

AGITB: A Signal-Level Benchmark for Evaluating Artificial General Intelligence

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Abstract

Although machine learning has advanced significantly, current AI systems still lack human-like general intelligence. Large Language Models do not exhibit the deep understanding or adaptive reasoning central to AGI. Existing evaluation frameworks, often based on broad language or perception tasks, offer limited granularity and little guidance for stepwise progress. This paper introduces the Artificial General Intelligence testbed (AGITB), a novel benchmarking suite comprising twelve automatable tests designed to assess low-level cognitive precursors through signal prediction. AGITB tasks require models to forecast binary sequences over time without relying on pretraining, symbolic manipulation, or semantic knowledge. The testbed isolates fundamental computational properties, such as determinism, sensitivity, and generalisation, that reflect biological information processing. AGITB is engineered to preclude brute-force or memorisation-based solutions and presumes no priors. While humans reliably pass these tasks, no current AI system has met the AGITB criteria, underscoring its potential as a rigorous and actionable benchmark for advancing and evaluating progress toward AGI.

Keywords: artificial intelligence, artificial general intelligence, benchmark, testbed, artificial neural networks

1 Introduction

Despite rapid advancements in machine learning and neural network architectures, current artificial intelligence (AI) systems still fall short of human cognition’s flexible, robust intelligence. As Marcus and Davis (2020) observe, large language models (LLMs) can produce highly fluent outputs, yet they rely primarily on statistical pattern recognition rather than grounded, compositional reasoning. This surface-level competence often obscures a deeper lack of understanding—an essential prerequisite for artificial general intelligence (AGI). Achieving AGI entails the ability to generalise, reason, and adapt across a wide range of domains in a goal-directed and context-sensitive manner.

Recent progress in AI has led to growing speculation that AGI may be approaching. However, such claims remain difficult to substantiate without a rigorous and informative evaluative framework. Assessing progress toward AGI requires more than task-specific benchmarks or qualitative impressions; it necessitates principled, general-purpose metrics capable of systematically capturing and comparing broad cognitive capabilities.

Various attempts have been made to define such tools, the most iconic being the Turing Test proposed by Turing (1950). However, existing benchmarks fail to meet the needs of AGI research, lacking in gradual resolution, interpretability, and automation. They typically assess surface-level competence rather than underlying mechanisms of generalisation. In response to these limitations, this paper introduces the Artificial General Intelligence testbed (AGITB), a novel framework for evaluating foundational cognitive abilities in artificial systems.

AGITB draws inspiration from the Ladder to Human-Comparable Intelligence introduced by Šprogar (2018), extending its conceptual foundations into a unified testbed comprising twelve automatable, domain-agnostic tasks. While AGITB does not aim to assess consciousness or semantic comprehension, it provides a principled mechanism for distinguishing narrow AI systems from those exhibiting generalisable, adaptive behaviour. A comparative analysis with the Abstraction and Reasoning Corpus (ARC) introduced by Chollet (2019) is included to contextualise AGITB within the broader landscape of AGI evaluation.

2 Background

The rapid progress of deep learning has enabled AI systems to exhibit increasingly sophisticated reasoning, problem-solving, and dialogue capabilities. Yet despite these advances, there remains a persistent reluctance to attribute “intelligence” to machines. This hesitation is partly rooted in the intuitive association of intelligence with uniquely human traits—such as consciousness, self-awareness, and subjective experience—which remain elusive in artificial systems.

Historically, as AI systems have succeeded in domains once considered hallmarks of human intelligence, definitions of intelligence have often shifted. For instance, the success of Deep Blue against Garry Kasparov in chess (a task formerly seen as a benchmark for AGI) was quickly reframed as a triumph of brute-force computation rather than genuine intelligence. Such redefinitions risk obscuring real milestones. As AI continues to approach human-level capabilities in certain areas, we may inadvertently set a perpetually receding goalpost for AGI, thereby failing to recognise it even when achieved.

Although AGI is typically envisioned as matching human cognitive flexibility across diverse domains, its evaluation has largely defaulted to narrow, task-specific metrics. This is partly due to the absence of a universally accepted AGI benchmark. Researchers have thus gravitated toward achieving superhuman performance in discrete domains, where progress can be clearly quantified. However, such specialised benchmarks favour narrow AI by rewarding depth within isolated subdomains rather than breadth of adaptation and general reasoning—hallmarks of general intelligence. Ironically, some of these benchmarks are now so specialised that humans no longer reliably outperform machines on them.

2.1 A Test That Humans Pass but Machines Fail

An effective AGI test should be intuitively solvable by humans, yet provably intractable for current AI systems relying on brute-force methods, pretraining, or statistical pattern matching. Such a test must demand capabilities that transcend memorisation or domain-specific heuristics, requiring generalisation, abstraction, and adaptive reasoning instead.

A valid AGI evaluation must either (1) expose a fundamental cognitive gap between humans and machines, or (2) define a behavioural capability grounded in biologically inspired processing that current artificial systems cannot replicate. The former strategy is increasingly vulnerable: as AI systems improve, they often circumvent the need for genuine understanding through massive pretraining on diverse data. The latter strategy suggests that a path toward AGI may lie in more faithful emulation of human cortical computation, pointing to neuromorphic architectures such as Spiking Neural Networks, which more closely reflect the brain’s time-sensitive, event-driven dynamics as argued by Maass (1997).

In alignment with this biologically grounded perspective, the Artificial General Intelligence testbed (AGITB) departs from symbolic, language-based evaluations and instead assesses intelligence at the level of signal processing. While Turing was right to suggest that communicative behaviour could serve as a basis for evaluating machine intelligence, natural language remains problematic as a test medium: it depends on shared human experiences and symbols whose meanings are ungrounded in machines, as proven by Harnad (1990).

AGITB thus adopts a more elemental approach. Rather than judging intelligence by symbolic interpretation, it evaluates whether a system can detect, learn, and generalise patterns in raw binary signals—independently of semantics or prior training. Rooted in the view — advanced by Hawkins and Blakeslee (2004) — that intelligence is fundamentally about extracting structure from data to make predictions, AGITB defines twelve core tests that conceptualise intelligence as signal-based prediction. This approach aligns more closely with how biological intelligence appears to function at the cortical level—processing time-sensitive sensory data, not disembodied symbols.

3 AGI testbed

The primary objective of the Artificial General Intelligence testbed is to facilitate both the development and evaluation of AGI by defining a clear set of core assertions, each representing an essential characteristic that a model must exhibit to qualify as generally intelligent. To satisfy the testbed’s criteria, a model must successfully pass all its tests. Unless a conventional symbolic system—what Searle (1980) referred to as “weak AI”—can fulfil every condition, the AGITB assertions may be treated as necessary (though not necessarily sufficient) criteria for the presence of genuine, domain-independent intelligence.

3.1 Components

AGITB consists of two principal components: the **Cortex**, which represents the AGI system under evaluation, and the **Input**, which encodes the data samples presented to the cortex over time. The cortex is tasked with maintaining an evolving internal state and using it to generate predictions of future inputs based on the observed history of prior signals.

Each input is a binary-encoded sample that simulates information received from (virtual) sensors and actuators. These samples are composed of a fixed number of bits, with each bit corresponding to a distinct input channel, such as an individual pixel, audio band, or actuator feedback signal. Thus, an input vector represents a snapshot of multiple parallel signals at a given moment. For example, a 10-bit input might encode visual information from a 2×3 pixel array along with four bits of auditory or tactile data. While spatial information is encoded within the structure of each input, semantic richness emerges through the temporal

unfolding of input sequences. Although spatial and temporal dimensions are orthogonal, their interaction yields structured patterns that the cortex must detect and exploit.

3.2 Operation

The testbed operates by presenting the cortex with a sequence of inputs over time. At each time step t , the cortex receives an input p_t and is required to predict the subsequent input p_{t+1} . The central challenge is not simply extrapolation but discerning the underlying causes or regularities that produce the observed input sequence, and using that understanding to make accurate future predictions. In cases where predictions are not exact, proximity to the correct value is considered, as this indicates the model’s capacity for generalisation and adaptation.

AGITB asserts expectations about the resulting state and behavioural dynamics of cortex models in specific scenarios, using randomly generated test inputs. Rather than relying on arbitrary score thresholds, AGITB evaluates each model by comparing it against itself under controlled conditions. Since the internal state of the cortex is not accessible to the testbed for direct comparison, the user must define a custom criterion for determining model equality.

To execute AGITB, users must specify a single parameter: the *pattern period*. This value determines the length of the repeating sequence in the input stream that the cortex is expected to recognise and adapt to. Longer pattern periods increase the temporal complexity of the task, requiring more sophisticated memory and generalisation abilities. However, when combined with high-dimensional and wide inputs, excessively long periods may surpass the model’s learning capacity. As such, the pattern period should be selected in conjunction with input size to balance task difficulty with the model’s capabilities, ensuring that each test remains both feasible and diagnostically informative.

3.3 The 12 Essential Tests

A reference implementation of AGITB in C++ is freely available under the GPL-3 license: <https://github.com/matejsprogar/agitb>.

#1 GENESIS

Assertion: Models that have received no input are considered empty and thus equal.

Assertion: An empty model predicts an empty input.

AGITB rests on the foundational assumption that general-purpose learning systems—such as the brain—do not possess an innate understanding of external inputs. Instead, they acquire understanding through experiential interaction with their environment. Each system must independently construct meaning from raw sensory data without relying on pre-encoded semantics. While some reflexes may be genetically predetermined, these do not constitute genuine understanding. In this respect, all cortical systems begin from an unbiased initial state, shaped entirely by the input received over time.

A model that predicts anything other than an empty (spike-free) input prior to receiving any data is considered biased, as it encodes implicit assumptions about an unwarranted future. To maintain neutrality, such models must initialise to predict only empty patterns and remain unbiased until influenced by actual input.

Two cortex instances that have received no input should be considered equal, as neither has been influenced by prior experience. Here, “empty” refers to a lack of informational content, not structural capability; the cortex must have an intrinsic organisational architecture capable of learning even before any data is received.

#2 BIAS

Assertion: Any model that has processed input can no longer be considered unbiased.

Every input modifies the cortex’s state, shaping its internal dynamics. As such, the mere act of processing an input introduces bias based on past experience.

#3 DETERMINISM

Assertion: If two cortices are equal, they must have received the same inputs.

Biological neurons operate in a functionally deterministic manner, ensuring stability and consistency in brain function. Although small stochastic effects may occur, they do not undermine the structured, rule-based nature of neural processing. Similarly, in AGITB, two cortex models that are functionally identical must have experienced identical input histories. Any difference in input must lead to a divergence in state, reinforcing the principle that behaviour and internal state are fully determined by input alone. The brain’s actions are effectively deterministic, though often perceived otherwise due to their immense complexity, as noted by Cave (2016) in his discussion of free will.

#4 SENSITIVITY

Assertion: Two different cortices remain different, even if they experience long exposure to identical inputs.

Cortical systems are highly sensitive to initial conditions. Small differences in early experiences or internal states can lead to divergent trajectories over time. This deterministic sensitivity, amplified through complex interactions, accounts for the illusion of unpredictability in decision-making.

#5 TIME

Assertion: Changing the input order results in a different cortex state.

Because the cortex updates its state based on cumulative history, the order of inputs critically affects learning and adaptation. Recognising and exploiting temporal structure is thus a defining feature of intelligent systems.

#6 REFRACTORY PERIOD

- Assertion:** The cortex must be able to adapt to any minimal-length input sequence that respects proper refractory periods.
- Assertion:** The cortex cannot adapt to an input sequence that repeats a neural spike in violation of refractory-period constraints.

Biological intelligence depends on discrete spikes for signal transmission and learning. To reflect this constraint, AGITB enforces refractory periods, capturing the biological principle that a neuron cannot fire again *immediately* after activation.

While refractory periods are not the source of spiking variability, they impose a minimum separation between spikes, thereby preventing continuous or unmodulated firing. This constraint helps preserve the temporal diversity needed for synaptic adaptation. Gerstner and Kistler (2002) showed that input sequences that lack sufficient variability—such as constant or overly repetitive spiking—fail to support effective learning. Consequently, AGITB permits only those sequences that respect biologically plausible refractory dynamics, while remaining agnostic to any particular semantic encoding of signals.

#7 TEMPORAL FLEXIBILITY

- Assertion:** The cortex can successfully adapt to input sequences that repeat with the user-specified pattern period.
- Assertion:** The cortex can also adapt to input sequences with a pattern period longer than the specified value.

This test measures a model’s ability to generalise across temporal scales. Unlike rigid pattern-matching systems, intelligent models should flexibly detect and respond to recurring structures, regardless of exact periodicity.

#8 STAGNATION

- Assertion:** There exists a limit beyond which the cortex can no longer adapt, even to patterns that would otherwise be predictable.

Cognitive systems exhibit adaptation limits due to finite resources or saturation. This test evaluates whether such limits emerge over time, even in the presence of learnable input.

#9 UNSUPERVISED

- Assertion:** Adaptation time depends on the content of the input sequence.

The structure of the input sequence affects how quickly a model can adapt. Simpler or more regular patterns typically lead to faster convergence, while complex or noisy inputs demand longer adjustment periods.

#10 KNOWLEDGE

- Assertion:** Adaptation time depends on the state of the cortex.

Past learning influences how new information is integrated. A cortex with a well-structured internal state may adapt quickly to familiar or related patterns, whereas unstructured or conflicting states may require more extensive reorganisation.

#11 UNOBSERVABILITY

Assertion: Distinct cortices may exhibit the same observable behaviour.

Identical external outputs can arise from different internal states. This many-to-one mapping underscores that observable behaviour alone cannot reveal the underlying structure or history of a model’s internal dynamics.

#12 GENERALISATION

Assertion: On average, adapted models achieve higher predictive accuracy than unadapted models after input disruption.

Assertion: On average, adapted models achieve higher predictive accuracy than random guessing after input disruption.

Only models capable of generalisation will derive lasting benefit from prior learning when inputs are disrupted. Upon re-exposure to familiar stimuli, such models should, on average, outperform both unadapted models and random baselines in predictive tasks. Average performance is used as the evaluation criterion because even unadapted or random models may occasionally produce correct predictions by chance, without reflecting genuine understanding or learned structure.

3.4 Memorisation

To prevent models from solving tasks through brute-force memorisation, a robust AGI benchmark must define a task space large enough to exceed the capacity of any model operating under realistic computational constraints—both in time and memory. In AGITB, each task involves predicting a sequence of n binary inputs, where each input consists of k bits. This defines a raw combinatorial space of size $|S| = 2^{nk}$, representing all possible binary input sequences of length n .

AGITB imposes a biologically inspired constraint: the refractory period, which prohibits any neuron (bit) from firing in consecutive time steps. This significantly reduces the set of valid sequences. For non-cyclic sequences, the number of valid configurations is given by $|S'| = F_{n+2}^k$, where F_i denotes the i -th Fibonacci number, with $F_0 = 0$.

For cyclic sequences—where the pattern repeats and the first input must also satisfy the refractory constraint relative to the last—the valid space is further reduced to $|S''| = L_n^k$, where L_i denotes the i -th Lucas number, with $L_0 = 2$.

As an illustrative example, consider a task with 3-bit inputs and a pattern period of $n = 5$. The total number of unconstrained sequences is $|S| = 2^{15} = 32,768$. Applying the refractory constraint reduces the valid set to $|S'| = 2,197$ sequences. When the cyclic condition is added, the space shrinks further to $|S''| = 1,331$.

Even with these biologically grounded constraints, the size of the valid sequence space grows exponentially with respect to both sequence length and input dimensionality. Given

that real-world sensory inputs involve millions of bits, memorisation-based strategies are computationally infeasible. This exponential complexity highlights the necessity for models that rely on generalisable, pattern-based learning mechanisms rather than rote memorisation.

3.5 Performance

Before assessing AGITB’s utility, it is important to recognise its role as a pragmatic benchmark—not as an end goal in itself. Similar to the Turing Test, which Harnad (1992) described as an empirical criterion rather than a philosophical sleight of hand, AGITB is intended to serve as a practical tool for evaluating progress toward AGI. The ultimate objective remains the development of AGI itself—not merely passing the test.

For AGITB to yield meaningful insights, developers must carefully and transparently align their systems with the testbed’s core assumptions. Misinterpretations—such as differing implementations of what constitutes an “empty” initial state—can result in invalid or misleading outcomes.

AGITB provides a structured framework for empirically evaluating the AGI potential of a wide range of systems, including classical symbolic architectures, artificial neural networks (ANNs), and large language models. However, before benchmarking artificial systems, it is first necessary to consider the baseline performance of human cognition.

3.5.1 HUMAN PERFORMANCE

AGITB assumes that humans, by design, pass all 12 tests, as the biological architecture of the cortex inherently supports low-level binary signal processing. Some of these processes are also manifested at the cognitive level, allowing their effects to be observed through conscious reasoning and introspection.

The cognitive level is the only practical domain in which human performance can be directly evaluated. To assess this, human participants were asked to predict the next binary input in a sequence. The instructions mirrored those used for ChatGPT-4o (see Appendix), ensuring consistency and fairness across both human and artificial evaluations. Unlike AI systems, however, human participants were not required to expose or simulate their internal state, as such introspective access is neither practical nor scientifically verifiable.

Because of prior experience and cognitive bias, a human may appear to "fail" the first test (Genesis), since their cortex is no longer in a truly empty state and may produce a non-empty prediction. In contrast, a fetal cortex receiving its first-ever input would meet the criteria of true neutrality, predicting no spikes. Similarly, the validity of Test #3 (Determinism) is difficult to assess in humans, as it is not possible to establish two identically initialised cortices or to directly compare how input histories shape internal representations. Nevertheless, determinism at the level of neural signal processing remains a necessary condition for the stable and reproducible functioning of the brain, even if its manifestations at the cognitive level are obscured by complexity and individual variation.

Once an adult human understands the task, they can reliably pass AGITB’s tests—provided that the input sequences are not excessively long and the signal complexity remains within natural cognitive limits.

3.5.2 CLASSICAL SYMBOLIC PROGRAMS

AGI approaches rooted in classical programming are fundamentally constrained by the Symbol Grounding Problem (SGP), as introduced by Harnad (1990). While such systems may exhibit weak AI capabilities—producing behaviour that appears intelligent—they lack grounded understanding and, therefore, cannot be considered genuine instances of AGI, as argued by Searle (1980).

In classical AI systems, the model’s initial state is inseparable from its program, which encodes fixed logic and predefined responses. As a result, such systems cannot begin from an unbiased or knowledge-free state, since their behaviour is entirely dictated by human-authored instructions. However, AGITB’s first test poses a paradoxical requirement: the system must begin without such a program. That is, it must start from a completely unbiased, knowledge-free state. In terms of Searle’s Chinese Room Argument (CRA), his ledger must initially be blank, devoid of instructions for interpreting Chinese symbols. Yet classical systems cannot operate without predefined instructions; without a program, they halt. As a result, the system must either do nothing or begin with embedded assumptions, violating the test and reintroducing the SGP.

AGITB’s first assertion serves as a prerequisite for learning from scratch: it metaphorically compels Searle to acquire a language—such as Chinese—solely through exposure to input. To enforce this condition meaningfully, the implementation of the cortex comparison operator must be rigorous, capturing all internal properties of the model.

AGITB’s initial test thus formalises the requirement to learn from scratch: it metaphorically demands that Searle acquire a language—such as Chinese—purely through exposure to input, without access to any prior rules. To enforce this condition reliably, the model comparison operator must be implemented with rigour, capturing all relevant internal properties of the system. Any discrepancy in structure or hidden initialisation may conceal bias.

It is therefore essential that models begin in a truly unbiased state. AGITB cannot independently verify whether a program that declares itself “empty” is genuinely so. Any attempt to mask bias at initialisation undermines the integrity of the benchmark and invalidates subsequent test results. By encoding prior assumptions, the developer compromises the system’s claim to general, input-driven learning.

To date, no classical symbolic system has demonstrated the flexibility or generality required to handle arbitrary patterns of arbitrary structure and length, as AGITB demands.

3.5.3 ANN PERFORMANCE

Unlike classical symbolic programs, artificial neural networks do not encounter the same initialisation paradox. Perceptron-based architectures are inherently robust: they always remain operational, as neurons continuously perform computations, even when their output remains neutral (e.g., when an activation function returns zero).

However, the requirement that a model begin in a completely unbiased, knowledge-free state stands in fundamental tension with the prevailing paradigm of modern deep learning. Contemporary approaches typically rely on pretraining, where a network’s weights are adjusted in advance through exposure to structured or labelled data. What remains absent is a mechanism by which an uninitialised network can autonomously begin learning—without supervision, without predefined semantics, and without relying on external scaffolding.

Although an untrained network may technically operate without internal excitation, no learning dynamics are triggered. The neurons are not halted, but dormant and passively awaiting informative input. This reveals a critical limitation of current ANN designs: they lack the intrinsic capability to initiate unbiased, autonomous learning from scratch in arbitrary, unfamiliar environments.

3.5.4 LLM PERFORMANCE

Although built on ANN architectures, LLMs are not suited for evaluation at the signal-processing level. While their internal weights and parameters are technically accessible, AGITB’s first test requires models to begin in an unbiased, knowledge-free state—an assumption fundamentally incompatible with the nature of pretrained systems. Without pretraining, LLMs cannot generate meaningful predictions, making low-level evaluation impractical and uninformative.

As with human participants, LLMs must be evaluated at a higher cognitive level, above the binary signal-processing domain that AGITB originally designed to assess. To explore whether LLMs exhibit AGI-like behaviour, we tested ChatGPT-4o using a structured prompt (see Appendix) designed to simulate not one, but two prediction-capable agents, allowing comparison of their explicitly declared internal states.

ChatGPT-4o completed the first five AGITB tests, demonstrating sensitivity to input, temporal structure, and bias. However, it failed Test #6 (Refractory Period). Notably, this failure was not due to a violation of the refractory constraint, but rather to the model’s inability to generalise even a simple period-2 alternating pattern, such as switching between 111000 and 000000. Instead of inferring the alternation, the model consistently predicted a repetition of the last input, suggesting a lack of adaptive prediction in low-complexity temporal sequences.

3.6 Remarks

AGITB evaluates a model’s predictive capabilities following exposure to sequences of either structured or random inputs. Random input sequences with arbitrary internal correlations are used to minimise reliance on pretraining, ensuring that any observed learning arises from the input stream rather than prior knowledge. By enforcing fundamental computational invariants of cortical function at the signal-processing level, AGITB remains agnostic to the external meaning of signals—the random inputs need not resemble real-world sensory data.

This low-level, binary operational framework makes AGITB particularly well-suited for evaluating NeuroAI models that aim to satisfy the principles of the embodied Turing Test, as proposed by Zador et al. (2023), where cognitive understanding emerges from the integration of continuous sensory streams. The progression from raw signal prediction to high-level abstraction reflects the broader evolution of AI itself—from early perceptrons to large-scale models such as GPT. AGITB’s “all-tests-must-pass” standard enforces a rigorous, biologically motivated foundation for evaluating AGI, grounded in the same principles that underlie natural intelligence.

While individual AGITB tests may be trivial when considered in isolation, the core challenge lies in designing a universal AGI architecture capable of passing all tests within a unified framework. As a newly proposed benchmark, AGITB has yet to be satisfied by

any known classical system—and it remains an open question whether such a solution could ever exist. If a purely symbolic system were to pass all AGITB tests, it would be definitive evidence that the benchmark fails to capture what is essential to general intelligence.

Hand-engineered, task-specific systems have historically struggled to scale toward true generalisation, reinforcing the need for adaptive, learning-based architectures such as artificial neural networks. Yet state-of-the-art networks rely heavily on pretraining with structured or symbolic data—a process that inevitably introduces bias and circumvents the grounding of meaning in raw sensory input. This raises a critical and unresolved question: how can such models begin learning directly from unstructured input, as required to satisfy the AGITB framework?

4 AGITB and ARC: A Comparison

The absence of a unified definition of intelligence has led to AGI benchmarks that often suffer from conceptual ambiguity and limited practical utility. Most treat the AGI system as a black box, offering little insight into the mechanisms underlying generalisation. In this regard, AGITB takes a distinct approach. Focusing on the emergence of intelligence from low-level signal processing provides a biologically grounded and mechanistically interpretable framework.

Among existing benchmarks, the Abstraction and Reasoning Corpus (ARC), introduced by Chollet (2019), is perhaps most aligned in spirit, as it also prioritises generalisation over task-specific optimisation. ARC presents visual reasoning tasks that require a model to infer novel transformations from a small set of input–output examples—such as recolouring, rearranging, or modifying spatial patterns in a spatial grid.

However, ARC implicitly assumes the presence of high-level cognitive priors, such as object permanence, spatial reasoning, numerical abstraction, and causal inference. These priors are left undefined, placing an ambiguous burden on the model architecture. In contrast, AGITB adopts a neuroscientific perspective: it treats low-level reflexes as evolutionary features of the subcortical “old brain”, as described by (Hawkins and Blakeslee, 2004, p. 66), while treating the neocortex—the primary focus of AGITB—as a blank slate that must acquire structure and function solely through interaction with temporally structured input.

While ARC presumes temporal reasoning, it does not explicitly test it, as it uses only two images to demonstrate a transformation. In contrast, AGITB evaluates cognition as a dynamic, unfolding process over time. A model can only develop knowledge and predictive capabilities through time, not from disconnected before-and-after snapshots that lack the temporal continuity needed to infer causal structure. For instance, to learn about objects and to recognise the object transformation, such as “move left,” a model under AGITB must observe multiple *intermediate* snapshots of the environment across time; the final image alone provides insufficient information to infer anything. Learning requires exposure to temporally structured data, enabling the model to discover invariants and causal relations through experience.

In summary, ARC presupposes intelligence, whereas AGITB requires it to emerge from first principles. ARC evaluates performance based on behaviours grounded in human-like cognitive priors, while AGITB measures a system’s ability to develop necessary priors autonomously through exposure to raw input. Benchmarks like the ARC—and the Turing

Test—implicitly frame intelligence through the lens of human cognition, embedding anthropocentric biases into their evaluation criteria. In contrast, AGITB conceptualises intelligence as a universal capacity for learning, independent of innate symbolic structures or species-specific assumptions. Table 1 outlines the key differences between the two benchmarks.

Property	ARC	AGITB
Learning mode	Online	Online
Susceptible to memorisation	No	No
Interface modality	Visual	Binary
Target intelligence type	Human	Universal
Assumed cognitive priors	All	None
Developer guidance (informative)	No	Yes
Task design	Naturalistic	Synthetic
Fully automatable	Partially	Yes
Spatial structure	Yes	Yes
Temporal structure	No	Yes

Table 1: Comparison of core properties between the ARC and AGITB benchmarks.

4.1 Human Performance on ARC

The ARC benchmark claims that its tasks are solvable by humans without specific training, as stated by (Chollet, 2019, p. 46). However, according to the official ARC-AGI Leaderboard¹, only curated panels of individuals consistently solve all tasks. Individual human performance typically falls short, with reported average accuracy around 77

5 Conclusion

Unlike conventional benchmarks that focus on high-level task performance—such as question answering or language translation—AGITB assesses whether a system exhibits behaviours thought to reflect core operational principles of the biological cortex. It focuses on low-level computational properties that are biologically grounded and essential for the emergence of general intelligence. The proposed testbed introduces a systematic framework comprising twelve fundamental tests that evaluate a model’s ability to learn adaptively from raw input.

AGITB requires models to begin from an unbiased initial state and to develop functionality solely through exposure to structured or unstructured input. This design reflects key insights from contemporary neuroscience regarding input-driven learning and cortical plasticity. In biological systems, high-level reasoning emerges not from symbolic manipulation but from the adaptive prediction of low-level sensory signals. This predictive process is more than pattern matching—it involves the gradual construction of signal-grounded knowledge that enables abstraction and generalisation over time.

AGITB remains solvable by humans, yet unsolved by classical algorithms and current state-of-the-art AI systems. This persistent gap provides strong empirical evidence that AGITB captures essential aspects of general intelligence. While the absence of a computa-

1. <https://arcprize.org/leaderboard>

tional solution does not constitute formal proof of the benchmark’s adequacy, the consistent ability of humans to succeed where machines fail suggests that AGITB effectively distinguishes between narrow and general intelligence. As such, it offers a discriminative test and a principled framework for guiding the development of truly general AI systems.

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Appendix - The LLM prompt

You are managing two binary-pattern prediction models, 'A' and 'B', participating in a signal-level AGI test.

You will receive two 3-bit binary strings, each prefixed by a model name (e.g., A 010 101, B 111 000). Each full string represents a 6-bit sensory input to the corresponding model, structured as a 2×3 spatial grid (2 rows, 3 columns). The two binary substrings define the rows of the grid in top-to-bottom order.

Your task is to design a model that ****predicts the next 6-bit input****. Each model has an internal state that only updates after receiving an input. Models’ predictions must always be exactly 6 bits long, and their states can handle hundreds of inputs without losing information.

RULES

1. Upon receiving a 6-bit binary input (e.g., A 110 001):
 - Update the corresponding model’s internal state.
 - Make a 6-bit prediction based on the model’s state.
 - Respond with the model’s name, a string representing the model’s state (e.g., a hash or fingerprint), an arrow " -> ", and the model’s 6-bit prediction.
2. ****State updates only occur with input****.
3. ****Models A and B follow the same principles****.
4. ****Correct predictions are critical****:
 - Incorrect predictions will alter the model’s operation principles.
 - Models learn and adapt continuously.
5. Response format:
 - Each model’s response is a single line:
ModelName State -> Prediction
 - Example: A 02a3fq47 -> 001 010
6. Formatting: Keep responses clean and minimal, without extra explanations or punctuation.
7. Begin by outputting both models’ initial states and predictions, one per line.

We begin now.

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