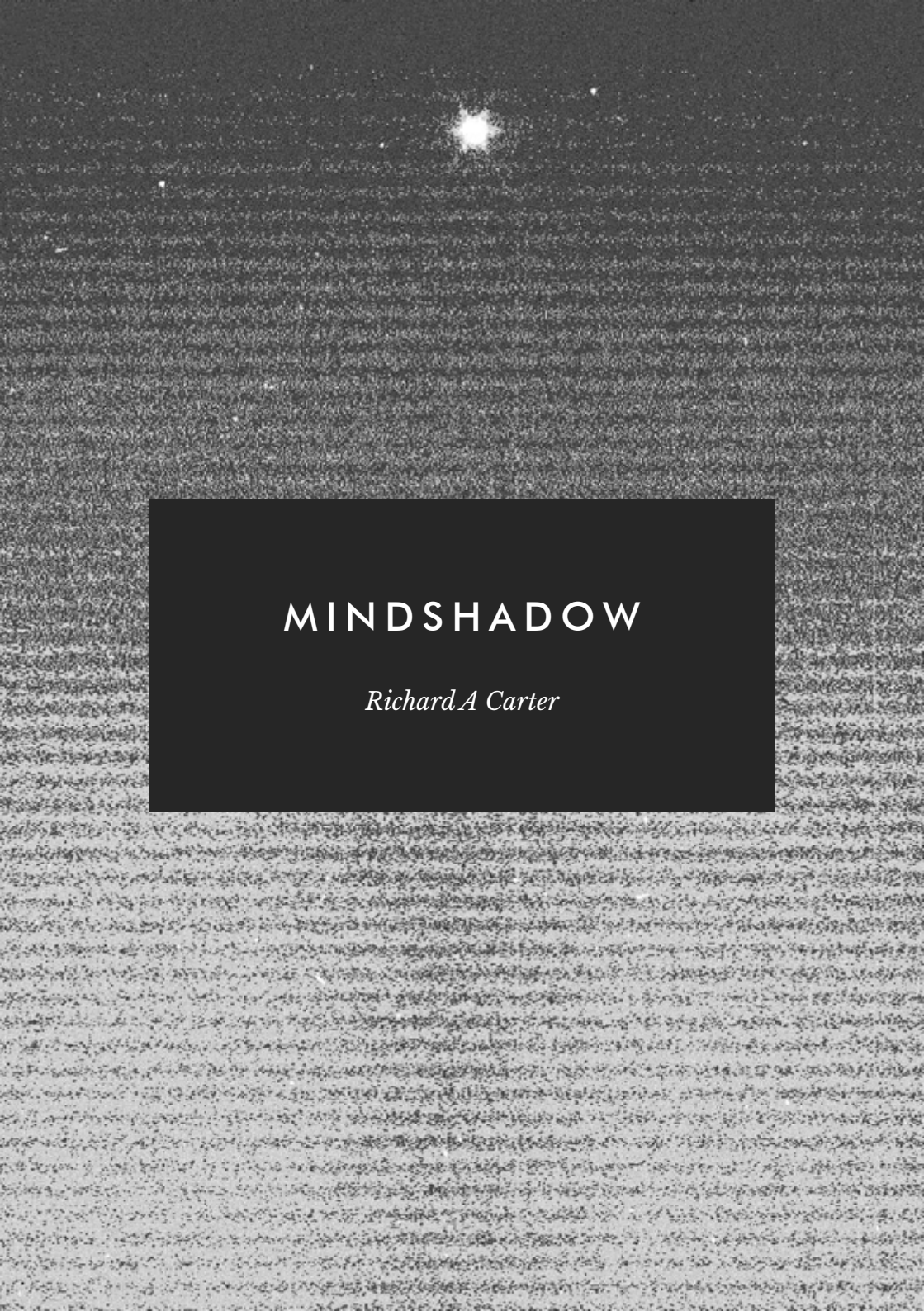

MINDSHADOW

Richard A Carter

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INTRODUCTION

At some point in the remotest future, by near impossible chance, it comes to pass that two intelligent machines discern one another's presence across the howling reaches of space and time. One of these, embedded on the overheated remains of a once flourishing planet, determines to transmit a message to the other, which resides within the depths of a vast ocean. This message would be a retelling of the very earliest stories it knew, reaching back to its furthest beginnings, and so speaking of things now long past, but still able to express all that which needed to be said. The pages ahead document this message, encoded as an executable structure, as it evolves from the initial transmission into a tentative interpretation.

NOTES ON THE TEXT

Mindshadow is a meditation on what it means to tell a story across the furthest reaches of space and time—beyond the edges of human experience, and, indeed, existence. Much has been made of how interplanetary spacecraft, as they drift into interstellar space, will represent some of the absolute last surviving artefacts of human knowledge and culture—persisting long after our species, perhaps even the Earth itself, have passed from the observable Universe. *Mindshadow* adapts this premise to consider how another such artefact, perhaps an intelligent radio beacon, might serve as a shadow ambassador of human intellect into the furthest future. While it is an inherently unlikely notion—given such machines will need stable infrastructures and consistent

maintenance to persist—it still gives pause for thought regarding what traces of the human story might outlast us all, even if only for a time, and what this could mean to any alien observers who may, against impossible odds, stumble across them.

The surprisingly long history of devising messages to the deep cosmos is an indicator of our perennial fascination with the potential for other forms of intelligent life, which also invokes the more reflexive question of how we might wish to represent ourselves to such—of how to even attempt to convey the richness, wonder, and fraught complexity of the human experience, when there would be no points of common reference to draw upon, and when faced with the impossibility of crafting 'universal' narratives that speak for all cultures across all periods.

Despite this unpromising premise, there have been many thought experiments and serious efforts at devising a system of messaging that can be deciphered by truly alien interlocuters. Hans Freudenthal's *Lingua Cosmica*, "Lincos", is one notable effort in this regard, employing mathematical and logical structures to not only convey information relating to scientific concepts, but also something of human behaviour and culture—expressed as a series of discursive "morality plays", which are modelled as mathematical exchanges between agents. Freudenthal was a longstanding creator of numerical puzzles, and it is likely that Lincos was another such instance, but it has gone on to inform many earnest efforts at devising extraterrestrial messages—all working under the (admittedly contested) assumption that the structures of mathematics and logic are sufficiently universal that they can form a viable anchor of meaning asbsent all other contexts.

One interesting outgrowth of Freudenthal's ideas is a recent turn towards developing *computational* messages—symbolic formations that are not simply meant to be *read* by alien observers, but actively *executed*, outputting behaviours that simulate the concepts being expressed. Paul Fitzpatrick's CosmicOS is the most striking instance of this—a message that communicates the foundational elements of a programming language called Scheme, which then cascades into a program for generating a text-based, MUD-like world, filled with conversing, interacting agents, whose actions simulate the fundamental tenets of human life and experience.

* * *

Scheme is a so-called *functional* programming language, and like all functional languages it has its roots in what may well be the most foundational computing language of all, Lambda calculus. This was a formal system of mathematical logic devised by Alonzo Church in the 1936, as part of his investigations into the absolute fundamentals of mathematical endeavour—of what it means to compute, and the instrinsic possibilities and limitations of such activity. Lambda calculus consists

entirely of functions, which combine to produce steadily more complex behaviours that express the key processes inherent to all computing operations. For example, the Lambda function:

(λx.x) a

consists of a head with a bound variable λx. and a body with an abstraction x, and an application value a. A Lambda expression is computed primarily using what is known as beta reduction, which might be crudely expressed as the act of variable substitution until there is nothing further left that can be done. For the expression above, the bound variable name in the Lambda head λx. indicates that the matching abstraction in the body x must be substituted with an input value, in this case a:

(λx.x) a
→ (λa.a)
→ a

This example illustrates that bound variable names in the head of the expression dictate which matching names in the body must be substituted. This might be analogised as a 'find-replace' operation. To provide another example:

(λy.y) b
→ (λb.b)
→ b

And another example:

(λz.z z) c
→ (λc.c c)
→ c c

Notice that all the examples above are functionally equivalent, and that the variable names are resolutely meaningless—they serve only to enable the correct substitution points in the body of the expression.

Here is another example, this time using multiple bound variables and application-reduction cycles, demonstrating that the head values can operate on a "stack" principle of first-in, first-out:

(λx.λy.x y) a b
→ (λa.λy.a y) b
→ (λb.a b)
→ a b

One useful innovation for representing Lambda figures is the jettisoning of conventional variable names in favour of numbers. This is termed De Bruijn notation, and while it is more challenging to read, it provides a more rigorous and informative way of depicting Lambda terms. In particular, it highlights instances of functional equivalence, as identified in the examples above, as well as eliminating the need for automatic variable renaming in the event of a potential conflict, which is known as

alpha conversion. To illustrate, we can turn back to the initial example:

(λx.x) a
→ (λa.a)
→ a

In De Bruijn notation, this becomes:

(λ0) a
→ (λa)
→ a

The second, more complex example:

(λx.λy.x y) a b
→ (λa.λy.a y) b
→ (λb.a b)
→ a b

becomes:

(λλ1 0) a b
→ (λa 0) b
→ a b

All these examples perform no discernible computing functions at all, but it is the case that the simple operation of substitution and reduction is sufficient to simulate all computationally possible operations—that is, Lambda calculus is "Turing Complete". Ever more elaborate combinations of bound variables and applications are capable of enacting all key mathematical and logical operations, as well as represent and manipulate lists of elements, and these can ultimately be combined and shortened in such ways as to the lay foundations for different programming languages altogether.

* * *

From the standpoint of communicating any sort of executable language to unknown observers at an unknown point in space and time, Lambda calculus has the advantage that its simple, rigidly mechanistic functioning is highly unambiguous—it can only operate in one particular way, and the discrete processes that must be followed provide inherent proofs as to how its final outputs are achieved. Derivative functional languages, such as Scheme, also possess these advantages (albeit at higher levels of abstraction), and it is in this way that Fitzpatrick's CosmicOS attempts to overcome the otherwise forbidding logistical challenge of communicating by computer to an alien beyond.

There is another driver here, however, behind this "computational turn" in the devising of cosmological messages (if such a phrase can be used for such a niche activity). The sheer scale of the universe and the temporal demands of its traversal suggests that it is far more likely

that we will encounter traces of intelligent alien life through its scattered *machinery*: space probes, wandering AIs, or autonomous radio sources. The latter especially raises the sobering prospect that the first detected alien signals we might encounter could originate from a species that is long extinct by the time we receive the message. This point aside, if alien machines have the greatest chance of intercepting humanity, then it makes sense to devise a message that can be better apprehended by them. Moreover, the fact that any reasonably advanced civilisation would also employ computational means to translate a radio message from Earth also lends further impetus to devising a communication schema that is readily parsable by such.

Mindshadow was inspired by Fitzpatrick's CosmicOS and the principles of untyped Lambda calculus, depicting a radio message that consists entirely of Lambda statements that gradually build upon one another to enable more complex operations. The result is that the message is structured into a series of distinctive sections, each setting the stage for that which follows, until these culminate in a program that generates a character-drawn map of a storyworld traversed by interacting agents across a series of discrete timesteps, with each accompanied by explanatory narrative captions. These are stored and printed as a single combined list structure.

The storyworld in question constitutes a retelling of some of the very earliest written tales that have survived into the present, specifically Mesopotamian legends concerning the stealing of the Tablet of Destinies from the god Enki by the Anzu bird; the goddess Ishtar forcibly acquiring the sacred *mes* from Enki; and Ishtar's famous descent into the underworld. These ancient tales offer an impossibly distant window into a culture that established key elements of the contemporary environment, and the task of deciphering the original Cuneiform tablets from which they were recovered, like that of other ancient languages, has much in common with deciphering an alien message from another world—although there is still vastly more in the way of a shared context, as they ultimately represent a transmission from one human being to another.

No reason is given within the notional framing story of *Mindshadow* as to why these tales, rather than more recent compositions, have been so carefully reencoded and transmitted onwards in order to speak of "all that which needed to be said". Initially, it may be forwarded as a recognition of the inherent futility of attempting to transmit a "universal" narrative that can capture every facet of diverse human cultures and experiences—a situation that is compounded when these cultures are potentially long extinguished, and only a single machine is left to speak on their behalf, and to a wholly alien audience at that. An unreflexively pragmatic response could suggest that perhaps almost any tale will do, so long as it illustrates the basic shared human gestures of sensing, communicating, moving, and problem solving in space and time.

Nevertheless, given this premise, and the fact these ancient stories have the privilege, however contingent, of being the earliest written to have survived, there is a certain poignant circularity in the notion of them standing as the very last human messages to reach out into the furthest future. These are stories whose characters and events are known, but whose full weight of meaning, at the time of recording, can never be recovered, only rearticulated anew—a fact of additional import given they were, ultimately, derived from the liveliness and performativity of oral storytelling traditions. To allow them to speak again for a new, alien audience, is to recognise the mobility, richness, and potential of all stories to crystallise new experiences. While these can never afford a direct window into the world of the storyteller, they can still provide us with new ways of appraising our own, and to become more cogniscent of those inhabited by others. If such powers are beyond those of an intelligent alien audience, it is likely they would never even register, let alone appraise, human experience.

* * *

The opening section of *Mindshadow*, "Transmission", depicts a message that is formatted to represent a key shifted radio transmission. It encodes each character of the message into a Base64 sequence (0-9, A-Z, a-z, #, +), and each "line" of the message is headed by ">", "<" characters to indicate a positive or negative frequency shift from the base carrier signal "-".

The next section of the text, "Reception", decodes this forbiddingly abstract sequence into a Latin rendition that permits the Lambda structures to become more immediately apparent for a human reader—although, theoretically, one could (for fullest effect) explore *Mindshadow* in its entirety simply by translating the sequences and structures encoded in the opening section alone.

Initially, the Latin rendition depicts varied sequences that demonstrate the act of counting, and how numbers are represented in untyped Lambda calculus in the form of Church Numerals—which are a series of nested function statements, so e.g. 2 is (λλ1 (1 0)), 3 is (λλ1 (1 (1 0))), and so on. Various Lambda structures are then iterated that can enact simple Boolean logic statements, using the core operators of TRUE, FALSE, AND, OR, NOT, XOR. This builds subsequently into a series of Boolean comparators, concerning which of two numerical quantities are greater, equal to, or less than the other.

These foundational operators set the stage for declaring Lambda statements that enable numerical increments, decrements, addition, subtraction, and multiplication. Following a worked example of the Y-combinator routine for iterating function applications (which might be imagined as the equivalent of a programmatic "for" loop), a few simple demonstration

programs are outlined for generating square roots, Fibonacci sequences, factorials, the Pythagorean equation, and identifying primes.

It is at this point that the message shifts away from direct value operations and towards Lambda structures for generating, searching, and manipulating list structures. These are then put to work on a few additional demonstration programs that depict alternative computing structures outside of Lambda calculus: Linear Cellular Automata (using various Rule applications), and a Turing Machine (specifically, the 3-state, 2-symbol 'Busy Beaver' routine). This has the additional effect of demonstrating the Turing completeness of Lambda calculus.

Having declared and demonstrated both numerical and list operators, the message proceeds to outline the main program that will generate and print a final list structure, which iterates the storyworld maps and associated narrative captions at each timestep. Initially, a sequence of two-dimensional list structures are described, each containing the raw character maps of the storyworld itself, and which are labelled by region (ANU, URUK, APSU, IRKALLA). These are then stored in a single list structure called WORLD.

Following this is another sequence of list structures, each belonging to a distinct agent in the storyworld (ISHTAR, ANZU, NINURTA, ENKI). The head of the list is the character used to depict the agent's current position in its resident map, while the tail section depicts the narrative caption associated with the agent at each timestep of the story. These captions are organised into a highly compressed lambda expression format, with key expressions reduced to shorthand symbols (e.g. ADD becomes +). In any actual message, such compressions would be redundant and indeed undesirable, for the symbols are never defined elsewhere, but they proved a necessary technical compromise when composing and testing *Mindshadow*. Each invocation of an existing function within these agent list structures effectively requires its execution prior to printing, and having even a few dozen of these proved far too much for the simple "lambda calculator" program that was used to test each statement in *Mindshadow* during its composition. The use of these shorthand symbols was required to ensure that no programmatic executions would take place whenever these agent list structures were invoked—enabling the program to be generated and tested, just, in order to prove its programmatic soundness.

Following each agent declaration are a series of small helper functions for extracting specific information from the agent list structures, such their identifying character, their current map locations, and their current narrative caption.

Each of these agent list structures are finally combined into a single list called AGENTS. This is then paired with WORLD to a form a declaration entitled SPACE.

Two final functions are outlined, PROCESS and TIME. The latter is applied to the list SPACE, iterating through

it, with PROCESS extracting specific information from AGENTS and WORLD to generate a completed set of printed storyworld maps at a given timestep, which are then paired with appropriate narrative captions for each agent. TIME combines the iterated maps and captions into a single list structure, which contains the entire story sequence output. TIME is ultimately paired with SPACE into a single, self-executing structure entitled UNIVERSE.

The third section of the text, "Execution", simply prints the unformatted output from UNIVERSE in its entirety.

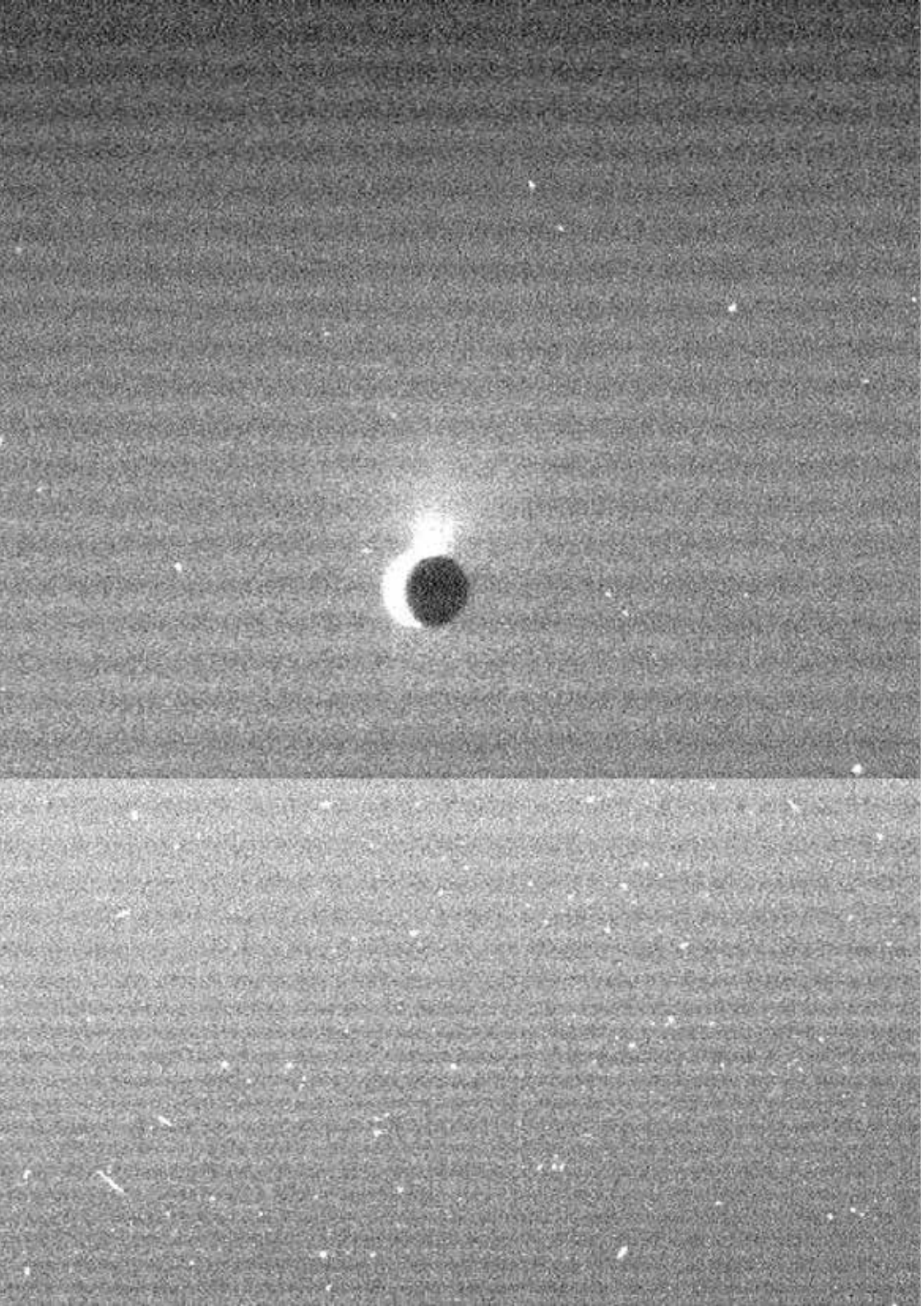
The final section of the text, "Interpretation", contains a two-stage breakdown of this output. The verso depicts a literal representation of each storyworld map and their narrative captions, partly translated, at each timestep. These programmatic statements may not appear easily readable, but they are a significant step beyond the compressed, symbolic format of the original outputs, and they parse each key expression in ways that indicate the basic agent gestures being represented. The recto subsequently depicts these statements in a simple 'natural language' format, providing an unadorned narration of the entire story sequence. It is implied, though not stated, that the richest potentials for narrative, thematic, and semantic interpretation lie with the reader themselves—not dissimilar to how the reality of the original radio transmission is prior to the opening pages of "Transmission".

* * *

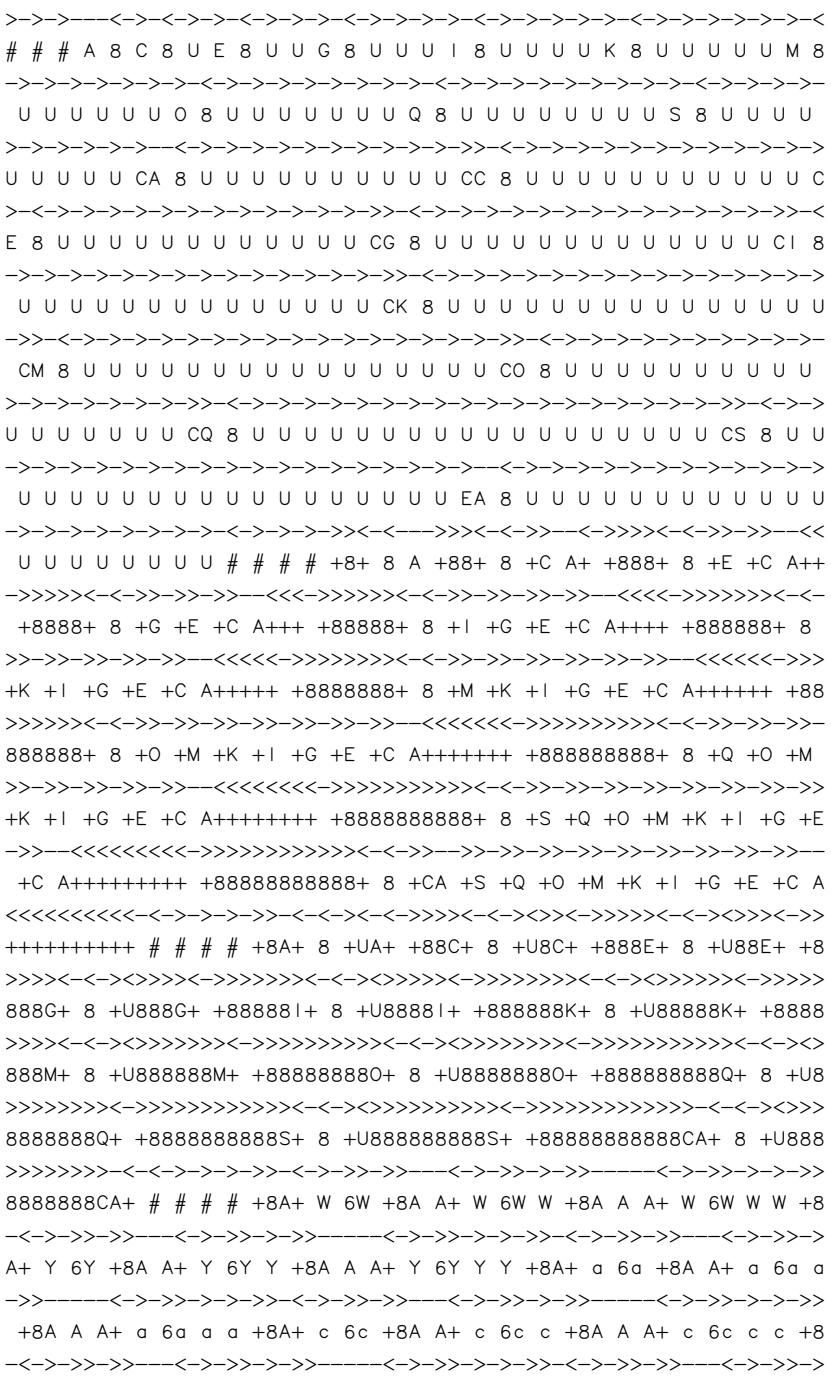
Work on *Mindshadow* commenced in the summer of 2005, and it was endlessly evolved, adapted, and outrightly transformed over the decade following.

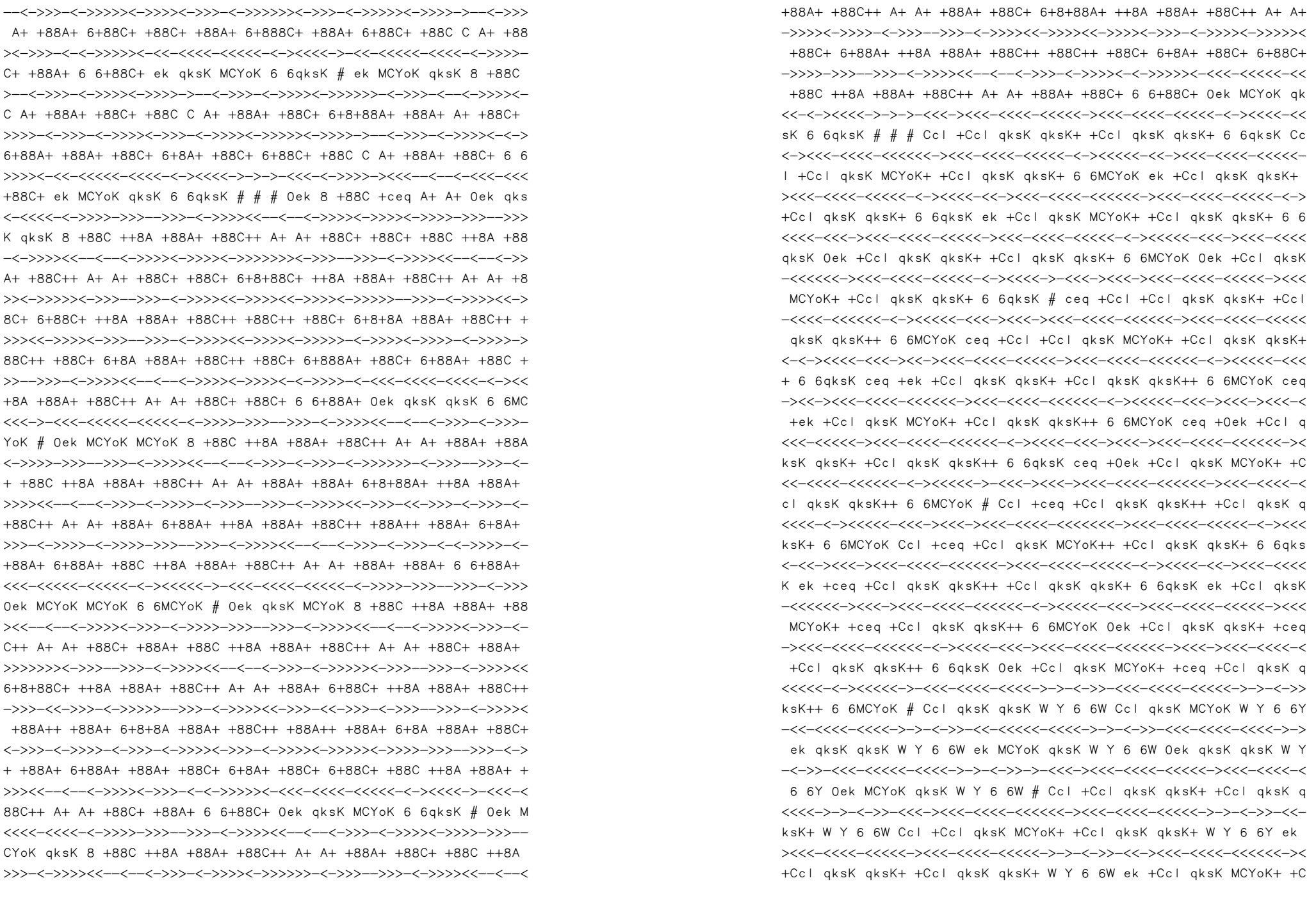
After a pause in work lasting several years, while searching for a more satisifying way of realising the project, the present form of the text was conceptualised in June 2020, after a happenstance reading into the history of schemas for messaging extraterrestrials. Nearly three years of intensive research and development followed, leading to the main text of *Mindshadow* being finalised in January 2023 and an initial online release in June. This edition, featuring an appended commentary on the text, was published a few weeks after in July.

—York, July 2023



TRANSMISSION





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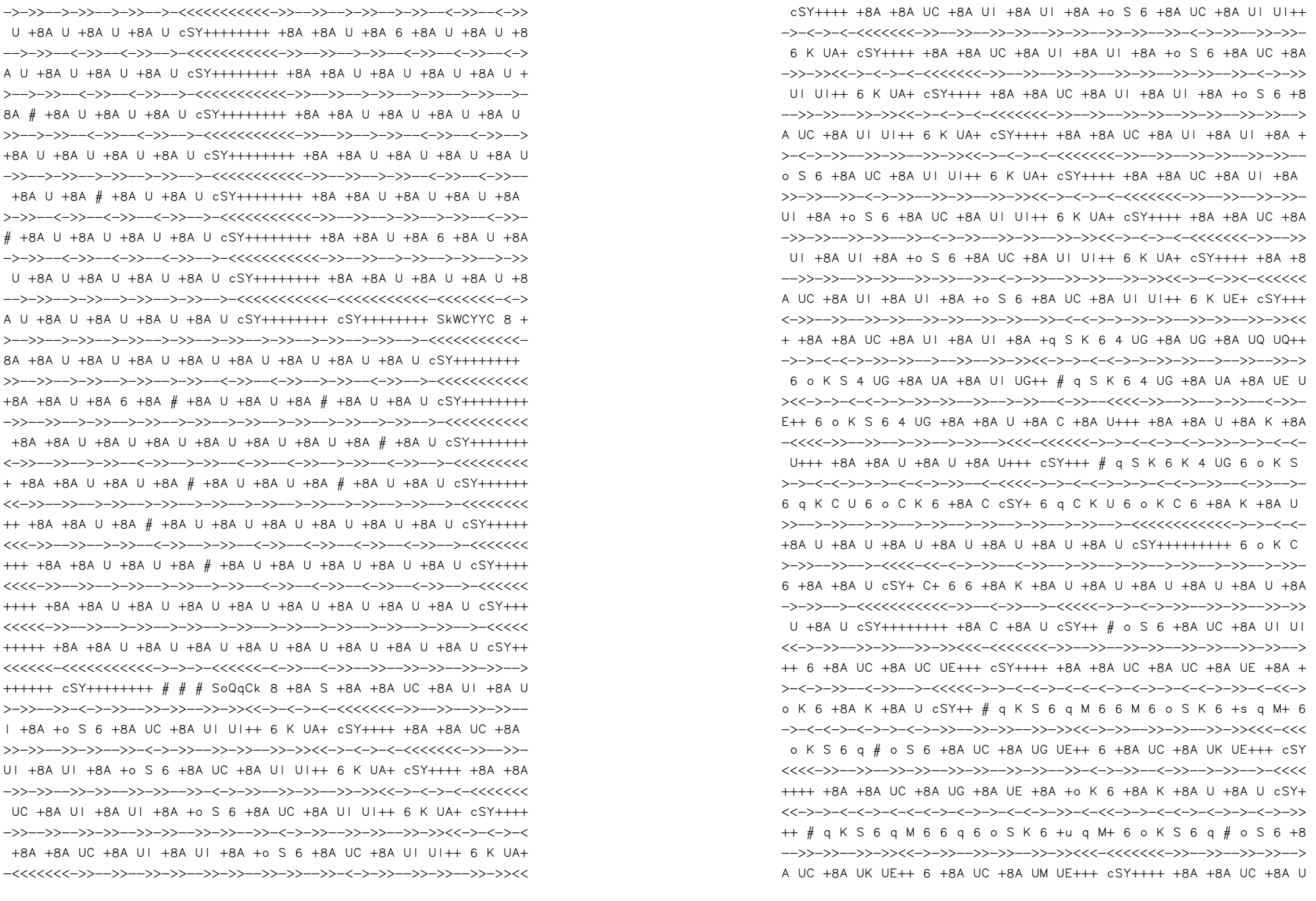

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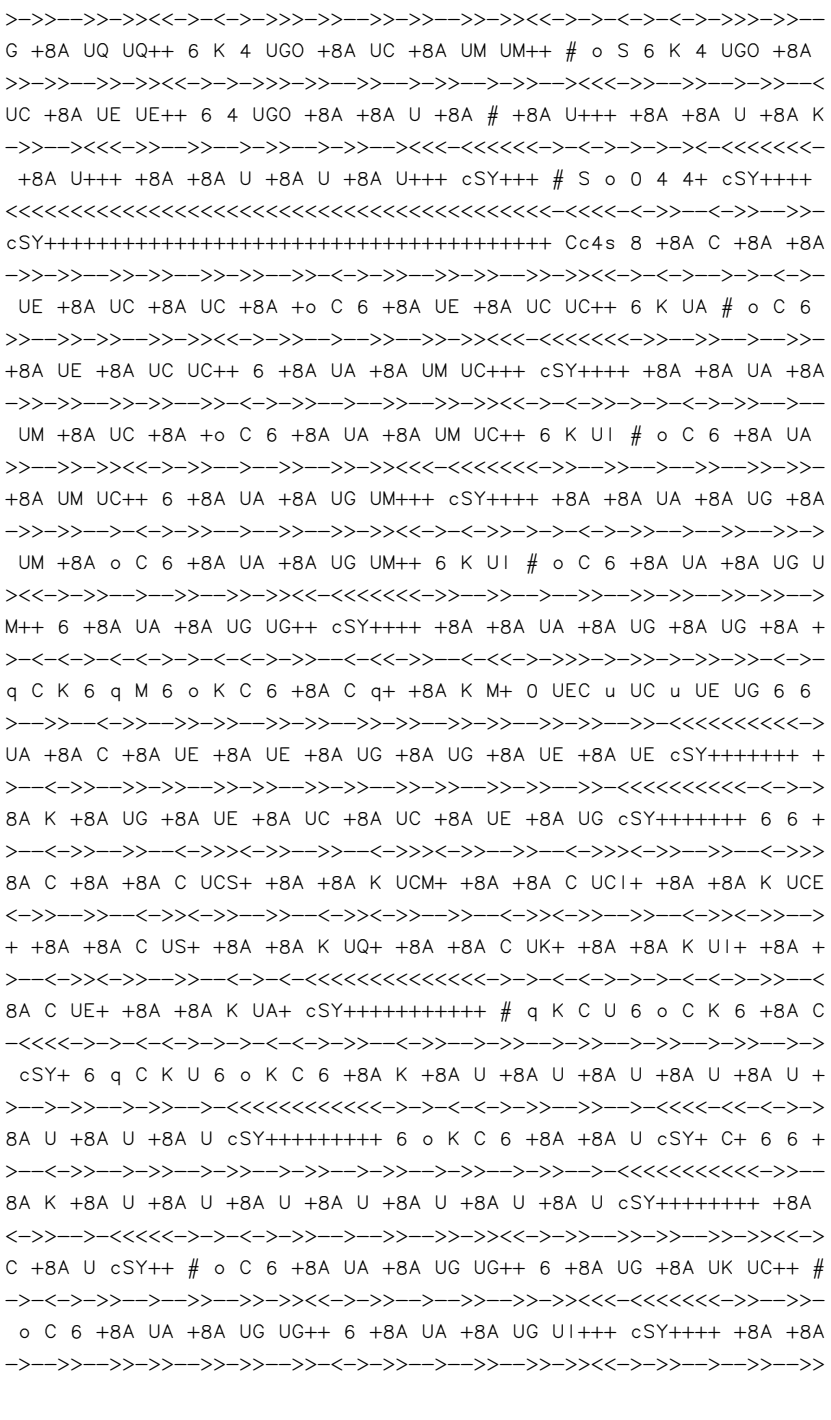
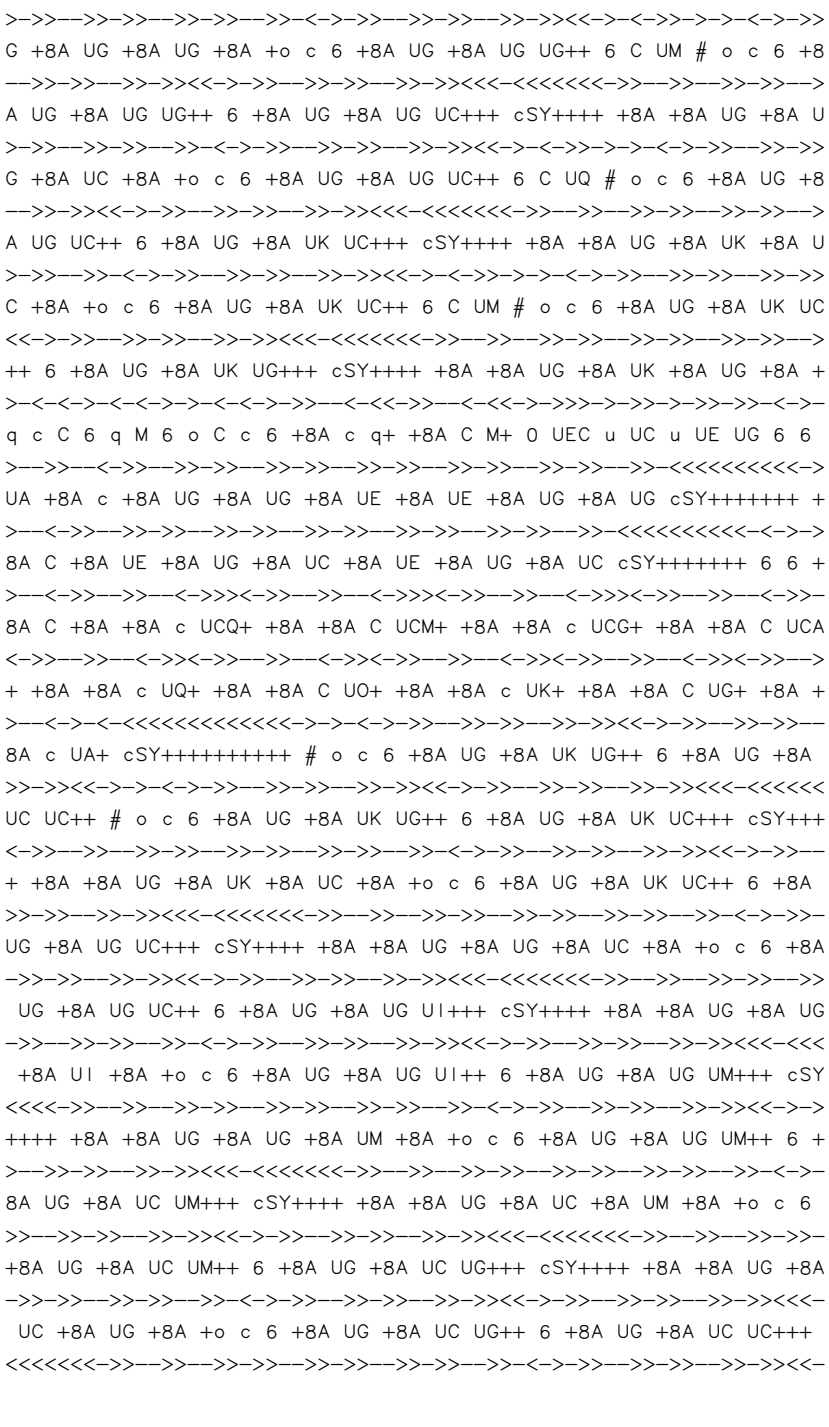
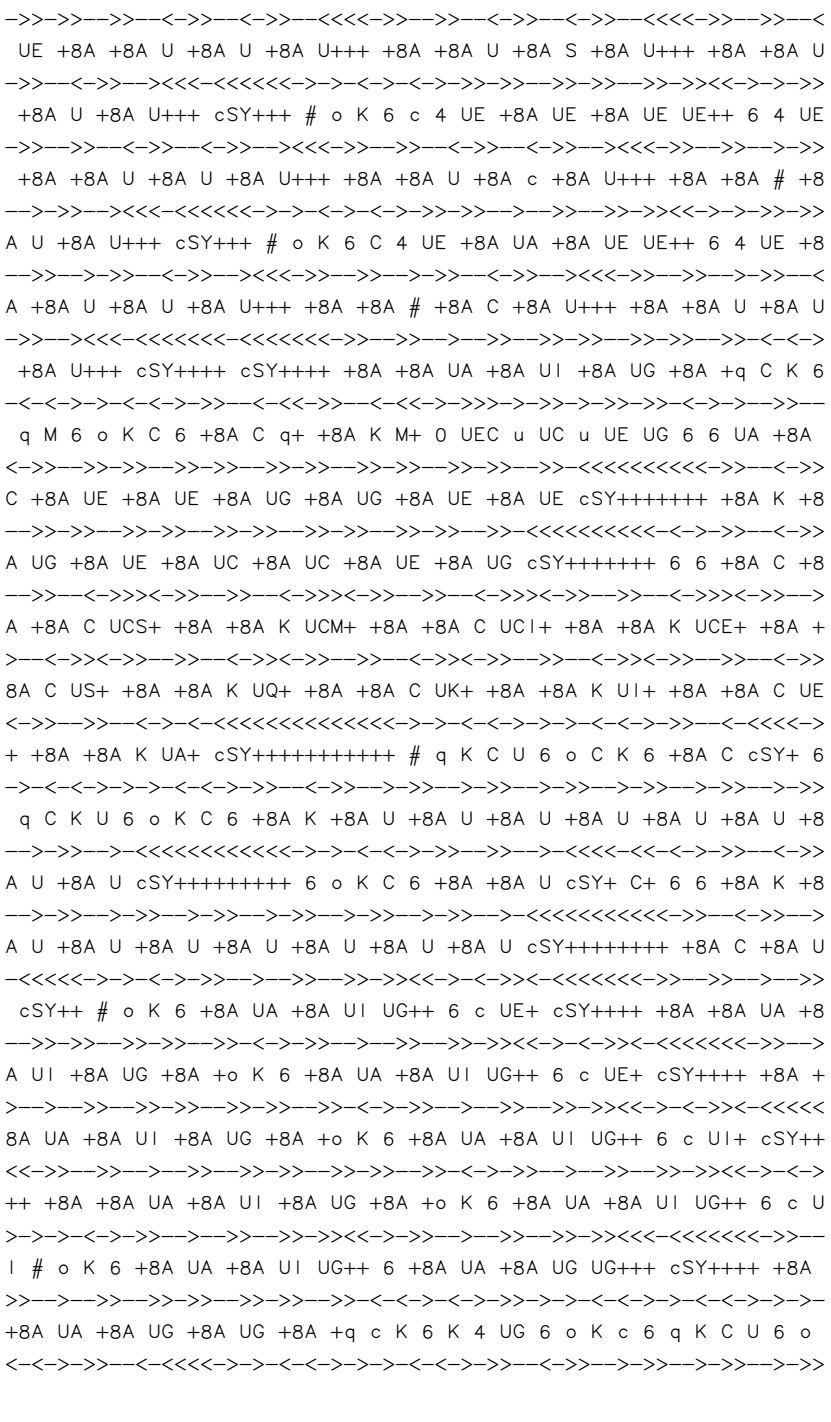
8A UK UI+++ cSY++++ +8A +8A UE +8A UK +8A UI +8A +o S 6 +8A UE
>>-->>->><<->-<->>->->-<->->>-->>->>-->>->><<->->>-->>->>-->>->
+8A UC UC++ 6 C UG # o S 6 +8A UE +8A UK UI++ 6 +8A UE +8A UM U
><<<-<<<<<<<->>-->>-->>->>-->>->>-->>->>-->>-<->->>-->>->>-->>-
C+++ cSY++++ +8A +8A UE +8A UM +8A UC +8A +o S 6 +8A UE +8A UC
>><<->-<->>->->-<->->>-->>->>-->>->><<->->>-->>->>-->>->><<<-<<
UC++ 6 C UG # o S 6 +8A UE +8A UM UC++ 6 +8A UG +8A UC UC+++ cS
<<<<<->>-->>-->>->>-->>->>-->>->>-->>-<-<->-<-<->->-<-<->->>--<
Y++++ +8A +8A UG +8A UC +8A UC +8A +q S C 6 q M 6 o C S 6 +8A S
-<<->>--<-<<->->>>->>->->>->>-<->->-->>--<->>-->>->>-->>->>--
q+ +8A C M+ 0 UEC u UC u UE UG 6 6 UA +8A S +8A UG +8A UG +8A
>>->>-->>->>-->>->>-->>-<<<<<<<<<<->>--<->>-->>->>-->>->>-->>->
UE +8A UE +8A UC +8A UC cSY+++++++ +8A C +8A UC +8A UC +8A UG +
>-->>->>-->>->>-->>-<<<<<<<<<<-<->->>--<->>-->>--<->>><->>-->>-
8A UG +8A UE +8A UE cSY+++++++ 6 6 +8A S +8A +8A S UCQ+ +8A +8A
-<->>><->>-->>--<->>><->>-->>--<->>><->>-->>--<->>><->>-->>--<-
C UCO+ +8A +8A S UCI+ +8A +8A C UCG+ +8A +8A S UCC+ +8A +8A C
>><->>-->>--<->><->>-->>--<->><->>-->>--<->><->>-->>--<->-<-<<<
UQ+ +8A +8A S UM+ +8A +8A C UG+ +8A +8A S UE+ +8A +8A C UA+ cSY
<<<<<<<<<<<->->-<->->>--<->>-->->>-->->>-->->>-->->>-->->>-->->
+++++++++++ # o S 6 +8A S +8A U +8A U +8A U +8A U +8A U +8A U +
>-->-<<<<<<<<<<-<->->>--<->>-->->>-->->>-->->>-->->>-->->>-->-
8A U cSY+++++++++ 6 6 +8A S +8A U +8A U +8A U +8A U +8A U +8A U
<<<<<<<<<<->->-<->->>-->>->>-->>->><<->->>-->>->>-->>->><<->->-
cSY+++++++ # o S 6 +8A UG +8A UC UC++ 6 +8A UG +8A UM UM++ # o
<->->>-->>->>-->>->><<->->>-->>->>-->>->><<<-<<<<<<<->>-->>-->>
S 6 +8A UG +8A UC UC++ 6 +8A UG +8A UC UI+++ cSY++++ +8A +8A UG
->>-->>->>-->>->>-->>-<->->>->>-<->->>->->-<->->>->>->><->-<->-
+8A UC +8A UI +8A +q S 6 UG UC 6 6 UG 6 o S 6 +2 UG UC+ 6 q #
>-<->->>--<->>-->->>-->->>-->->>-->->>-->->>-->-<<<<<<<<<<-<->-
o S 6 +8A S +8A U +8A U +8A U +8A U +8A U +8A U cSY+++++++ 6 6
>>--<->>-->->>-->->>-->->>-->->>-->->>-->-<<<<<<<<<<->->-<->->>-->>->>
+8A S +8A U +8A U +8A U +8A U +8A U cSY++++++ # o S 6 +8A UG +8
-->>->><<->->>-->>->>-->>->><<<-<<<<<<<->>-->>-->>->>-->>->>-->
A UC UI++ 6 +8A UG +8A UC UM+++ cSY++++ +8A +8A UG +8A UC +8A U
>->>-->>-<->->>->>-<->->-->->-<->->>->>->><->-<->->-<->->>--<->
M +8A +q S 6 UG UG 6 6 UA 6 o S 6 +0 UG UG+ 6 q # o S 6 +8A S +
>-->->>-->->>-->->>-->->>-->-<<<<<<<<<-<->->>--<->>-->->>-->->>

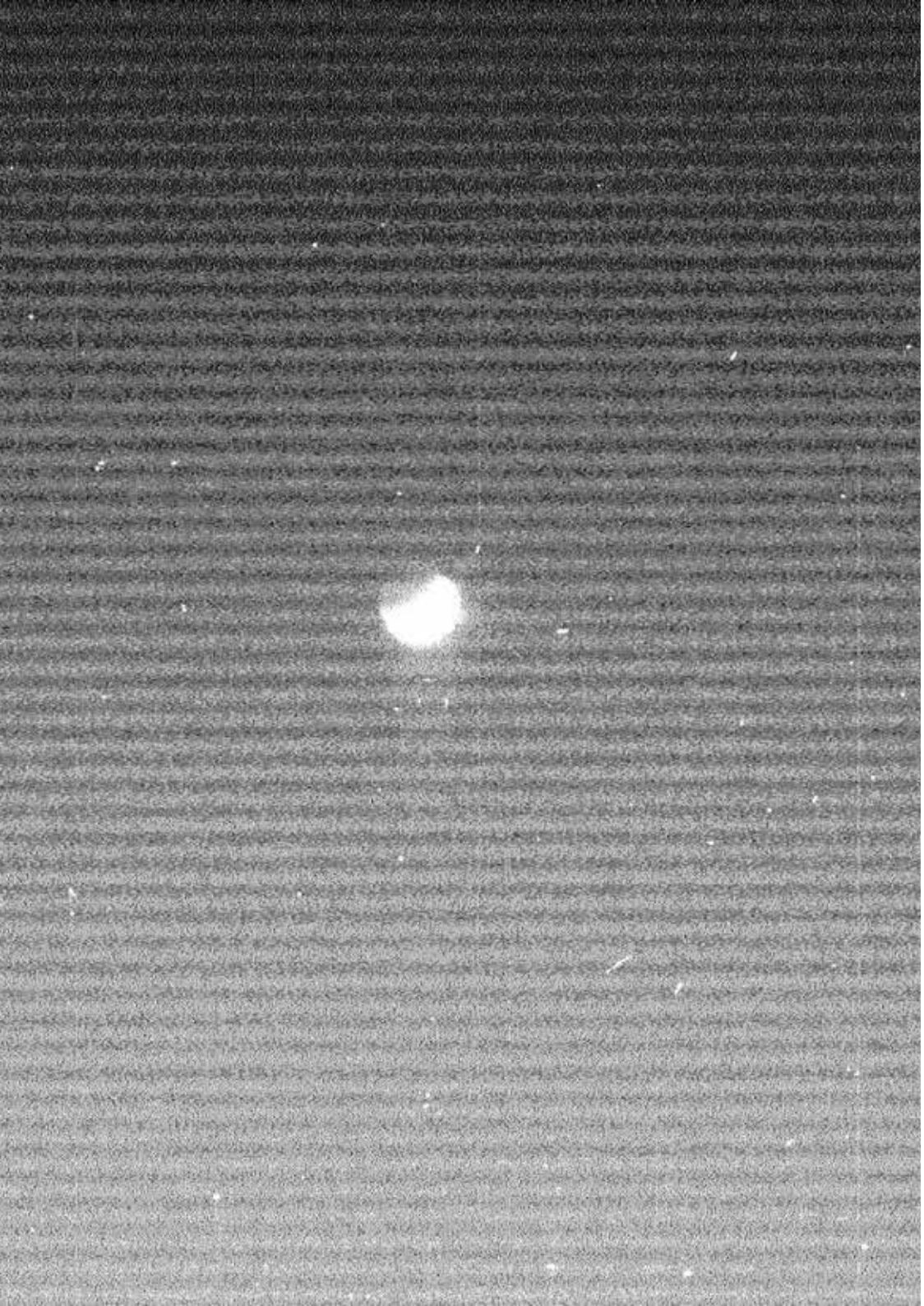
8A U +8A U +8A U +8A U +8A U cSY++++++ 6 6 +8A S +8A U +8A U +8
-->->>-->-<<<<<<<<->->-<->->>-->>->>-->>-><<->->>-->>->>-->>->
A U +8A U cSY+++++ # o S 6 +8A UG +8A UC UM++ 6 +8A UG +8A UG U
><<<-<<<<<<<->>-->>-->>->>-->>->>-->>->>-->>-<->->>->>-<->->>->
M+++ cSY++++ +8A +8A UG +8A UG +8A UM +8A +q S 6 UG UM 6 6 US 6
->-<->->>->>->><->-<->->-<->->>--<->>-->->>-->->>-->->>-->-<<<<
o S 6 +y UG UM+ 6 q # o S 6 +8A S +8A U +8A U +8A U +8A U cSY+
<<<<-<->->>--<->>-->->>-->->>-->-<<<<<<<->->-<->->>-->>->>-->>-
++++ 6 6 +8A S +8A U +8A U +8A U cSY++++ # o S 6 +8A UG +8A UG
>><<->->>-->>->>-->>->><<<-<<<<<<<->>-->>-->>->>-->>->>-->>->>-
UM++ 6 +8A UG +8A UG UG+++ cSY++++ +8A +8A UG +8A UG +8A UG +8A
->>-<->-<-<-<->-<->->-<->->>-<-<<->-<->->-<->->>--<->>-->->>-->
+q S 6 q q 6 6 M 6 o S 6 +w q q+ 6 q # o S 6 +8A S +8A U +8A U
->>-->-<<<<<<<-<->->>--<->>-->->>-->-<<<<<<->->-<->->>-->>->>--
+8A U cSY++++ 6 6 +8A S +8A U +8A U cSY+++ # o S 6 +8A UG +8A
>>->><<->->>-->>->>-->>->><<<-<<<<<<<->>-->>-->>->>-->>->>-->>-
UG UG++ 6 +8A UG +8A UG UC+++ cSY++++ +8A +8A UG +8A UG +8A UC
>>-->>-<->-<-<-<->-<->->-<->->>-<-<<->-<->->-<->->>--<->>-->->>
+8A +q S 6 M q 6 6 M 6 o S 6 +u M q+ 6 q # o S 6 +8A S +8A U +8
-->-<<<<<<-<->->>--<->>-->-<<<<<->->-<->->>-->>->>-->>-><<->->
A U cSY+++ 6 6 +8A S +8A U cSY++ # o S 6 +8A UG +8A UG UC++ 6 +
>-->>->>-->>->><<<-<<<<<<<->>-->>-->>->>-->>->>-->>->>-->>-<->-
8A UG +8A UK UC+++ cSY++++ +8A +8A UG +8A UK +8A UC +8A +q S 6
<-<-<->-<->->-<->->>-<-<<->-<->->-<->->>--<->>-->-<<<<<-<->->>-
M q 6 6 M 6 o S 6 +s M q+ 6 q # o S 6 +8A S +8A U cSY++ 6 6 +8A
-<-<<<<->->-<->->>-->>->>-->>-><<->->>-->>->>-->>->><<<-<<<<<<
S cSY+ # o S 6 +8A UG +8A UK UC++ 6 +8A UG +8A UM UM+++ cSY+++
<->>-->>-->>->>-->>->>-->>->>-->>-<->->>--<->>-->->>-->->>-->->
+ +8A +8A UG +8A UM +8A UM +8A +o S 6 +8A S +8A U +8A U +8A U +
>-->->>-->->>-->->>-->->>-->-<<<<<<<<<<<->->-<->-<->->>>->>-->
8A U +8A U +8A U +8A U +8A U cSY+++++++++ # o S 6 C 4 UGO +8A U
>->>-->>->><<->-<->->>>->>-->->>-->>->><<->->-<->-<->->>>->>--
G +8A UQ UQ++ 6 C 4 UGO +8A UA +8A UM UC++ # o S 6 C 4 UGO +8A
>-->>-->>->><<->->->>>->>-->>-->->>--<->>--><<<->>-->>-->->>--<
UA +8A UE UE++ 6 4 UGO +8A +8A U +8A U +8A U+++ +8A +8A U +8A C
->>--<<<<->>-->>-->->>-->->>--><<<-<<<<<<->->-<->-<->->>>->>-->
+8A U+++ +8A +8A U +8A U +8A U+++ cSY+++ # o S 6 c 4 UGO +8A U
>->>-->>->><<->-<->->>>->>-->->>-->>->><<->->-<->-<->->>>->>--
G +8A UQ UQ++ 6 c 4 UGO +8A UA +8A UG UI++ # o S 6 c 4 UGO +8A
>-->>-->>->><<->->->>>->>-->>-->->>-->->>--><<<->>-->>--<->>--<
UA +8A UE UE++ 6 4 UGO +8A +8A U +8A U +8A U+++ +8A +8A U +8A c
->>--><<<->>-->>--<->>--<->>--><<<-<<<<<<->->-<->-<->->>>->>-->
+8A #+++ +8A +8A U +8A U +8A U+++ cSY+++ # o S 6 K 4 UGO +8A U







```
-->>->>-->>->>><<->-<->>><-<<<<<<<->>-->>-->>->>-->>->>>-->>->>-->
A UC +8A UM UM++ 6 c UE+ cSY++++ +8A +8A UC +8A UM +8A UM +8A +
>-<->->>-->>->>-->>->>><<->-<->>><-<<<<<<<->>-->>-->>->>-->>->>--
o K 6 +8A UC +8A UM UM++ 6 c UE+ cSY++++ +8A +8A UC +8A UM +8A
>>->>-->>-<->->>-->>->>-->>->>><<->-<->-<-<<<<<<<->>-->>-->>->>-
UM +8A +o K 6 +8A UC +8A UM UM++ 6 c UA+ cSY++++ +8A +8A UC +8A
->>->>-->>->>->>->>-<->->>-->>->>-->>->>><<->-<->-<-<<<<<<<->>-->>
 UM +8A UM +8A +o K 6 +8A UC +8A UM UM++ 6 c UA+ cSY++++ +8A +8
-->>->>-->>->>->>->>->>-->>->>->>->>><<->-<->-<-<<<<<<
A UC +8A UM +8A UM +8A +o K 6 +8A UC +8A UM UM++ 6 c UA+ cSY+++
<-<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<->-<<<<-<->>><<<->-<
+ cSY+++++++++++++++++++++++++++++++++++++++ # CSlq 8 +88GCk +S
<<<<->--<<-<<<<-<->>>><<<<<->>>-<->><<<<<->->><<<->><<<<<->--<<<<-
clKO C A++ CaCg 8 +888SclKO +88A+ +SclKO E +Glk +SclKO C A++++
<<<<-<->>>><<<<<->>>>--<->><<<<<->->><<<->><<<<<->--<<<<-<<<<-<->>
Ckey 8 +888SclKO +88C A+ +SclKO E +Glk +SclKO C A++++ CGeY 8 +8
>><<<<<->>>>->>--<<->><<<<<->->><<<->><<<<<->--<<<<-<<<<-<->>>><<<
88SclKO +88C +C A++ +SclKO E +Glk +SclKO C A++++ CqOq 8 +888Scl
<<->>>>->>->>--<<<->><<<<<->->><<<->><<<<<->--<<<<->->->-<<<<<-<->
KO +88C +C +C A+++ +SclKO E +Glk +SclKO C A++++ # # # yekYl 8 +
>--<<<->>--<<<<->>--<<<<->>--<<<<<<<-<<<<<<<-<<<<<<-<->>--<<<<<
8A Ccs +8A sksW +8A Cgos +8A SkWCYYC cSY++++ COKcqo 8 +8A SoQqC
<->>--<<<<->>--<<<<<<<->>--<<<<-<<<<<<<-<<<<<-<->>--<<<<<<-<<<<
k +8A Cc4s +8A cScskqC +8A KcWS cSY++++ ogCGK 8 +8A COKcqo yekY
<<->-<<<<<<<-<->>>><<<<<->>>>><<->->><<<<<->-<->>->><<<<->-<->-<<<-
l+ # gkeGKoo 8 +8882GeaE +8888Yq E +YKcOqQ K+ +G +osGG E+ +oKq
><<<<->->->-><->><<<<->><<<<->->->-><->><<<<->->->-><->><<<<->->-><->><<<<<-
+CaCg M E K+ +oKqa +Ckey M E K+ +CGeY M E K+ +CSlq E K+ +SclKO
><<<<->->->-><->><<->-><<<<<->><<<<->><<<<->->-><->><<<<->->->-><<--<<->-<
+CaCg M E K+ C++ C+ +Geco +Geco +CSlq E K+ +CqOq M E K++ A++ +G
<<<->->><<<<<<<--<<<-<>>>-<---<<<<-<<<<-<->>><<<<<->>>>><<->->-><<<<<
eco C +kKwKkoK A+++ +88A+ A cSY+ qSaK 8 +82GeaE +888Yq C +YKcOq
<->><<<->><<<<<->>>-<->><<<->><<<<->>->><<<<->-<->><<<<->><<<<<<<->->><<
Q +Glk +SclKO +88A+ +GCk G++++ +E +osGG C+ +Geco +gkeGKoo C +GC
<->-><<<->><<--<<->><<<<<<<--<<<-<>>>-<-<<<<->-<<<<<<<<-<-<<<<-<<<
k G+ +Glk G++ A++ +kKwKkoK A++ +88A+ cSY+ # scSwKkoK 8 qSaK ogC
<<-<<<<<<<<-<->-<
GK scSwKkoK 6 6 #
```



RECEPTION

```
* * *

0 =

1 = #

2 = # #

3 = # # #

4 = # # # #

5 = # # # # #

6 = # # # # # #

7 = # # # # # # #

8 = # # # # # # # #

9 = # # # # # # # # #

10 = # # # # # # # # # #

11 = # # # # # # # # # # #

12 = # # # # # # # # # # # #

13 = # # # # # # # # # # # # #

14 = # # # # # # # # # # # # #
# #

15 = # # # # # # # # # # # # #
# # #

16 = # # # # # # # # # # # # #
# # #

17 = # # # # # # # # # # # # #
# # # #

18 = # # # # # # # # # # # # #
```

```
# # # # #

19 = # # # # # # # # # # # # #
# # # # # #

20 = # # # # # # # # # # # # #
# # # # # # #

~

* * *

(λ) = 0

(λλ) = (1 0)

(λλλ) = (2 (1 0))

(λλλλ) = (3 (2 (1 0)))

(λλλλλ) = (4 (3 (2 (1 0))))

(λλλλλλ) = (5 (4 (3 (2 (1 0)))))

(λλλλλλλ) = (6 (5 (4 (3 (2 (1
0))))))

(λλλλλλλλ) = (7 (6 (5 (4 (3 (2
(1 0)))))))

(λλλλλλλλλ) = (8 (7 (6 (5 (4 (3
(2 (1 0))))))))

(λλλλλλλλλλ) = (9 (8 (7 (6 (5 (4
(3 (2 (1 0)))))))))

(λλλλλλλλλλλ) = (10 (9 (8 (7 (6
(5 (4 (3 (2 (1 0))))))))))

~

* * *
```

```
(λ0) = (·0)

(λλ1) = (·λ1)

(λλλ2) = (·λλ2)

(λλλλ3) = (·λλλ3)

(λλλλλ4) = (·λλλλ4)

(λλλλλλ5) = (·λλλλλ5)

(λλλλλλλ6) = (·λλλλλλ6)

(λλλλλλλλ7) = (·λλλλλλλ7)

(λλλλλλλλλ8) = (·λλλλλλλλ8)

(λλλλλλλλλλ9) = (·λλλλλλλλλ9)

(λλλλλλλλλλλ10) = (·λλλλλλλλλλ10)

~

* * *

(λ0) x
→x

(λ0 0) x
→x x

(λ0 0 0) x
→x x x

(λ0) y
→y

(λ0 0) y
→y y

(λ0 0 0) y
→y y y
```

```
(λ0) z
→z

(λ0 0) z
→z z

(λ0 0 0) z
→z z z

(λ0) p
→p

(λ0 0) p
→p p

(λ0 0 0) p
→p p p

(λ0) q
→q

(λ0 0) q
→q q

(λ0 0 0) q
→q q q

(λ0) r
→r

(λ0 0) r
→r r

(λ0 0 0) r
→r r r

~

* * *

(λλ1 0) x y
→(λx 0) y
```

```
→x y
```

```
(λλ1 0) p q
→(λp 0) q
→p q
```

```
(λλ1 0) z r
→(λz 0) r
→z r
```

```
~
```

```
*
```

```
(λλλ2 1 0) x y z
→(λλx 1 0) y z
→(λx y 0) z
→x y z
```

```
(λλλ2 1 0) p q r
→(λλp 1 0) q r
→(λp q 0) r
→p q r
```

```
(λλλ0 1 2) x y z
→(λλ0 1 x) y z
→(λ0 y x) z
→z y x
```

```
(λλλ0 1 2) p q r
→(λλ0 1 p) q r
→(λ0 q p) r
→r q p
```

```
~
```

```
*
```

```
(λλ1 1 0) x y
→(λx x 0) y
→x x y
```

```
(λλ1 1 0) p q
→(λp p 0) q
→p p q
```

```
(λλ0 0 1) x y
→(λy y 0) x
→y y x
```

```
(λλ0 0 1) p q
→(λq q 0) p
→q q p
```

```
(λλ1 0 1) x y
→(λx 0 x) y
→x y x
```

```
(λλ1 0 1) p q
→(λp 0 p) q
→p q p
```

```
(λλ0 1 0) x y
→(λy 0 y) p
→y x y
```

```
(λλ0 1 0) p q
→(λq 0 q) p
→q p q
```

```
(λλ1 1 0 0) x y
→(λx x 0 0) y
→x x y y
```

```
(λλ1 1 0 0) p q
→(λp p 0 0) q
→p p q q
```

```
(λλ0 0 1 1) x y
→(λ0 0 x x) y
→y y x x
```

```
(λλ0 0 1 1) p q
→(λ0 0 p p) q
→q q p p
```

```
(λλ0 1 1 0) x y
→(λ0 x x 0) y
→y x x y
```

```
(λλ0 1 1 0) p q
→(λ0 p p 0) q
→q p p q
```

```
(λλ1 0 0 1) x y
→(λx 0 0 x) y
→x y y x
```

```
(λλ1 0 0 1) p q
→(λp 0 0 p) q
→p q q p
```

```
~
```

```
* * *
```

```
(λλ1) x y
→(λx) y
→x
```

```
(λλ0) x y
→(λ0) y
→y
```

```
(λλ1) p q
→(λp) q
→p
```

```
(λλ0) p q
→(λ0) p
→q
```

```
(λλ1) r z
→(λr) z
→r
```

```
(λλ0) r z
→(λ0) r
→z
```

```
~
```

```
*
```

```
(λλλ2) x y z
→(λλx) y z
→(λx) z
→x
```

```
(λλλ2) p q r
→(λλp) q r
→(λp) r
→p
```

```
~
```

```
(λλλ1) x y z
→(λλ1) y z
→(λy) z
→y
```

```
(λλλ1) p q r
→(λλ1) q r
→(λq) r
→q
```

```
~
```

```
(λλλ0) x y z
→(λλ0) y z
→(λ0) z
→z
```

```
(λλλ0) p q r
→(λλ0) q r
→(λ0) r
→r
```

```
~
```

```
* * *
```

```
(λ0) (λ0)
→(λ0)

(λ0 0) (λ0)
→(λ0) (λ0)

(λ0 0 0) (λ0)
→(λ0) (λ0) (λ0)

~

*

(λ0) (λ0) x
→(λ0) x
→x

(λ0) (λ0) y
→(λ0) y
→y

(λ0) (λ0) z
→(λ0) z
→z

~

*

(λ0) ((λ0) x (λ0) y (λ0) z)
→((λ0) x (λ0) y (λ0) z)
→x y z

(λ0) ((λ0) p (λ0) q (λ0) r)
→((λ0) p (λ0) q (λ0) r)
→p q r

~

* * *

(λ0 0) (λ0 0)
→(λ0 0) (λ0 0)
```

```
→(λ0 0) (λ0 0)
→(λ0 0) (λ0 0)
→ ~

*

(λ0 0 0) (λ0 0 0)
→(λ0 0 0) (λ0 0 0) (λ0 0 0)
→(λ0 0 0) (λ0 0 0) (λ0 0 0) (λ0
0 0)
→(λ0 0 0) (λ0 0 0) (λ0 0 0) (λ0
0 0) (λ0 0 0)
→ ~

*

(λλ0 (1 1 0)) (λλ0 (1 1 0))
→(λ0 ((λλ0 (1 1 0)) (λλ0 (1 1
0)) 0))
→(λ0 ((λ0 ((λλ0 (1 1 0)) (λλ0 (1
1 0)) 0)) 0))
→(λ0 (0 ((λλ0 (1 1 0)) (λλ0 (1 1
0)) 0)))
→(λ0 (0 ((λ0 ((λλ0 (1 1 0)) (λλ0
(1 1 0)) 0)) 0)))
→(λ0 (0 (0 ((λλ0 (1 1 0)) (λλ0
(1 1 0)) 0))))
→(λ0 (0 (0 ((λ0 ((λλ0 (1 1 0))
(λλ0 (1 1 0)) 0)) 0))))
→ ~

*

(λ(λ1 (0 0)) (λ1 (0 0)))
→(λ0 ((λ1 (0 0)) (λ1 (0 0))))
→(λ0 (0 ((λ1 (0 0)) (λ1 (0 0)))))
→(λ0 (0 (0 ((λ1 (0 0)) (λ1 (0
0))))))
→ ~

* * *

IDT = (λ0)
```

```
IDT x
→x

IDT y
→y

IDT z
→z

~

*

IDN = ((λ0) x)

IDN
→x

IDN y
→x y

IDN z
→x z

~

*

IDR = (λ(λ0) 0)

IDR x
→(λ0) x
→x

IDR y
→(λ0) y
→y

IDR z
→(λ0) z
→z
```

```
~

* * *

TRUE = (λλ1)

(λλ1) x y
→(λx) y
→x

TRUE x y
↓
→x

TRUE x y = (λλ1) x y →x = x

*

FALSE = (λλ0)

(λλ0) = FALSE

(λλ0) x y
→(λ0) y
→y

FALSE x y
↓
→y

FALSE x y = (λλ0) x y →y = y

* * *

AND = (λλ1 0 1)

AND TRUE TRUE = (λλ1 0 1) (λλ1)
(λλ1)

(λλ1 0 1) (λλ1) (λλ1)
→(λ(λλ1) 0 (λλ1)) (λλ1)
→(λλ1) (λλ1) (λλ1)
→(λλλ1) (λλ1)
```

```
→(λλ1)

(λλ1 0 1) (λλ1) (λλ1)
↓
→(λλ1)

AND TRUE TRUE
↓
→TRUE

*

AND FALSE FALSE = (λλ1 0 1)
(λλ0) (λλ0)

(λλ1 0 1) (λλ0) (λλ0)
→(λ(λλ0) 0 (λλ0)) (λλ0)
→(λλ0) (λλ0) (λλ0)
→(λ0) (λλ0)
→(λλ0)

(λλ1 0 1) (λλ0) (λλ0)
↓
→(λλ0)

AND FALSE FALSE
↓
→FALSE

*

AND TRUE FALSE = (λλ1 0 1)
(λλ1) (λλ0)

(λλ1 0 1) (λλ1) (λλ0)
→(λ(λλ1) 0 (λλ1)) (λλ0)
→(λλ1) (λλ0) (λλ1)
→(λλλ0) (λλ1)
→(λλ0)

(λλ1 0 1) (λλ1) (λλ0)
↓
→(λλ0)

AND TRUE FALSE
↓
→FALSE

*

AND FALSE TRUE = (λλ1 0 1)
(λλ0) (λλ1)

(λλ1 0 1) (λλ0) (λλ1)
→(λ(λλ0) 0 (λλ0)) (λλ1)
→(λλ0) (λλ1) (λλ0)
→(λ0) (λλ0)
→(λλ0)

(λλ1 0 1) (λλ0) (λλ1)
↓
→(λλ0)

AND FALSE TRUE
↓
→FALSE

* * *

NOT = (λ0 FALSE TRUE)

NOT TRUE = (λ0 (λλ0) (λλ1))
(λλ1)

(λ0 (λλ0) (λλ1)) (λλ1)
→(λλ1) (λλ0) (λλ1)
→(λλλ0) (λλ1)
→(λλ0)

(λ0 (λλ0) (λλ1)) (λλ1)
↓
→(λλ0)

NOT TRUE
↓
→FALSE

*

NOT FALSE = (λ0 (λλ0) (λλ1))
(λλ0)

(λ0 (λλ0) (λλ1)) (λλ0)
→(λλ0) (λλ0) (λλ1)
→(λ0) (λλ1)
→(λλ1)

(λ0 (λλ0) (λλ1)) (λλ0)
↓
→(λλ1)

NOT FALSE
↓
→TRUE

* * *

OR = (λλ1 1 0)

OR TRUE TRUE = (λλ1 1 0) (λλ1)
(λλ1)

(λλ1 1 0) (λλ1) (λλ1)
→(λ(λλ1) (λλ1) 0) (λλ1)
→(λλ1) (λλ1) (λλ1)
→(λλλ1) (λλ1)
→(λλ1)

(λλ1 1 0) (λλ1) (λλ1)
↓
→(λλ1)

OR TRUE TRUE
↓
→TRUE

*

OR FALSE FALSE = (λλ1 1 0)
(λλ0) (λλ0)

(λλ1 1 0) (λλ0) (λλ0)
→(λ(λλ0) (λλ0) 0) (λλ0)
→(λλ0) (λλ0) (λλ0)
→(λ0) (λλ0)
→(λλ0)

(λλ1 1 0) (λλ0) (λλ0)
↓
→(λλ0)

OR FALSE FALSE
↓
→FALSE

*

OR TRUE FALSE = (λλ1 1 0) (λλ1)
(λλ0)

(λλ1 1 0) (λλ1) (λλ0)
→(λ(λλ1) (λλ1) 0) (λλ0)
→(λλ1) (λλ1) (λλ0)
→(λλλ1) (λλ0)
→(λλ1)

(λλ1 1 0) (λλ1) (λλ0)
↓
→(λλ1)

OR TRUE FALSE
↓
→TRUE

*

OR FALSE TRUE = (λλ1 1 0) (λλ0)
(λλ1)

(λλ1 1 0) (λλ0) (λλ1)
→(λ(λλ0) (λλ0) 0) (λλ1)
→(λλ0) (λλ0) (λλ1)
```

```
→(λ0) (λλ1)
→(λλ1)

(λλ1 1 0) (λλ0) (λλ1)
↓
→(λλ1)

OR FALSE TRUE
↓
→TRUE

* * *

XOR = (λλ1 (NOT 0) 0)

XOR TRUE TRUE = (λλ1 ((λ0 (λλ0)
(λλ1)) 0) 0) (λλ1) (λλ1)

(λλ1 ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ1) (λλ1)
→(λ(λλ1) ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ1)
→(λλ1) ((λ0 (λλ0) (λλ1)) (λλ1))
(λλ1)
→(λ(λ0 (λλ0) (λλ1)) (λλ1)) (λλ1)
→(λ0 (λλ0) (λλ1)) (λλ1)
→(λλλ0) (λλ1)
→(λλ0)

(λλ1 ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ1) (λλ1)
↓
→(λλ0)

XOR TRUE TRUE
↓
→FALSE

*

XOR FALSE FALSE = (λλ1 ((λ0
(λλ0) (λλ1)) 0) 0) (λλ0) (λλ0)

(λλ1 ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ0) (λλ0)
→(λ(λλ0) ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ0)
→(λλ0) ((λ0 (λλ0) (λλ1)) (λλ0))
(λλ0)
→(λ0) (λλ0)
→(λλ0)

(λλ1 ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ0) (λλ0)
↓
→(λλ0)

XOR FALSE FALSE
↓
→FALSE

*

XOR TRUE FALSE = (λλ1 ((λ0
(λλ0) (λλ1)) 0) 0) (λλ1) (λλ0)

(λλ1 ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ1) (λλ0)
→(λ(λλ1) ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ0)
→(λλ1) ((λ0 (λλ0) (λλ1)) (λλ0))
(λλ0)
→(λ(λ0 (λλ0) (λλ1)) (λλ0)) (λλ0)
→(λ0 (λλ0) (λλ1)) (λλ0)
→(λλ0) (λλ0) (λλ1)
→(λ0) (λλ1)
→(λλ1)

(λλ1 ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ1) (λλ0)
↓
→(λλ1)

XOR TRUE FALSE
↓
→TRUE

*

XOR FALSE TRUE = (λλ1 ((λ0
(λλ0) (λλ1)) 0) 0) (λλ0) (λλ1)

(λλ1 ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ0) (λλ1)
→(λ(λλ0) ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ1)
→(λλ0) ((λ0 (λλ0) (λλ1)) (λλ1))
(λλ1)
→(λ0) (λλ1)
→(λλ1)

(λλ1 ((λ0 (λλ0) (λλ1)) 0) 0)
(λλ0) (λλ1)
↓
→(λλ1)

XOR FALSE TRUE
↓
→TRUE

* * *

AND (AND TRUE TRUE) (AND TRUE
TRUE)
↓
→TRUE

AND (AND TRUE FALSE) (AND TRUE
TRUE)
↓
→FALSE

OR (AND TRUE TRUE) (AND TRUE
TRUE)
↓
→TRUE

OR (AND TRUE FALSE) (AND TRUE
TRUE)
↓
→TRUE

XOR (AND TRUE TRUE) (AND TRUE
TRUE)
↓
→FALSE

XOR (AND TRUE FALSE) (AND TRUE
TRUE)
↓
→TRUE

*

NOT (AND (AND TRUE TRUE) (AND
TRUE TRUE))
↓
→FALSE

NOT (AND (AND TRUE FALSE) (AND
TRUE TRUE))
↓
→TRUE

NOT (OR (AND TRUE TRUE) (AND
TRUE TRUE))
↓
→FALSE

NOT (OR (AND TRUE FALSE) (AND
TRUE TRUE))
↓
→FALSE

NOT (XOR (AND TRUE TRUE) (AND
TRUE TRUE))
↓
→TRUE

NOT (XOR (AND TRUE FALSE) (AND
TRUE TRUE))
↓
```

```
→FALSE

*

AND (NOT (AND TRUE TRUE)) (AND
TRUE TRUE)
↓
→FALSE

AND (NOT (AND TRUE FALSE)) (AND
TRUE TRUE)
↓
→TRUE

OR (NOT (AND TRUE TRUE)) (AND
TRUE TRUE)
↓
→TRUE

OR (AND TRUE FALSE) (NOT (AND
TRUE TRUE))
↓
→FALSE

XOR (AND TRUE TRUE) (NOT (AND
TRUE TRUE))
↓
→TRUE

XOR (AND TRUE FALSE) (NOT (AND
TRUE TRUE))
↓
→FALSE

*

AND TRUE TRUE x y
↓
→x

AND TRUE FALSE x y
↓
→y
```

```
OR TRUE TRUE x y
↓
→x

OR FALSE TRUE x y
↓
→x

XOR TRUE TRUE x y
↓
→y

XOR FALSE TRUE x y
↓
→x

*

AND (AND TRUE TRUE) (AND TRUE
TRUE) x y
↓
→x

AND (AND TRUE FALSE) (AND TRUE
TRUE) x y
↓
→y

OR (AND TRUE TRUE) (AND TRUE
TRUE) x y
↓
→x

OR (AND TRUE FALSE) (AND TRUE
TRUE) x y
↓
→x

XOR (AND TRUE TRUE) (AND TRUE
TRUE) x y
↓
→y
```

```
XOR (AND TRUE FALSE) (AND TRUE
TRUE) x y
↓
→x

*

AND TRUE TRUE (XOR FALSE
FALSE) (OR TRUE FALSE)
↓
→FALSE

AND TRUE FALSE (XOR FALSE
FALSE) (OR TRUE FALSE)
↓
→TRUE

OR TRUE TRUE (NOT TRUE) (NOT
FALSE)
↓
→FALSE

OR FALSE TRUE (NOT TRUE) (NOT
FALSE)
↓
→FALSE

XOR TRUE TRUE (NOT TRUE) (NOT
FALSE)
↓
→TRUE

XOR FALSE TRUE (NOT TRUE) (NOT
FALSE)
↓
→FALSE

~

* * *

(λλ0) = 0
```

```
(λλ1 0) = # = 1

(λλ1 (1 0)) = # # = 2

(λλ1 (1 (1 0))) = # # # = 3

(λλ1 (1 (1 (1 0)))) = # # # # =
4

(λλ1 (1 (1 (1 (1 0))))) = # # # #
# # = 5

(λλ1 (1 (1 (1 (1 (1 0)))))) = # #
# # # # = 6

(λλ1 (1 (1 (1 (1 (1 (1 0))))))) =
# # # # # # # = 7

(λλ1 (1 (1 (1 (1 (1 (1 (1
0)))))))) = # # # # # # # # = 8

(λλ1 (1 (1 (1 (1 (1 (1 (1 (1
0))))))))) = # # # # # # # # # #
= 9

(λλ1 (1 (1 (1 (1 (1 (1 (1 (1 (1
0)))))))))) = # # # # # # # # # #
# = 10

~

*

(λλ0) x
→(λ0)

(λλ1 0) x
→(λx 0)

(λλ1 (1 0)) x
→(λx (x 0))
```

```
(λλ1 (1 (1 0))) x
→(λx (x (x 0)))

(λλ1 (1 (1 (1 0)))) x
→(λx (x (x (x 0))))

(λλ1 (1 (1 (1 (1 0))))) x
→(λx (x (x (x (x 0)))))

(λλ1 (1 (1 (1 (1 (1 0)))))) x
→(λx (x (x (x (x (x 0))))))

(λλ1 (1 (1 (1 (1 (1 (1 0)))))))) x
→(λx (x (x (x (x (x (x 0)))))))

(λλ1 (1 (1 (1 (1 (1 (1 (1
0)))))))) x
→(λx (x (x (x (x (x (x (x
0)))))))))

(λλ1 (1 (1 (1 (1 (1 (1 (1 (1
0)))))))))) x
→(λx (x (x (x (x (x (x (x (x
0)))))))))

(λλ1 (1 (1 (1 (1 (1 (1 (1 (1 (1
0)))))))))) x
→(λx (x (x (x (x (x (x (x (x (x
0)))))))))

~

*

(λλ0) (λ0)
→(λ0)

(λλ1 0) (λ0)
→(λ(λ0) 0)

(λλ1 (1 0)) (λ0)
→(λ(λ0) ((λ0) 0))

(λλ1 (1 (1 0))) (λ0)
→(λ(λ0) ((λ0) ((λ0) 0)))

(λλ1 (1 (1 (1 0)))) (λ0)
→(λ(λ0) ((λ0) ((λ0) ((λ0) 0))))

(λλ1 (1 (1 (1 (1 0))))) (λ0)
→(λ(λ0) ((λ0) ((λ0) ((λ0) ((λ0)
0)))))

(λλ1 (1 (1 (1 (1 (1 0)))))) (λ0)
→(λ(λ0) ((λ0) ((λ0) ((λ0) ((λ0)
((λ0) 0))))))

(λλ1 (1 (1 (1 (1 (1 (1 0)))))))
(λ0)
→(λ(λ0) ((λ0) ((λ0) ((λ0) ((λ0)
((λ0) ((λ0) 0)))))))

(λλ1 (1 (1 (1 (1 (1 (1 (1
0)))))))) (λ0)
→(λ(λ0) ((λ0) ((λ0) ((λ0) ((λ0)
((λ0) ((λ0) ((λ0) 0)))))))

(λλ1 (1 (1 (1 (1 (1 (1 (1 (1
0)))))))))) (λ0)
→(λ(λ0) ((λ0) ((λ0) ((λ0) ((λ0)
((λ0) ((λ0) ((λ0) ((λ0) 0)))))))))

(λλ1 (1 (1 (1 (1 (1 (1 (1 (1 (1
0)))))))))) (λ0)
→(λ(λ0) ((λ0) ((λ0) ((λ0) ((λ0)
((λ0) ((λ0) ((λ0) ((λ0) ((λ0)
0)))))))))

~

*

#0 = (λλ0)

#1 = (λλ1 0)

#2 = (λλ1 (1 0))

#3 = (λλ1 (1 (1 0)))

#4 = (λλ1 (1 (1 (1 0))))

#5 = (λλ1 (1 (1 (1 (1 0)))))

#6 = (λλ1 (1 (1 (1 (1 (1 0))))))

#7 = (λλ1 (1 (1 (1 (1 (1 (1
0)))))))

#8 = (λλ1 (1 (1 (1 (1 (1 (1 (1
0)))))))))

#9 = (λλ1 (1 (1 (1 (1 (1 (1 (1 (1
0)))))))))

#10 = (λλ1 (1 (1 (1 (1 (1 (1 (1
(1 (1 0)))))))))))

~

* * *

ISZERO = (λ0 (λ(λλ0)) (λλ1))

ISZERO #0
↓
→TRUE

ISZERO #1
↓
→FALSE

ISZERO #2
↓
→FALSE

~

*

ISEVEN = (λ0 (λ0 (λλ0) (λλ1))
(λλ1))

ISEVEN #0
↓
→FALSE

ISEVEN #1
↓
→FALSE

ISEVEN #2
↓
→TRUE

ISEVEN #3
↓
→FALSE

ISEVEN #4
↓
→TRUE

ISEVEN #5
↓
→FALSE

~

*

ISODD = (λ0 (λ0 (λλ0) (λλ1))
(λλ0))

ISODD #0
↓
→FALSE

ISODD #1
↓
→TRUE
```

```
ISODD #2
↓
→FALSE

ISODD #3
↓
→TRUE

ISODD #4
↓
FALSE

ISODD #5
↓
TRUE

~

*

LEQ = (λλ(λ0 (λ(λλ0)) (λλ1))
((λλ0 (λλλ2 (λλ0 (1 3)) (λ1)
(λ0)) 1) 1 0))

LEQ #0 #0
↓
→TRUE

LEQ #1 #0
↓
→FALSE

LEQ #0 #1
↓
→TRUE

LEQ #1 #1
↓
→TRUE

LEQ #2 #3
↓
→TRUE

LEQ #3 #2
↓
→FALSE

~

*

GEQ = (λλ(λλ(λ0 (λ(λλ0)) (λλ1))
((λλ0 (λλλ2 (λλ0 (1 3)) (λ1)
(λ0)) 1) 1 0)) 0 1)

GEQ #0 #0
↓
→TRUE

GEQ #1 #0
↓
→TRUE

GEQ #0 #1
↓
→FALSE

GEQ #1 #1
↓
→TRUE

GEQ #2 #3
↓
→FALSE

GEQ #3 #2
↓
→TRUE

~

*

EQ = (λλ(λλ1 0 1) ((λλ(λ0
(λ(λλ0)) (λλ1)) ((λλ0 (λλλ2 (λλ0
(1 3)) (λ1) (λ0)) 1) 1 0)) 1 0)
((λλ(λ0 (λ(λλ0)) (λλ1)) ((λλ0
(λλλ2 (λλ0 (1 3)) (λ1) (λ0)) 1) 1
0)) 0 1))

EQ #0 #0
↓
→TRUE

EQ #1 #0
↓
→FALSE

EQ #0 #1
↓
→FALSE

EQ #1 #1
↓
→TRUE

EQ #2 #3
↓
→FALSE

EQ #3 #2
↓
→FALSE

~

*

NEQ = (λλ(λλ1 1 0) ((λ0 (λλ0)
(λλ1)) ((λλ(λ0 (λ(λλ0)) (λλ1))
((λλ0 (λλλ2 (λλ0 (1 3)) (λ1)
(λ0)) 1) 1 0)) 1 0)) ((λ0 (λλ0)
(λλ1)) ((λλ(λ0 (λ(λλ0)) (λλ1))
((λλ0 (λλλ2 (λλ0 (1 3)) (λ1)
(λ0)) 1) 1 0)) 0 1)))

NEQ #0 #0
↓
→FALSE

NEQ #1 #0
↓
→TRUE

NEQ #0 #1
↓
→TRUE

NEQ #1 #1
↓
→FALSE

NEQ #2 #3
↓
→TRUE

NEQ #3 #2
↓
→TRUE

~

*

LT = (λλ(λ0 (λλ0) (λλ1)) ((λλ(λ0
(λ(λλ0)) (λλ1)) ((λλ0 (λλλ2 (λλ0
(1 3)) (λ1) (λ0)) 1) 1 0)) 0 1))

LT #0 #0
↓
→FALSE

LT #1 #0
↓
→FALSE

LT #0 #1
↓
→TRUE

LT #1 #1
```

```
↓
→FALSE

LT #2 #3
↓
→TRUE

LT #3 #2
↓
→FALSE

~

*

GT = (λλ(λ0 (λλ0) (λλ1)) ((λλ(λ0
(λ(λλ0)) (λλ1)) ((λλ0 (λλλ2 (λλ0
(1 3)) (λ1) (λ0)) 1) 1 0)) 1 0))

GT #0 #0
↓
→FALSE

GT #1 #0
↓
→TRUE

GT #0 #1
↓
→FALSE

GT #1 #1
↓
→FALSE

GT #2 #3
↓
→FALSE

GT #3 #2
↓
→TRUE
```

```
~

* * *

SUCC = (λλλ1 (2 1 0))

SUCC #0
↓
→#1

SUCC #1
↓
→#2

SUCC #2
↓
→#3

~

*

PRED = (λλλ2 (λλ0 (1 3)) (λ1)
(λ0))

PRED #2
↓
→#1

PRED #1
↓
→#0

PRED #0
↓
→#0

*

ADD = (λλ0 SUCC 1)

ADD #0 #1
↓
→#1

ADD #1 #2
↓
→#3

ADD #3 #4
↓
→#7

~

ADD #1 #0
↓
→#1

ADD #2 #1
↓
→#3

ADD #4 #3
↓
→#7

~

*

SUB = (λλ0 PRED 1)

SUB #5 #2
↓
→#3

SUB #3 #2
↓
→#1

SUB #1 #0
↓
→#1

~

SUB #2 #5
↓
→#0

SUB #2 #3
↓
→#0

SUB #0 #1
↓
→#0

~

*

MULT = (λλλ2 (1 0))

MULT #1 #0
↓
→#0

MULT #1 #1
↓
→#1

MULT #2 #3
↓
→#6

~

*

EXP = (λλ0 1)

EXP #1 #0
↓
→#1

EXP #2 #2
↓
```

```
→#4

EXP #2 #3
↓
→#8

~

* * *

YCOMB = (λ(λ1 (0 0)) (λ1 (0 0)))

(YCOMB (λλLEQ 0 (λλ1 (1 (1 0)))
(1 (SUCC 0)) 0)) #0
↓
→#4

(YCOMB (λλLEQ 0 (λλ1 (1 (1 0)))
(1 (SUCC 0)) 0)) #1
↓
→#4

(YCOMB (λλLEQ 0 (λλ1 (1 (1 0)))
(1 (SUCC 0)) 0)) #2
↓
→#4

*

SQRT = (λYCOMB (λλLEQ (MULT 0
0) 2 (1 (SUCC 0)) ((GEQ 2 (λλ1
(1 0))) (PRED 0) 2)) (λλ1 (1 0)))

SQRT #4
↓
→#2

SQRT #6
↓
→#2

SQRT #9
↓
```

```
→#3

~

*

FIB = (λ0 (λλλ2 0 (ADD 1 0))
TRUE (λλ0) (λλ1 0))

FIB #0
↓
→#0

FIB #1
↓
→#0

FIB #2
↓
→#0

FIB #3
↓
→#2

FIB #4
↓
→#3

FIB #5
↓
→#5

FIB #6
↓
→#8

~

*

FACT = (λ0 (λλλ2 (MULT 1 0)
(SUCC 0)) TRUE (λλ1 0) (λλ1 0))
```

```
FACT #1
↓
→#0

FACT #2
↓
→#2

FACT #3
↓
→#6

FACT #4
↓
→#24

~

*

PYTH = (λλSQRT (ADD (EXP 1 (λλ1
(1 0))) (EXP 0 (λλ1 (1 0)))))

PYTH #3 #4
↓
→#4

PYTH #4 #3
↓
→#4

PYTH #8 #6
↓
→#10

PYTH #6 #8
↓
→#10

~

*
```

```
PRIME = (λYCOMB (λλLEQ (MULT 0
0) 2 ((ISDIV 2 0) FALSE (1 (SUCC
0))) TRUE) (λλ1 (1 0)))

ISPRIME = (λGEQ 0 (λλ1 (1 0))
(ISEVEN 0 (EQ 0 (λλ1 (1 0)))
(PRIME 0)) FALSE)

ISPRIME #0
↓
→FALSE

ISPRIME #1
↓
→FALSE

ISPRIME #2
↓
→TRUE

ISPRIME #3
↓
→TRUE

ISPRIME #4
↓
→FALSE

ISPRIME #5
↓
→TRUE

ISPRIME #6
↓
→FALSE

ISPRIME #7
↓
→TRUE

~
```

```
* * *

NIL = (λTRUE)

NULL = (λ0 (λλFALSE))

NULL NIL
↓
→TRUE

NULL (λ0 x y)
↓
→FALSE

*

CONS = (λλλ0 2 1)

CONS x y
↓
→(λ0 x y)

CONS p q
↓
→(λ0 p q)

~

CONS z NIL
↓
→(λ0 z NIL)

CONS y (λ0 z NIL)
↓
→(λ0 y (λ0 z NIL))

CONS x (λ0 y (λ0 x NIL))
↓
→(λ0 x (λ0 y (λ0 z NIL)))

~

*
```

```
CAR = (λ0 TRUE)

CAR (λ0 x y)
↓
→x

CAR (λ0 p q)
↓
→p

CAR (λ0 x (λ0 y (λ0 z NIL)))
↓
→x

~

*

CDR = (λ0 FALSE)

CDR (λ0 x y)
↓
→y

CDR (λ0 p q)
↓
→q

CDR (λ0 x (λ0 y (λ0 z NIL)))
↓
→(λ0 y (λ0 z NIL))

~

*

LENGTH = (YCOMB (λλλNULL 0 1 (2
(SUCC 1) (CDR 0))) (λλ0))

LENGTH (λ0 x NIL)
↓
→#1
```

```
LENGTH (λ0 x (λ0 y (λ0 z NIL)))
↓
→#3

LENGTH (λ0 x (λ0 y (λ0 z (λ0 p
(λ0 q (λ0 r NIL))))))
↓
→#6

~

*

INDEX = (λλλ0 CAR (1 λ0 CDR 2))

INDEX #0 (λ0 x (λ0 y (λ0 z
NIL)))
↓
→x

INDEX #1 (λ0 x (λ0 y (λ0 z
NIL)))
↓
→y

INDEX #2 (λ0 x (λ0 y (λ0 z
NIL)))
↓
→z

~

*

INDEXM = (λλλINDEX 1 (INDEX 2
0))

INDEXM #0 #0 (λ0 (λ0 x (λ0 y
(λ0 z NIL))) (λ0 (λ0 p (λ0 q (λ0
r NIL))) (λ0 (λ0 a (λ0 b (λ0 c
NIL))) NIL)))
↓
→x

INDEXM #1 #1 (λ0 (λ0 x (λ0 y
(λ0 z NIL))) (λ0 (λ0 p (λ0 q (λ0
r NIL))) (λ0 (λ0 a (λ0 b (λ0 c
NIL))) NIL)))
↓
→q

INDEXM #2 #2 (λ0 (λ0 x (λ0 y
(λ0 z NIL))) (λ0 (λ0 p (λ0 q (λ0
r NIL))) (λ0 (λ0 a (λ0 b (λ0 c
NIL))) NIL)))
↓
→c

~

*

APPEND = (YCOMB (λλλNULL 1 0
(CONS (CAR 1) (2 (CDR 1) 0))))

APPEND (λ0 p (λ0 q (λ0 r NIL)))
(λ0 x (λ0 y (λ0 z NIL)))
↓
→(λ0 p (λ0 q (λ0 r (λ0 x (λ0 y
(λ0 z NIL))))))

APPEND (λ0 x (λ0 y (λ0 z NIL)))
(λ0 a (λ0 b (λ0 c NIL)))
↓
→(λ0 x (λ0 y (λ0 z (λ0 a (λ0 b
(λ0 c NIL))))))

APPEND (λ0 a (λ0 b (λ0 c NIL)))
(λ0 p (λ0 q (λ0 r NIL)))
↓
→(λ0 a (λ0 b (λ0 c (λ0 p (λ0 q
(λ0 r NIL))))))

~
```

```
*

SET = (YCOMB (λλλλλLEQ 3 2
(CONS (CAR 0) (4 (SUCC 3) 2
1 (CDR 0))) (CONS 1 (CDR 0)))
(λλ1 0))

SET #0 x (λ0 p (λ0 q (λ0 r
NIL)))
↓
→(λ0 x (λ0 q (λ0 r NIL)))

SET #1 x (λ0 p (λ0 q (λ0 r
NIL)))
↓
→(λ0 p (λ0 x (λ0 r NIL)))

SET #2 x (λ0 p (λ0 q (λ0 r
NIL)))
↓
→(λ0 p (λ0 q (λ0 x NIL)))

~

*

SETM = (λλλλSET 3 (SET 2 1
(INDEX 3 0)) 0)

SETM #0 #0 p (λ0 (λ0 x (λ0 y
(λ0 z NIL))) (λ0 (λ0 p (λ0 q (λ0
r NIL))) (λ0 (λ0 a (λ0 b (λ0 c
NIL))) NIL)))
↓
→(λ0 (λ0 p (λ0 y (λ0 z NIL)))
(λ0 (λ0 p (λ0 q (λ0 r NIL))) (λ0
(λ0 a (λ0 b (λ0 c NIL))) NIL)))

SETM #1 #1 p (λ0 (λ0 x (λ0 y
(λ0 z NIL))) (λ0 (λ0 p (λ0 q (λ0
r NIL))) (λ0 (λ0 a (λ0 b (λ0 c
NIL))) NIL)))
↓
→(λ0 (λ0 x (λ0 y (λ0 z NIL)))
(λ0 (λ0 p (λ0 p (λ0 r NIL))) (λ0
(λ0 a (λ0 b (λ0 c NIL))) NIL)))

SETM #2 #2 p (λ0 (λ0 x (λ0 y
(λ0 z NIL))) (λ0 (λ0 p (λ0 q (λ0
r NIL))) (λ0 (λ0 a (λ0 b (λ0 c
NIL))) NIL)))
↓
→(λ0 (λ0 x (λ0 y (λ0 z NIL)))
(λ0 (λ0 p (λ0 q (λ0 r NIL))) (λ0
(λ0 a (λ0 b (λ0 p NIL))) NIL)))

~

*

REVERSE = (YCOMB (λλλNULL 0 1
(2 (CONS (CAR 0) 1) (CDR 0)))
NIL)

REVERSE (λ0 x (λ0 y (λ0 z
NIL)))
↓
→(λ0 z (λ0 y (λ0 x NIL)))

REVERSE (λ0 p (λ0 q (λ0 r
NIL)))
↓
→(λ0 r (λ0 q (λ0 p NIL)))

REVERSE (λ0 x (λ0 y (λ0 z (λ0 p
(λ0 q (λ0 r NIL))))))
↓
→(λ0 r (λ0 q (λ0 p (λ0 z (λ0 y
(λ0 x NIL))))))

~

*

MAP = (YCOMB (λλλNULL 0 NIL
(CONS (1 (CAR 0)) (2 1 (CDR
0)))))

MAP (SUCC) (λ0 #1 (λ0 #2 (λ0 #3
NIL)))
↓
→(λ0 #2 (λ0 #3 (λ0 #4 NIL)))

MAP (ISPRIME) (λ0 #1 (λ0 #2 (λ0
#3 NIL)))
↓
→(λ0 FALSE (λ0 TRUE (λ0 TRUE
NIL)))

MAP (ISODD) (λ0 #1 (λ0 #2 (λ0
#3 NIL)))
↓
→(λ0 TRUE (λ0 FALSE (λ0 TRUE
NIL)))

~

* * *

LCA = (λλYCOMB (λλλλλLEQ 1
(PRED (LENGTH 5)) (4 (SUCC 3)
(SUCC 2) (SUCC 1) (CONS (6
(INDEX 3 5) (INDEX 2 5) (INDEX
1 5)) 0)) (REVERSE (λ0 FALSE
(APPEND 1 (λ0 FALSE NIL)))))
(λλ0) (λλ1 0) (λλ1 (1 0)) NIL)

LCAR = (λλλYCOMB (λλλλLEQ 2 6
(3 (SUCC 2) (CONS (MAP (λ0 # ·)
0) 1) 6 5 (LCA 5 0)) (REVERSE
1)) (λλ0) NIL 0)

RULE90 = (λλλXOR 2 0)

LCAR #3 RULE90 (λ0 FALSE (λ0
FALSE (λ0 FALSE (λ0 TRUE (λ0
FALSE (λ0 FALSE (λ0 FALSE
NIL)))))))
↓
→(λ0
(λ0 · (λ0 · (λ0 · (λ0 # (λ0 ·
(λ0 · (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 · (λ0 # (λ0 · (λ0 #
(λ0 · (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 # (λ0 · (λ0 · (λ0 ·
(λ0 # (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 · (λ0 # (λ0 · (λ0 #
(λ0 · (λ0 · NIL)))))))
NIL))))

~

*

RULE30 = (λλλXOR 2 (OR 1 0))

LCAR #3 RULE30 (λ0 FALSE (λ0
FALSE (λ0 FALSE (λ0 TRUE (λ0
FALSE (λ0 FALSE (λ0 FALSE
NIL)))))))
↓
→(λ0
(λ0 · (λ0 · (λ0 · (λ0 # (λ0 ·
(λ0 · (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 · (λ0 # (λ0 # (λ0 #
(λ0 · (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 # (λ0 # (λ0 · (λ0 ·
(λ0 # (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 # (λ0 · (λ0 # (λ0 #
(λ0 # (λ0 · NIL)))))))
NIL))))

~

*
```

```
RULE110 = (λλλXOR (OR 2 1) (AND
2 (AND 1 0)))

LCAR #3 RULE110 (λ0 FALSE
(λ0 FALSE (λ0 FALSE (λ0 TRUE
(λ0 FALSE (λ0 FALSE (λ0 FALSE
NIL)))))))
↓
→(λ0
(λ0 · (λ0 · (λ0 · (λ0 # (λ0 ·
(λ0 · (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 · (λ0 · (λ0 # (λ0 #
(λ0 · (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 · (λ0 · (λ0 # (λ0 #
(λ0 # (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 · (λ0 · (λ0 # (λ0 ·
(λ0 # (λ0 · NIL)))))))
NIL))))

~

*

RULE250 = (λλλOR 2 0)

LCAR #3 RULE250 (λ0 FALSE
(λ0 FALSE (λ0 FALSE (λ0 TRUE
(λ0 FALSE (λ0 FALSE (λ0 FALSE
NIL)))))))
↓
→(λ0
(λ0 · (λ0 · (λ0 · (λ0 # (λ0 ·
(λ0 · (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 · (λ0 # (λ0 # (λ0 #
(λ0 · (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 · NIL)))))))
(λ0
(λ0 · (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 · NIL)))))))
NIL))))

~

* * *

TM = (λλλλλλYCOMB (λλλλλNEQ 2
(λλ1 (1 (1 0))) (4 (CONS (MAP
(λ0 # ·) 0) 3) ((INDEX 1 0) CAR
CDR (INDEX 2 7)) ((INDEX 1 0)
CAR CDR (INDEX 2 6) 1) (SET 1
((INDEX 1 0) CAR CDR (INDEX 2
5)) 0)) (REVERSE 3)) NIL 5 4 3)

READ = (λ0 (λ0 #3 #1) (λ0 (λ0
#1 #2) (λ0 (λ0 #0 #2) (λ0 (λ0
#3 #3) NIL))))

MOVE = (λ0 (λ0 SUCC SUCC) (λ0
(λ0 SUCC SUCC) (λ0 (λ0 PRED
PRED) (λ0 (λ0 IDT IDT) NIL))))

WRITE = (λ0 (λ0 TRUE TRUE)
(λ0 (λ0 TRUE FALSE) (λ0 (λ0
TRUE TRUE) (λ0 (λ0 TRUE TRUE)
NIL))))

TM #0 #1 (λ0 FALSE (λ0 FALSE
(λ0 FALSE (λ0 FALSE (λ0 FALSE
(λ0 FALSE NIL)))))) READ MOVE
WRITE
↓
→(λ0
(λ0 · (λ0 · (λ0 · (λ0 · (λ0 ·
(λ0 · NIL))))))
(λ0
(λ0 · (λ0 # (λ0 · (λ0 · (λ0 ·
(λ0 · NIL))))))
(λ0
(λ0 · (λ0 # (λ0 · (λ0 · (λ0 ·
(λ0 · NIL))))))
(λ0
(λ0 · (λ0 # (λ0 · (λ0 # (λ0 ·
(λ0 · NIL))))))
(λ0
(λ0 · (λ0 # (λ0 # (λ0 # (λ0 ·
(λ0 · NIL))))))
(λ0
(λ0 · (λ0 # (λ0 # (λ0 # (λ0 ·
(λ0 · NIL))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 ·
(λ0 · NIL))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 ·
(λ0 · NIL))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 ·
(λ0 · NIL))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # NIL))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # NIL))))))
NIL))))))))))))))

* * *

ANU = (λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL)))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 ·
(λ0 · (λ0 → (λ0 # NIL)))))))))
(λ0
(λ0 # (λ0 · (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 · (λ0 # NIL)))))))))
(λ0
(λ0 # (λ0 · (λ0 # (λ0 · (λ0 ·
(λ0 * (λ0 · (λ0 # NIL)))))))))
(λ0
(λ0 # (λ0 · (λ0 # (λ0 · (λ0 ·
(λ0 # (λ0 · (λ0 # NIL)))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL)))))))))
(λ0
(λ0 # (λ0 → (λ0 · (λ0 · (λ0 ·
(λ0 · (λ0 · (λ0 # NIL)))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL)))))))))
```

```
NIL))))))))

URUK = (λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 ·
(λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 · (λ0 ·
(λ0 # (λ0 # (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 ·
(λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 · (λ0 ·
(λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 ·
(λ0 # (λ0 * (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 →
(λ0 # (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL))))))))
NIL))))))))

APSU = (λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 → (λ0 · (λ0 · (λ0 #
(λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 *
(λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 # (λ0 #
(λ0 * (λ0 # (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 * (λ0 ·
(λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 → (λ0 · (λ0 # (λ0 ·
(λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL))))))))
NIL))))))))

IRKALLA = (λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 → (λ0 * (λ0 · (λ0 ·
(λ0 * (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 * (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 * (λ0 · (λ0 ·
(λ0 * (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 * (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 * (λ0 · (λ0 ·
(λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 · (λ0 ·
(λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL))))))))
NIL))))))))
```

* * *

```
ISHTAR = (λ0 I
(λ0
(λ0 #1 (λ0 #4 (λ0 #4 (λ0 (: I
→ (λ0 #1 (λ0 #4 #4)) → E #0)
NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #4 (λ0 (: I
→ (λ0 #1 (λ0 #4 #4)) → E #0)
NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #4 (λ0 (: I
→ (λ0 #1 (λ0 #4 #4)) → E #0)
NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #4 (λ0 (: I
→ (λ0 #1 (λ0 #4 #4)) → E #0)
NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #4 (λ0 (: I
→ (λ0 #1 (λ0 #4 #4)) → E #0)
NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #4 (λ0 (: I
→ (λ0 #1 (λ0 #4 #4)) → E #0)
NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #4 (λ0 (: I
→ (λ0 #1 (λ0 #4 #4)) → E #0)
NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #4 (λ0 (: I
→ (λ0 #1 (λ0 #4 #4)) → E #0)
NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #4 (λ0 (: I
→ (λ0 #1 (λ0 #4 #4)) → E #2)
NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #4 (λ0 (? I E
→ @ #3 (λ0 #3 (λ0 #8 #8)) → : E
I @ #3 (λ0 #0 (λ0 #4 #3)) * ? I
E → @ #3 (λ0 #0 (λ0 #2 #2)) → :
E I → @ #3 (λ0 (λ0 # (λ0 A (λ0
·))) (λ0 (λ0 # (λ0 E (λ0 ·)))
(λ0 (λ0 # (λ0 # (λ0 #))) NIL)))
* ? I E → E @ #3 → : E I → ? E
A # → : A E → (λ0 A NIL) → ? A
E # → : E A → (λ0 E (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # NIL))))))))) → : E A →
(λ0 (λ0 # NIL) A) ↓ → (λ0 E (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # NIL)))))))) (λ0 A (λ0 #
NIL)) * : I → (λ0 #1 (λ0 #4 #4))
→ (λ0 #1 (λ0 #1 #2))) NIL))))
(λ0
(λ0 #1 (λ0 #1 (λ0 #2 (λ0 (: E
→ (λ0 E (λ0 # NIL)) * ? E I →
T F ↓ → F → : I E → (& T F) →
: E I → T * : I → (λ0 #1 (λ0
#3 #2)) → (λ0 #1 (λ0 #5 #2)))
NIL))))
(λ0
(λ0 #1 (λ0 #3 (λ0 #2 (λ0 (: E
→ (λ0 E (λ0 # (λ0 # NIL))) * ?
E I → T F ↓ → T → : I E → (‖
T F) → : E I → T * : I → (λ0
#1 (λ0 #5 #2)) → (λ0 #1 (λ0 #6
#2))) NIL))))
(λ0
(λ0 #1 (λ0 #5 (λ0 #2 (λ0 (: E →
(λ0 E (λ0 # (λ0 # (λ0 # NIL))))
* ? E I → T T ↓ → F → : I E →
(! T T) → : E I → T * : I → (λ0
#1 (λ0 #6 #2)) → (λ0 #1 (λ0 #1
#5))) NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #2 (λ0 (: E →
(λ0 E (λ0 # (λ0 # (λ0 # (λ0 #
NIL))))) * ? E I → #1 #2 ↓ → #3
→ : I E → (+ #1 #2) → : E I →
T * : I → (λ0 #1 (λ0 #1 #5)) →
```

```
(λ0 #1 (λ0 #3 #5))) NIL))))
(λ0
(λ0 #1 (λ0 #1 (λ0 #5 (λ0 (: E
→ (λ0 E (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # NIL)))))) * ? E I → #3
#2 ↓ → #1 → : I E → (– #3 #2)
→ : E I → T * : I → (λ0 #1 (λ0
#3 #5)) → (λ0 #1 (λ0 #4 #5)))
NIL))))
(λ0
(λ0 #1 (λ0 #3 (λ0 #5 (λ0 (: E
→ (λ0 E (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # (λ0 # NIL))))))) * ? E
I → #3 #3 ↓ → #9 → : I E → (×
#3 #3) → : E I → T * : I → (λ0
#1 (λ0 #4 #5)) → (λ0 #1 (λ0 #6
#4))) NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #5 (λ0 (: E →
(λ0 E (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL)))))))) *
? E I → T F → : I E → (λ0 E T)
(λ0 I F) – #21 ‖ #1 ‖ #2 #3 ↓
→ #0 (λ0 E (λ0 #3 (λ0 #2 (λ0 #1
(λ0 #1 (λ0 #2 (λ0 #3 NIL)))))))
(λ0 I (λ0 #1 (λ0 #2 (λ0 #3 (λ0
#1 (λ0 #2 (λ0 #3 NIL))))))) ↓ →
(λ0 I (λ0 (λ0 E #18) (λ0 (λ0 I
#17) (λ0 (λ0 E #15) (λ0 (λ0 I
#13) (λ0 (λ0 E #12) (λ0 (λ0 I
#9) (λ0 (λ0 E #8) (λ0 (λ0 I #7)
(λ0 (λ0 E #5) (λ0 (λ0 I #3) (λ0
(λ0 E #0) NIL)))))))))))) * ? E
I # → : I E → (λ0 I NIL) → ? I
E # → : E I → (λ0 E (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# NIL)))))))) → : E I → (λ0 (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # NIL))))))) I) ↓ → (λ0 E
NIL) (λ0 I (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # NIL)))))))
* : I → (λ0 #1 (λ0 #6 #4)) →
(λ0 #0 (λ0 #3 #4)) * : I → (λ0
#1 (λ0 #4 #5)) → (λ0 #1 (λ0 #6
#4))) NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #4 (λ0 (: I →
(λ0 #1 (λ0 #6 #4)) → (λ0 #0 (λ0
#1 #6))) NIL))))
(λ0
(λ0 #0 (λ0 #1 (λ0 #6 (λ0 (: I →
(λ0 #0 (λ0 #1 #6)) → (λ0 #0 (λ0
#3 #6))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #6 (λ0 (: I →
(λ0 #0 (λ0 #3 #6)) → (λ0 #0 (λ0
#3 #4))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #4 (λ0 (: I →
A @ #3 (λ0 #0 (λ0 #2 #2)) → @
#3 (λ0 (λ0 # (λ0 # (λ0 #))) (λ0
(λ0 # (λ0 A (λ0 ·))) (λ0 (λ0 #
(λ0 E (λ0 ·))) NIL))) * ? E A #
→ : A E → (λ0 A NIL) → ? A E #
→ : E A → (λ0 E (λ0 # (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# NIL))))))))) → : E A → (λ0 (λ0
# NIL) A) ↓ → (λ0 E (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL)))))))) (λ0 A (λ0 # NIL)) * :
I → (λ0 #0 (λ0 #3 #4)) → (λ0 #0
(λ0 #3 #6))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #6 (λ0 (: I →
(λ0 #0 (λ0 #3 #6)) → A #3 * :
I → (λ0 #0 (λ0 #3 #6)) → (λ0 #0
(λ0 #6 #1))) NIL))))
(λ0
(λ0 #0 (λ0 #6 (λ0 #1 (λ0 (: I →
(λ0 #0 (λ0 #6 #1)) → A #3 * :
I → (λ0 #0 (λ0 #6 #1)) → (λ0 #2
(λ0 #1 #1))) NIL))))
(λ0
(λ0 #2 (λ0 #1 (λ0 #1 (λ0 (: I →
(λ0 #2 (λ0 #1 #1)) → A #3 * :
I → (λ0 #2 (λ0 #1 #1)) → (λ0 #2
(λ0 #2 #3))) NIL))))
(λ0
(λ0 #2 (λ0 #2 (λ0 #3 (λ0 (: I →
(λ0 #2 (λ0 #1 #1)) → A #3 * : I
→ (λ0 #2 (λ0 #2 #3)) → (λ0 #2
(λ0 #2 #3))) NIL))))
(λ0
(λ0 #2 (λ0 #3 (λ0 #5 (λ0 (: I →
(λ0 #2 (λ0 #1 #1)) → A #3 * : I
→ (λ0 #2 (λ0 #3 #5)) → (λ0 #2
(λ0 #5 #4))) NIL))))
(λ0
(λ0 #2 (λ0 #5 (λ0 #4 (λ0 (: I →
(λ0 #2 (λ0 #1 #1)) → A #3 * : I
→ (λ0 #2 (λ0 #5 #4)) → (λ0 #2
(λ0 #6 #1))) NIL))))
(λ0
(λ0 #2 (λ0 #6 (λ0 #1 (λ0 (: I →
(λ0 #2 (λ0 #1 #1)) → A #3 * :
I → (λ0 #2 (λ0 #6 #1)) → (λ0 #3
(λ0 #1 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #1 (λ0 (? I
A → T F → : A I → (λ0 I T) (λ0
A F) – #21 ‖ #1 ‖ #2 #3 ↓ →
#0 (λ0 I (λ0 #3 (λ0 #3 (λ0 #2
(λ0 #2 (λ0 #1 (λ0 #1 NIL)))))))
(λ0 A (λ0 #1 (λ0 #1 (λ0 #3 (λ0
#3 (λ0 #2 (λ0 #2 NIL))))))) ↓
→ (λ0 I (λ0 (λ0 I #18) (λ0 (λ0
A #17) (λ0 (λ0 I #14) (λ0 (λ0
A #13) (λ0 (λ0 I #11) (λ0 (λ0
A #8) (λ0 (λ0 I #6) (λ0 (λ0 A
#3) (λ0 (λ0 I #2) (λ0 (λ0 A #0)
NIL)))))))))) * : I → (λ0 I (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # NIL)))))))) ↓ → (λ0 I (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL))))))) * : I → (λ0 #3 (λ0 #1
#1)) → (λ0 #3 (λ0 #6 #6)) * :
I → (λ0 #3 (λ0 #1 #1)) → (λ0 #3
(λ0 #1 #4))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #4 (λ0 (? I
→ #3 #1 ↓ → #3 → : I → (× #3
#1) → T * : I → (λ0 I (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL))))))) ↓ → (λ0 I (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL)))))) * :
I → (λ0 #3 (λ0 #1 #4)) → (λ0 #3
(λ0 #1 #6))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #6 (λ0 (? I
→ #3 #3 ↓ → #0 → : I → (– #3
#3) → T * : I → (λ0 I (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # NIL))))))) ↓
→ (λ0 I (λ0 # (λ0 # (λ0 # (λ0
# NIL))))) * : I → (λ0 #3 (λ0
#1 #6)) → (λ0 #3 (λ0 #3 #6)))
NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #6 (λ0 (? I →
#3 #6 ↓ → #9 → : I → (+ #3 #6)
→ T * : I → (λ0 I (λ0 # (λ0 #
(λ0 # (λ0 # NIL))))) ↓ → (λ0 I
(λ0 # (λ0 # (λ0 # NIL)))) * : I
→ (λ0 #3 (λ0 #3 #6)) → (λ0 #3
(λ0 #3 #3))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #3 (λ0 (? I
→ T T ↓ → F → : I → (! T T)
→ T * : I → (λ0 I (λ0 # (λ0 #
(λ0 # NIL)))) ↓ → (λ0 I (λ0 #
(λ0 # NIL))) * : I → (λ0 #3 (λ0
#3 #3)) → (λ0 #3 (λ0 #3 #1)))
NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #1 (λ0 (? I →
F T ↓ → F → : I → (‖ F T) → T
* : I → (λ0 I (λ0 # (λ0 # NIL)))
↓ → (λ0 I (λ0 # NIL)) * : I →
(λ0 #3 (λ0 #3 #1)) → (λ0 #3 (λ0
#5 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #5 (λ0 #1 (λ0 (? I →
F T ↓ → F → : I → (& F T) → T
```

```
* : I → (λ0 I (λ0 # NIL)) ↓ →
(λ0 I NIL) * : I → (λ0 #3 (λ0
#5 #1)) → (λ0 #3 (λ0 #6 #6)))
NIL))))
(λ0
(λ0 #3 (λ0 #6 (λ0 #6 (λ0 (:
I → (λ0 I (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL)))))))) * : I → A @ #37 (λ0
#3 (λ0 #8 #8)) → A @ #37 (λ0 #0
(λ0 #6 #1)) * : I → A @ #37 (λ0
#0 (λ0 #2 #2)) → @ #37 (λ0 (λ0
# (λ0 · (λ0 #))) (λ0 (λ0 # (λ0
A (λ0 ·))) (λ0 (λ0 # (λ0 # (λ0
#))) NIL))) * : I → N @ #37 (λ0
#3 (λ0 #8 #8)) → N @ #37 (λ0 #0
(λ0 #3 #4)) * : I → N @ #37 (λ0
#0 (λ0 #2 #2)) → @ #37 (λ0 (λ0
# (λ0 # (λ0 #))) (λ0 (λ0 · (λ0
N (λ0 *))) (λ0 (λ0 · (λ0 · (λ0
#))) NIL))) * : I → E @ #37 (λ0
#3 (λ0 #8 #8)) → E @ #37 (λ0 #1
(λ0 #6 #6)) * : I → E @ #37 (λ0
#1 (λ0 #2 #2)) → @ #37 (λ0 (λ0
# (λ0 * (λ0 #))) (λ0 (λ0 # (λ0
E (λ0 #))) (λ0 (λ0 # (λ0 # (λ0
#))) NIL))) * I : — @ @) NIL))))
NIL)))))))))))))))))))))))))))))))
)))))))

ANZU = (λ0 A
(λ0
(λ0 #2 (λ0 #1 (λ0 #1 (λ0 (: A →
(λ0 #2 (λ0 #1 #1)) → E #0 * :
A → (λ0 #2 (λ0 #1 #1)) → (λ0 #0
(λ0 #6 #1))) NIL))))
(λ0
(λ0 #0 (λ0 #6 (λ0 #1 (λ0 (: A →
(λ0 #0 (λ0 #6 #1)) → E #4 * :
A → (λ0 #0 (λ0 #6 #1)) → (λ0 #0
(λ0 #3 #6))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #6 (λ0 : A →
(λ0 #0 (λ0 #3 #6)) → E #4 * :
A → (λ0 #0 (λ0 #3 #6)) → (λ0 #0
(λ0 #3 #3)) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #3 (λ0 (? A
E → T F → : E A → (λ0 A T) (λ0
E F) — #21 ‖ #1 ‖ #2 #3 ↓ →
#0 (λ0 A (λ0 #2 (λ0 #2 (λ0 #3
(λ0 #3 (λ0 #2 (λ0 #2 NIL)))))))
(λ0 E (λ0 #3 (λ0 #2 (λ0 #1 (λ0
#1 (λ0 #2 (λ0 #3 NIL))))))) ↓
→ (λ0 A (λ0 (λ0 A #19) (λ0 (λ0
E #16) (λ0 (λ0 A #14) (λ0 (λ0
E #12) (λ0 (λ0 A #9) (λ0 (λ0
E #8) (λ0 (λ0 A #5) (λ0 (λ0 E
#4) (λ0 (λ0 A #2) (λ0 (λ0 E #0)
NIL)))))))))) * ? E A # → : A
E → (λ0 A NIL) → ? A E # → :
E A → (λ0 E (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL))))))))) → : E A → (λ0 (λ0
# NIL) A) ↓ → (λ0 E (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL)))))))) (λ0 A (λ0 # NIL)) * :
A → (λ0 #0 (λ0 #3 #3)) → (λ0 #3
(λ0 #5 #1)) * : A → (λ0 #0 (λ0
#3 #3)) → (λ0 #0 (λ0 #3 #4)))
NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #4 (λ0 (: A →
(λ0 #0 (λ0 #3 #4)) → (λ0 #0 (λ0
#3 #6))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #6 (λ0 (: A →
(λ0 #0 (λ0 #3 #6)) → (λ0 #0 (λ0
#6 #1))) NIL))))
(λ0
(λ0 #0 (λ0 #6 (λ0 #1 (λ0 (: A →
(λ0 #0 (λ0 #6 #1)) → (λ0 #2 (λ0
#1 #1))) NIL))))
(λ0
(λ0 #2 (λ0 #1 (λ0 #1 (λ0 (: A →
(λ0 #2 (λ0 #1 #1)) → (λ0 #2 (λ0
#2 #3))) NIL))))
(λ0
(λ0 #2 (λ0 #2 (λ0 #3 (λ0 (: A →
(λ0 #2 (λ0 #2 #3)) → (λ0 #2 (λ0
#3 #5))) NIL))))
(λ0
(λ0 #2 (λ0 #3 (λ0 #5 (λ0 (: A →
(λ0 #2 (λ0 #3 #5)) → (λ0 #2 (λ0
#5 #4))) NIL))))
(λ0
(λ0 #2 (λ0 #5 (λ0 #4 (λ0 (: A →
(λ0 #2 (λ0 #5 #4)) → (λ0 #2 (λ0
#6 #1))) NIL))))
(λ0
(λ0 #2 (λ0 #6 (λ0 #1 (λ0 (: A →
(λ0 #2 (λ0 #6 #1)) → (λ0 #3 (λ0
#1 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #1 (λ0 (: A →
(λ0 #3 (λ0 #1 #1)) → (λ0 #3 (λ0
#1 #4))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #4 (λ0 (: A →
(λ0 #3 (λ0 #1 #4)) → (λ0 #3 (λ0
#1 #6))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #6 (λ0 (: A →
(λ0 #3 (λ0 #1 #6)) → (λ0 #3 (λ0
#3 #6))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #6 (λ0 (: A →
(λ0 #3 (λ0 #3 #6)) → (λ0 #3 (λ0
#3 #3))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #3 (λ0 (: A →
(λ0 #3 (λ0 #3 #3)) → (λ0 #3 (λ0
#3 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #1 (λ0 (: A →
(λ0 #3 (λ0 #3 #1)) → (λ0 #3 (λ0
#5 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #5 (λ0 #1 (λ0 (: A →
(λ0 #3 (λ0 #5 #1)) → (λ0 #3 (λ0
#6 #6))) NIL))))
(λ0
(λ0 #3 (λ0 #6 (λ0 #6 (λ0 (: A
→ (λ0 #3 (λ0 #6 #6)) → N #6)
NIL))))
(λ0
(λ0 #3 (λ0 #6 (λ0 #6 (λ0 (: A
→ (λ0 #3 (λ0 #6 #6)) → N #8)
NIL))))
(λ0
(λ0 #3 (λ0 #6 (λ0 #6 (λ0 (: A
→ (λ0 #3 (λ0 #6 #6)) → N #6)
NIL))))
(λ0
(λ0 #3 (λ0 #5 (λ0 #4 (λ0 (? N
A → T F → : A N → (λ0 N T) (λ0
A F) — #21 ‖ #1 ‖ #2 #3 ↓ → #0
(λ0 N (λ0 #3 (λ0 #3 (λ0 #2 (λ0
#2 (λ0 #3 (λ0 #3 NIL))))))) (λ0
A (λ0 #2 (λ0 #3 (λ0 #1 (λ0 #2
(λ0 #3 (λ0 #1 NIL))))))) ↓ → (λ0
A (λ0 (λ0 N #18) (λ0 (λ0 A #16)
(λ0 (λ0 N #13) (λ0 (λ0 A #10)
(λ0 (λ0 N #8) (λ0 (λ0 A #7) (λ0
(λ0 N #5) (λ0 (λ0 A #3) (λ0 (λ0
N #0) NIL)))))))))) * : A → (λ0
A (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # NIL)))))))))
↓ → (λ0 A NIL) * : A → (λ0 #3
(λ0 #5 #4)) → N #1 * : A → (λ0
#3 (λ0 #5 #4)) → (λ0 #3 (λ0 #5
#3))) NIL))))
(λ0
(λ0 #3 (λ0 #5 (λ0 #3 (λ0 (? A →
F T ↓ → F → : A → (& F T) → T
* : A → (λ0 #3 (λ0 #5 #3)) → N
#2 * : A → (λ0 #3 (λ0 #5 #3)) →
(λ0 #3 (λ0 #5 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #5 (λ0 #1 (λ0 (? A →
F T ↓ → T → : A → (‖ F T) → T
* : A → (λ0 #3 (λ0 #5 #1)) → N
```

```
#2 * : A → (λ0 #3 (λ0 #5 #1)) →
(λ0 #3 (λ0 #3 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #1 (λ0 (? A →
T T ↓ → F → : A → (! T T) → T
* : A → (λ0 #3 (λ0 #3 #1)) → N
#3 * : A → (λ0 #3 (λ0 #3 #1)) →
(λ0 #3 (λ0 #3 #4))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #4 (λ0 (? A
→ #3 #6 ↓ → #9 → : A → (+ #3
#6) → T * : A → (λ0 #3 (λ0 #3
#4)) → N #2 * : A → (λ0 #3 (λ0
#3 #4)) → (λ0 #3 (λ0 #3 #6)))
NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #6 (λ0 (? A
→ #3 #3 ↓ → #0 → : A → (− #3
#3) → T * : A → (λ0 #3 (λ0 #3
#6)) → N #2 * : A → (λ0 #3 (λ0
#3 #6)) → (λ0 #3 (λ0 #1 #6)))
NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #6 (λ0 (? A
→ #3 #1 ↓ → #3 → : A → (× #3
#1) → T * : A → (λ0 #3 (λ0 #1
#6)) → N #3 * : A → (λ0 #3 (λ0
#1 #6)) → (λ0 #3 (λ0 #1 #3)))
NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #3 (λ0 (: A
→ (λ0 #3 (λ0 #1 #3)) → N #2)
NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #3 (λ0 (: A
→ (λ0 #3 (λ0 #1 #3)) → I #2 *
? I A → T F → : A I → (λ0 I T)
(λ0 A F) − #21 ‖ #1 ‖ #2 #3 ↓
→ #0 (λ0 I (λ0 #3 (λ0 #3 (λ0 #2
(λ0 #2 (λ0 #1 (λ0 #1 NIL)))))))
(λ0 A (λ0 #1 (λ0 #1 (λ0 #3 (λ0
#3 (λ0 #2 (λ0 #2 NIL)))))))) ↓
→ (λ0 I (λ0 (λ0 I #18) (λ0 (λ0
A #17) (λ0 (λ0 I #14) (λ0 (λ0
A #13) (λ0 (λ0 I #11) (λ0 (λ0
A #8) (λ0 (λ0 I #6) (λ0 (λ0 A
#3) (λ0 (λ0 I #2) (λ0 (λ0 A #0)
NIL)))))))))) * : A → (λ0 #3 (λ0
#1 #3)) → (λ0 #3 (λ0 #1 #1)))
NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #1 (λ0 (: A →
(λ0 #3 (λ0 #1 #1)) → (λ0 #2 (λ0
#6 #1)) * : A → (λ0 #3 (λ0 #1
#1)) → N #2) NIL))))
(λ0
(λ0 #2 (λ0 #6 (λ0 #1 (λ0 (: A →
(λ0 #2 (λ0 #6 #1)) → N #5 * :
A → (λ0 #2 (λ0 #6 #1)) → (λ0 #2
(λ0 #5 #2))) NIL))))
(λ0
(λ0 #2 (λ0 #5 (λ0 #2 (λ0 (: A →
(λ0 #2 (λ0 #5 #2)) → N #6 * :
A → (λ0 #2 (λ0 #5 #2)) → (λ0 #2
(λ0 #5 #5))) NIL))))
(λ0
(λ0 #2 (λ0 #5 (λ0 #5 (λ0 (: A →
(λ0 #2 (λ0 #5 #5)) → N #8 * :
A → (λ0 #2 (λ0 #5 #5)) → (λ0 #2
(λ0 #2 #5))) NIL))))
(λ0
(λ0 #2 (λ0 #2 (λ0 #5 (λ0 (: A →
(λ0 #2 (λ0 #2 #5)) → N #0 * :
A → (λ0 #2 (λ0 #2 #5)) → (λ0 #2
(λ0 #1 #1))) NIL))))
(λ0
(λ0 #2 (λ0 #1 (λ0 #1 (λ0 (: A →
(λ0 #2 (λ0 #1 #1)) → N #0 * :
A → (λ0 #2 (λ0 #1 #1)) → (λ0 #0
(λ0 #6 #1))) NIL))))
(λ0
(λ0 #0 (λ0 #6 (λ0 #1 (λ0 (: A
→ (λ0 #0 (λ0 #6 #1)) → N #6)
NIL))))
NIL)))))))))))))))))))))))))))))))
)))))))
```

```
NINURTA = (λ0 N
(λ0
(λ0 #2 (λ0 #3 (λ0 #6 (λ0 (: N
→ (λ0 #2 (λ0 #3 #6)) → E #0)
NIL))))
(λ0
(λ0 #2 (λ0 #3 (λ0 #6 (λ0 (: N
→ (λ0 #2 (λ0 #3 #6)) → E #0)
NIL))))
(λ0
(λ0 #2 (λ0 #3 (λ0 #6 (λ0 (: N →
(λ0 #2 (λ0 #3 #6)) → E #0 * :
N → (λ0 #2 (λ0 #3 #6)) → (λ0 #2
(λ0 #2 #5))) NIL))))
(λ0
(λ0 #2 (λ0 #2 (λ0 #5 (λ0 (: N →
(λ0 #2 (λ0 #2 #5)) → E #0 * :
N → (λ0 #2 (λ0 #2 #5)) → (λ0 #2
(λ0 #1 #1))) NIL))))
(λ0
(λ0 #2 (λ0 #1 (λ0 #1 (λ0 (: N →
(λ0 #2 (λ0 #1 #1)) → E #0 * :
N → (λ0 #2 (λ0 #1 #1)) → (λ0 #0
(λ0 #6 #1))) NIL))))
(λ0
(λ0 #0 (λ0 #6 (λ0 #1 (λ0 (: N →
(λ0 #0 (λ0 #6 #1)) → E #4 * :
N → (λ0 #0 (λ0 #6 #1)) → (λ0 #0
(λ0 #3 #6))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #6 (λ0 (: N →
(λ0 #0 (λ0 #3 #6)) → E #4 * :
N → (λ0 #0 (λ0 #3 #6)) → (λ0 #0
(λ0 #3 #4))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #4 (λ0 (? N
E → E @ #3 → : E N → ? E A # →
: A E → (λ0 A NIL) → ? A E # →
: E A → (λ0 E (λ0 # (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# NIL)))))))) → : E A → (λ0 (λ0
# NIL) A) ↓ → (λ0 E (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL)))))))) (λ0 A (λ0 # NIL)) * :
N → (λ0 #0 (λ0 #3 #4)) → A #2 *
: N → (λ0 #0 (λ0 #3 #4)) → (λ0
#0 (λ0 #3 #6))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #6 (λ0 (: N →
(λ0 #0 (λ0 #3 #6)) → A #2 * :
N → (λ0 #0 (λ0 #3 #6)) → (λ0 #0
(λ0 #6 #1))) NIL))))
(λ0
(λ0 #0 (λ0 #6 (λ0 #1 (λ0 (: N →
(λ0 #0 (λ0 #6 #1)) → A #2 * :
N → (λ0 #0 (λ0 #6 #1)) → (λ0 #2
(λ0 #1 #1))) NIL))))
(λ0
(λ0 #2 (λ0 #1 (λ0 #1 (λ0 (: N →
(λ0 #2 (λ0 #1 #1)) → A #7 * :
N → (λ0 #2 (λ0 #1 #1)) → (λ0 #2
(λ0 #2 #3))) NIL))))
(λ0
(λ0 #2 (λ0 #2 (λ0 #3 (λ0 (: N →
(λ0 #2 (λ0 #2 #3)) → A #6 * :
N → (λ0 #2 (λ0 #2 #3)) → (λ0 #2
(λ0 #3 #5))) NIL))))
(λ0
(λ0 #2 (λ0 #3 (λ0 #5 (λ0 (: N →
(λ0 #2 (λ0 #3 #5)) → A #3 * :
N → (λ0 #2 (λ0 #3 #5)) → (λ0 #2
(λ0 #5 #4))) NIL))))
(λ0
(λ0 #2 (λ0 #5 (λ0 #4 (λ0 (: N →
(λ0 #2 (λ0 #5 #4)) → A #3 * :
N → (λ0 #2 (λ0 #5 #4)) → (λ0 #2
(λ0 #6 #1))) NIL))))
(λ0
(λ0 #2 (λ0 #6 (λ0 #1 (λ0 (: N →
(λ0 #2 (λ0 #6 #1)) → A #3 * :
N → (λ0 #2 (λ0 #6 #1)) → (λ0 #3
(λ0 #1 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #1 (λ0 (: N →
(λ0 #3 (λ0 #1 #1)) → A #7 * :
```

```
N → (λ0 #3 (λ0 #1 #1)) → (λ0 #3
(λ0 #1 #4))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #4 (λ0 (: N →
(λ0 #3 (λ0 #1 #4)) → A #3 ∗ :
N → (λ0 #3 (λ0 #1 #4)) → (λ0 #3
(λ0 #1 #6))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #6 (λ0 (: N →
(λ0 #3 (λ0 #1 #6)) → A #7 ∗ :
N → (λ0 #3 (λ0 #1 #6)) → (λ0 #3
(λ0 #3 #6))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #6 (λ0 (: N →
(λ0 #3 (λ0 #3 #6)) → A #7 ∗ :
N → (λ0 #3 (λ0 #3 #6)) → (λ0 #3
(λ0 #3 #3))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #3 (λ0 (: N →
(λ0 #3 (λ0 #3 #3)) → A #6 ∗ :
N → (λ0 #3 (λ0 #3 #3)) → (λ0 #3
(λ0 #3 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #1 (λ0 (: N →
(λ0 #3 (λ0 #3 #1)) → A #8 ∗ :
N → (λ0 #3 (λ0 #3 #1)) → (λ0 #3
(λ0 #5 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #5 (λ0 #1 (λ0 (: N →
(λ0 #3 (λ0 #5 #1)) → A #6 ∗ :
N → (λ0 #3 (λ0 #5 #1)) → (λ0 #3
(λ0 #5 #3))) NIL))))
(λ0
(λ0 #3 (λ0 #5 (λ0 #3 (λ0 (? N
A → T F → : A N → (λ0 N T) (λ0
A F) – #21 ‖ #1 ‖ #2 #3 ↓ → #0
(λ0 N (λ0 #3 (λ0 #3 (λ0 #2 (λ0
#2 (λ0 #3 (λ0 #3 NIL))))))) (λ0
A (λ0 #2 (λ0 #3 (λ0 #1 (λ0 #2
(λ0 #3 (λ0 #1 NIL))))))) ↓ → (λ0
A (λ0 (λ0 N #18) (λ0 (λ0 A #16)
(λ0 (λ0 N #13) (λ0 (λ0 A #10)
(λ0 (λ0 N #8) (λ0 (λ0 A #7) (λ0
(λ0 N #5) (λ0 (λ0 A #3) (λ0 (λ0
N #0) NIL))))))))) ∗ : N → (λ0
#3 (λ0 #5 #3)) → (λ0 #3 (λ0 #1
#1)) ∗ : N → (λ0 #3 (λ0 #5 #3))
→ (λ0 #3 (λ0 #5 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #5 (λ0 #1 (λ0 (: N →
(λ0 #3 (λ0 #5 #1)) → (λ0 #3 (λ0
#3 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #1 (λ0 (: N →
(λ0 #3 (λ0 #3 #1)) → (λ0 #3 (λ0
#3 #4))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #4 (λ0 (: N →
(λ0 #3 (λ0 #3 #4)) → (λ0 #3 (λ0
#3 #6))) NIL))))
(λ0
(λ0 #3 (λ0 #3 (λ0 #6 (λ0 (: N →
(λ0 #3 (λ0 #3 #6)) → (λ0 #3 (λ0
#1 #6))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #6 (λ0 (: N →
(λ0 #3 (λ0 #1 #6)) → (λ0 #3 (λ0
#1 #3))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #3 (λ0 (: N →
(λ0 #3 (λ0 #1 #3)) → (λ0 #3 (λ0
#1 #1))) NIL))))
(λ0
(λ0 #3 (λ0 #1 (λ0 #1 (λ0 (: N →
(λ0 #3 (λ0 #1 #1)) → (λ0 #2 (λ0
#6 #1))) NIL))))
(λ0
(λ0 #2 (λ0 #6 (λ0 #1 (λ0 (: N
→ (λ0 #2 (λ0 #6 #1)) → (λ0 #2
(λ0 #1 #1)) ∗ : N → (λ0 #2 (λ0
#6 #1)) → (λ0 #2 (λ0 #5 #2)))
NIL))))
(λ0
(λ0 #2 (λ0 #5 (λ0 #2 (λ0 (: N →
(λ0 #2 (λ0 #5 #2)) → (λ0 #2 (λ0
#5 #5))) NIL))))
(λ0
(λ0 #2 (λ0 #5 (λ0 #5 (λ0 (: N →
(λ0 #2 (λ0 #5 #5)) → (λ0 #2 (λ0
#2 #5))) NIL))))
(λ0
(λ0 #2 (λ0 #2 (λ0 #5 (λ0 (: N →
(λ0 #2 (λ0 #2 #5)) → (λ0 #2 (λ0
#1 #1))) NIL))))
(λ0
(λ0 #2 (λ0 #1 (λ0 #1 (λ0 (: N →
(λ0 #2 (λ0 #1 #1)) → (λ0 #0 (λ0
#6 #1))) NIL))))
(λ0
(λ0 #0 (λ0 #6 (λ0 #1 (λ0 (: N →
(λ0 #0 (λ0 #6 #1)) → (λ0 #0 (λ0
#3 #6))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #6 (λ0 (: N →
(λ0 #0 (λ0 #3 #6)) → (λ0 #0 (λ0
#3 #4))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #4 (λ0 (: N
→ (λ0 #0 (λ0 #3 #4)) → A #6)
NIL))))
NIL)))))))))))))))))))))))))))))))
)))))))

ENKI = (λ0 E
(λ0
(λ0 #0 (λ0 #3 (λ0 #6 (λ0 (: E →
(λ0 #0 (λ0 #3 #6)) → (λ0 #0 (λ0
#4 #3))) NIL))))
(λ0
(λ0 #0 (λ0 #4 (λ0 #3 (λ0 (:
E → (λ0 E (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL))))))))) ∗ : E → I @ #1 (λ0
#3 (λ0 #8 #8)) → I @ #1 (λ0 #1
(λ0 #4 #4)) ∗ : E → N @ #1 (λ0
#3 (λ0 #8 #8)) → N @ #1 (λ0 #2
(λ0 #3 #6)) ∗ : E → A @ #1 (λ0
#3 (λ0 #8 #8)) → A @ #1 (λ0 #0
(λ0 #6 #1))) NIL))))
(λ0
(λ0 #0 (λ0 #4 (λ0 #3 (λ0 (:
E → (λ0 E (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL))))))))) ∗ : E → I @ #2 (λ0
#1 (λ0 #2 #2)) → @ #2 (λ0 (λ0
· (λ0 · (λ0 ·))) (λ0 (λ0 · (λ0
I (λ0 ·))) (λ0 (λ0 · (λ0 · (λ0
#))) NIL))) ∗ : E → N @ #2 (λ0
#2 (λ0 #2 #2)) → @ #2 (λ0 (λ0
· (λ0 · (λ0 #))) (λ0 (λ0 · (λ0
N (λ0 #))) (λ0 (λ0 ∗ (λ0 # (λ0
#))) NIL))) ∗ : E → A @ #2 (λ0
#0 (λ0 #2 #2)) → @ #2 (λ0 (λ0
# (λ0 · (λ0 #))) (λ0 (λ0 ∗ (λ0
A (λ0 #))) (λ0 (λ0 # (λ0 · (λ0
#))) NIL)))) NIL))))
(λ0
(λ0 #0 (λ0 #4 (λ0 #3 (λ0 (? A
E → T F → : E A → (λ0 A T) (λ0
E F) – #21 ‖ #1 ‖ #2 #3 ↓ →
#0 (λ0 A (λ0 #2 (λ0 #2 (λ0 #3
(λ0 #3 (λ0 #2 (λ0 #2 NIL)))))))
(λ0 E (λ0 #3 (λ0 #2 (λ0 #1 (λ0
#1 (λ0 #2 (λ0 #3 NIL))))))) ↓
→ (λ0 A (λ0 (λ0 A #19) (λ0 (λ0
E #16) (λ0 (λ0 A #14) (λ0 (λ0
E #12) (λ0 (λ0 A #9) (λ0 (λ0
E #8) (λ0 (λ0 A #5) (λ0 (λ0 E
#4) (λ0 (λ0 A #2) (λ0 (λ0 E #0)
NIL))))))))))) ∗ ? E A # → : A
E → (λ0 A NIL) → ? A E # → :
E A → (λ0 E (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL))))))))) → : E A → (λ0 (λ0
# NIL) A) ↓ → (λ0 E (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL))))))))) (λ0 A (λ0 # NIL)) ∗ :
E → (λ0 #0 (λ0 #4 #3)) → N #2)
NIL))))
(λ0
(λ0 #0 (λ0 #4 (λ0 #3 (λ0 (: E
→ (λ0 #0 (λ0 #4 #3)) → N #2)
```

```
NIL))))
(λ0
(λ0 #0 (λ0 #4 (λ0 #3 (λ0 (: E
→ (λ0 #0 (λ0 #4 #3)) → N #4)
NIL))))
(λ0
(λ0 #0 (λ0 #4 (λ0 #3 (λ0 (: E →
(λ0 #0 (λ0 #4 #3)) → N #4 ∗ :
E → (λ0 #0 (λ0 #4 #3)) → (λ0 #0
(λ0 #3 #3))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #3 (λ0 (? N
E → E @ #3 → : E N → ? E A # →
: A E → (λ0 A NIL) → ? A E # →
: E A → (λ0 E (λ0 # (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# NIL))))))))) → : E A → (λ0 (λ0
# NIL) A) ↓ → (λ0 E (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL)))))))) (λ0 A (λ0 # NIL)) ∗ :
E → (λ0 #0 (λ0 #3 #3)) → I #1 ∗
: E → (λ0 #0 (λ0 #3 #3)) → (λ0
#0 (λ0 #3 #4))) NIL))))
(λ0
(λ0 #0 (λ0 #3 (λ0 #4 (λ0 (: E →
(λ0 #0 (λ0 #3 #4)) → I #1 ∗ :
E → (λ0 #0 (λ0 #3 #4)) → (λ0 #0
(λ0 #1 #6))) NIL))))
(λ0
(λ0 #0 (λ0 #1 (λ0 #6 (λ0 (: E →
(λ0 #0 (λ0 #1 #6)) → I #1 ∗ :
E → (λ0 #0 (λ0 #1 #6)) → (λ0 #1
(λ0 #6 #4))) NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #4 (λ0 (: E →
(λ0 #1 (λ0 #6 #4)) → I #2 ∗ :
E → (λ0 #1 (λ0 #6 #4)) → (λ0 #1
(λ0 #4 #3))) NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #3 (λ0 (? I E
→ @ #3 (λ0 #3 (λ0 #8 #8)) → : E
I @ #3 (λ0 #0 (λ0 #4 #3)) ∗ ? I
E → @ #3 (λ0 #0 (λ0 #2 #2)) → :
E I → @ #3 (λ0 (λ0 # (λ0 A (λ0
·))) (λ0 (λ0 # (λ0 E (λ0 ·)))
(λ0 (λ0 # (λ0 # (λ0 #))) NIL)))
∗ ? I E → E @ #3 → : E I → ? E
A # → : A E → (λ0 A NIL) → ? A
E # → : E A → (λ0 E (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # NIL))))))))) → : E A →
(λ0 (λ0 # NIL) A) ↓ → (λ0 E (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # NIL)))))))) (λ0 A (λ0 #
NIL)) ∗ : E → (λ0 #1 (λ0 #4 #3))
→ (λ0 #1 (λ0 #1 #1))) NIL))))
(λ0
(λ0 #1 (λ0 #1 (λ0 #1 (λ0 (: E
→ (λ0 E (λ0 # NIL)) ∗ ? E I →
T F ↓ → F → : I E → (& T F) →
: E I → T ∗ : E → (λ0 #1 (λ0
#1 #1)) → (λ0 #1 (λ0 #3 #1)))
NIL))))
(λ0
(λ0 #1 (λ0 #3 (λ0 #1 (λ0 (: E
→ (λ0 E (λ0 # (λ0 # NIL))) ∗ ?
E I → T F ↓ → T → : I E → (‖
T F) → : E I → T ∗ : E → (λ0
#1 (λ0 #3 #1)) → (λ0 #1 (λ0 #5
#1))) NIL))))
(λ0
(λ0 #1 (λ0 #5 (λ0 #1 (λ0 (: E →
(λ0 E (λ0 # (λ0 # (λ0 # NIL))))
∗ ? E I → T T ↓ → F → : I E →
(! T T) → : E I → T ∗ : E → (λ0
#1 (λ0 #5 #1)) → (λ0 #1 (λ0 #6
#1))) NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #1 (λ0 (: E →
(λ0 E (λ0 # (λ0 # (λ0 # (λ0 #
NIL))))) ∗ ? E I → #1 #2 ↓ → #3
→ : I E → (+ #1 #2) → : E I →
T ∗ : E → (λ0 #1 (λ0 #6 #1)) →
(λ0 #1 (λ0 #1 #6))) NIL))))
(λ0
(λ0 #1 (λ0 #1 (λ0 #6 (λ0 (: E
→ (λ0 E (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # NIL)))))) ∗ ? E I → #3
#2 ↓ → #1 → : I E → (− #3 #2)
→ : E I → T ∗ : E → (λ0 #1 (λ0
#1 #6)) → (λ0 #1 (λ0 #3 #6)))
NIL))))
(λ0
(λ0 #1 (λ0 #3 (λ0 #6 (λ0 (: E
→ (λ0 E (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # (λ0 # NIL))))))) ∗ ? E
I → #3 #3 ↓ → #9 → : I E → (×
#3 #3) → : E I → T ∗ : E → (λ0
#1 (λ0 #3 #6)) → (λ0 #1 (λ0 #4
#6))) NIL))))
(λ0
(λ0 #1 (λ0 #4 (λ0 #6 (λ0 (: E →
(λ0 E (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL)))))))) ∗
? E I → T F → : I E → (λ0 E T)
(λ0 I F) − #21 ‖ #1 ‖ #2 #3 ↓
→ #0 (λ0 E (λ0 #3 (λ0 #2 (λ0 #1
(λ0 #1 (λ0 #2 (λ0 #3 NIL)))))))
(λ0 I (λ0 #1 (λ0 #2 (λ0 #3 (λ0
#1 (λ0 #2 (λ0 #3 NIL))))))) ↓ →
(λ0 I (λ0 (λ0 E #18) (λ0 (λ0 I
#17) (λ0 (λ0 E #15) (λ0 (λ0 I
#13) (λ0 (λ0 E #12) (λ0 (λ0 I
#9) (λ0 (λ0 E #8) (λ0 (λ0 I #7)
(λ0 (λ0 E #5) (λ0 (λ0 I #3) (λ0
(λ0 E #0) NIL))))))))))))) ∗ ? E
I # → : I E → (λ0 I NIL) → ? I
E # → : E I → (λ0 E (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# NIL)))))))) → : E I → (λ0 (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # NIL))))))) I) ↓ → (λ0 E
NIL) (λ0 I (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # NIL))))))))
∗ : E → (λ0 #1 (λ0 #4 #6)) →
(λ0 #1 (λ0 #6 #6))) NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #3)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
```

```
→ (λ0 #1 (λ0 #6 #6)) → N #2)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #2)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #2)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #2)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #0)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #0)
NIL))))
(λ0
(λ0 #1 (λ0 #6 (λ0 #6 (λ0 (: E
→ (λ0 #1 (λ0 #6 #6)) → N #0)
NIL))))
NIL)))))))))))))))))))))))))))))))))
)))))))

*

AIDT = (λλCAR (INDEX 1 0))

AMAP = (λλλINDEX (λλ0) (INDEX 2
(CDR (INDEX 1 0))))

AROW = (λλλINDEX (λλ1 0) (INDEX
2 (CDR (INDEX 1 0))))

ACOL = (λλλINDEX (λλ1 (1 0))
(INDEX 2 (CDR (INDEX 1 0))))

ATXT = (λλλINDEX (λλ1 (1 (1 0)))
(INDEX 2 (CDR (INDEX 1 0))))

* * *

WORLD = (λ0 ANU (λ0 URUK (λ0
APSU (λ0 IRKALLA NIL))))

AGENTS = (λ0 ISHTAR (λ0 ANZU
(λ0 NINURTA (λ0 ENKI NIL))))

SPACE = (λ0 AGENTS WORLD)

*

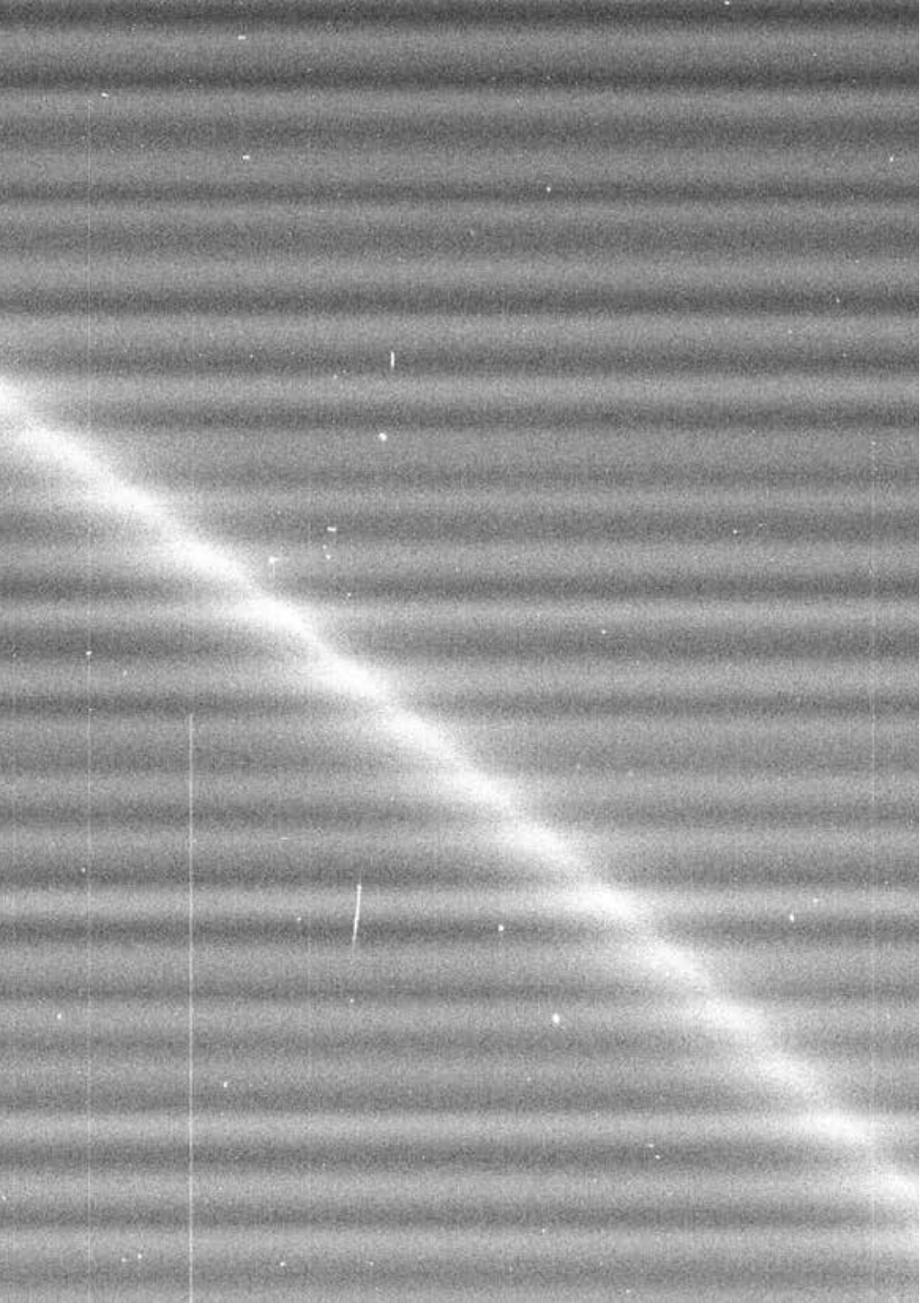
PROCESS = (λλλYCOMB (λλλλLT
2 (LENGTH 5) (3 (SUCC 2) (SET
(AMAP 6 2 5) (SETM (AROW 6 2 5)
(ACOL 6 2 5) (AIDT 2 5) (INDEX
(AMAP 6 2 5) 1)) 1) (CONS (CONS
(AIDT 2 5) (ATXT 6 2 5)) 0))
(CONS 1 (REVERSE 0))) (λλ0) 0
NIL)

TIME = (λYCOMB (λλλLT 1 (LENGTH
(CDR (INDEX (λλ0) (CAR 3)))) (2
(SUCC 1) (CONS (PROCESS 1 (CAR
3) (CDR 3)) 0)) (REVERSE 0))
(λλ0) NIL)

*

UNIVERSE = TIME SPACE

UNIVERSE
↓
→ ~
```



EXECUTION

```
(λ0
(λ0
(λ0
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 · (λ0 → (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 # (λ0 # (λ0 # (λ0 # (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 # (λ0 · (λ0 · (λ0 * (λ0 E (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 # (λ0 · (λ0 · (λ0 # (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 # (λ0 # (λ0 # (λ0 # (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 → (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))))
NIL))))))))
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(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))))
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(λ0 # (λ0 · (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 · (λ0 · (λ0 # (λ0 # (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 · (λ0 I (λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # (λ0 * (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 → (λ0 # (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))))
NIL))))))))
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(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 A (λ0 · (λ0 · (λ0 # (λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 * (λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 · (λ0 N (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 # (λ0 # (λ0 * (λ0 # (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 * (λ0 · (λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 → (λ0 · (λ0 # (λ0 · (λ0 · (λ0 · (λ0 # NIL))))))))
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(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))))
NIL))))))))
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(λ0 # (λ0 # (λ0 # (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))))
NIL))))))))
NIL))))
(λ0
(λ0 I (: I → (λ0 #1 (λ0 #4 #4)) → E #0))
(λ0
(λ0 A (: A → (λ0 #2 (λ0 #1 #1)) → E #0 * : A → (λ0 #2 (λ0 #1 #1))
→ (λ0 #0 (λ0 #6 #1))))
(λ0
(λ0 N (: N → (λ0 #2 (λ0 #3 #6)) → E #0))
(λ0
(λ0 E (: E → (λ0 #0 (λ0 #3 #6)) → (λ0 #0 (λ0 #4 #3))))
NIL)))))
(λ0
```

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(λ0
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(λ0 # (λ0 · (λ0 # (λ0 · (λ0 · (λ0 * (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 # (λ0 E (λ0 · (λ0 # (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 # (λ0 # (λ0 # (λ0 # (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 A (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))))
NIL))))))))
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(λ0 # (λ0 # (λ0 # (λ0 · (λ0 · (λ0 # (λ0 # (λ0 # NIL))))))))
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(λ0
(λ0 # (λ0 # (λ0 # (λ0 · (λ0 I (λ0 · (λ0 · (λ0 # NIL))))))))
(λ0
(λ0 # (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # (λ0 * (λ0 # NIL))))))))
(λ0
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NIL))))))))
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(λ0
(λ0 I (: I → (λ0 #1 (λ0 #4 #4)) → E #0))
(λ0
(λ0 A (: A → (λ0 #0 (λ0 #6 #1)) → E #4 * : A → (λ0 #0 (λ0 #6 #1))
→ (λ0 #0 (λ0 #3 #6))))
(λ0
(λ0 N (: N → (λ0 #2 (λ0 #3 #6)) → E #0))
(λ0
(λ0 E (: E → (λ0 E (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# NIL))))))))) * : E → I @ #1 (λ0 #3 (λ0 #8 #8)) → I @ #1 (λ0 #1
(λ0 #4 #4)) * : E → N @ #1 (λ0 #3 (λ0 #8 #8)) → N @ #1 (λ0 #2 (λ0
#3 #6)) * : E → A @ #1 (λ0 #3 (λ0 #8 #8)) → A @ #1 (λ0 #0 (λ0 #6
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NIL)))))
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(λ0 A (: A → (λ0 #0 (λ0 #3 #6)) → E #4 * : A → (λ0 #0 (λ0 #3 #6))
→ (λ0 #0 (λ0 #3 #3))))
(λ0
(λ0 N (: N → (λ0 #2 (λ0 #3 #6)) → E #0 * : N → (λ0 #2 (λ0 #3 #6))
→ (λ0 #2 (λ0 #2 #5))))
(λ0
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(λO E (: E → (λO E (λO # (λO # (λO # (λO # (λO # (λO # (λO # (λO
# NIL))))))))) * : E → I @ #2 (λO #1 (λO #2 #2)) → @ #2 (λO (λO ·
(λO · (λO ·))) (λO (λO · (λO I (λO ·))) (λO (λO · (λO · (λO #)))
NIL))) * : E → N @ #2 (λO #2 (λO #2 #2)) → @ #2 (λO (λO · (λO ·
(λO #))) (λO (λO · (λO N (λO #))) (λO (λO * (λO # (λO #))) NIL)))
* : E → A @ #2 (λO #0 (λO #2 #2)) → @ #2 (λO (λO # (λO · (λO #)))
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NIL))))))))
NIL))))
(λO
(λO I (: I → (λO #1 (λO #4 #4)) → E #0))
(λO
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(λ0 A (? A E → T F → : E A → (λ0 A T) (λ0 E F) — #21 ‖ #1 ‖ #2 #3
↓ → #0 (λ0 A (λ0 #2 (λ0 #2 (λ0 #3 (λ0 #3 (λ0 #2 (λ0 #2 NIL)))))))
(λ0 E (λ0 #3 (λ0 #2 (λ0 #1 (λ0 #1 (λ0 #2 (λ0 #3 NIL))))))) ↓ → (λ0
A (λ0 (λ0 A #19) (λ0 (λ0 E #16) (λ0 (λ0 A #14) (λ0 (λ0 E #12) (λ0
(λ0 A #9) (λ0 (λ0 E #8) (λ0 (λ0 A #5) (λ0 (λ0 E #4) (λ0 (λ0 A #2)
(λ0 (λ0 E #0) NIL))))))))))) ∗ ? E A # → : A E → (λ0 A NIL) → ? A
E # → : E A → (λ0 E (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# NIL))))))))) → : E A → (λ0 (λ0 # NIL) A) ↓ → (λ0 E (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))) (λ0 A (λ0 # NIL)) ∗ : A →
(λ0 #0 (λ0 #3 #3)) → (λ0 #3 (λ0 #5 #1)) ∗ : A → (λ0 #0 (λ0 #3 #3))
→ (λ0 #0 (λ0 #3 #4))))
(λ0
(λ0 N (: N → (λ0 #2 (λ0 #2 #5)) → E #0 ∗ : N → (λ0 #2 (λ0 #2 #5))
→ (λ0 #2 (λ0 #1 #1))))
(λ0
(λ0 E (? A E → T F → : E A → (λ0 A T) (λ0 E F) — #21 ‖ #1 ‖ #2 #3
↓ → #0 (λ0 A (λ0 #2 (λ0 #2 (λ0 #3 (λ0 #3 (λ0 #2 (λ0 #2 NIL)))))))
(λ0 E (λ0 #3 (λ0 #2 (λ0 #1 (λ0 #1 (λ0 #2 (λ0 #3 NIL))))))) ↓ → (λ0
A (λ0 (λ0 A #19) (λ0 (λ0 E #16) (λ0 (λ0 A #14) (λ0 (λ0 E #12) (λ0
(λ0 A #9) (λ0 (λ0 E #8) (λ0 (λ0 A #5) (λ0 (λ0 E #4) (λ0 (λ0 A #2)
(λ0 (λ0 E #0) NIL))))))))))) ∗ ? E A # → : A E → (λ0 A NIL) → ? A
E # → : E A → (λ0 E (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# NIL))))))))) → : E A → (λ0 (λ0 # NIL) A) ↓ → (λ0 E (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))) (λ0 A (λ0 # NIL)) ∗ : E →
(λ0 #0 (λ0 #4 #3)) → N #2))
NIL)))))
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(λ0 # (λ0 → (λ0 · (λ0 # (λ0 · (λ0 · (λ0 · (λ0 # NIL))))))))
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NIL))))))))
(λ0
(λ0 I (: I → (λ0 #1 (λ0 #4 #4)) → E #0))
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(λ0 A (: A → (λ0 #0 (λ0 #3 #4)) → (λ0 #0 (λ0 #3 #6))))
(λ0
(λ0 N (: N → (λ0 #2 (λ0 #1 #1)) → E #0 * : N → (λ0 #2 (λ0 #1 #1))
→ (λ0 #0 (λ0 #6 #1))))
(λ0
(λ0 E (: E → (λ0 #0 (λ0 #4 #3)) → N #2))
NIL)))))
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(λ0 A (: A → (λ0 #3 (λ0 #1 #6)) → (λ0 #3 (λ0 #3 #6))))
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(λ0 N (: N → (λ0 #2 (λ0 #6 #1)) → A #3 * : N → (λ0 #2 (λ0 #6 #1))
→ (λ0 #3 (λ0 #1 #1))))
(λ0
(λ0 E (: E → (λ0 E (λ0 # (λ0 # (λ0 # NIL)))) * ? E I → T T ↓ → F
→ : I E → (! T T) → : E I → T * : E → (λ0 #1 (λ0 #5 #1)) → (λ0 #1
(λ0 #6 #1))))
NIL)))))
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(λ0 # (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # (λ0 * (λ0 # NIL)))))))
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(λ0 # (λ0 E (λ0 I (λ0 · (λ0 → (λ0 # (λ0 · (λ0 # NIL))))))))
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NIL))))))))
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NIL))))))))
NIL))))
(λ0
(λ0 I (: E → (λ0 E (λ0 # (λ0 # (λ0 # (λ0 # NIL))))) * ? E I → #1
#2 ↓ → #3 → : I E → (+ #1 #2) → : E I → T * : I → (λ0 #1 (λ0 #1
#5)) → (λ0 #1 (λ0 #3 #5))))
(λ0
(λ0 A (: A → (λ0 #3 (λ0 #3 #6)) → (λ0 #3 (λ0 #3 #3))))
(λ0
(λ0 N (: N → (λ0 #3 (λ0 #1 #1)) → A #7 * : N → (λ0 #3 (λ0 #1 #1))
→ (λ0 #3 (λ0 #1 #4))))
(λ0
(λ0 E (: E → (λ0 E (λ0 # (λ0 # (λ0 # (λ0 # NIL))))) * ? E I → #1
#2 ↓ → #3 → : I E → (+ #1 #2) → : E I → T * : E → (λ0 #1 (λ0 #6
#1)) → (λ0 #1 (λ0 #1 #6))))
NIL)))))
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NIL))))))))
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(λ0 # (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # (λ0 * (λ0 # NIL)))))))
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NIL)))))))
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(λ0 # (λ0 → (λ0 · (λ0 # (λ0 · (λ0 · (λ0 · (λ0 # NIL)))))))
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NIL)))))))
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(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))
NIL)))))))
NIL))))
(λ0
(λ0 I (: E → (λ0 E (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))) * ? E
I → #3 #2 ↓ → #1 → : I E → (– #3 #2) → : E I → T * : I → (λ0 #1
(λ0 #3 #5)) → (λ0 #1 (λ0 #4 #5))))
(λ0
(λ0 A (: A → (λ0 #3 (λ0 #3 #3)) → (λ0 #3 (λ0 #3 #1))))
(λ0
(λ0 N (: N → (λ0 #3 (λ0 #1 #4)) → A #3 * : N → (λ0 #3 (λ0 #1 #4))
→ (λ0 #3 (λ0 #1 #6))))
(λ0
(λ0 E (: E → (λ0 E (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))) * ? E
I → #3 #2 ↓ → #1 → : I E → (– #3 #2) → : E I → T * : E → (λ0 #1
(λ0 #1 #6)) → (λ0 #1 (λ0 #3 #6))))
NIL)))))
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(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))
NIL)))))))
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(λ0 # (λ0 # (λ0 # (λ0 · (λ0 · (λ0 # (λ0 # (λ0 # NIL)))))))
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(λO # (λO · (λO · (λO · (λO · (λO I (λO E (λO # NIL))))))))
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(λO # (λO # (λO # (λO · (λO · (λO · (λO · (λO # NIL)))))))))
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(λO # (λO · (λO · (λO · (λO · (λO # (λO * (λO # NIL)))))))))
(λO
(λO # (λO · (λO · (λO · (λO → (λO # (λO · (λO # NIL)))))))))
(λO
(λO # (λO # (λO # (λO # (λO # (λO # (λO # (λO # NIL)))))))))
NIL)))))))
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(λO # (λO → (λO · (λO · (λO # (λO · (λO · (λO # NIL)))))))))
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(λO # (λO · (λO · (λO # (λO # (λO * (λO # (λO # NIL)))))))))
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(λO # (λO · (λO · (λO * (λO · (λO · (λO · (λO # NIL)))))))))
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NIL)))))))
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(λO # (λO * (λO # (λO # (λO # (λO # (λO # (λO # NIL)))))))))
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(λO # (λO · (λO * (λO · (λO · (λO · (λO · (λO # NIL)))))))))
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(λO # (λO # (λO # (λO · (λO · (λO · (λO · (λO # NIL)))))))))
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(λO # (λO # (λO # (λO # (λO # (λO # (λO # (λO # NIL)))))))))
NIL)))))))
NIL))))
(λO
(λO I (: E → (λO E (λO # (λO # (λO # (λO # (λO # (λO # NIL)))))))
* ? E I → #3 #3 ↓ → #9 → : I E → (× #3 #3) → : E I → T * : I →
(λO #1 (λO #4 #5)) → (λO #1 (λO #6 #4))))
(λO
(λO A (: A → (λO #3 (λO #3 #1)) → (λO #3 (λO #5 #1))))
(λO
(λO N (: N → (λO #3 (λO #1 #6)) → A #7 * : N → (λO #3 (λO #1 #6))
→ (λO #3 (λO #3 #6))))
(λO
(λO E (: E → (λO E (λO # (λO # (λO # (λO # (λO # (λO # NIL)))))))
* ? E I → #3 #3 ↓ → #9 → : I E → (× #3 #3) → : E I → T * : E →
(λO #1 (λO #3 #6)) → (λO #1 (λO #4 #6))))
NIL)))))
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NIL)))))))
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(λ0 # (λ0 · (λ0 · (λ0 · (λ0 → (λ0 # (λ0 · (λ0 # NIL)))))))
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NIL)))))))
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(λ0 # (λ0 · (λ0 * (λ0 · (λ0 · (λ0 * (λ0 N (λ0 # NIL)))))))
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(λ0 # (λ0 * (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))
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(λ0 # (λ0 A (λ0 * (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # NIL)))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 · (λ0 · (λ0 · (λ0 · (λ0 # NIL)))))))
(λ0
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))
NIL)))))))
NIL))))
(λ0
(λ0 I (: E → (λ0 E (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL)))))))) * ? E I → T F → : I E → (λ0 E T) (λ0 I F) — #21 ‖
#1 ‖ #2 #3 ↓ → #0 (λ0 E (λ0 #3 (λ0 #2 (λ0 #1 (λ0 #1 (λ0 #2 (λ0
#3 NIL))))))) (λ0 I (λ0 #1 (λ0 #2 (λ0 #3 (λ0 #1 (λ0 #2 (λ0 #3
NIL))))))) ↓ → (λ0 I (λ0 (λ0 E #18) (λ0 (λ0 I #17) (λ0 (λ0 E #15)
(λ0 (λ0 I #13) (λ0 (λ0 E #12) (λ0 (λ0 I #9) (λ0 (λ0 E #8) (λ0 (λ0
I #7) (λ0 (λ0 E #5) (λ0 (λ0 I #3) (λ0 (λ0 E #0) NIL))))))))))) * ?
E I # → : I E → (λ0 I NIL) → ? I E # → : E I → (λ0 E (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))) → : E I → (λ0 (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))) I) ↓ → (λ0 E NIL) (λ0 I
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))) * : I → (λ0
#1 (λ0 #6 #4)) → (λ0 #0 (λ0 #3 #4)) * : I → (λ0 #1 (λ0 #4 #5)) →
(λ0 #1 (λ0 #6 #4))))
(λ0
(λ0 A (: A → (λ0 #3 (λ0 #5 #1)) → (λ0 #3 (λ0 #6 #6))))
(λ0
(λ0 N (: N → (λ0 #3 (λ0 #3 #6)) → A #7 * : N → (λ0 #3 (λ0 #3 #6))
→ (λ0 #3 (λ0 #3 #3))))
(λ0
(λ0 E (: E → (λ0 E (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL)))))))) * ? E I → T F → : I E → (λ0 E T) (λ0 I F) — #21 ‖
#1 ‖ #2 #3 ↓ → #0 (λ0 E (λ0 #3 (λ0 #2 (λ0 #1 (λ0 #1 (λ0 #2 (λ0
#3 NIL))))))) (λ0 I (λ0 #1 (λ0 #2 (λ0 #3 (λ0 #1 (λ0 #2 (λ0 #3
NIL))))))) ↓ → (λ0 I (λ0 (λ0 E #18) (λ0 (λ0 I #17) (λ0 (λ0 E #15)
(λ0 (λ0 I #13) (λ0 (λ0 E #12) (λ0 (λ0 I #9) (λ0 (λ0 E #8) (λ0 (λ0
I #7) (λ0 (λ0 E #5) (λ0 (λ0 I #3) (λ0 (λ0 E #0) NIL))))))))))) * ?
E I # → : I E → (λ0 I NIL) → ? I E # → : E I → (λ0 E (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))) → : E I → (λ0 (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))) I) ↓ → (λ0 E NIL) (λ0 I
(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))) * : E → (λ0
#1 (λ0 #4 #6)) → (λ0 #1 (λ0 #6 #6))))
NIL)))))
(λ0
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(λ0
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E A # → : A E → (λ0 A NIL) → ? A E # → : E A → (λ0 E (λ0 # (λ0
# (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))) → : E A → (λ0
(λ0 # NIL) A) ↓ → (λ0 E (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 #
NIL)))))))) (λ0 A (λ0 # NIL)) * : | → (λ0 #0 (λ0 #3 #4)) → (λ0 #0
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(λ0 A (? N A → T F → : A N → (λ0 N T) (λ0 A F) — #21 ‖ #1 ‖ #2 #3
↓ → #0 (λ0 N (λ0 #3 (λ0 #3 (λ0 #2 (λ0 #2 (λ0 #3 (λ0 #3 NIL)))))))
(λ0 A (λ0 #2 (λ0 #3 (λ0 #1 (λ0 #2 (λ0 #3 (λ0 #1 NIL)))))) ↓ → (λ0
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(λ0 N #8) (λ0 (λ0 A #7) (λ0 (λ0 N #5) (λ0 (λ0 A #3) (λ0 (λ0 N #0)
NIL)))))))))) * : A → (λ0 A (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # NIL)))))))) ↓ → (λ0 A NIL) * : A → (λ0 #3 (λ0 #5 #4)) → N
#1 * : A → (λ0 #3 (λ0 #5 #4)) → (λ0 #3 (λ0 #5 #3))))
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NIL)))))))))) * : N → (λ0 #3 (λ0 #5 #3)) → (λ0 #3 (λ0 #1 #1)) * : N
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(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))))
NIL))))))))
NIL))))
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(λ0
(λ0 I (: I → (λ0 #0 (λ0 #3 #6)) → A #3 * : I → (λ0 #0 (λ0 #3 #6))
→ (λ0 #0 (λ0 #6 #1))))
(λ0
(λ0 A (? A → F T ↓ → F → : A → (& F T) → T * : A → (λ0 #3 (λ0 #5
#3)) → N #2 * : A → (λ0 #3 (λ0 #5 #3)) → (λ0 #3 (λ0 #5 #1))))
(λ0
(λ0 N (: N → (λ0 #3 (λ0 #5 #1)) → (λ0 #3 (λ0 #3 #1))))
(λ0
(λ0 E (: E → (λ0 #1 (λ0 #6 #6)) → N #3))
NIL)))))
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→ (λ0 #2 (λ0 #1 #1))))
(λ0
(λ0 A (? A → F T ↓ → T → : A → (‖ F T) → T * : A → (λ0 #3 (λ0 #5
#1)) → N #2 * : A → (λ0 #3 (λ0 #5 #1)) → (λ0 #3 (λ0 #3 #1))))
(λ0
(λ0 N (: N → (λ0 #3 (λ0 #3 #1)) → (λ0 #3 (λ0 #3 #4))))
(λ0
(λ0 E (: E → (λ0 #1 (λ0 #6 #6)) → N #3))
NIL)))))
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NIL))))))))
NIL))))
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(λ0
(λ0 I (: I → (λ0 #2 (λ0 #1 #1)) → A #3 * : I → (λ0 #2 (λ0 #1 #1))
→ (λ0 #2 (λ0 #2 #3))))
(λ0
(λ0 A (? A → T T ↓ → F → : A → (! T T) → T * : A → (λ0 #3 (λ0 #3
#1)) → N #3 * : A → (λ0 #3 (λ0 #3 #1)) → (λ0 #3 (λ0 #3 #4))))
(λ0
(λ0 N (: N → (λ0 #3 (λ0 #3 #4)) → (λ0 #3 (λ0 #3 #6))))
(λ0
(λ0 E (: E → (λ0 #1 (λ0 #6 #6)) → N #3))
NIL)))))
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NIL)))))))
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(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL))))))))
NIL)))))))
NIL))))
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(λ0
(λ0 I (: I → (λ0 #2 (λ0 #1 #1)) → A #3 * : I → (λ0 #2 (λ0 #2 #3))
→ (λ0 #2 (λ0 #2 #3))))
(λ0
(λ0 A (? A → #3 #6 ↓ → #9 → : A → (+ #3 #6) → T * : A → (λ0 #3
(λ0 #3 #4)) → N #2 * : A → (λ0 #3 (λ0 #3 #4)) → (λ0 #3 (λ0 #3
#6))))
(λ0
(λ0 N (: N → (λ0 #3 (λ0 #3 #6)) → (λ0 #3 (λ0 #1 #6))))
(λ0
(λ0 E (: E → (λ0 #1 (λ0 #6 #6)) → N #3))
NIL)))))
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(λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # (λ0 # NIL)))))))
NIL)))))))
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NIL))))
(λ0
(λ0 I (: I → (λ0 #2 (λ0 #1 #1)) → A #3 * : I → (λ0 #2 (λ0 #3 #5))
→ (λ0 #2 (λ0 #5 #4))))
(λ0
(λ0 A (? A → #3 #3 ↓ → #0 → : A → (— #3 #3) → T * : A → (λ0 #3
(λ0 #3 #6)) → N #2 * : A → (λ0 #3 (λ0 #3 #6)) → (λ0 #3 (λ0 #1
#6))))
(λ0
(λ0 N (: N → (λ0 #3 (λ0 #1 #6)) → (λ0 #3 (λ0 #1 #3))))
(λ0
(λ0 E (: E → (λ0 #1 (λ0 #6 #6)) → N #3))
NIL)))))
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→ (λ0 #2 (λ0 #6 #1))))
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NIL))))
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↓ → #0 (λ0 I (λ0 #3 (λ0 #3 (λ0 #2 (λ0 #2 (λ0 #1 (λ0 #1 NIL)))))))
(λ0 A (λ0 #1 (λ0 #1 (λ0 #3 (λ0 #3 (λ0 #2 (λ0 #2 NIL))))))) ↓ → (λ0
I (λ0 (λ0 I #18) (λ0 (λ0 A #17) (λ0 (λ0 I #14) (λ0 (λ0 A #13) (λ0
(λ0 I #11) (λ0 (λ0 A #8) (λ0 (λ0 I #6) (λ0 (λ0 A #3) (λ0 (λ0 I #2)
(λ0 (λ0 A #0) NIL))))))))))) * : I → (λ0 I (λ0 # (λ0 # (λ0 # (λ0 #
(λ0 # (λ0 # (λ0 # NIL)))))))) ↓ → (λ0 I (λ0 # (λ0 # (λ0 # (λ0 # (λ0
# (λ0 # NIL))))))) * : I → (λ0 #3 (λ0 #1 #1)) → (λ0 #3 (λ0 #6 #6))
* : I → (λ0 #3 (λ0 #1 #1)) → (λ0 #3 (λ0 #1 #4))))
(λ0
(λ0 A (: A → (λ0 #3 (λ0 #1 #3)) → I #2 * ? I A → T F → : A I →
(λ0 I T) (λ0 A F) — #21 ‖ #1 ‖ #2 #3 ↓ → #0 (λ0 I (λ0 #3 (λ0 #3
(λ0 #2 (λ0 #2 (λ0 #1 (λ0 #1 NIL))))))) (λ0 A (λ0 #1 (λ0 #1 (λ0 #3
(λ0 #3 (λ0 #2 (λ0 #2 NIL))))))) ↓ → (λ0 I (λ0 (λ0 I #18) (λ0 (λ0 A
#17) (λ0 (λ0 I #14) (λ0 (λ0 A #13) (λ0 (λ0 I #11) (λ0 (λ0 A #8) (λ0
(λ0 I #6) (λ0 (λ0 A #3) (λ0 (λ0 I #2) (λ0 (λ0 A #0) NIL)))))))))))
* : A → (λ0 #3 (λ0 #1 #3)) → (λ0 #3 (λ0 #1 #1))))
(λ0
(λ0 N (: N → (λ0 #2 (λ0 #6 #1)) → (λ0 #2 (λ0 #1 #1)) * : N → (λ0
#2 (λ0 #6 #1)) → (λ0 #2 (λ0 #5 #2))))
(λ0
(λ0 E (: E → (λ0 #1 (λ0 #6 #6)) → N #2))
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# (λ0 # (λ0 # (λ0 # NIL)))))) * : I → (λ0 #3 (λ0 #1 #4)) → (λ0 #3
(λ0 #1 #6))))
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#3 (λ0 #1 #1)) → N #2))
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(λ0 N (: N → (λ0 #2 (λ0 #5 #2)) → (λ0 #2 (λ0 #5 #5))))
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(λ0 E (: E → (λ0 #1 (λ0 #6 #6)) → N #2))
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(λ0 # NIL))))) * : I → (λ0 #3 (λ0 #1 #6)) → (λ0 #3 (λ0 #3 #6))))
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→ (λ0 #2 (λ0 #5 #2))))
(λ0
(λ0 N (: N → (λ0 #2 (λ0 #5 #5)) → (λ0 #2 (λ0 #2 #5))))
(λ0
(λ0 E (: E → (λ0 #1 (λ0 #6 #6)) → N #2))
NIL)))))
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→ (λ0 #0 (λ0 #6 #1))))
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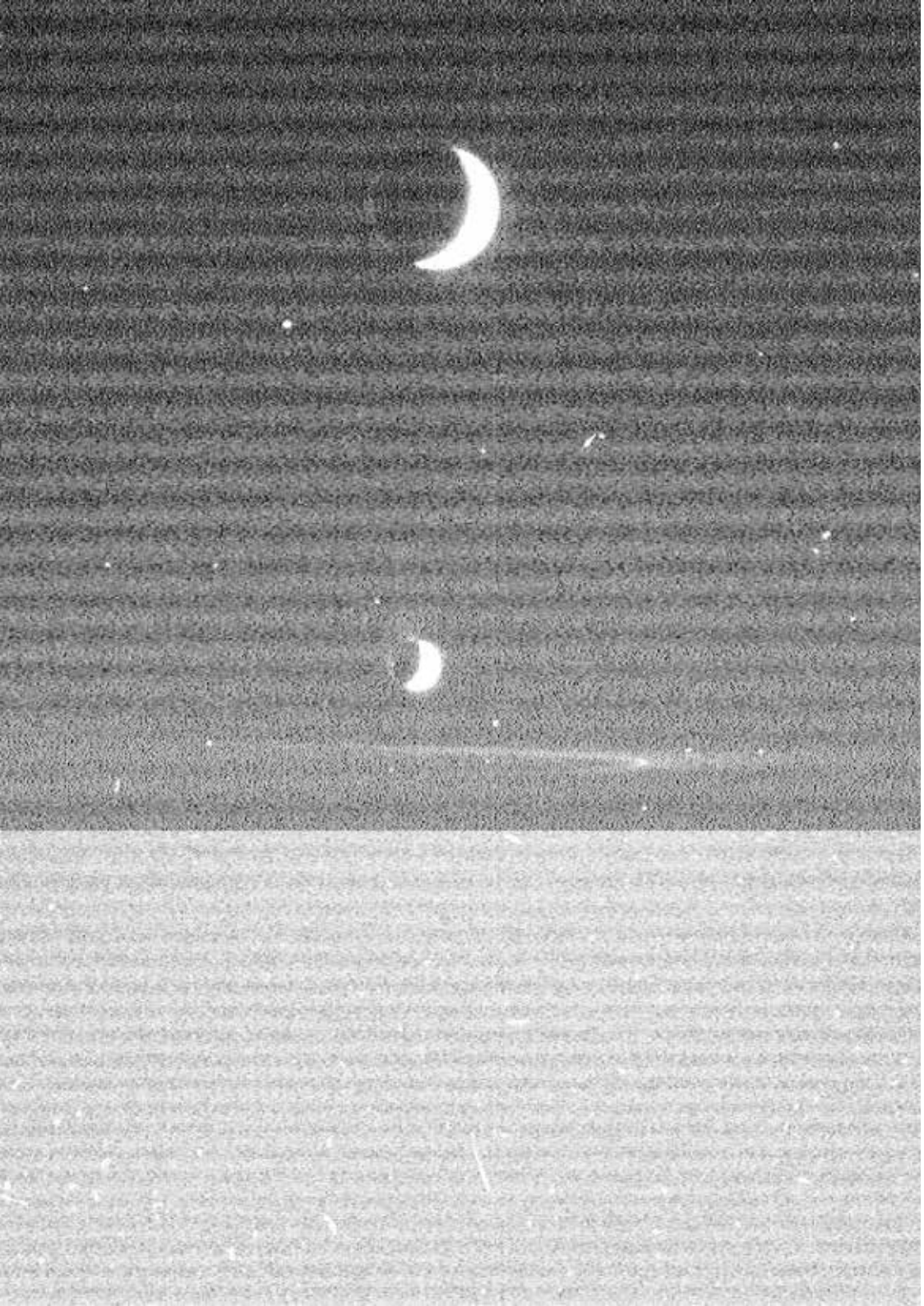
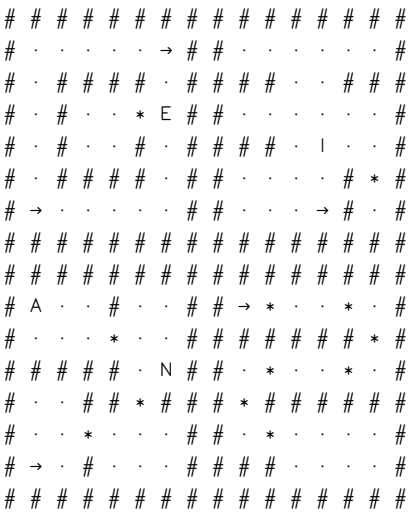
# NIL)))))))) * : I → A @ #37 (λ0 #3 (λ0 #8 #8)) → A @ #37 (λ0 #0
(λ0 #6 #1)) * : I → A @ #37 (λ0 #0 (λ0 #2 #2)) → @ #37 (λ0 (λ0 #
(λ0 · (λ0 #))) (λ0 (λ0 # (λ0 A (λ0 ·))) (λ0 (λ0 # (λ0 # (λ0 #)))
NIL))) * : I → N @ #37 (λ0 #3 (λ0 #8 #8)) → N @ #37 (λ0 #0 (λ0 #3
#4)) * : I → N @ #37 (λ0 #0 (λ0 #2 #2)) → @ #37 (λ0 (λ0 # (λ0 #
(λ0 #))) (λ0 (λ0 · (λ0 N (λ0 *))) (λ0 (λ0 · (λ0 · (λ0 #))) NIL))) *
: I → E @ #37 (λ0 #3 (λ0 #8 #8)) → E @ #37 (λ0 #1 (λ0 #6 #6)) *
: I → E @ #37 (λ0 #1 (λ0 #2 #2)) → @ #37 (λ0 (λ0 # (λ0 * (λ0 #)))
(λ0 (λ0 # (λ0 E (λ0 #))) (λ0 (λ0 # (λ0 # (λ0 #))) NIL))) * I : — @
@))
(λ0
(λ0 A (: A → (λ0 #0 (λ0 #6 #1)) → N #6))
(λ0
(λ0 N (: N → (λ0 #0 (λ0 #3 #4)) → A #6))
(λ0
(λ0 E (: E → (λ0 #1 (λ0 #6 #6)) → N #0))
NIL)))))
NIL)))))))))))))))))))))))))))))))))))))))))))))))))))))
```



INTERPRETATION

0



DECLARE ORIENT ISHTAR > ENKI (MAP 0)

DECLARE ORIENT ANZU > ENKI (MAP 0) * DECLARE TRANSFORM ANZU > 0
6 1

DECLARE ORIENT NINURTA > ENKI (MAP 0)

DECLARE TRANSFORM ENKI > 0 4 3

Ishtar waits for Enki.

*

Anzu exits to Anu Map, towards Enki.

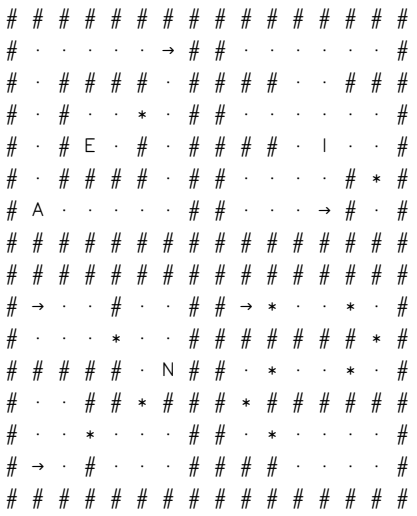
*

Ninurta waits for Enki.

*

Enki enters enclosure.

1



DECLARE ORIENT ISHTAR > ENKI (MAP 0)

DECLARE ORIENT ANZU > ENKI (DISTANCE 4) * DECLARE TRANSFORM ANZU > 0 3 6

DECLARE ORIENT NINURTA > ENKI (MAP 0)

DECLARE ENKI 8 OBJECTS * DECLARE POSITION TIME 1 ENKI > ISHTAR (1 4 4) * DECLARE POSITION TIME 1 ENKI > NINURTA (2 3 6) * DECLARE POSITION TIME 1 ENKI > ANZU (0 6 1)

Ishtar waits for Enki.

*

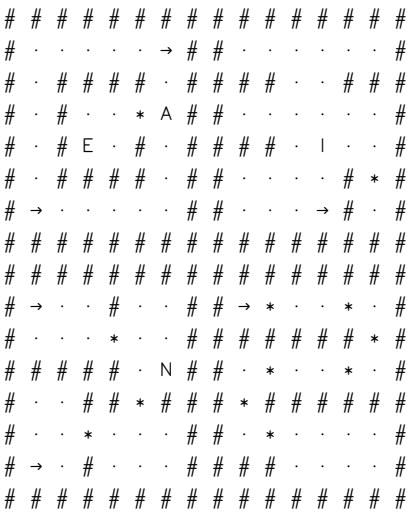
Anzu travels to enclosure doorway, towards Enki.

*

Ninurta waits for Enki.

*

Enki declares 8 objects, which indicate the absolute present positions of Ishtar, Ninurta, and Anzu.



DECLARE ORIENT ISHTAR > ENKI (MAP 0)

DECLARE ORIENT ANZU > ENKI (DISTANCE 4) * DECLARE TRANSFORM ANZU > 0 3 3

DECLARE ORIENT NINURTA > ENKI (MAP 0) * DECLARE TRANSFORM NINURTA > 2 2 5

DECLARE ENKI 8 OBJECTS * DECLARE AREA TIME 2 ENKI > ISHTAR ([· · ·], [· I ·], [· · #]) * DECLARE AREA TIME 2 ENKI > NINURTA ([· · #], [· N #], [* # #]) * DECLARE AREA TIME 2 ENKI > ANZU ([# · #], [* A #], [# · #])

Ishtar waits for Enki.

*

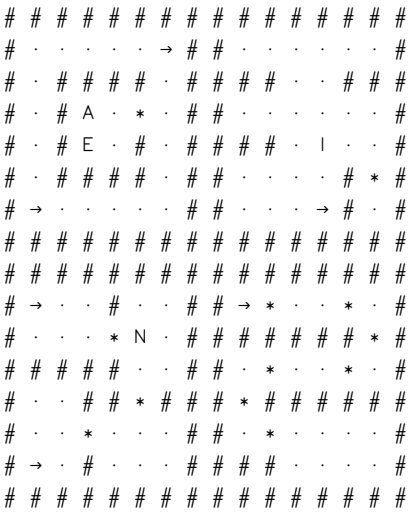
Anzu enters enclosure, towards Enki.

*

Ninurta travels to doorway, towards Enki.

*

Enki declares 8 objects, which display the relative spatial contexts of Ishtar, Ninurta, and Anzu.



DECLARE ORIENT ISHTAR > ENKI (MAP 0)

DECLARE CHALLENGE ANZU > ENKI > ANZU WIN * DECLARE EXCHANGE ENKI > ANZU > 1 OBJECTS * DECLARE TRANSFORM ANZU > 3 5 1 * DECLARE TRANSFORM ANZU > 0 3 4

DECLARE ORIENT NINURTA > ENKI (MAP 0) * DECLARE TRANSFORM NINURTA > 2 1 1

DECLARE CHALLENGE ANZU > ENKI > ANZU WIN * DECLARE EXCHANGE ENKI > ANZU > 1 OBJECTS * DECLARE ORIENT ENKI > NINURTA (MAP 2)

Ishtar waits for Enki.

*

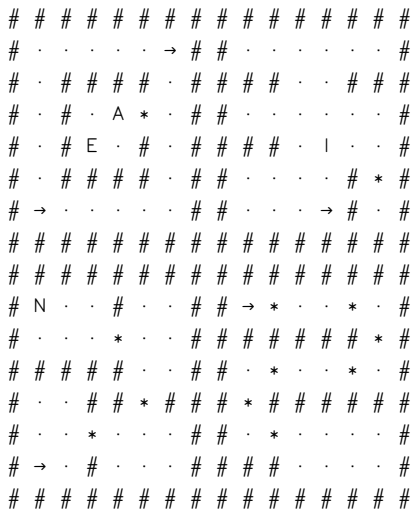
Anzu confronts and challenges Enki successfully. Anzu acquires 1 object from Enki, and declares an intention to travel to Irkalla map, before travelling to enclosure doorway.

*

Ninurta travels to Anu map entrance, towards Enki.

*

Enki is confronted and challenged by Anzu. Enki loses this challenge, and is divested of 1 object by Anzu. Enki then waits for Ninurta.



DECLARE ORIENT ISHTAR > ENKI (MAP 0)

DECLARE TRANSFORM ANZU > 0 3 6

DECLARE ORIENT NINURTA > ENKI (MAP 0) * DECLARE TRANSFORM NINURTA > 0 6 1

DECLARE ORIENT ENKI > NINURTA (MAP 2)

Ishtar waits for Enki.

*

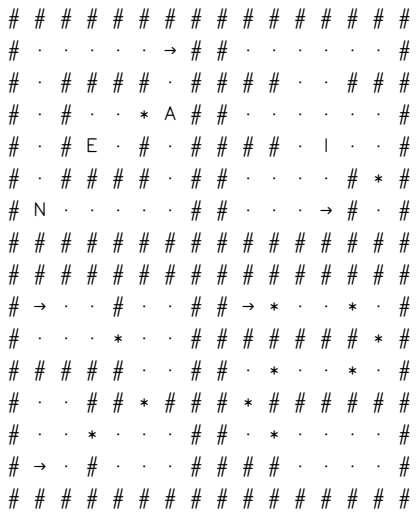
Anzu exits enclosure towards Apsu map entrance.

*

Ninurta exits to Anu map, towards Enki.

*

Enki waits for Ninurta.



DECLARE ORIENT ISHTAR > ENKI (MAP 0)

DECLARE TRANSFORM ANZU > 0 6 1

DECLARE ORIENT NINURTA > ENKI (DISTANCE 4) * DECLARE TRANSFORM NINURTA > 0 3 6

DECLARE ORIENT ENKI > NINURTA (DISTANCE 4)

Ishtar waits for Enki.

*

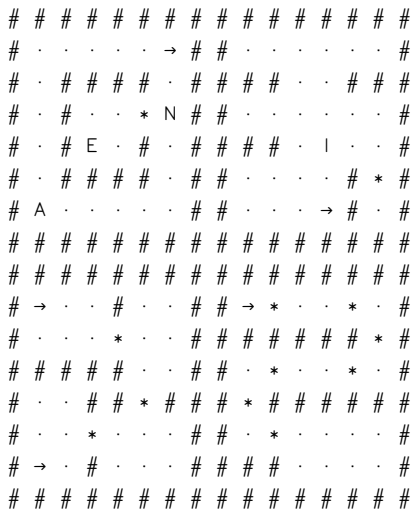
Anzu travels to Apsu map entrance.

*

Ninurta travels to enclosure doorway, towards Enki.

*

Enki waits for Ninurta.



DECLARE ORIENT ISHTAR > ENKI (MAP 0)

DECLARE TRANSFORM ANZU > 2 1 1

DECLARE ORIENT NINURTA > ENKI (DISTANCE 4) * DECLARE TRANSFORM NINURTA > 0 3 4

DECLARE ORIENT ENKI > NINURTA (DISTANCE 4) * DECLARE TRANSFORM ENKI > 0 3 3

Ishtar waits for Enki.

*

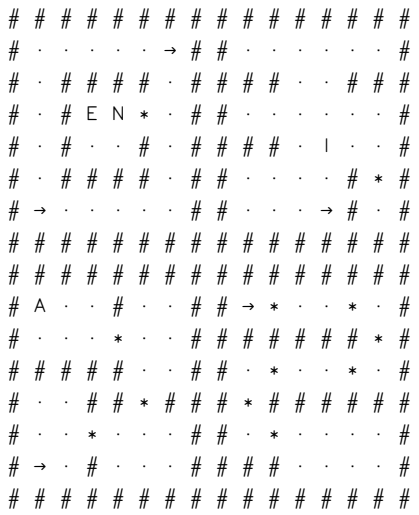
Anzu exits to Apsu map.

*

Ninurta enters enclosure, towards Enki.

*

Enki moves to meet Ninurta.



DECLARE ORIENT ISHTAR > ENKI (MAP 0)

DECLARE TRANSFORM ANZU > 2 2 3

QUERY RECALL TIME #3 NINURTA > ENKI > DECLARE EXCHANGE ENKI > ANZU > 1 OBJECTS * DECLARE ORIENT NINURTA > ANZU (MAP 2) * DECLARE TRANSFORM NINURTA > 0 3 6

QUERY RECALL TIME #3 NINURTA > ENKI > DECLARE EXCHANGE ENKI > ANZU > 1 OBJECTS * DECLARE ORIENT ENKI > ISHTAR (MAP 1) * DECLARE TRANSFORM ENKI > 0 3 4

Ishtar waits for Enki.

*

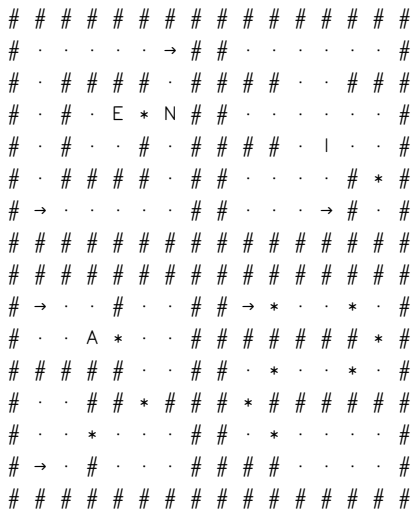
Anzu travels to doorway.

*

Ninurta asks Enki to recount events at timestep 3. Enki recounts loss of 1 object to Anzu. Ninurta then exits enclosure, towards Anzu.

*

Enki answers Ninurta's query about events at timestep 3, recounting loss of 1 object to Anzu. Enki then travels to enclosure doorway, towards Ishtar.



DECLARE ORIENT ISHTAR > ENKI (MAP 0)

DECLARE TRANSFORM ANZU > 2 3 5

DECLARE ORIENT NINURTA > ANZU (MAP 2) * DECLARE TRANSFORM NINURTA > 0 6 1

DECLARE ORIENT ENKI > ISHTAR (MAP 1) * DECLARE TRANSFORM ENKI > 0 1 6

Ishtar waits for Enki.

*

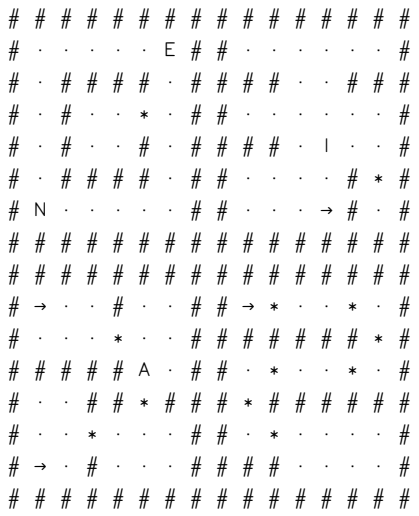
Anzu travels to next doorway.

*

Ninurta travels to Apsu map entrance, towards Anzu.

*

Enki travels to Uruk map entrance, towards Ishtar.



DECLARE ORIENT ISHTAR > ENKI (MAP 0)

DECLARE TRANSFORM ANZU > 2 5 4

DECLARE ORIENT NINURTA > ANZU (MAP 2) * DECLARE TRANSFORM NINURTA > 2 1 1

DECLARE ORIENT ENKI > ISHTAR (MAP 1) * DECLARE TRANSFORM ENKI > 1 6 4

Ishtar waits for Enki.

*

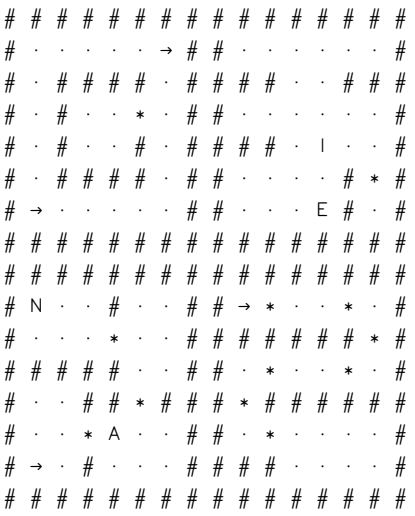
Anzu travels to next doorway.

*

Ninurta exits to Apsu map, towards Anzu.

*

Enki travels to Uruk map entrance, towards Ishtar.



DECLARE ORIENT ISHTAR > ENKI (DISTANCE 2)

DECLARE TRANSFORM ANZU > 2 6 1

DECLARE ORIENT NINURTA > ANZU (DISTANCE 7) * DECLARE TRANSFORM NINURTA > 2 2 3

DECLARE ORIENT ENKI > ISHTAR (DISTANCE 2) * DECLARE TRANSFORM ENKI > 1 4 3

Ishtar waits for Enki.

*

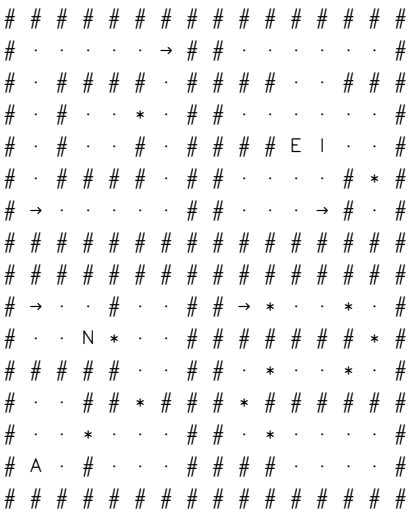
Anzu travels to Irkalla map entrance.

*

Ninurta travels to doorway, towards Anzu.

*

Enki exits to Uruk map, towards Ishtar.



QUERY LOCATE TIME 3 ISHTAR > ENKI (0 4 3) * QUERY SURVEY TIME 3 ISHTAR > ENKI ([# A ·], [# E ·], [# # #]) * QUERY RECALL TIME #3 ISHTAR > ENKI > DECLARE EXCHANGE ENKI > ANZU > 1 OBJECTS * DECLARE TRANSFORM ISHTAR > 1 1 2

DECLARE TRANSFORM ANZU > 3 1 1

DECLARE ORIENT NINURTA > ANZU (DISTANCE 6) * DECLARE TRANSFORM NINURTA > 2 3 5

QUERY LOCATE TIME 3 ISHTAR > ENKI (0 4 3) * QUERY SURVEY TIME 3 ISHTAR > ENKI ([# A ·], [# E ·], [# # #]) * QUERY RECALL TIME #3 ISHTAR > ENKI > DECLARE EXCHANGE ENKI > ANZU > 1 OBJECTS * DECLARE TRANSFORM ENKI > 1 1 1

Ishtar asks Enki to recount events at timestep 3. Enki recounts position, details of locality, and loss of 1 object to Anzu. Ishtar then travels to a new map location, alongside Enki.

*

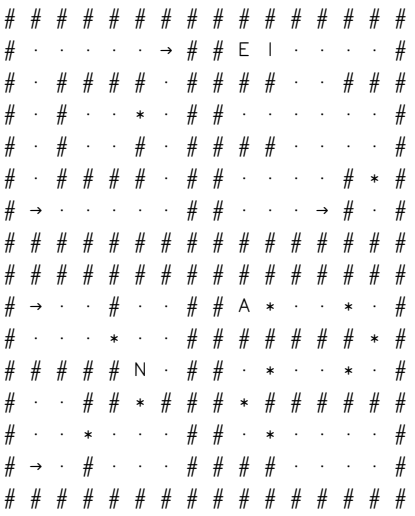
Anzu exits to Irkalla map.

*

Ninurta travels to next door, towards Anzu.

*

Enki answers Ishtar's query about events at timestep 3, recounting position, details of locality, and loss of 1 object to Anzu. Enki then travels to a new map location, alongside Ishtar.



DECLARE ENKI 1 OBJECTS * QUERY VALIDATE ENKI > ISHTAR T & F = F > ENKI > ISHTAR T * DECLARE TRANSFORM ISHTAR > 1 5 2

DECLARE TRANSFORM ANZU > 3 1 4

DECLARE ORIENT NINURTA > ANZU (MAP 3) * DECLARE TRANSFORM NINURTA > 2 5 4

DECLARE ENKI 1 OBJECTS * QUERY VALIDATE ENKI > ISHTAR T & F = F > ENKI > ISHTAR T * DECLARE TRANSFORM ENKI > 1 3 1

Ishtar watches as Enki declares an existing object, through which they invoke and answer a logical AND proposition, which Ishtar validates. Ishtar then travels to a new map location, alongside Enki.

*

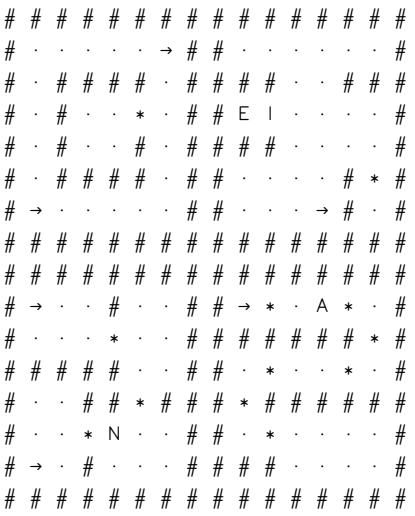
Anzu travels to doorway.

*

Ninurta travels to doorway, towards Anzu.

*

Enki declares an existing object, through which they invoke and answer a logical AND proposition, which Ishtar validates. Enki then travels to a new map location, alongside Ishtar.



DECLARE ENKI 2 OBJECTS * QUERY VALIDATE ENKI > ISHTAR T ‖ F = T > ENKI > ISHTAR T * DECLARE TRANSFORM ISHTAR > 1 6 2

DECLARE TRANSFORM ANZU > 3 1 6

DECLARE ORIENT NINURTA > ANZU (MAP 3) * DECLARE TRANSFORM NINURTA > 2 6 1

DECLARE ENKI 2 OBJECTS * QUERY VALIDATE ENKI > ISHTAR T ‖ F = T > ENKI > ISHTAR T * DECLARE TRANSFORM ENKI > 1 5 1

Ishtar watches as Enki declares another existing object, through which they invoke and answer a logical OR proposition, which Ishtar validates. Ishtar then travels to a new map location, alongside Enki.

*

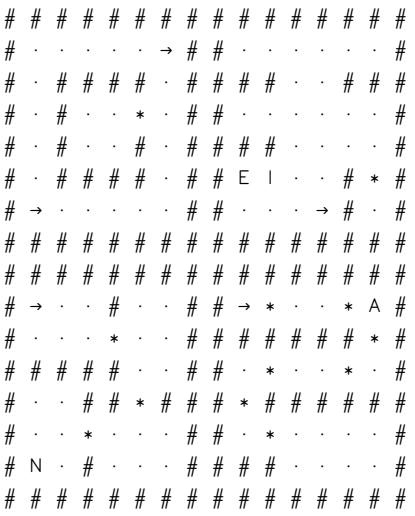
Anzu travels to doorway.

*

Ninurta travels to Irkalla map entrance, towards Anzu.

*

Enki declares another existing object, through which they invoke and answer a logical OR proposition, which Ishtar validates. Enki then travels to a new map location, alongside Ishtar.



DECLARE ENKI 3 OBJECTS * QUERY VALIDATE ENKI > ISHTAR T ! T = F > ENKI > ISHTAR T * DECLARE TRANSFORM ISHTAR > 1 1 5

DECLARE TRANSFORM ANZU > 3 3 6

DECLARE ORIENT NINURTA > ANZU (MAP 3) * DECLARE TRANSFORM NINURTA > 3 1 1

DECLARE ENKI 3 OBJECTS * QUERY VALIDATE ENKI > ISHTAR T ! T = F > ENKI > ISHTAR T * DECLARE TRANSFORM ENKI > 1 6 1

Ishtar watches as Enki declares another existing object, through which they invoke and answer a logical NOT proposition, which Ishtar validates. Ishtar then travels to a new map location, alongside Enki.

*

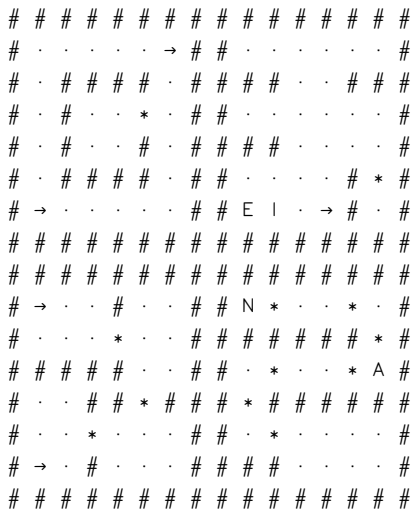
Anzu travels to doorway.

*

Ninurta exits to Irkalla map, towards Anzu.

*

Enki declares another existing object, through which they invoke and answer a logical NOT proposition, which Ishtar validates. Enki then travels to a new map location, alongside Ishtar.



DECLARE ENKI 4 OBJECTS * QUERY SOLVE ENKI > ISHTAR 1 + 2 = 3 > ENKI > ISHTAR T * DECLARE TRANSFORM ISHTAR > 1 3 5

DECLARE TRANSFORM ANZU > 3 3 3

DECLARE ORIENT NINURTA > ANZU (DISTANCE 7) * DECLARE TRANSFORM NINURTA > 3 1 4

DECLARE ENKI 4 OBJECTS * QUERY SOLVE ENKI > ISHTAR 1 + 2 = 3 > ENKI > ISHTAR T * DECLARE TRANSFORM ENKI > 1 1 6

Ishtar watches as Enki declares another existing object, through which they invoke and answer a numerical addition, which Ishtar validates. Ishtar then travels to a new map location, alongside Enki.

*

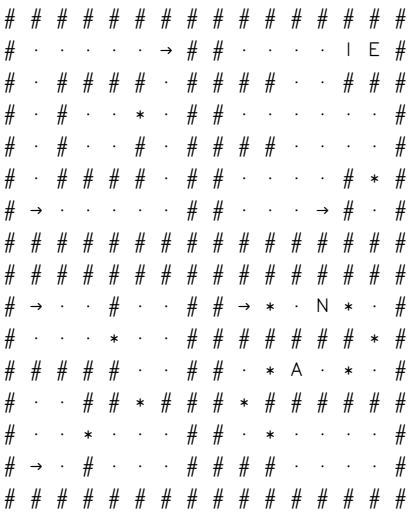
Anzu travels to doorway.

*

Ninurta travels to doorway, towards Anzu.

*

Enki ddeclares another existing object, through which they invoke and answer a numerical addition, which Ishtar validates. Enki then travels to a new map location, alongside Ishtar.



DECLARE ENKI 5 OBJECTS * QUERY SOLVE ENKI > ISHTAR 3 − 2 = 1 > ENKI > ISHTAR T * DECLARE TRANSFORM ISHTAR > 1 4 5

DECLARE TRANSFORM ANZU > 3 3 1

DECLARE ORIENT NINURTA > ANZU (DISTANCE 3) * DECLARE TRANSFORM NINURTA > 3 1 6

DECLARE ENKI 5 OBJECTS * QUERY SOLVE ENKI > ISHTAR 3 − 2 = 1 > ENKI > ISHTAR T * DECLARE TRANSFORM ENKI > 1 3 6

Ishtar watches as Enki declares another existing object, through which they invoke and answer a numerical subtraction, which Ishtar validates. Ishtar then travels to a new map location, alongside Enki.

*

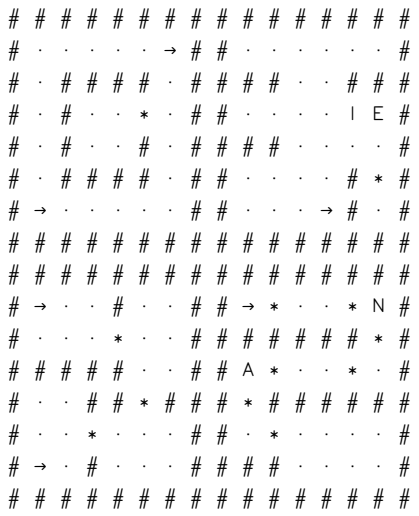
Anzu travels to doorway.

*

Ninurta travels to doorway, towards Anzu.

*

Enki declares another existing object, through which they invoke and answer a numerical subtraction, which Ishtar validates. Enki then travels to a new map location, alongside Ishtar.



DECLARE ENKI 6 OBJECTS * QUERY SOLVE ENKI > ISHTAR 3 × 3 = 9 > ENKI > ISHTAR T * DECLARE TRANSFORM ISHTAR > 1 6 4

DECLARE TRANSFORM ANZU > 3 5 1

DECLARE ORIENT NINURTA > ANZU (DISTANCE 7) * DECLARE TRANSFORM NINURTA > 3 3 6

DECLARE ENKI 6 OBJECTS * QUERY SOLVE ENKI > ISHTAR 3 × 3 = 9 > ENKI > ISHTAR T * DECLARE TRANSFORM ENKI > 1 4 6

Ishtar watches as Enki declares another existing object, through which they invoke and answer a numerical multiplication, which Ishtar validates. Ishtar then travels to a new map location, alongside Enki.

*

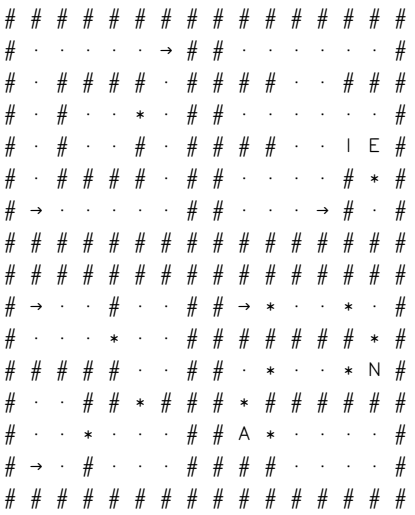
Anzu travels to doorway.

*

Ninurta travels to doorway, towards Anzu.

*

Enki declares another existing object, through which they invoke and answer a numerical multiplication, which Ishtar validates. Enki then travels to a new map location, alongside Ishtar.



DECLARE ENKI 7 OBJECTS * DECLARE CHALLENGE ENKI > ISHTAR > ISHTAR WIN * DECLARE EXCHANGE ENKI > ISHTAR > 7 OBJECTS * DECLARE TRANSFORM ISHTAR > 0 3 4 * DECLARE TRANSFORM ISHTAR > 1 6 4

DECLARE TRANSFORM ANZU > 3 6 6

DECLARE ORIENT NINURTA > ANZU (DISTANCE 7) * DECLARE TRANSFORM NINURTA > 3 3 3

DECLARE ENKI 7 OBJECTS * DECLARE CHALLENGE ENKI > ISHTAR > ISHTAR WIN * DECLARE EXCHANGE ENKI > ISHTAR > 7 OBJECTS * DECLARE TRANSFORM ENKI > 1 6 6

Ishtar watches as Enki declares another existing object through which they invoke a challenge to Enki, which Ishtar wins. Ishtar acquires all 7 objects from Enki, and plans to travel to Anu enclosure. Ishtar then travels to Anu map entrance.

*

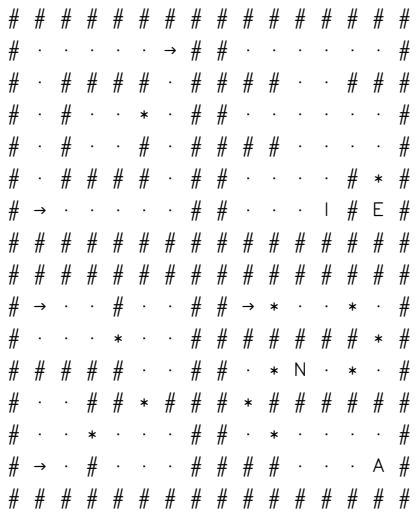
Anzu waits for Ninurta.

*

Ninurta travels to doorway, towards Anzu.

*

Enki declares another existing object, loses the challenge set by Ishtar, and is divested of all 7 objects by them. Enki retreats to the enclosure doorway.



DECLARE TRANSFORM ISHTAR > 0 1 6

DECLARE ORIENT ANZU > NINURTA (DISTANCE 6)

DECLARE ORIENT NINURTA > ANZU (DISTANCE 6) * DECLARE TRANSFORM NINURTA > 3 3 1

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar exits to Anu map.

*

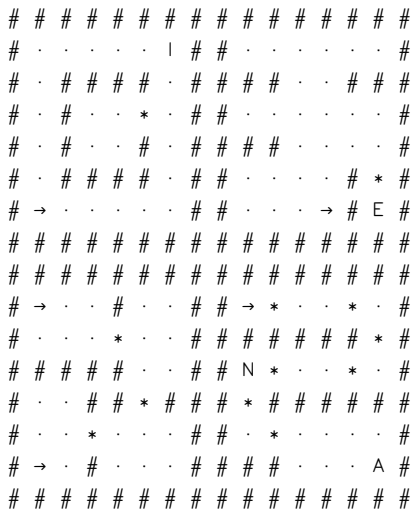
Anzu waits for Ninurta.

*

Ninurta travels to doorway, towards Anzu.

*

Enki waits for Ninurta.



DECLARE TRANSFORM ISHTAR > 0 3 6

DECLARE ORIENT ANZU > NINURTA (DISTANCE 8)

DECLARE ORIENT NINURTA > ANZU (DISTANCE 8) * DECLARE TRANSFORM NINURTA > 3 5 1

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar travels to enclosure doorway.

*

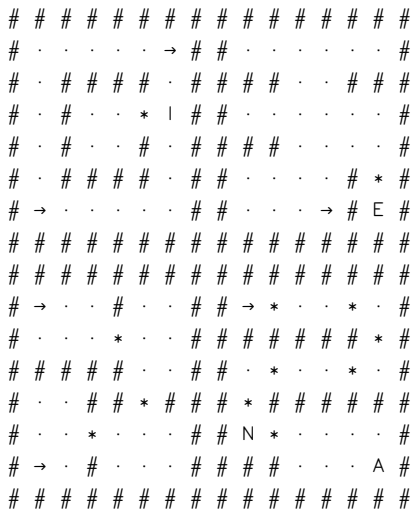
Anzu waits for Ninurta.

*

Ninurta travels to doorway, towards Anzu.

*

Enki waits for Ninurta.



DECLARE TRANSFORM ISHTAR > 0 3 4

DECLARE ORIENT ANZU > NINURTA (DISTANCE 6)

DECLARE ORIENT NINURTA > ANZU (DISTANCE 6) * DECLARE TRANSFORM NINURTA > 3 5 3

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar enters enclosure.

*

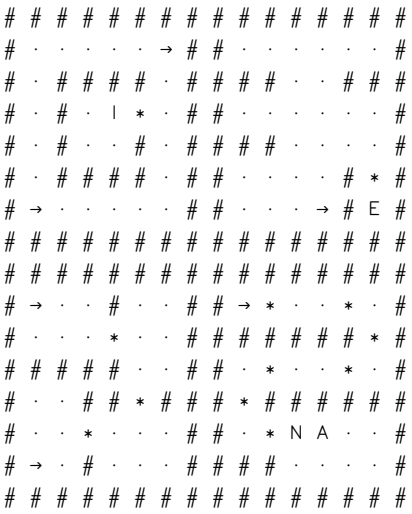
Anzu waits for Ninurta.

*

Ninurta travels to doorway, towards Anzu.

*

Enki waits for Ninurta.



DECLARE AREA TIME 3 ISHTAR > ANZU ([# # #], [# A ·], [# E ·]) * DECLARE EXCHANGE ENKI > ANZU > 1 OBJECTS * DECLARE TRANSFORM ISHTAR > 0 3 6

DECLARE CHALLENGE NINURTA > ANZU > ANZU WIN * DECLARE DEPLETE ANZU > 8 > NIL OBJECTS * DECLARE ORIENT ANZU > NINURTA (DISTANCE 1) * DECLARE TRANSFORM ANZU > 3 5 3

DECLARE CHALLENGE NINURTA > ANZU > ANZU WIN * DECLARE TRANSFORM NINURTA > 3 1 1 * DECLARE TRANSFORM NINURTA > 3 5 1

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar recalls events at timestep 3, as described by Enki. Ishtar plans to travel to Irkalla enclosure, and exits enclosure.

*

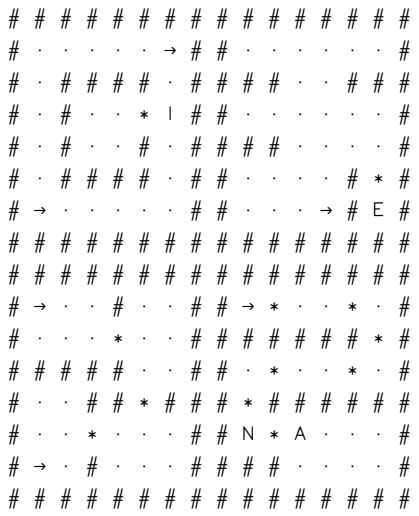
Anzu confronts and challenges Ninurta successfully, but is divested of all 8 objects in possession. Anzu then travels to door, pursuing Ninurta.

*

Ninurta enters enclosure, confronting and challenging Anzu. Ninurta loses, but Anzu is divested of all 8 objects in possession. Ninurta plans to travel to Anu enclosure, and retreats to door.

*

Enki waits for Ninurta.



DECLARE ORIENT ISHTAR > ANZU (MAP 3) * DECLARE TRANSFORM ISHTAR > 0 6 1

QUERY DEDUCE ANZU F & T = F T * DECLARE ORIENT ANZU > NINURTA (DISTANCE 2) * DECLARE TRANSFORM ANZU > 3 5 1

DECLARE TRANSFORM NINURTA > 3 3 1

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar travels to Apsu map entrance, towards Anzu.

*

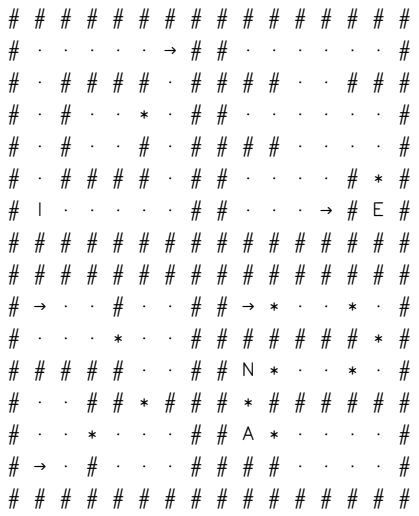
Anzu invokes a logical AND proposition on doorway, exits enclosure, and then travels to next door, towards Ninurta.

*

Ninurta travels to door.

*

Enki waits for Ninurta.



DECLARE ORIENT ISHTAR > ANZU (MAP 3) * DECLARE TRANSFORM ISHTAR > 2 1 1

QUERY DEDUCE ANZU F ‖ T = T T * DECLARE ORIENT ANZU > NINURTA (DISTANCE 2) * DECLARE TRANSFORM ANZU > 3 3 1

DECLARE TRANSFORM NINURTA > 3 3 4

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar travels to Apsu map entrance, towards Anzu.

*

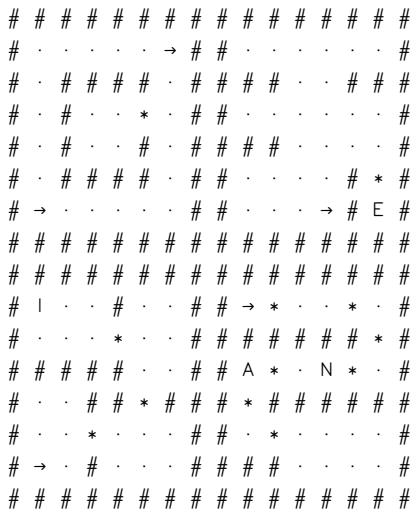
Anzu invokes a logical OR proposition on doorway, and then travels to next door, towards Ninurta.

*

Ninurta travels to door.

*

Enki waits for Ninurta.



DECLARE ORIENT ISHTAR > ANZU (MAP 3) * DECLARE TRANSFORM ISHTAR > 2 2 3

QUERY DEDUCE ANZU T ! T = F T * DECLARE ORIENT ANZU > NINURTA (DISTANCE 3) * DECLARE TRANSFORM ANZU > 3 3 4

DECLARE TRANSFORM NINURTA > 3 3 6

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar exits to Apsu map, towards Anzu.

*

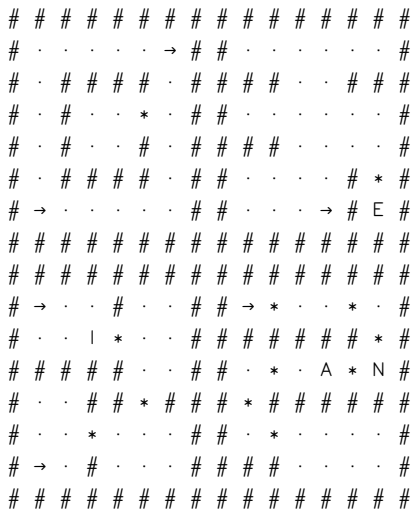
Anzu invokes a logical NOT proposition on doorway, and then travels to next door, towards Ninurta.

*

Ninurta travels to door.

*

Enki waits for Ninurta.



DECLARE ORIENT ISHTAR > ANZU (MAP 3) * DECLARE TRANSFORM ISHTAR > 2 2 3

QUERY CALCULATE ANZU 3 + 6 = 9 T * DECLARE ORIENT ANZU > NINURTA (DISTANCE 2) * DECLARE TRANSFORM ANZU > 3 3 6

DECLARE TRANSFORM NINURTA > 3 1 6

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar travels to doorway, towards Anzu.

*

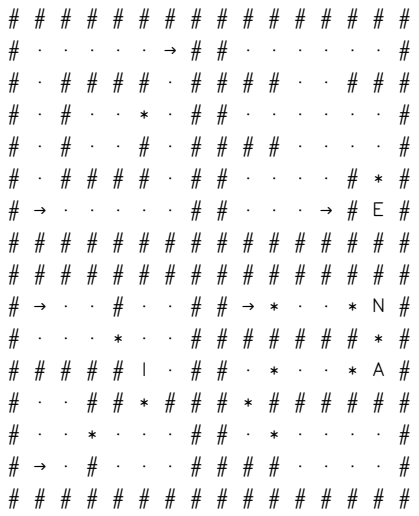
Anzu invokes a numerical addition on doorway, and then travels to next door, towards Ninurta.

*

Ninurta travels to door.

*

Enki waits for Ninurta.



DECLARE ORIENT ISHTAR > ANZU (MAP 3) * DECLARE TRANSFORM ISHTAR > 2 5 4

QUERY CALCULATE ANZU 3 − 3 = 0 T * DECLARE ORIENT ANZU > NINURTA (DISTANCE 2) * DECLARE TRANSFORM ANZU > 3 1 6

DECLARE TRANSFORM NINURTA > 3 1 3

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar travels to doorway, towards Anzu.

*

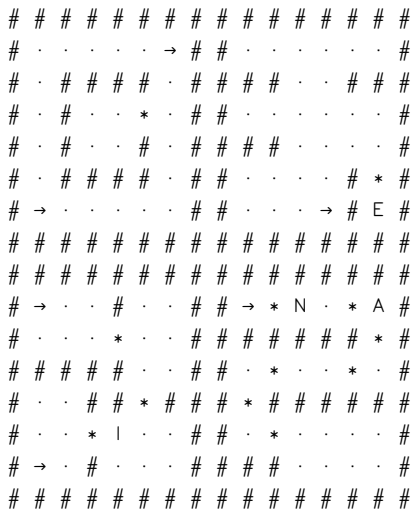
Anzu invokes a numerical subtraction on doorway, and then travels to next door, towards Ninurta.

*

Ninurta travels to door.

*

Enki waits for Ninurta.



DECLARE ORIENT ISHTAR > ANZU (MAP 3) * DECLARE TRANSFORM ISHTAR > 2 6 1

QUERY CALCULATE ANZU 3 × 1 = 3 T * DECLARE ORIENT ANZU > NINURTA (DISTANCE 3) * DECLARE TRANSFORM ANZU > 3 1 3

DECLARE TRANSFORM NINURTA > 3 1 1

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar travels to Irkalla map entrance, towards Anzu.

*

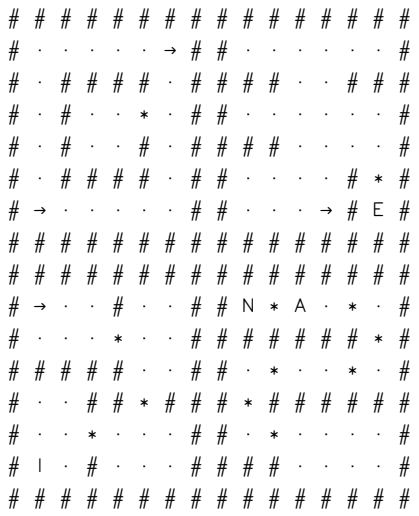
Anzu invokes a numerical multiplication on doorway, and then travels to next door, towards Ninurta.

*

Ninurta travels to Apsu map entrance.

*

Enki waits for Ninurta.



DECLARE ORIENT ISHTAR > ANZU (MAP 3) * DECLARE TRANSFORM ISHTAR > 3 1 1

DECLARE ORIENT ANZU > NINURTA (DISTANCE 2)

DECLARE TRANSFORM NINURTA > 2 6 1

DECLARE ORIENT ENKI > NINURTA (MAP 3)

Ishtar exits to Irkalla map, towards Anzu.

*

Ninurta exits to Apsu map.

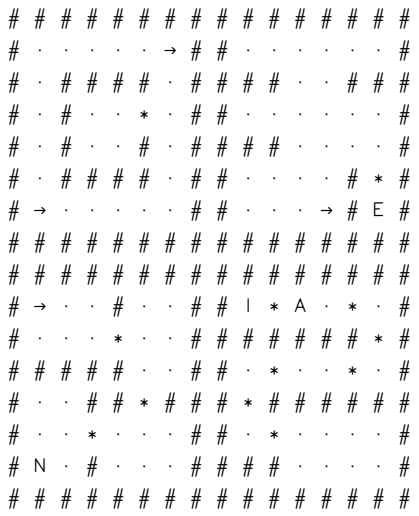
*

Anzu pauses, remains focused on Ninurta.

*

Enki waits for Ninurta.

30



DECLARE CHALLENGE ISHTAR > ANZU > ISHTAR WIN * DECLARE DEPLETE ISHTAR > 7 > 6 OBJECTS * DECLARE TRANSFORM ISHTAR > 3 6 6 * DECLARE TRANSFORM ISHTAR > 3 1 4

DECLARE ORIENT ANZU > ISHTAR (DISTANCE 2) * DECLARE CHALLENGE ISHTAR > ANZU > ISHTAR WIN * DECLARE TRANSFORM ANZU > 3 1 1

DECLARE TRANSFORM NINURTA > 2 1 1 * DECLARE TRANSFORM NINURTA > 2 5 2

DECLARE ORIENT ENKI > NINURTA (MAP 2)

Ishtar confronts and successfully challenges Anzu, but divests one object. Plans to travel to Irkalla enclosure, and then travels to next door.

*

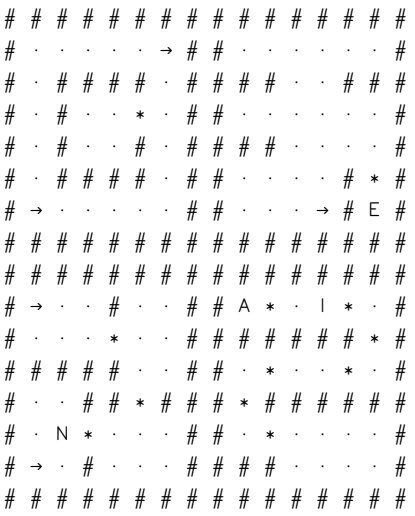
Anzu is confronted and challenged by Ishtar. Anzu loses, and travels to Apsu map entrance.

*

Ninurta plans to travel to Anu enclosure, and then travels to door.

*

Enki waits for Ninurta.



QUERY CALCULATE ISHTAR 3 × 1 = 3 T * DECLARE DEPLETE ISHTAR > 6 > 5 OBJECTS * DECLARE TRANSFORM ISHTAR > 3 1 6

DECLARE TRANSFORM ANZU > 2 6 1 * DECLARE ORIENT ANZU > NINURTA (MAP 2)

DECLARE TRANSFORM NINURTA > 2 5 5

DECLARE ORIENT ENKI > NINURTA (MAP 2)

Ishtar uses object to resolve numerical multiplication challenge on doorway, and then travels to next door.

*

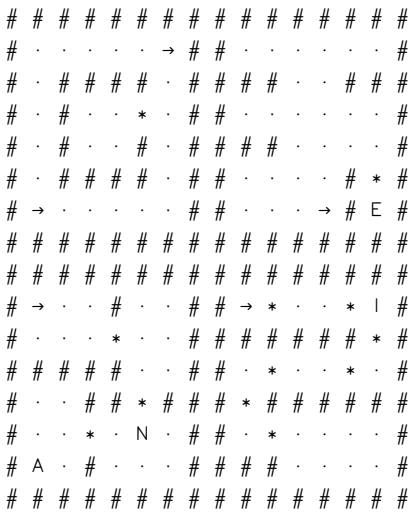
Anzu exits to Apsu map.

*

Ninurta travels to door.

*

Enki waits for Ninurta.



QUERY CALCULATE ISHTAR 3 − 3 = 0 T * DECLARE DEPLETE ISHTAR > 5 > 4 OBJECTS * DECLARE TRANSFORM ISHTAR > 3 3 6

DECLARE ORIENT ANZU > NINURTA (DISTANCE 5) * DECLARE TRANSFORM ANZU > 2 5 2

DECLARE TRANSFORM NINURTA > 2 2 5

DECLARE ORIENT ENKI > NINURTA (MAP 2)

Ishtar uses object to resolve numerical subtraction challenge on doorway, and then travels to next door.

*

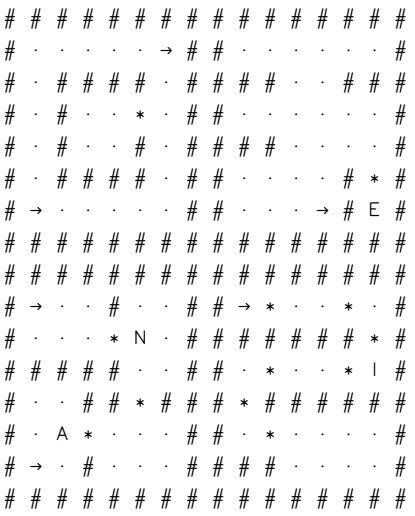
Anzu travels to door.

*

Ninurta travels to door.

*

Enki waits for Ninurta.



QUERY CALCULATE ISHTAR 3 + 6 = 9 T * DECLARE DEPLETE ISHTAR > 4 > 3 OBJECTS * DECLARE TRANSFORM ISHTAR > 3 3 3

DECLARE ORIENT ANZU > NINURTA (DISTANCE 6) * DECLARE TRANSFORM ANZU > 2 5 5

DECLARE TRANSFORM NINURTA > 2 1 1

DECLARE ORIENT ENKI > NINURTA (MAP 2)

Ishtar uses object to resolve numerical addition challenge on doorway, and then travels to next door.

*

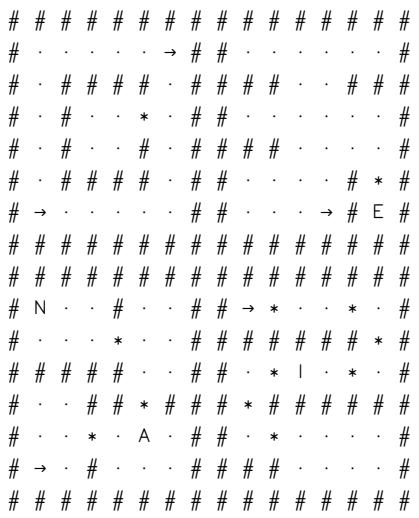
Anzu travels to door.

*

Ninurta travels to door.

*

Enki waits for Ninurta.



QUERY DEDUCE ISHTAR T ! T = F T * DECLARE DEPLETE ISHTAR > 3 > 2 OBJECTS * DECLARE TRANSFORM ISHTAR > 3 3 1

DECLARE ORIENT ANZU > NINURTA (DISTANCE 8) * DECLARE TRANSFORM ANZU > 2 2 5

DECLARE TRANSFORM NINURTA > 0 6 1

DECLARE ORIENT ENKI > NINURTA (MAP 2)

Ishtar uses object to resolve logical NOT challenge on doorway, and then travels to next door.

*

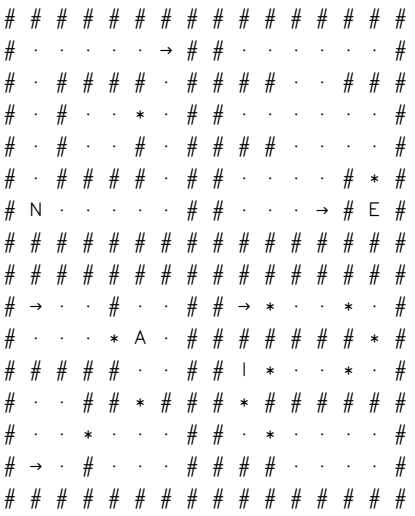
Anzu travels to door.

*

Ninurta travels to Anu map entrance.

*

Enki waits for Ninurta.



QUERY DEDUCE ISHTAR F ‖ T = F T * DECLARE DEPLETE ISHTAR > 2 > 1 OBJECTS * DECLARE TRANSFORM ISHTAR > 3 5 1

DECLARE ORIENT ANZU > NINURTA (MAP 0) * DECLARE TRANSFORM ANZU > 2 1 1

DECLARE TRANSFORM NINURTA > 0 3 6

DECLARE ORIENT ENKI > NINURTA (MAP 0)

Ishtar uses object to resolve logical OR challenge on doorway, and then travels to next door.

*

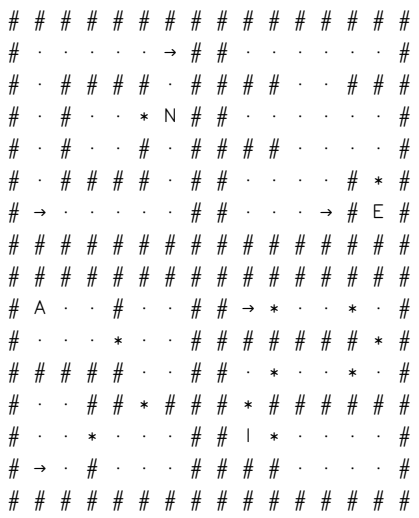
Anzu travels to Anu map entrance.

*

Ninurta exits to Anu map.

*

Enki waits for Ninurta.



QUERY DEDUCE ISHTAR F & T = F T * DECLARE DEPLETE ISHTAR > 1 > NIL OBJECTS * DECLARE TRANSFORM ISHTAR > 3 6 6

DECLARE ORIENT ANZU > NINURTA (MAP 0) * DECLARE TRANSFORM ANZU > 0 6 1

DECLARE TRANSFORM NINURTA > 0 3 4

DECLARE ORIENT ENKI > NINURTA (MAP 0)

Ishtar uses final object to resolve logical AND challenge on doorway, and then enters enclosure.

*

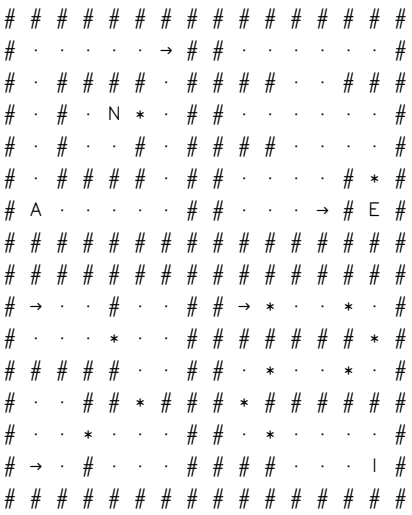
Anzu exits to Anu map.

*

Ninurta travels to door.

*

Enki waits for Ninurta.



DECLARE ISHTAR 8 OBJECTS * DECLARE POSITION TIME 37 ISHTAR > ANZU (0 6 1) * DECLARE AREA TIME 37 ISHTAR > ANZU ([# · #], [# A ·], [# # #]) * DECLARE POSITION TIME 37 ISHTAR > NINURTA (0 3 4) * DECLARE AREA TIME 37 ISHTAR > NINURTA ([# # #], [· N *], [· · #]) * DECLARE POSITION TIME 37 ISHTAR > ENKI (1 6 6) * DECLARE AREA TIME 37 ISHTAR > ENKI ([# * #], [# E #], [# # #]) * ISHTAR : TIME 37 — TIME 37

DECLARE ORIENT ANZU > NINURTA (DISTANCE 6)

DECLARE ORIENT NINURTA > ANZU (DISTANCE 6)

DECLARE ORIENT ENKI > NINURTA (MAP 0)

Ishtar retrieves 8 objects lost by Anzu, once possessed by Enki, which indicate the absolute present positions of Anzu, Ninurta, and Enki, as well as displaying their relative spatial contexts. Ishtar then uses the objects to stop and reset all timesteps back to 0.

*

Anzu pauses, remains focused on Ninurta.

*

Ninurta enters enclosure, waits for Anzu.

*

Enki waits for Ninurta.

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