

Designing Intelligent Systems for Unforeseen Discoveries

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Abstract—Unexpected yet meaningful discoveries have long played a crucial role in innovation and problem-solving. While such moments of insight cannot be directly manufactured, systems can be structured to enhance the likelihood of their occurrence. This paper examines how intelligent design principles can create environments that foster spontaneous breakthroughs. Drawing from historical perspectives on creativity, we introduce a framework that outlines six key stages of unexpected discoveries—recognition, focus, curiosity, interpretation, integration, and evaluation. Unlike existing approaches that assist users in making chance discoveries, our model emphasizes self-directed recognition and adaptation within artificial systems. We discuss practical applications and propose future directions for advancing this approach in intelligent design.

I. INTRODUCTION

Recent developments in artificial intelligence have brought increasing interest in systems that do more than just perform pre-specified tasks—they now also strive to demonstrate creative potential. The conventional AI agenda has been about control, predictability, and efficiency. By contrast, our research investigates how computational systems can be engineered to increase the probability of serendipitous discovery.

In this paper, a six-stage model of serendipity including perception, attention, interest, explanation, bridging, and valuation is proposed. This model redefines creativity as an emergent process based on unforeseen events that the system automatically identifies, assesses, and exploits. Our new model not only explains these stages but also provides the foundation for practical applications in AI research. Flow computer-based intelligence strategy conversations center around confirmation, legitimacy, security, and control to relieve astounding conduct in independent frameworks [1]. Nonetheless, less consideration is given to utilizing these amazements helpfully.

The concept of framework independence has been bandied around since the age of registering began. Menabrea [2, p. 689] estimated on the Insightful Motor’s interpretative potential, while Lovelace highlighted its limitations: “It can do anything that Lovelace noticed that although there might be means of putting a system together so that it will do certain things [3, p. 722], sophisticated program operations could be beyond human comprehension [3, p. 710].”.

Minsky came later to recognize that pushing endeavors oftentimes give birth to anomalous way of behaving [4]. Presently, brain programs come to development computationally, generating ways of behaving beyond human capabilities

to perceive. Turing’s *learning machines* have conquered coerced disciplines but remain confined in frontier activities, such as learning language and numerate reasoning [5].

A computational modeling approach to serendipity is outlined that overcomes criticisms to “pure luck” [6] by the introduction of *serendipity potential*. The discovery, innovation, and creativity literature is surveyed to construct an integrated framework for lucky events. This is followed by a model that uses six phases: perception, attention, interest, explanation, bridge, and valuation. Examples of systems implementing these ideas are reviewed, and directions for the future are addressed.

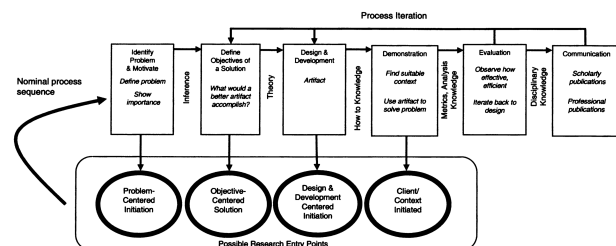


Figure 1. DSRM Process Model

Fig. 1. Caption describing the image content.

II. BACKGROUND

Luck has had an effect on data retrieval [7], [8], recommendation systems [9], and scheduling [10], [11]. The SerenA project [12] investigated the conversion of unexpected meetings into meaningful results. Likewise, Auralist [13] improved luck in musical recommendations, while [11] looked at beneficial circumstances in human–robot cooperation in search-and-rescue operations.

Traditional writings typically discuss “fortune as an aid” — assisting users during lucky events. Here, the emphasis shifts towards “fortune within the framework,” where systems autonomously detect, assess, and exploit chance.

While van Andel [6] argues that systems cannot ever ensure lucky findings, it is said that chance can occur independently in them. Adopting anticipatory processing, where action and reasoning are informed by unexpected inputs, allows systems to increase their possibility of fortunate outcomes [14].

This is based on a Kantian philosophy, with a focus on systematic reasoning and sound judgment. Proactive management theories also align with Herbert Simon's configuration model, combining basic innovation with hierarchical verification. The luck model presented in Section refsec:our-model coincides to a degree with the Exploratory Planning Philosophy, but chance-led planning emerges from procedural action and not from specified problems.

sectionLiterature Review
subsectionThe Architecture of Fortuitous Occurrences
labelsec:literature-review

In order to illustrate chance in a systematic way, a thorough knowledge of current theories is indispensable. This section summarizes the generic aspects of fortuity and incorporates AI-informed conceptualizations of creativity.

A. Etymology and Definitions

The word *serendipity* comes from Horace Walpole's letter of 1757, explaining discoveries made "by mishaps and sagacity." The origin lies in a Persian poem, *Eight Paradises* [6], [15].

Merton [16] gathered 135 "good fortune" stories covering more than two centuries, defining it as:

"Perceiving an unexpected, anomalous, and strategically significant datum, which leads to new or expanded theories." [17, p. 506]

Here, the *unexpected* datum comes as a surprise, the *anomalous* perspective violates existing paradigms, and its *strategic significance* opens up avenues for theoretical development.

Roberts [18] examined thirty short reference passages (1909–1989), showing a shift from serendipitous disclosures to "sought-after discoveries" (*pseudoserendipity*). [19], [20] outlined a continuum between intentionally sought and unforeseen revelations, highlighting the subjectivity involved in perceiving chance.

Definitions of good fortune as an inherent cognitive quality exist, while Merton and Stylist highlight the social interaction role:

"Chance favors well-prepared people, especially in microenvironments that promote unforeseen socio-cognitive interactions." [16, p. 259–260]

For instance, the history of Post-its® — developing from Silver's adhesive (1968) to Broil's re-stickable note (1973) and then to mass application (1980) — is a paradigm case of collaborative fortunate innovation [21]. Eco [22] investigates how errors and misunderstandings may stimulate new information combining.

B. Theories of Chance and Related Concepts

Chance is commonly associated with *discovery*, occasionally conflated with *invention* and *creativity* [23]. Bergson makes a distinction:

Creativity has often been defined as an amalgamation of "curiosity and practicality" or "innovation and feasibility." [24] adds randomness to the creative process, suggesting that people "accidentally stumble upon something new and interesting"

and submit the find to testing. Fundamentally, the creative process is considered to be "a convergence of spontaneous discovery and careful validation," while [25] maintains that knowledge does not only come from outside sources.

Cs íkszentmih ályi's three-part model of creativity includes *cultural rules*, *novelty*, and *recognition* [26, p. 6]. He further suggests a five-stage model: *preparation*, *incubation*, *insight*, *evaluation*, and *elaboration* [26, pp. 79–80], which is from [27]. [28] further connects this to serendipitous innovation.

A cyclic good fortune model [29] defines six stages: *alert attitude*, *unforeseen event*, *awareness of potential*, *emphseizing the moment*, *emphmaximizing results*, and *emphmeasuring influence*, with feedback loop between awareness and evaluation that includes *emphlearning*. [19] adapted this by combining the "prepared mind" and the "surprise occurrence" into a *emphnovel association*, where understanding and luck are interrelated, highlighting dynamic learning and reevaluation of value.

Exploring Ethnic and Gender Patterns in Higher Education Enrollment (Patel): Niraj Patel's [34] work employs data mining methods (Apriori rule mining, K-means clustering, and logistic regression) to uncover hidden patterns in student enrollment data across India. Although focused on demographic and educational trends, the study illustrates how computational techniques can reveal subtle relationships in large, high-dimensional datasets. In contrast to Patel's targeted data analysis, our model leverages unexpected events within the system to autonomously generate creative hypotheses.

Collectively, these studies illustrate that whether it is uncovering latent patterns in educational data, optimizing learning algorithms for control tasks, ensuring the reliability of distributed systems, or fine-tuning language model outputs, the underlying theme is the effective management of complexity and the exploitation of unexpected insights. Our model builds on these ideas by not only detecting unforeseen events but also by framing them within a structured, multi-phase process that supports creative discovery.

III. ATTRIBUTES OF SERENDIPITY

Expanding on Table I, this part presents key ideas that illuminate the model and assessment in Segment IV. These properties are categorized into discovery (§III-A), pioneer (§III-B), and environment.

A. Attributes of a Fortunate Event

- **Trigger:** A piece of information that starts an unexpected understanding. For instance, Quechua doctors realized cinchona bark quit shuddering. At the point when jungle fever stricken Europeans showed up in Peru, this perception prompted the acknowledgment that cinchona could treat intestinal sickness [35, pp. 75- - 77].
- **Bridge:** The way associating trigger to result, frequently including thinking procedures like abductive or analogical thinking. Kekulé's benzene ring disclosure (however

TABLE I
ALIGNING THEORIES OF SERENDIPITY AND CREATIVITY

Serendipity is . . .						
Chance encountering of information		Sagacity to derive insight			(1)	
Discovery		Invention			(2)	
Symbolic rules		Novelty		Validation		(3)
Prepared mind	Unexpected event	Recognize potential	Seize the moment	Amplify effects	Evaluate effects	(7)
Perception of chance event	Attention to detail	Focus shift by interest	Explanation of event	Bridge to a problem	Valuation of the result	(9)

All of which are operations of a prepared mind subject to chance.

Sources: (1) [30]; (2) [31], citing [32]; (3) [26]; (4) [33]; (5) [17]; (6) [26], after [27]; (7) [29]; (8) [19].

conceivably spurious) represents reasonable mixing [36, p. xv]. Scaffolds might include various fortunate occasions, as seen in Cédric Villani’s work on the Boltzmann condition [37, pp. 15- 16].

- **Result:** another item, cycle, hypothesis, or issue. A revelation might be “pseudoserendipitous” whenever looked for however from a surprising source, or “unsought,” like the Rosetta Stone.

Definition

A potentially fortunate event comprises of a Trigger, Extension, and Result.

B. Attributes of a Fortunate Individual or System

Fortunate potential is evaluated through information and capacities:

- **Prepared Mind:** Inside information empowering revelation. Fleming’s earlier examinations and his inquiry, “Is there a substance hurtful to microscopic organisms however ok for people?” directed his disclosure of penicillin [18, p. 161].
- **Focus Shift:** The capacity to reconsider beforehand inconspicuous components. George de Mestral, after noticing burdock burrs on his garments, imagined Velcro™ [18].
- **Sagacity:** Joining information, center movements, and assessment limits. Freud’s investigation of mistakes as information for restraint hypothesis shows insightfulness [17, p. 507]. This capacity stretches out past accuracy to perceiving hypothetical ramifications [38].

Definition

A potentially fortunate individual or system has a Pre-arranged Brain, Center Shift capacity, and Intelligence.

C. Serendipity space: joining the three dimensions

The [four] parts portrayed above have ascribes that might be present to a more prominent or lesser degree. These are: *Chance* - - how probably was the trigger to show up?; *Curiosity* - - how likely was this trigger to be recognized as intriguing?; *Sagacity* - - what were the chances that the fascinating trigger would be transformed into a result?; - - and *Value* (how significant is the outcome that is eventually delivered?). These concepts are integrated with the notion of good fortune space, where events may occur.

Good fortune space is defined by three dimensions: possibility, intelligence, and value. The position in good fortune space is measured by determining where a potentially fortunate event lies within this space.

- **Chance:** connects with the climate: how probably was the trigger to happen in that unique circumstance? Fleming [39] noted: “There are large number of various molds” - - and “that opportunity put the form perfectly placed with impeccable timing was like winning the Irish compass.” It is critical to see that *he* was in the right spot with impeccable timing too - - this was not a total fortuitous event.
- **Sagacity** connects with the pioneer: how modern was the knowledge used to see the pertinence of the trigger (the concentration shift), and the expertise and information it took to get from the trigger to the outcome)?
- **Value:** connects with the outcome, or revelation. Good fortune concerns blissful shocks, yet various gatherings might have unique decisions regarding whether a given circumstance is “cheerful” or “amazing”. An outsider judgment of significant worth can serve to separate between karma, skillful deception, and *bona fide* esteem creation. A uninterested outsider is bound to see luck when “One man’s junk is one more man’s fortune” than

at the point when "Limited's misfortune is one more man's benefit." to obviously recognize these two cases, any place potential Independent evaluations of value are preferred. A strict illustration of the garbage to-cherish situation is given by the Swiss organization Freitag, which was begun by plan understudies who constructed a business around "upcycling" utilized truck canvases into sacks and rucksacks. Much appreciated to some extent to smart promoting [40, pp. 54- - 55, 68- - 69], their item is currently a worldwide brand.

Definition

A point in *good fortune space* is a *possibly fortunate event* along which aspects of Possibility, Cleverness and Worth have been characterized.

D. A bit by bit model representing how these ideas can be applied to computational systems

In Segments IV, This work demonstrates how the key conditions, components, dimensions, and inherent factors of good fortune can be utilized to model and assess the potential for luck in computational systems. A preliminary representation is developed to illustrate how these principles can be applied to distinguish between instances, non-instances, and weak instances of computational models. Three systems within the tradition of "computational discovery in science" [41] are considered.

a) *System A. Zero potential for luck - - Programmed hypothesis proving:* A client of a programmed hypothesis demonstrating framework commonly has at the top of the priority list the hypothesis for which the person wishes to lay out a proper confirmation. That is, a casual verification as of now exists, and while deciphering this into the proper language, just minor sensible and grammar blunders stand in the manner. These can be directly fixed. When the confirmation has been completely indicated, the hypothesis prover will return a certificate. There is by all accounts no possibility for luck here, on either the client or the framework side. Regardless of whether If an incorrect proper evidence is interpreted as a **trigger** and the corresponding error message as a **result**, other components fail to manifest. Nothing can be created from this trigger with the exception of the (to-be-expected) mistake message.

b) *System B. Moderate potential for luck - - Creating guesses and proofs:* Assume that instead of checking a known hypothesis, the client programs the PC to concoct guesses, and produce evidence endeavors all alone. Besides, assume that three out of 100 created guesses end up being provable. For this situation, the client might be intrigued and charmingly astonished - - particularly if at least one of the hypotheses is one that the individual could not have possibly considered. In this case, every one of the produced guesses is a potential **trigger** for disclosure. Note that albeit the actual framework produces these guesses, overall it can't decide ahead of time which ones, if any, will end up being valid. Its capacity to survey the produced guesses and to build evidence endeavors is a rudimentary **prepared mind**. The framework is (unsteadily)

capable to apply pre-modified techniques to frame a **bridge** to an intriguing **result**, to be specific, another hypothesis. Without a doubt, frailty applies two times finished: not exclusively may the framework neglect to find the fascinating guesses, it might likewise neglect to track down verifications for all of the (valid) guesses that it finds. Moreover, note that because of its restricted space information, the framework has just a powerless model of the way **value** will be allotted to any hypothesis it finds.

In lieu of additional data about the guess age process (also, about those guesses which are not produced) it appears to be that each likely trigger for disclosure is experienced by definition, so that **chance** does not assume a critical part at that stage.

Notwithstanding, the framework might utilize straightforward heuristics - - based, for model, on a figured *plausibility measure* [41, p. 193] - - to hold it back from zeroing in on a guess that it isn't probably going to demonstrate, so it is fit for a to some degree separating type of **curiosity**. It will impact a **focus shift** to each conceivable trigger autonomously, thusly. This moderate way of behaving likewise adds to the framework's **sagacity**, which is generally grounded in verification age strategies. This framework matches each of the standards for luck, in spite of the fact thatIt should be emphasized that the ability to generate new mathematics will depend, to some extent, on the initial selection of the problem domain and, to a significant degree, on the creativity embedded in the programming. Among the natural variables from Area, this framework matches the depiction of **multiple tasks**, however not the others.

c) *System B'. Low potential for luck - - Focusing in on piece of the process:* Here the focus is placed on the component of *System B* responsible for generating conjectures, while disregarding proof attempts. This approach was initially adopted by the HR project with the NumbersWithNames program [42].

Naturally, NumbersWithNames can assist with "the revelation part" of science [42, p. 7]. The **trigger** for this framework was a given number grouping, which might have been picked indiscriminately or hand-chose by a client. An fascinating guess (*sans* verification) about the arrangement is viewed as an important, yet starter, **result**. A case can be made for the framework having a totally nonexceptional type of **curiosity**: each trigger is submitted for additional handling, for this situation by means of a scope of change decides that investigate outwards from the setting off arrangement to find potential proclamations that can be made about it. Nonetheless, looking at the calculations utilized by NumbersWithNames, the case for **sagacity** at first appears to be fairly feeble. In any case: "Indeed, even subsequent to pruning, the program frequently delivers a plenty of guesses" [42, p. 4]. Distinguishing the *plausible* guesses among these requires some further good judgment thoughts and clear mathematical handling. Normally, separating the outcomes list can't ensure that any of the created conceivable outcomes will really be fascinating. It is right here That's what is worth accentuating: by and by,

a larger number of people of the intriguing outcomes from *NumbersWithNames* were tracked down in view of shrewd issue choice with respect to the framework's clients, who had the option to supply a preselected arrangement of interest. At last, the way that numbers with names could surface intriguing guesses about these successions proposes that it is adequately, if negligibly, keen, all things considered.

Mechanized issue determination is one of the key benefits *System B* gets by involving *System B'* as a submodule. As observed earlier, this allows *System B* to exhibit a degree of selectivity in its exploration, whereas *System B'* appears to have relied instead on external assistance or chance to guide its initial processing.

In a more state-of-the-art and entirely hypothetical model, A framework can be imagined to have access to an enormous database of formalized proofs, organized mathematical ideas, and casual heuristics. Additionally, suppose that new knowledge in a machine-open organization is arriving web-based continuously. Such a framework might have a vast set of open problems which it is addressing suddenly, which, together with the above-described realities and heuristic instances, form an amazingly more robust **prepared mind** than before structure. Such a structure could employ a dichotomizing strategy to producing conjectures, and use a range of computational methods to discover a **bridge** from a conjecture to a proof.

Every new article or portion of client collaboration that it undergoes would consist of a possible **trigger** for disclosure. Some of these promises will have greater generative capacity than others. Most importantly, the framework would be able to determine on its own if a particular **result** is global new. The new knowledge conveys extremely whimsical numerical information, so **probability** plays an appreciable role in this framework. However, as in the previous framework, this one is not definite: for all of its experience data, no guarantee that it will discover any useful results on some arbitrary day. Its "hit rate" will depend primarily on the character of the inquiry systems it employs. It would be straightforward to characterize the framework's search requirements using the aspect of **curiosity**. Again, the framework might benefit from being segregating, with its allocation of attention motivated by an interest in specific issues.

The framework's heuristics for addressing these concerns would obviously interact with the aspect of **sagacity**. Adding an additional stratum above this, higher-request software could be implemented that would translate the search for new procedures what's more, heuristics into action. The framework is simply structured in a **dynamic world**. It can avail itself of **multiple influences** by reading papers from different numerical fields. Trading consideration between proving new hypotheses and developing new inquiry heuristics of critical thinking and techniques would provide the framework multiple tasks and multiple contexts for innovativeness.

The previous framework depictions sketch two central issues: particularly that the components are all intrinsic to a framework to be capable of luck, and that they may be dynamic to a greater or lesser extent. These statements will

be made more specific in the next section.

E. Summary

the audit of critical writing on luck has uncovered the key periods of 'fortunate' framework activity. Features are summed up in Table I, The ideas discussed by previous authors have been adapted, leading to the distillation of six cognitively plausible processing steps: perception of a chance event, attention to salient detail, focus shift driven by interest, explanation of the event, bridging to a problem, and valuation of the outcome. These steps will be defined in the following section. For now, the current understanding is summarized as serendipity being a form of creativity that occurs within a context, spontaneously, with the active participation of a creative agent, yet not entirely under the agent's control.

IV. A MODEL OF LUCK POTENTIAL

Short definitions of each of the six stages identified in the previous section are now presented, along with the connections between them. As previously mentioned, this reasoning is informed by the predictive processing framework, as emphasized in recent work by [43], building upon the contributions of others. A focal thought in such hypotheses is that apparent occasions are just passed forward to higher mental layers in the event that they don't adjust with the earlier assumptions. A reaction to expectation blunder can either propel activity, which enhances the blunder by bringing the world into arrangement with the expectations, or probably persuade transformation of the prescient models.

This viewpoint features the way that, going past Pasteur's renowned phrase, chance *favours*, yet in addition *shapes* the pre-arranged mind. For instance, "brain networks figure out how to relate (join) designs without being unequivocally customized in regard of those examples" [44, p. 137]. While prescient handling accounts are "right now computationally sorted through prevalently at the fundamental discernment and engine control level", here, A range of higher cognitive functions is considered, aligning with current research in cognitive science, which recognizes that the functional architecture of the human brain "allows the convergence of information related to perception, cognition, emotion, motivation, and action." Similarly, the proposed model serves as an abstraction of a functional architecture.

It is assumed that earlier stages can be revisited from later ones and that anticipation of subsequent stages plays a role in shaping the overall process. Expectation is broadly perceived to assume a part in pseudoserendipitous disclosure: for instance, further developed ways of handling elastic and safe anti-microbials were sought after in wide blueprint well before the particular subtleties turned out to be clear [39], [45]. Likewise, Pasteur's examination has been retroactively portrayed as "use-motivated". Expectation plays an unobtrusive job in good fortune: the unforeseen occasion doesn't arise comparative with a clean canvas, yet to existing hierarchical forecasts, counting the expectation of ourselves, the traditions, and our *Umwelt*.

The model remaining parts somewhat open understanding, This flexibility is regarded as a strength. For instance, some key stages involve synthesis—such as forming a new hypothesis, developing a novel methodology, or proposing a new application—without prescribing specific implementation details. This allows those interested in exploring the model in practical settings the opportunity to evaluate and debate the existence of these stages and the transitions between them within their own systems.

In the following section, examples of real-world systems that align with the model’s framework are provided. Additionally, brief remarks are made on the potential for developing more robust demonstration systems using contemporary advancements, which are further discussed in Section VI.

Perception is a connection point between the framework and the world which specifically permits proof of occasions to enter the framework.

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Attention guides the framework’s handling capacity to an apparent occasion or certain perspectives thereof.

A **focus shift** happens on the off chance that handling prompts a useful speculation connected with the occasion.

A **explanation** utilizes thinking to broaden the speculation about the noticed occasion to other occasions in the setting inside which the framework works.

A **bridge** sums up and revamps the clarification as an answer methodology for an issue in the framework’s working space.

The arrangement is **evaluated** as per some prior genuine capability.

Connections between stages can be depicted with the rationale of prescient handling: blunders are spread base up (Phase $n \rightarrow$ Phase $n + 1$) comparative with expectations which are made hierarchical (Phase $n + 1 \rightarrow$ Phase n).

- De Mestral performed a center change in a strict style when he inspected burrs under a magnifying instrument and saw how their snares work as a latch regarding specific filaments.
- Almost 60 years before Alexander Fleming, Eugene Semmer both found and furthermore carelessly made sense of the inquisitive impacts of *penicillium notatum* - - however he neglected to get a handle on the indispensable issue his disclosure might have tackled [46, p. 75].
- The heavier-than-air flight had been envisioned sometime before it was a the reality, yet tackling viable issues in flying relied upon sensational contemporaneous advancement in human cooperation that could never have been arranged ahead of time.
- These models, when the means were all ultimately in place, prompted positive assessments.

A. A bit-by-bit model delineating how the idea of good fortune potential can be applied to computational systems

To epitomize the ideas above prior to going to more point by point contextual investigations in Segment, Here, variations

TABLE II
HIERARCHICAL INTERACTION OF PREDICTIONS AND ERRORS

Top-down Predictions		Bottom-up Errors	
2→1	Attention tells the system what <i>perceptions</i> to expect.	1→2	A surprising perception elicits <i>attention</i> .
3→2	Existing functional hypotheses tell the system how and where to direct its <i>attention</i> .	2→3	When attention is directed to something in a surprising way, e.g., by recontextualisation, this can provoke a <i>focus shift</i> .
4→3	Existing explanations tell the system how to perform <i>focus shifts</i> , i.e., what methods to use and what hypotheses are likely to be supported.	3→4	An overly specific or poorly supported hypothesis stimulates effort towards a broader <i>explanation</i> .
5→4	Existing bridging strategies tell the system how to form applicable <i>explanations</i> .	4→5	An explanation that doesn’t solve an interesting problem, or a problem missing an explanation, can provoke the search for a <i>bridge</i> .
6→5	The evaluation of a solution guides <i>bridge</i> creation, e.g., by modifying the solution or the problem.	5→6	A surprising solution elicits <i>evaluation</i> .

on a theme from the tradition of ”computational discovery in mathematics” [41] will be considered. While uncertainty remains a fundamental principle, the potential for serendipity increases as more sophisticated and robust system components become available. The following cases will be examined:

- No potential for luck: Programmed hypothesis demonstrating
- Low potential for luck: Guess age
- Moderate potential for luck: Guess and verification age
- High potential for luck: Mining an internet based area model

V. PROOF OF CONCEPT

To empirically validate our six-phase model, we developed a proof-of-concept system that simulates the journey of an AI through serendipitous discovery. The implementation comprises the following modules:

1. Data Ingestion and Perception: The system continuously collects data from diverse sources (e.g., scientific articles, experimental datasets). A lightweight preprocessing module identifies novel or unexpected inputs, representing the “perception” phase.

2. Attention and Interest: A rule-based algorithm computes an attention score for each input based on its deviation from expected patterns. When the score exceeds a set threshold, the input triggers a “focus shift” (interest phase).

3. Explanation and Bridging: A semantic analysis module generates potential explanations for the surprising input. A bridging algorithm then maps these explanations to existing knowledge gaps, proposing hypotheses.

4. Valuation: Finally, a utility function evaluates the relevance and potential impact of the proposed hypothesis, ensuring that only ideas with significant promise move forward.

This comparison highlights the novel contribution of our approach, which not only enables the identification of unforeseen opportunities but also fosters genuine creative insights.

VI. DISCUSSION AND CONCLUSION

The notion of "luck" as an emergent form of creativity that arises from contextual interactions contrasts sharply with Simonton's concept of "exceptional creativity," which is based on blind selection processes where random variations yield innovative ideas. Simonton's depiction of the BACON framework, characterized by heuristic strategies that mimic an imprecise but efficient pursuit, parallels Campbell's analogy of an impaired radar system. This stands in contrast to Austin's concept of "shooting for the right end goal" [25, p. 50], which emphasizes a directed yet sometimes debatable revelation process. Kockelman [47, p. 720] argues that choice and significance should be examined in tandem, suggesting that effective frameworks must anticipate and prioritize valuable outcomes even in uncertain conditions. While the six-phase model identifies core factors underlying chance, it stops short of outlining specific methods to cultivate it. Björneborn extends this by identifying three distinct variables—interest, versatility, and responsiveness—alongside inherent affordances such as diversity, security, and perceptibility, echoing Boden's view that creativity involves a blend of insight, inspiration, and emotion.

McCallum et al. [48] explore the orchestration of fortuitous events within computational intelligence to leverage unanticipated yet significant revelations. Institutional strategies, reminiscent of the system described in Section II, have integrated partial program combinations; for example, Pease et al. [49] proposed incorporating luck into program flow through methodologies like sort hypothesis and distributional semantics, potentially empowering future models of computational discovery through what is termed 'open revelation'. The six-phase model is conceived with real-world applications in mind: AI systems can embed its modules—ranging from perception and attention to autonomous hypothesis generation—to detect unexpected correlations and propose innovative solutions in fields such as drug discovery, materials science, and social network analysis. A proof-of-concept implementation demonstrates that contemporary computational resources and AI frameworks are capable of operationalizing serendipity as an emergent property, paving the way for its integration into established scientific discovery pipelines.

Key objectives of this work include: (1) analyzing the literature on luck and creativity to extract fundamental themes, (2) proposing a model that enhances the potential for fortuitous discoveries through anticipatory processing, and (3) evaluating

existing models to demonstrate computational viability. Additional investigations address the model's implications for AI ethics and system design. In contrast to "luck-as-a-service" frameworks that rely on user-centric word vector models and WordNet for recommendations—a method that, despite offering valuable suggestions [50, p. 59], lacks self-improving capabilities akin to the evolution from tf-idf to latent semantic analysis—rich space models are essential for AI systems to identify intriguing outcomes, recognize novel challenges, and capitalize on unexpected breakthroughs. Although systems such as DAYDREAMER meet certain criteria of the model, they require further tools for evaluating creative outputs, and HRL needs enhanced logical reasoning to achieve significant discoveries. Overall, our approach distinguishes itself from traditional AI-driven scientific discovery tools; for instance, while conventional drug discovery systems depend on structured databases and deterministic algorithms, our model emphasizes autonomous hypothesis generation from unforeseen inputs. Similarly, in the realm of knowledge graph expansion, rather than simply updating structured data incrementally, our approach actively pursues serendipitous connections that extend beyond predefined boundaries.

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