



MARCH 17-21, 2025
SAN FRANCISCO, CA

Designing 10,000 handcrafted puzzles for Islands of Insight

Elyot Grant
CEO and Game Director, Lunarch Studios

ISLANDS OF INSIGHT



A woman with long dark hair, wearing a light-colored, patterned dress, is seen from behind, sitting in a small wooden boat. She is looking out over a vast cityscape at sunset. The sky is a mix of orange, pink, and purple, with a large, glowing sun. The city below is densely packed with buildings, and the water in the foreground is dark and reflects the light from the sky. The overall mood is contemplative and serene.

ISLANDS OF INSIGHT

OFFICIAL TRAILER



- Open world multiplayer puzzle game with GaaS/MMO features



- Open world multiplayer puzzle game with GaaS/MMO features
- Developed in partnership with Behaviour Interactive



- Open world multiplayer puzzle game with GaaS/MMO features
- Developed in partnership with Behaviour Interactive
- Over 10,000 handcrafted puzzles by 27 puzzle designers

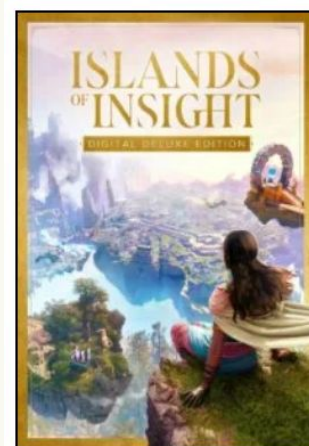


RECTIFY GAMING Since 2013



PC Gaming
Review: Islands of Insight

fncwill



Islands of Insight

Developer: Lunarch Studios
Publisher: Behaviour Interactive
Played On: PC (Microsoft Windows)
Genre: Adventure, Puzzle
Review Score: 9



REVIEWS * FEATURES * GUIDES * NEWS * PODCASTS * OUR PATREON

EDITOR RATING

OUR SCORE

9.0

SCORE OUT OF TEN

9.0

IN SHORT

Islands of Insight is one of the most ambitious puzzle games I've played, with a huge open world and progression hooks that make it essential.

Islands of Insight

Community Hub



Seek out and solve 10,000+ puzzles at your own pace across this sublime shared-world puzzle game.

RECENT REVIEWS: **Mixed** (34)

ALL REVIEWS: **Very Positive** (1,277)

RELEASE DATE: 13 Feb, 2024

DEVELOPER: **Lunarch Studios**

PUBLISHER: **Behaviour Interactive Inc.**

Popular user-defined tags for this product:

[Multiplayer](#) [Puzzle Platformer](#) [Puzzle](#) [Exploration](#) [+](#)



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Games > Puzzle > Islands of Insight

Finally, an online game shutting down the right way: Islands of Insight will close servers next month and 'permanently modify the game to be offline-only' so the promising puzzler can live on

News By Andy Chalk published September 30, 2024



(Image credit: Lunarch Studios)

This talk

- Design goals and pillars
- Puzzle types
- Design techniques
- Algorithmic puzzle generation
- Production and QA of 10,000 handmade puzzles
- Lessons from design failures

But first...

Why make this game?

Why make this game?

- The PC/console puzzle genre had fallen behind relative to:
 - Mobile Puzzle Games
 - Escape Rooms
 - Puzzle Content Creators

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 - The shift to live services had left the core puzzle genre behind
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 - Puzzle Content Creators
- Our hypothesis: demand was there, but:
 - The shift to live services had left the core puzzle genre behind
 - Existing games weren't friendly for content creators
- Our goals:
 - Become the dominant live service for a genre that had none
 - Make the best game in the genre for creators

Puzzles and GaaS

Puzzles and GaaS

The Mini Crossword Sunday, March 16, 2025

By Ian Livengood • Edited by Joel Fagliano



1:09

Rebus

Reset



1A The "J" in PB&J

1	J	2	E	3	L	4	L	5	Y
6	A	G	I	L	E				
7	M	Y	M	A	N				
		8	P	O	M				
		9	T	S	A				

ACROSS

- 1 The "J" in PB&J
- 6 Nimble
- 7 "Look at this guy coming through when it really matters!"
- 8 Fluffy toy dog, informally
- 9 Org. with a Known Traveler Number option

DOWN

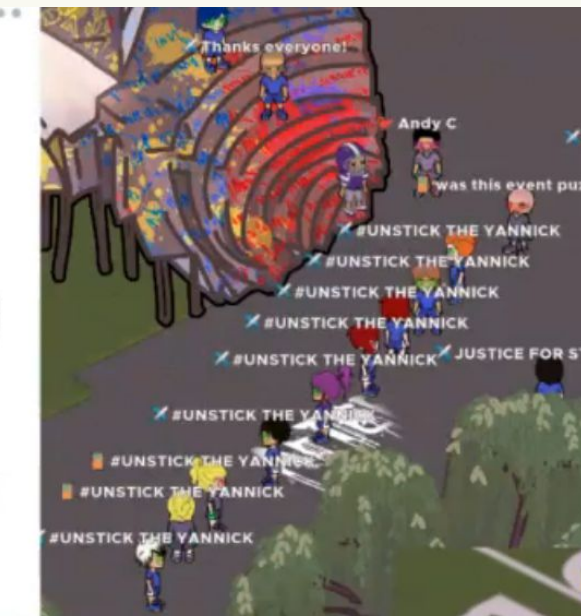
- 1 Rush hour annoyance
- 2 Its national soccer team is nicknamed the Pharaohs
- 3 Big cars with minibars, say
- 4 Animal that fills both blanks in the kids' book "_____ Holiday Drama"
- 5 Money in Japan

Puzzles and GaaS



Michael Andersen
@mjandersen

Mystery Hunt update: Day One captured the thrill and terror of getting hilariously lost in the maze that is the MIT Campus, without ever leaving my apartment.



Puzzles and GaaS

Puzzles are great for solving the ***content problem***.

Why?

Many people think of ***zero marginal cost*** algorithmic puzzles.

But our secret was ***low marginal cost*** high-quality handmade puzzles.

Marginal cost of high-quality handmade puzzles

\$2 - single hidden object puzzle

\$5 - simple environmental puzzle

\$10 - simple logic puzzle

\$20 - complex environmental puzzle

\$30 - complex, artistically-designed logic puzzle

\$50 - with curation, testing, editing, etc.

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→ 10,000+ puzzles is surprisingly doable (relative to the typical costs of an open world game)

A shared-world puzzle game

- 28 Enclaves (puzzle dungeons)
- Open world full of puzzles that cycle daily (sandbox)
- Dozens of side quests and challenges
- Progression: skill tree, cosmetics, unlockables, dailies, etc.



Design Pillars

Design Pillars

- Maximize the density of **Eureka Moments**
- Maximize the value of **Live Service Multiplayer**
- Imbue everything with **Sublime Beauty**
- Optimize the experience for the **Viewers**

Eureka Moments

Sudden, **pleasureful**, **fluent**, **confident** feelings of understanding.

Eureka Moments

Sudden, **pleasureful**, **fluent**, **confident** feelings of understanding.

Viewers experience them too!

This is a double-edged sword:

- Great for content creators
- Watching may be a substitute for playing

Why puzzle games are bad for live streaming

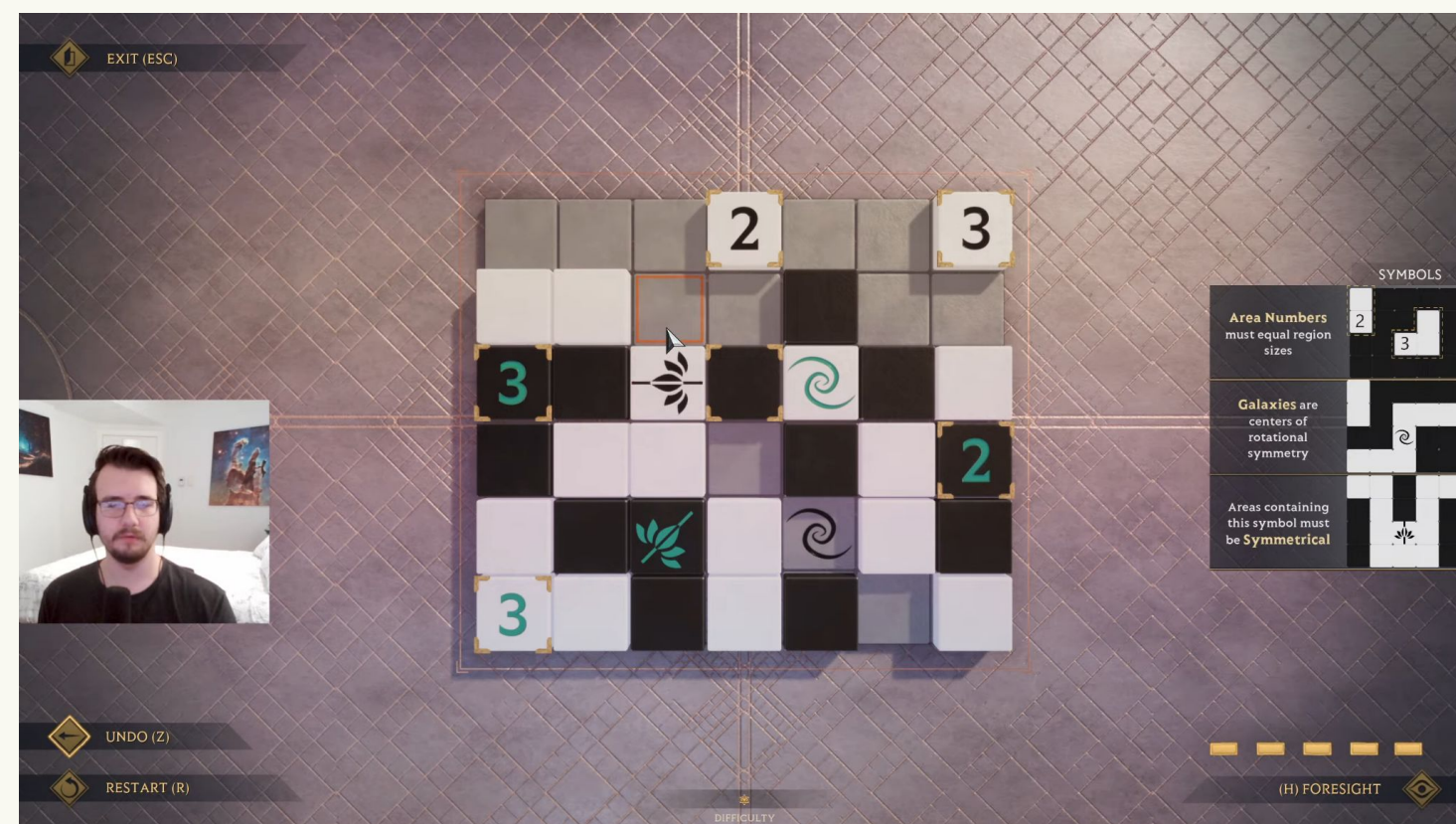
Why puzzle games are bad for live streaming

- (1) Puzzles are inherently not replayable
- (2) Puzzle games lack tension in the meta-structure
- (3) Streamers get stuck and it gets boring
- (4) Twitch chat constantly spoils puzzles and ruins the fun
- (5) The interesting part of puzzles is not visual enough
- (6) They don't grow or sustain audiences or communities
- (7) Viewers don't understand what they're looking at
- (8) They're too hard
- (9) They're ugly
- (10) Streamers are self-conscious about playing them

Audience-first puzzle design

Audience-first puzzle design

- Obvious goals
- No intransparencies
- Visible progress
- Beautiful artstyle
- Rules on screen when needed
- Lots of easy & fast content
- Rotating content



We prototyped ~45 puzzle types

We shipped 24 of them.

6 categories

- Grid puzzles
- Environment
- Perspective
- Movement
- Hidden Objects
- Interactive





VERDANT GLEN

- Travel to the Glass Temple
- Travel to the Chambers of the Triunes



LUMINOUS QUEST

- Solve 15 puzzles found on floor slabs 0/15

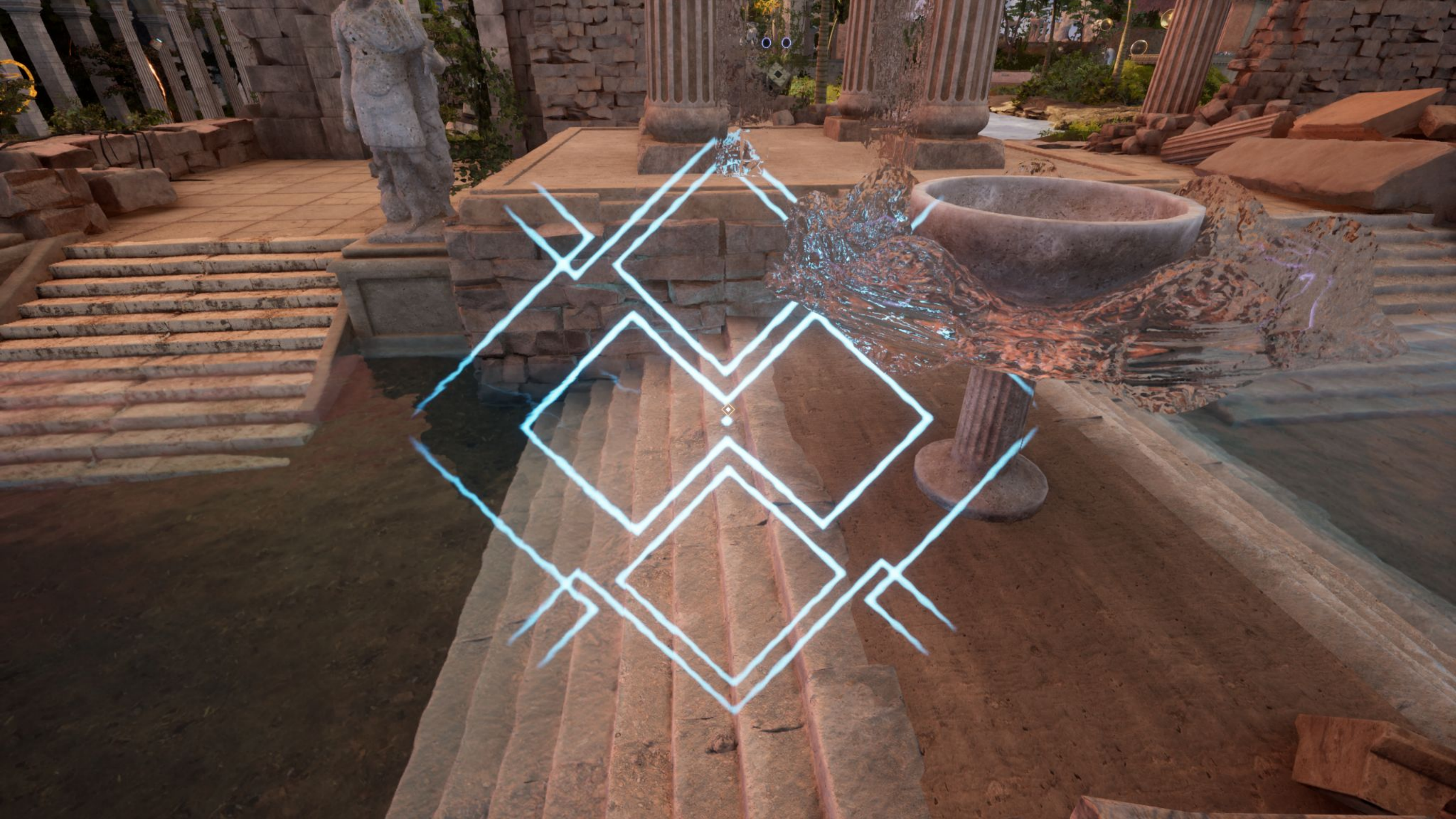
544m



357m









Balance and pacing

- Puzzles are tiring!

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 - Repeating the same activity is tiring

Balance and pacing

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 - Repeating the same activity is tiring
- Need lots of flowy content
- Variety is key: Use different parts of the player's brain:
 - Logic
 - Observation
 - Navigation
 - Memory
 - Music

Balance and pacing

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 - Logic
 - Observation
 - Navigation
 - Memory
 - Music
 - Face Detection (?!)

We also picked puzzles to...

- Minimize the marginal cost of creating new instances
- Maximizing the expressive power of puzzle authors



THE CLIFF AND THE VOID

GOALS

- Complete one Pillar of Insight
- Solve 6 Logic Grids 0/6
- Follow 3 Wandering Echoes 0/3
- Solve 4 Light Motifs 0/4

BONUS

- ◆ Find 20 Hidden Cubes 0/20

Wandering echoes can be...

- Tutorials
- Guidance down paths
- Clues to secrets/shortcuts
- Speedrun challenges
- Platforming challenges
- Hide and seek
- Art
- Tricks (how do I get there in time?)
- Memorable, unique experiences



Elaborate one-offs

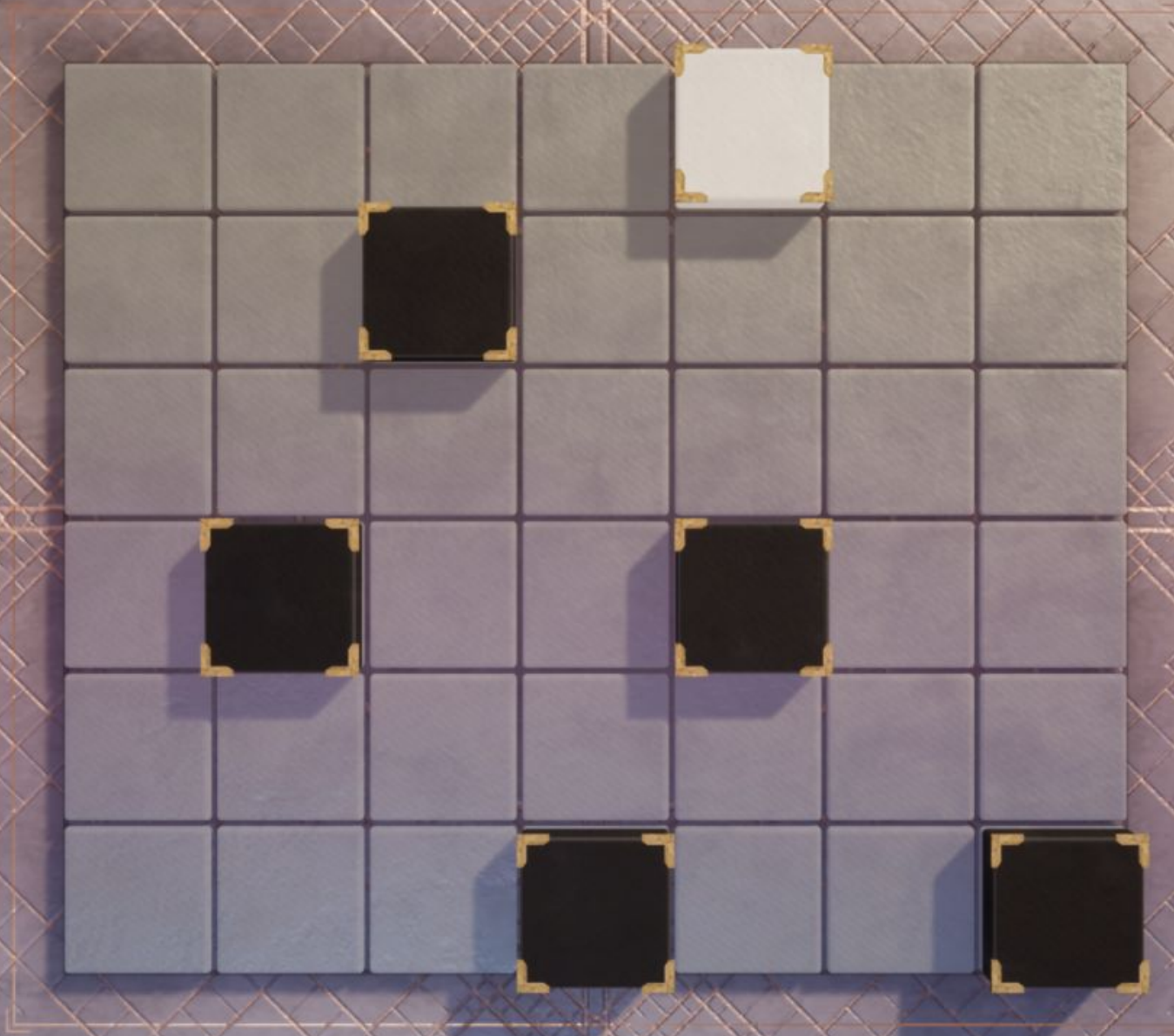


Logic Grids





EXIT (ESC)



RULES

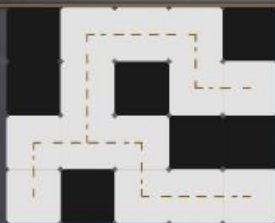
Don't make this pattern



Don't make this pattern



Connect all light cells



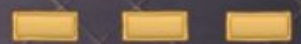
UNDO (Z)



RESTART (R)



DIFFICULTY

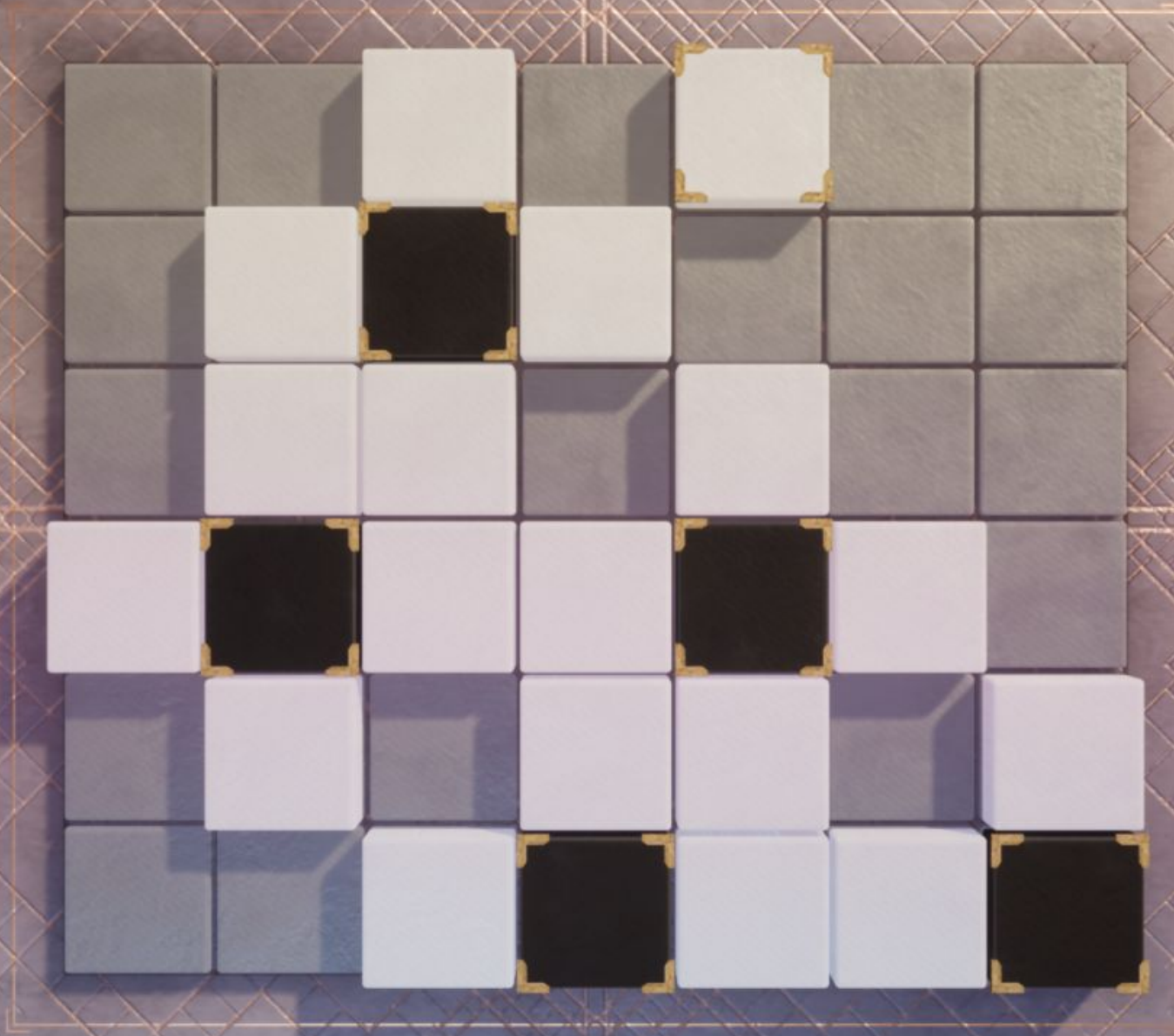


(H) FORESIGHT





EXIT (ESC)



RULES

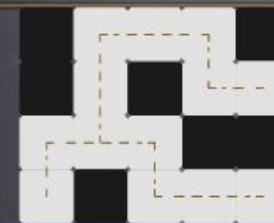
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Don't make this pattern



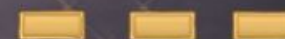
Connect all light cells



UNDO (Z)



RESTART (R)



(H) FORESIGHT



DIFFICULTY



EXIT (ESC)



RULES

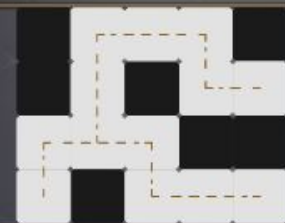
Don't make this pattern



Don't make this pattern



Connect all light cells



UNDO (Z)



RESTART (R)



DIFFICULTY



(H) FORESIGHT





EXIT (ESC)



RULES

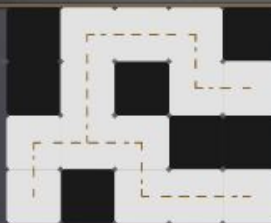
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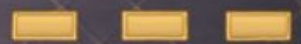
Connect all light cells



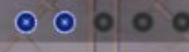
UNDO (Z)



RESTART (R)



(H) FORESIGHT



DIFFICULTY



EXIT (ESC)



RULES

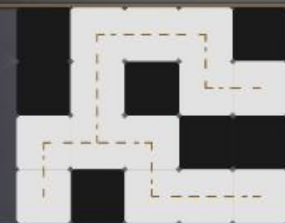
Don't make this pattern



Don't make this pattern



Connect all light cells



UNDO (Z)



RESTART (R)



DIFFICULTY



(H) FORESIGHT





EXIT (ESC)



RULES

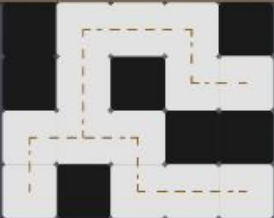
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Connect all light cells



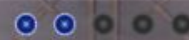
UNDO (Z)



RESTART (R)



(H) FORESIGHT



DIFFICULTY



EXIT (ESC)



RULES

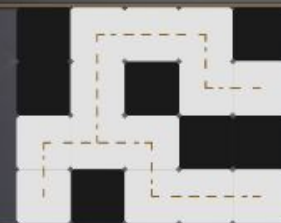
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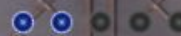
Connect all light cells



UNDO (Z)



RESTART (R)



DIFFICULTY



(H) FORESIGHT





EXIT (ESC)



RULES

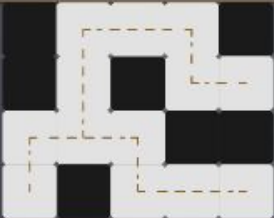
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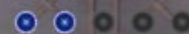
Connect all light cells



UNDO (Z)



RESTART (R)



DIFFICULTY



(H) FORESIGHT





EXIT (ESC)



RULES

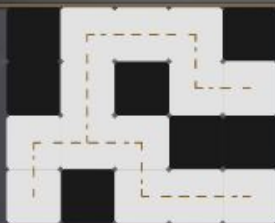
Don't make this pattern



Don't make this pattern



Connect all light cells



UNDO (Z)



RESTART (R)



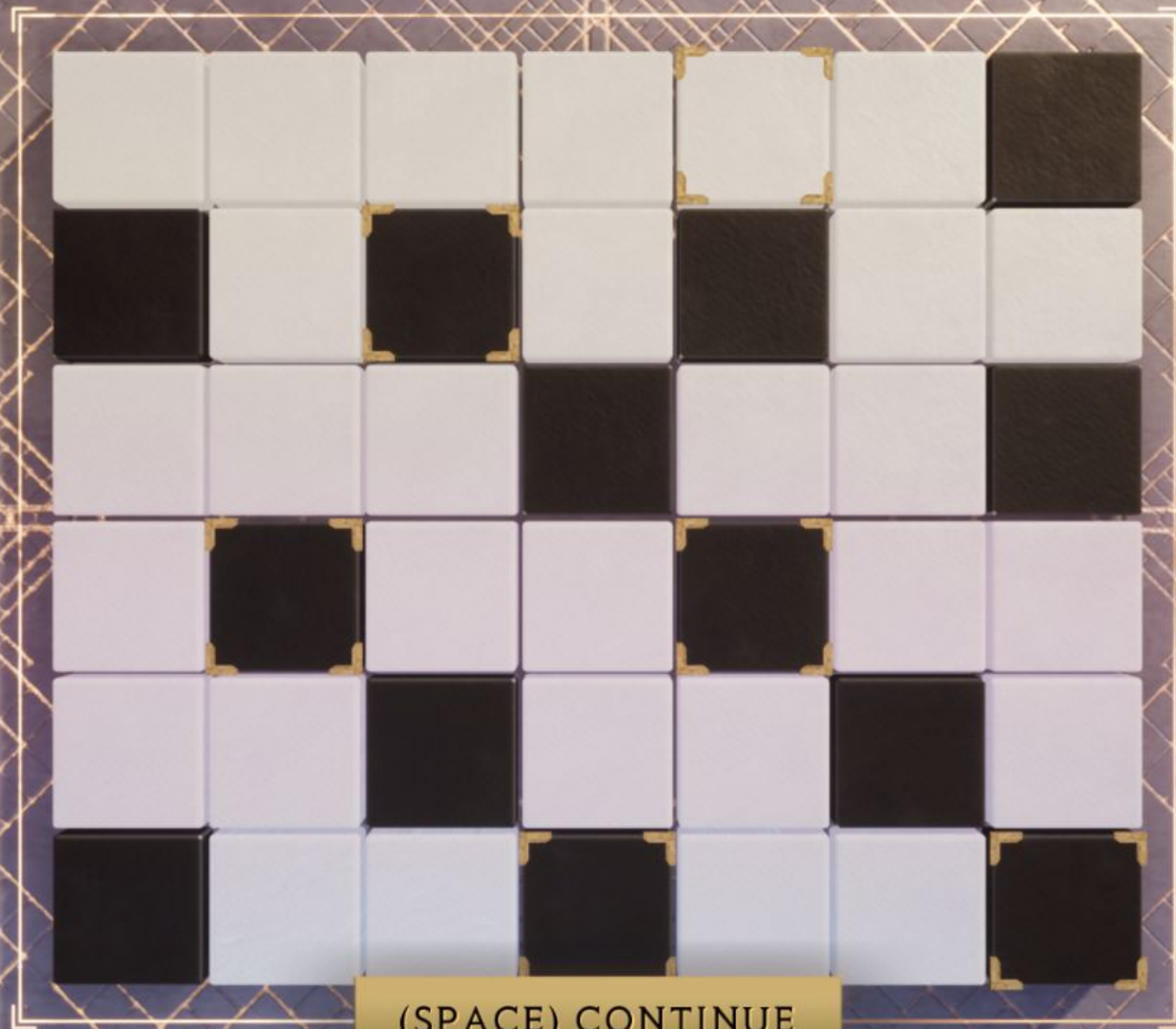
(H) FORESIGHT



DIFFICULTY



EXIT (ESC)



(SPACE) CONTINUE

RULES

Don't make this pattern



Don't make this pattern



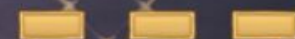
Connect all light cells



UNDO (Z)



RESTART (R)

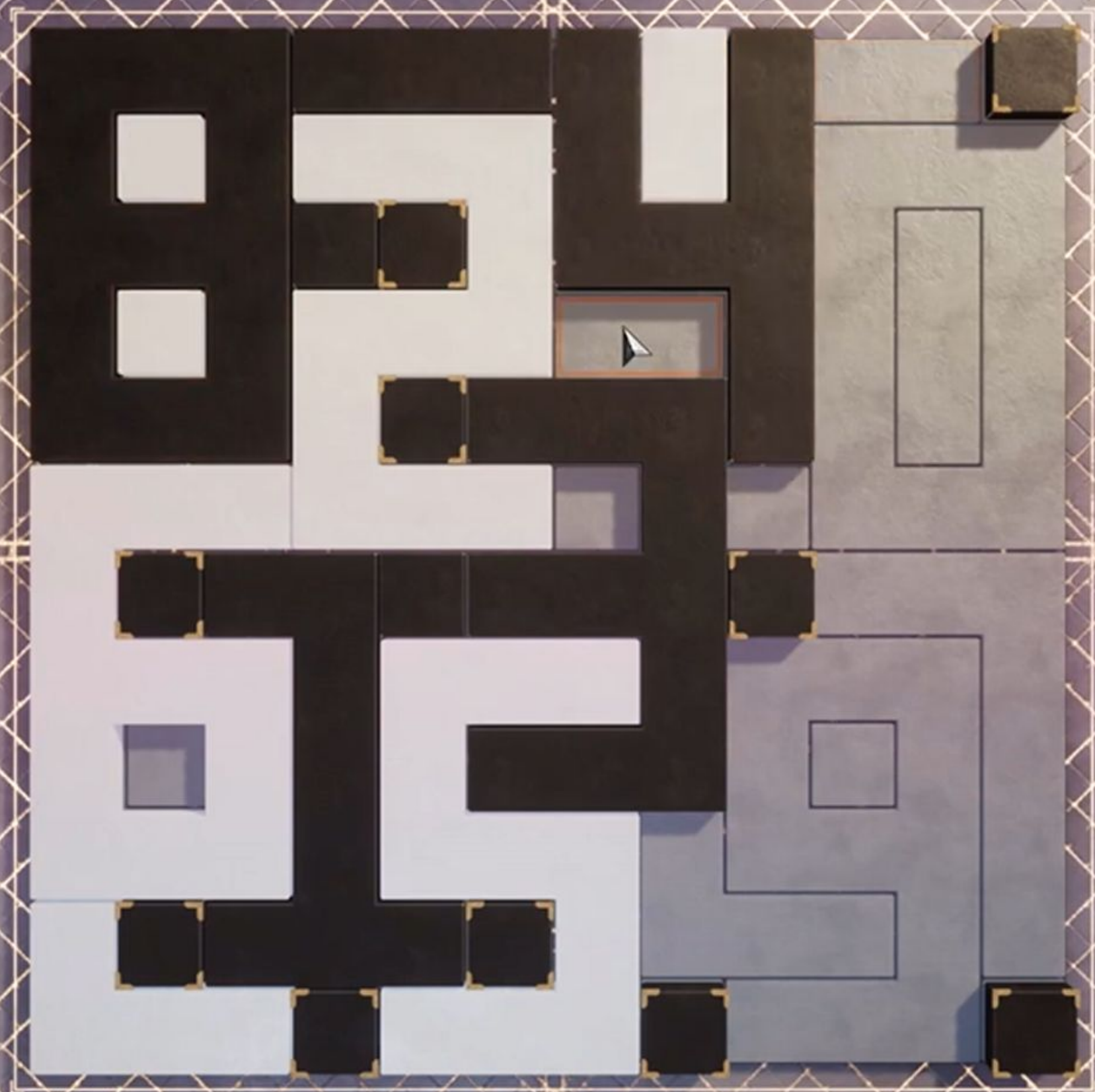


(H) FORESIGHT



DIFFICULTY

EXIT (ESC)



RULES

Don't make this pattern



Connect all dark cells



UNDO (Z)

RESTART (R)

DIFFICULTY

(H) FORESIGHT





Grid rules

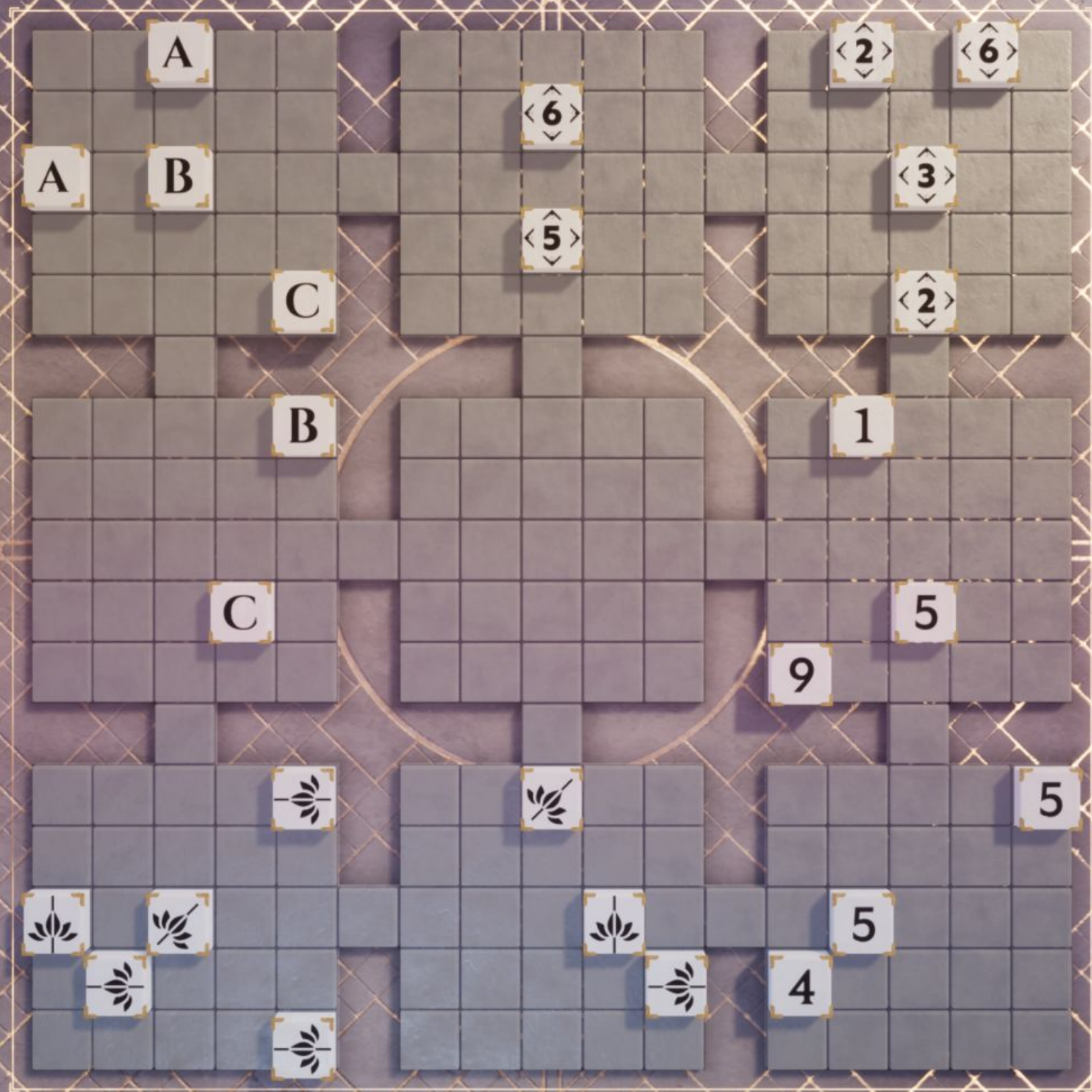


Grid rules

- 6 logic grid symbols (+1 post launch)
- 7 logic grid rules (+2 post launch)
- Arbitrary grid shape, merged cells, black and white givens
- 3 additional grid types:
 - Pattern grid
 - Music grid
 - Memory grid



EXIT (ESC)



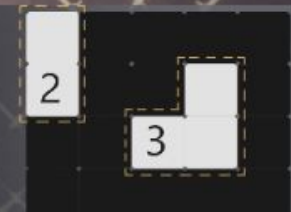
RULES

All dark regions have area 3



SYMBOLS

Area Numbers must equal region sizes



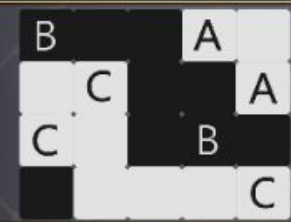
Viewpoint Numbers count visible cells in the four directions



Areas containing this symbol must be Symmetrical



Letters must be sorted into one type per area



UNDO (Z)

RESTART (R)

DIFFICULTY



(H) FORESIGHT



Grid puzzles

- Deep and expressive puzzle system
- One solution per puzzle, reachable with logic alone
- Lots of effort put into UI (e.g. dragging, undo, restart)
- Foresight (hint system)
- Rules chosen carefully
 - All rules can be combined with all other rules
 - Combos of multiple rules have interesting emergent interactions
 - About 100 different puzzle rules were considered

Some rules can be shockingly deep

Some rules can be shockingly deep

“Don’t make this pattern” is really 10 rules in 1





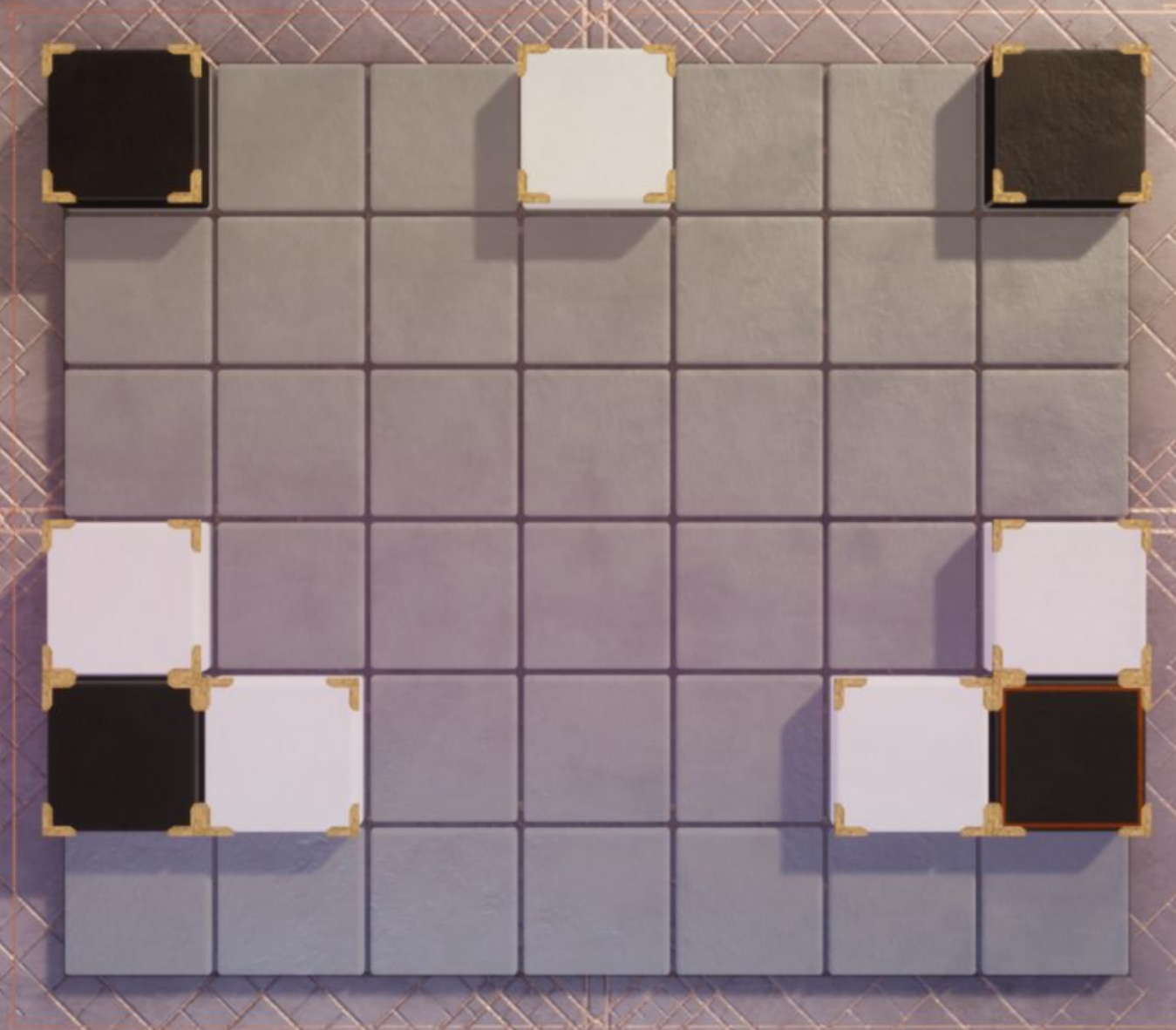
EXIT (ESC)



UNDO (Z)



RESTART (R)

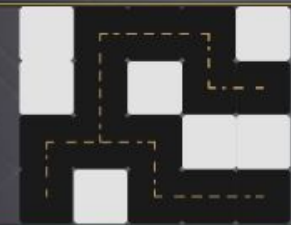


RULES

Don't make this pattern



Connect all dark cells



(H) FORESIGHT



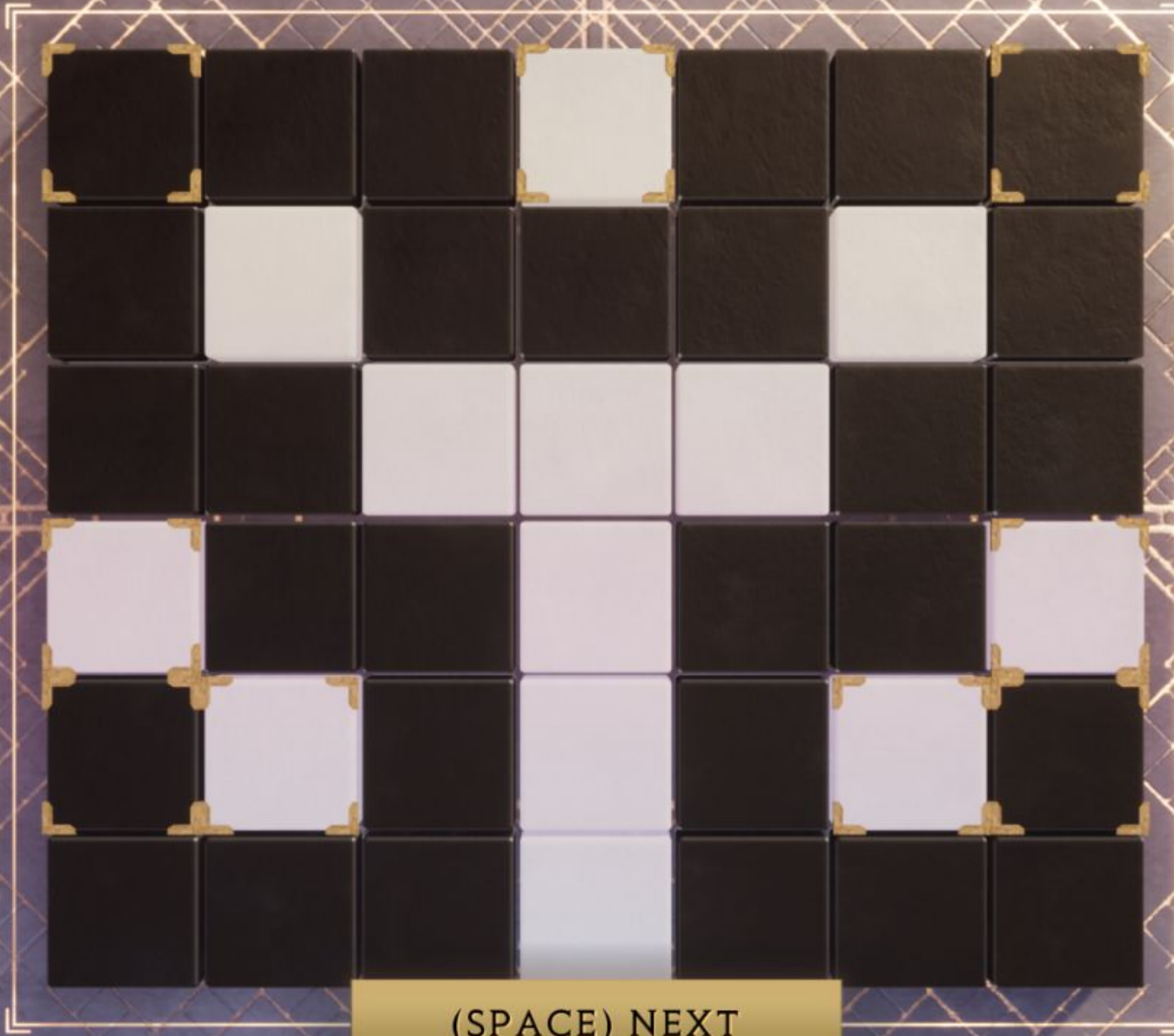
DIFFICULTY

EXIT (ESC)



UNDO (Z)

RESTART (R)



(SPACE) NEXT

RULES

Don't make this pattern



Connect all dark cells



(H) FORESIGHT



DIFFICULTY

Logic Grids were the most successful puzzle type

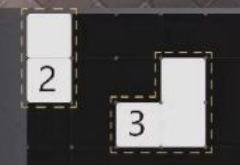
They comprised about 25% of the puzzles, but a majority of the engagement.

EXIT (ESC)



SYMBOLS

Area Numbers must equal region sizes



Galaxies are centers of rotational symmetry



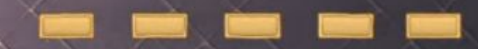
Areas containing this symbol must be Symmetrical



UNDO (Z)

RESTART (R)

DIFFICULTY



(H) FORESIGHT

Popular puzzles

All puzzles

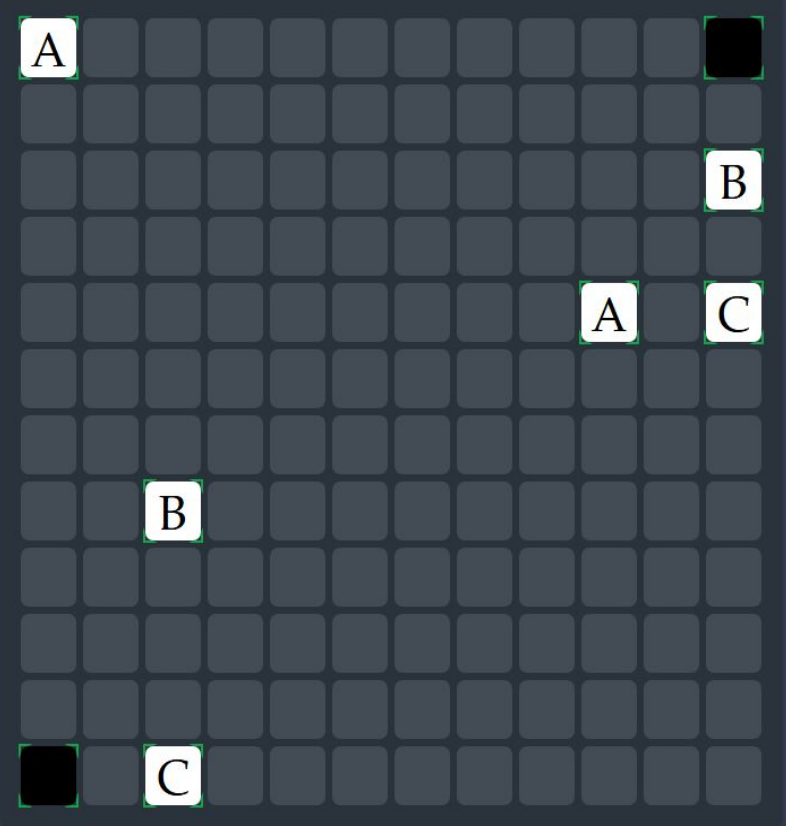
 **Small galaxies**
mincho 🌟
★ • 3 plays • about 13 hours ago

 **Letter Grid 4**
Agilo
★½ • 3 plays • about 15 hours ago

 **All Smiles**
Agilo
★½ • 5 plays • 4 days ago

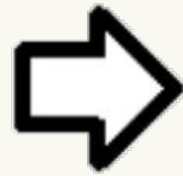
Logic Pad Create Solve Theme

Barricaded
Lysine
Tiles Remaining: 42



RULES
Underclued Grid: Mark only what is definitely true
Connect all dark cells

SYMBOLS
Letters must be sorted into one type per area



How we make logic grids

How we make logic grids

The “forward design” method
AKA “design from the front”

How we make logic grids

The “forward design” method
AKA “design from the front”

→ Design the puzzle’s logical steps ***in the same order that the solver will experience them***

Forward design

- 1) Pick the rules, clue types, and grid shape you want to use
- 2) Put a clue in the grid
- 3) Deduce everything you can from the clues placed so far*
- 4) Repeat steps 2-3 until the grid is determined uniquely

* If you reach a contradiction, go back and try a different clue

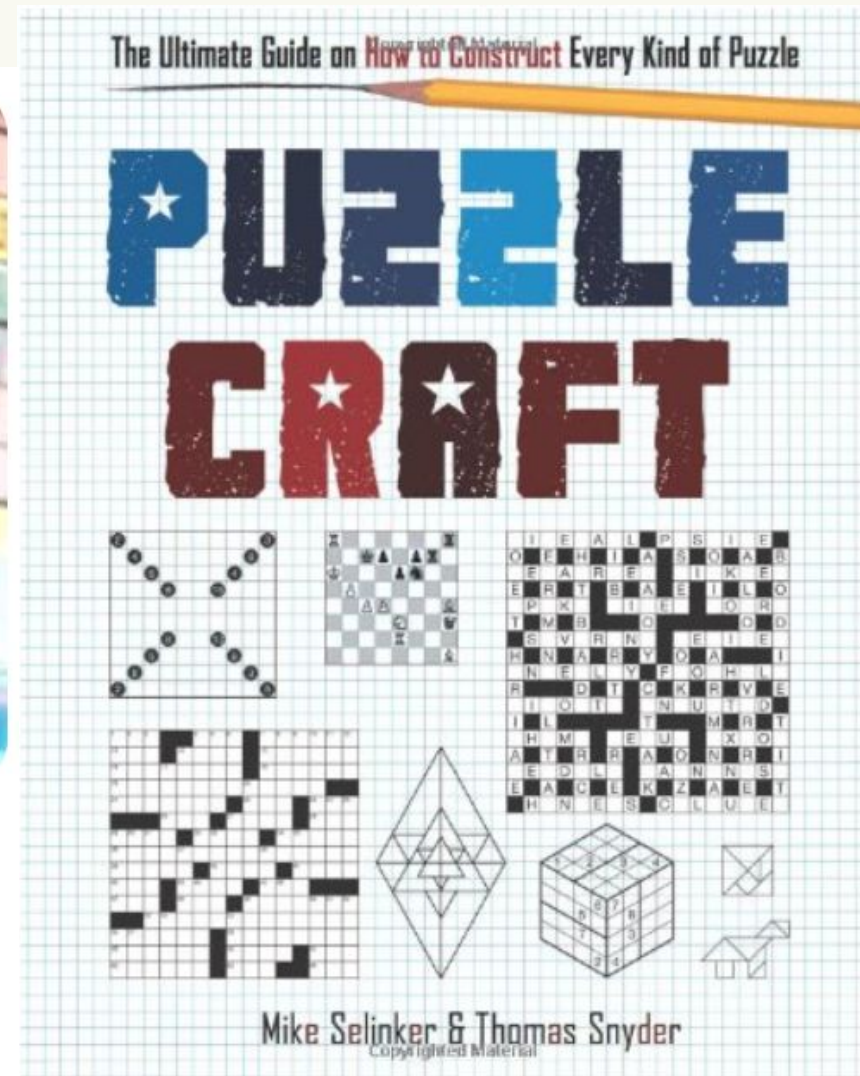
See also

- My “30 puzzle design lessons” talk from 2021
- Thomas Snyder writes about the process in Puzzle Craft
- Matthew Van Devander (creator of Taiji) has a video



Elyot Grant - 30 Puzzle Design Lessons, Extended Director's Cut (Part 3 of 3)

5.4K views • 3 years ago



⋮



How To Forward Design A Puzzle (Using The Witness As An Example)

1K views • 5 years ago

⋮

Benefits of forward design

- Tight control over the solution journey
 - Is it a flowy linear sequence?
 - Can the player find multiple places to make progress?
 - Do we force them to use a specific logical deduction?
- Huge amount of expressiveness for puzzle authors
 - Authors are energized and motivated by creativity
 - Puzzles feel “logical” and “designed”
 - Content feels unique and valuable to players, not “slop”
- It can be very economical (but requires skilled designers)
- It enables our hint system

Foresight System

The image shows a puzzle interface with a 6x6 grid of tiles. The tiles are arranged in a pattern of dark and light colors. A blue question mark is placed in the center of the grid, indicating a puzzle state. A notification box at the top center contains an eye icon and the text: "Your progress is correct. Now look at this tile." To the right, a "RULES" panel lists two rules: "Don't make this pattern" with a red 'X' over a 2x2 grid, and "Connect all dark cells" with a diagram of a path connecting dark cells. At the bottom left, there are "UNDO (Z)" and "RESTART (R)" buttons. At the bottom center, there is a "DIFFICULTY" indicator with five circles, the first two of which are filled. At the bottom right, there is a "(H) FORESIGHT" button with an eye icon. The background is a dark purple wall with a diamond-shaped tile pattern.

UNDO (Z)

RESTART (R)

DIFFICULTY

(H) FORESIGHT

RULES

Don't make this pattern

Connect all dark cells

Your progress is correct. Now look at this tile.

Foresight System

How we implemented it:

- A human tester solves the puzzle logically
- We record the **order** in which the grid cells are filled in

When the player requests a hint:

- If the player is on the right track (no mistakes), we highlight the location of **the earliest step not yet filled in by the player**
- If mistakes were made, we highlight **the earliest mistake**



Foresight System

Benefits:

- Players liked that it just showed them *where to look* rather than how to make progress
- We didn't have to detect solving steps or explain them

Drawbacks:

- Requires a puzzle type where progress is entered as you go
- Requires the puzzle to have a logical solution path
- Players were reluctant to ask for hints
- A "check my work so far" would have been better for many



Insights

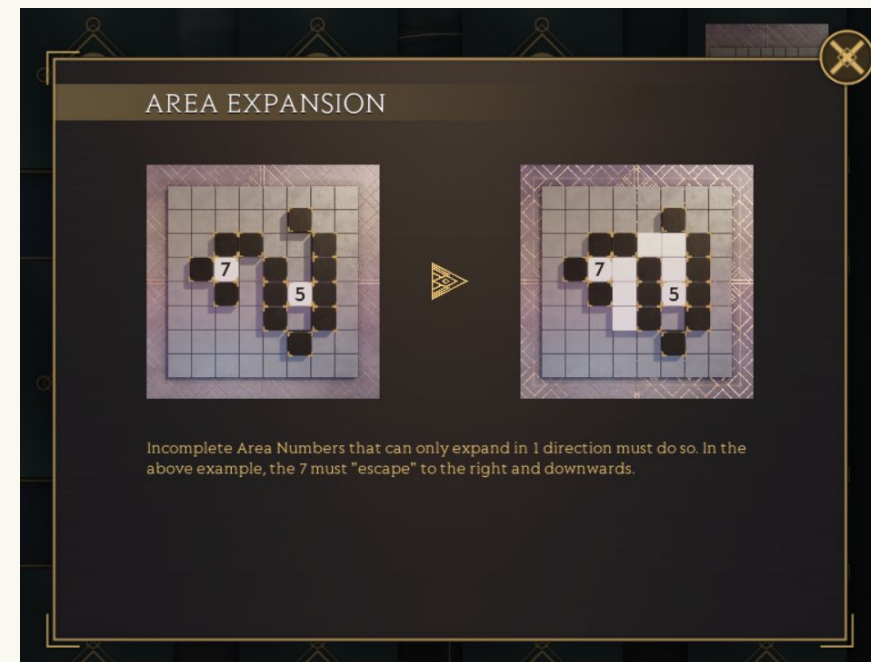
AREA EXPANSION



Incomplete Area Numbers that can only expand in 1 direction must do so. In the above example, the 7 must "escape" to the right and downwards.

Insights

- Encyclopedia of logical solving techniques
- Earned after beating a puzzle that needs the technique
- Consent model
 - Players are shown the title of the insight and choose to read or skip
 - Many chose not to read!



Underclued grids

The image shows a screenshot of the game 'Underclued'. On the left is a 6x6 grid of tiles. A dark grey tile is in the second row, fifth column. A light grey tile is in the first row, first column. A mouse cursor is over the fourth row, fifth column. A dark grey bar at the top left contains a yellow diamond icon and the text 'Tiles Remaining: 3'. On the right is a 'RULES' panel with two sections: 'Underclued grid: Mark only what is definitely true' and 'Connect all dark cells'. The first section shows a 3x3 grid with a '1' in the center and question marks in other cells. The second section shows a 3x3 grid with a path of dark cells and a dashed line indicating a connection.

Tiles Remaining: 3

RULES

Underclued grid:
Mark only what is definitely true

Connect all dark cells

Underclued grids

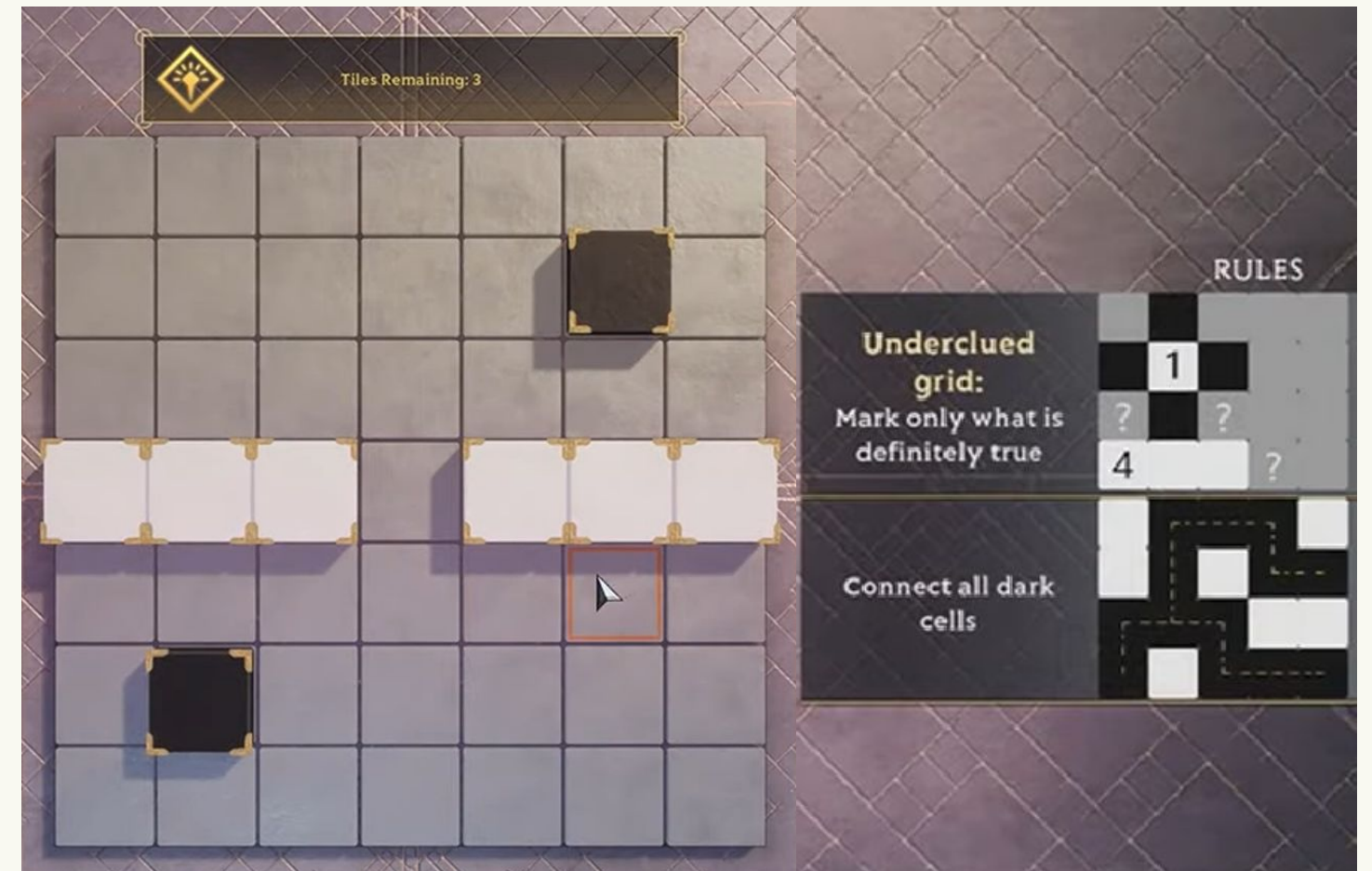


Underclued grids

- Inspired by “one cell sudoku”

Purposes:

- Force players into a logical mindset
- Isolate a specific deduction
- Teach solving tricks to players
- Create unique challenges



Underclued grids

- Inspired by “one cell sudoku”

Purposes:

- Force players into a logical mindset
- Isolate a specific deduction
- Teach solving tricks to players
- Create unique challenges

→ Turned out to be a fan-favorite feature

Campaign Structure

Problem: people get stuck on puzzles! Even easy ones!

Campaign Structure

Problem: people get stuck on puzzles! Even easy ones!

Solution: everything is optional

- “Super Mario 64 Progression”
- Collect 60 of 150 Mirabilis to awaken zone 5
- Complete 15 of 50 puzzles to clear an enclave

THE EMPYREAN JOURNEY

22 Puzzles solved

GOALS

- ✓ Complete the chain of Logic Grids to earn your wings 11/11
- ✓ Follow the Wandering Echo with your new wings

BONUS

- 🔲 Solve 13 Hidden Rings 7/13
- 🔲 Solve 8 Armillary Rings 0/8
- 🔲 Solve 8 Skydrops 2/8
- 🔲 Solve 12 additional Logic Grids 1/12

LUMINOUS QUEST

- Solve 15 puzzles found on floor slabs 0/15

Puzzle Awakening

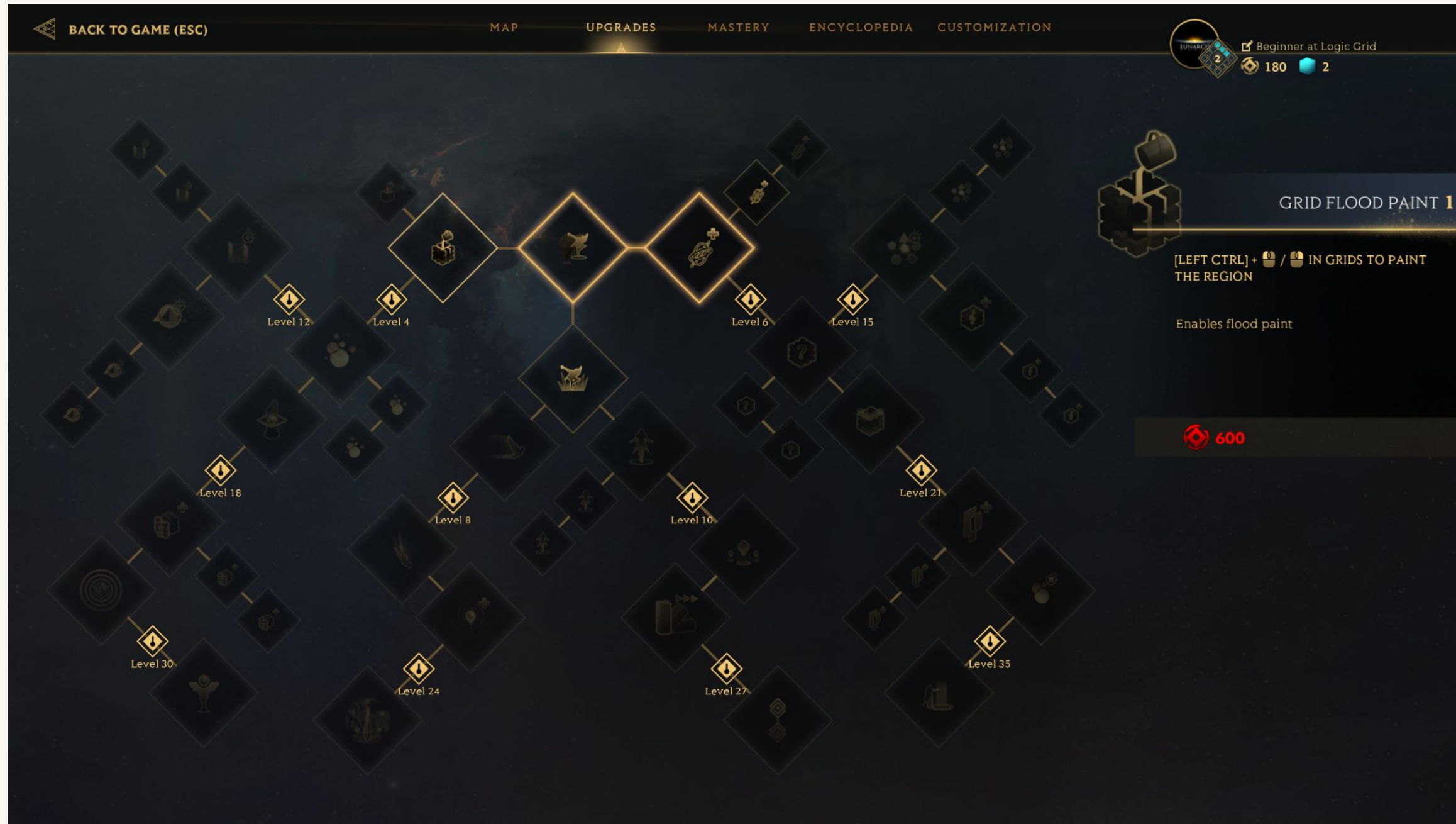


Puzzle Awakening

- Added late in development (after big beta test)
- Players didn't feel they were affecting the world
- Puzzles encountered before the intended tutorial
- We actually wanted a bit less freedom

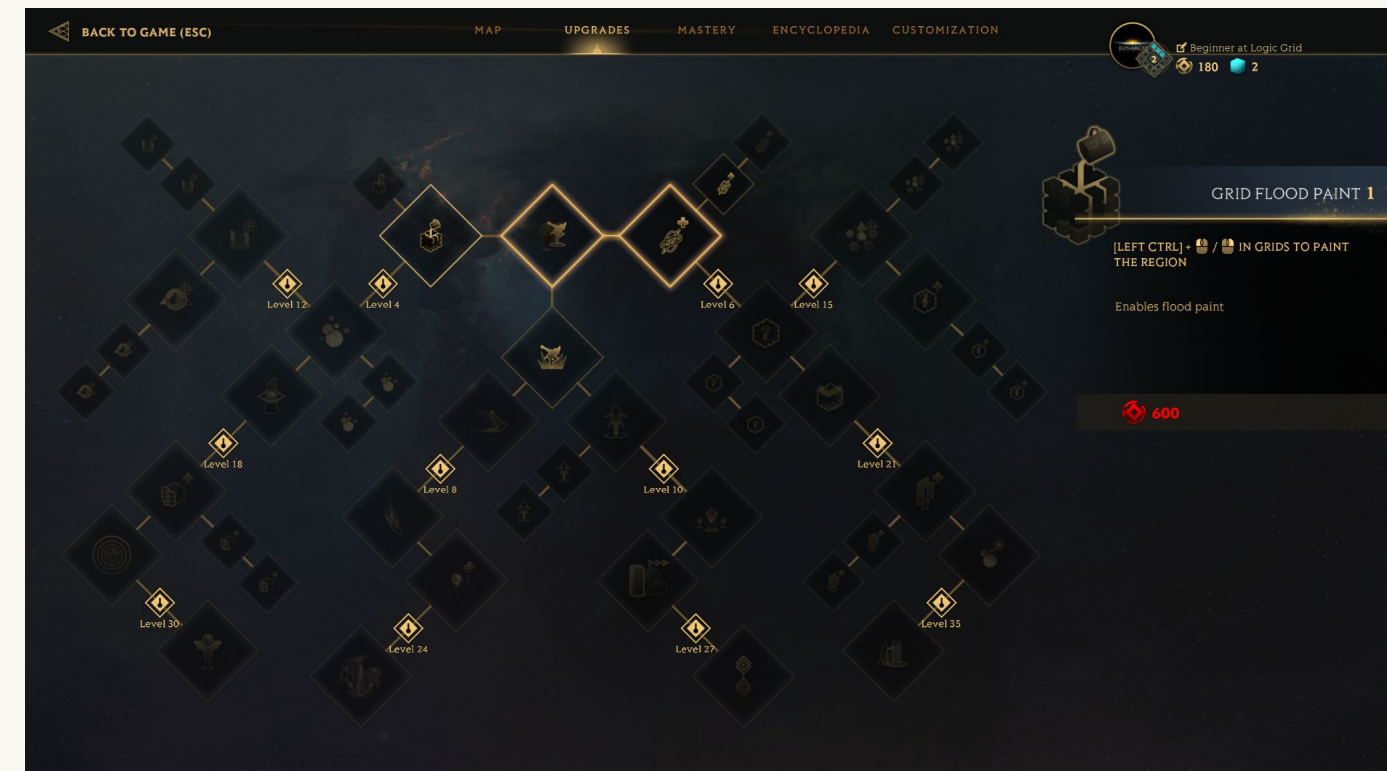


Upgrades



Upgrades

- You can add a skill tree to any game, even a puzzle game
- Good for slowly introducing QoL features or subtle mechanics
 - Example: area counter + paint bucket tool in grid puzzles
- Good for optional challenges
 - maze speed-solving bonus
 - memory grid perfection bonus

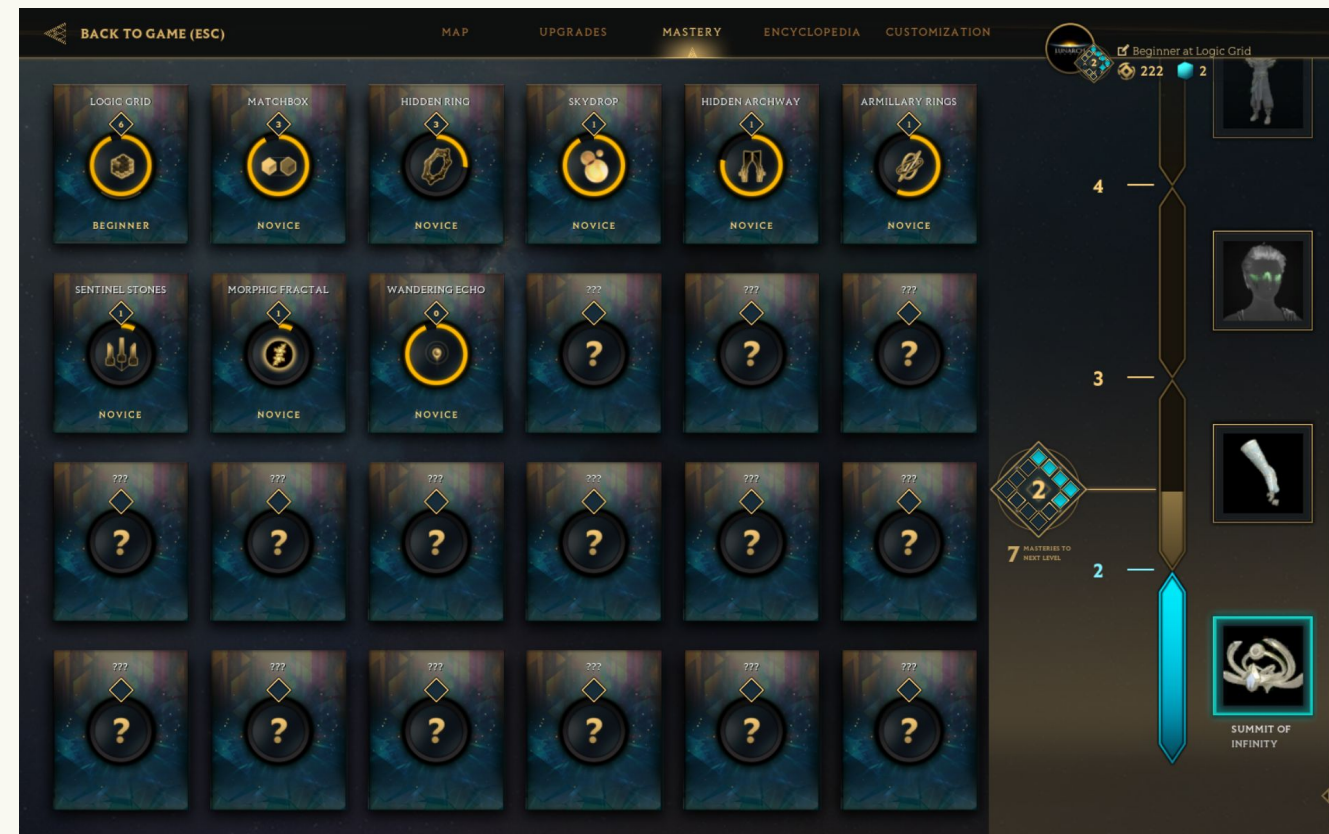


Masteries



Masteries

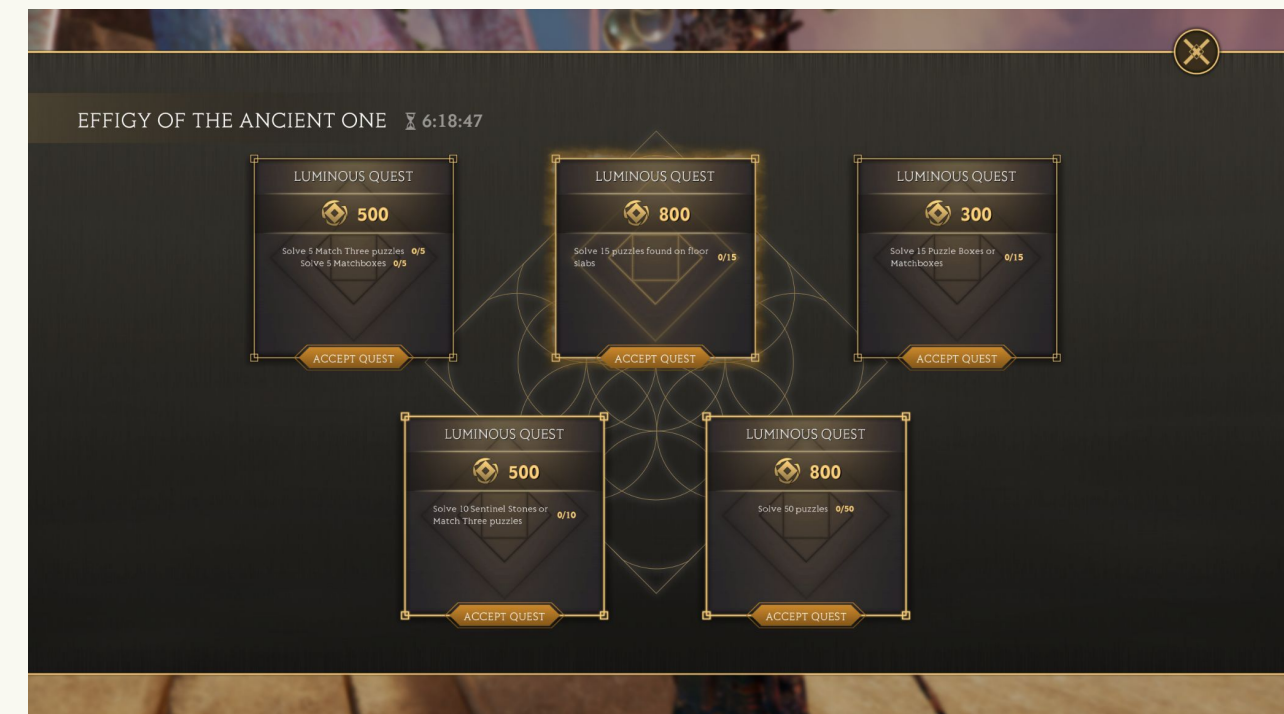
- Adds a little celebration after every solve
- Players love making numbers go up
- Unlock cosmetics, currency, rewards, titles



Daily Quests



Daily Quests



- Possible in a puzzle game due the amount of content
- Finding puzzles was often more work than solving them
 - “Puzzle radar” item needed
- Incentives were upgrades and cosmetics (no currency sinks)
- Players preferred quests where they had a choice of what to do

Tooling

- In-engine tools
- Outside-of-engine tools
- Puzzle database

In-engine tooling



In-engine tooling

- Minimize the total amount of work needed to produce puzzles:
 - creation
 - testing
 - curation
 - deployment
- Eliminate toil
- Minimize probability of mistakes
- Avoid RSI



In-engine tooling

- Minimize the total amount of work needed to produce puzzles:
 - creation
 - testing
 - curation
 - deployment
- Eliminate toil
- Minimize probability of mistakes
- Avoid RSI
- **Maximize quality of life for puzzle designers so their creativity can shine**



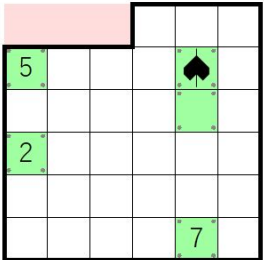
Web-based puzzle creation tools

SoPACT Version 3357/3357/3357 ?
[go to main page](#)

Mirror Area Numbers by javis

File Edit Display Setting

Mode | **Edit mode** Answer mode
Input Type | **L/R buttons** One button
Input Mode | **Auto** Nurikabe number Cave number Yajilin number
Givens Aleph Mirror Dominion Text Border
Merge Null Hidden Erase data
Check shaded cell connection
Automatic givens | **Unshaded** Shaded None



- Do Not Make This Pattern: [] ?
- Black Connected
- White Connected
- Black 1 Symbol Per Island
- White 1 Symbol Per Island
- KnappDaneben ?
- Complete The Pattern
- Memory Grid
- Search The Environment
- Complete Only What You Can
- All black areas have size: []
- All white areas have size: []

Grid type: **Rectangular (no wrap)**

Check [] [] Erase answer Erase aux. marks Trial mode

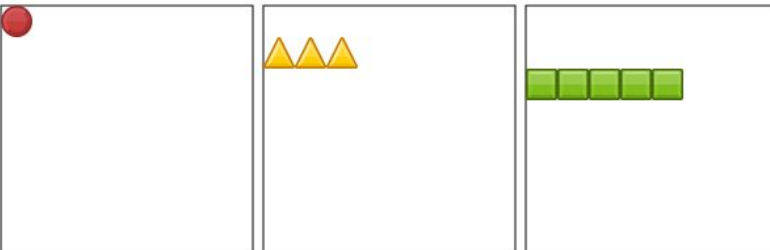
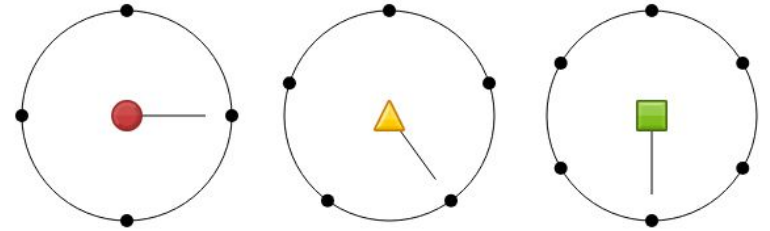

View selected hint path 0 Jeffrey Delete hint path BPM: 120

View solution (100%)

Border colour: #000000
 Use asymmetric mirror symbol

Switch black/white

NoPattern templates (click to add):



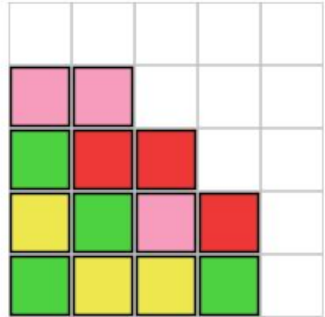
clocks 3 # buttons 3 save state load state

filename.lockpick Download the handmade lockpick file

Clock: Click to advance the hand. Shift-Click to add a pip. Ctrl-click to remove a pip.
Button: Click to use. Shift-Click to add a symbol. Ctrl-click to remove a symbol.

Choose File No file chosen Import Export

Test Play




Expand Crop Fix palette

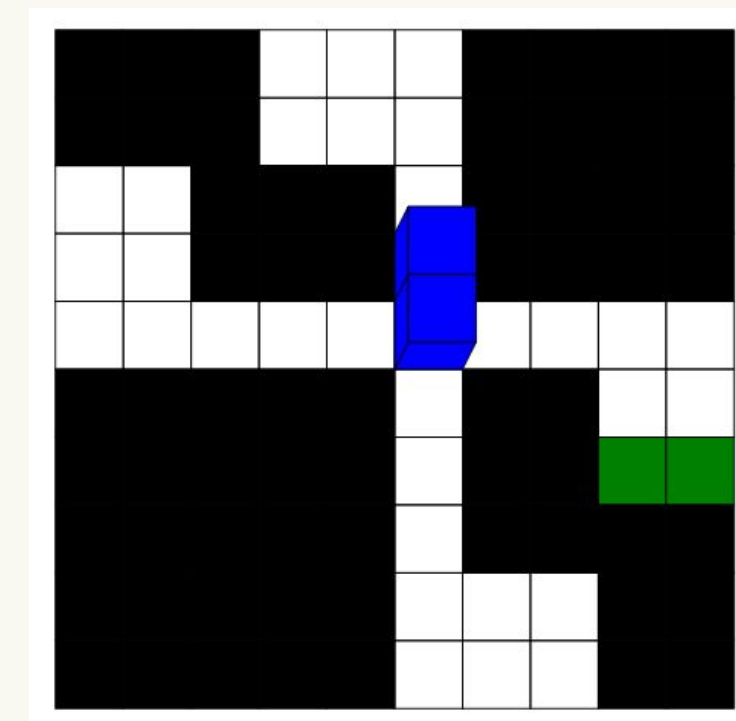
Warning: these ones might mess up your puzzle

Compress palette ?

Brushes



Air Wall



Web-based puzzle creation tools

- Simple javascript tools
- Simple, human-readable puzzle formats
- **No game engine needed for non-environmental puzzles**
 - This massively increased submission rates from puzzle authors
 - Some contributors did not have PCs powerful enough to compile and run the project
 - No engine needed for testing and curation either

SoPACT

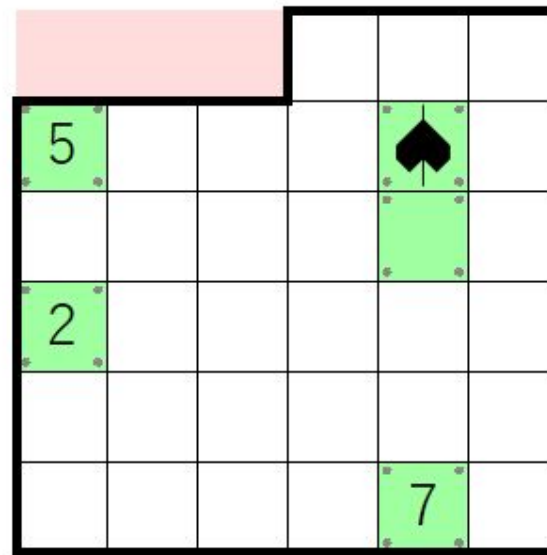
Private fork of puzz.link
(a fork of pzprv3)

[go to main page](#)

Mirror Area Numbers by javis ▾

File Edit Display Setting

Mode | **Edit mode** Answer mode
Input Type | **L/R buttons** One button
Input Mode | **Auto** Nurikabe number Cave number Yajilin number
Givens Aleph Mirror Dominion Text Border
Merge Null Hidden Erase data
Check shaded cell connection
Automatic givens | **Unshaded** Shaded None



- Do Not Make This Pattern: ?
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 - KnappDaneben ?
 - Complete The Pattern
 - Memory Grid
 - Search The Environment
 - Complete Only What You Can
 - All black areas have size:
 - All white areas have size:
- Grid type

BPM:

Border colour:

Use asymmetric mirror symbol

NoPattern templates (click to add):



Puzzle database

- Tagging (size, rules, etc.)
- Searching
- Editing
- Solution recording
 - Testing, timing, and playback
 - Hint generation
- Link-sharing
- Difficulty rating
- Comments
- Paying puzzle authors
- Setting spawning zones
- Making puzzles go live

ID 018638 [play](#) [edit](#) [delete](#) [save comment](#) 2: Post-CEP+ dungeon Diff: Pool: **Isowatari Trippel, N=2** by martin

3.DX Cross the Streams Doppels

solves: nat (02:32), **Jeffrey**

tags: [edit](#)

ID 018637 [play](#) [edit](#) [delete](#) [save comment](#) 2: Post-CEP+ dungeon Diff: Pool: **Isowatari Trippel, N=1** by martin

3.DX Cross the Streams Doppels

ME: This wasn't too painful to construct, so it might be worth a shot redoing this with a stronger visual theme. (Or going

solves: **Jeffrey**

tags: [edit](#)

ID 025076 [play](#) [edit](#) [delete](#) [save comment](#) 2: Post-CEP+ dungeon Diff: Pool: **Isowatari Quadruple, N=1** by martin

3.DX Cross the Streams Doppels

solves: nat (01:07), wcooper (00:35), **Jeffrey**

tags: [edit](#)

ID 019987 [play](#) [edit](#) [delete](#) [save comment](#) 2: Post-CEP+ live Diff: Pool: **Cramped** by nat

JB: I almost think this would be better with a small tweak to make it a unique puzzle, instead.

NA: Hmm, could do 7/8, two 7s, or add a black given to disambiguate the 6?

solves: Jeffrey, **Jeffrey**

tags: [edit](#)

What about computer generation?

Infinite content?

- Considered for some game modes, e.g.
 - Raids
 - PvP challenges
- Wasn't wanted or needed for the campaign or sandbox

What about computer generation?

Depending on the *puzzle type*, computer generation can be:

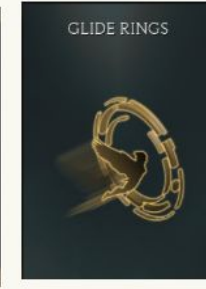
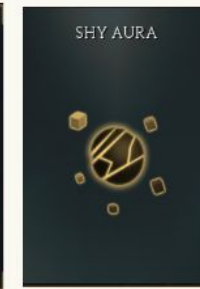
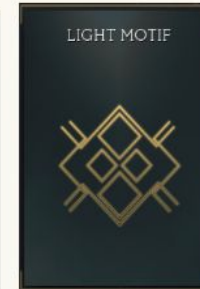
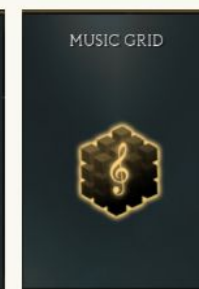
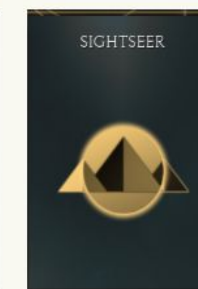
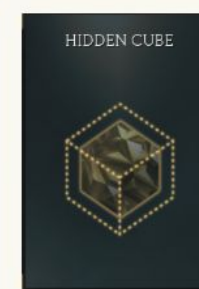
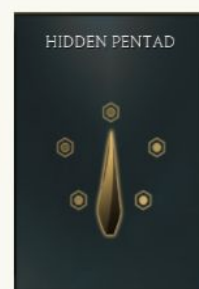
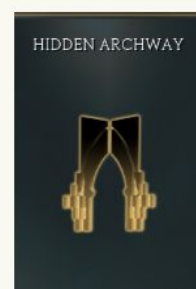
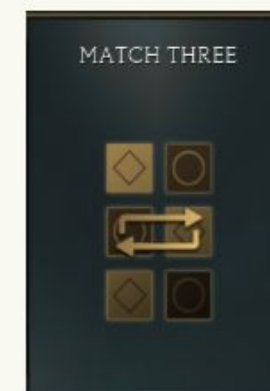
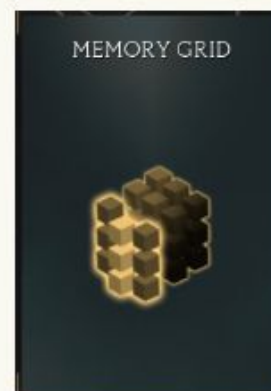
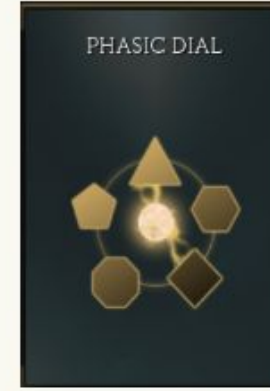
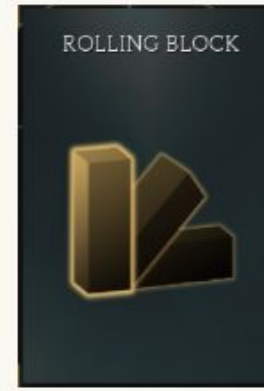
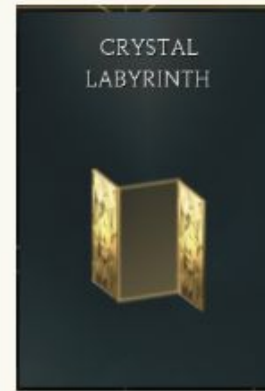
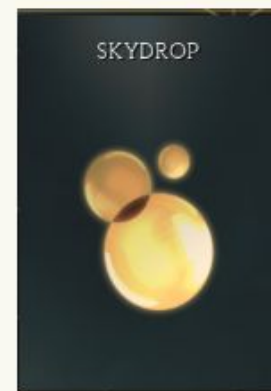
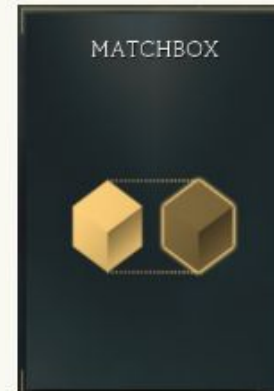
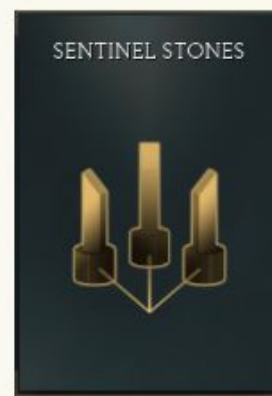
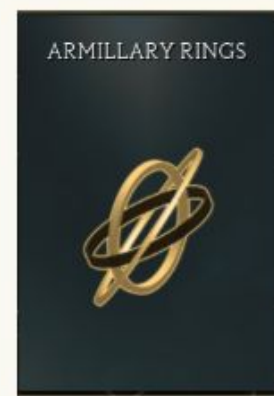
- **Amazing:** better than human puzzles or the key to a new puzzle type
- **Great:** consistently good and varied puzzles for low cost
- **Mediocre:** average-quality puzzles, or tweaking/curation needed
- **Poor:** a big time sink, not worth the effort

Amazing

Great

Mediocre

Didn't attempt





Loc: 106,126 33,483 15,078
Hor. Speed: 0
Ver. Speed: 0

Build ID: Development-master-development-4d2e2b6b59-20240402





Loc: -24,301 56,280 6,820
Hor. Speed: 0
Ver. Speed: 0

Build ID: Development-master-development-4d2e2b6b59-20240402



Loc: -25,280 56,202 6,712
Hor. Speed: 0
Ver. Speed: 0

Build ID: Development-master-development-4d2e2b6b59-20240402



A SOLITARY ISLAND



GOALS



Learn more about a new grid rule: 0/6

BONUS



Solve all 13 Skydrops 0/13



Generate + curate

- Underrated combo
- If a generator makes 50% great puzzles and 50% garbage, consider NOT improving it

Time Remaining: 117.18

Puzzle 3



EXIT (ESC)



UNDO (Z)



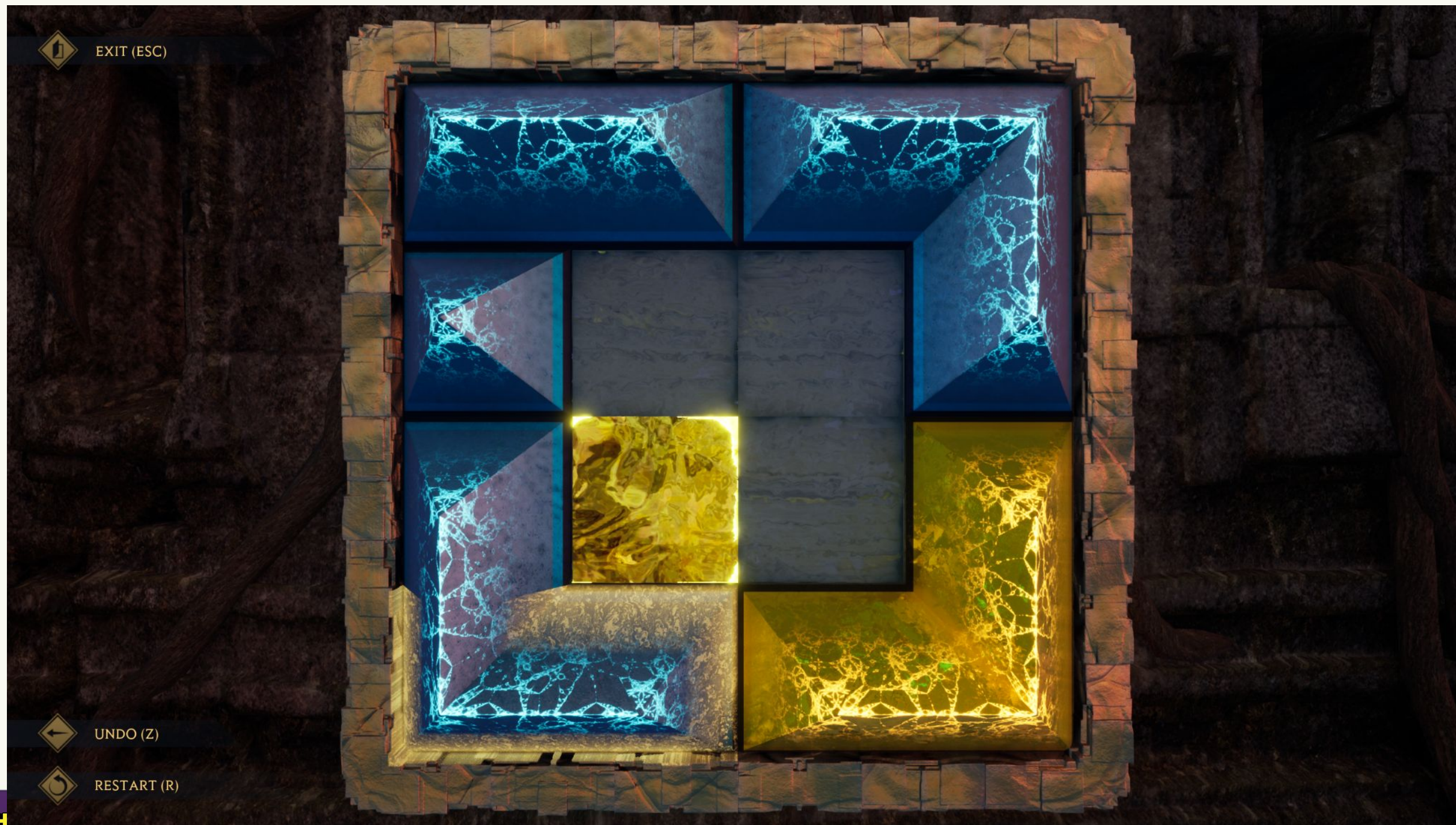
RESTART (R)

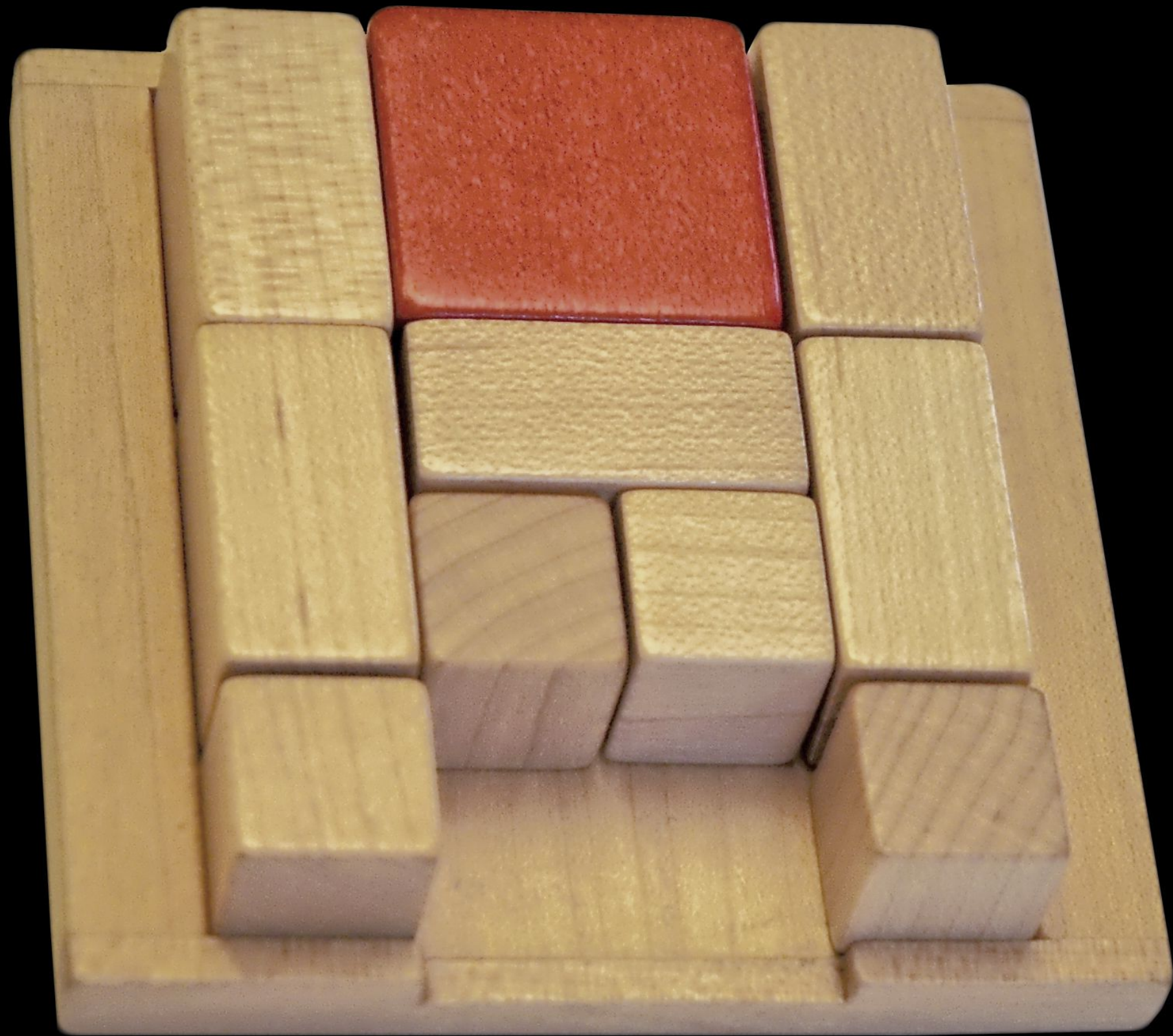
Logic grid generation

- Lots of prior art on this topic
- We tried approaches that mimic a human creator
- Attempted ~10 different rulesets, about 6-7 were excellent
- Still required a lot of tweaking and curation
- Our human puzzle team outperformed the generators!
 - Example: quest for perfection

An unexpectedly good use of computer generation...

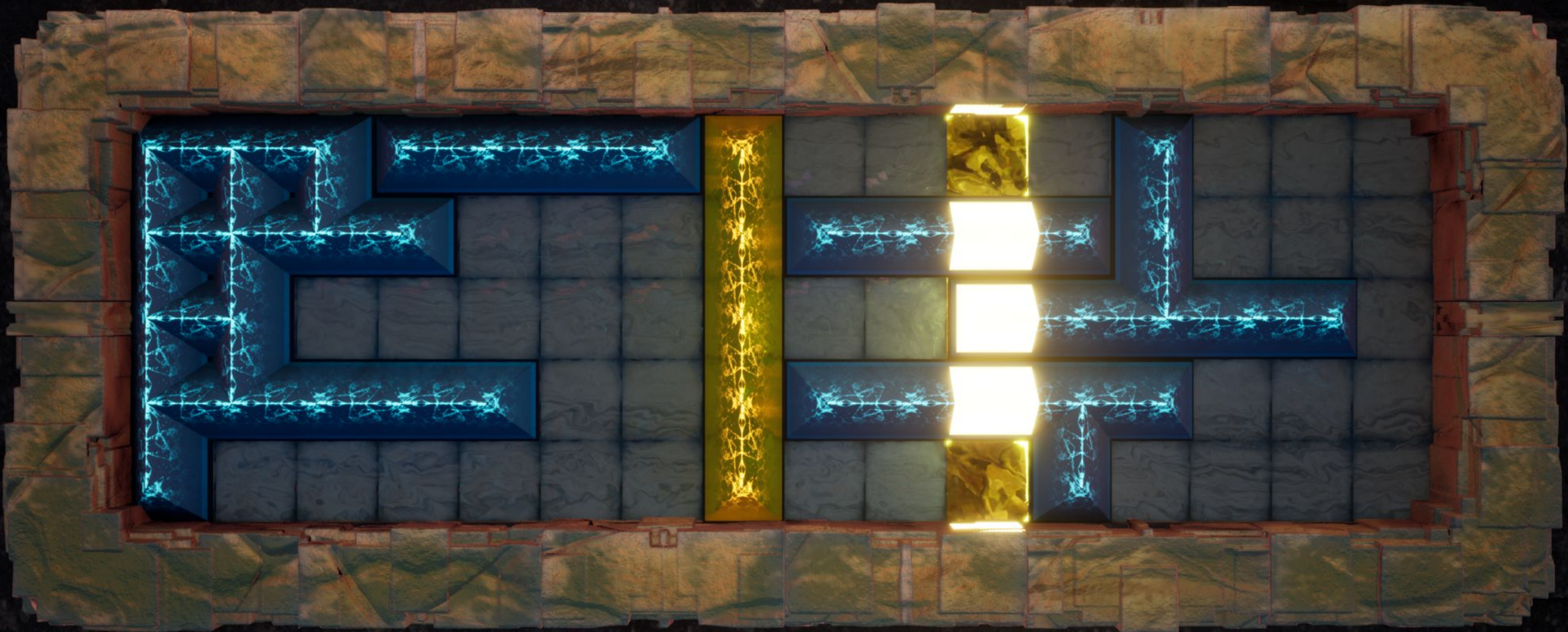
Shifting Mosaic







EXIT (ESC)



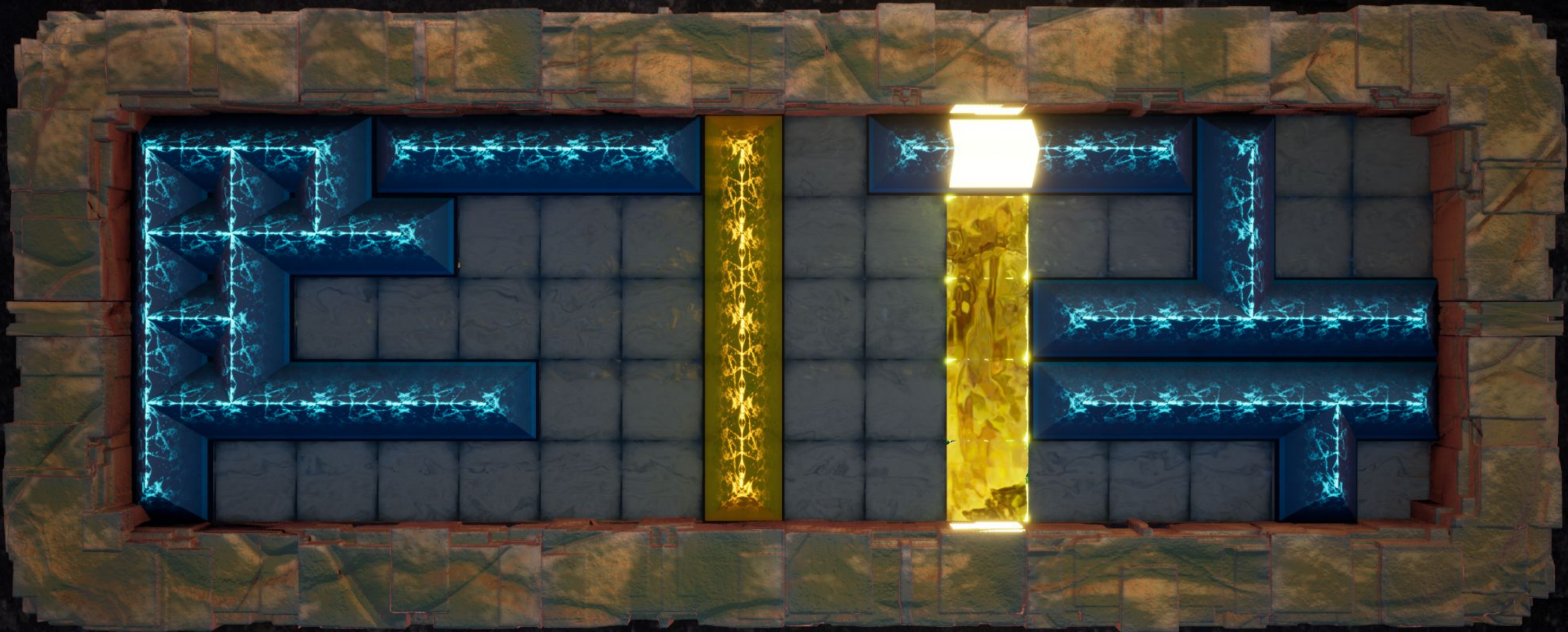
UNDO (Z)



RESTART (R)



EXIT (ESC)



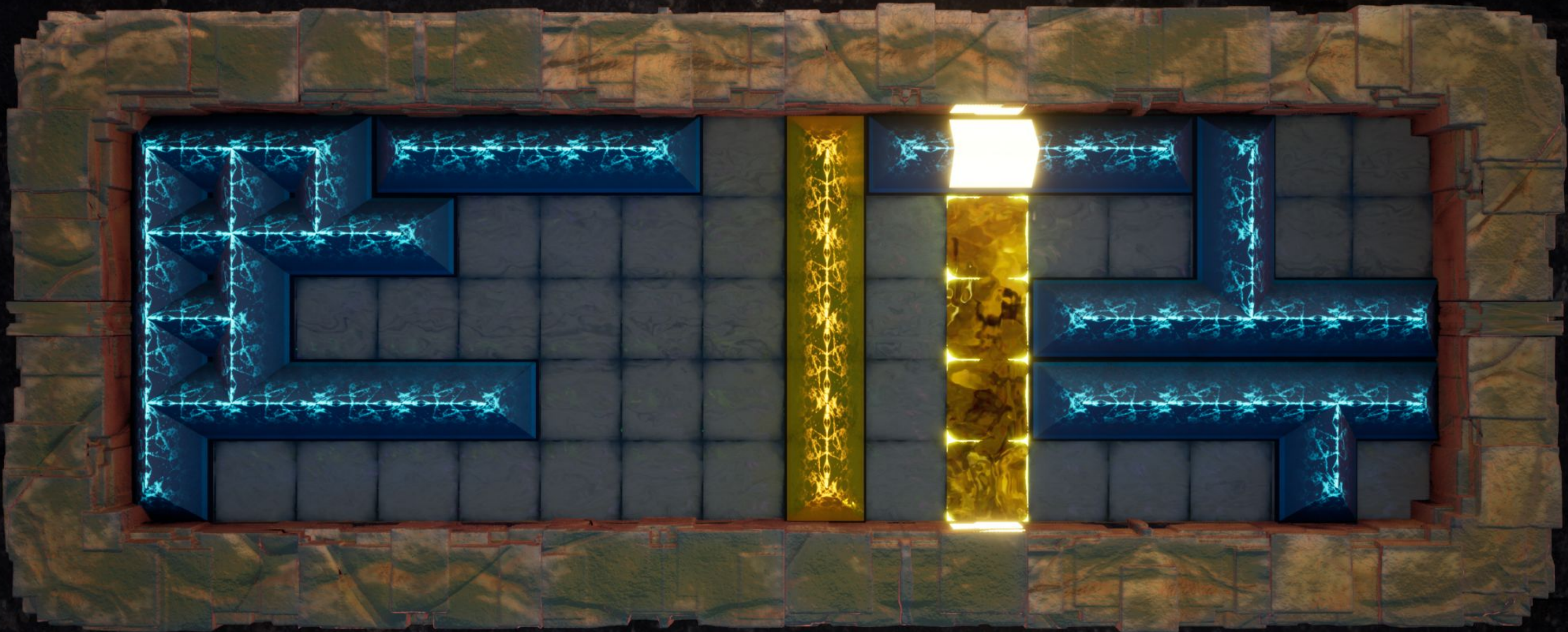
UNDO (Z)



RESTART (R)



EXIT (ESC)



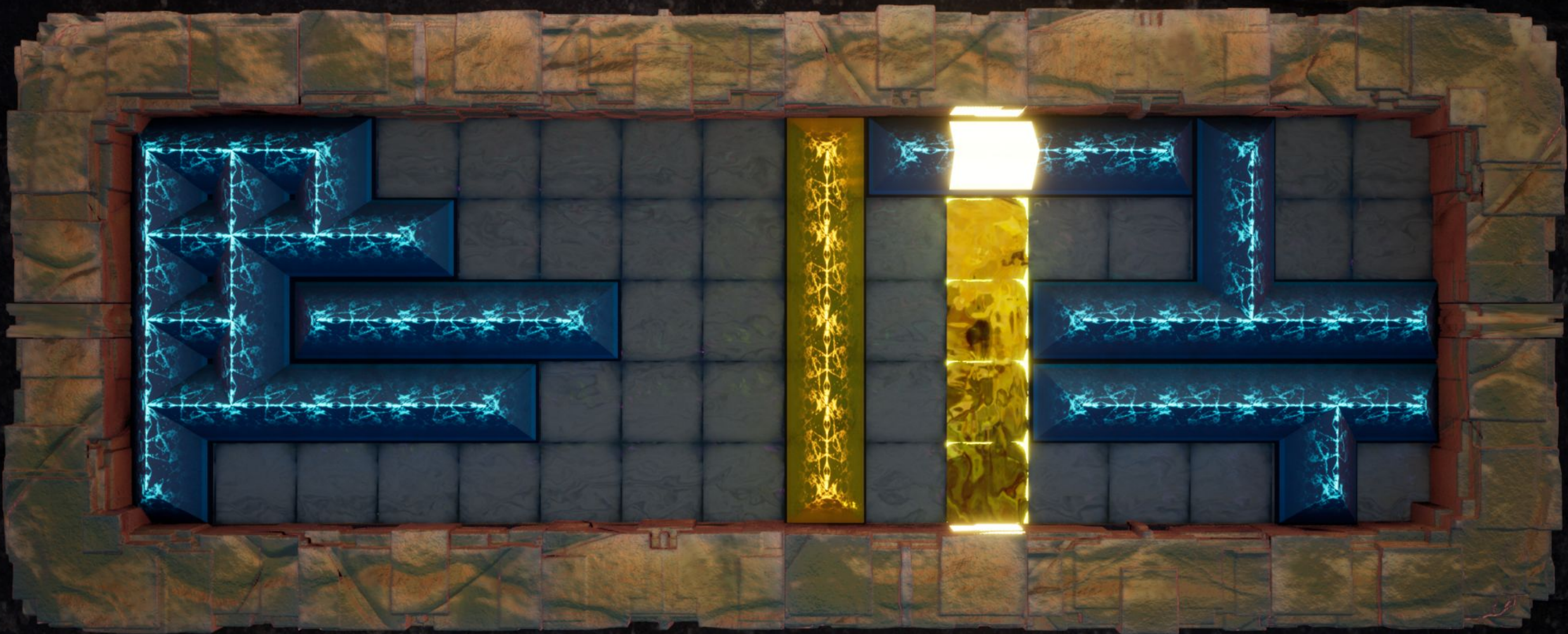
UNDO (Z)



RESTART (R)



EXIT (ESC)



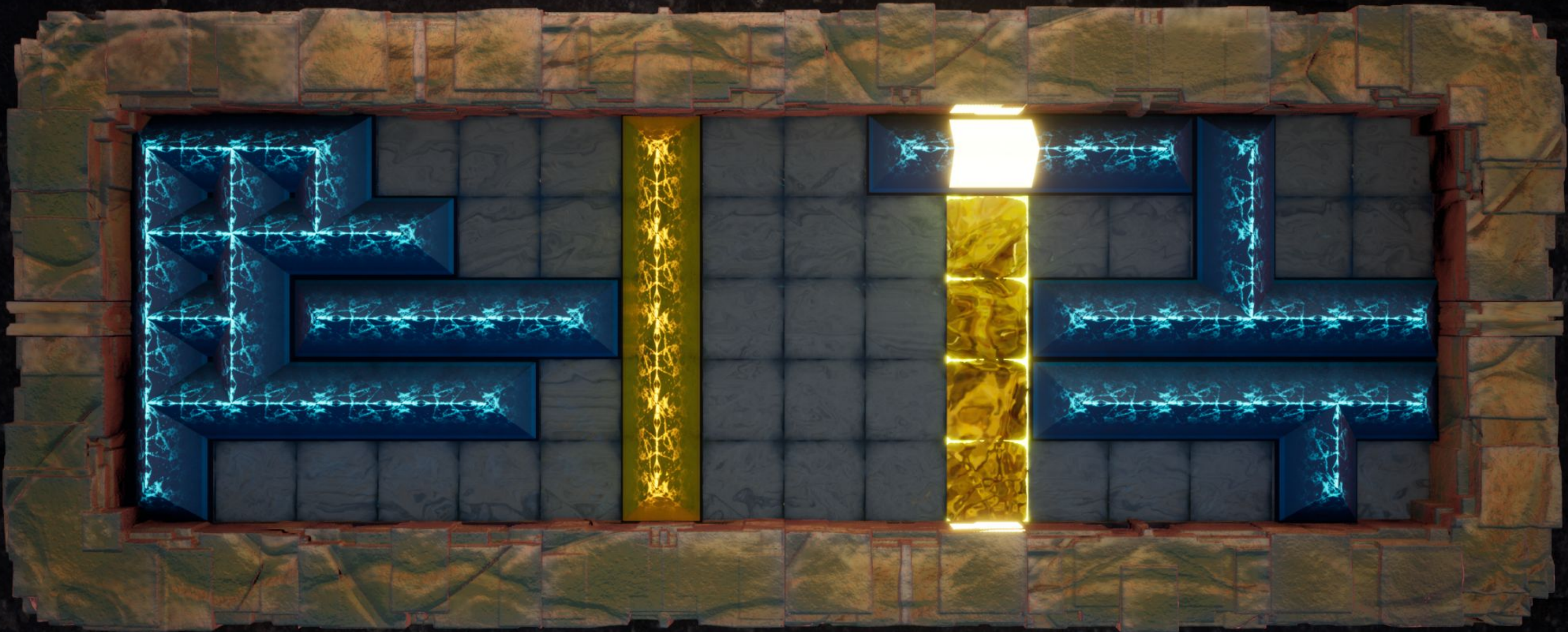
UNDO (Z)



RESTART (R)



EXIT (ESC)



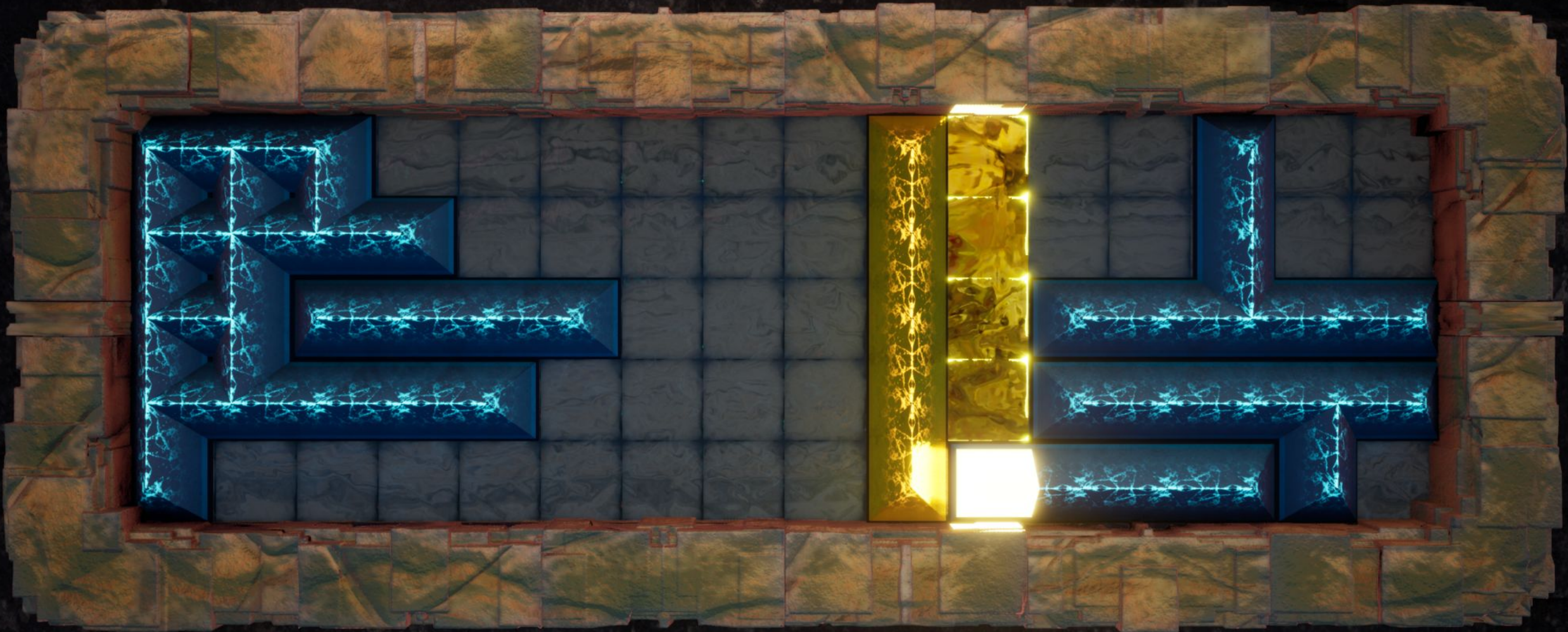
UNDO (Z)



RESTART (R)



EXIT (ESC)



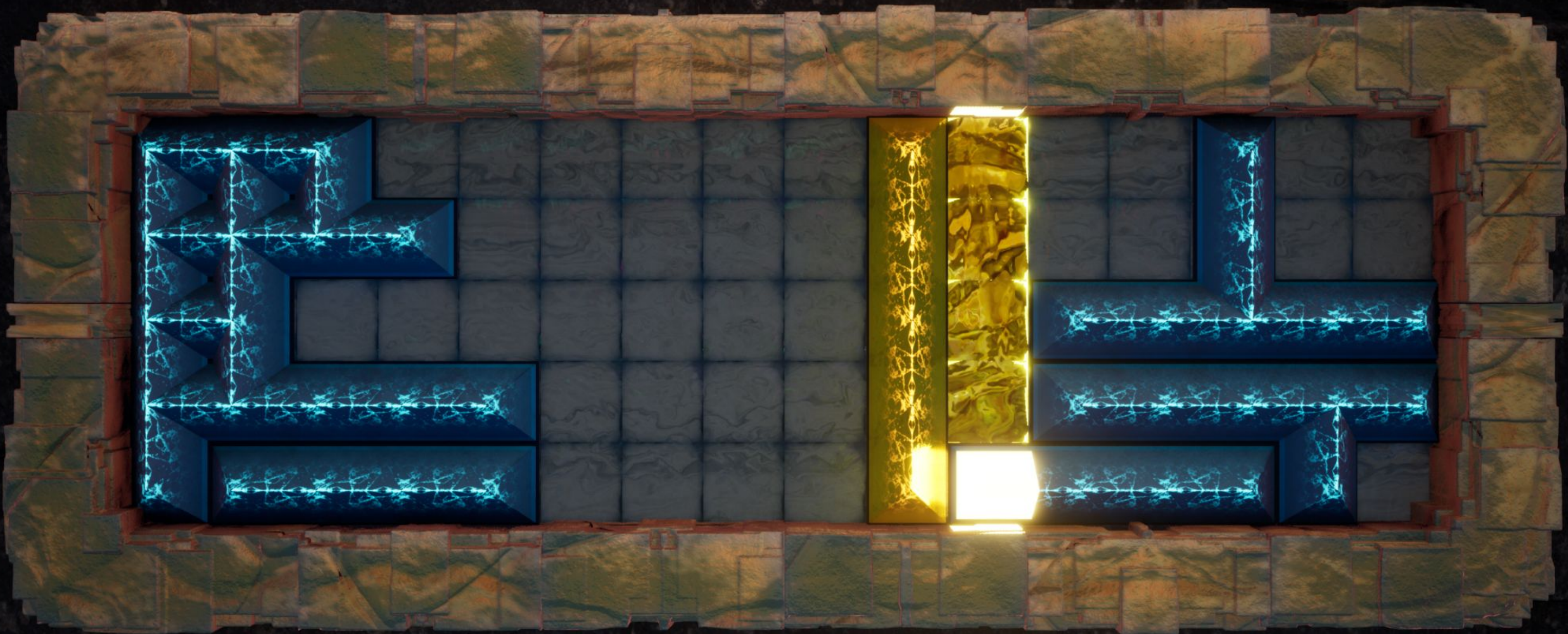
UNDO (Z)



RESTART (R)



EXIT (ESC)



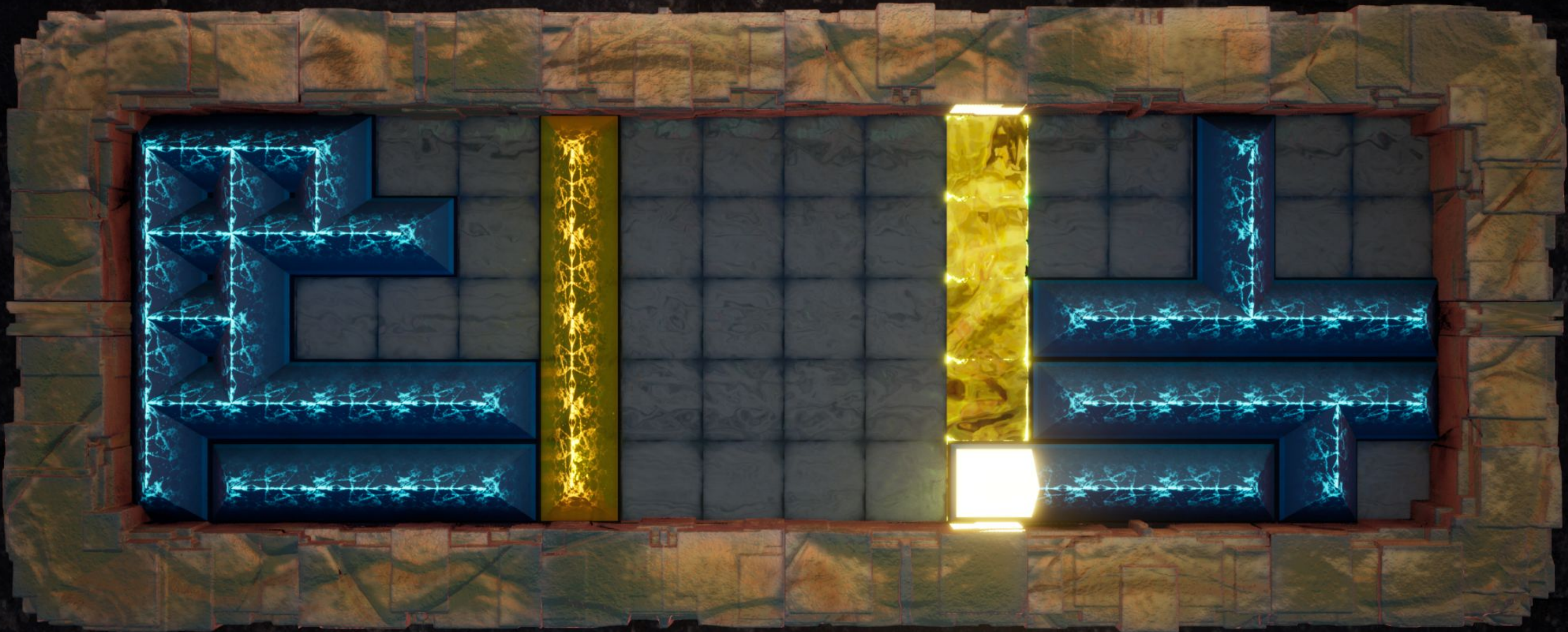
UNDO (Z)



RESTART (R)



EXIT (ESC)



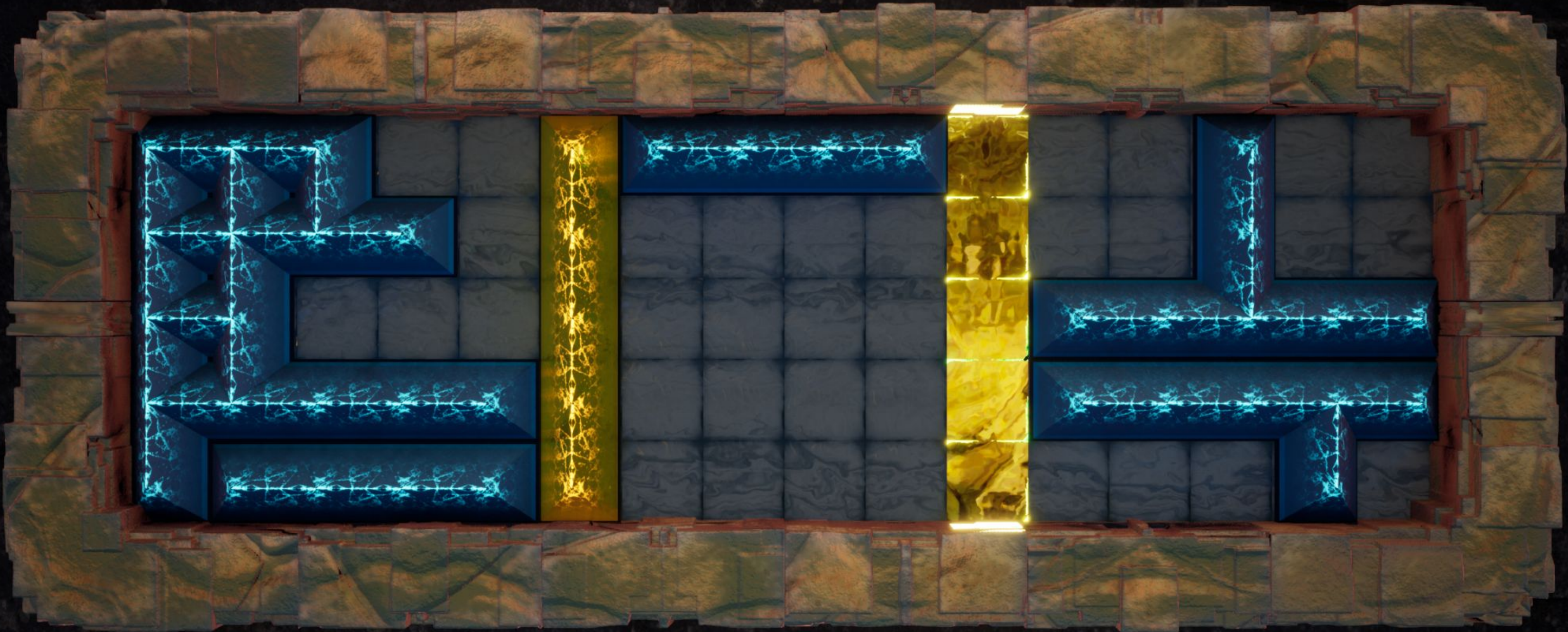
UNDO (Z)



RESTART (R)



EXIT (ESC)



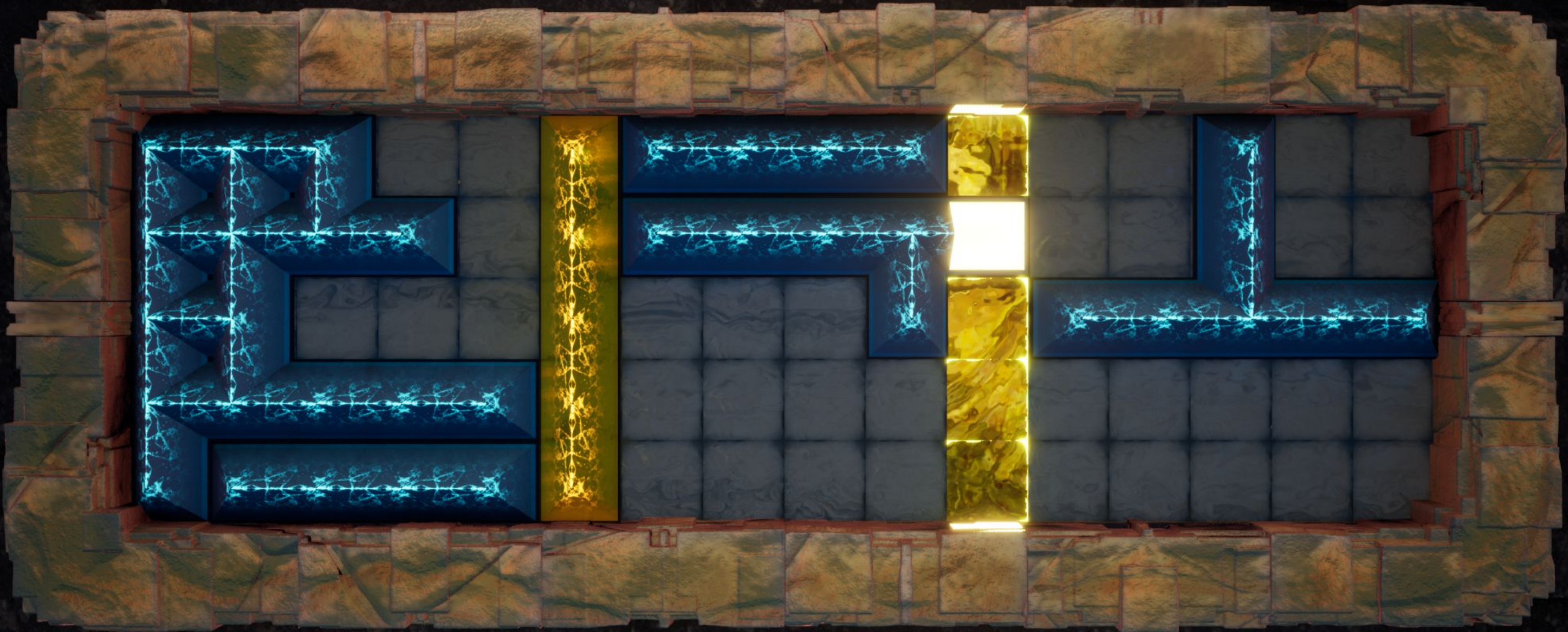
UNDO (Z)



RESTART (R)



EXIT (ESC)



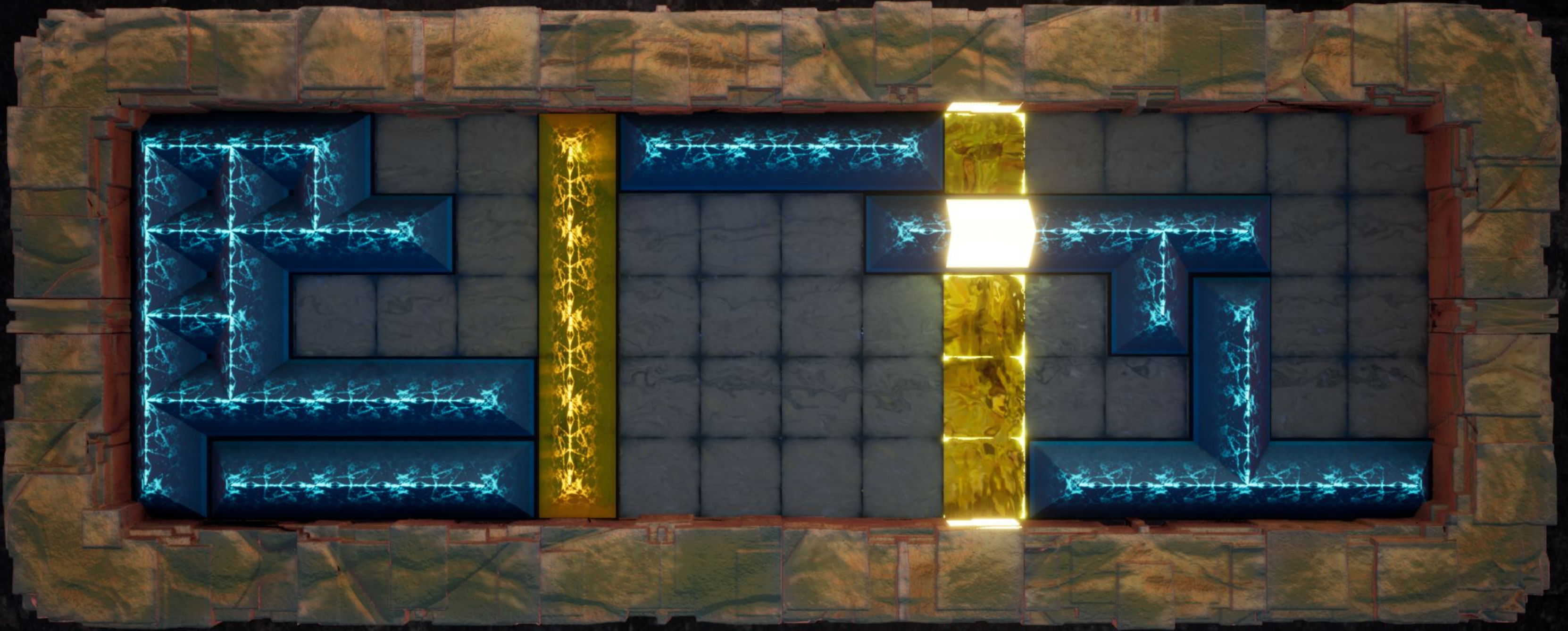
UNDO (Z)



RESTART (R)



EXIT (ESC)



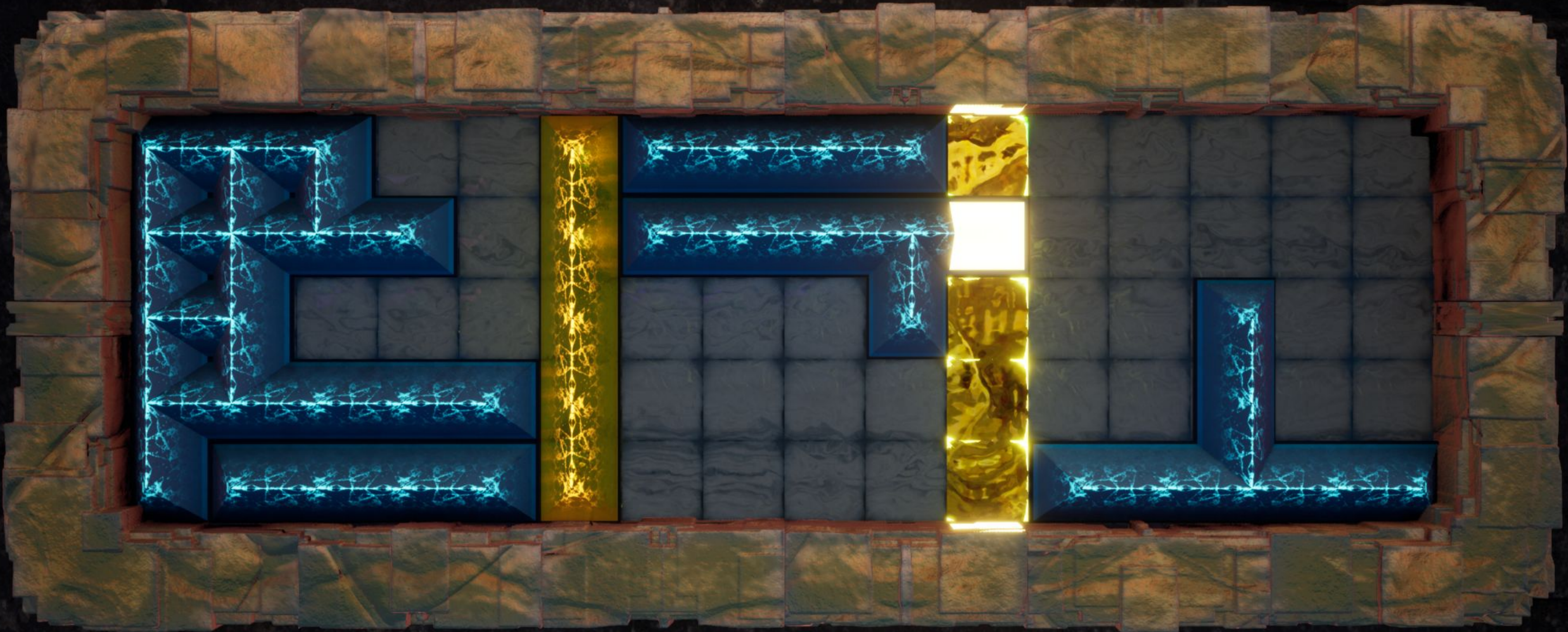
UNDO (Z)



RESTART (R)



EXIT (ESC)



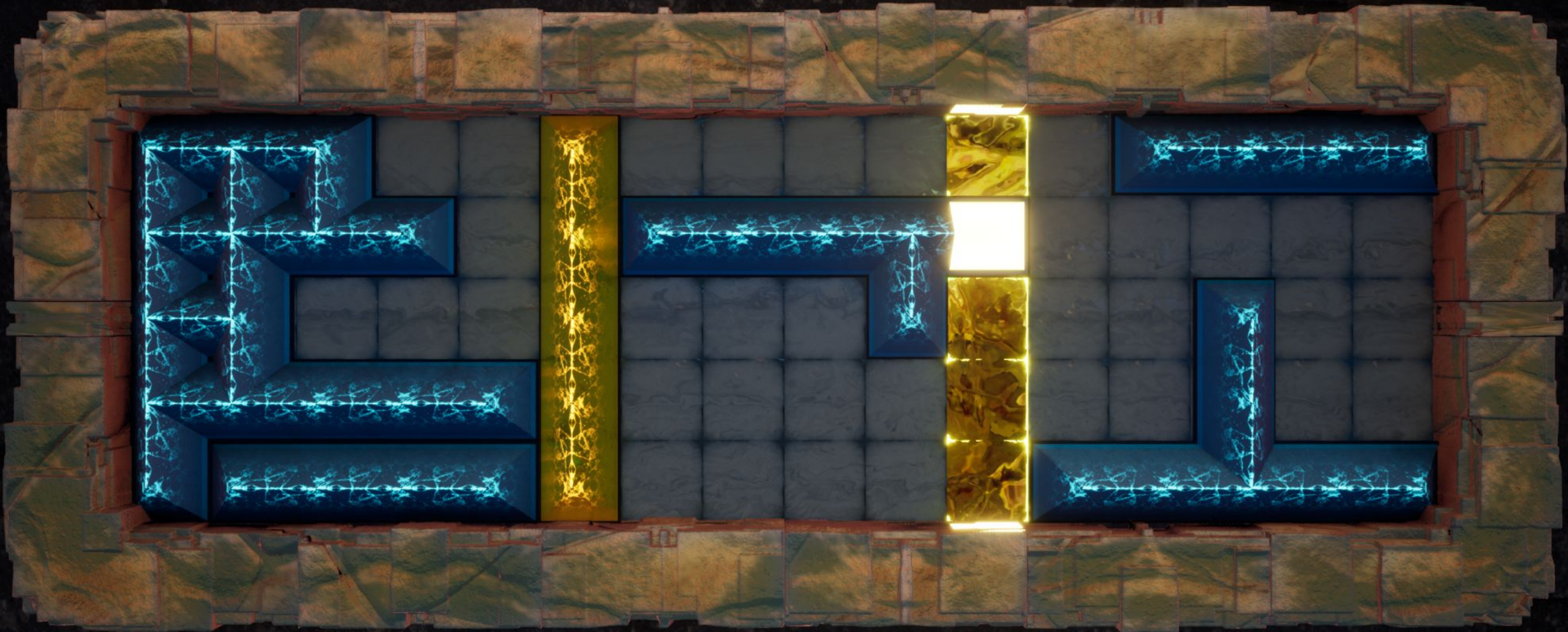
UNDO (Z)



RESTART (R)



EXIT (ESC)



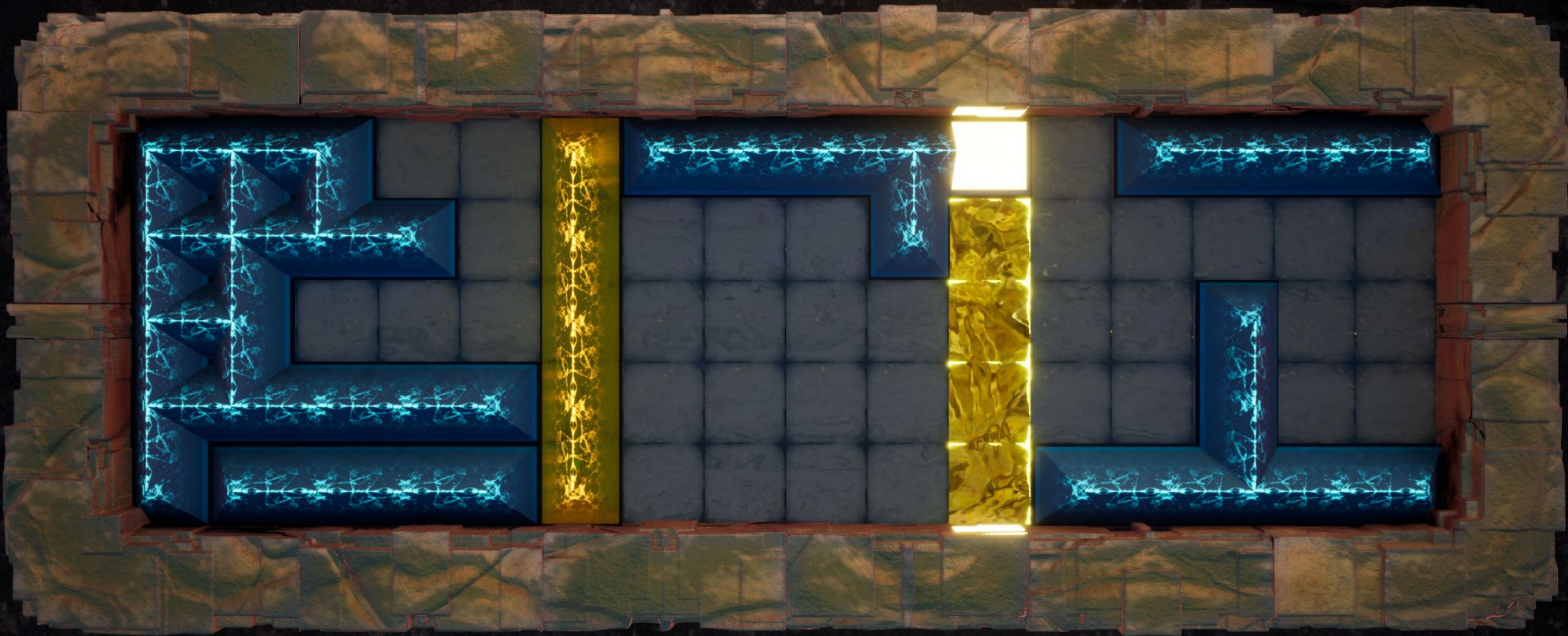
UNDO (Z)



RESTART (R)



EXIT (ESC)



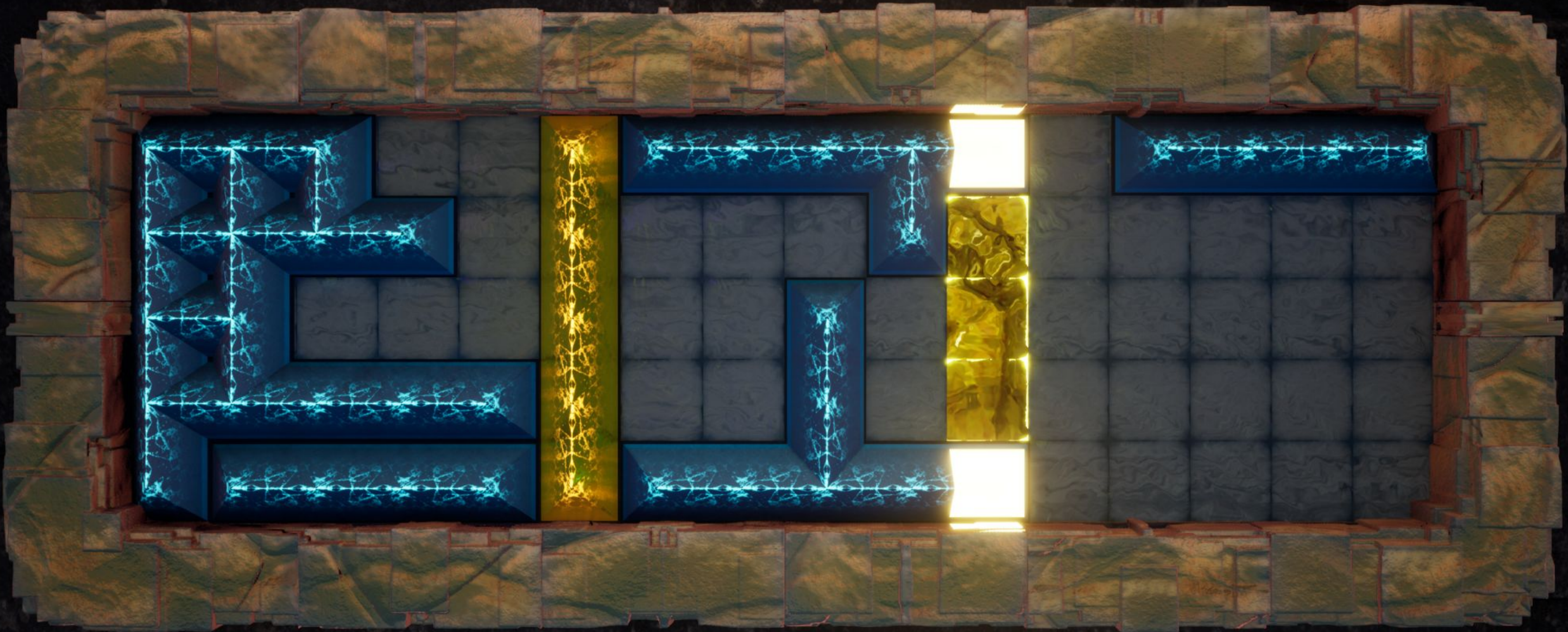
UNDO (Z)



RESTART (R)



EXIT (ESC)



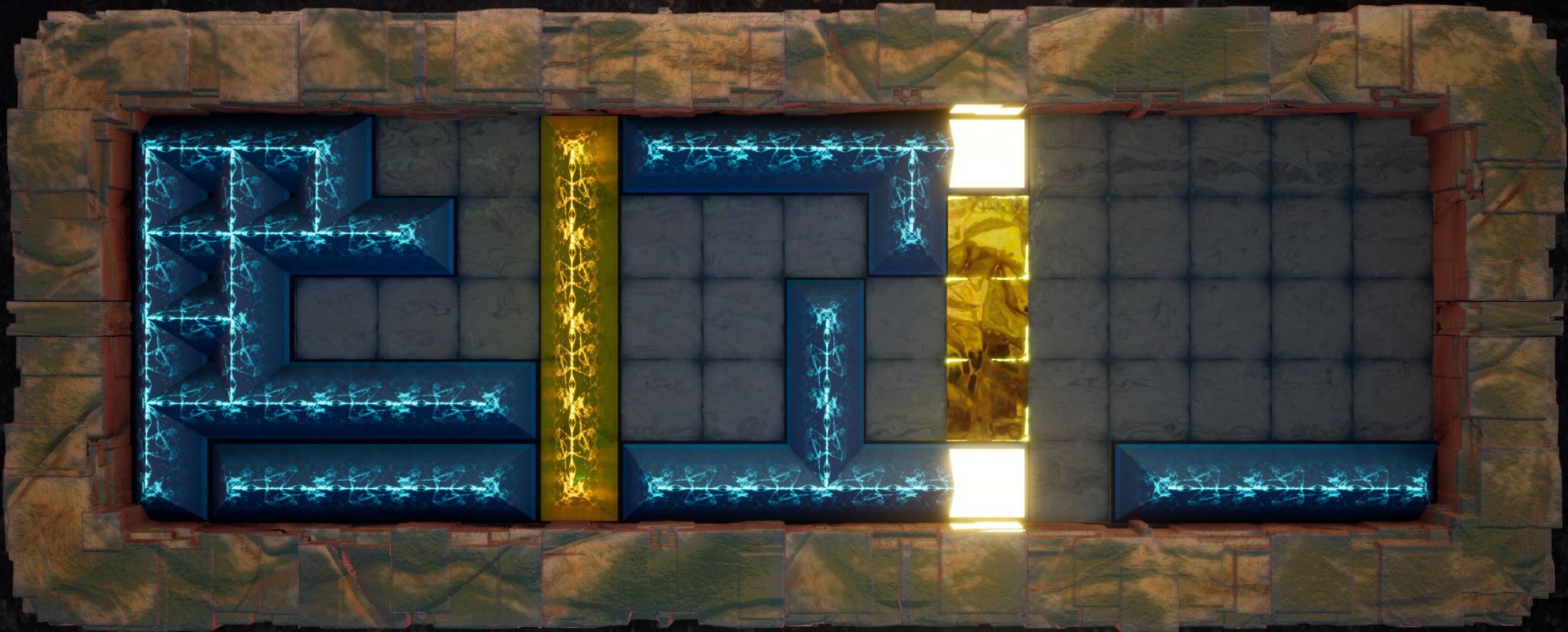
UNDO (Z)



RESTART (R)



EXIT (ESC)



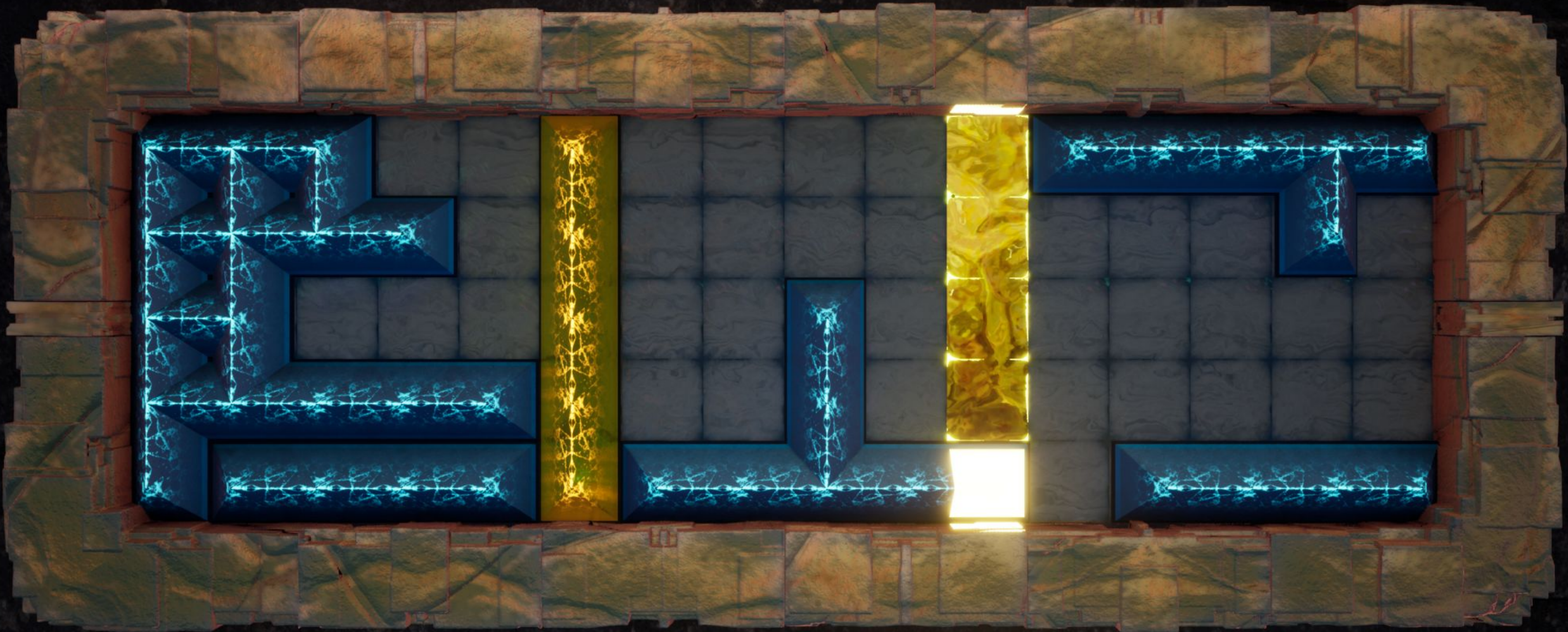
UNDO (Z)



RESTART (R)



EXIT (ESC)



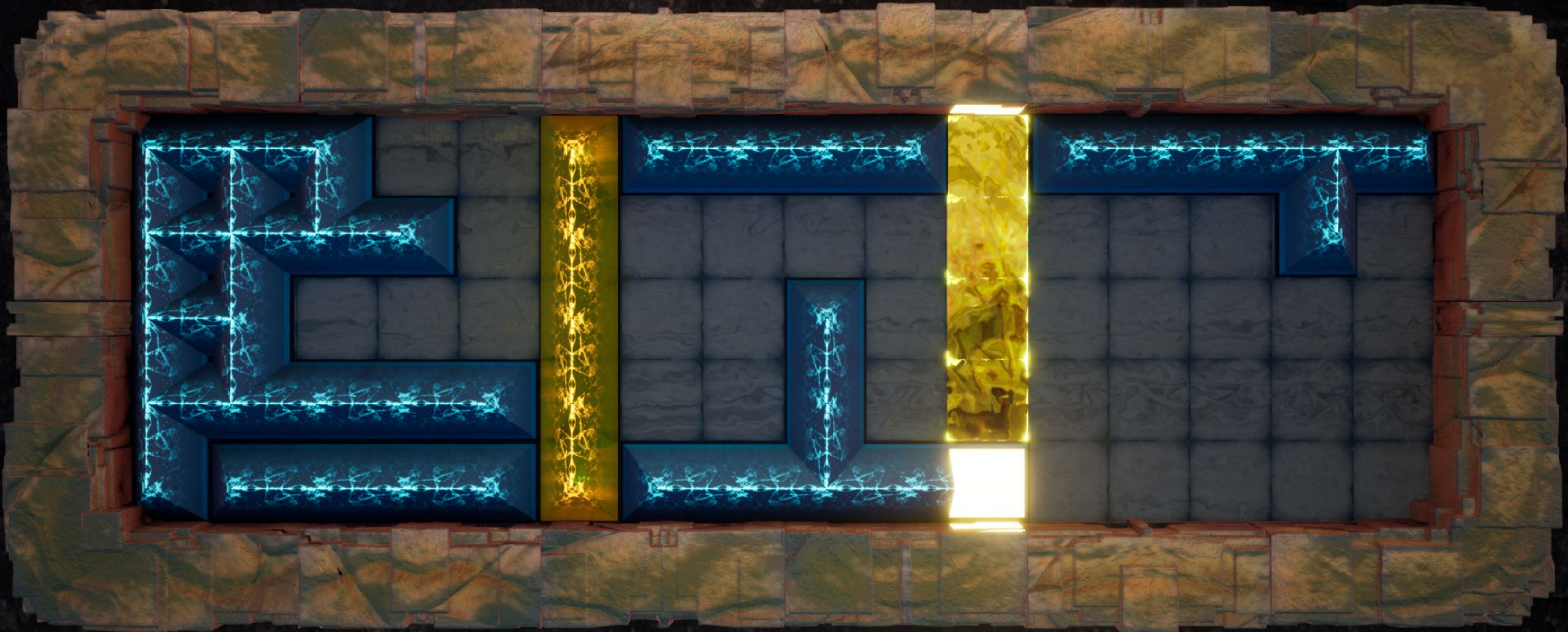
UNDO (Z)



RESTART (R)



EXIT (ESC)



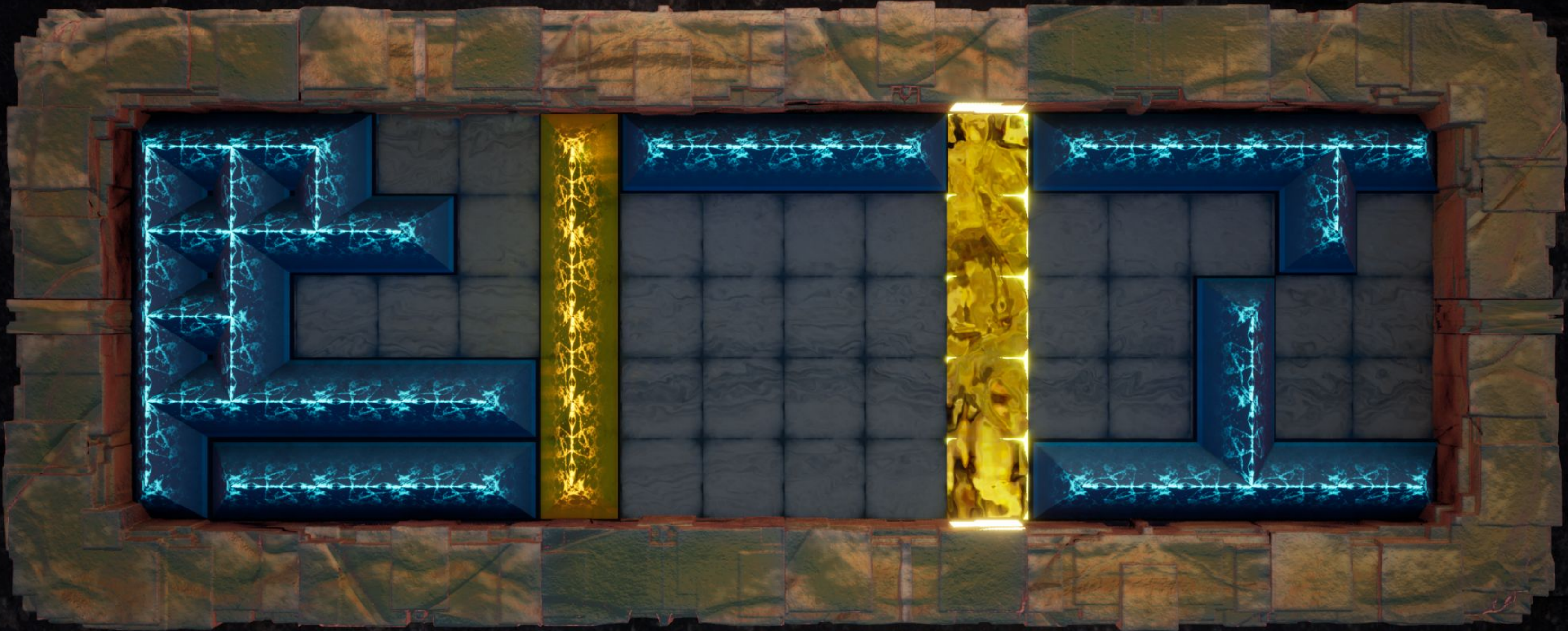
UNDO (Z)



RESTART (R)



EXIT (ESC)



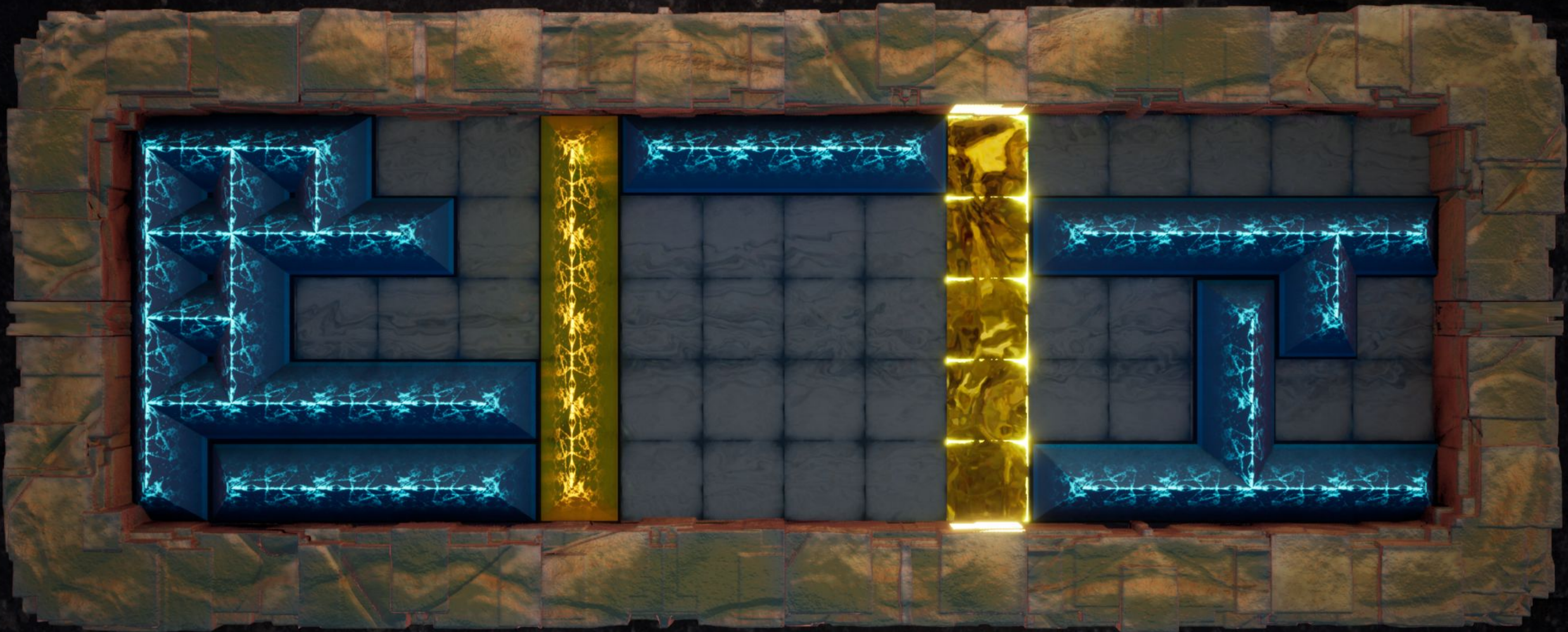
UNDO (Z)



RESTART (R)



EXIT (ESC)



UNDO (Z)



RESTART (R)



EXIT (ESC)



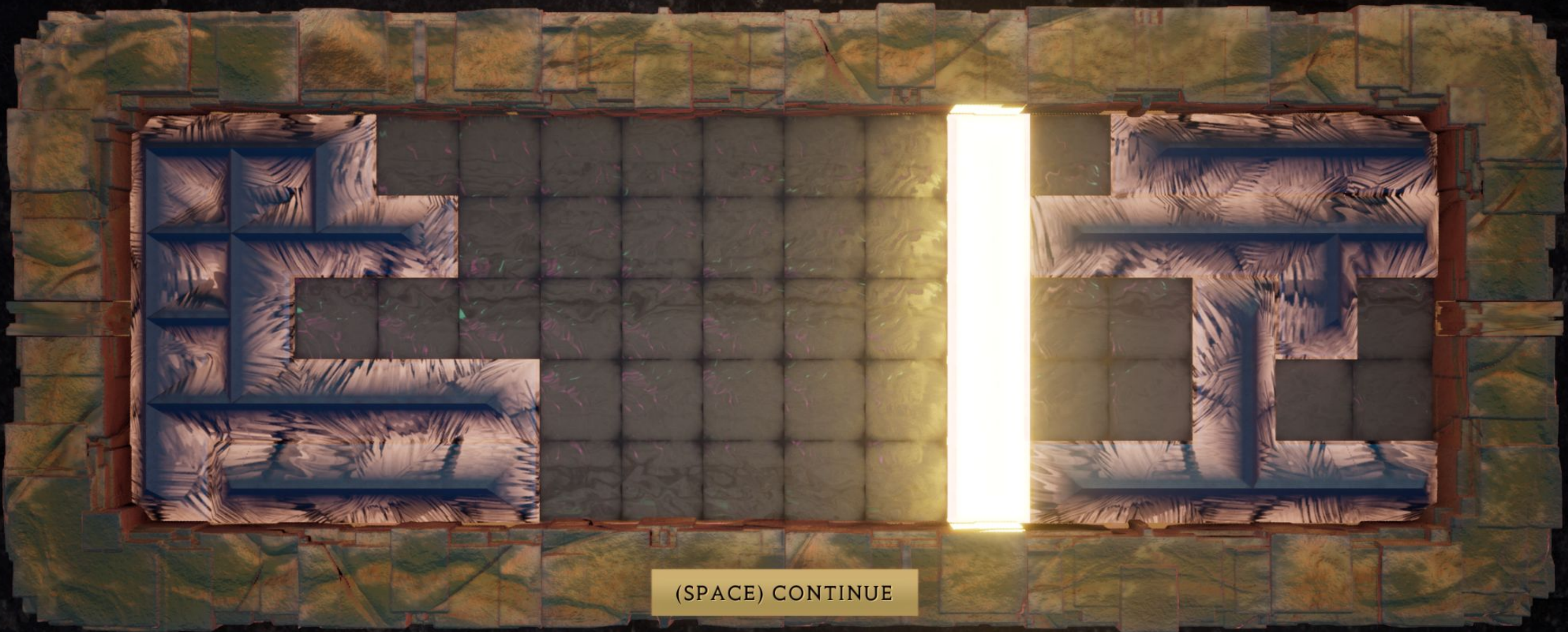
UNDO (Z)



RESTART (R)



EXIT (ESC)



(SPACE) CONTINUE



UNDO (Z)



RESTART (R)

Could a generator make something like that?

Could a generator make something like that?

Maybe...

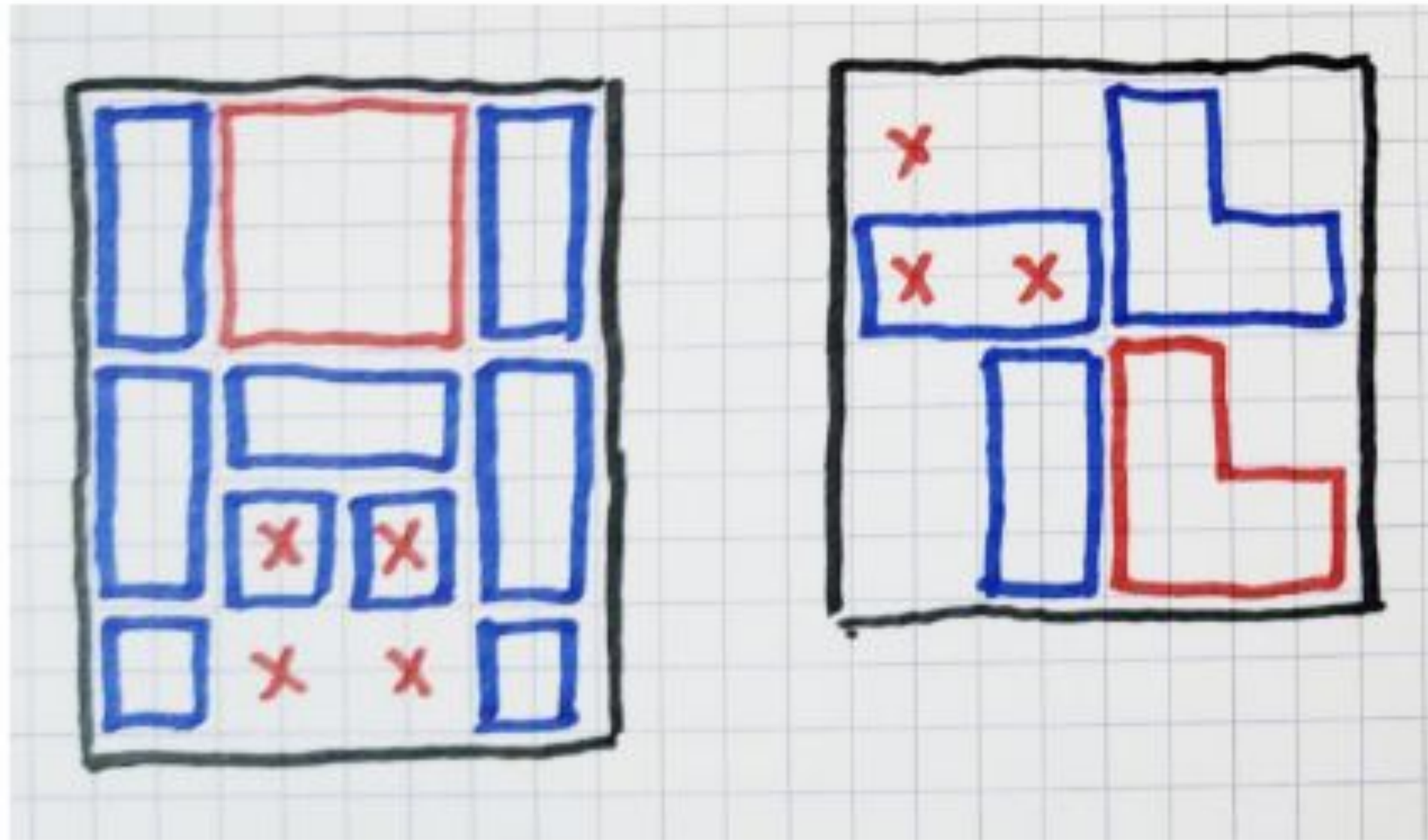


Figure 3: Two sliding-block puzzles. On the left is the L'Ane Rouge puzzle (Hordern, 1986, p. 81) and on the right is the Simplicity puzzle (Stephens, 2019). Image by Yang Zhong

Difficulty Rating of Sokoban Puzzle¹

Petr Jarušek and Radek Pelánek²

Abstract. Sokoban puzzle is very challenging problem for both humans and computers. It also illustrates differences between human and artificial intelligence – different problems are difficult for humans and for computers. Whereas algorithmic techniques for Sokoban solving have been intensively studied by previous research, factors determining difficulty for humans have not been sufficiently explained so far. We describe two methods for difficulty rating of Sokoban puzzle – a problem decomposition metric and a computational model which simulates human traversal of a state space. We evaluate these metrics on large scale data on human solving (2000 problems solved, 785 hour of problem solving activity).

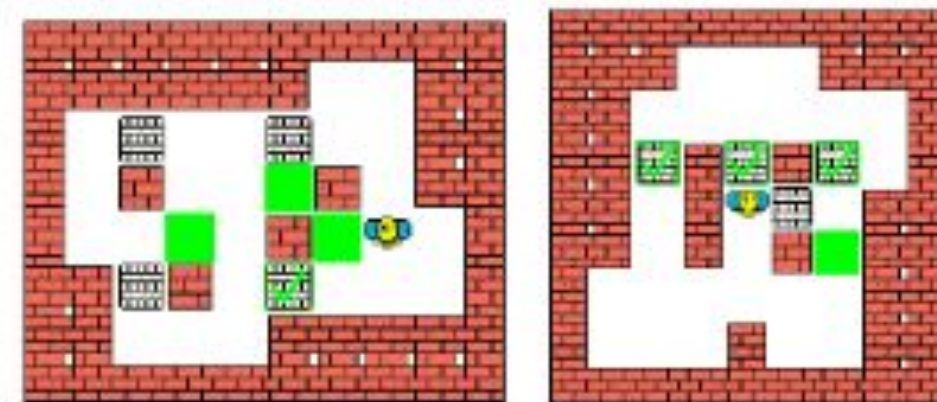


Figure 1. Example of two difficult Sokoban puzzles. The median solving time for the left problem (further denoted example 1) is 43 minutes, for the right one (denoted example 2) it is 49 minutes.

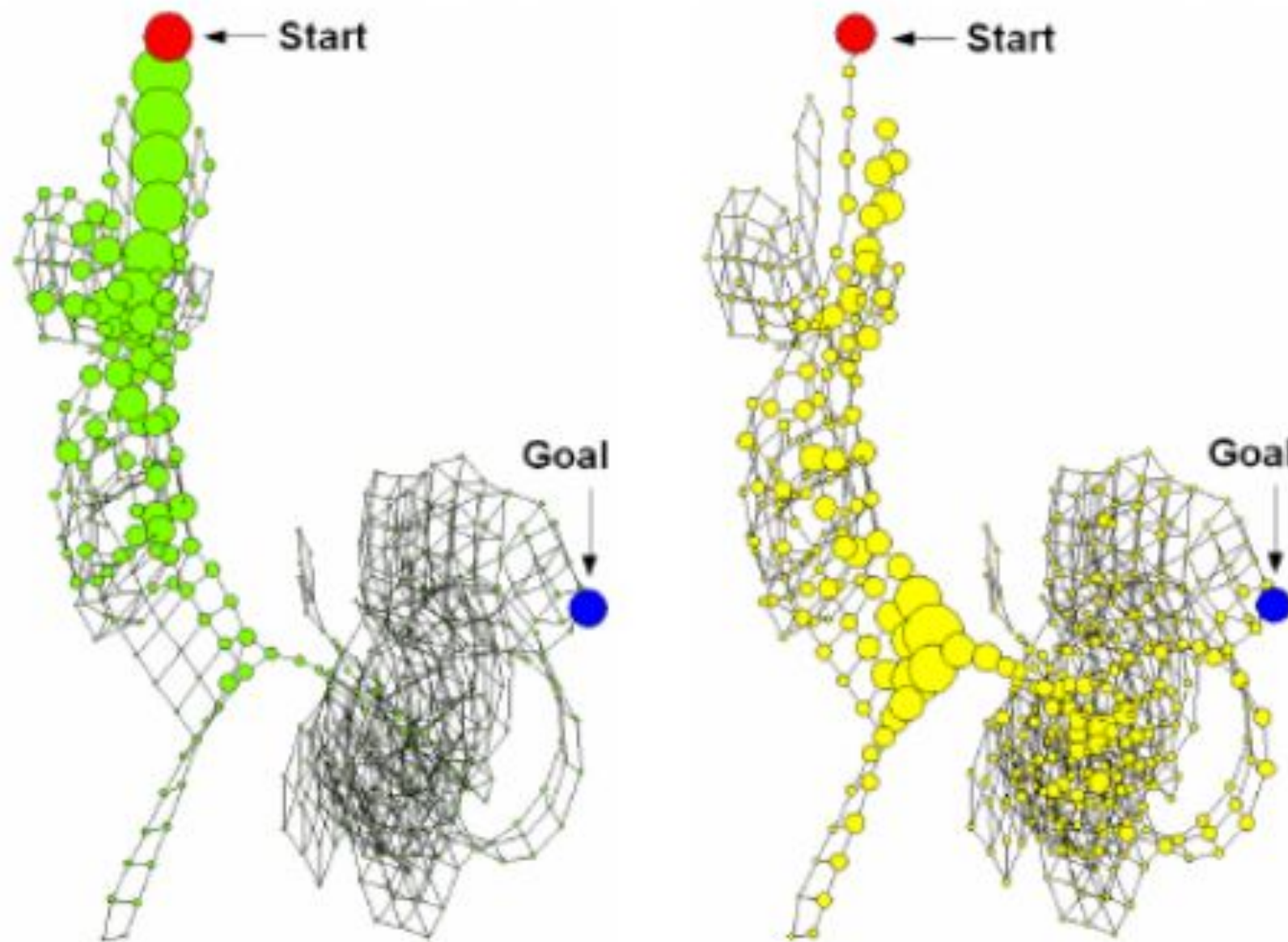


Figure 4. Comparison of human visits (left) and model visits (right) for the example 2. Vertexes represent states of the game, edges represents transitions between states. Size of each vertex is proportional to visits spent by human solvers / model.

Shifting Mosaic Generator (Yang Zhong)

- Create randomized puzzles according to heuristics
- Analyze the state-space graph
 - Remove/shrink/split pieces if puzzle is impossible
 - Add/grow/merge pieces if statespace graph is too big
- Repeat hundreds of times, generating a library of puzzles
- Select puzzles procedurally from the library that have:
 - Not too many state spaces (so pieces can't become too jumbled up)
 - At least one articulation point (a **cut vertex** in the state-space graph)
 - Where **multiple pieces are movable** (to differentiate obvious moves from key moves)
 - High in-degree is not enough

Some puzzle types that didn't work as well...

EXIT (ESC)



RESTART (R)

Fractal Match

- A **toy** that people loved
- A **puzzle** that was far less loved



Fractal Match

- Good performance and graphics scalability
 - Fractals are less detailed on low settings → less iterations in shader
- Problems with TAA, AI upscalers
- Large manual effort to avoid bad instances:
 - Target shape not distinctive enough
 - Target shape looks too similar to other achievable shapes
 - Puzzle too easy, trivial matching problem
 - Too much precision needed
 - Target shape too hard to find
- Difficulty was very hard to balance



Fractal Match

- Lesson: talented devs make really cool stuff serendipitously!
- Lesson: a fun toy is not always a good puzzle

3

Wheel up: Teleport Wheel down: Solve puzzle Z: Connect to all powered meshes T: Show all unsolved puzzles 5: Solve all visible runes Players online: 1



Find the
-Head over

Gravity Ball

- Throw ball through all rings
- Trajectory is warped by “planets”
- Ball reflected by “mirrors”
- Trajectory preview is shown



Gravity Ball

It never shipped!

- Difficult to make good ones
- Lots of work to test
- High cost of content creation
- Higher-than-average art and sound needs
- Lower-than-average replayability (got too repetitive)
- Lower-than-average enjoyment from players



Spot The Difference

- Popular and classic puzzle type
- We tried 3 different approaches to algorithmic generation
- They felt like busywork
 - Got old after 1 or 2 of them



Multiplayer Modes

We saw huge potential here.

Multiplayer Modes

We saw huge potential here.

- IOI was actually pitched as a puzzle battle royale!
- Team-based zone capture mode
- Replayable “raid” versions of puzzle dungeons
- Individual puzzle types where co-op was explicitly required

Multiplayer Modes

- Liked by experienced players
- Not beginner-friendly
- Added a lot of stress and pressure
- Ultimately didn't ship

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- Liked by experienced players
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Lessons:

- Puzzle gameplay can substitute for combat in PvP or PvE
- Players don't learn when stressed

The emotional cost of all that work on the cutting room floor

Closing thought

Our biggest win was the incredible team we hired

- Gamedev experience didn't matter very much
- Some of the most valuable contributions came from first-timers
- Environment team did incredible puzzle design work
- Do whatever you can to make them happy and motivated

Thank you!

