Course Wrapup

15-462 / 15-662 Computer Graphics

Upcoming Courses

Fall 2023

15-327/15-627/15-860	Monte Carlo Methods and Applications	Keenan Crane
15-462/15-662	Computer Graphics	Oscar Dadfar
15-463/15-663/15-862	Computational Photography	Ioannis Gkioulekas
15-466/15-666	Computer Game Programming	Jim McCann
16-895	Understanding and Critiquing Generative Computer Vision	Jun-Yan Zhu and Abhinav Gupta

Spring 2024

15-458/15-858	Discrete Differential Geometry	Keenan Crane
15-462/15-662	Computer Graphics	Nancy Pollard
15-468/15-668/15-868	Physics-based Rendering	Ioannis Gkioulekas
15-469/15-669	Real-Time Graphics with Vulkan	Jim McCann
16-726	Learning-based Image Synthesis	Jun-Yan Zhu
16-848	Hands: Design and Control for Dexterous Manipulation	Nancy Pollard

Monte Carlo Methods and Applications

21-387 | 15-327 | 15-627 | 15-860 FALL 2023

Instructors: Keenan Crane (CSD/RI) and Gautam Iyer (MSC)

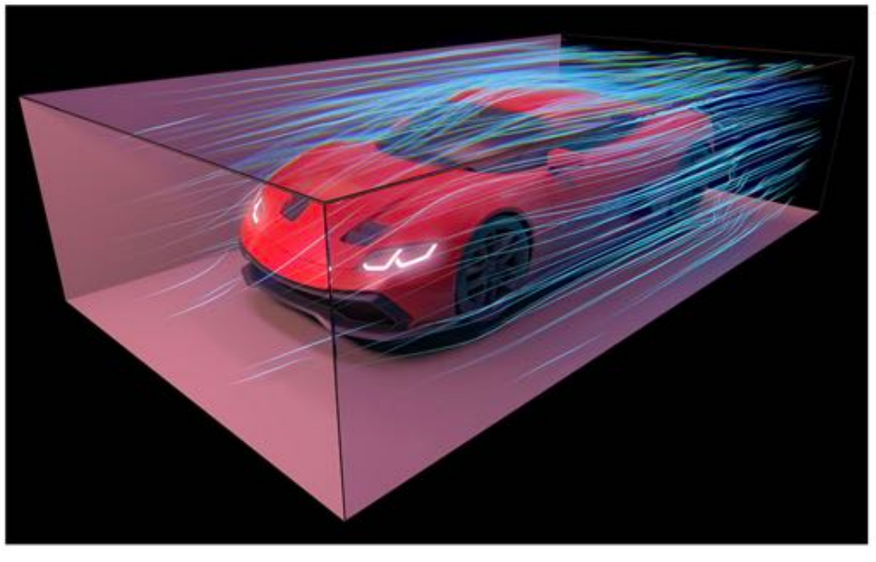
Units: 9 (3 in-class/6 outside)

Course Description

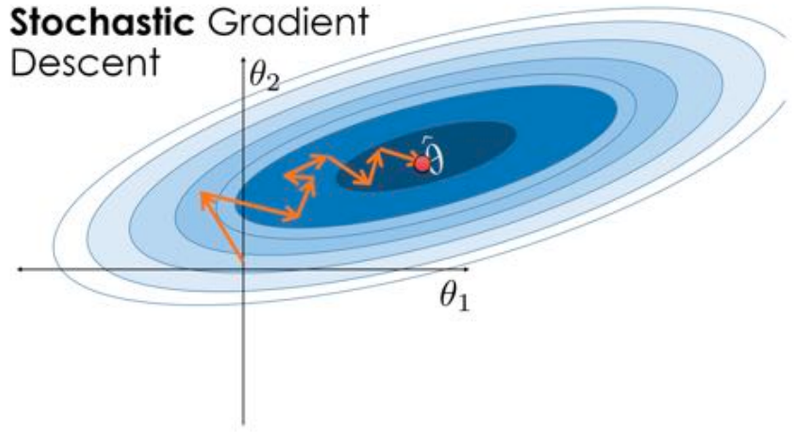
The Monte Carlo method uses random sampling to solve computational problems that would otherwise be intractable, and enables computers to model complex systems in nature that are otherwise too difficult to simulate. This course provides a first introduction to Monte Carlo methods from complementary theoretical and applied points of view, and will include implementation of practical algorithms. Topics include random number generation, sampling, Markov chains, Monte Carlo integration, stochastic processes, and applications in computational science. Students need a basic background in probability, multivariable calculus, and some coding experience in any language.

Topic suggestion: Monte Carlo Ray Tracing

Topic suggestion: Walk on Spheres



Topic suggestion: Stochastic Optimization



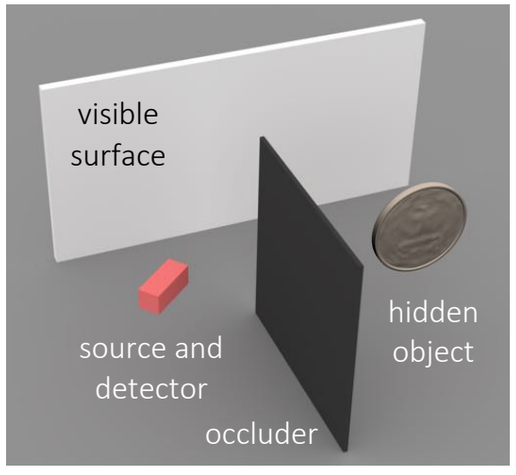
https://www.cs.cmu.edu/~kmcrane/random/

15-463/15-663/15-862 Computational Photography

Learn about scientific and unconventional cameras – and build your own!

cameras that capture video at the speed of light

cameras that measure depth in real time



cameras that see around corners

cameras that measure entire lightfields

http://graphics.cs.cmu.edu/courses/15-463/

15-466/15-666 Computer Game Programming

http://graphics.cs.cmu.edu/courses/15-466-f22/

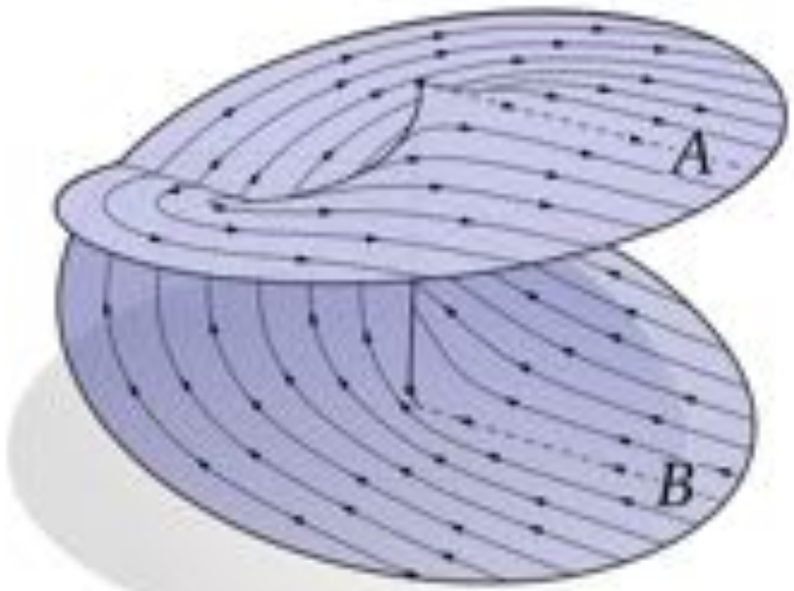
16-895 (Fall 2023): Seminar/debate class on advanced topics in generative models. (mostly for Ph.D. students level)

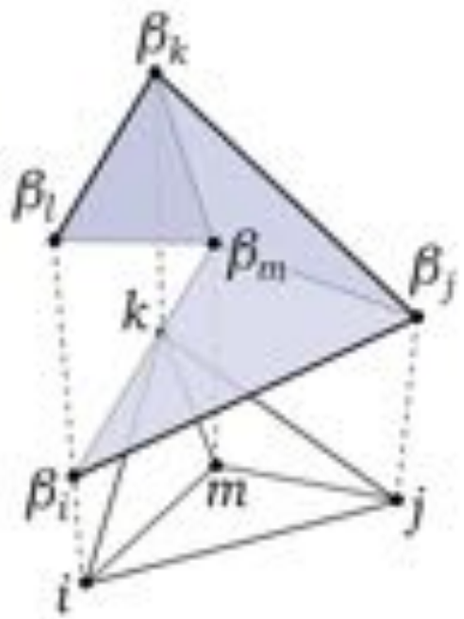
Title: Understanding and Critiquing Generative Computer Vision
Instructors: Abhinav Gupta and Jun-Yan Zhu
Description: In recent years, there have been significant advances in the field of large-scale generative modeling for visual data, such as DALL·E 2 and Stable Diffusion. This seminar course explores these advances beyond just reading and discussion. The goal is to not only inform state of the art but also develop critical and philosophical thinking among students. The course will involve reading papers, presentations, and discussions. The course will also involve reviewing and developing critical thinking.

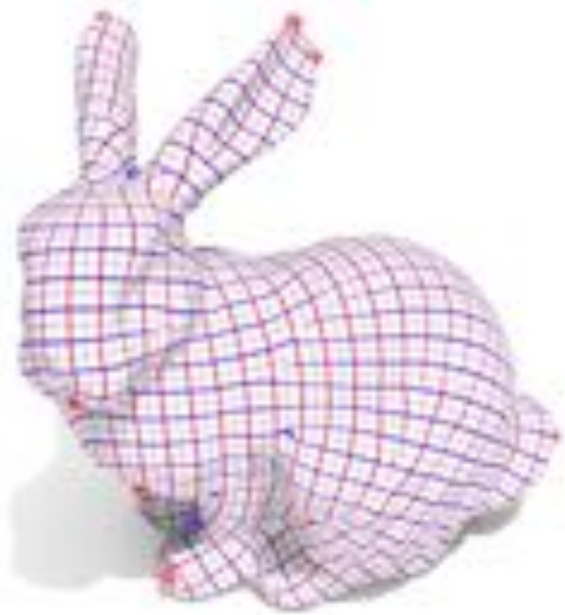
CS 15-458/858: Discrete Differential Geometry

CARNEGIE MELLON UNIVERSITY | SPRING 2022 | TUE/THU 11:50-1:10 | GHC 4215

ASSIGNMENTS CALENDAR COURSE DESCRIPTION COURSE NOTES GRADING POLICY SLIDES







Reading 9—Choose Your Own Adventure (due 4/26)

April 19, 2022

Uncateg orized

There are ***way*** more topics and ideas in Discrete Differential Geometry than we could ever hope to cover in this course. For this final reading assignment, you can choose from one of several options that we'll cover in the remainder of our course:

Search …

https://brickisland.net/DDGSpring2022/

CS 15-458/858: Discrete Differential Geometry

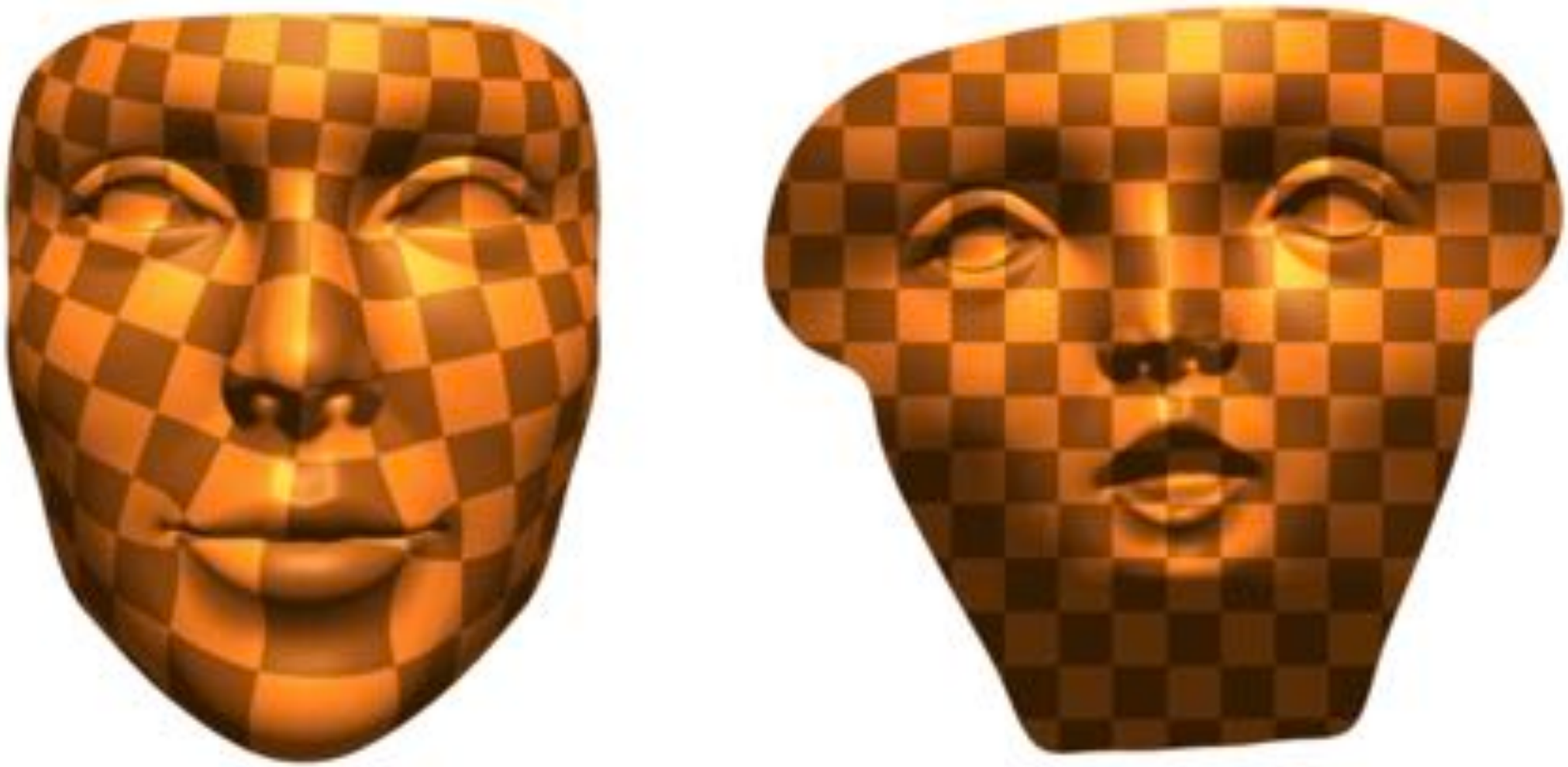
CARNEGIE MELLON UNIVERSITY | SPRING 2022 | TUE/THU 11:50-1:10 | GHC 4215

Assignment 4 [Coding]: Conformal Parameterization (due 4/20)

April 6, 2022

Assignments

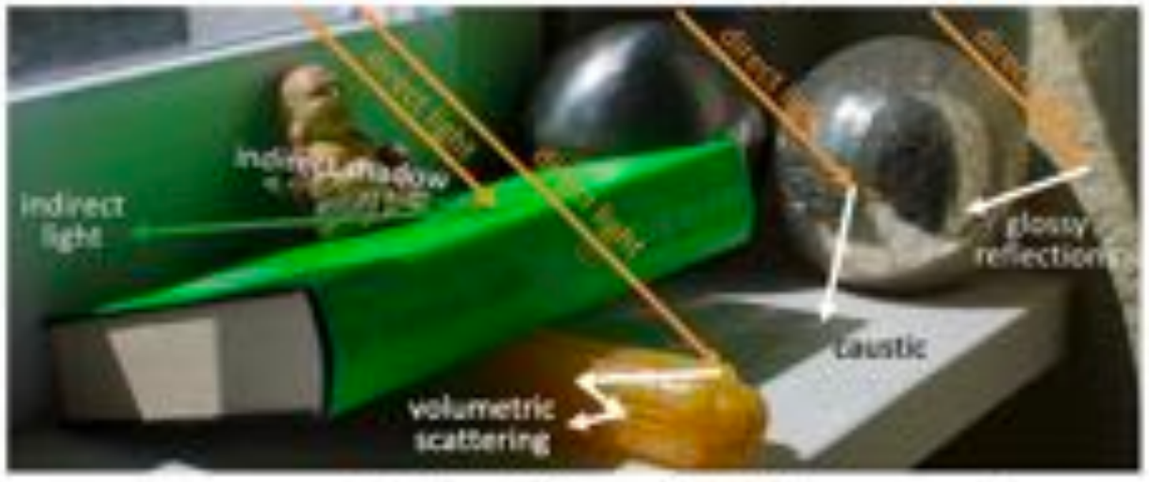
Leave a comment



For the coding portion of your assignment on conformal parameterization, you will implement the Spectral Conformal Parameterization (SCP) algorithm as described in the course notes.Please implement the following routines in

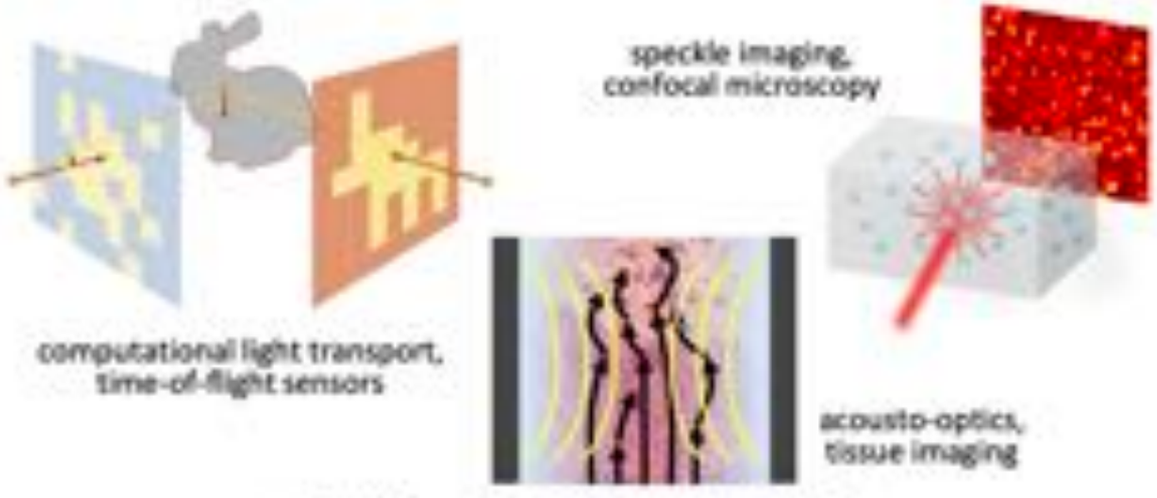
15-468/15-668/15-868 Physics-based Rendering

Learn all about modeling, simulating, differentiating, and inverting light!

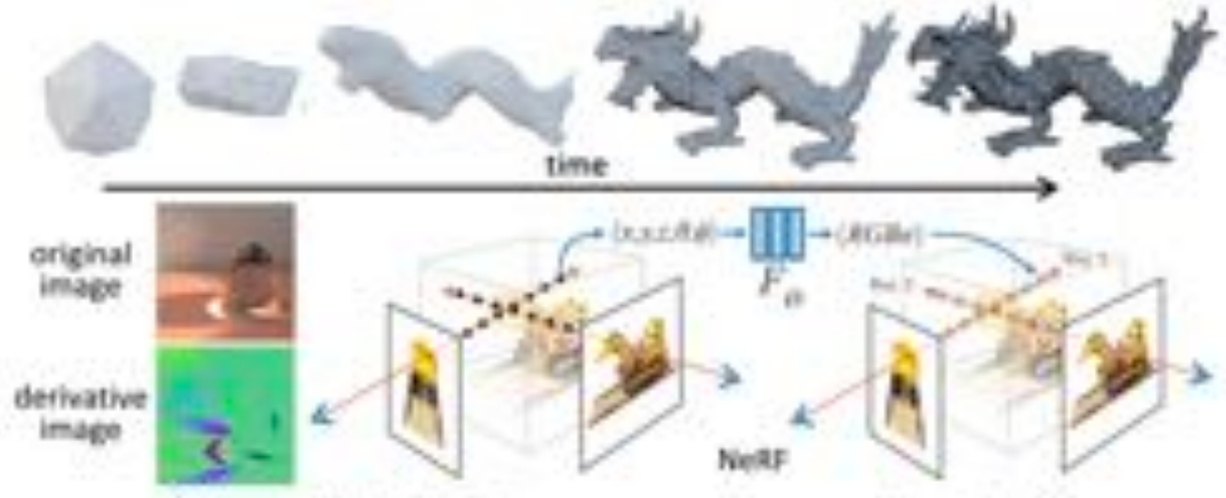


theory and simulation of light transport

rendering competition (win free SIGGRAPH registrations!)



scientific imaging applications

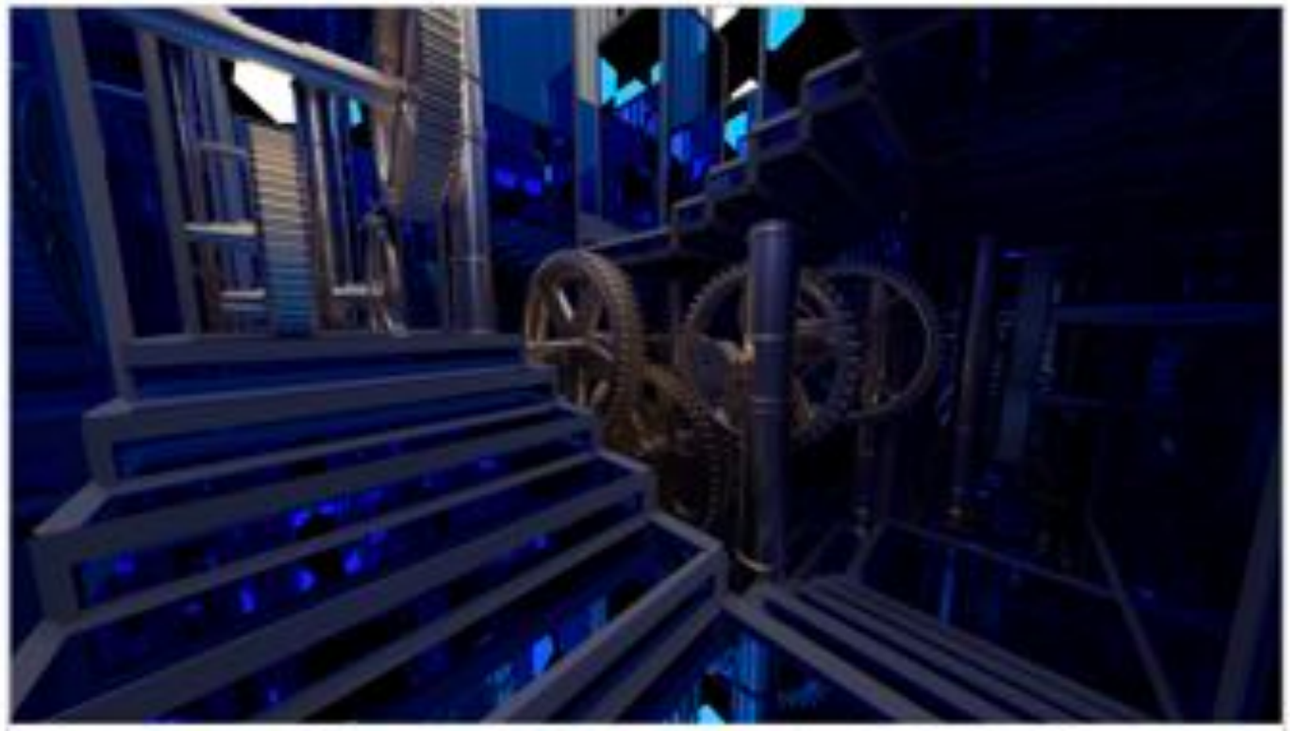


differentiable, inverse, and neural rendering

http://graphics.cs.cmu.edu/courses/15-468/

15-468, 15-668, 15-868
Physics-based rendering,
Rendering competition

🏆 Technical award winner



Max Slater

🏆 Art award winner

Arpit Agarwal

http://graphics.cs.cmu.edu/courses/15-468/2021_spring/

16-726 Learning-based Image Synthesis

https://learning-image-synthesis.github.io/

Classic machine learning (KNN, Graphcut, PCA, GMM)

Style Transfer (cGANs, neural style)

GANs (StyleGAN, GauGAN)

Autoregressive Models

Diffusion models (DALL·E 2)

16-848 Hands: Design and Control for Dexterous Manipulation

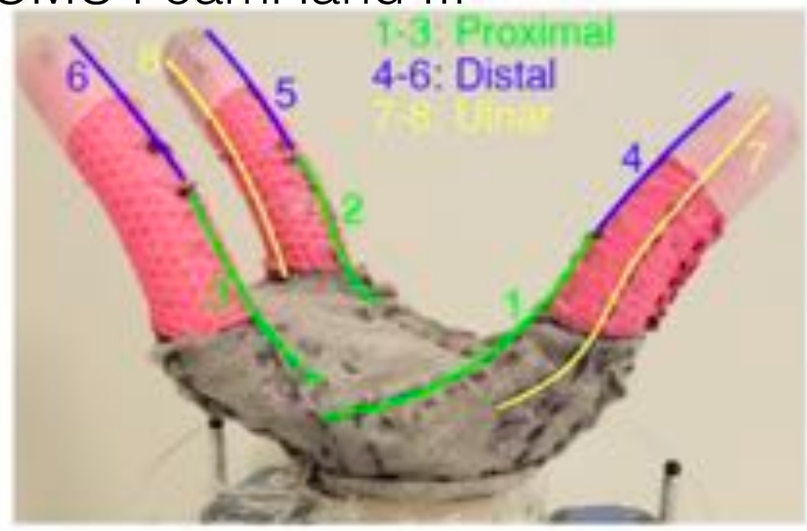
Research related to hands has increased dramatically over the past decade. Robot hand innovation may be at an all time high, with new materials and manufacturing techniques promoting an explosion of ideas. Hands have become a priority in virtual reality and telepresence. Even the study of how people use their hands is seeing the growth of new ideas and themes.

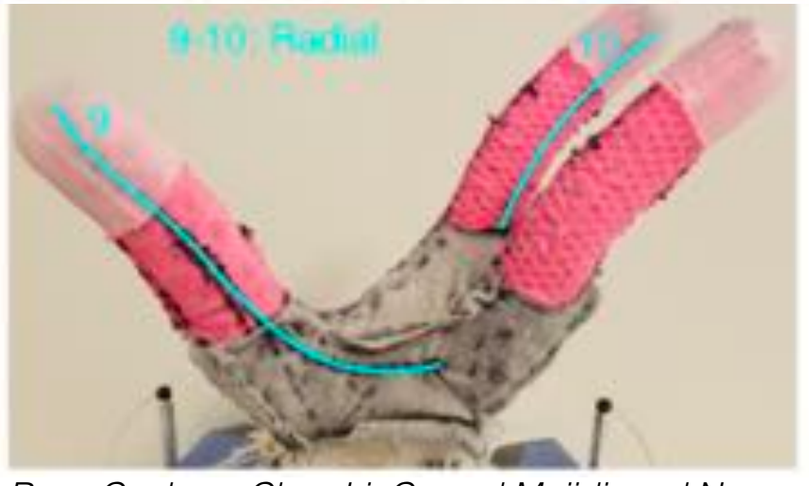
With all of this attention on hands, are we close to a breakthrough in dexterity, or are we still missing some things needed for truly dexterous manipulation?

In this course, we will survey robotic hands and learn about the human hand with the goal of pushing the frontiers on hand design and control for dexterous manipulation. We will consider the necessary kinematics and dynamics for dexterity, what sensors are required to carry out dexterous interactions, the importance of reflexes and compliance, the role of machine learning in grasping and manipulation, and the challenge of uncertainty. We will explore state of the art manufacturing and design techniques, including innovations in soft robotics and embedded sensing. We will examine the human hand: its structure, sensing capabilities, human grasp choice and control strategies for inspiration and benchmarking. Students will be asked to present one or two research papers, participate in discussions and short research or design exercises, and carry out a final project.

CMU FoamHand I

CMU FoamHand III

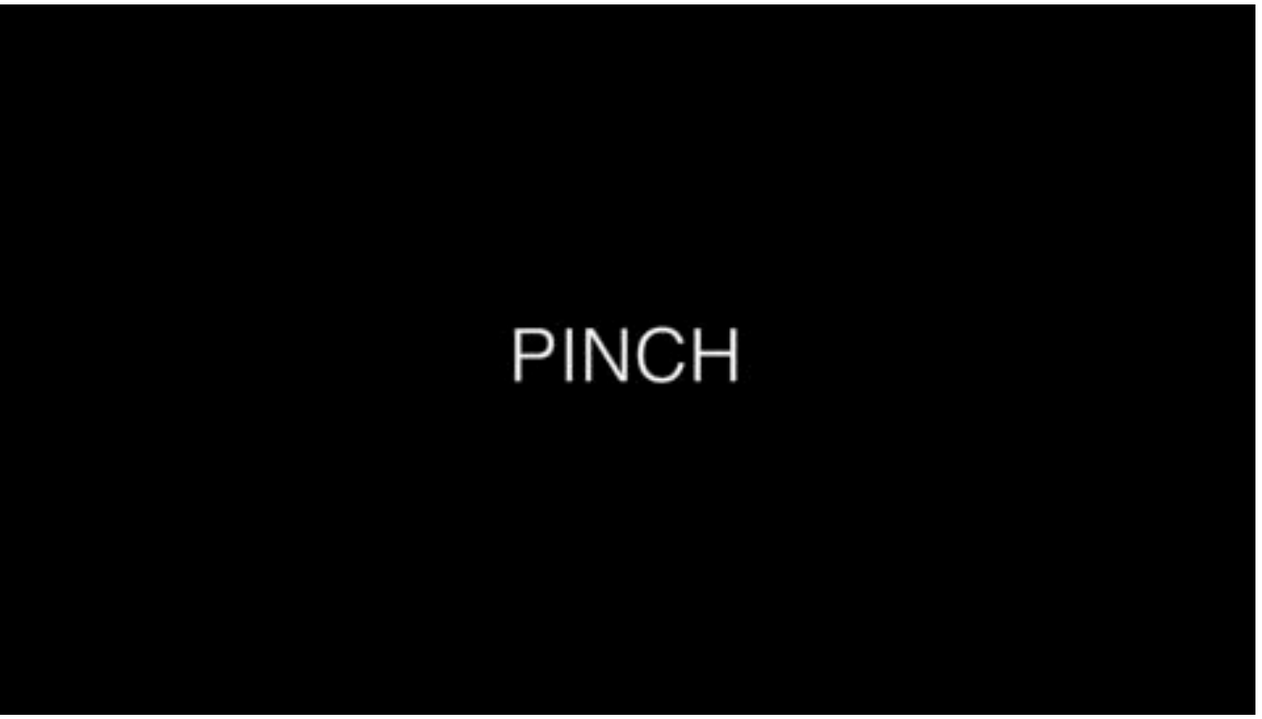




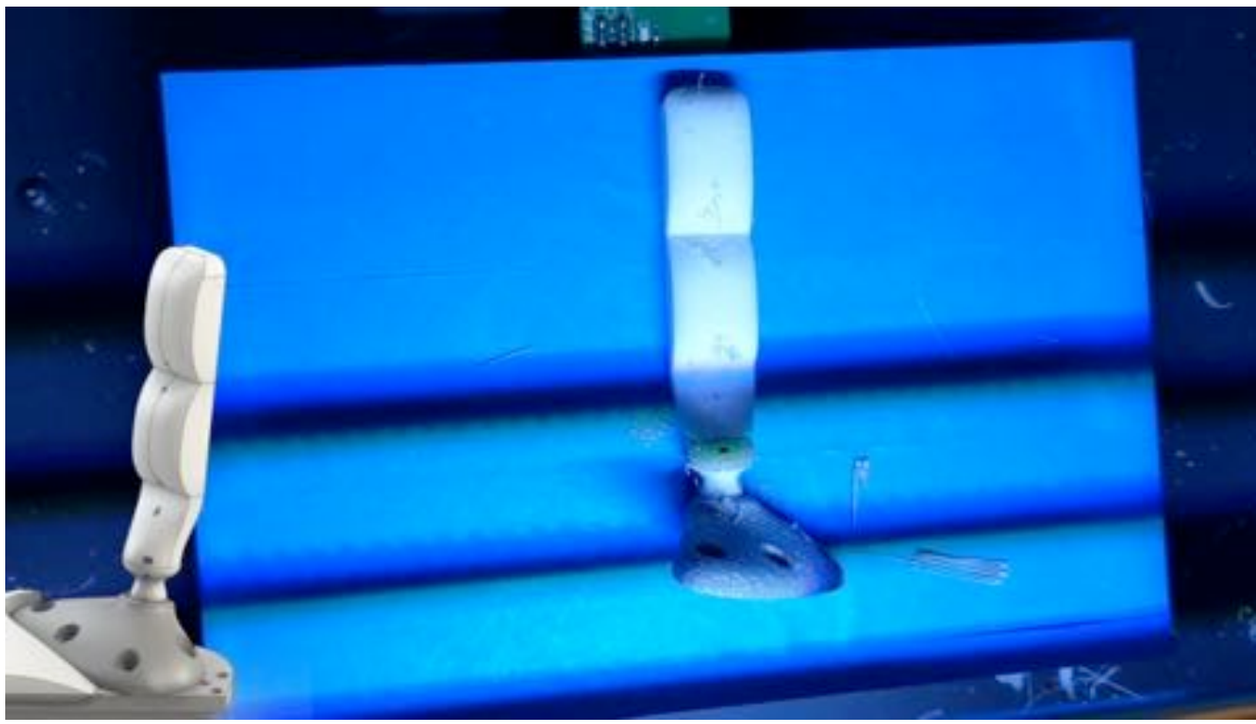
Bauer, Dominik, Cornelia Bauer, Jonathan P. King, Daniele Moro, Kai-Hung Chang, Stelian Coros, and Nancy Pollard. "Design and control of foam hands for dexterous manipulation." International Journal of Humanoid Robotics 17, no. 01 (2020).

Ryan Coulson, Chao Li, Carmel Majidi, and Nancy S. Pollard. "The Elliott and Connolly benchmark: A test for evaluating the in-hand dexterity of robot hands." In IEEE-RAS 20th International Conference on Humanoid Robots (Humanoids), IEEE, 2021.

Dominik Bauer, Cornelia Bauer, Jonathan P. King, Daniele Moro, Kai-Hung Chang, Stelian Coros, and Nancy Pollard. "Design and control of foam hands for dexterous manipulation." International Journal of Humanoid Robotics 17 (1) (2020).



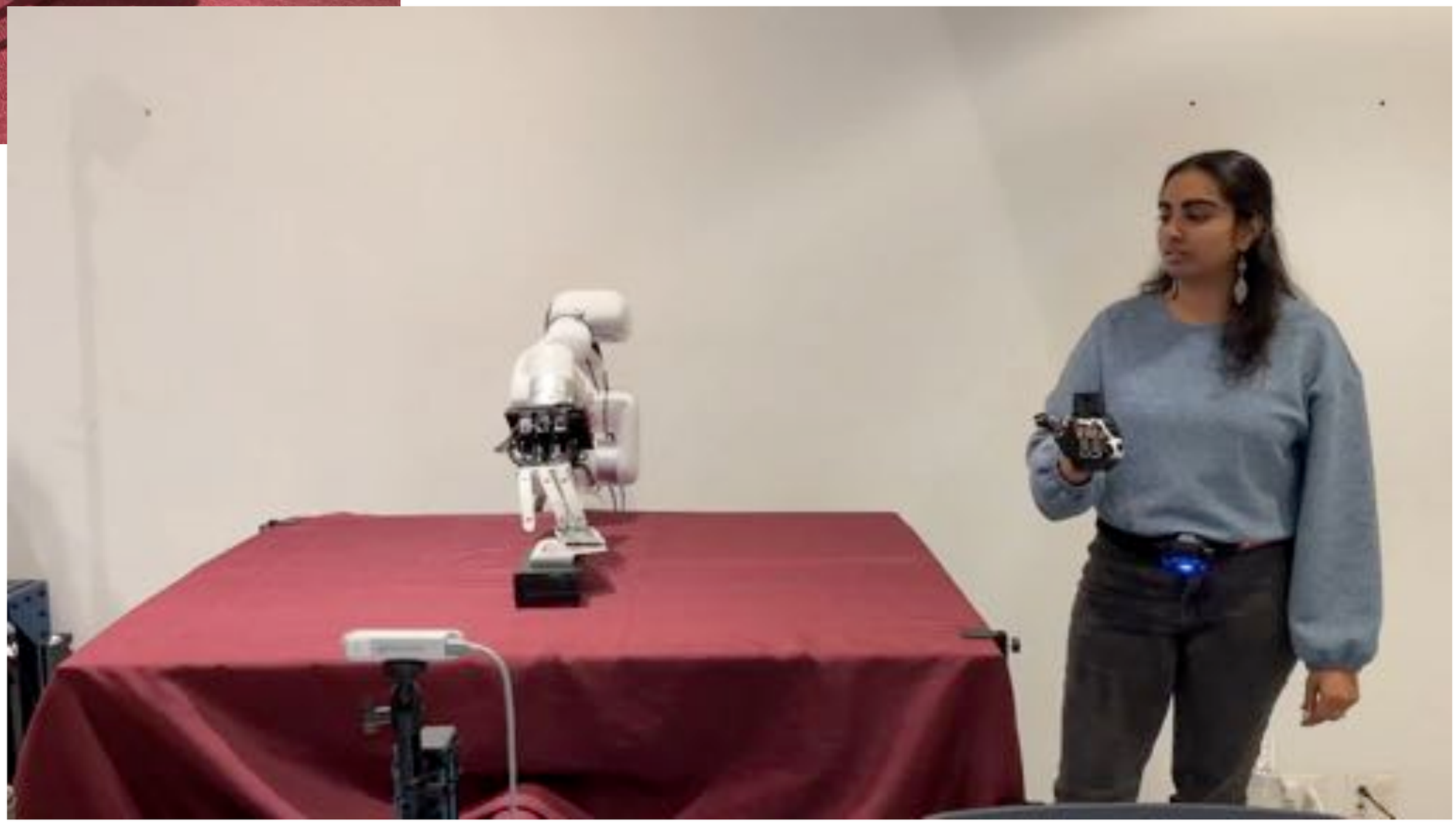
Ryan Coulson, Chao Li, Carmel Majidi, and Nancy S. Pollard. "The Elliott and Connolly benchmark: A test for evaluating the in-hand dexterity of robot hands." Humanoids 2021.



Dominik Bauer, Cornelia Bauer, Arjun Lakshmipathy, Roberto Shu, and Nancy S. Pollard. "Towards very low-cost iterative prototyping for fully printable dexterous soft robotic hands." Robosoft 2022.

Dominik Bauer, Cornelia Bauer, and Nancy Pollard. "Soft Robotic End-Effectors in the Wild: A Case Study of a Soft Manipulator for Green Bell Pepper Harvesting." In AI for Agriculture and Food Systems. 2023.

with Pragna Mannam, Kenny Shaw, Jean Oh, and Deepak Pathak



with Pragna Mannam, Kenny Shaw, Jean Oh, and Deepak Pathak

COMPUTER GRAPHICS CONCENTRATION

The SCS Computer Graphics Concentration provides an opportunity for SCS undergraduate students at Carnegie Mellon to learn Computer Graphics foundations and specialties from a variety of application and research areas. Students gain a broad view of Computer Graphics in an introductory course and in-depth experience from a choice of topic areas, including the option of independent research.

Courses include:

- Computational photography
- Computer games
- Computer animation
- Computational geometry
- Physics-based rendering

This concentration provides an excellent introduction to the area for students considering industry and the opportunity for research experience for those considering graduate study.

https://csd.cmu.edu/academics/undergraduate/computer_graphics_concentration

Required core course (12 units)

15-462 — Computer Graphics

Electives (minimum 33 units)

Students must complete 3 electives from the following list of courses for a minimum of 33 units. A maximum of 12 units of research may be applied to the elective count and must be approved by the concentration advisor.

- 15-365 — Experimental Animation
- 15-418 — Parallel Computer Architecture and Programming
- 15-456 — Computational Geometry
- 15-458 — Discrete Differential Geometry
- 15-463 — Computational Photography
- 15-464 — Technical Animation
- 15-465 — Animation Art and Technology
- 15-466 — Computer Game Programming
- 15-468 — Physics-Based Rendering
- 15-469 — Algorithmic Textiles Design
- 16-726 — Learning-based Image Synthesis 16-823 Physics-based Vision

https://csd.cmu.edu/academics/undergraduate/computer_graphics_concentration

Your projects!

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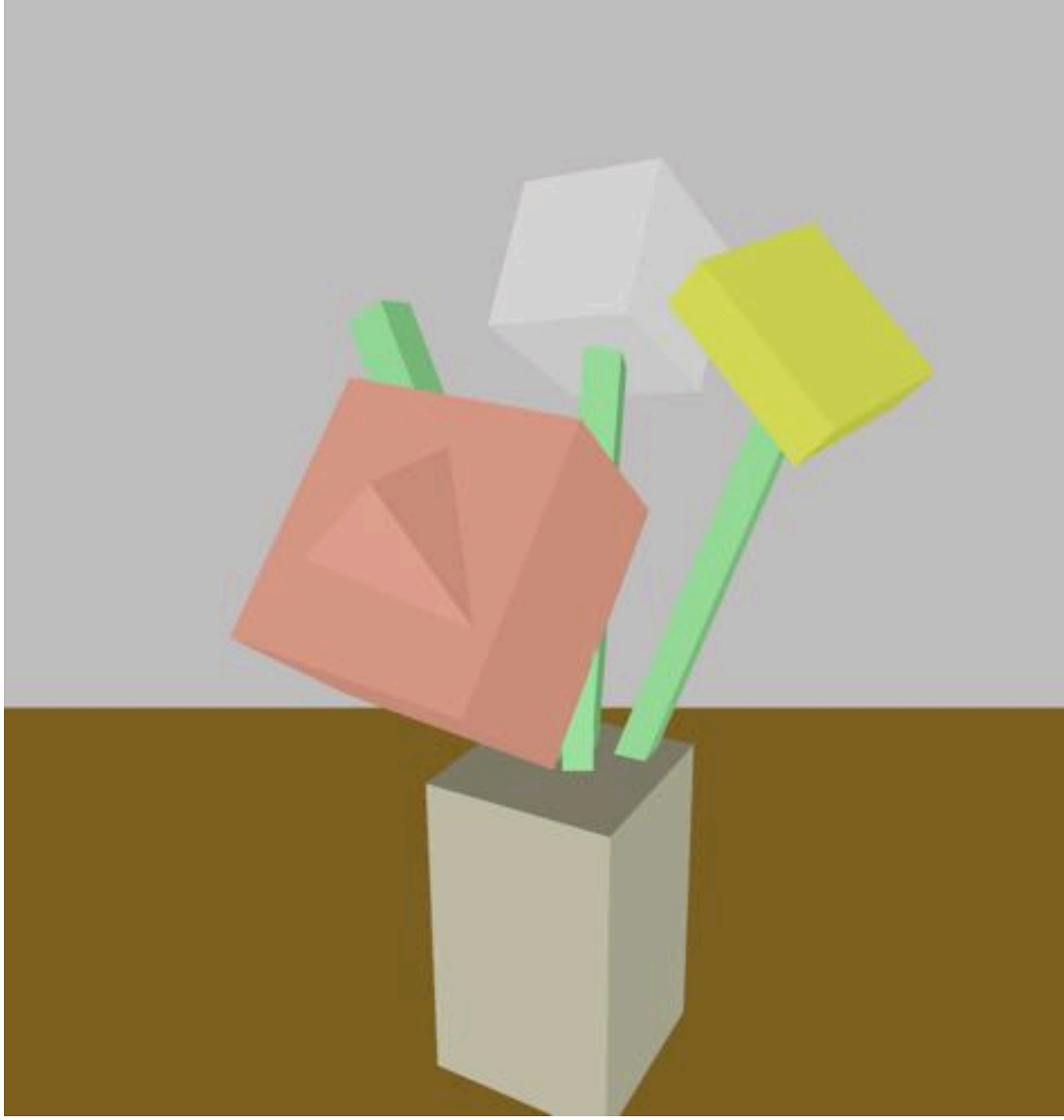

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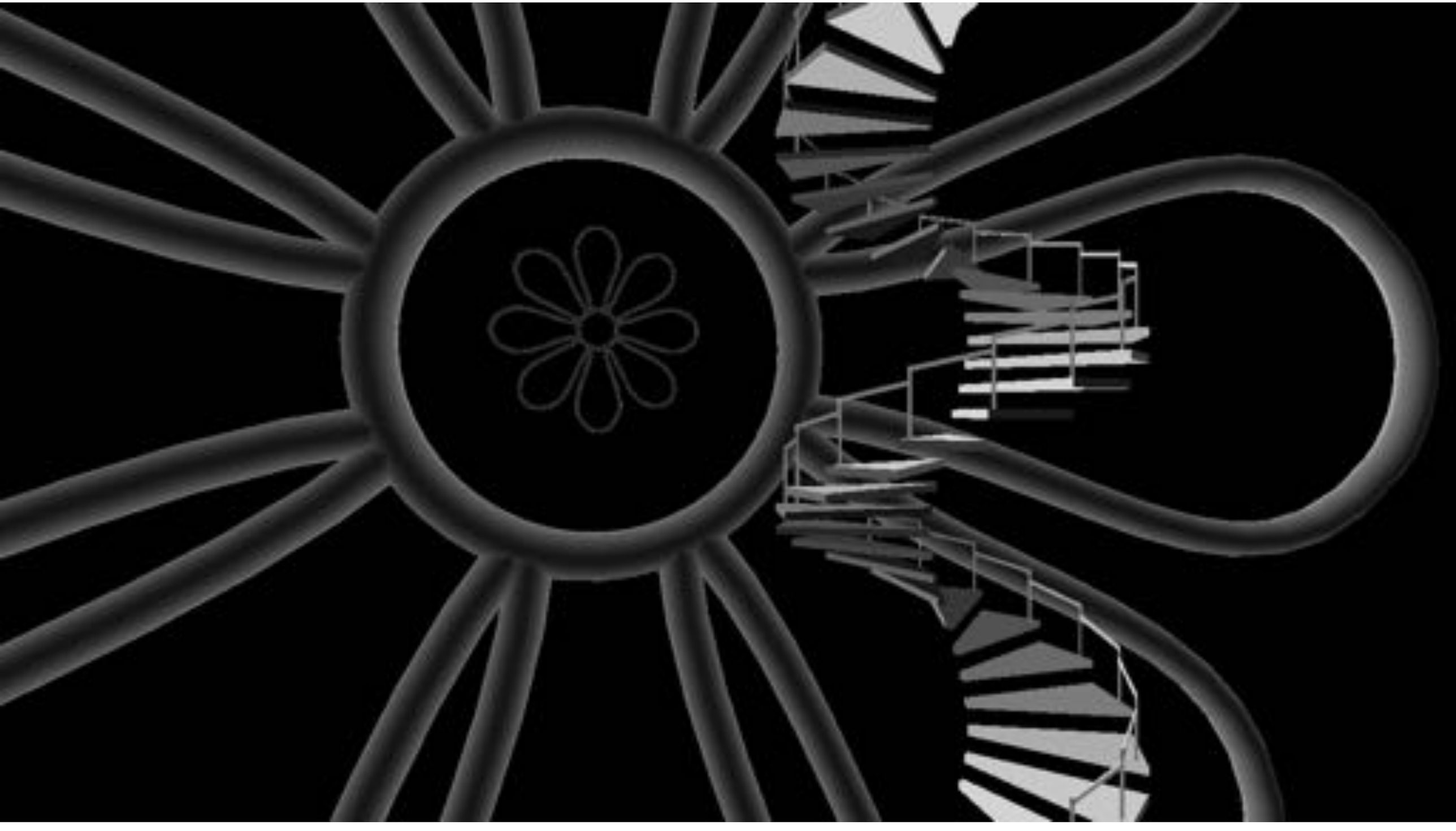

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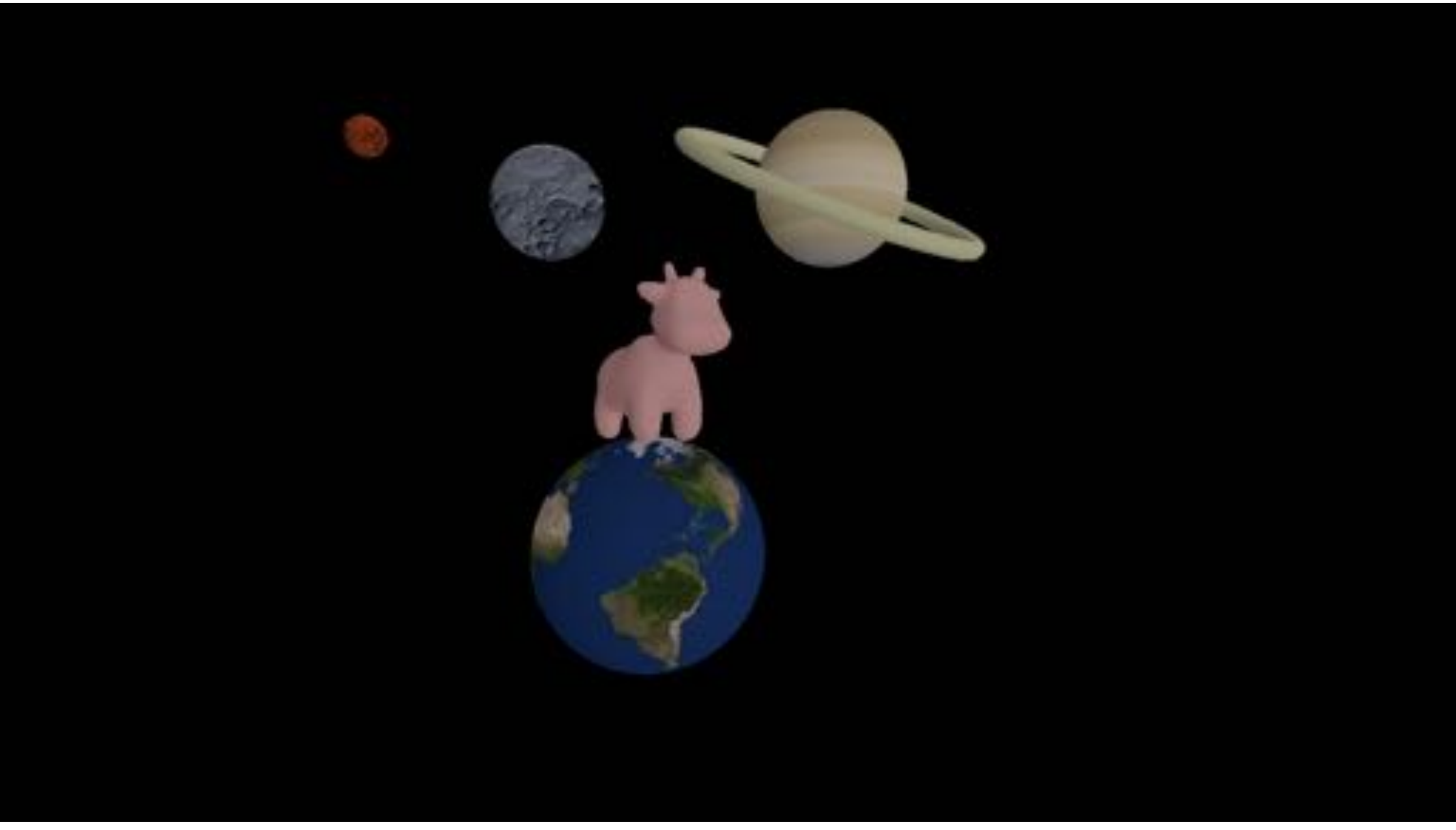

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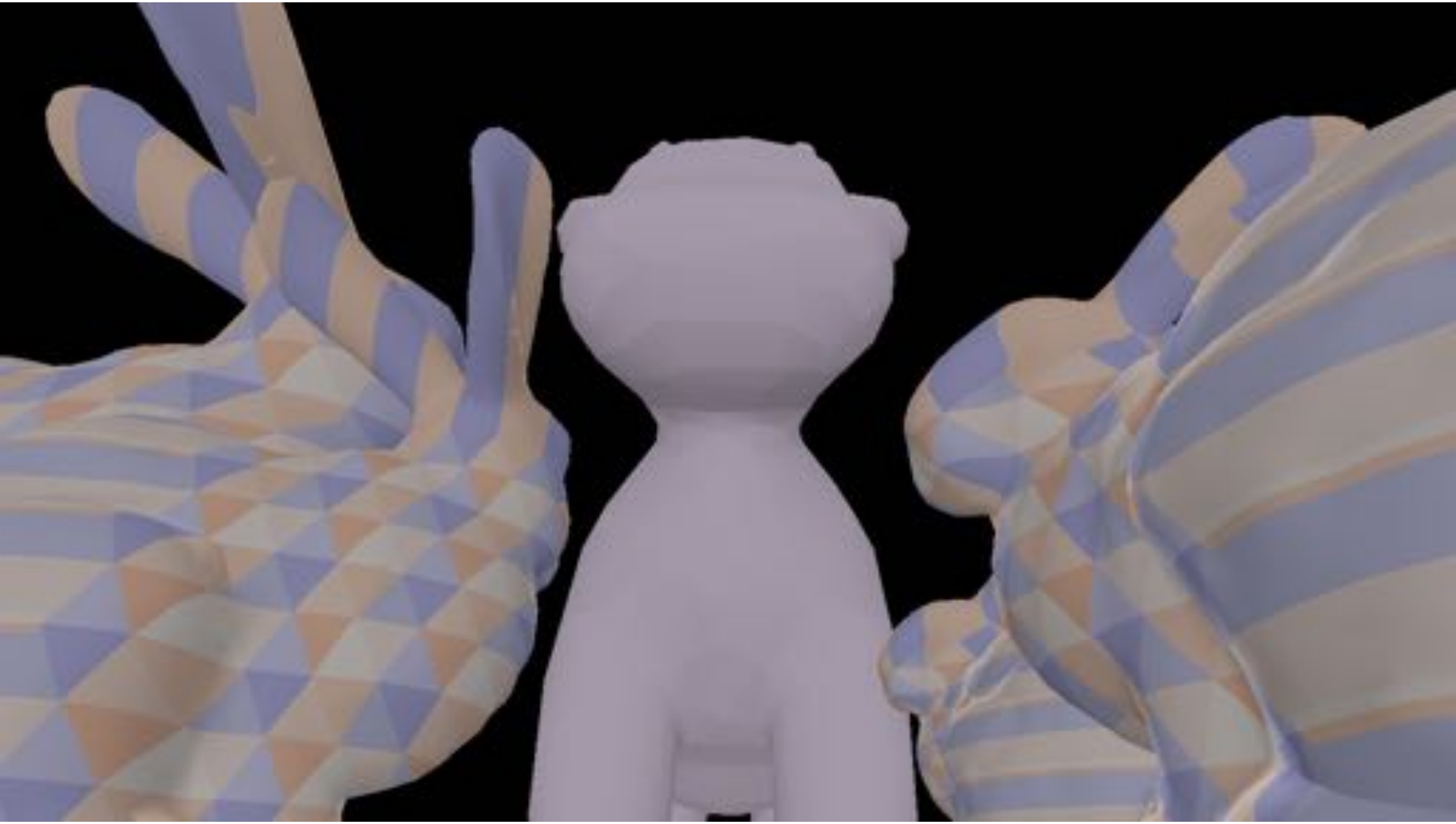

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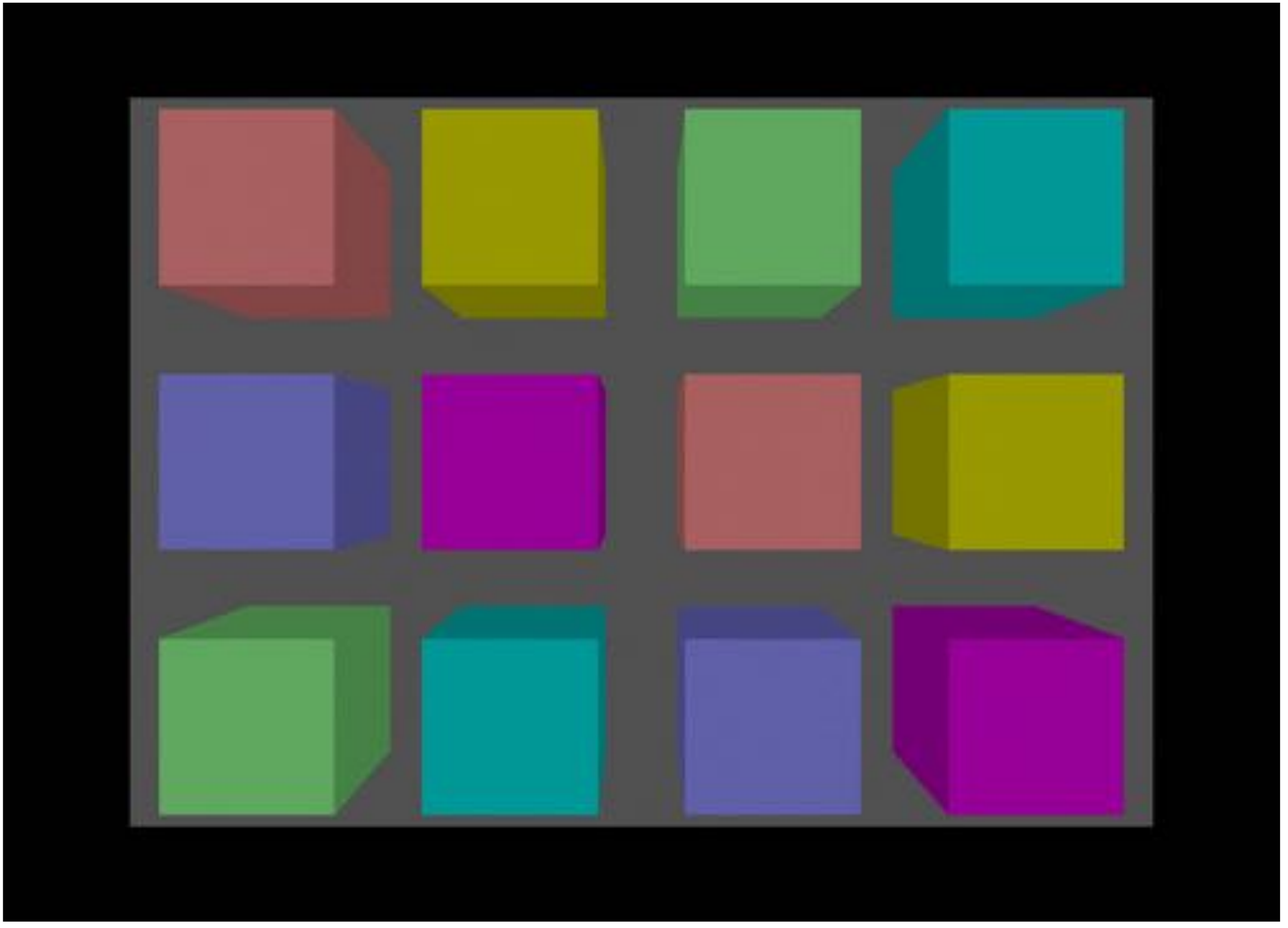

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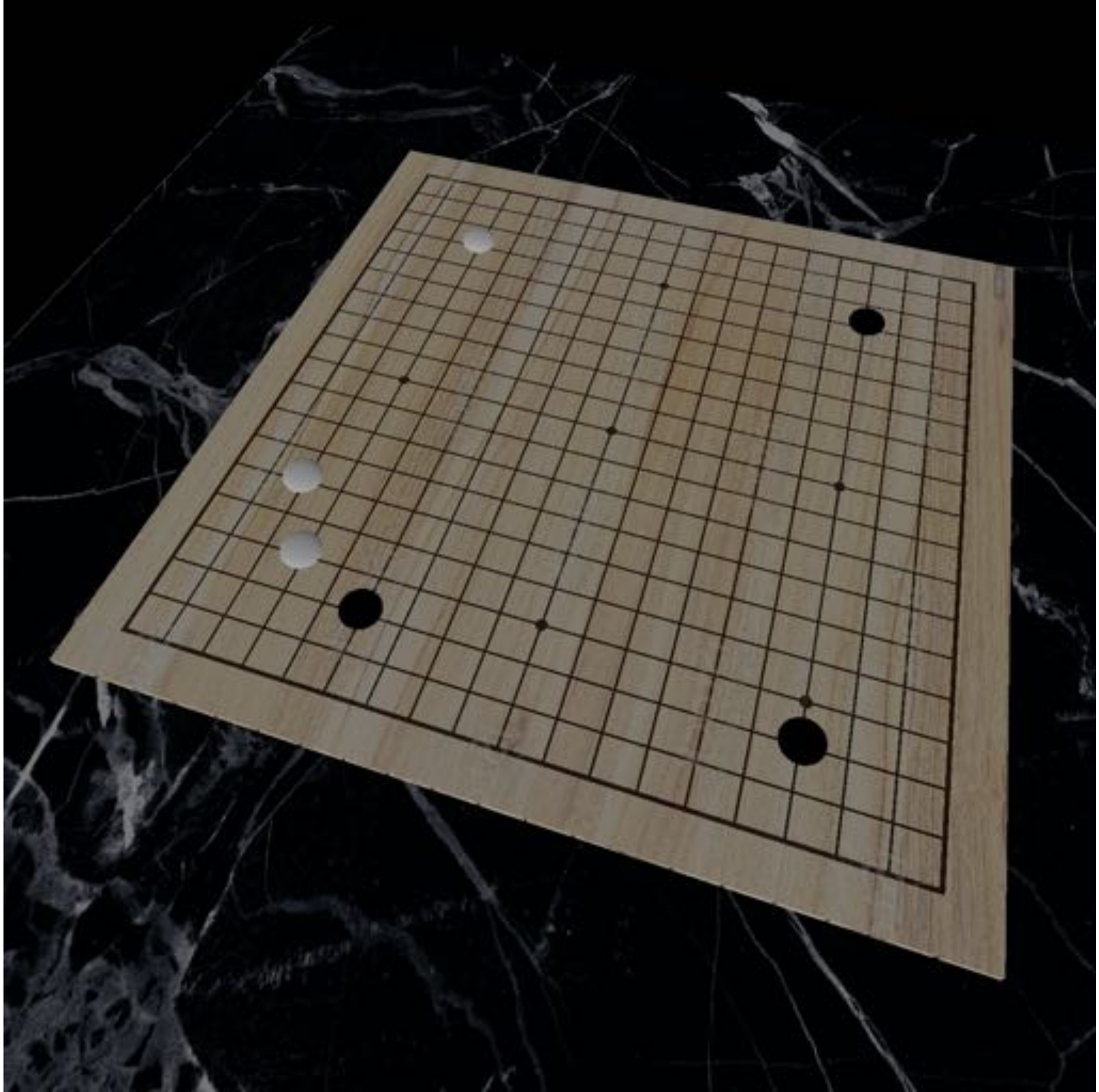

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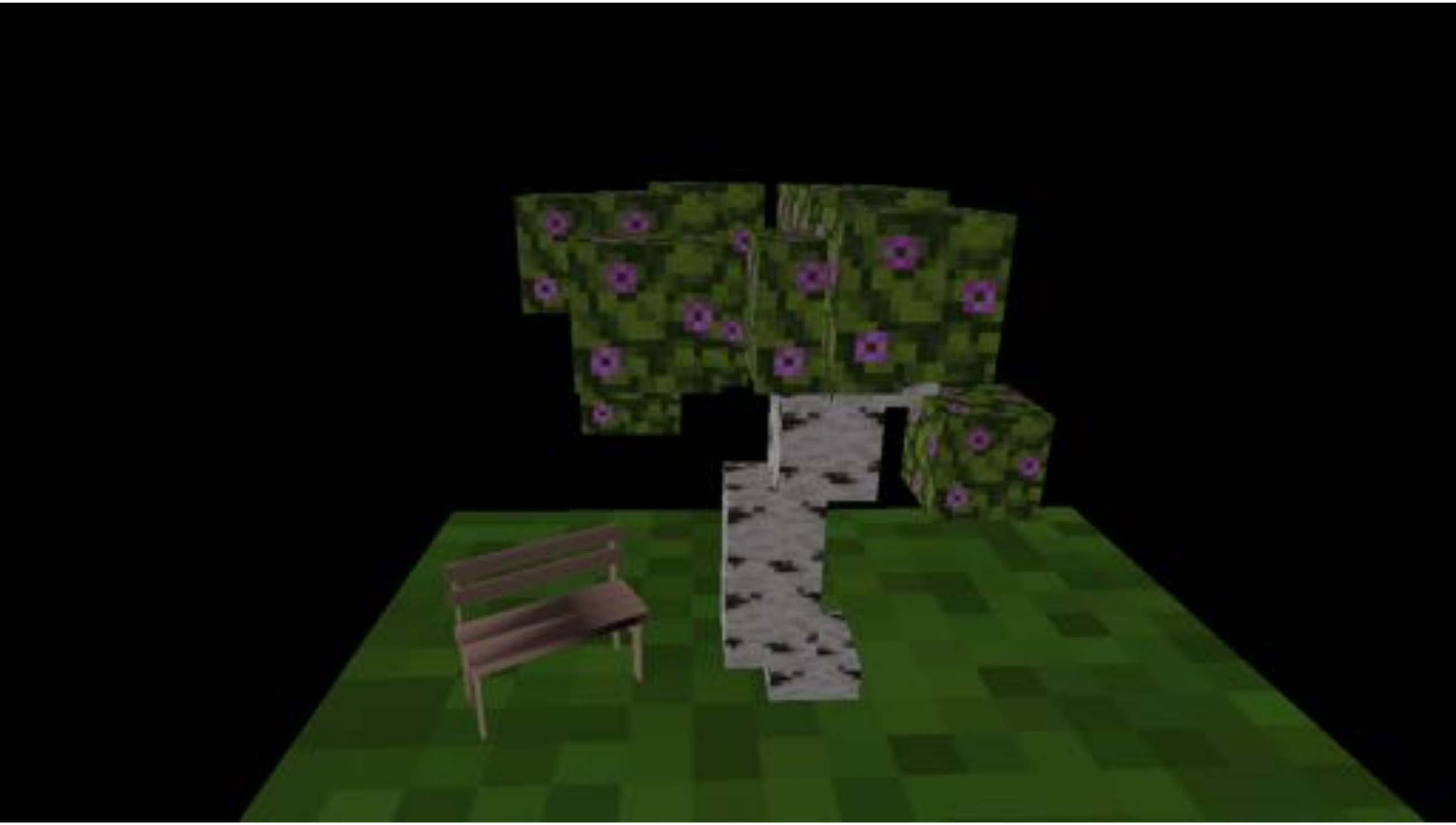

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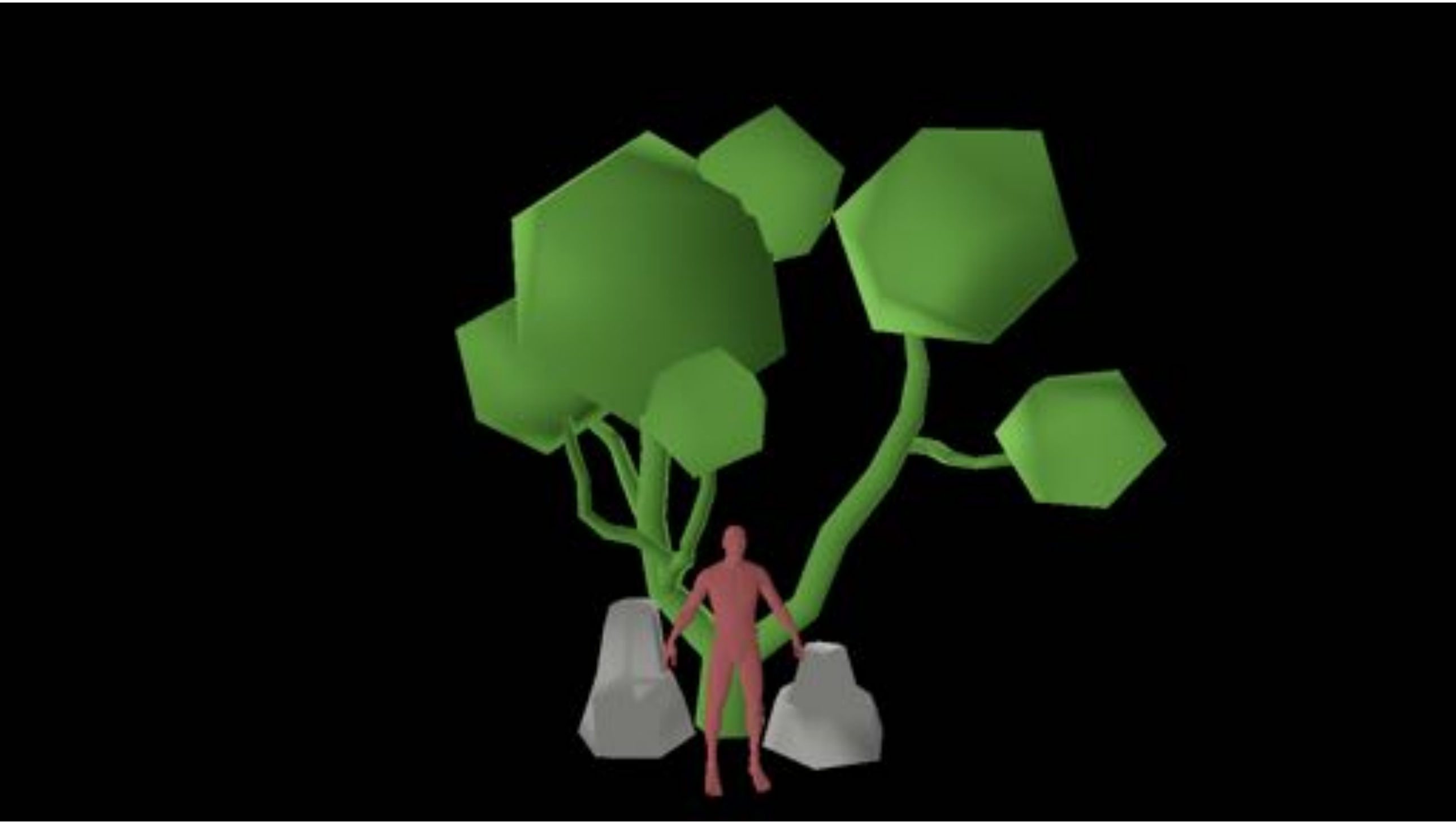

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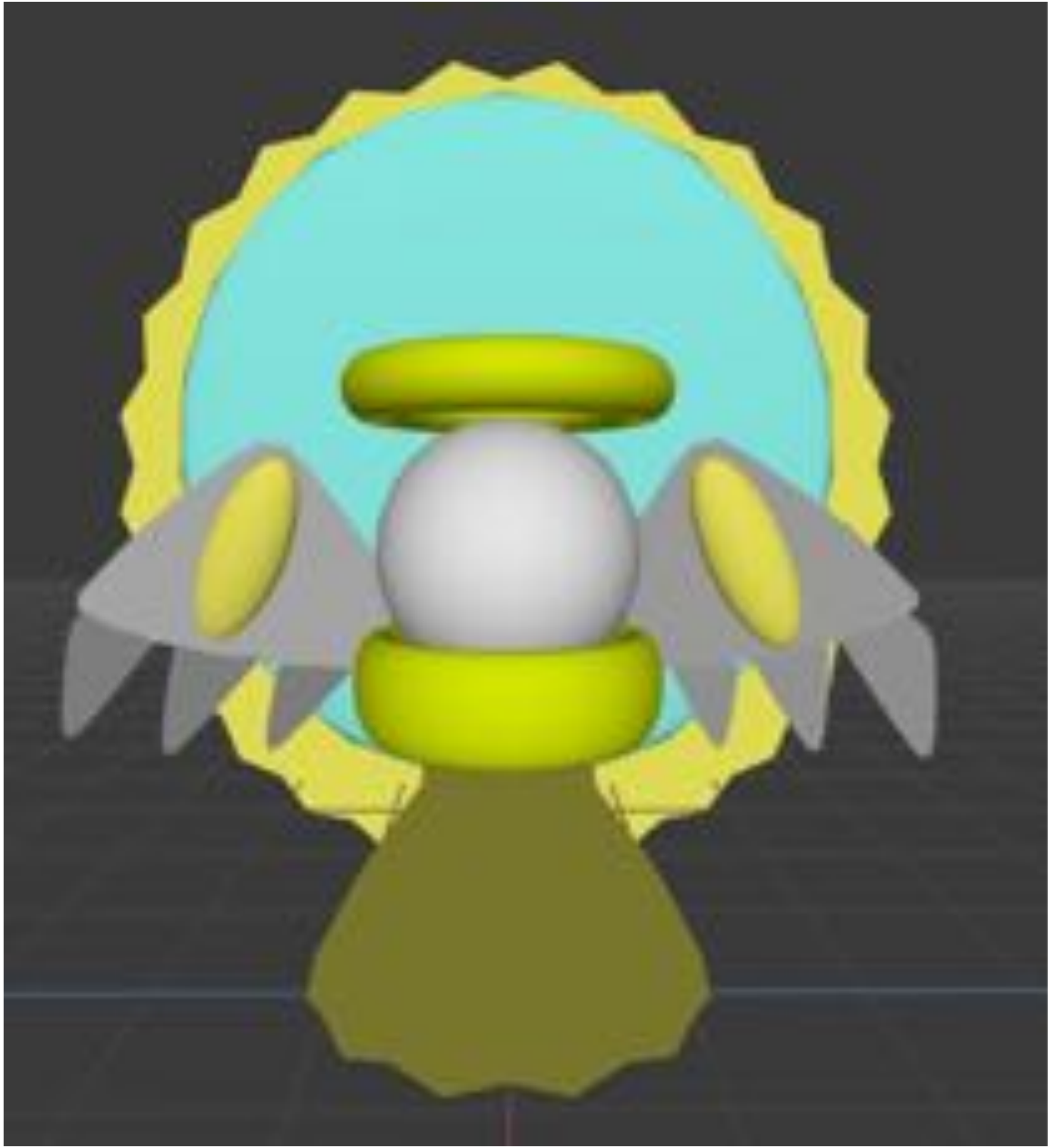
agerald



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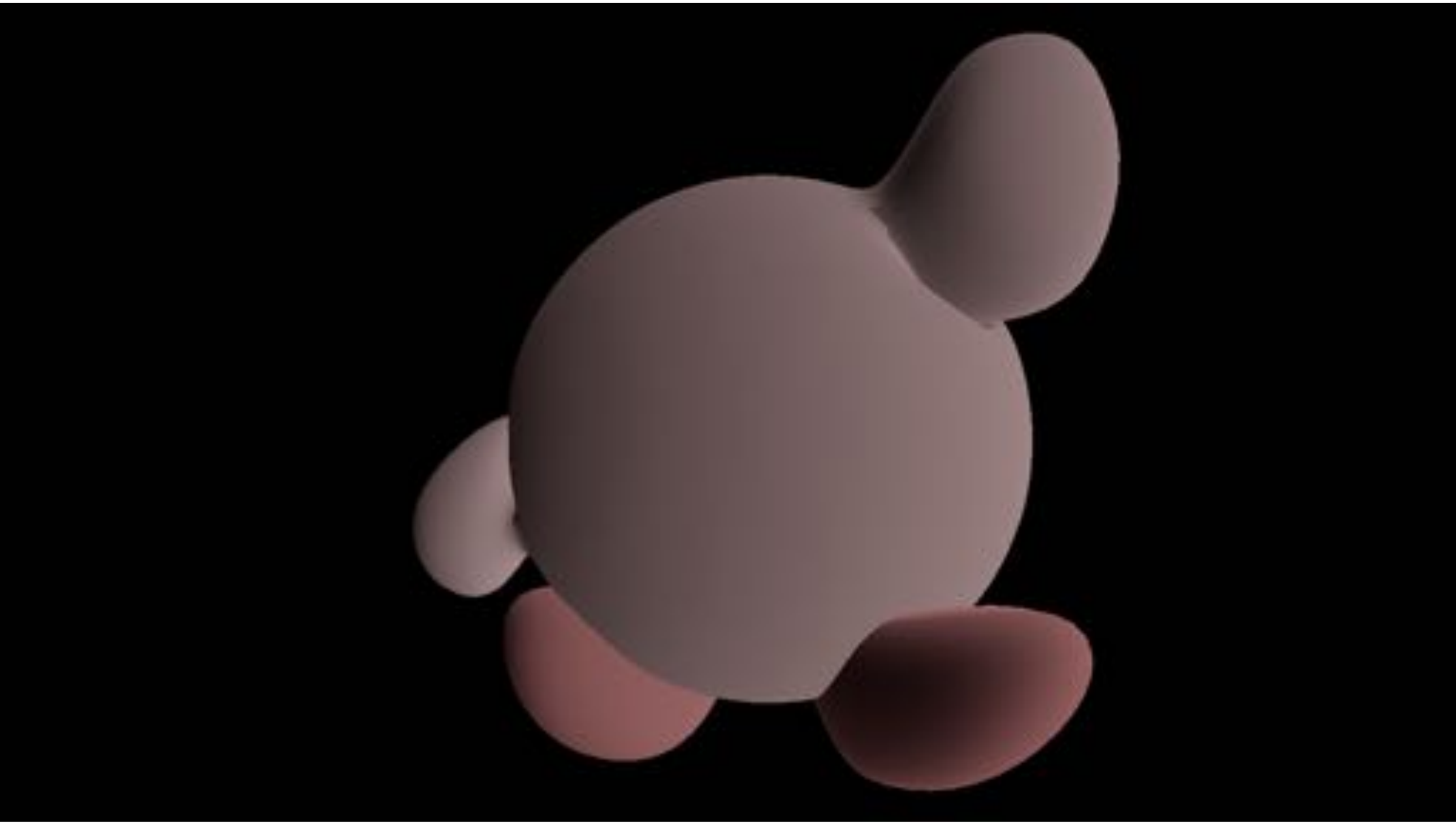

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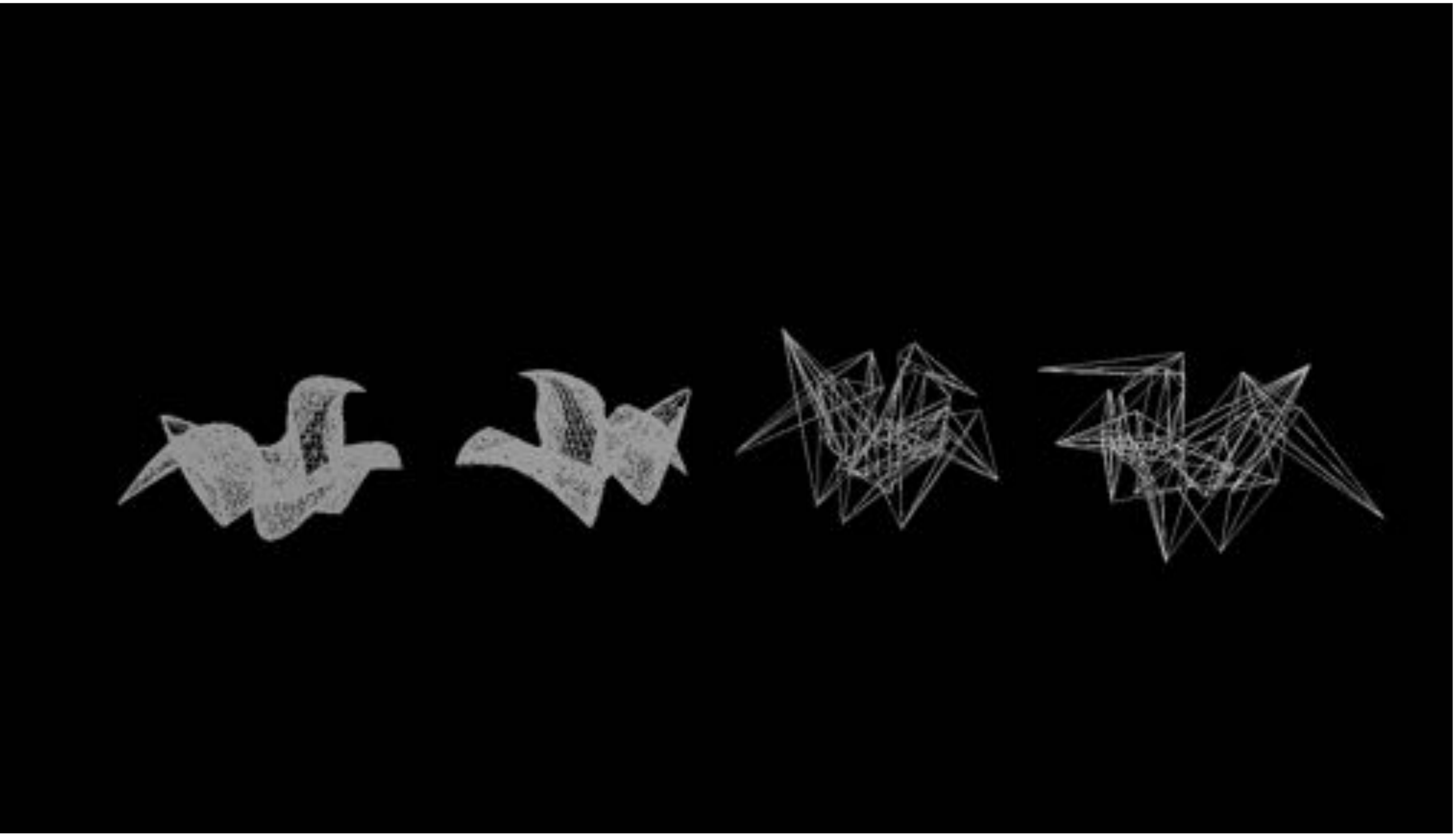

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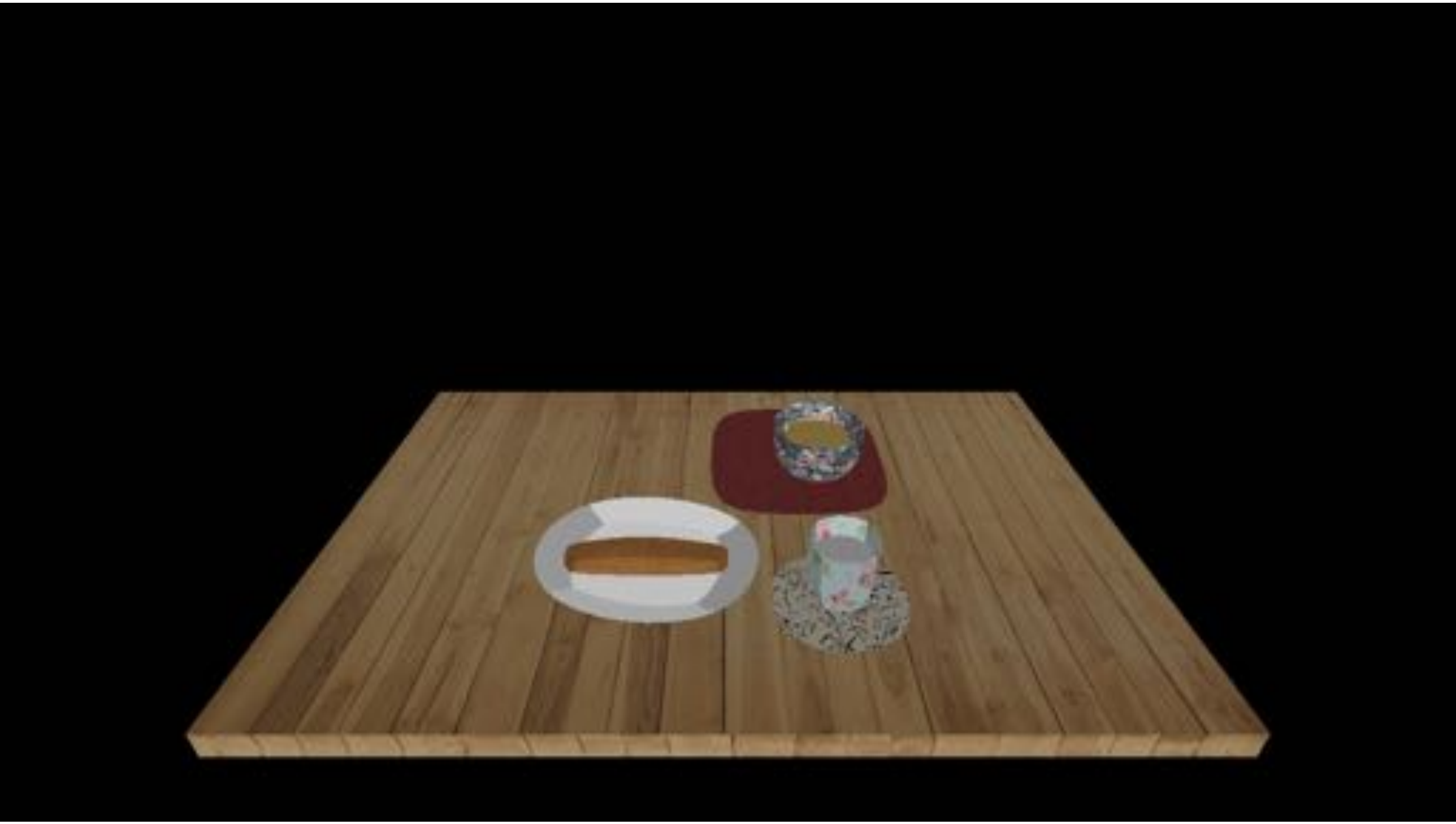

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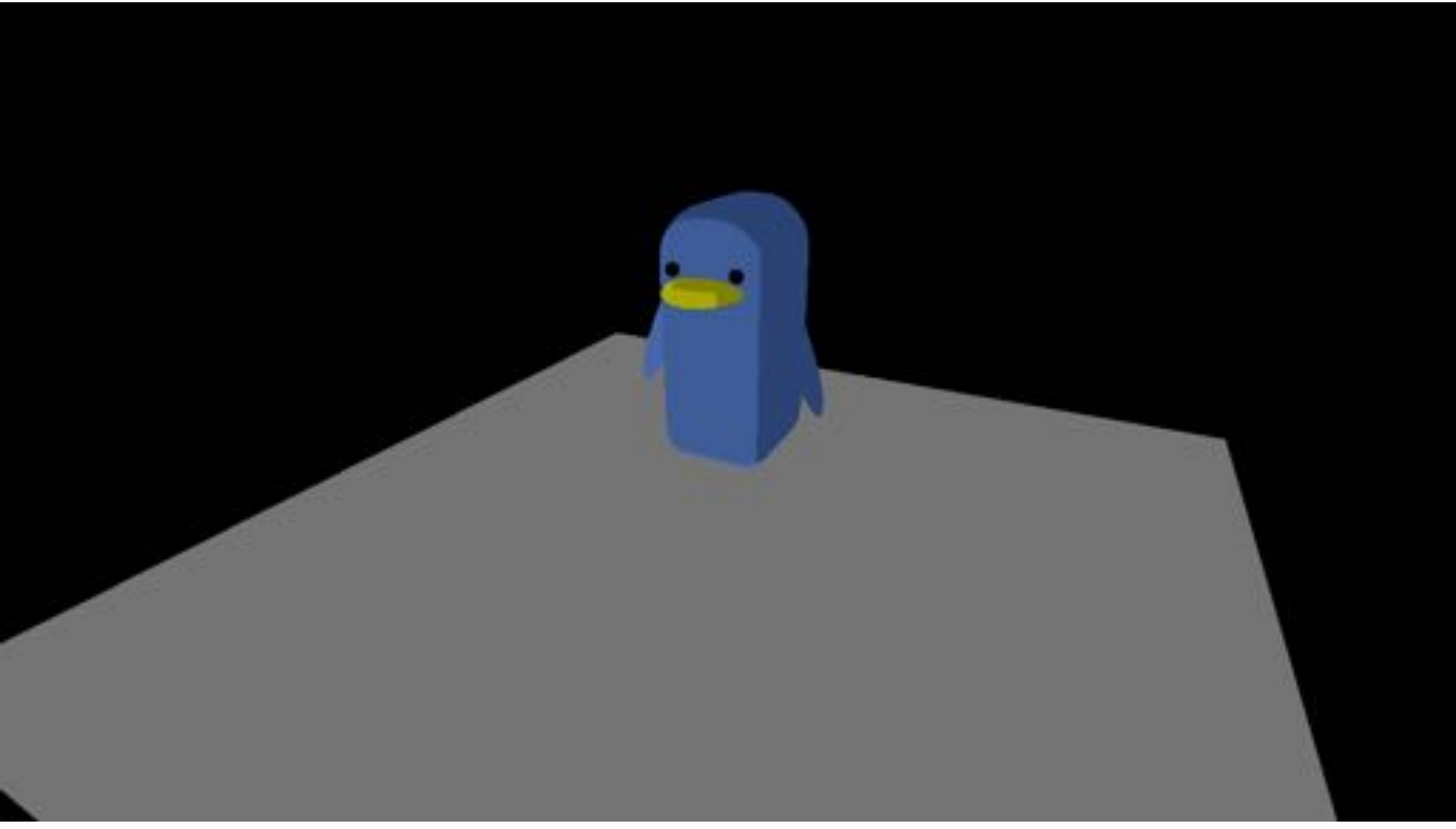

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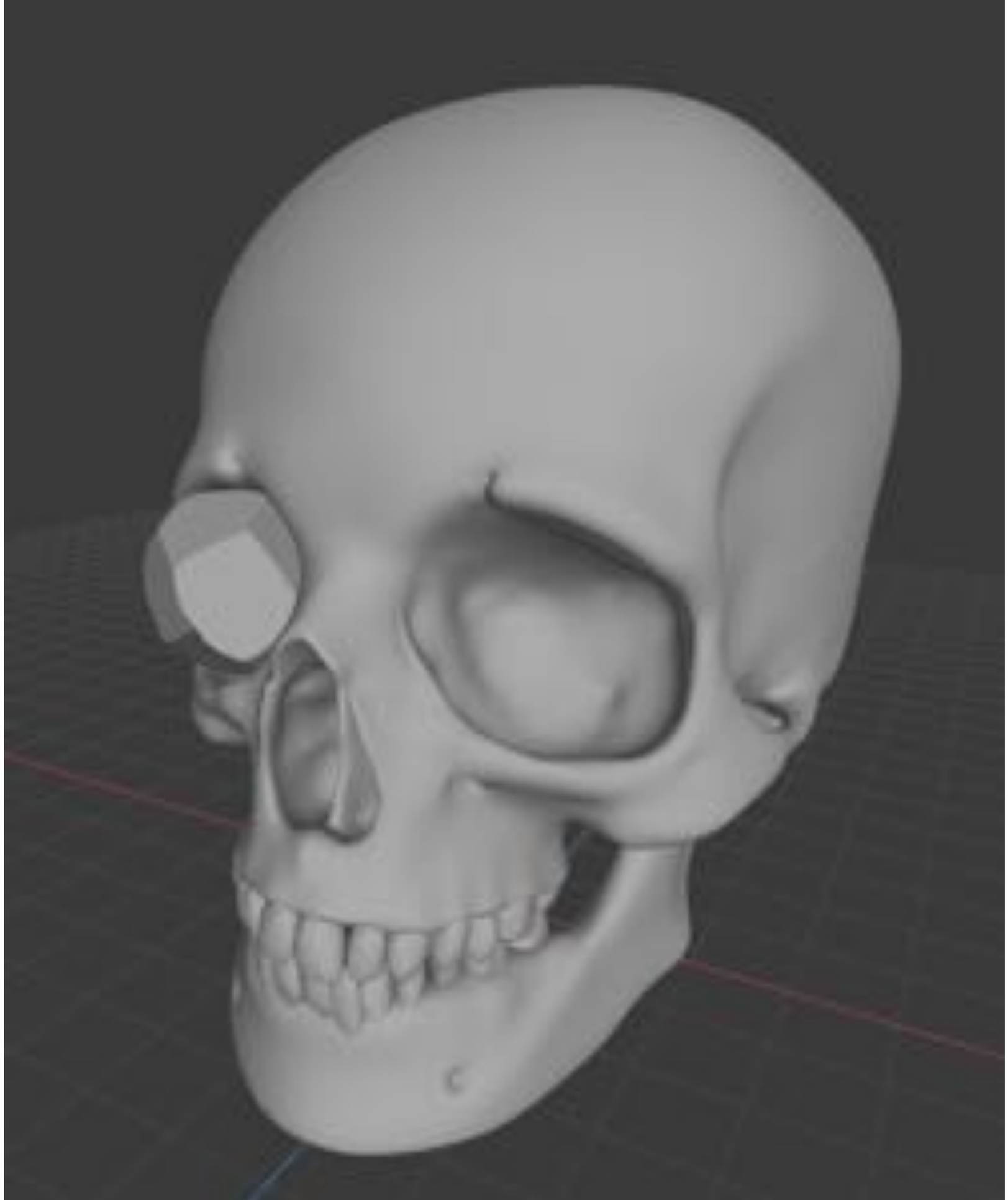

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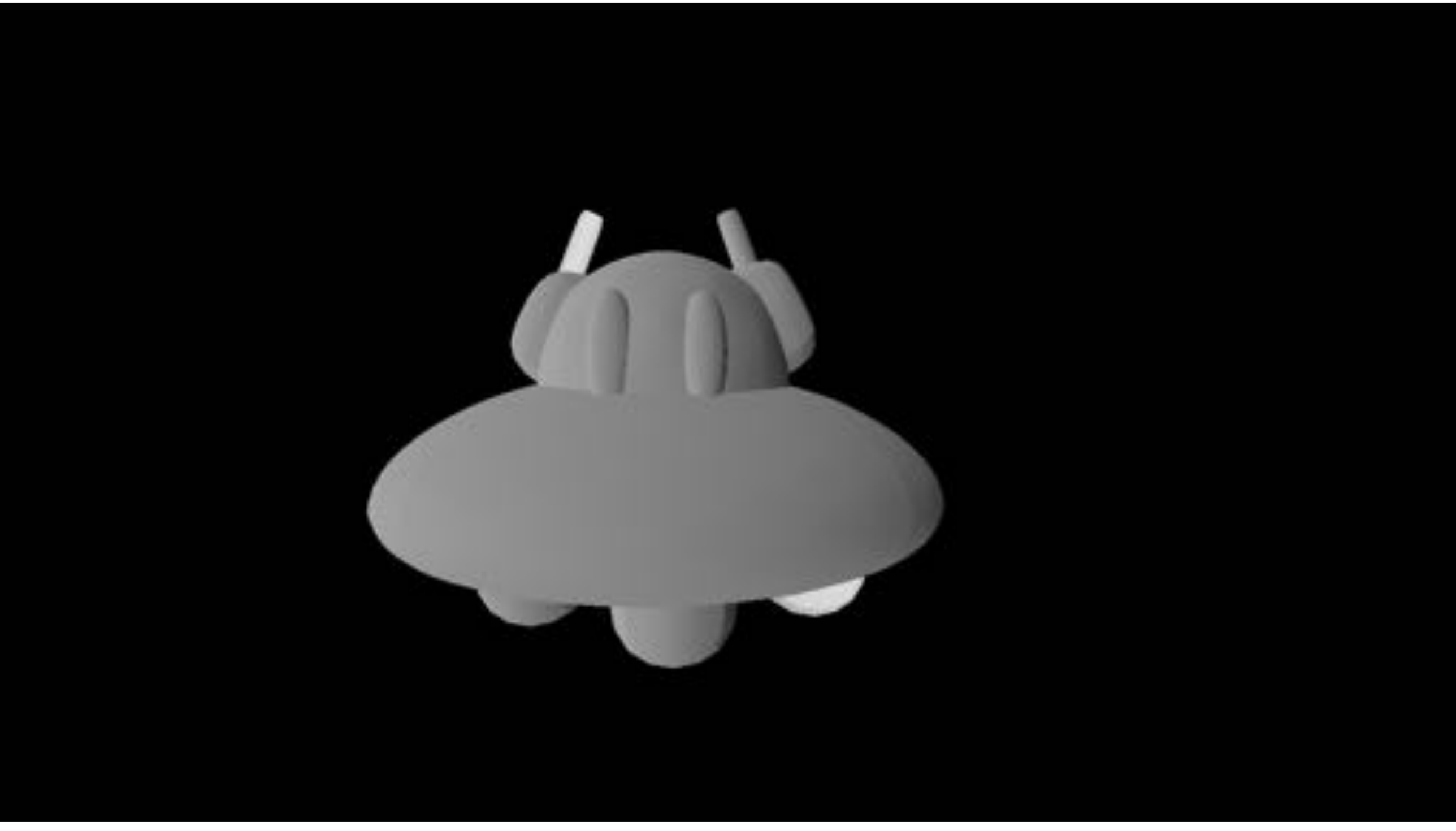

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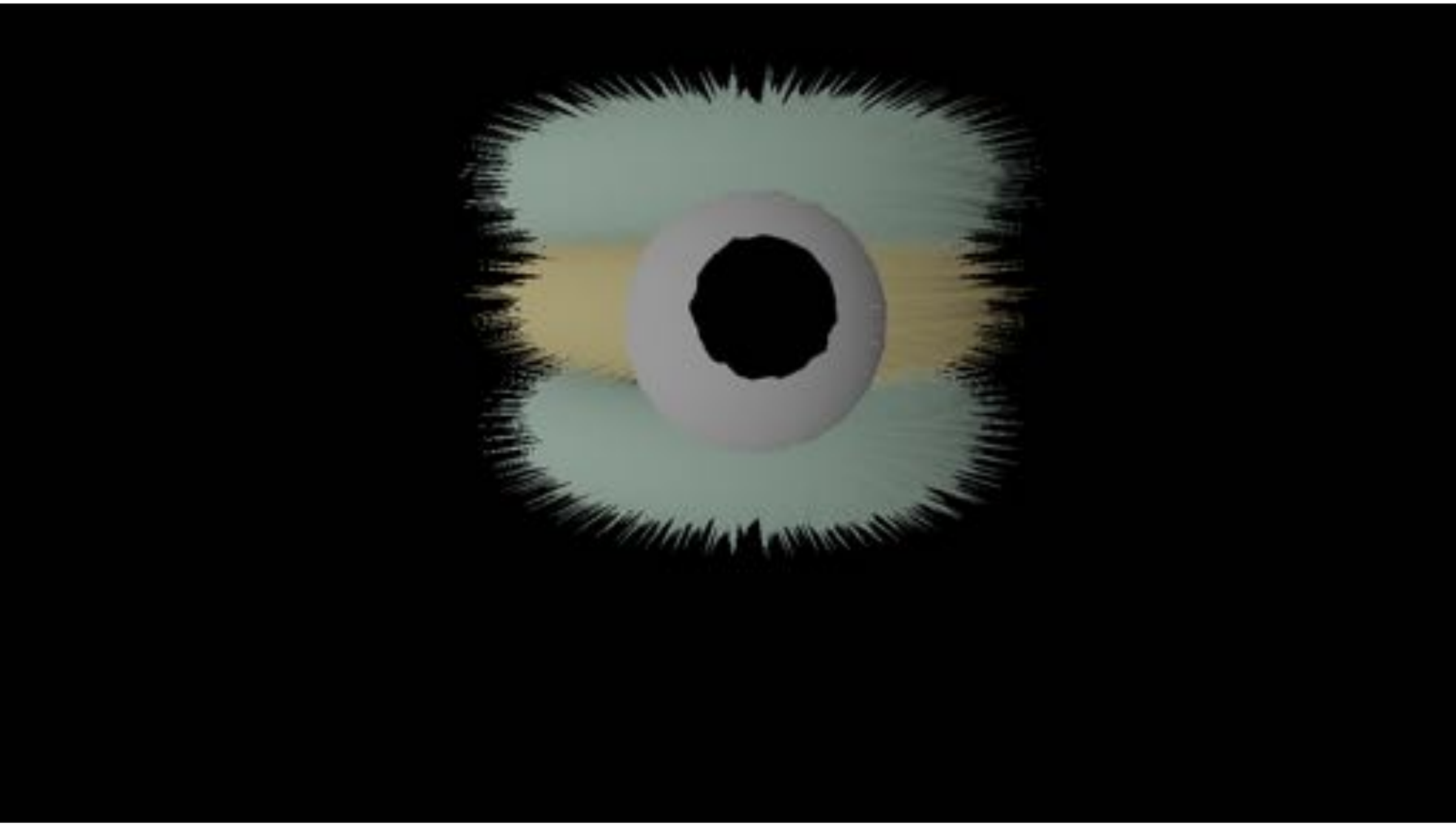

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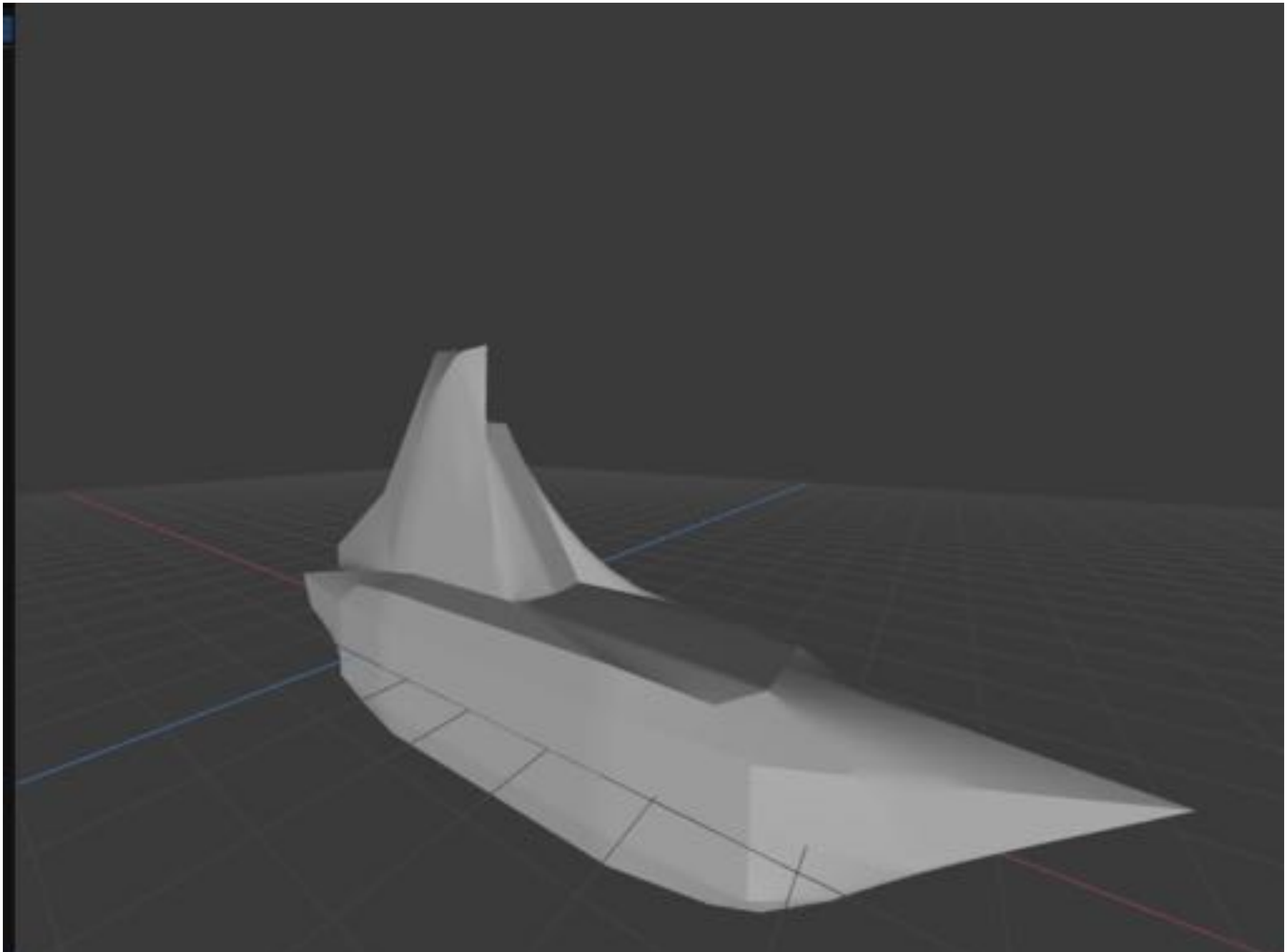

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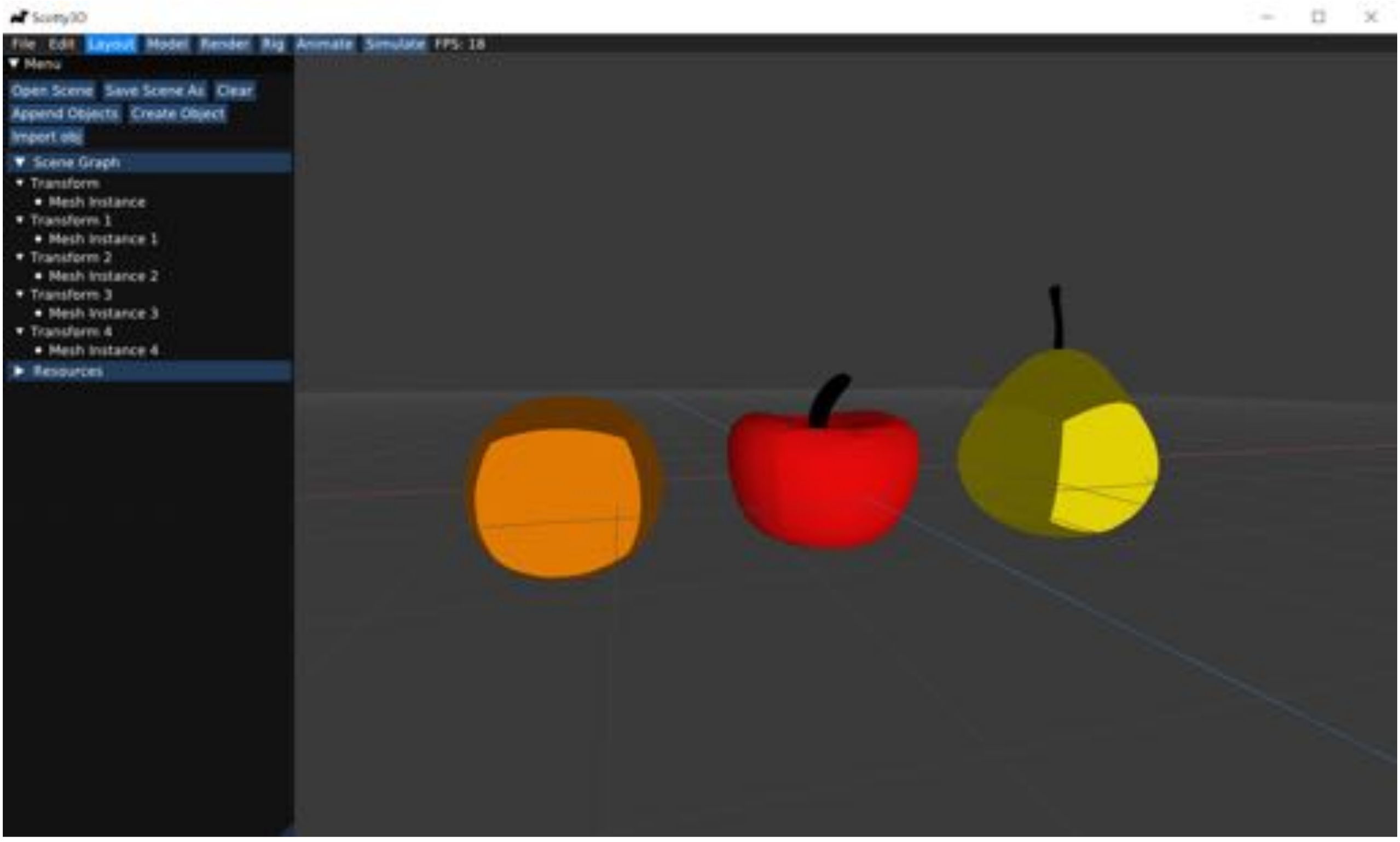
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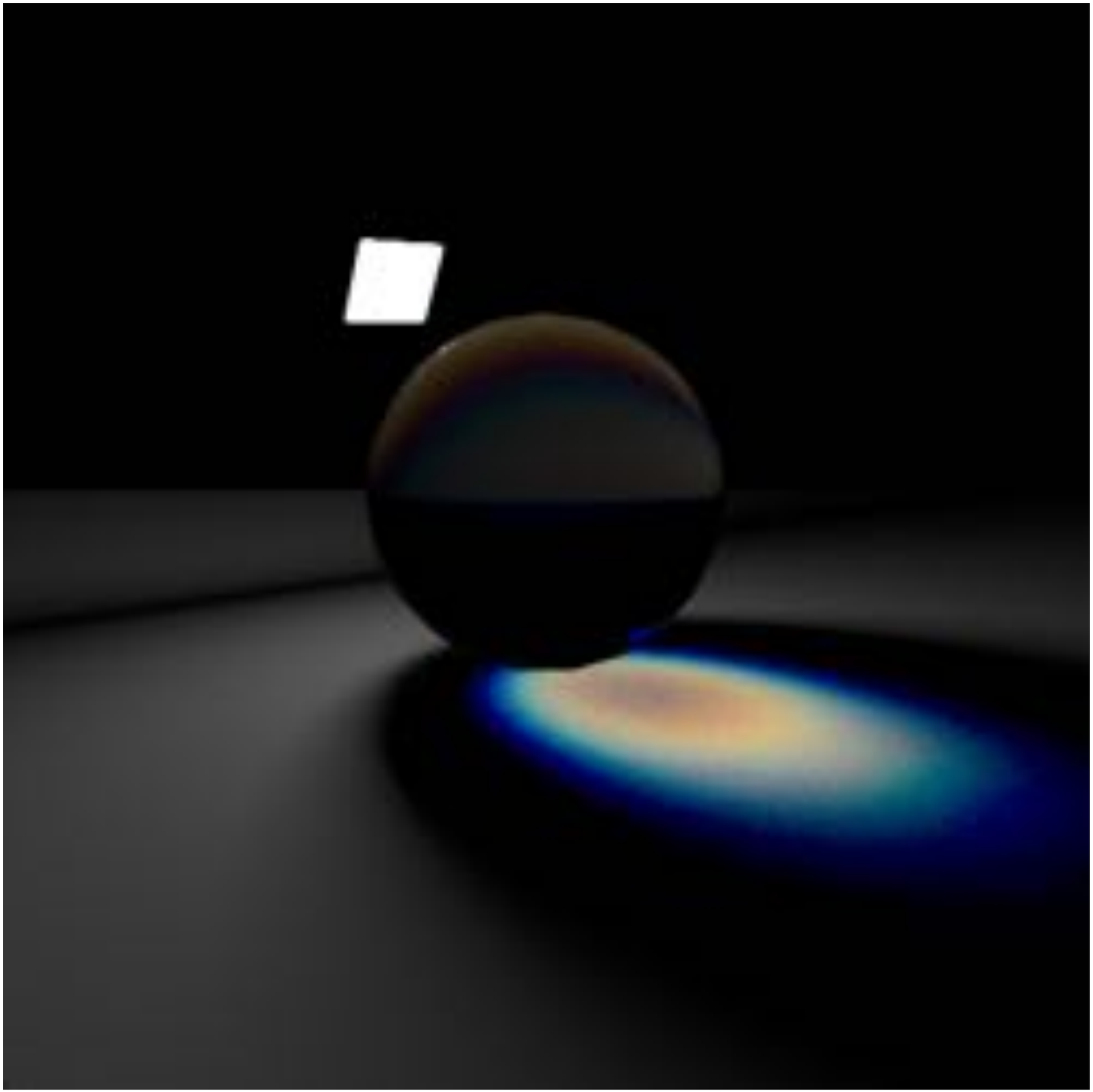
dprince



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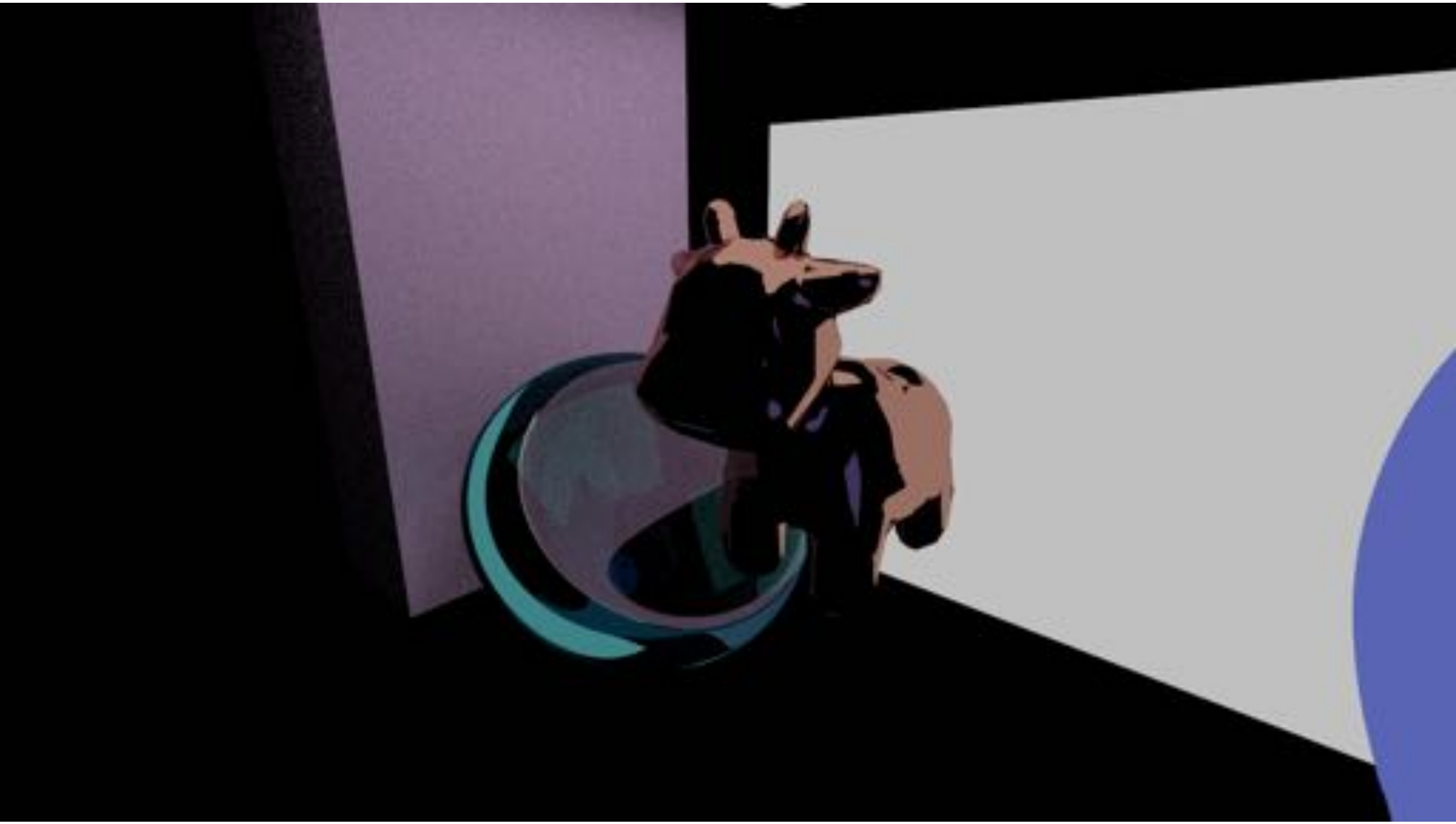

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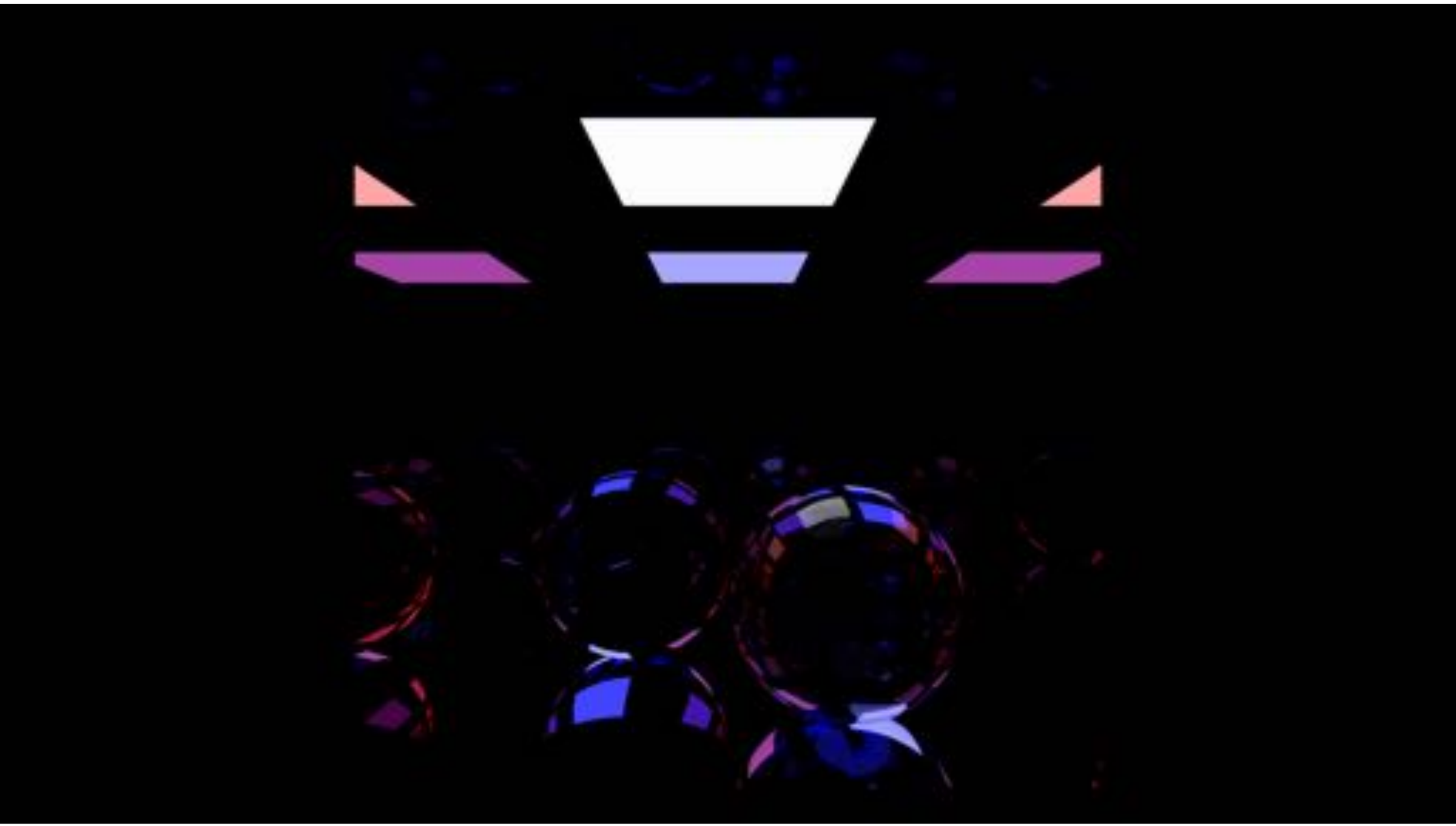

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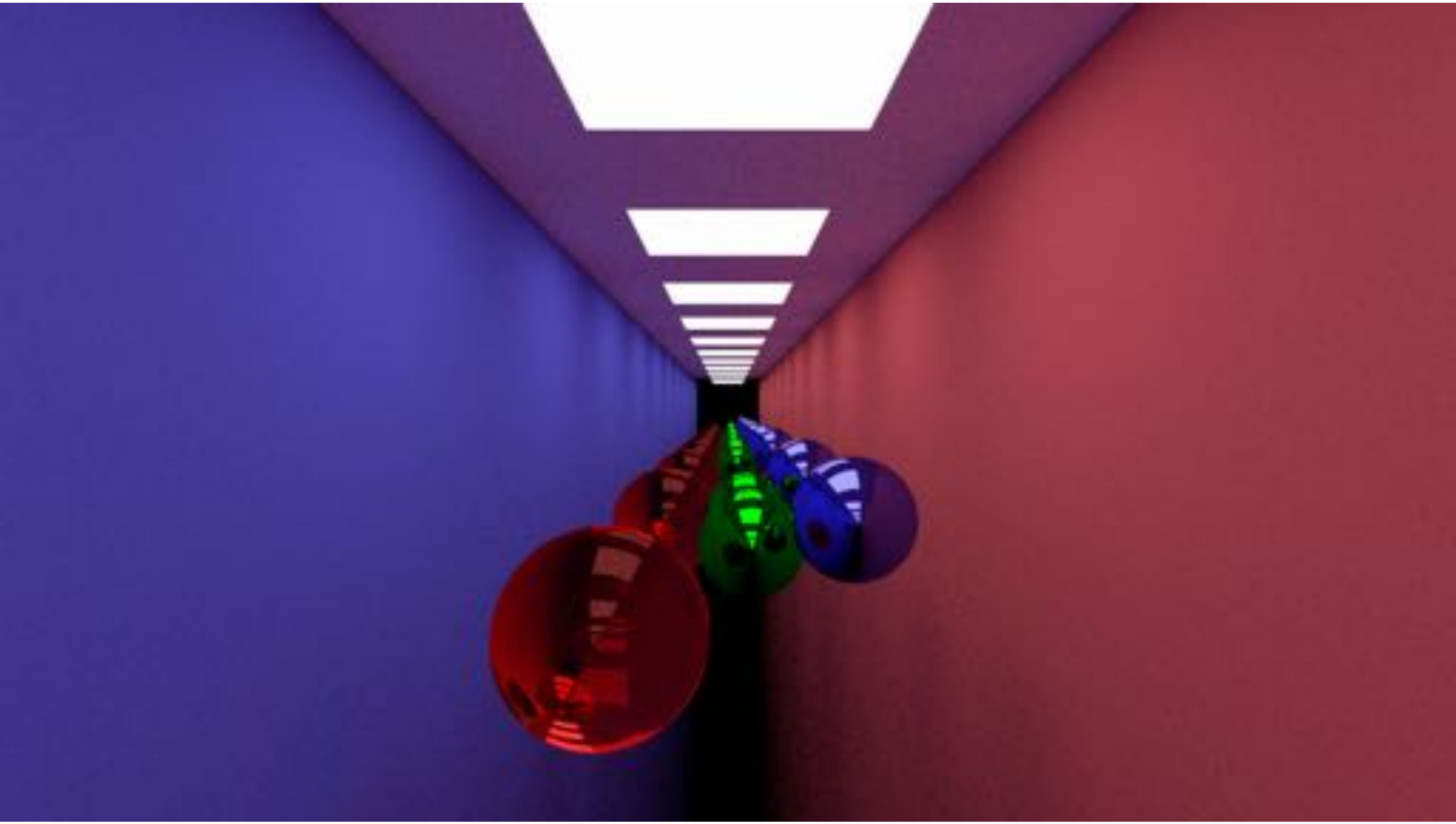

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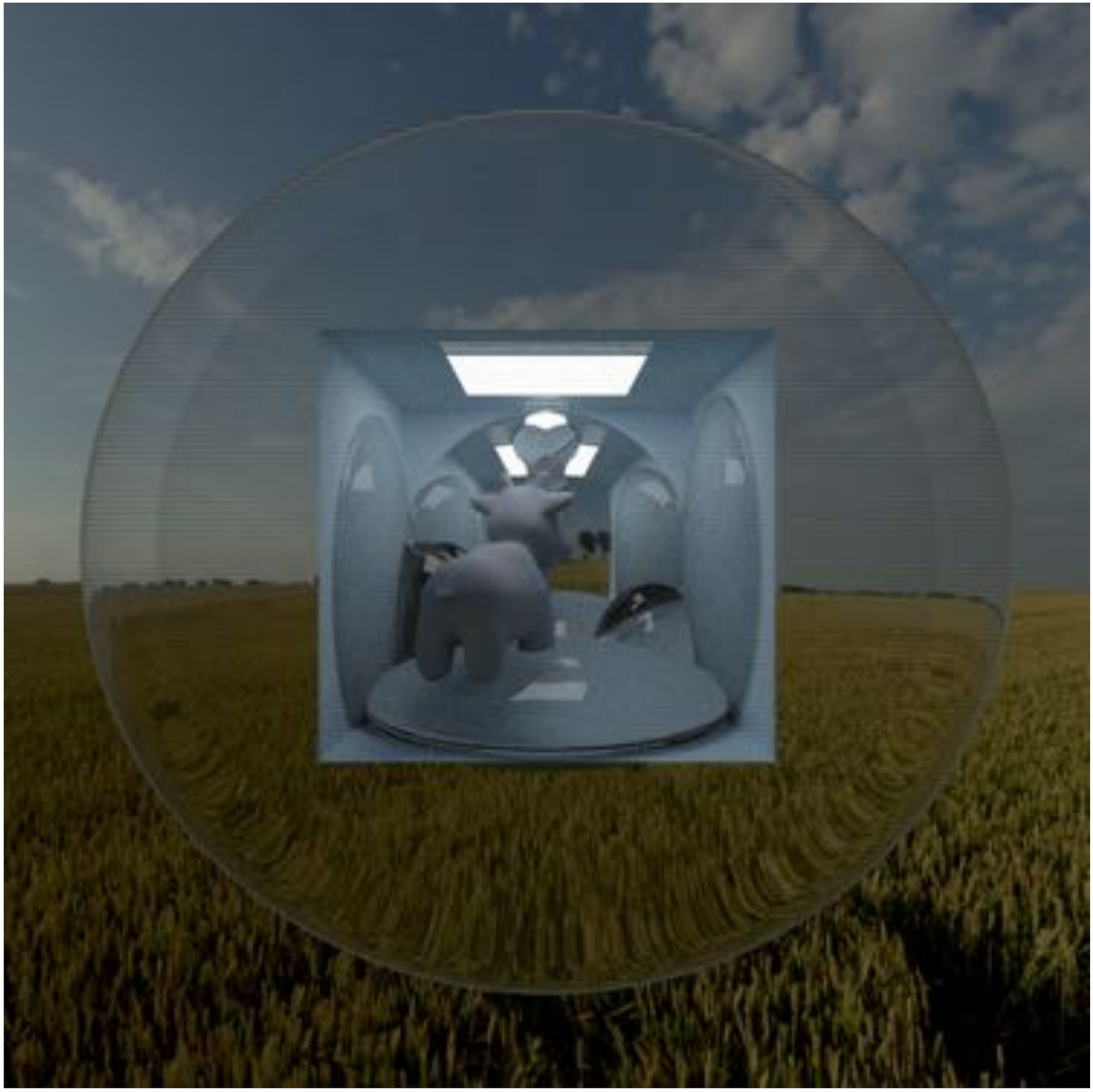

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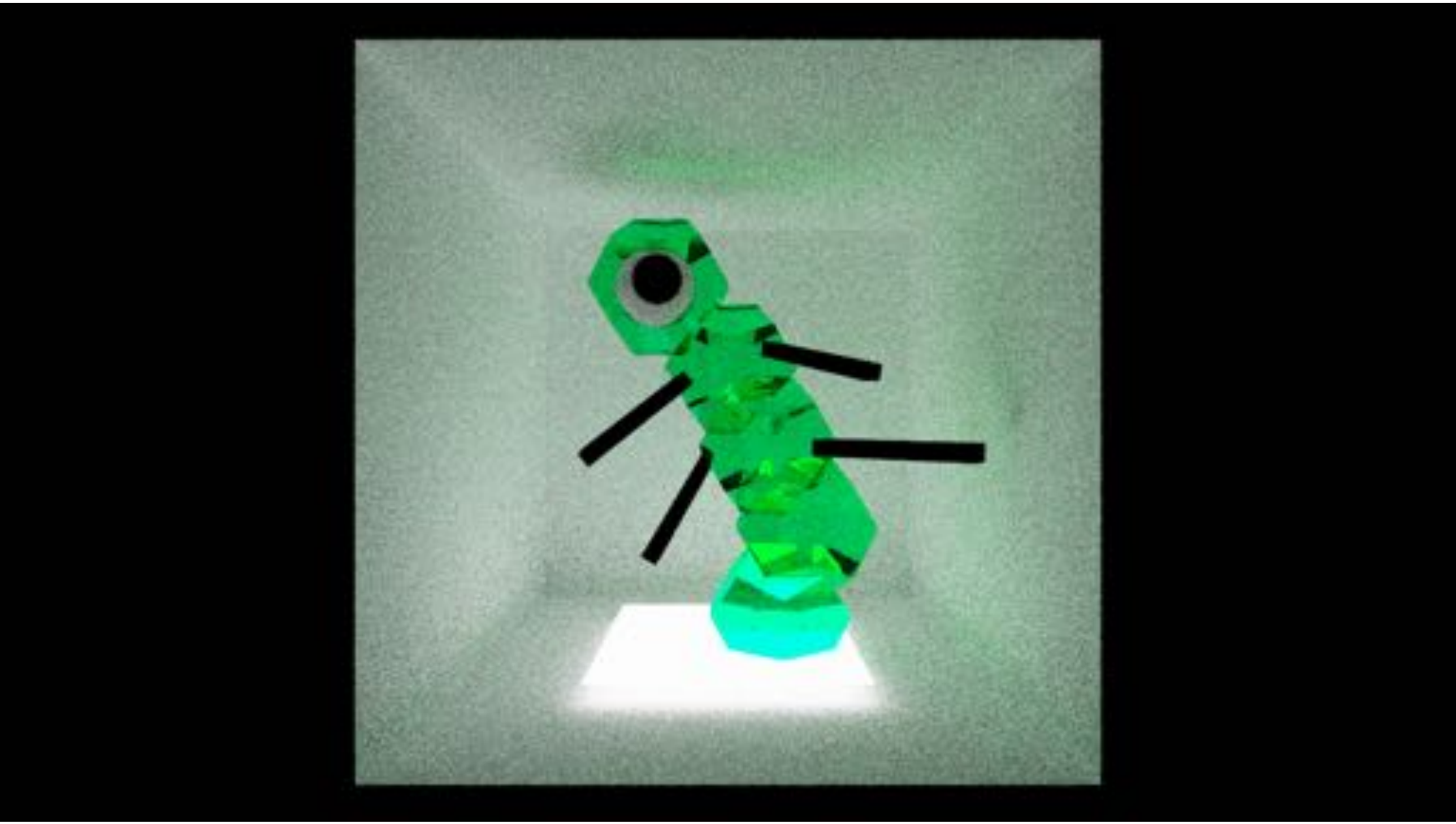

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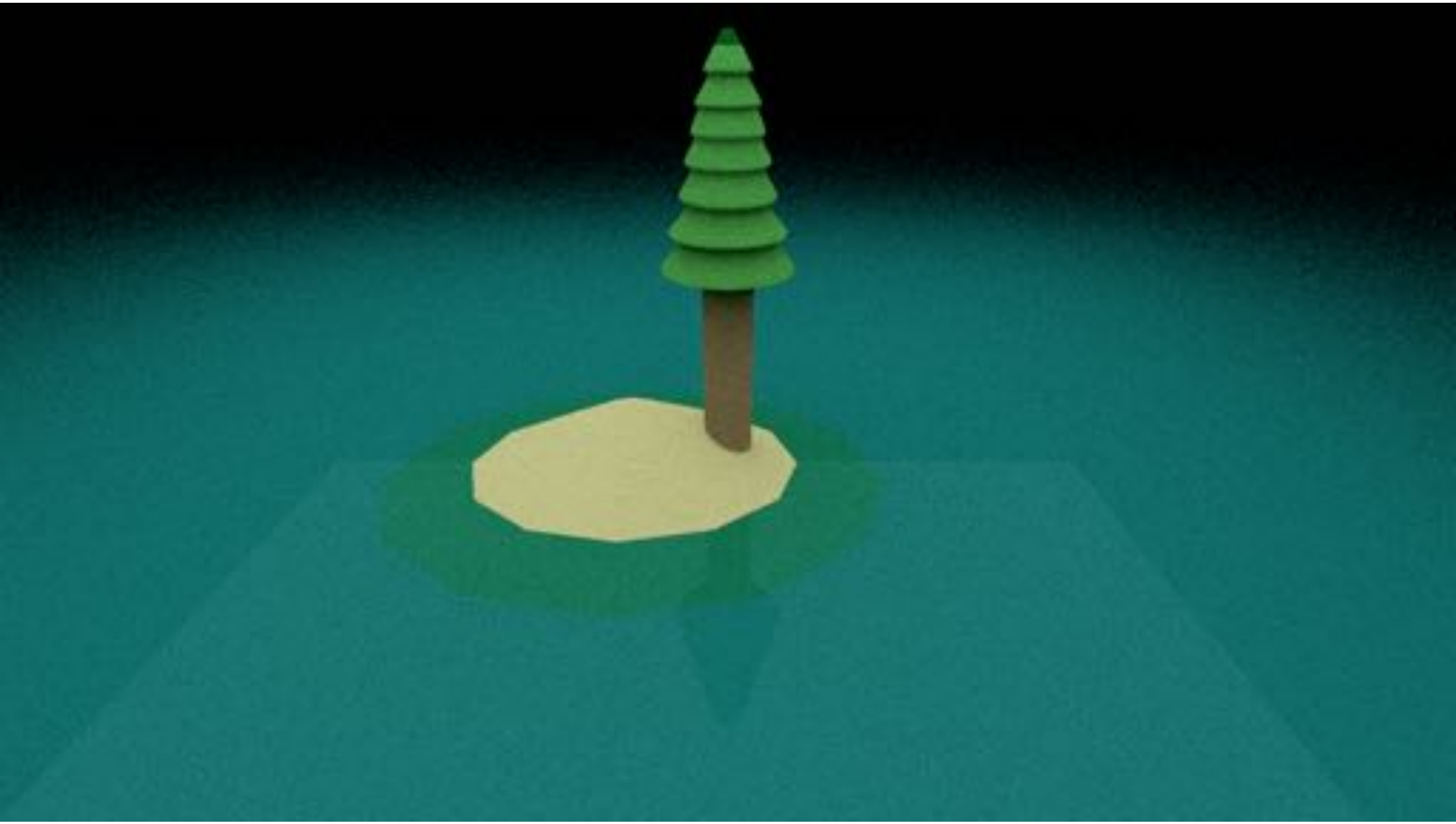

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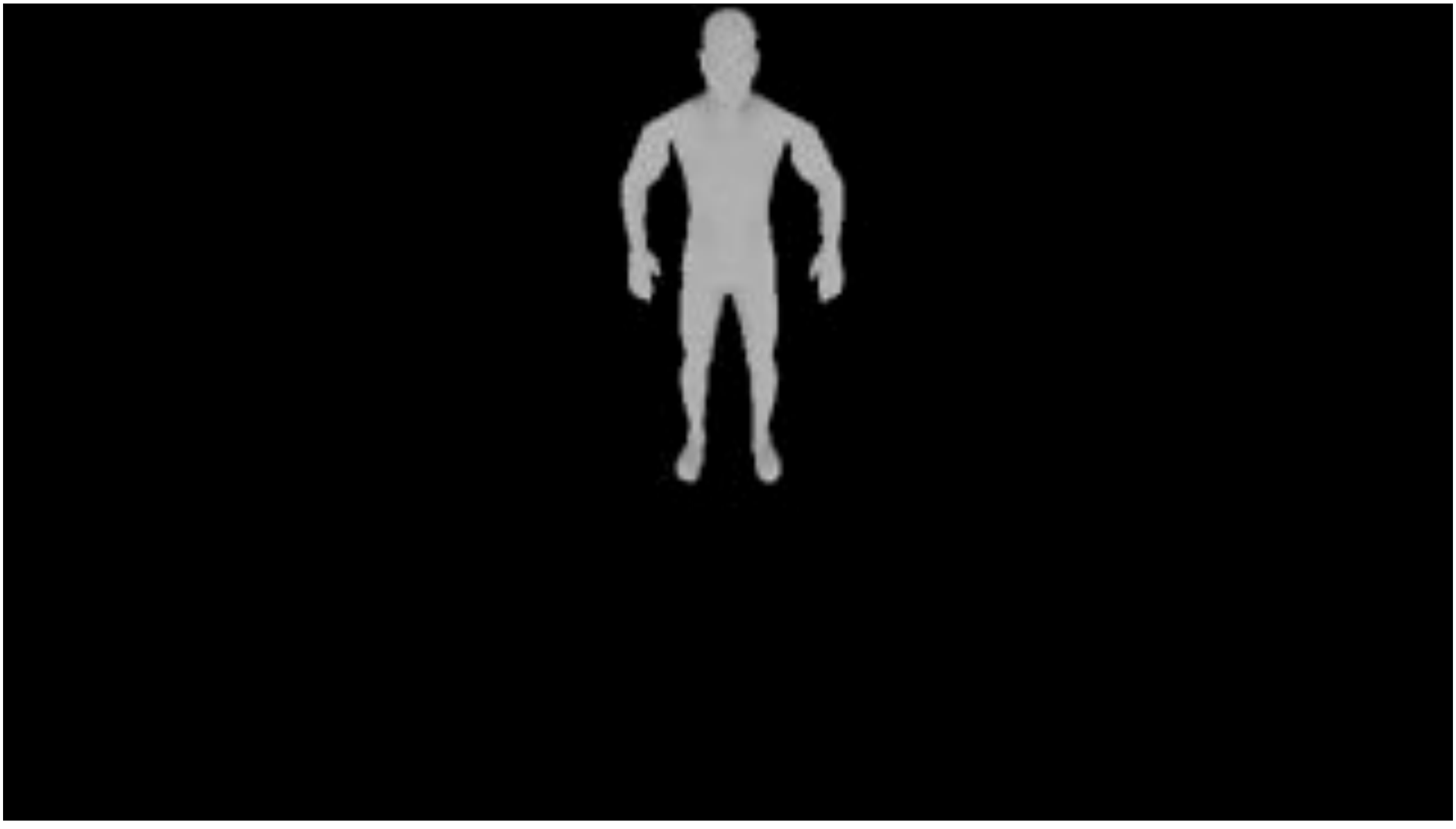

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Thanks for being a great class!

See you at the final! (study hard, but don't stress too much)

Credit: Inside Out (Pixar)