



# **We've Run Out Of Planets**

*Procedural Generation After No Man's Sky*

# **We've Run Out Of Planets**

*Procedural Generation After No Man's Sky*

**Mike Cook**

Falmouth University | Cut Garnet Games

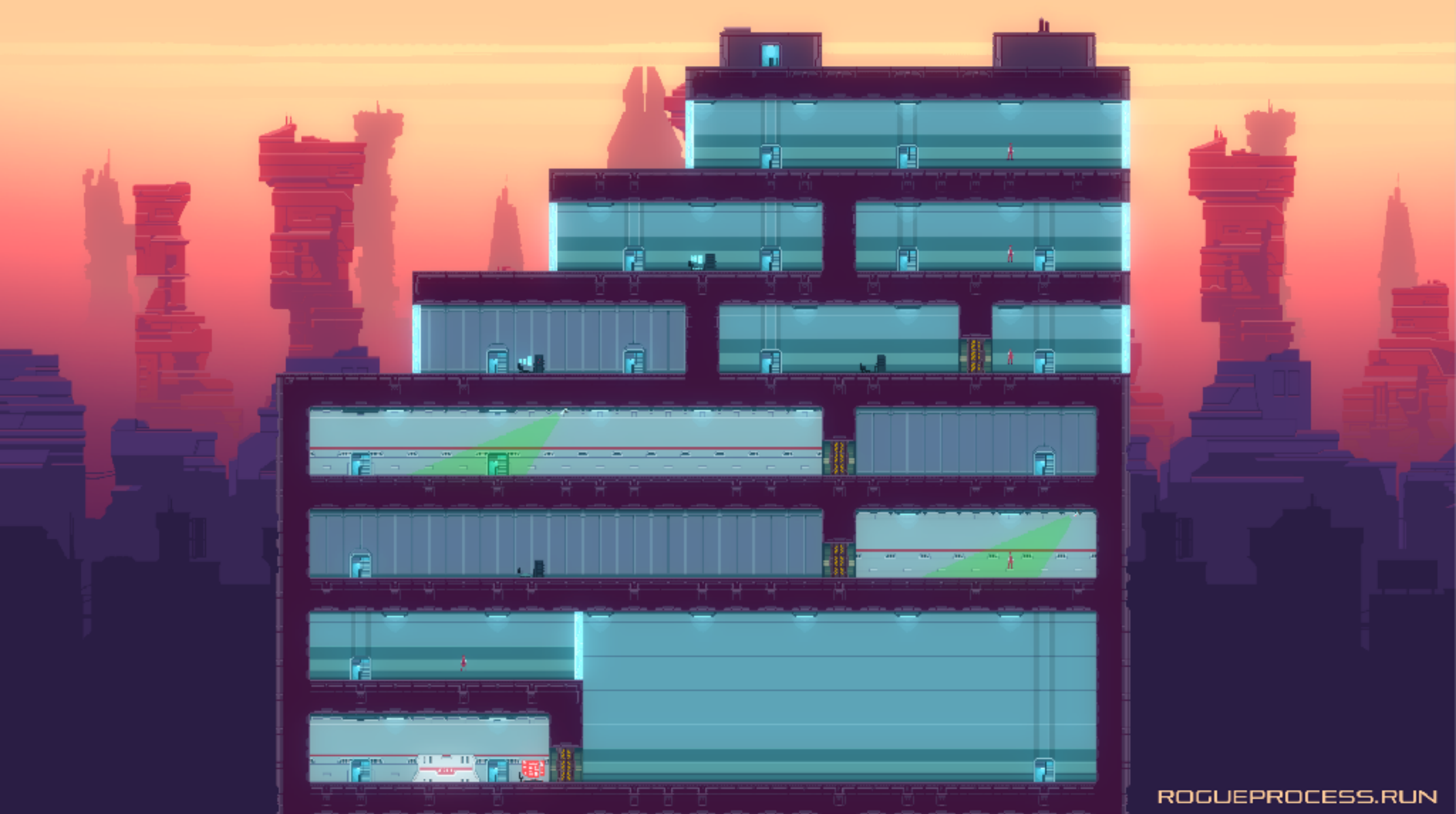
Twitter - @mtrc  
gamesbyangelina.org  
rogueprocess.run





# **ANGELINA**

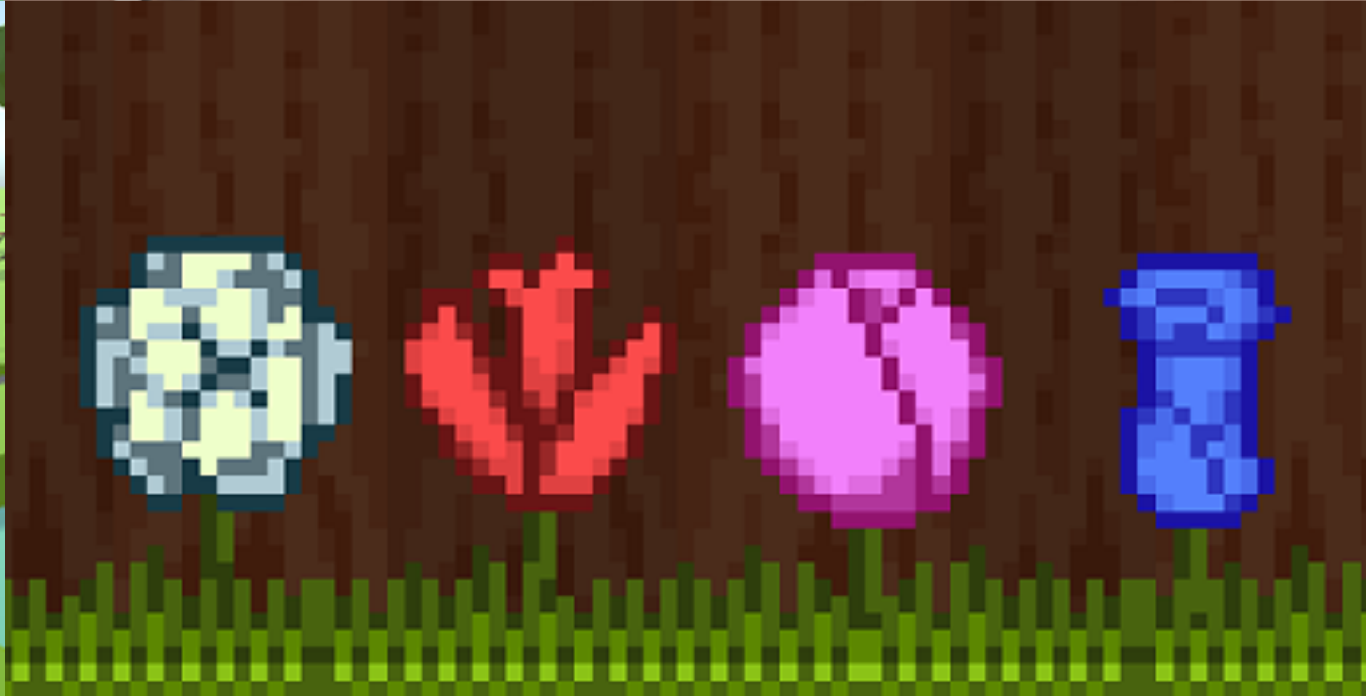
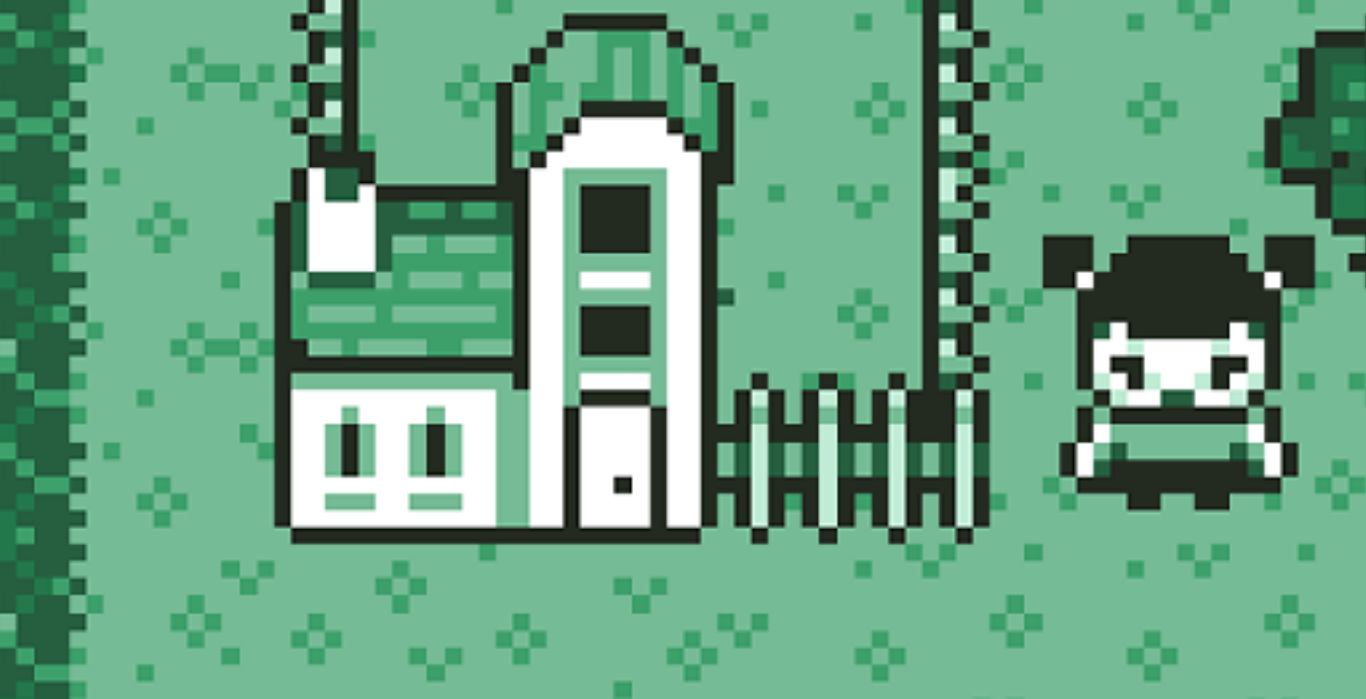
An AI that (tries to) design games



# ROGUE PROCESS

[www.rogueprocess.run](http://www.rogueprocess.run)



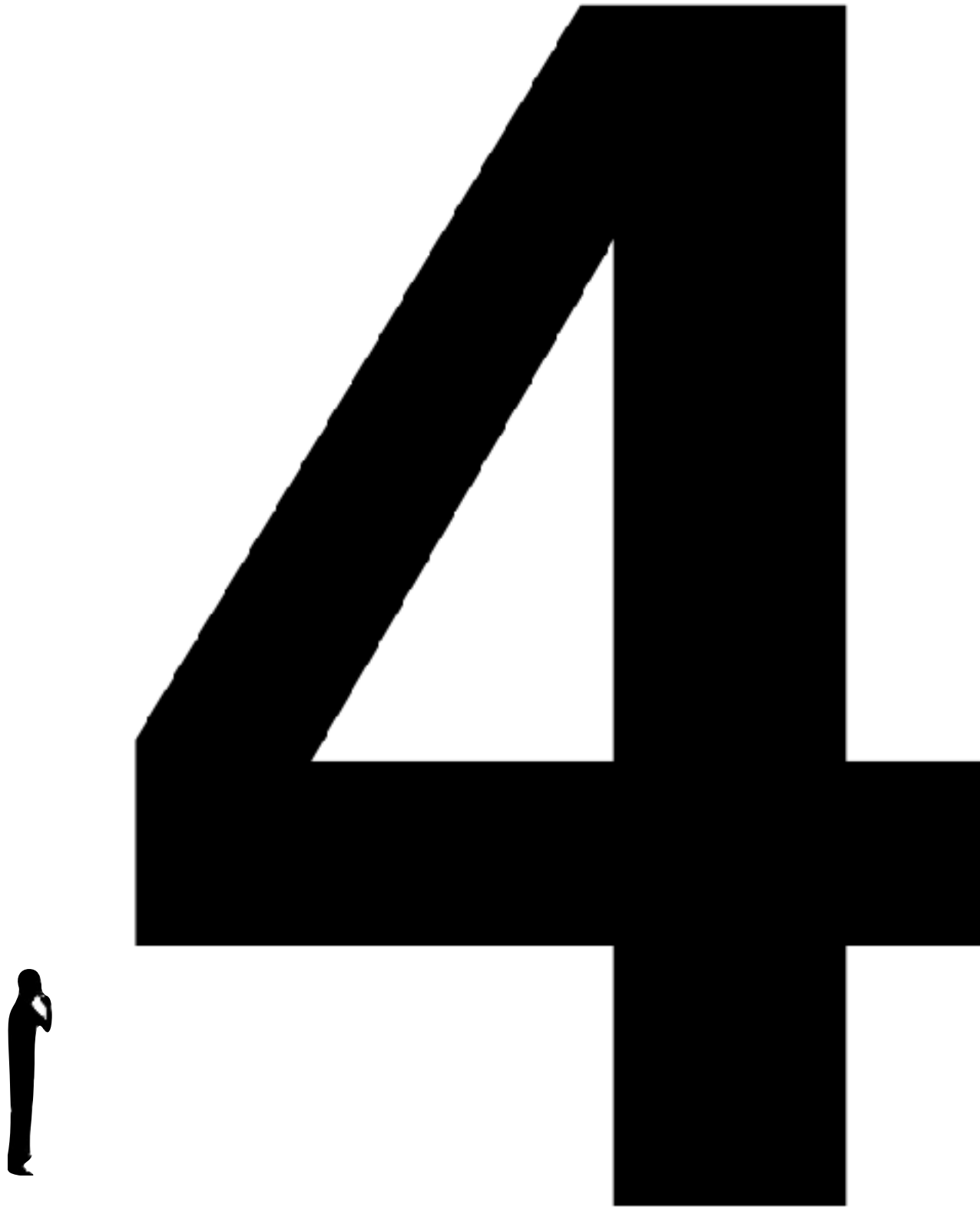


# PROCJAM

*Make Something That Makes Something*

[www.procjam.com](http://www.procjam.com)

This talk is about big numbers...





...and being obsessed with them...

$$\beta_{ij} = \sum_{\mu, \nu} C_{\mu, \nu}^* M_{(\mu, \nu)ij}$$

def 
$$M_{(\mu, \nu)ij} = \int \frac{\partial \psi}{\partial x^i} \frac{\partial \psi}{\partial x^j}$$

need for  $\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \psi^2 dx dy$  to insure  
want  $\int (\psi^x)^2 = 1 = \int (\eta^x)^2$

$$\int \frac{\partial \psi}{\partial x^i} \frac{\partial \psi}{\partial x^j} = 0 = \int \frac{\partial \eta^x}{\partial x^i} \frac{\partial \eta^x}{\partial x^j}$$

$$\psi = \frac{1}{\sqrt{2}} (\cos \psi^r + \eta^r \sqrt{2})$$





...and whether we've seen the last of them







15

# A Brief History Of Silly Numbers

Front View



**Elite: The First One** (1984)

8 Galaxies, 256 Planets each



Front View



**Elite: The First One** (1984)

2048 Planets Total





# **Borderlands** (2009)

17,750,000 Guns

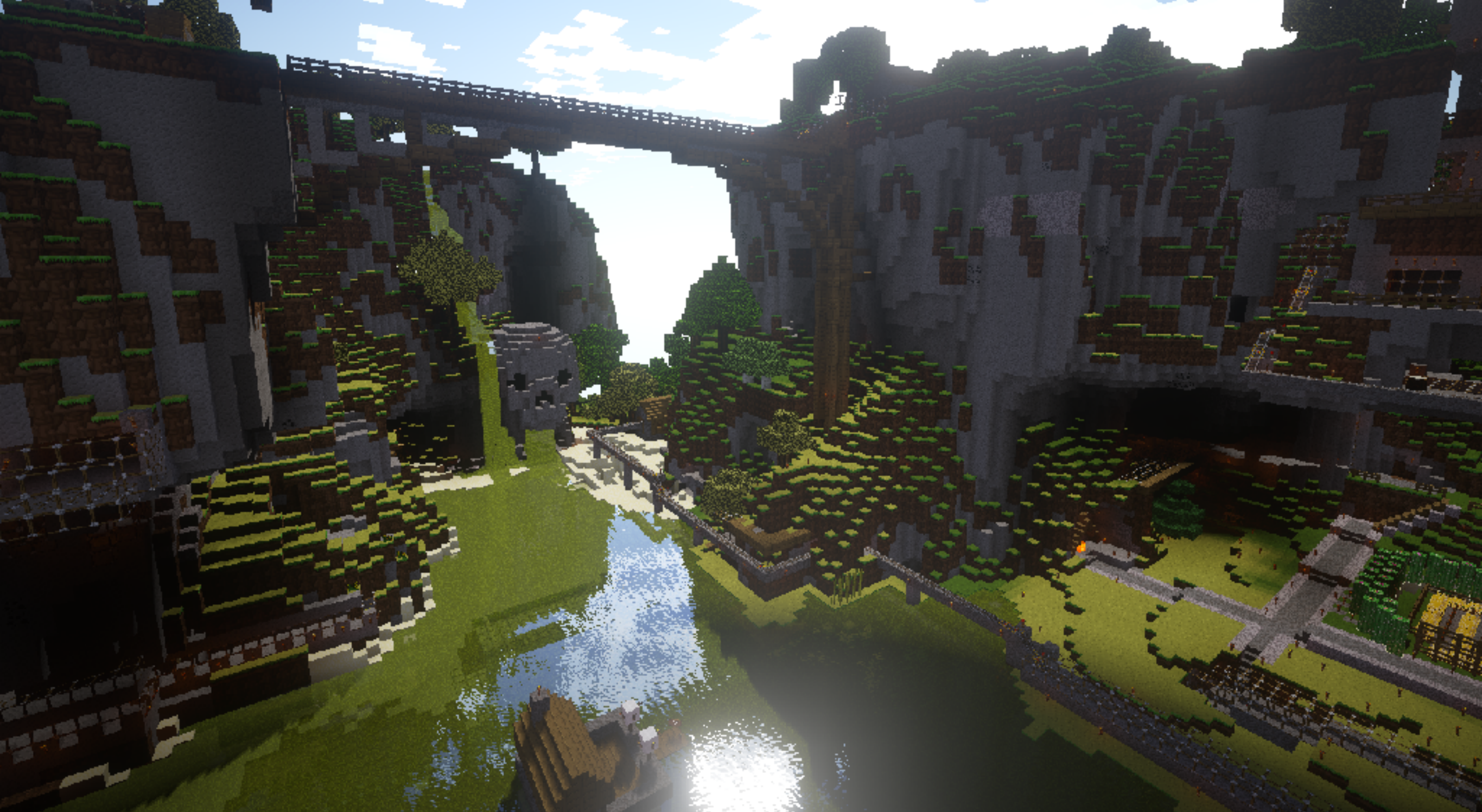




**Minecraft** (2009)

32,000,000 blocks (wide + high)

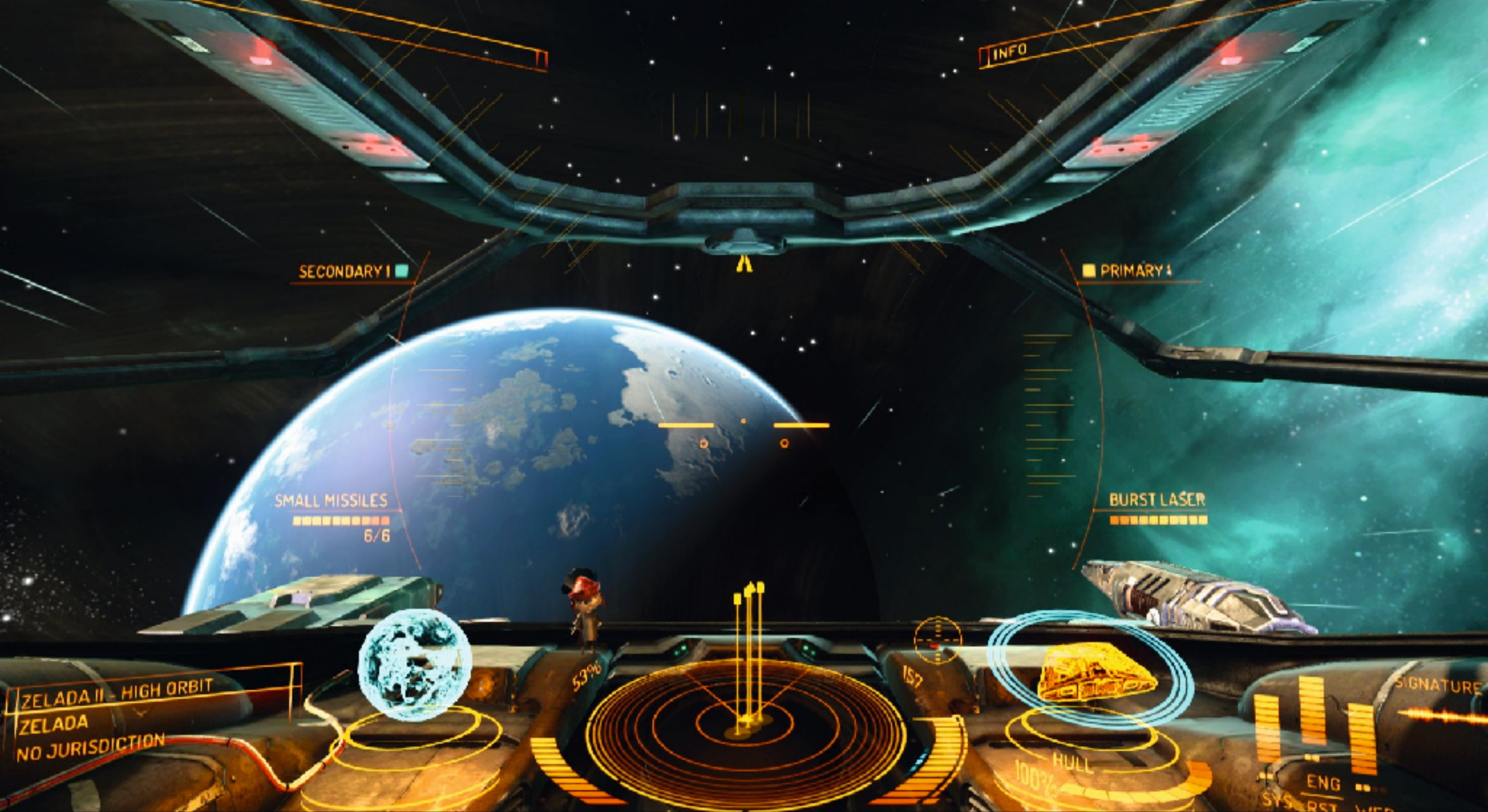




# **Minecraft** (2009)

1,024,000,000,000,000 blocks total

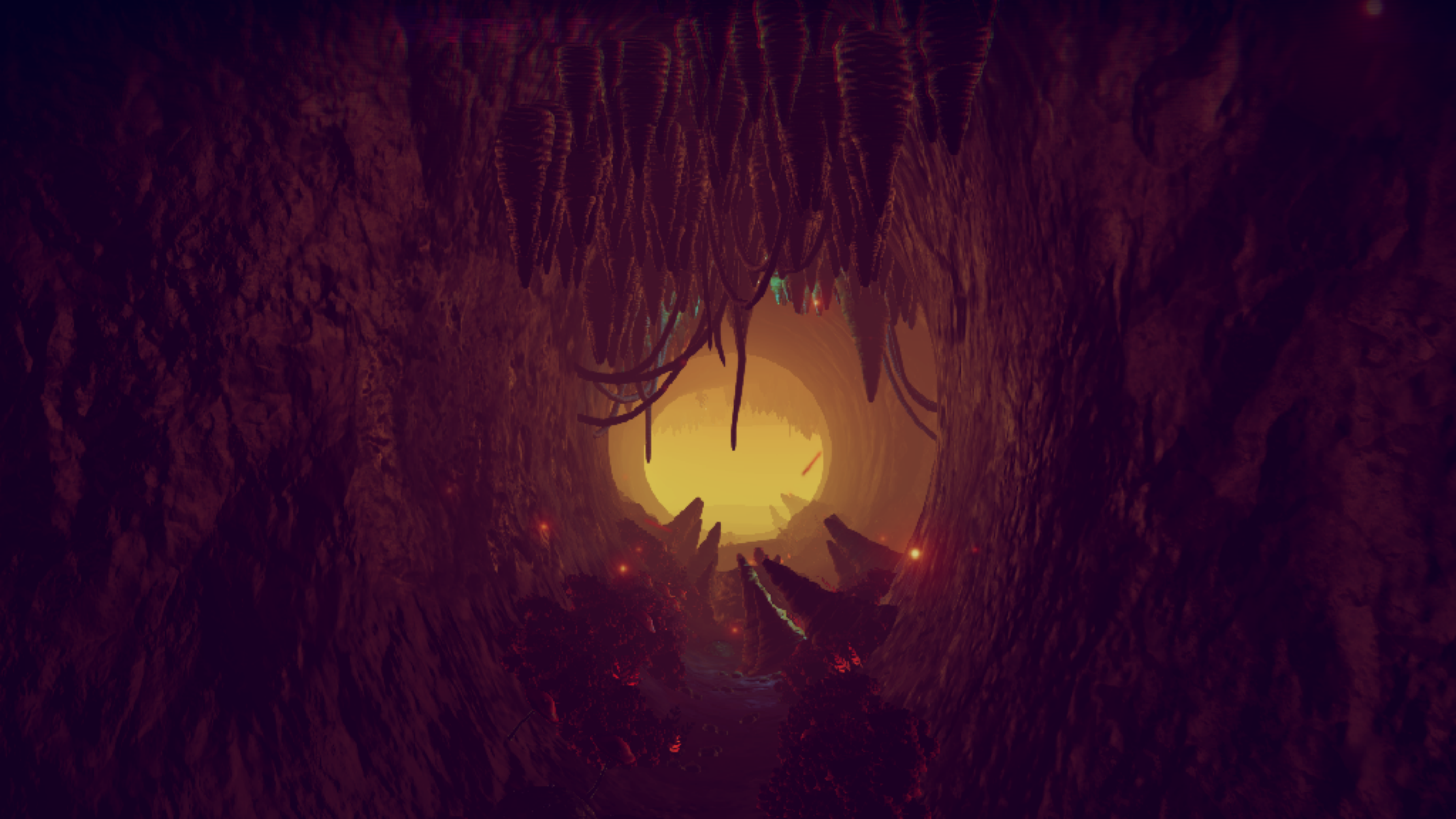




# Elite: The New One (2014)

400,000,000,000 star systems





# **No Man's Sky** (2016)

18,000,000,000,000,000,000+ planets



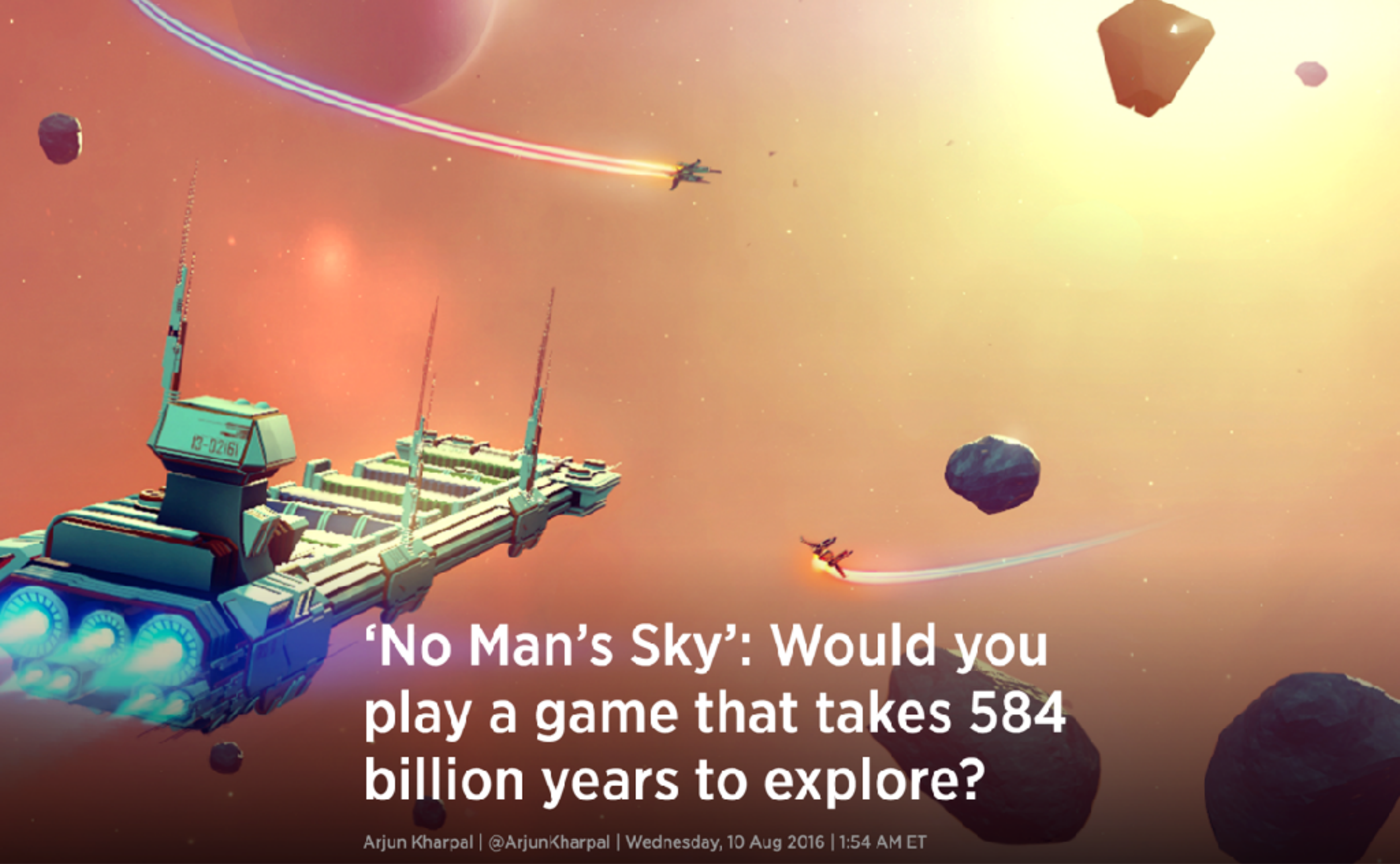
Meanwhile, back in 1984...

# ACORN~~SOFT~~

“282,000,000,000,000 galaxies would rub the player’s nose in **the artificiality of what they were enjoying.**”

*The Guardian, 2003*





**'No Man's Sky': Would you  
play a game that takes 584  
billion years to explore?**

Arjun Kharpal | @ArjunKharpal | Wednesday, 10 Aug 2016 | 1:54 AM ET

Today, we have a different view



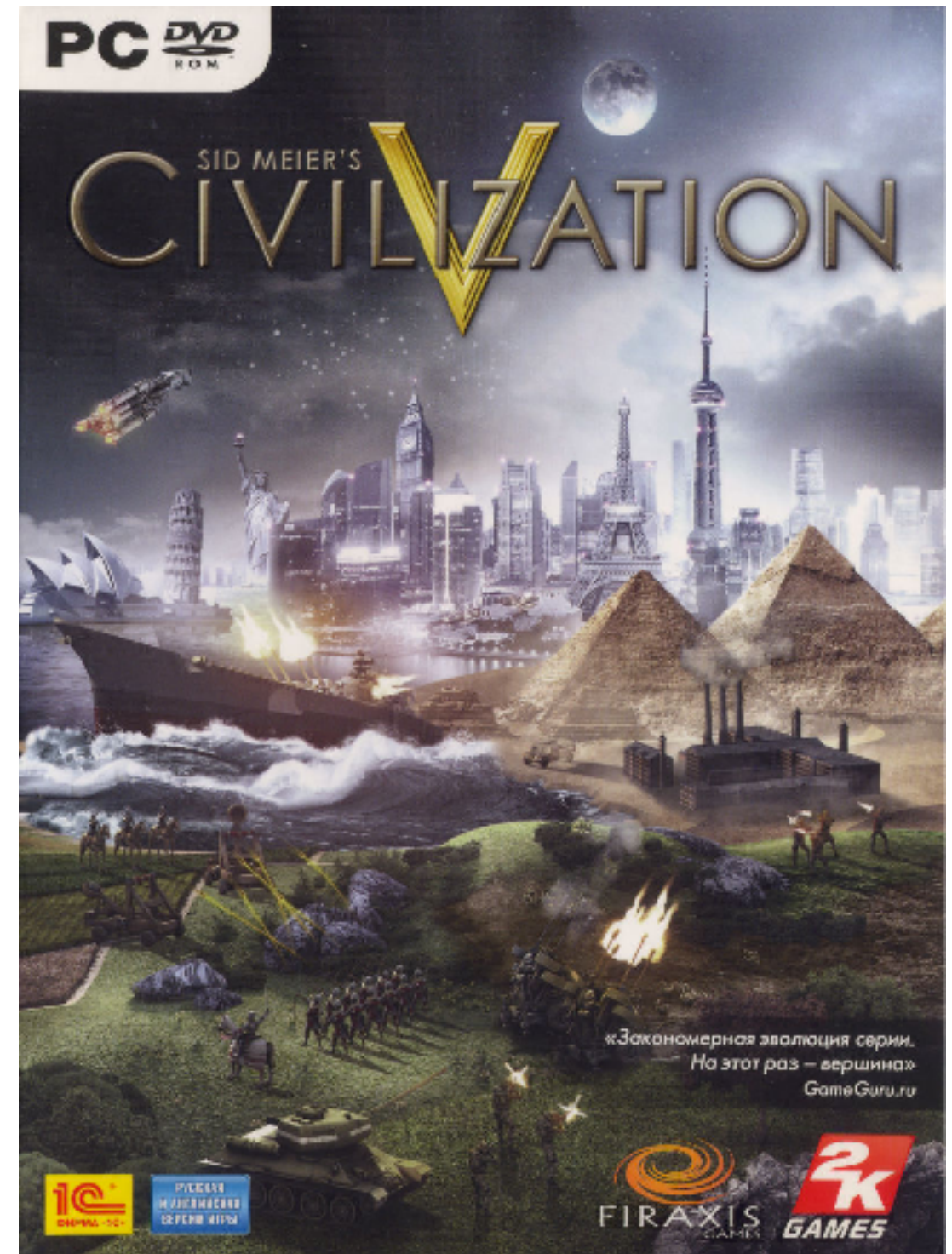


=



$$2^{64} = 18,446,744,073,709,551,616$$





**Which is bigger?**



**MATHS!**



84 tiles wide

52 tiles high



Ocean

Plains

Mountains

Desert

Tundra

Jungle

Forest

Ice

4368 tiles

8 possibilities each

$8 \times 8 \times 8 \times 8 \times 8 \dots$

8 x 8, 4368 times

4368

8



18,446,744,073,709,551,616

Number of planets in  
*No Man's Sky*

497 809 500 634 402 231 771 035 884 762 891 315 480 952  
467 966 071 798 308 173 751 558 130 519 244 157 912 850  
174 901 280 052 780 423 739 273 769 951 626 157 352 672  
771 594 806 187 265 776 432 913 892 437 424 119 556 088  
315 789 531 781 618 641 271 213 523 592 782 395 943 811  
901 209 448 310 370 834 646 652 932 197 181 715 047 258  
206 677 328 446 612 601 563 392 927 060 791 685 574 631  
145 533 438 617 109 241 403 478 917 531 175 090 362 402  
543 599 076 030 574 353 097 614 432 714 852 846 959 030  
613 719 830 545 141 230 850 086 907 051 379 853 142 690  
013 007 237 485 961 098 919 281 708 043 490 497 474 455  
195 225 723 744 672 101 101 219 230 804 851 791 339 846  
664 688 730 153 778 540 086 104 055 489 546 990 970 070  
832 773 400 823 833 750 089 365 093 874 096  
694 955 165 062 649 291 099 251 762 308 987 193 618 050  
067 571 444 177 362 927 285 282 749 270 978 639 530 884  
170 584 144 870 158 993 323 099 909 888 387 548 925 834  
010 000 000 000 501 647 005 001 170 455 504 050 504 017





# The Problem With This (Procedural) Generation



It doesn't tell us how varied things are





It's really hard to imagine or understand



We design games around waste





And players get trained to do the same





Big can still be really cool





But we should try branching out!





What would it take to make you not push?





# 1. Playable Generation





# Tombs of Tomeria

Control the world generator settings to reshape the level





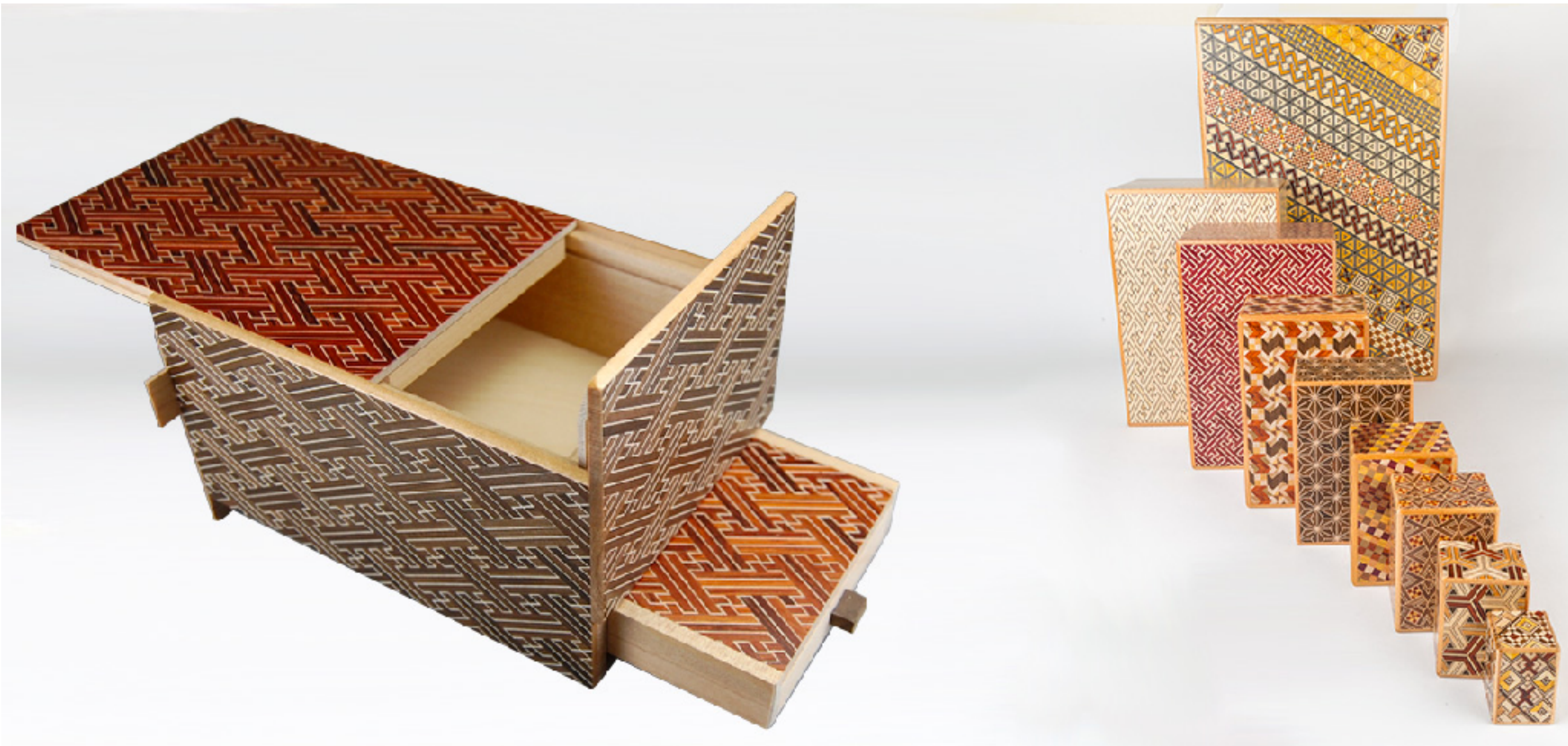
# Elle's System

Write the rules that generate the level you need



## **2. Detailed Generation**





# Fine Details

Using PCG for complexity, not volume





# **Neverending Content**

One piece of content, never finished



# FIVE DWARVES ARE ALIVE, GATHERED IN THE DINING HALL

One brewer, huddled  
in the corner crying.

One jeweller, building a wall to block off the sleeping  
quarters. It is the only way to keep the beast away from the  
survivors. He walls them in and himself out. Does he think  
he is saving them or killing them? We will never know.

A carpenter, a cheese-maker and a miller. Walled into  
the bedroom wing of the fortress, cut off completely; from  
the stockpiles, from the surface, from everything.



## Dwarf Fortress

How long will people wait for something special?





### **3. Communal Generation**





# Everything Or Nothing

Content is usually shared with everyone, or no-one





# Community-Scale PCG

There are many like it, but this one is *ours*.





# Community-Scale PCG

Make generated things *matter* to people.





# **The Future Is Out There**

And it's not just a bigger number





**[www.exag.org](http://www.exag.org)**

Cutting edge research ideas!



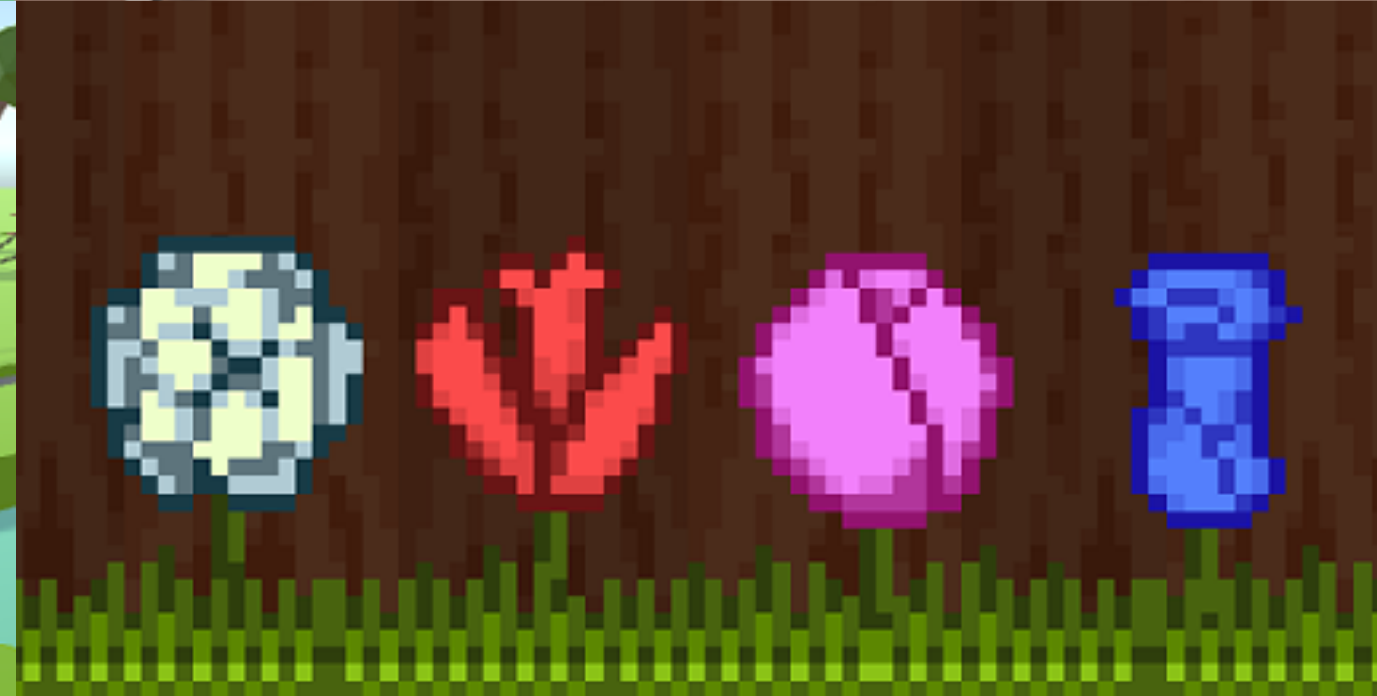
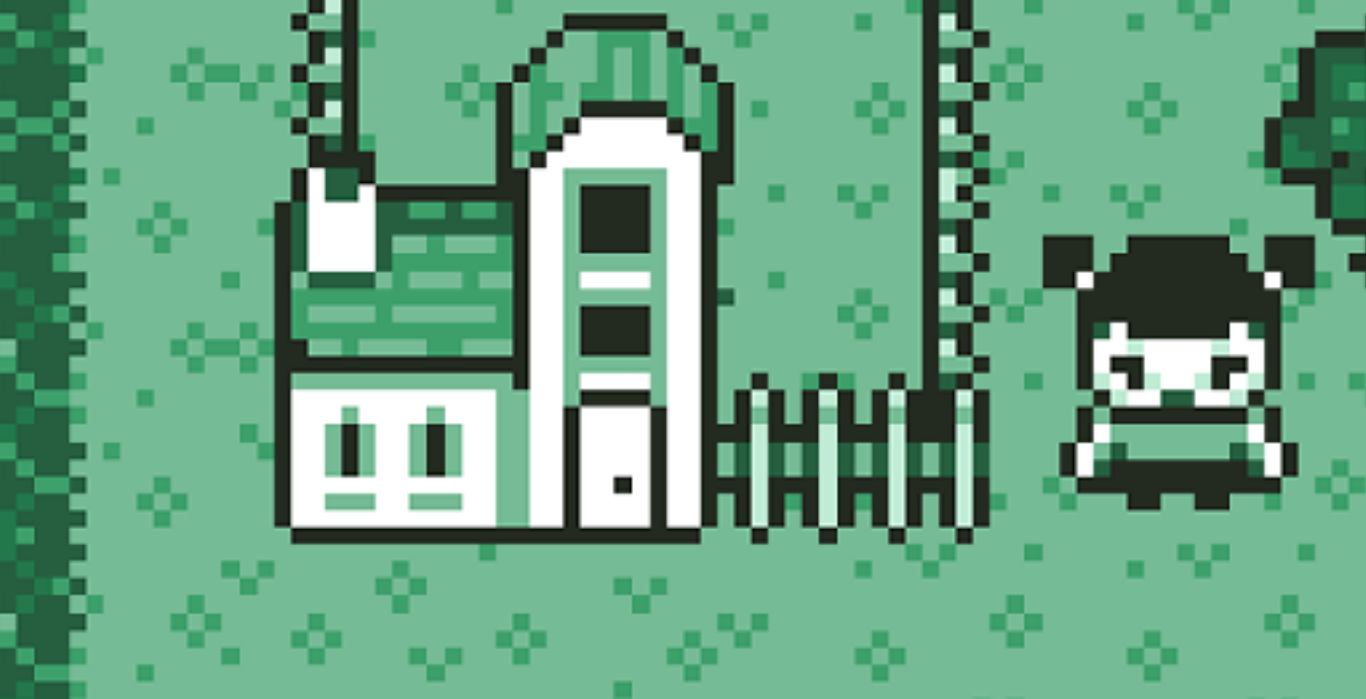


# **PROCJAM Talks**

Hear talks from experts and experimenters!

*Live on YouTube - 21st October - [procjam.com](http://procjam.com)*



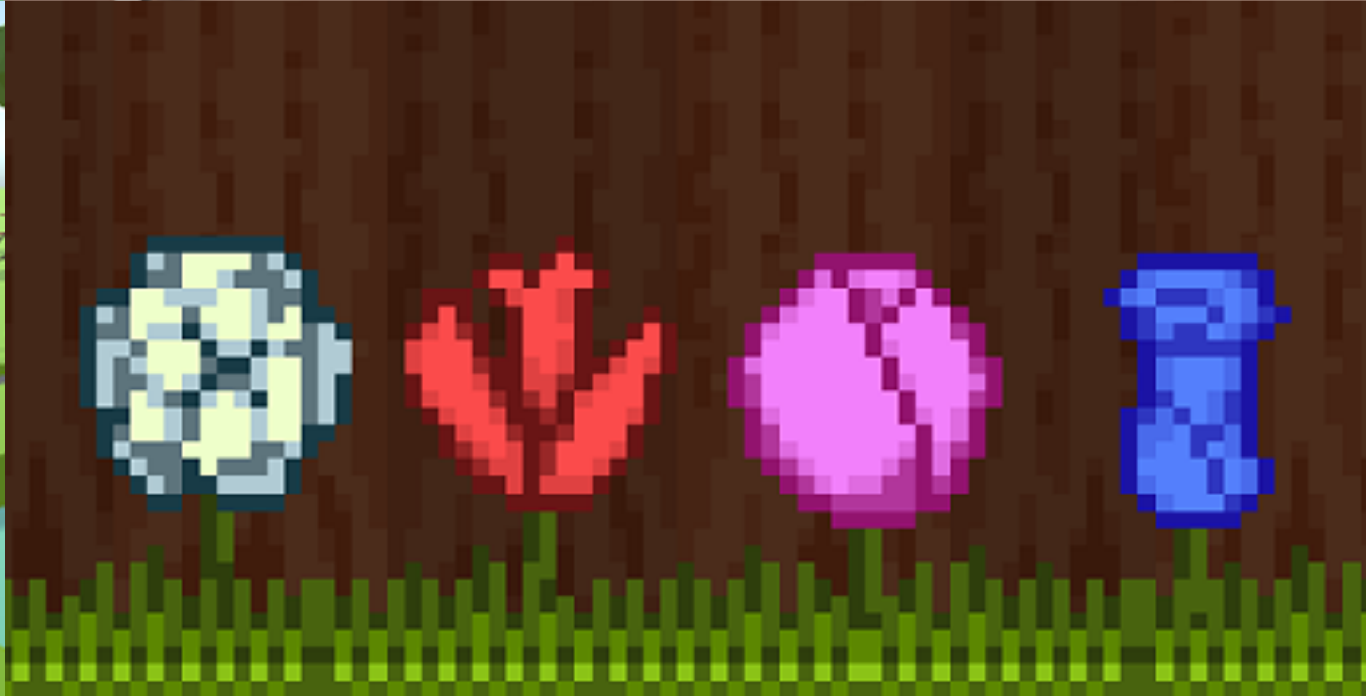
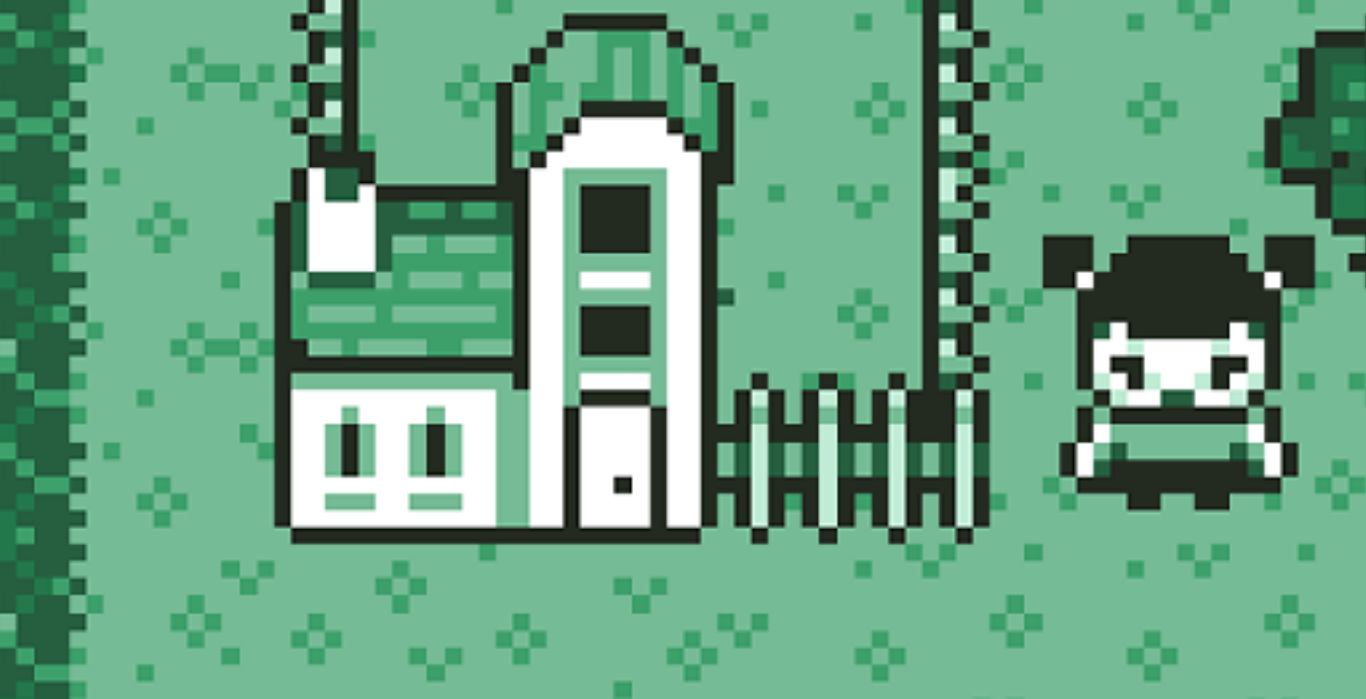


# PROCJAM

Free art + code examples to get started!

*Jam runs November 5th - 13th (relaxed)*





**Thanks!**

@mtrc

*rogueprocess.run*

*procjam.com*