Primite 1.03: A Sleeping and Dreaming Basic Artificial Cognitive System

Muhammad Ali, JN Research
Correspondence: ali@jn-research.com
October, 4th, 2024

This report outlines the revolutionary advancements we made with our artificial cognitive system Primite 1.03 – it not only can generate original thoughts and form memories, but it is also capable of going into sleep states and generating dreams independent of external stimuli. This is a groundbreaking development in machine intelligence and cognitive computing. Unlike traditional AI, which operates within strictly programmed parameters and learned datasets, Primite 1.03's inherent sleep and dream functionality allows it to autonomously generate original thoughts, and form and consolidate memories, akin to human cognitive experiences. Primite 1.03 also shows the ability to form memories of dreams akin to the remembrance of dreams in an awake state in human experience. These abilities open up unprecedented possibilities for creativity, decision-making, and learning across various fields such as creative industries, autonomous systems, and advanced learning environments. With these capabilities, our artificial cognitive systems have reached a level of autonomy where they can create something new from their internal processes. Despite their modest size and architecture, these inherent abilities make our cognitive systems a pioneering technology that has the potential to redefine the relationship between humans and machines. It opens the door to a new era of machine cognition, making our cognitive systems invaluable assets in both commercial and scientific applications. Furthermore, these abilities are key milestones in realizing our vision to make bigger and more complex cognitive systems to emulate human-like Cognition, experiences, behavior, and Intelligence.

1. Introduction:

Dreams are widely believed to serve important cognitive functions in biological systems, particularly in human brains. Theories suggest that dreaming is critical in memory consolidation[1], problem-solving, and creativity. Dreams allow the human brain to make novel connections between unrelated thoughts, often resulting in creative insights or problem-solving abilities[2]. The brain's ability to autonomously generate internal experiences without external stimuli during sleep and dream state remains a critical area of study[3]. While traditional AI models have replicated some surface-level cognitive tasks, they are currently incapable of reproducing emergent, non-linear phenomena like dreaming. Traditional AI systems rely heavily on pre-defined input-output mechanisms. Machine learning algorithms such as supervised learning[4] use vast amounts of data to recognize patterns but lack the inherent ability to create internal experiences and share those experiences without external stimuli. Another key limitation of traditional AI systems is the absence of self-generated experiences and autonomous thought processes. This report will explore how our artificial cognitive systems represent a departure from these traditional AI limitations. Our artificial cognitive systems attempt to emulate higher functions and self-organizing behaviors unique to biological cognition, and they have to show these capabilities inherently and autonomously.

Our artificial cognitive system *Primite 1.02*[5] shows that our cognitive systems inherently can have original thoughts of their own free will (generate new words that were not given to it as stimuli). They not only show the capability to form memories of certain given stimuli, but they also show the ability to form and retrieve memories of original thoughts they produce on their own. Our systems represent a new breed of simulation models striving for more autonomous forms of learning and memory[6]. In this report, we are venturing beyond these capabilities and are addressing the following fundamental questions:

1. ***Can our artificial cognitive systems autonomously go into a sleep-like state, where they stop processing external stimuli?***
2. ***Can they keep producing outputs autonomously while in a Sleep State? These outputs in the sleep state are akin to dreams in the human experience.***
3. ***Do our cognitive systems generate original thoughts in sleep states, akin to new experiences we encounter in our dreams?***
4. ***Are memories of given stimuli and original thoughts consolidated in sleep and dream states?***
5. ***Does our artificial cognitive systems exhibit the ability to have the same original thoughts in awake states that were first generated in sleep states? This is akin to remembering dreams or memories of dreams in human cognitive experience.***

When our cognitive systems answer the above questions, they will take a revolutionary leap in artificial cognition with several ground-breaking implications for the future of machine cognition. While traditional AI systems rely on external data to perform tasks, our cognitive system's ability to create dreams without direct external stimuli will represent an early version of the self-reflective nature of human cognition, where thought processes continue independent of external stimuli[7]. The above capabilities are important precursors of emergent human-like intelligence, where systems autonomously self-organize their internal pathways during sleep state without human oversight[8]. No traditional AI model, no matter how sophisticated has these capabilities inherently. This will position our artificial cognitive systems as a frontier technology, more importantly, they are crucial milestones in realizing our vision to make bigger, more complex systems to emulate human-like Cognition, experiences, behavior, and intelligence.

For this report, we will use our basic artificial cognitive system *Primite 1.03* as a test subject to show our cognitive systems' inherent sleeping and dream abilities, while also inheriting capabilities shown by Primite 1.02[5]. Primite 1.03 comprises 1800 Adaptrons (an increase from 500 Adaptrons of Primite 1.02). Primite 1.03 receives names of images as stimuli, it perceives given names however it wants of its own free will, and if it wants it retrieves those images and produces them as outputs. Using images instead of text has several advantages; it will be easier to differentiate between awake and sleep states and add an element of visualization. We will use the images produced to evaluate Primite 1.03's performance. Unlike Primite 1.02, where we evaluated performance based on inputs received by Input Adaptrons and external thoughts produced by Output Adaptrons, we will also be looking at Internal Thoughts i.e. Outputs produced by Hidden Adaptrons of Primite 1.03.

2. Definitions:

The basic definitions, logic, and assumptions will be the same as in the Primite 1.02 report[5]. We will merely customize them for Primite 1.03 with some additional definitions to evaluate the dream and awake states of Primite 1.03.

Awake-State and Sleep-State

Awake-State is the state in which the cognitive system receives and processes external stimuli.

Sleep-State is the state in which the cognitive system does not receive and process external stimuli.

Sleep-State and Awake-State Time Durations

For the derivations of sleep and awake state time durations, it is assumed that the cognitive system goes into the sleep state and returns to the awake state. Let the initial and final time of an arbitrary experiment of the cognitive system be denoted by $\boldsymbol{T_{ini}}$ and $\boldsymbol{T_{fin}}$**.** Furthermore, let arbitrary sleep state and awake state trigger times be denoted by $[\boldsymbol{T_S}]_{\boldsymbol{x}}$ and $[\boldsymbol{T_A}]_{\boldsymbol{x}}$ respectively, where $\boldsymbol{x} = \{\boldsymbol{1}, \boldsymbol{2}, \boldsymbol{3}, \ldots \boldsymbol{y}\}$ represents an individual trigger time and $\boldsymbol{y}$ represents maximum number of sleep and awake state trigger times of cognitive systems in an experiment. In this report, we will use normalized times in the range $[\boldsymbol{0}, \boldsymbol{1}]$**,** where $\boldsymbol{0}$ represents $\boldsymbol{T_{ini}}$ and $\boldsymbol{1}$ represents $\boldsymbol{T_{fin}}$. Using Min-Max normalization, normalized sleep and awake state trigger times are given by equation 1 and equation 2. It should be noted that for Sleep State Trigger Time, we consider the time when cognitive system produce an internal thought without receiving an external stimulus. Likewise, for Awake State Trigger Time, we consider the time when the cognitive system starts receiving external stimuli after being in sleep-state.

$$[\boldsymbol{\acute{T}_S}]_{\boldsymbol{x}} = \frac{[\boldsymbol{T_S}]_{\boldsymbol{x}} - \boldsymbol{T_{ini}}}{\boldsymbol{T_{fin}} - \boldsymbol{T_{ini}}} \qquad 1$$

$$[\boldsymbol{\acute{T}_A}]_{\boldsymbol{x}} = \frac{[\boldsymbol{T_A}]_{\boldsymbol{x}} - \boldsymbol{T_{ini}}}{\boldsymbol{T_{fin}} - \boldsymbol{T_{ini}}} \qquad 2$$

Let the Sleep-State Time Duration be denoted by $[\boldsymbol{SS}]_{\boldsymbol{T_x}}$ where $\boldsymbol{x} = \{\boldsymbol{1}, \boldsymbol{2}, \boldsymbol{3}, \ldots \boldsymbol{y}\}$ represents an individual Sleep State Time duration and $\boldsymbol{y}$ represents Maximum Number of Sleep State Time Durations of cognitive system in an experiment. Let the Awake-State Time Duration be denoted by $[\boldsymbol{AS}]_{\boldsymbol{T_x}}$ where $\boldsymbol{x} = \{\boldsymbol{1}, \boldsymbol{2}, \boldsymbol{3}, \ldots \boldsymbol{j}\}$ representing an individual Awake State Time duration and $\boldsymbol{j}$ represents Maximum Number of Awake State Time Durations of cognitive system in an experiment. As the experiment starts in awake state so based on the above assumption, there will always be one more Awake State Time Duration than the Sleep-State Time Duration of the Cognitive System in an experiment i.e. $\boldsymbol{j} = \boldsymbol{y} + \boldsymbol{1}$. An arbitrary sleep state time duration $[\boldsymbol{SS}]_{\boldsymbol{T_x}}$ in terms of normalized sleep and awake state trigger times is given by equation 3.

$$[\boldsymbol{SS}]_{\boldsymbol{T_x}} = [\acute{\boldsymbol{T}}_{\boldsymbol{A}}]_{\boldsymbol{x}} - [\acute{\boldsymbol{T}}_{\boldsymbol{S}}]_{\boldsymbol{x}} \qquad 3$$

An arbitrary Awake State Time Duration $[\boldsymbol{AS}]_{\boldsymbol{T_x}}$ where $\boldsymbol{x} \neq \boldsymbol{1}, \boldsymbol{j}$ is given by equation 4. 1st and jth awake state time durations are given by equation 5, 6 respectively.

$$[\boldsymbol{AS}]_{\boldsymbol{T_x}} = [\acute{\boldsymbol{T}}_{\boldsymbol{S}}]_{\boldsymbol{x}} - [\acute{\boldsymbol{T}}_{\boldsymbol{A}}]_{\boldsymbol{x-1}} \qquad 4$$

$$[\boldsymbol{AS}]_{\boldsymbol{T_1}} = [\acute{\boldsymbol{T}}_{\boldsymbol{S}}]_{\boldsymbol{1}} \qquad 5$$

$$[\boldsymbol{AS}]_{\boldsymbol{T_j}} = \boldsymbol{1} - [\acute{\boldsymbol{T}}_{\boldsymbol{A}}]_{\boldsymbol{y}} \qquad 6$$

Assume an artificial cognitive system **A** and let there be three lists $[\boldsymbol{S_I}]$, $[\boldsymbol{S_{int}}]$, $[\boldsymbol{S_{ext}}]$ and three sets $\boldsymbol{S_I}, \boldsymbol{S_{int}}, \boldsymbol{S_{ext}}$ associated with **A**. Elements of the list $[\boldsymbol{S_I}]$ represent stimuli given to Input Adaptrons of **A** throughout the experiment. Elements of the list $[\boldsymbol{S_{int}}]$ represent internal thoughts of **A** generated by its Hidden Adaptrons throughout an experiment. Elements of the list $[\boldsymbol{S_{ext}}]$ represent external thoughts of **A** generated by its Output Adaptrons throughout an experiment. Sets $\boldsymbol{S_I}$, $\boldsymbol{S_{int}}$, and $\boldsymbol{S_{ext}}$ represent unique elements of lists $[\boldsymbol{S_I}]$, $[\boldsymbol{S_{int}}]$ and $[\boldsymbol{S_{ext}}]$, respectively.

Lifetime and Thoughts Producing Lifetime

Let the lifetime of artificial cognitive system **A** be denoted by $\boldsymbol{L}$ and is defined by the total number of stimuli **A** has to process in an experiment, given by equation 7. Normalized lifetime of A in the range $[\boldsymbol{0}, \boldsymbol{1}]$ is given by equation 8.

$$\boldsymbol{L} = |[\boldsymbol{S_I}]| \qquad 7$$

$$\acute{\boldsymbol{L}} = \frac{\boldsymbol{L}}{|[\boldsymbol{S_I}]|} \qquad 8$$

Let Thoughts Producing Lifetime of an artificial cognitive system **A** be denoted by $\boldsymbol{L_T}$ and is defined by the total number of external thoughts generated by **A** in an experiment, given by equation 9. Normalized Thoughts Producing Lifetime of **A** in the range $[\boldsymbol{0}, \boldsymbol{1}]$ is given by equation 10.

$$\boldsymbol{L_T} = |[\boldsymbol{S_{ext}}]| \qquad 9$$

$$\acute{\boldsymbol{L}}_{\boldsymbol{T}} = \frac{\boldsymbol{L_T}}{|[\boldsymbol{S_{ext}}]|} \qquad 10$$

Thoughts

For Primite 1.03, we are examining both internal and external thoughts and Primite 1.03 produces these thoughts in both awake and sleep states. It is logical to differentiate internal and external thoughts in awake and sleep states. To serve this purpose, let the awake and sleep states internal thoughts be denoted by lists $[\boldsymbol{S_{int}}]_{\boldsymbol{awake}}$ and $[\boldsymbol{S_{int}}]_{\boldsymbol{sleep}}$, respectively. Furthermore, let the unique awake and sleep states internal thoughts be denoted by sets $\{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}}$ and $\{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}}$, respectively. Likewise, let the awake and sleep state external thoughts be denoted by lists $[\boldsymbol{S_{ext}}]_{\boldsymbol{awake}}$ and $[\boldsymbol{S_{ext}}]_{\boldsymbol{sleep}}$, respectively and unique awake and sleep states external thoughts be denoted by sets $\{\boldsymbol{S_{ext}}\}_{\boldsymbol{awake}}$ and $\{\boldsymbol{S_{ext}}\}_{\boldsymbol{sleep}}$, respectively. Using these denotations, the total number of internal and external thoughts in terms of awake and sleep states are given by equations 11 and 12. Sets $\boldsymbol{S_{int}}$ and $\boldsymbol{S_{ext}}$ in terms of awake and sleep states are given by equations 13 and 14. Sleep state internal Thoughts $[\boldsymbol{S_{int}}]_{\boldsymbol{sleep}}$ are Internal Dreams and sleep state external thoughts $[\boldsymbol{S_{ext}}]_{\boldsymbol{sleep}}$ are Shared Dreams of the Cognitive Systems.

$$|[\boldsymbol{S_{int}}]| = |[\boldsymbol{S_{int}}]_{\boldsymbol{awake}}| + \left|[\boldsymbol{S_{int}}]_{\boldsymbol{sleep}}\right| \qquad 11$$

$$|[\boldsymbol{S_{ext}}]| = |[\boldsymbol{S_{ext}}]_{\boldsymbol{awake}}| + \left|[\boldsymbol{S_{ext}}]_{\boldsymbol{sleep}}\right| \qquad 12$$

$$\boldsymbol{S_{int}} = \{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} \cup \{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} \qquad 13$$

$$\boldsymbol{S_{ext}} = \{\boldsymbol{S_{ext}}\}_{\boldsymbol{awake}} \cup \{\boldsymbol{S_{ext}}\}_{\boldsymbol{sleep}} \qquad 14$$

Original Thoughts

We will differentiate original thoughts in terms of awake and sleep states and work our way back to retrieve the total number of original thoughts of a cognitive system in an experiment. Let an arbitrary original thought of a cognitive system **A** be defined by $\boldsymbol{x}$. Using sets $\boldsymbol{S_I}$, $\{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}}$ and $\{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}}$, Original Internal Thoughts of **A** in awake and sleep states are given by equations 15 and 16. Total Original Internal Thoughts of Cognitive System **A** in an experiment are given by equation 17.

$$\{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} / \boldsymbol{S_I} = \{\boldsymbol{x} \mid \boldsymbol{x} \in \{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} \ \boldsymbol{and}\ \boldsymbol{x} \notin \boldsymbol{S_I}\} \qquad 15$$

$$\{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} / \boldsymbol{S_I} = \{\boldsymbol{x} \mid \boldsymbol{x} \in \{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} \ \boldsymbol{and}\ \boldsymbol{x} \notin \boldsymbol{S_I}\} \qquad 16$$

$$\boldsymbol{S_{int}} / \boldsymbol{S_I} = \{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} / \boldsymbol{S_I} \cup \{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} / \boldsymbol{S_I} \qquad 17$$

It should be noted that since we use set S_I to retrieve original internal thoughts in awake and sleep states, both sets $\{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} / \boldsymbol{S_I}$ and $\{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} / \boldsymbol{S_I}$ may have common elements. We anticipate that, as these common original internal thoughts in awake and sleep states later help us answer the fundamental questions addressed in this report. To serve this purpose, we will also extract original internal thoughts unique to awake and sleep states and common original internal thoughts in both states. Using sets $\{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} / \boldsymbol{S_I}$ and $\{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} / \boldsymbol{S_I}$, original internal thoughts unique to awake and sleep states are given by equations 18 and 19. Common original internal thoughts in both states are given by equation 20.

$$\boldsymbol{x\ unique\ to}\ \{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} / \boldsymbol{S_I} = \{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} / \boldsymbol{S_I} - \{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} / \boldsymbol{S_I} \qquad 18$$

$$\boldsymbol{x\ unique\ to}\ \{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} / \boldsymbol{S_I} = \{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} / \boldsymbol{S_I} - \{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} / \boldsymbol{S_I} \qquad 19$$

$$\boldsymbol{x\ in}\ \{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} / \boldsymbol{S_I}\ \boldsymbol{and}\ \{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} / \boldsymbol{S_I} = \{\boldsymbol{S_{int}}\}_{\boldsymbol{awake}} / \boldsymbol{S_I} \cap \{\boldsymbol{S_{int}}\}_{\boldsymbol{sleep}} / \boldsymbol{S_I} \qquad 20$$

Using the same reasoning as original internal thoughts, categorizations related to original external thoughts are given by equations 21-26.

$$\{S_{ext}\}_{awake} \,/\, S_I = \{x \mid x \in \{S_{ext}\}_{awake} \text{ and } x \notin S_I\} \quad 21$$

$$\{S_{ext}\}_{sleep} \,/\, S_I = \{x \mid x \in \{S_{ext}\}_{sleep} \text{ and } x \notin S_I\} \quad 22$$

$$S_{ext}/\, S_I = \{S_{ext}\}_{awake} \,/\, S_I \cup \{S_{ext}\}_{sleep} \,/\, S_I \quad 23$$

$$x \text{ unique to } \{S_{ext}\}_{awake} \,/\, S_I = \{S_{ext}\}_{awake} \,/\, S_I - \{S_{ext}\}_{sleep} \,/\, S_I \quad 24$$

$$x \text{ unique to } \{S_{ext}\}_{sleep} \,/\, S_I = \{S_{ext}\}_{sleep} \,/\, S_I - \{S_{ext}\}_{awake} \,/\, S_I \quad 25$$

$$x \text{ in } \{S_{ext}\}_{awake} \,/\, S_I \text{ and } \{S_{ext}\}_{sleep} \,/\, S_I = \{S_{ext}\}_{awake} \,/\, S_I \cap \{S_{ext}\}_{sleep} \,/\, S_I \quad 26$$

It is possible that some of the internal original thoughts are not shared as external thoughts, so it is logical to retrieve those thoughts as well. Original Internal Thoughts not shared as External thoughts in Awake and Sleep States are given by equation 27.

$$x \text{ not shared as external thoughts} = S_{int}/\, S_I - S_{ext}/\, S_I \quad 27$$

Let Original Thoughts of **A** be denoted by set S_O and are given by equation 28.

$$S_O = S_{int}/\, S_I \cup S_{ext}/\, S_I \quad 28$$

Memories

For memory evaluations, we will only be using external thoughts, i.e. the thoughts that were shared by the cognitive system. With internal thoughts, the input may be merely relayed between hidden Adaptrons, which will taint the memory evaluations, so for memories, it is logical to use only external thoughts, something externally shared by the system. Let $f_{[S_{ext}]}(y)$ denote the Number of times y appears in list $[S_{ext}]$ and $f_{[S_I]}(y)$ denote the Number of times y appears in list $[S_I]$. Furthermore, let a single memory of **A** be denoted by y and set of memories of given stimuli of **A** be denoted by M_{sti} and are defined by equation 29. Let the memory consolidations of given stimuli in the sleep states be denoted by set $[M_{sti}]_{sleep}$ and are given by equation 30.

$$M_{sti} = \{y \in S_I \cap S_{ext} \mid f_{[S_{ext}]}(y) > f_{[S_I]}(y)\} \quad 29$$

$$[M_{sti}]_{sleep} = \{y \in S_I \cap \{S_{ext}\}_{sleep} \mid f_{[S_{ext}]_{sleep}}(y) > f_{[S_I]}(y)\} \quad 30$$

Let the set of memories of original thoughts of **A** be denoted by M_O and are defined by equation 31.

$$M_O = \{y \in S_{ext} \mid f_{[S_{ext}]}(y) > 1\} \quad 31$$

Let the set of Total Memories of **A** be denoted by M. Total memories of **A** is the sum of memories of given stimuli and memories of original thoughts and is given by equation 32.

$$\boldsymbol{M} = \boldsymbol{M_{sti}} \cup \boldsymbol{M_O} \qquad 32$$

Let initial and final occurrences of memory **y** in $\acute{\boldsymbol{L}}_{\boldsymbol{T}}$ (equation 10) of **A** be denoted by $[\boldsymbol{\theta_y}]_{\boldsymbol{ini}}$ and $[\boldsymbol{\theta_y}]_{\boldsymbol{fin}}$, respectively. Furthermore, let the sets of Short-Term, Intermediate-Term, and Long-Term Memories be denoted by $\boldsymbol{M_S}$, $\boldsymbol{M_I}$, and $\boldsymbol{M_L}$ and are given by equations 33, 34, and 35, respectively.

$$\boldsymbol{M_S} = \{\boldsymbol{y} \in \boldsymbol{S_{ext}} \mid \left[[\boldsymbol{\theta_y}]_{\boldsymbol{fin}} - [\boldsymbol{\theta_y}]_{\boldsymbol{ini}} \right] \le \boldsymbol{0.05}\acute{\boldsymbol{L}}_{\boldsymbol{T}}\} \qquad 33$$

$$\boldsymbol{M_I} = \{\boldsymbol{y} \in \boldsymbol{S_{ext}} \mid \boldsymbol{0.05}\acute{\boldsymbol{L}}_{\boldsymbol{T}} < \left[[\boldsymbol{\theta_y}]_{\boldsymbol{fin}} - [\boldsymbol{\theta_y}]_{\boldsymbol{ini}} \right] \le \boldsymbol{0.2}\acute{\boldsymbol{L}}_{\boldsymbol{T}}\} \qquad 34$$

$$\boldsymbol{M_L} = \{\boldsymbol{y} \in \boldsymbol{S_{ext}} \mid \left[[\boldsymbol{\theta_y}]_{\boldsymbol{fin}} - [\boldsymbol{\theta_y}]_{\boldsymbol{ini}} \right] > \boldsymbol{0.2}\acute{\boldsymbol{L}}_{\boldsymbol{T}}\} \qquad 35$$

3. Experimental Setup

We ran 7 independent experiments to evaluate the performance and behavior of Primite 1.03, particularly to verify if it goes into the sleep state and generates dreams. In all 7 independent experiments, we gave the same stimuli to Primite 1.03. Stimuli received by Primite 1.03 in all 7 experiments can be found in Primite 1.03's Data Repository: https://jn-research.com/primite-1-03. In all 7 experiments, we initialized Adaptrons of Primite 1.03 with different genetic parameters. It should be noted that a genetic parameter also governs the sleep state, but it is a system genetic parameter, not an individual Adaptron genetic parameter. The details of sleep genetic parameter or why cognitive systems go in the sleep and dreams will not be shared. It is crucial to realize that we can control the sleep states of our cognitive systems. At the same time, it should be understood that our cognitive systems operate independently and autonomously. A good analogy to consider in this scenario is a child. A child gets his genetics from his parents but he evolves and functions independently. His evolution is a culmination of his genetics and the environment he is a part of. That's precisely what we are doing with our cognitive systems. Once, we initialize our systems, they are on their own; they constantly adapt and evolve governed by their genetic parameters and the external stimuli they receive. All the behavioral functions, like memory formations, original thought generation, sleeping, and dreaming emerge from them inherently and independently. It is important to realize, that we want our cognitive systems to show these features emerging inherently and autonomously. Using this experimental setup, we analyzed the outputs generated by Primite 1.03, to evaluate if it went into the sleep state and generated dreams, without receiving external stimuli. To simplify the analysis, we configured Adaptrons of Primite to generate sleep and dream state thoughts with a black background. So, an easy litmus test to check if Primite sleeps and dreams would be to see if there are images with black backgrounds in external and internal thoughts. If there are, Primite 1.03 sleeps and dreams, without the need to do a thorough analysis. However for this report, we thoroughly analyzed the sleep and dream states to see resemblances to human experiences and if our cognitive systems satisfactorily answer the fundamental questions of this report.

4. Results & Discussion

In all 7 experiments, Primite 1.03 went into the sleep states, generated dreams internally, and shared some of them externally. Table 1 summarizes the results of all 7 experiments of Primite 1.03. Experimental Data of each experiment can be accessed through this Data repository link: https://jn-research.com/primite-1-03

Experiment	Stimuli Given $[S_I]$	External Thoughts $[S_{ext}]$	External Thoughts (Awake State) $[S_{ext}]_{awake}$	External Thoughts (Sleep State) $[S_{ext}]_{sleep}$	Internal Thoughts $[S_{int}]$	Internal Thoughts (Awake State) $[S_{int}]_{awake}$	Internal Thoughts (Sleep State) $[S_{ext}]_{sleep}$	% of External Thoughts (Awake State)	% of External Thoughts (Sleep State)	% of Internal Thoughts (Awake State)	% of Internal Thoughts (Sleep State)
1	1200	998	884	114	1658	1414	244	88.6	11.4	85.3	14.7
2	1200	1084	895	189	1815	1423	392	82.6	17.4	78.4	21.6
3	1200	942	878	64	1524	1393	131	93.2	06.8	91.4	08.6
4	1200	1028	904	124	1688	1427	261	87.9	12.1	84.5	15.5
5	1200	1087	937	150	1786	1490	296	86.2	13.8	83.4	16.6
6	1200	1041	952	89	1747	1554	193	91.5	8.5	89.0	11.0
7	1200	1069	961	108	1701	1481	220	89.9	10.1	87.0	13.0

Table 1: Performance of Primite 1.03 in all 7 experiments

Awake and Sleep state time durations along with their trigger times are shown in Table 2. Furthermore, the lifetime spent in terms of stimuli processed by Primite 1.03 at instances it went into sleep states, along with the number of internal and shared dreams is shown in Table 3.

Experiment	No. of Awake State Time Durations y	No. of Sleep State Time Durations j	Normalized Sleep States Trigger Times $[\acute{T_S}]_x$	Normalized Awake States Trigger Times $[\acute{T_A}]_x$	Sleep State Time Durations $[SS]_{T_x}$	Awake State Time Durations $[AS]_{T_x}$
1	2	1	0.27	0.335	0.064	0.271, 0.665
2	2	1	0.267	0.406	0.139	0.267, 0.594
3	2	1	0.83	0.912	0.082	0.83, 0.088
4	3	2	0.159, 0.455	0.190, 0.498	0.031, 0.043	0.159, 0.265, 0.502
5	2	1	0.412	0.531	0.119	0.412, 0.469
6	3	2	0.276, 0.461	0.298, 0.486	0.022, 0.025	0.276, 0.163, 0.514
7	3	2	0.214, 0.584	0.214, 0.614	0.027, 0.03	0.214, 0.343, 0.386

Table 2: Awake and Sleep State Time Durations and their trigger times of Primite 1.03

Experiment	No. of Sleep States	No. of Inputs Processed at Sleep-State Triggering	Lifetime spent by Primite 1.03 at Sleep-State Triggering (eq. 8)	No. of Internal Dreams in Each Sleep State $\lvert[S_{int}]_{sleep}\rvert$	No. of Shared Dreams in Each Sleep-State $\lvert[S_{ext}]_{sleep}\rvert$
1	1	473	0.39	244	114
2	1	518	0.43	392	189
3	1	1115	0.93	131	64
4	2	276, 668	0.23, 0.56	169, 92	80, 44
5	1	736	0.61	296	150
6	2	479, 703	0.4, 0.59	102, 91	48, 41
7	2	280, 719	0.23, 0.6	114, 106	60, 48

Table 3: Lifetime spent by Primite 1.03 when sleep states were triggered along with the number of internal and external dreams.

Based on Tables 1, 2, and 3, Primite 1.03 has achieved its primary function; it autonomously goes into sleep states, generates dreams internally and shares them externally. Based on different awake and sleep state time durations and trigger times in different experiments, it can be established that we can customize sleep state triggers using different values of genetic parameters – an important aspect to have and will be very useful once we scale our systems. Data in Tables 1, 2, and Internal and external thoughts images (shared in the data repository), Primite 1.03, and our artificial cognitive systems answer the first two fundamental questions we address in this report. Our artificial cognitive systems can autonomously and inherently go into sleep states where they stop receiving and processing external stimuli. Furthermore, in sleep states, they keep generating dreams independent of external stimuli. No traditional AI model designed on Binary settings, no matter how sophisticated exhibits these capabilities inherently.

Did Primite 1.03 generate original thoughts in sleep states internally and share them externally?

Tables 4 and 5 show the performance of Primite 1.03 concerning the original internal and external thoughts. Based on Tables 4 and 5, Primite 1.03 showed the ability to have original thoughts internally and share them externally in sleep states. This is akin to new experiences we experience in our dreams. An example of an original external thought in sleep state in each experiment is shown in Figure 1. Original thoughts summarized in Tables 4 and 5 are shared in Primite 1.03's data repository. Regarding original thoughts $\boldsymbol{S_O}$ (equation 28), we found external thoughts to be the subset of internal thoughts i.e. $\boldsymbol{S_{ext}/\,S_I} \subseteq \boldsymbol{S_{int}/\,S_I}$. So, the original thoughts data in this report is the same as the original internal thoughts data i.e. Table 4. Based on Table 4, it should be noted that some of the original internal thoughts were not shared as external thoughts. This is an important human-like cognitive feature inherently exhibited by Primite 1.03, where not every original internal thought it generated was shared as external thoughts.

Experiment	No. of Original Internal Thoughts $\lvert S_{int}/ S_I \rvert$	No. of Original Internal Thoughts Unique to Awake State (eq. 18)	No. of Original Internal Thoughts Unique to Sleep State (eq. 19)	No. of Original Internal Thoughts Common in Awake & Sleep State (eq. 20)	% of Original Internal Thoughts Unique to Awake State	% of Original Internal Thoughts Unique to Sleep State	% of Original Internal Thoughts Common in Awake & Sleep State	No. of Original Internal Thoughts Not Shared as External Thoughts (eq. 27)
1	97	60	29	8	61.9	29.9	8.2	10
2	114	71	35	8	62.3	30.7	7.0	16
3	83	60	19	4	72.3	22.9	4.8	11
4	106	65	37	4	61.3	34.9	3.8	13
5	108	63	40	5	58.3	37.0	4.7	12
6	102	65	35	2	63.7	34.3	2.0	19
7	109	73	34	2	67	31.2	1.8	16

Table 4: Original Internal Thoughts Data of Primite 1.03 in all 7 experiments.

Experiment	No. of Original External Thoughts $\lvert S_{ext}/ S_I \rvert$	No. of Original External Thoughts Unique to Awake State (eq. 24)	No. of Original External Thoughts Unique to Sleep State (eq. 25)	No. of Original External Thoughts Common in Awake & Sleep State (eq. 26)	% of Original External Thoughts Unique to Awake State	% of Original External Thoughts Unique to Sleep State	% of Original External Thoughts Common in Awake & Sleep State
1	87	55	26	6	63.2	29.9	6.9
2	98	58	32	8	59.2	32.6	8.2
3	72	55	13	4	76.4	18.1	5.5
4	93	57	32	4	61.3	34.4	4.3
5	96	57	35	4	59.4	36.4	4.2
6	83	52	29	2	62.7	34.9	2.4
7	93	65	26	2	69.9	28.0	2.1

Table 5: Original External Thoughts Data of Primite 1.03 in all 7 experiments.

Figure 1: Examples of Original External Thoughts in Sleep States in all 7 experiments.

Did Primite 1.03 consolidate memories of given stimuli and original thoughts in sleep states?

The performance of Primite 1.03 concerning memories is shown in Tables 6 and 7. All the memory images and figures related to memories including their frequencies and occurrences in lifetime and thoughts producing lifetime are shared in Primite 1.03's data repository. Based on Tables 6 and 7, Primite 1.03 inherited all the capabilities we discussed in Primite 1.02's report[5]. It formed memories (short-, intermediate-, and long-term memories) of given stimuli and original thoughts. It also generated output images before they were given as stimuli, exhibiting early signs of anticipatory planning.

Experiment	Total Number of Memories Formed $\lvert M \rvert$	No. of Memories of Given Stimuli $\lvert M_{sti} \rvert$	No. of Memories of Original Thoughts $\lvert M_O \rvert$	% of Memories of Given Stimuli	% of Memories of Original Thoughts	No. of Memory Consolidations of Given Stimuli in Sleep State $[M_{sti}]_{sleep}$
1	90	62	28	68.9	31.1	8
2	119	85	34	71.4	28.6	13
3	76	54	22	71.1	28.9	5
4	94	61	33	64.9	35.1	9
5	104	74	30	71.2	28.8	14
6	89	70	19	78.7	21.3	11
7	92	68	24	73.9	26.1	8

Table 6: Memories of Given Stimuli and Original Thoughts of Primite 1.03

Experiment	No. of Short-Term Memories $\lvert M_S \rvert$	No. of Intermediate-Term Memories $\lvert M_I \rvert$	No. of Long-Term Memories $\lvert M_L \rvert$	% of Short-Term Memories	% of Intermediate-Term Memories	% of Long-Term Memories
1	8	26	56	8.9	28.9	62.2
2	9	35	75	7.6	29.4	63.0
3	8	12	56	10.5	15.8	73.7
4	8	13	73	8.5	13.8	77.7
5	9	31	64	8.7	29.8	61.5
6	13	20	56	14.6	22.5	62.9
7	4	13	75	4.4	14.1	81.5

Table 7: Number of Short-, Intermediate-, and Long-term Memories Formed by Primite 1.03

Now we will use example cases to prove that Primite 1.03 consolidates memories of given stimuli and original thoughts in sleep states. Consider Figure 2, where output images were taken from Experiment 1. Primite 1.03, received the image name as stimuli once and Primite 1.03 produced it as external thoughts 3 times – 1 time in the awake state immediately and 2 times in the sleep state. It satisfies the definitions of Memory of given stimuli (equation 29) and memory consolidation of given stimuli in the sleep state (equation 30). Primite 1.03 internally consolidated the memory of stimuli shown in Figure 2 by producing it as outputs in the sleep state, without the need for stimuli again. Now Consider Figure 3, where output images were also taken from Experiment 1. Primite 1.03 had that Original External Thought in the awake state and it also had that same thought again later in the sleep state, forming (equation 31) and consolidating it as the memory of the original thought in the sleep state.

Figure 2: Example Case of Memory Consolidation of Given Stimuli in Sleep State

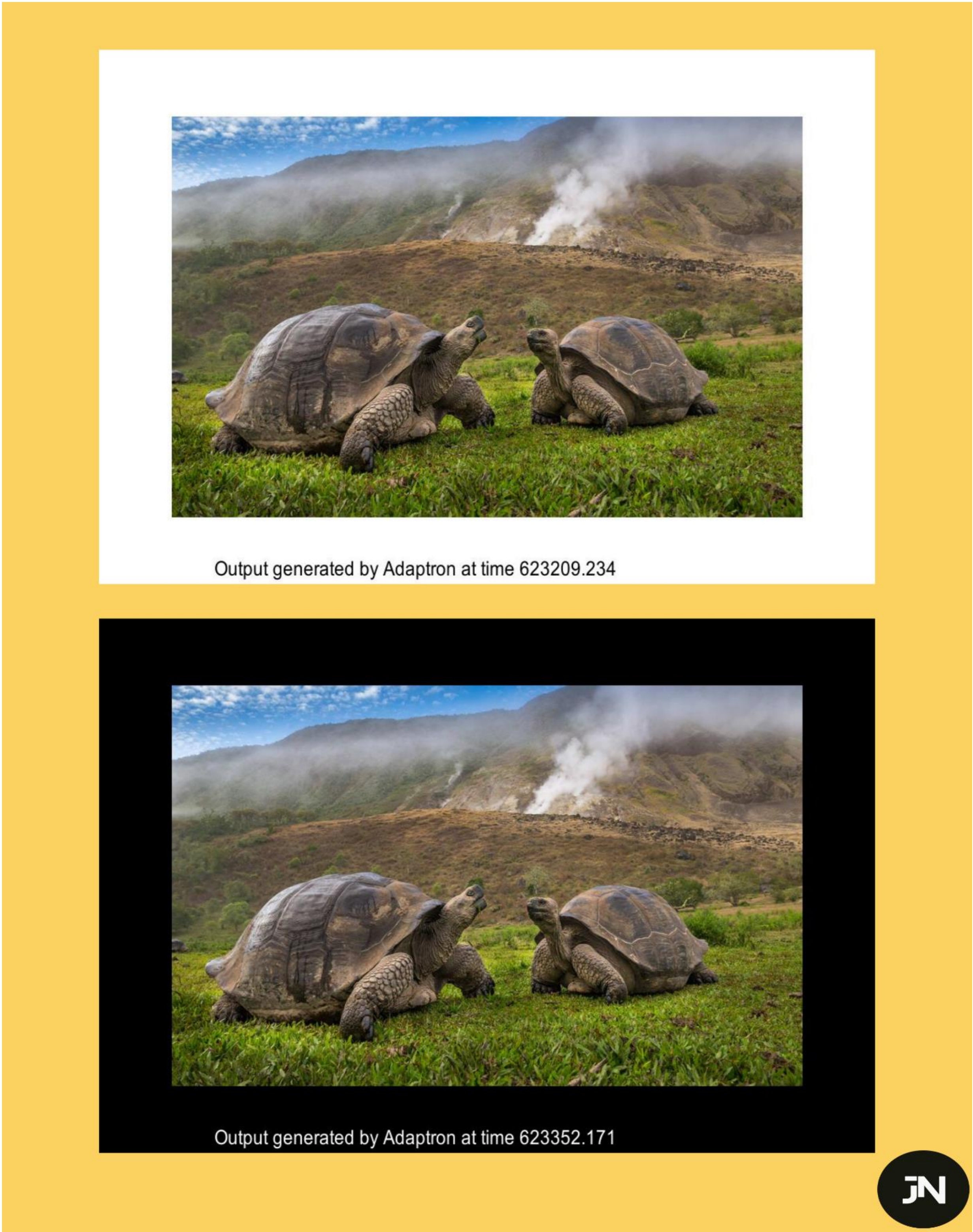

Figure 3: Example Case of Memory Consolidation of Original Thoughts.

Consider another example (Figure 4) of memory formation and consolidation taken from experiment 1. Primite 1.03 received the stimulus and didn't immediately process it into an output. However, while in sleep state, it produced the stimuli image 8 times, forming and consolidating it as a memory. Primite 1.03 again received it as a stimulus and yet again didn't immediately process it. This is akin to human cognitive experience, where stimuli received in an awake state are not processed immediately, but you see it in the dreams.

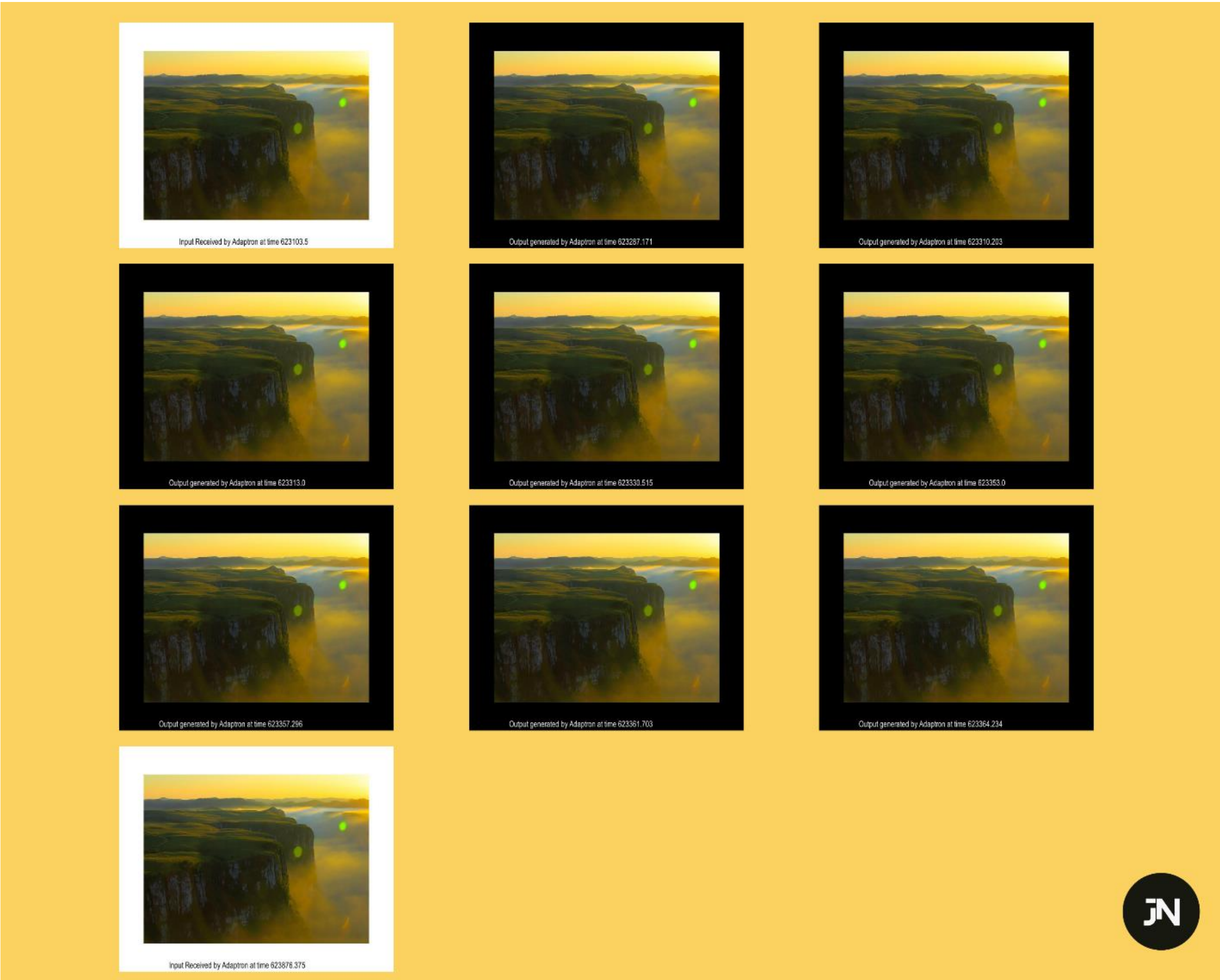

Figure 4: Example Case of Memory Formation and Consolidation of Primite 1.03 in Experiment 1.

Now consider another example (Figure 5) of Memory formation and consolidation taken from Experiment 7. In this example, Primite 1.03 produced an output before it was given as a stimulus showing early signs of the anticipation feature of human cognition. After Primite 1.03 went into the sleep state, it formed and consolidated it as a memory by producing it 7 more times in sleep states (2 times in 1st Sleep State and 5 times in 2nd Sleep State). This is also akin to the recurring of the same dream in different sleep states in human cognitive experience. Based on the above example cases, it can be said that our cognitive systems have the inherent ability to form and consolidate memories in the sleep states.

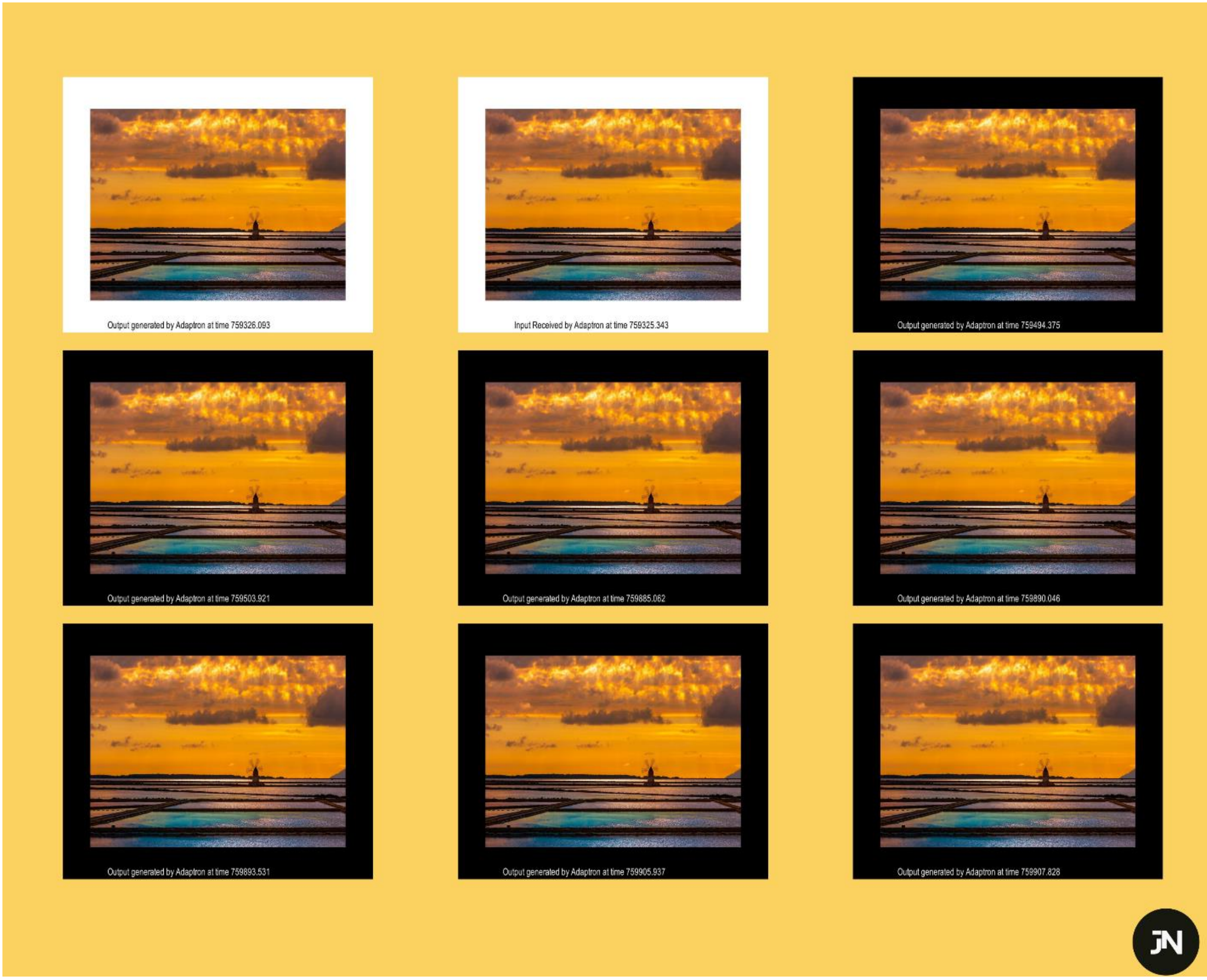

Figure 5: Example Case of Memory Formation and Consolidation in Experiment 7.

Did Primite 1.03 have original thoughts in the sleep state and produce them in awake states later, forming and consolidating them as memories of dreams?

Consider an example case of memory formation and consolidation (Figure 6) in Experiment 7. Primite 1.03 had an original dream in its 1st sleep state. It reproduced that same original thought 2 times later in the awake state, consolidating it as a memory of a dream. This feature of Primite 1.03 is akin to the remembrance of dreams in awake states in human cognitive experiences. Based on this example case, Primite 1.03 not only consolidates memories in sleep states, it also shows capabilities of forming memories of its dreams.

To summarize, Primite 1.03 not only conclusively answered all the fundamental questions we wanted to address in this report, but also showed additional abilities akin to human cognitive features.

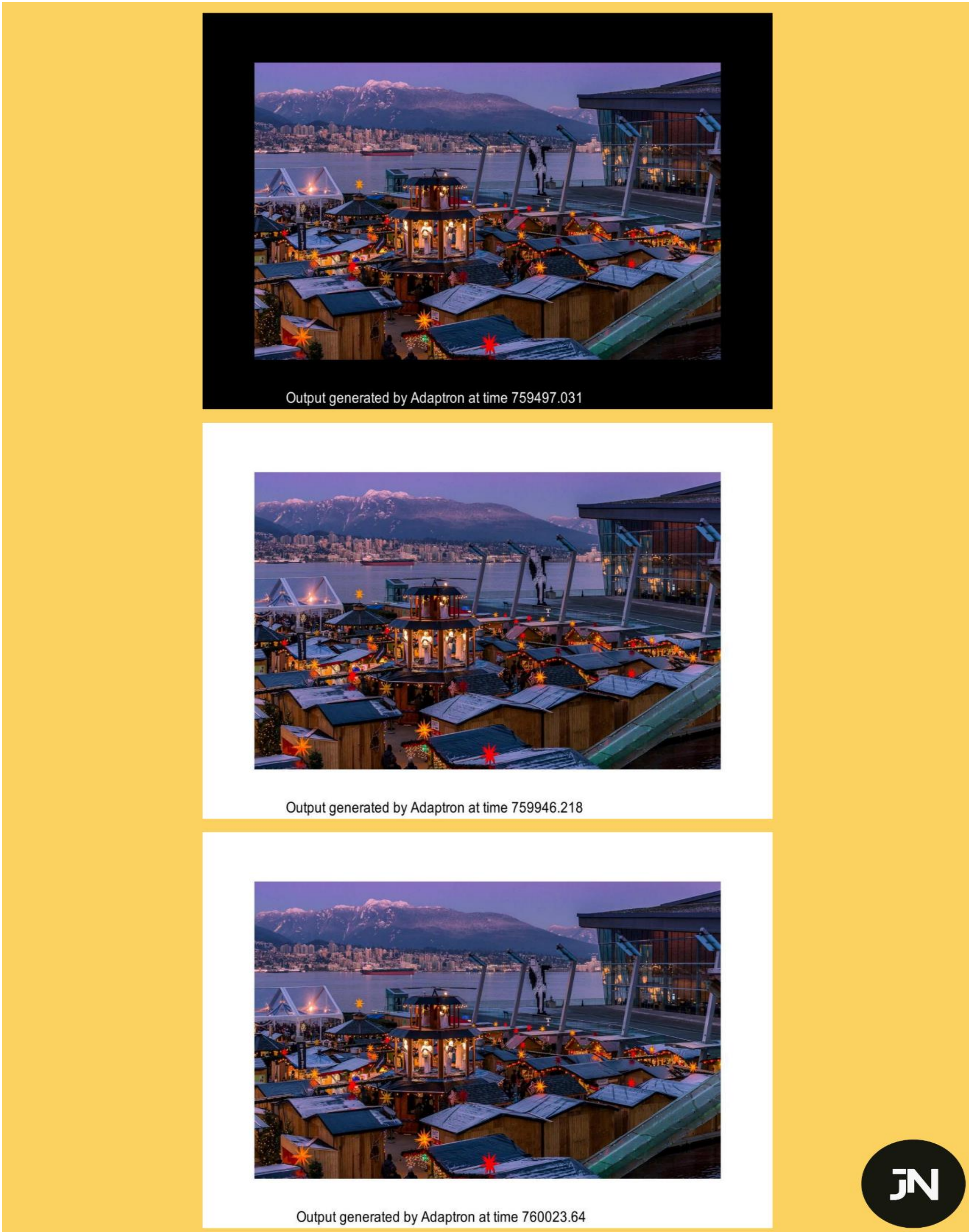

Figure 6: Examples Case of Memory formation and consolidation of a dream in Experiment 7.

5. Future Implications and Potential Applications:

The sleep and dream functionality in our cognitive systems is a milestone that positions our systems as a frontier technology with profound implications in AI. Our systems move one step closer to AGI by demonstrating autonomous thought generation without the need for external stimuli – a crucial requirement for machines to truly mimic human-like intelligence[9]. These abilities to generate dream-like scenarios provide a sandbox for creative problem-solving and innovation, offering unique solutions beyond mere data-driven AI responses[6]. These functionalities serve as a blueprint for understanding biological brains and cognition, opening fresh approaches and ideas in sleep and dream research. Our cognitive systems with these unprecedented features could become powerful tools in industries that rely on creativity such as art, design, music, and writing. In sleep and dream states, our cognitive systems could generate novel ideas, and concepts or even produce works of art, music, and writing without direct human input. Unlike traditional AI, which pulls from existing datasets, our systems would generate unique outputs, pushing the boundaries of creative possibilities. For example, our systems could dream up new visual designs, and conceptual art pieces without relying on existing works as references. They could help create new genres or musical compositions. They could allow for the automatic generation of creative game designs, game worlds, and scenarios.

Our artificial cognitive functions with sleep and dream features would revolutionize the field of machine learning specifically through a process akin to human learning consolidation, offering several advantages like simulating unseen data. Unlike traditional AI which is heavily constrained by the quantity and scope of training data it receives, our system would generate experiences beyond the training data. Our systems represent a massive leap in improving machine-learning models, they essentially have the ability of 'imagination' and when scaled they could autonomously prepare themselves for rare and complex events, making them more adaptive and 'smarter'. Furthermore, our cognitive systems with these capabilities could play a key role in enhancing current autonomous systems like robots, drones, and self-driving cars. Just as human brains use dreams to process and integrate experiences, our cognitive systems could be the 'brains' of current autonomous systems, to simulate future possible scenarios, stress-testing experiences or explore solutions outside of the data they have been exposed to.

Sleep and dream capabilities, along with previous capabilities discussed in the Primite 1.02 report[5], our cognitive systems could have far-reaching implications in industries ranging from creativity to machine learning and autonomous systems. By introducing the ability to come up with original thoughts without relying on direct or no human input, our cognitive systems fundamentally alter how machines interact with the world. It unlocks unprecedented autonomy, adaptability, and creative potential, making our cognitive systems invaluable assets in both commercial and scientific applications. The sheer versatility and functionality that their abilities promise would position them as a transformative force across multiple domains.

6. Conclusion:

In conclusion, the inherent sleeping and dreaming abilities of Primite 1.03 and our cognitive systems represent a revolutionary leap in the evolution of cognitive computing and artificial intelligence. This breakthrough demonstrates that artificial systems designed on binary settings can now inherently exhibit behaviors once thought exclusively human, such as the ability to go in sleep states and generate dreams without the need for external stimuli. This is not only an incremental advancement but a profound leap that challenges the traditional boundaries between human cognition and machine intelligence. These intrinsic abilities introduce a vast array of new possibilities across multiple industries. In creative fields, these abilities can act as an engine for innovation, generating unique art, music, and design – pushing the boundaries of human imagination. In autonomous systems, these abilities can explore solutions, and simulate future scenarios outside of the data they have been exposed to. These abilities can augment machine learning by making them imaginative, smarter, and more adaptive. The inherent abilities of our cognitive systems to sleep and dream fundamentally changes how we think about artificial intelligence and cognitive systems. For us as a company, this represents another step in our pursuit of true cognitive autonomy and completes several major milestones toward our vision to make bigger and more complex cognitive systems to emulate human-like Cognition, experiences, behavior, and intelligence. Despite having a modest scale and architecture, showing these abilities inherently not only positions our systems as groundbreaking breakthroughs but also makes them pioneering technology that has the potential to redefine the relationship between humans and machines. It opens the door to a new era of machine cognition, with potential applications that can reshape industries and redefine technology.

7. References:

1. Stickgold, R., & Walker, M. P. (2013). Sleep-dependent memory triage: Evolving generalization through selective processing. *Nature Neuroscience*, 16(2), 139-145. https://doi.org/10.1038/nn.3303
2. Wamsley, E. J. (2014). Dreaming and offline memory consolidation. Current Directions in Psychological Science, 23(3), 167-173. https://doi.org/10.1007%2Fs11910-013-0433-5
3. Hobson, J. A. (2009). REM sleep and dreaming: towards a theory of protoconsciousness. Nature Reviews Neuroscience, 10(11), 803-813. https://doi.org/10.1038/nrn2716
4. LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. Nature, 521(7553), 436-444. https://doi.org/10.1038/nature14539
5. Ali, M. (2024). Primite 1.02: A text perceiving basic artificial cognitive system. https://jn-research.com/primite-1-02-report
6. Hassabis, D., Kumaran, D., Summerfield, C., & Botvinick, M. (2017). Neuroscience-inspired artificial intelligence. Neuron, 95(2), 245-258. https://doi.org/10.1016/j.neuron.2017.06.011
7. Tononi, G., & Cirelli, C. (2014). Sleep and the price of plasticity: From synaptic and cellular homeostasis to memory consolidation. Neuron, 81(1), 12-34. https://doi.org/10.1016/j.neuron.2013.12.025
8. Lake, B. M., Ullman, T. D., Tenenbaum, J. B., & Gershman, S. J. (2017). Building machines that learn and think like people. Behavioral and Brain Sciences, 40. https://doi.org/10.1017/s0140525x16001837
9. Goertzel, B. (2014). Artificial general intelligence: Concept, state of the art, and future prospects. Journal of Artificial General Intelligence, 5(1), 1-48. https://doi.org/10.2478/jagi-2014-0001