map_state** statement is used to map one state distribution to another state distribution. For example the BMI_Category state distribution can be mapped to the heart_disease risk_level.

```
# map_state example
object/person;metric/risk_level;of/heart_disease;action;ktp_type/dir_est;start_time/2000.00;end_time/+2040.00;address;gender;ethnicity;enum/low/medium/high
	bmi_cat = get('object/person;metric/bmi_cat')

	state_distribution_to_return = map_state(bmi_cat):
		case 'under_weight' : 'low'
		case 'normal_weight': 'low'
		case 'over_weight' : 'medium'
		case 'obese' : 'high'

	return state_distribution_to_return
```

The 'case' statements correspond to different states in the 'BMI category' . For each state ('under_weight', 'normal_weight', etc.), an associated mapped state is returned. Unlike a traditional 'switch' statement, which executes only one case, all cases in the 'map_state' statement are evaluated. The map_state operation will merge probabilities where multiple input states map to the same output state. For example, if the bmi_cat had a probability state distribution of {'under_weight': 0.1 , 'normal_weight':0.3, 'over_weight': 0.4 , 'obese': 0.2 } then the results of the map_state will be {'low': 0.4 , 'medium': 0.4 , 'large' : 0.2}

Enum Dimension ,as seen in the 'shatter' and 'map_state' examples, plays a critical role in protecting against outlier attacks from corrupted KnowledgeCells. A malicious actor may corrupt a TruthCoin and introduce a KnowledgeCell with a bmi state of 'malicious_state' to create issues with the computation of state.

The enum in the CellLoc is intended to list all possible states so that the malicious state can be filtered out. By examining which enumerations have the highest TruthCoins, the UniversalKnowledgeTensor is able to identify malicious states that have very few TruthCoins.

During the 'mend' and 'map_state' operations, any KnowledgeCells with invalid or unrecognized states (i.e., states not found in the 'enum') are discarded, preserving the reliability of the data and reducing the impact of any potential outlier attacks.

E.3.3 LEC Knowledge

The fundamental purpose of **knowledge** is to enable individuals to develop **accurate mental models of the world**, allowing them to make informed **decisions (i.e., actions)** that enhances their well-being. All knowledge within the **multidimensional knowledge space** can be categorized into two primary types:

1. IS Knowledge: Refers to instances where an individual believes that the **MultiDimensional Location** of knowledge **IS** a specific claim. For example, the probability of an individual contracting COVID-19 at a particular time, in a specific city, with a given gender and ethnicity **IS** a measurable value. KnowledgeTensors are designed to support IS Knowledge, with this paper specifically addressing **metric-based knowledge** used in the **evaluation of topics and actions.**

2. Location Equals Claim (LEC) Knowledge: In this category, the **MultiDimensional Location itself represents the claim**, with no distinction between the location and the claim. For example, the historical statement, "In 1492, Columbus sailed the ocean blue," can be structured as: "time/1492;object/Columbus;action/sail;sail_parameter/ocean". In this case, there is no separate claim distinct from the MultiDimensional Location since the location itself embodies the knowledge.

The primary objective of **Structured Knowledge** is to **overcome the three fundamental cognitive limitations** that contribute to suboptimal knowledge processing:

1. Finite Attention Span – The human mind has limited cognitive capacity, making it difficult to process large volumes of information efficiently.
2. Faulty Knowledge Dimensional Collapse – The reduction of high-dimensional knowledge into simplified narratives often leads to distortions and omissions, compromising accuracy.
3. Impression-Based Reasoning – The reliance on **impressions rather than objective analysis** is the most significant and most difficult limitation to resolve.

To address these challenges, KnowledgeTensors leverage IS Knowledge, which enables structured, computable knowledge processing. However**, LEC Knowledge remains a challenge**, particularly in the areas of organization, aggregation, and relevance.

Organization Given the vastness of human knowledge within the multidimensional knowledge space, it is necessary to establish a **systematic method for organizing information** to enable **efficient retrieval and processing.**

- IS Knowledge facilitates organization through **Simple Mutual Exclusivity**, where each **CellLoc** is inherently **mutually exclusive** from any other if there is any difference in its dimensions. This allows for **unambiguous categorization** and structured retrieval.
- LEC Knowledge, however, **lacks Simple Mutual Exclusivity** because **small variations in a CellLoc** may or may not indicate distinct claims.

For example, consider the following CellLocs:
1. "time/1492;object/Columbus;action/sail;sail_parameter/ocean"
2. "time/1493;object/Columbus;action/sail;sail_parameter/ocean"
3. "object/Columbus; action/sail;sail_parameter/ocean"
4. "time/1492;object/Columbus;action/sail"

While (1) and (2) **may or may not be mutually exclusive**, their compatibility depends on **external domain knowledge** regarding voyage durations. Similarly, (3) lacks a **specific timestamp**, making it unclear whether it refers to (1), (2), or another event entirely. Finally, (4) introduces further **ambiguity**, as Columbus could have sailed on a lake rather than the ocean in 1492.

A possible approach to **organizing LEC Knowledge** is a **blockchain-based system,** where transactions specify relationships between knowledge claims. Potential transaction types include:

1. LEC Equivalence – Defines that two **seemingly different knowledge claims** are actually the same.
2. LEC Support – Establishes that one knowledge claim **supports** another.
3. LEC Incompatibility – Specifies that two knowledge claims **cannot both be true simultaneously.**

However, the volume of LEC Knowledge is vast, and the return on investment for organizing it remains low compared to the benefits of structuring IS Knowledge.

Aggregation IS Knowledge, as implemented in KnowledgeTensors, enables aggregation by computing a **weighted average based on TruthCoin Counts**. However, **LEC Knowledge lacks a straightforward aggregation method.**

For instance, assume the organization challenge has been resolved, and the following LEC Knowledge are determined to be **conflicting**:
1. "time/1492;object/Columbus;action/sail;sail_parameter/ocean;wearing/red_hat"
2. "time/1492;object/Columbus;action/sail;sail_parameter/ocean;wearing/blue_hat"

Unlike quantifiable metrics, these discrete knowledge claims cannot be easily aggregated into a single usable claim that could meaningfully inform **another claim elsewhere**. This makes **LEC Knowledge fundamentally more difficult to integrate** into structured evaluations.

Relevance All knowledge can be placed in a graph where "input knowledge" are "processed" to support an "output knowledge". Additionally all Knowledge can be categorized as either **informational** (e.g., "The Earth is flat") or **evaluative** (e.g., "COVID-19 is a hoax").

KnowledgeTensors do not explicitly distinguish between them since informational knowledge may get used in a formula for metric expansion during the evaluation of the LifeScore. The "processing" of knowledge is well defined in the KnowledgeCell's TruthScript. The relevance of any input knowledge in this graph can be shown by marginally changing its value and then determining the adjustment in the LifeScore.

But objectively determining the relevance of LEC knowledge remains a challenge. Consider the informational example, "In 1492, Columbus sailed the ocean blue" and the evaluative example, "Columbus was immoral due to his treatment of the natives". Historians adopted this "output" knowledge based on other "input" knowledge. It is difficult to determine how much one of these input ideas must change for a historian to reject this output idea.

E.3.3 Evaluation of People

Evaluating people is significantly more challenging than evaluating topics. Consider the **Nixon Paradox of People Evaluation**, where Richard Nixon enacted numerous environmental regulations that greatly **improved the lives of man**y, yet he was also involved in the **illegal surveillance** of political opponents. While the environmental regulations undeniably contributed to a higher LifeScore for many people, it is far more difficult to quantify the impact on LifeScore due to his political espionage. Similarly, other political figures have engaged in actions that leave negative impressions—whether through affairs, bribery, or outright violations of the law. Humanity defaults to using impressions to evaluate people, but the main goal of structured knowledge is to **avoid Impression-Based Reasoning since it leads to subjective, inconsistent assessments.**

A general way to frame this problem is to imagine two presidential candidates, both advocating for policies that would improve the LifeScore of voters in an identical manner. However, Candidate A committed Action X and Candidate B committed Action Y. How does one decide who is the better candidate to vote for? Action X and Action Y may involve violations of cultural norms (e.g., infidelity), laws (e.g., illegal surveillance), or both (e.g., sexual assault).

One possible approach is **morality quantification through Morality Points,** where actions are **assigned numerical values** rather than being judged based on subjective impressions. While this approach may **not be optimal**, it would still be **preferable to the deeply flawed Impression-Based Reasoning currently used by society**.

Instead of awarding TruthCoins to the most accomplished experts, **MoralityCoins** would be distributed to leading researchers and authoritative figures within specific morality systems. Each MoralityCoin Custodian would be responsible for evaluating **moral trade-offs** within their respective frameworks, determining which of two given actions is more immoral when both are deemed unethical by the system. These evaluations would be encoded into **MoralityTensors**, which would be purchased on a morality-specific blockchain (e.g., ChristianityCoin, ConfucianCoin, etc.). The **aggregated MoralityTensors** would then be used to quantify the morality of actions within each moral framework, allowing for a **computable model of ethical evaluation.**

Despite its structured approach, **MoralityCoin faces several key challenges**:
1. The Nixon Paradox – The system does not resolve the fundamental question: How immoral must an individual be to justify an increase in another's LifeScore? The quantification of morality must account for whether certain immoral actions can ever be outweighed by positive contributions.
2. Cultural System Reflection – Every morality system is, to some extent, a reflection of its cultural system. This creates an issue if a morality system were to **deviate significantly** from the prevailing cultural system, it would struggle to gain **widespread adoption**. However, cultural systems evolve across time and geography, raising the question of how to distinguish core moral principles from cultural artifacts of the past.

3. Legality vs. Morality – Not all legal actions are moral, and not all moral actions are legal. While there is often overlap, history has demonstrated cases where legal frameworks fail to uphold ethical principles (e.g., the Holocaust was legal under Nazi law yet universally recognized as deeply immoral).

E.3.4 Advertisements as LEC Knowledge

Everything in this document has addressed the role of Structured Knowledge in supporting the processing of **Public Knowledge**. This section attempts to address how Structured Knowledge affects Private Knowledge that individuals create for themselves. Private knowledge differs significantly from public knowledge with respect to the following:
- A. Scale: Private Knowledge encompasses an immense volume of data. With approximately 8 billion individuals globally, each contributing vast quantities of personal content (e.g., images, videos, documents), managing this data requires extensive computational and bandwidth resources. Whereas Public Knowledge focuses on key public events and figures rather than individual experiences.
- B. Access: Due to the personal nature of Private Knowledge, mechanisms to ensure data exclusivity and prevent unauthorized access are imperative. Public Knowledge generally does not require these mechanisms unless there is an attempt to monetize it.
- C. Value: Despite its significance to the individual (e.g., the sentimental value of a personal photo), Private Knowledge typically has limited broader relevance to others. Public Knowledge has immense utility for others to evaluate the state of the world. Public IS Computable knowledge has the highest value of all.

While the previous sections discuss the feasibility of disseminating Public Knowledge using leftover device bandwidth, Private Knowledge cannot be supported in this manner due to the significant increase in computational and bandwidth requirements. This section analyzes the chain of mechanisms that supports Private Knowledge Platforms.

Why is Private Knowledge Computing 'Free'?: Tech monopolies find it profitable to invest billions in infrastructure and provide 'free' services to users in order to collect billions in ad revenue from normal companies.

Why do normal companies pay for ads? Normal companies could have used their ad budgets to expand their business or improve their product or give it to investors in the form of dividends or stock buybacks. Nevertheless, companies find it profitable to buy ads.

What is an ad? It is a **forced reservation of attention span** to disseminate desired public knowledge that was already publicly available. To illustrate, assume all nations banned advertising tomorrow, what knowledge would be lost to humanity? The answer is **none**.

Why are ads valuable given their minimal knowledge content? Advertising is not just about promoting a product; it's about **'capturing and controlling attention'**. The mechanics of ads show that the value is not in the information provided, but in their ability to generate corporate gain.

The value of ads is largely tied to the fact that **advertising** manipulates human **attention span** and, in turn, **decision-making.** Companies recognize that human attention span is limited, and by purchasing ad space, they are able to capture that attention and direct it in a way that favors their products or services. Ads, at their core, are not providing valuable knowledge, they are merely a way for businesses to capture limited attention span, influence decision-making, and shape consumer behavior to increase profits.

Essentially, the true cost of this system is the manipulation of human decision-making, based on a limited and finite resource: attention span.

What is the role of TruthCoin? TruthCoin represents a paradigm shift toward incorruptible knowledge distribution. By decentralizing knowledge access and using blockchain technology, **TruthCoin** ensures that knowledge remains pure, unaffected by external influence or monopolistic tech companies.

If humanity had an incorruptible source of all public Structured Knowledge and the ability to make optimal decisions with an infinite attention span, ads would no longer hold value. The **advertising-driven model** extracting value from user attention span would **no longer be sustainable.** In a world where ads lose their influence, the monopolies built on advertising revenue would face collapse. TruthCoin could mark th**e beginning of the end** for the advertising-driven monopolies that dominate the tech industry, shifting humanity toward a future of **optimal decision-making** and unbiased knowledge.