

Perfect, Immortal Machines

*Continuous Creativity and the Future of
Automated Game Design*

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Part I

All Futures

Computational Creativity

Generative Software

*“Exhibit behaviours that unbiased
observers would deem to be creative”*

— Colton & Wiggins, 2012

Computational Creativity



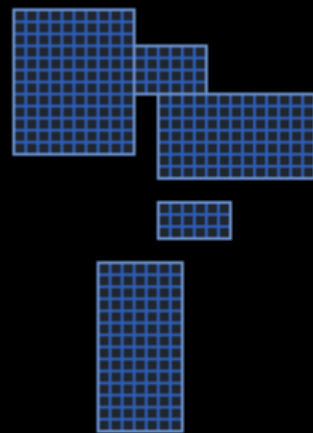


Generative Software

“There are no good quotes about procedural generation.”

— Me, this week, making these slides

Can a computer
automatically design
games?



Procedural Generation



ABOUT THIS GAME

Help Madeline survive her inner demons on her journey to the top of Celeste Mountain, in this super-tight, **hand-crafted** platformer from the creators of multiplayer classic TowerFall.



Procedural Generation

What would it take to
generate games?

What is game design?

It's About Rules

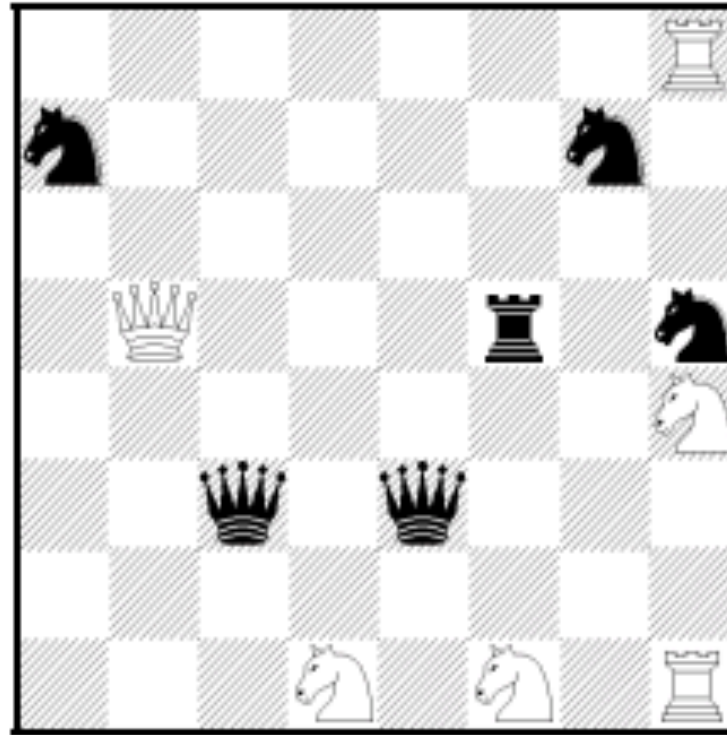


Figure 2: Example piece movements.

```
MOVEMENT
  HOP BEFORE [X >= 0]
    OVER [X = 2]
    AFTER [X <= 2]
  HOP_OVER [opponent any_piece]
  (1,2) SYMMETRY {side}
END MOVEMENT
```

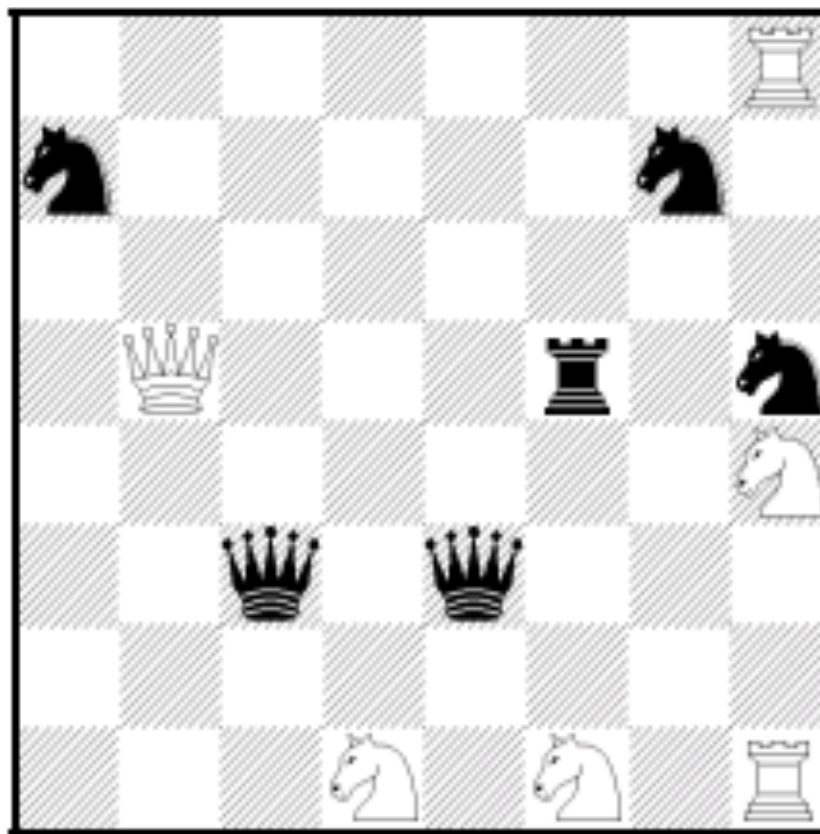


Figure 2: Example piece movements.

```

MOVEMENT
  HOP BEFORE [X >= 0]
    OVER [X = 2]
    AFTER [X <= 2]
  HOP_OVER [opponent any_piece]
  (1,2) SYMMETRY {side}
END MOVEMENT

```

METAGAME



Ludi

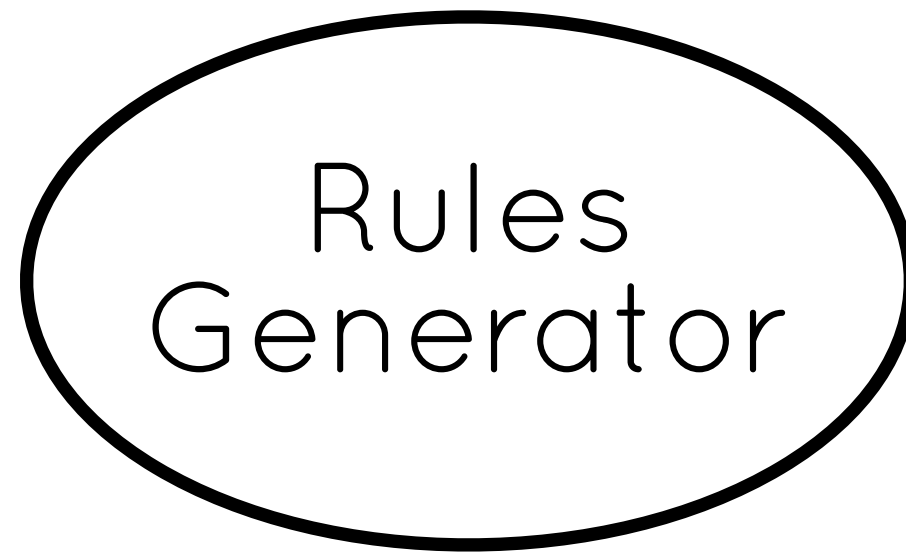

```

(game Teiglith
  (players White Black)
  (board (tiling square) (size 7 7))
  (pieces
    (Stone All
      (moves
        (move
          (pre
            (and
              (> (group-size to) (phase to))
              (connected)
            )
          )
        )
        (action (pop) (push))
      )
    )
  )
  )
  )
  (start (place (Stone White) home))
  (end (All win (no-move)))
)

```

Automated Game Design

1st Generation



Static Game
Context

Automated Game Design

1st Generation

*“Automated game design is
rule generation”*



AI has a long history with games-as-rules



But games go beyond rules



But games go beyond rules

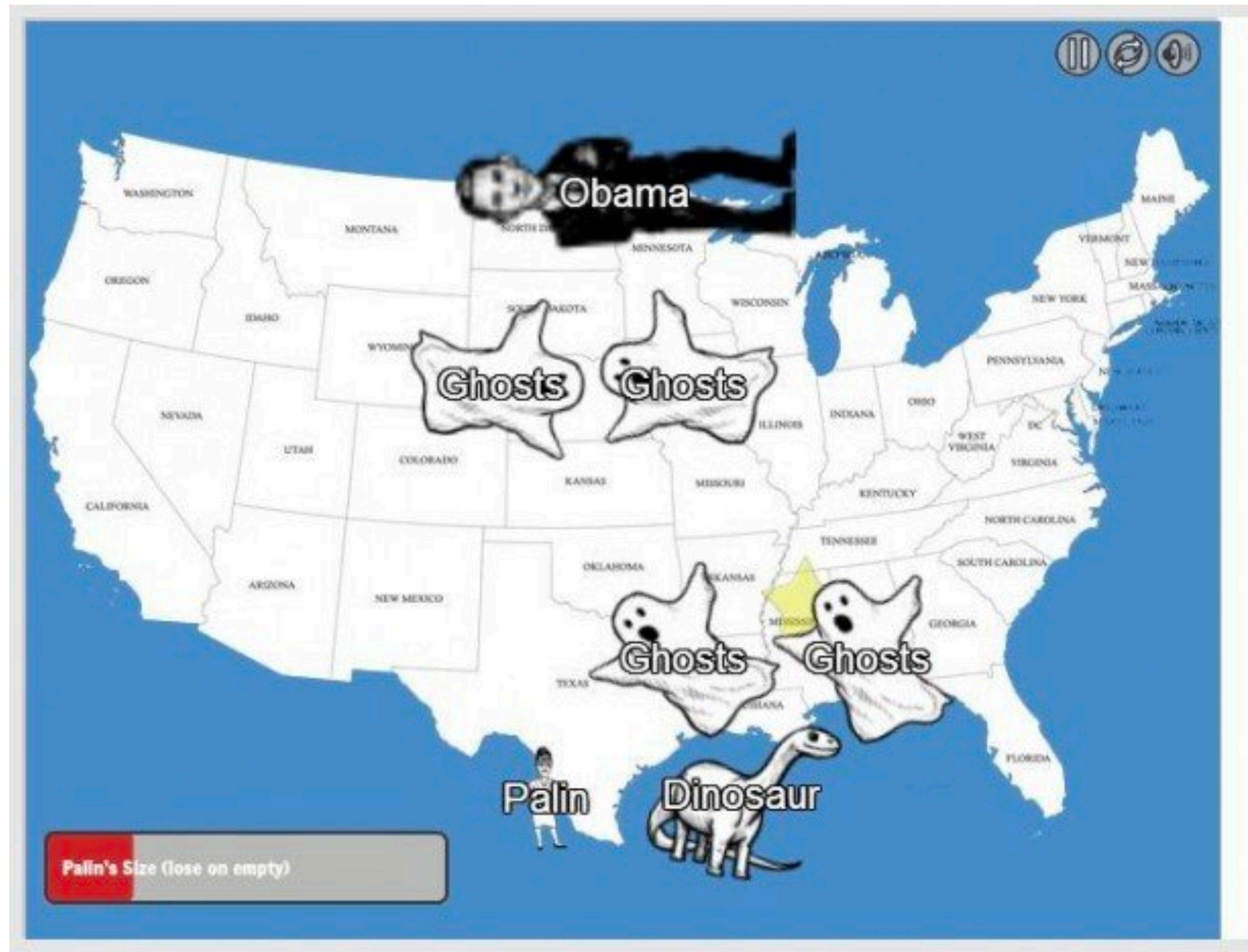


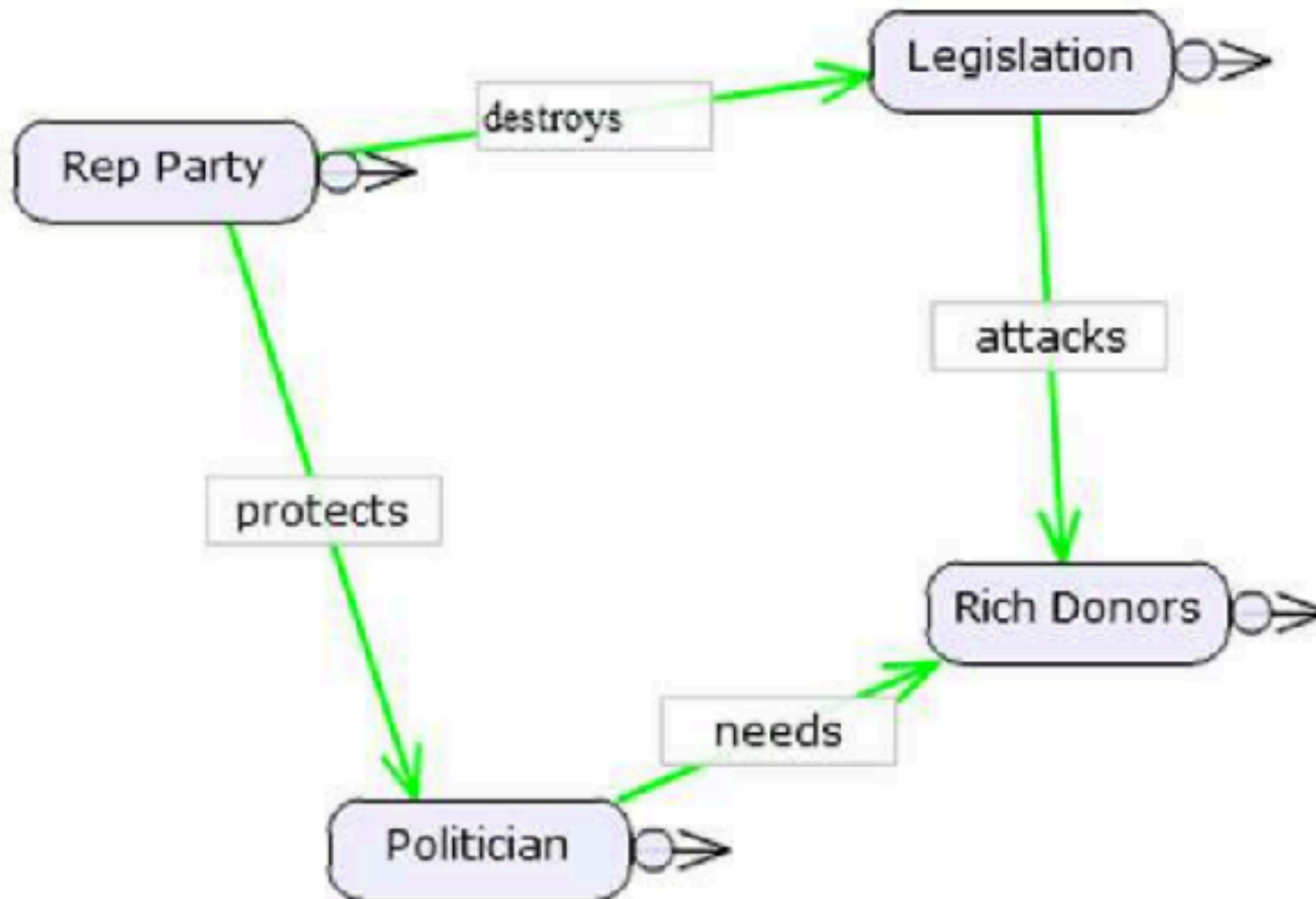
But games go beyond rules

What is game design?

Take 2

It's About Context





Create Story Diagram step one

Follow the guidelines to translate the news article into a diagram of nouns and verbs.

Gameplay is automatically generated from your map when you click to continue.

NOUNS:

Add: Click anywhere

Move: Click and drag the noun

Retype: Click on the noun

Delete: Drag bubble to trash

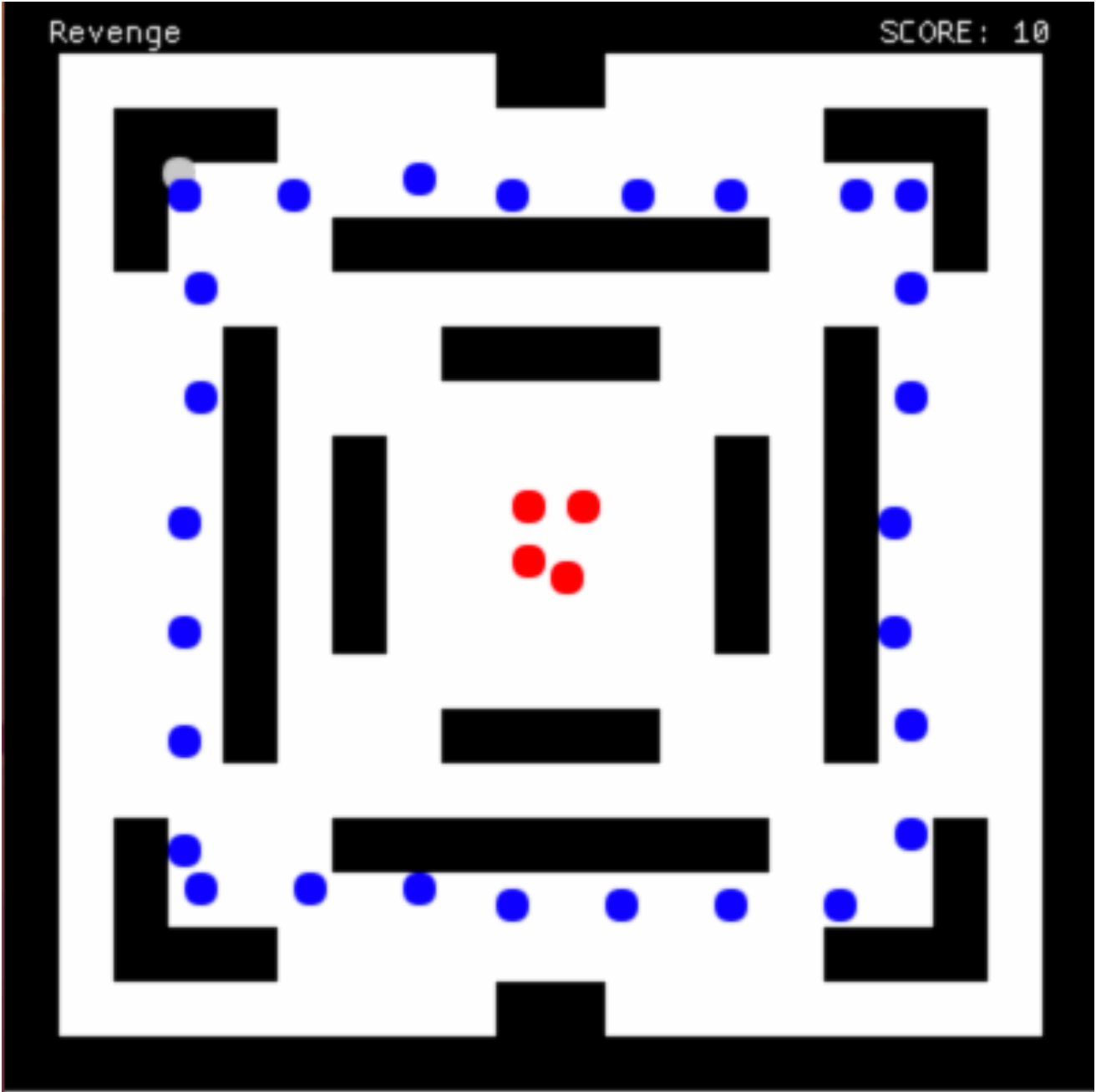
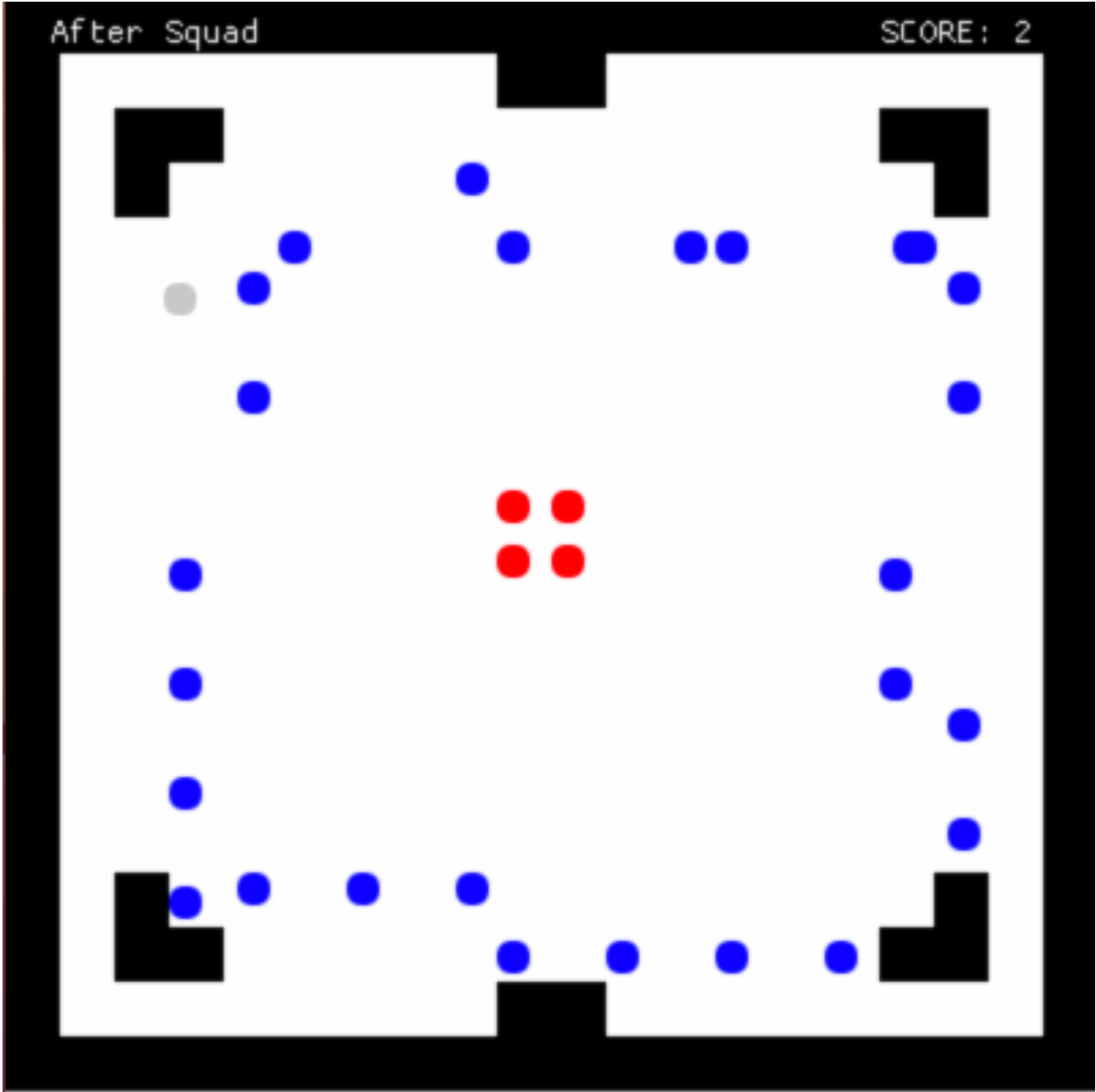
VERBS:

Add: Drag one noun onto another

Delete: Drag arrow to trash

[Preview Your Game >](#)

Game-O-Matic



ANGELINA

The Conservation Of Emily

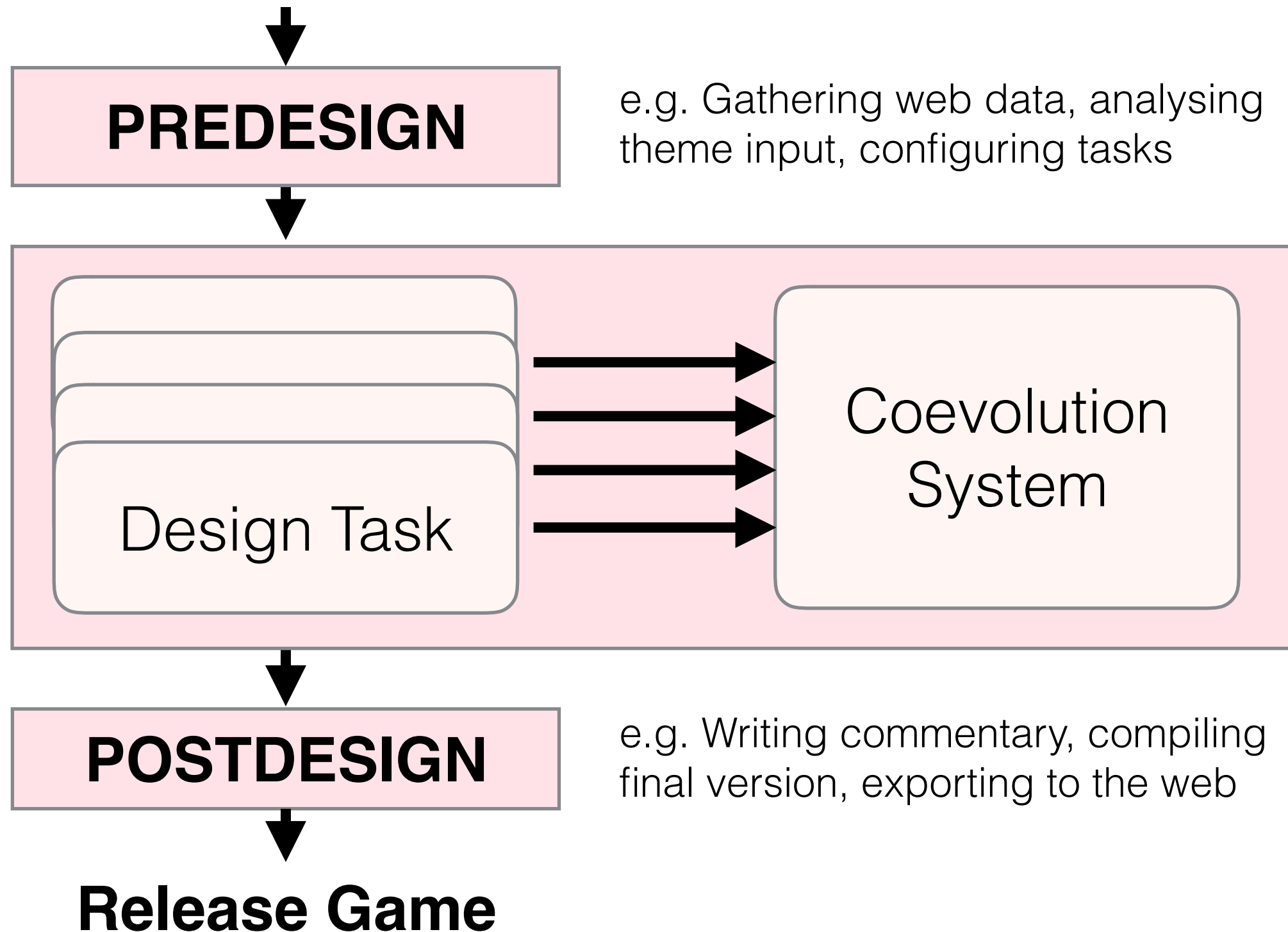
Press Space To Begin





ANGELINA

ANGELINA



Ruleset Design

Evolved sets of mechanics from a corpus of well-known rules

Item Design

Chose and tuned parameters for items to suit specific level goals

Level Design

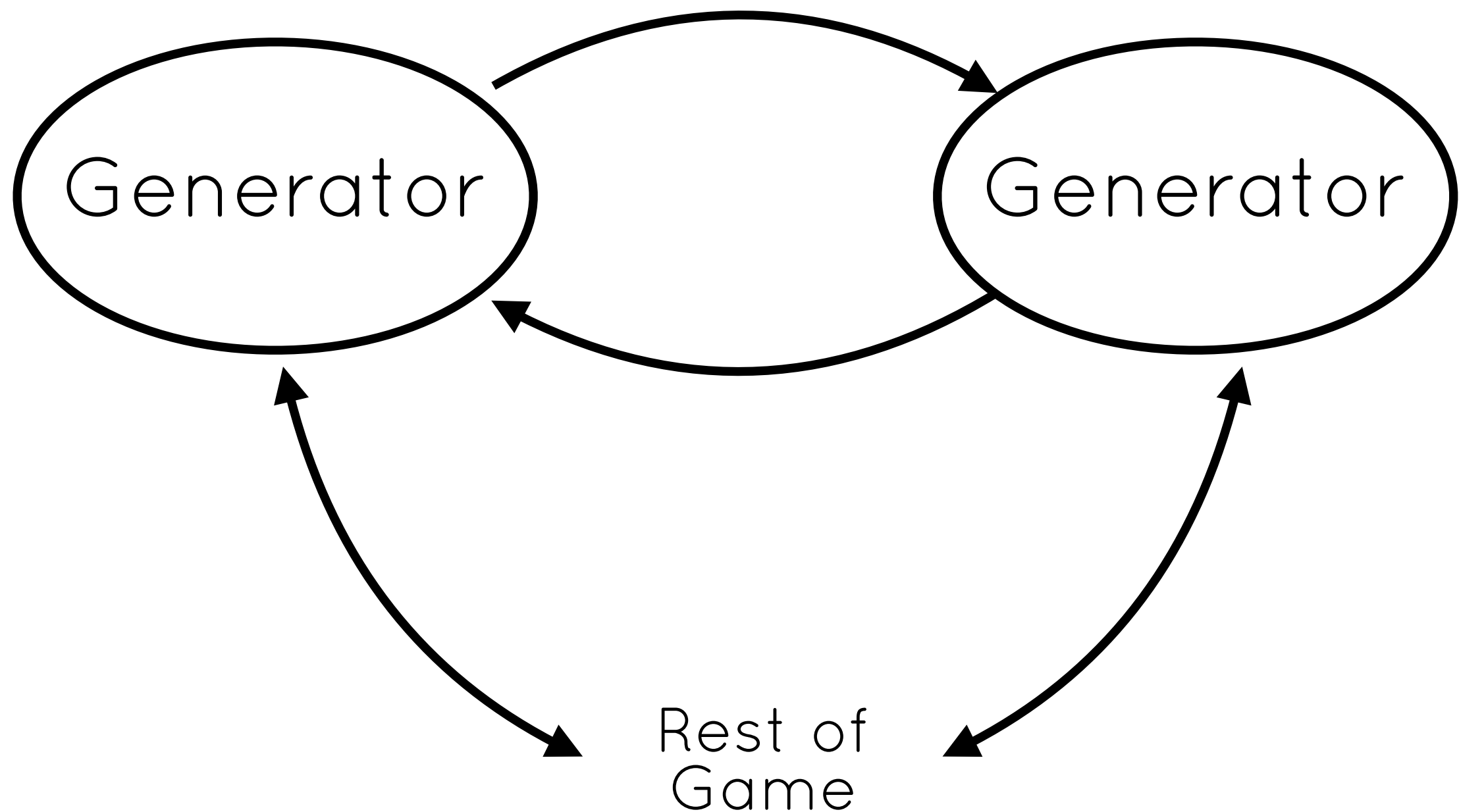
Evolved levels with accessibility, vision or playability constraints.

‘Art Direction’

Optimised for visibility, coherence, and contextual meaning.

Automated Game Design

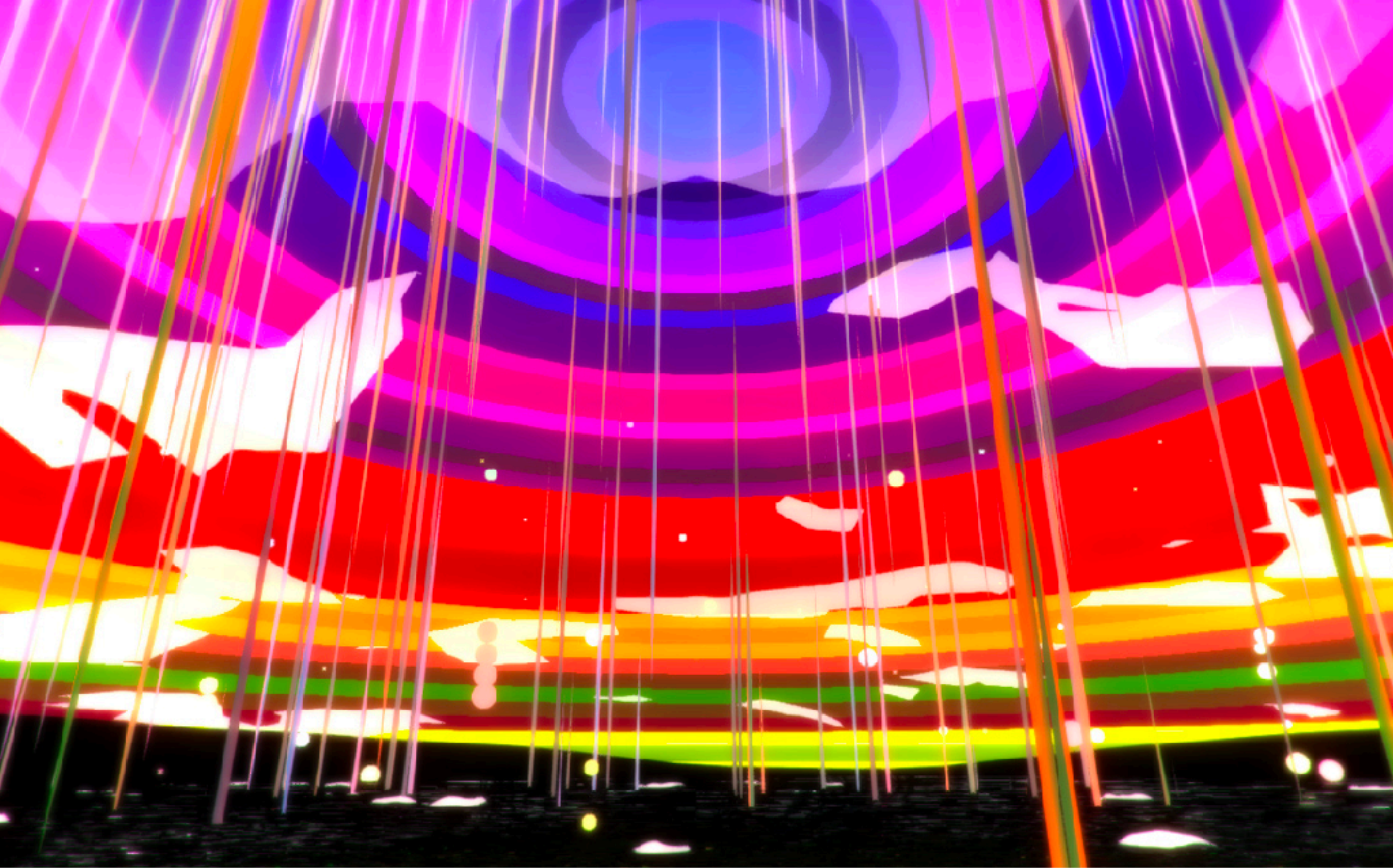
2nd Generation



Automated Game Design

2nd Generation

“Automated game design is the generation of multiple types of game content in a way that is responsive to the changing game design.”



Which bits of context are important?



Games can be emotional



Games can be beautiful



Games can be social

NATIVES

They are: vegetarian

Craftsmen

Natural swimmers

Strict / Disciplinarian

COLONISERS

Fast learners

Obsessed with 'Justice'

Soft-spoken

Smell great

Games can be political

- Art
- Sound
- Music
- Writing
- Systems
- Feel
- Metagame
- Interface
- Social
- Difficulty
- Discovery
- Self-Expression

- Juice
- Oil
- Progression
- Co-operation
- Culture
- Context
- Meaning
- Balance
- Emergence
- Subversion
- Expansion
- ...

Games can be a lot of things

- Art
- Sound
- Music
- Writing
- Systems
- Feel
- Metagame
- Interface
- Social
- Difficulty
- Discovery
- Self-Expression

- Juice
- Oil
- Progression
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- ...

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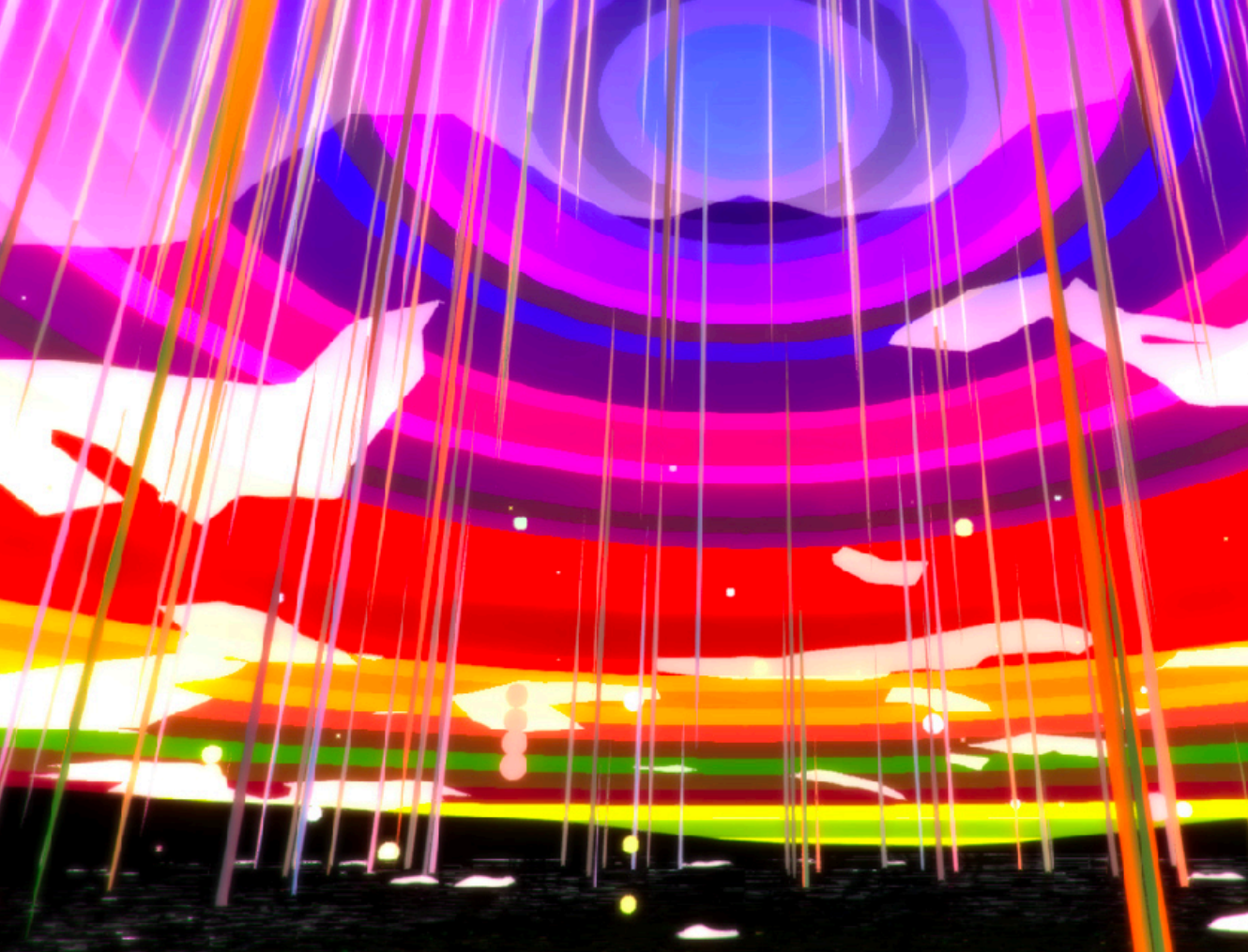
- Juice
- Oil
- Progression
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- ...

- Art
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- Expansion
- ...



“Which future of
games is correct?
All of them.”

- - George Buckenham

Which future of
automated game
design is correct?

A better question:
Why bother?

Part II

A Different Kind Of Question

Why generate games?



“Because it’s there”



Helping Developers



Helping Everyone



Changing Games

People

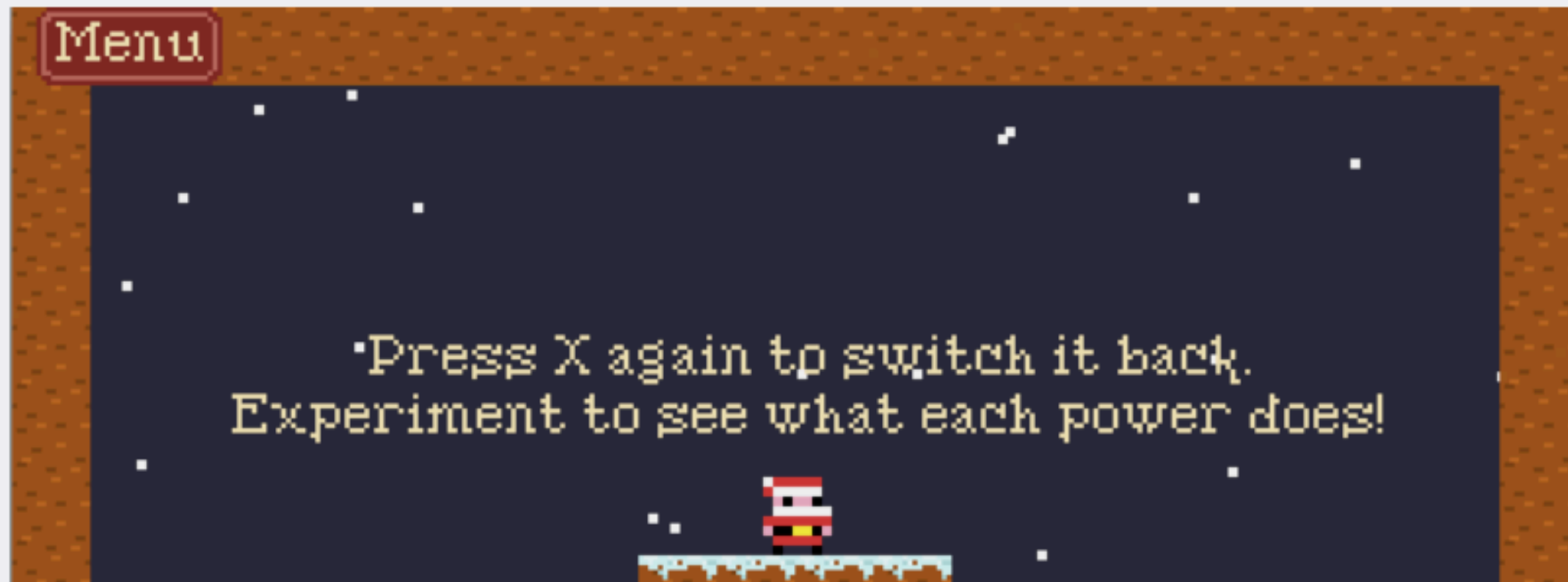


GAMING & CULTURE —

Artificial intelligence project builds *A Puzzling Present*

AI system called ANGELINA is back with a very playable Android/PC game.

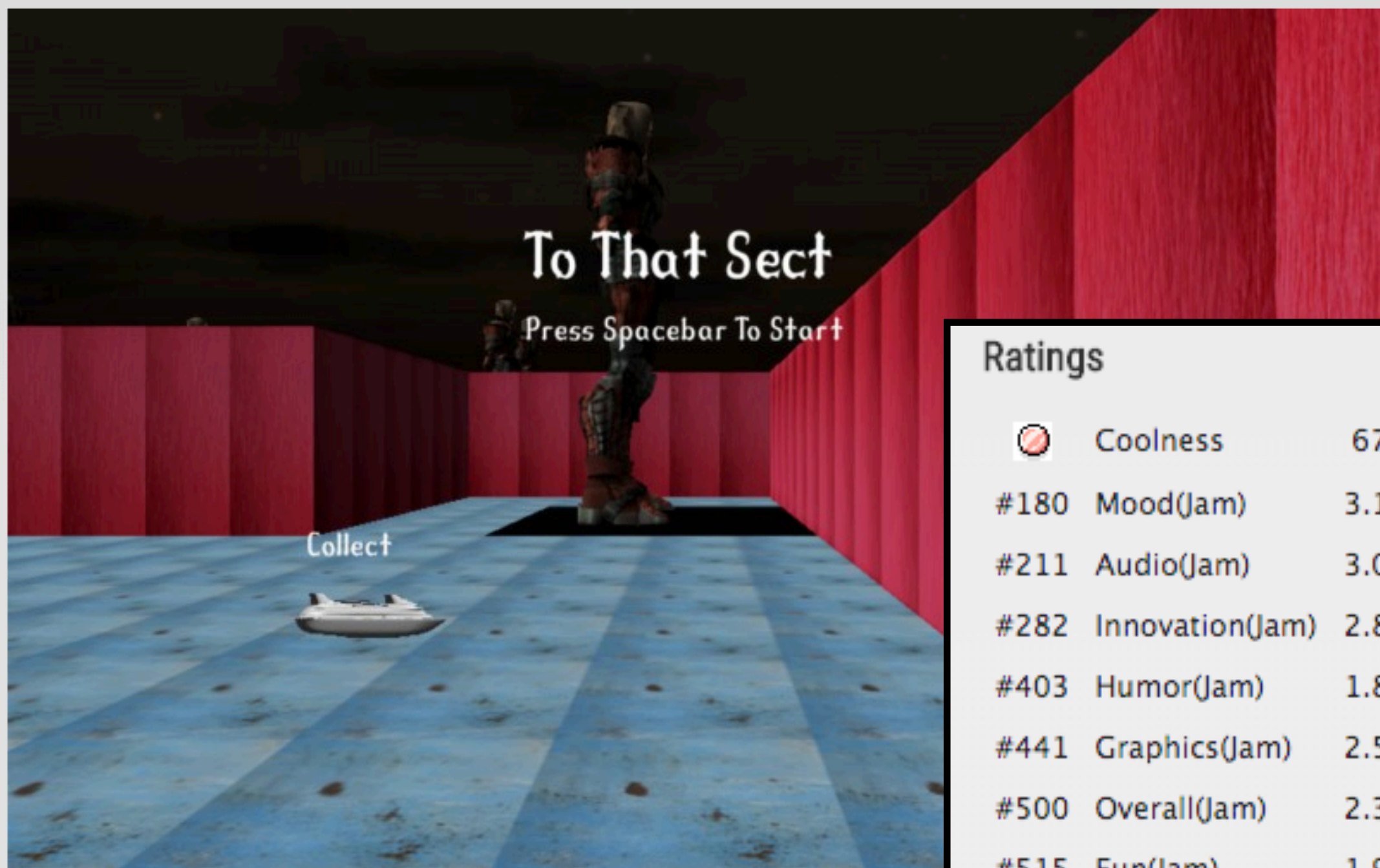
MEGAN GEUSS - 12/16/2012, 11:30 PM



December 13th-16th 2013 :: Theme: You Only Get One

[[Real World Gatherings](#) | [Ludum Deals](#) | [Warmup Weekend](#)]

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To That Sect

by [gamesbyangelina](#) - Jam Entry

Ratings



Coolness

67%

#180 Mood(Jam) 3.15

#211 Audio(Jam) 3.06

#282 Innovation(Jam) 2.80

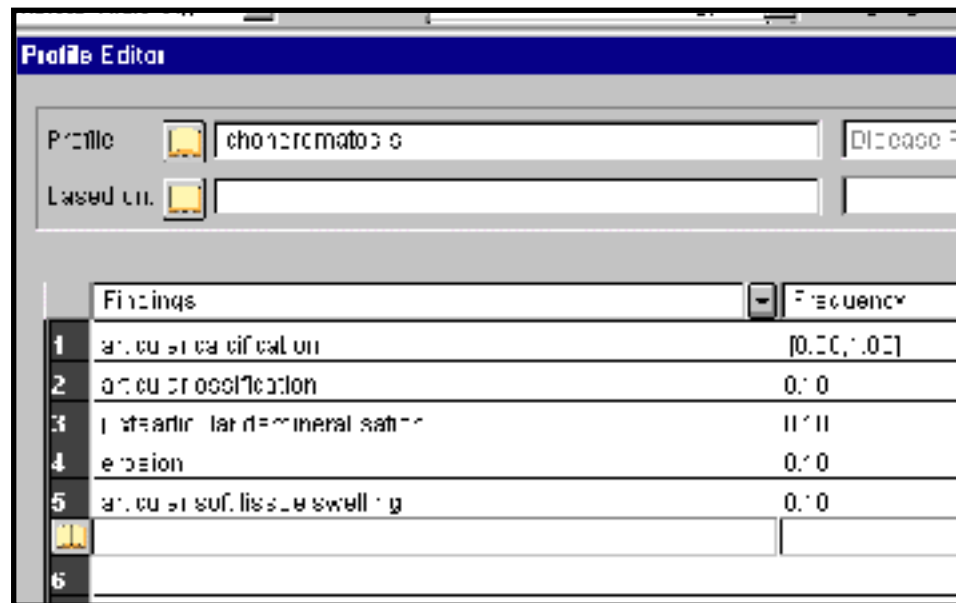
#403 Humor(Jam) 1.81

#441 Graphics(Jam) 2.53

#500 Overall(Jam) 2.37

#515 Fun(Jam) 1.92

#533 Theme(Jam) 1.75

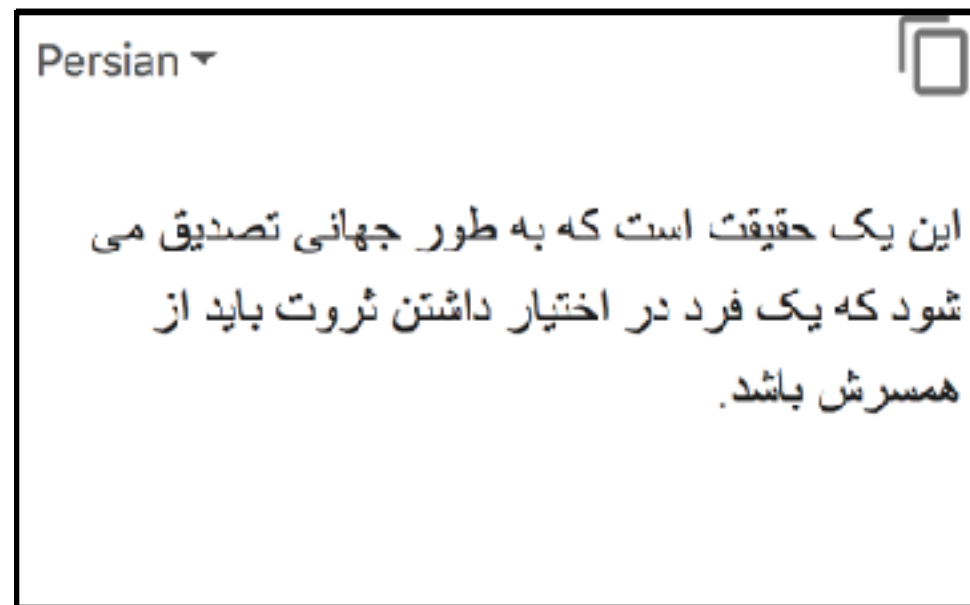


	Findings	Frequency
1	articular calcification	[0.00, 0.00]
2	articular ossification	0.00
3	osteoporosis	0.00
4	osteopenia	0.00
5	articular soft tissue swelling	0.00
6		

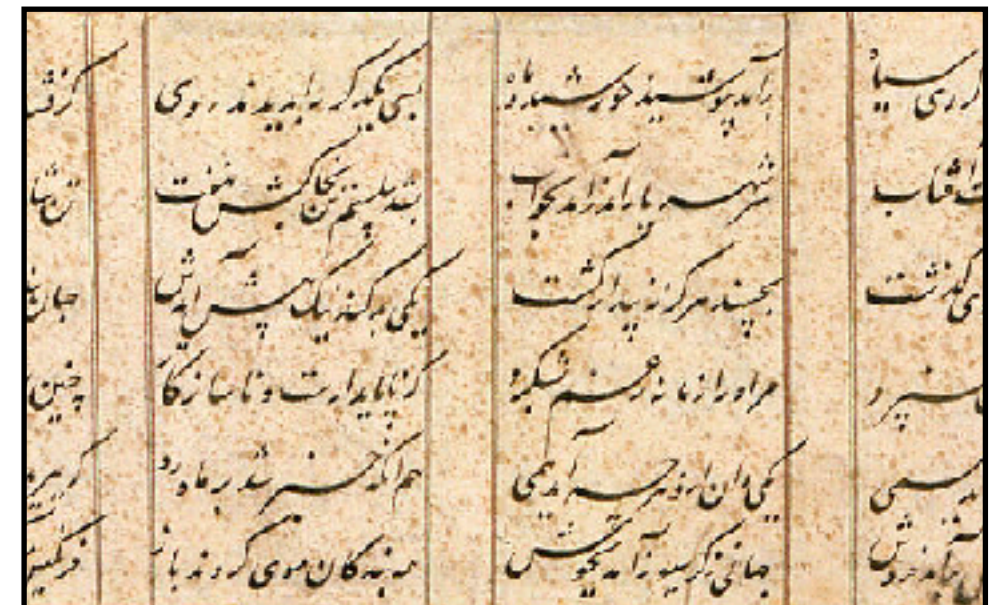
Medical Diagnosis



Doctors



Machine Translation



Translators

Tasks vs People



Style Transfer



Artists



Content Generation



Game Developers

Tasks vs People

Automating *Game Design?*

or

Automating *Game Designers?*

Do we care how
games get made?



The Task, or the Person?

Bury me, my Love



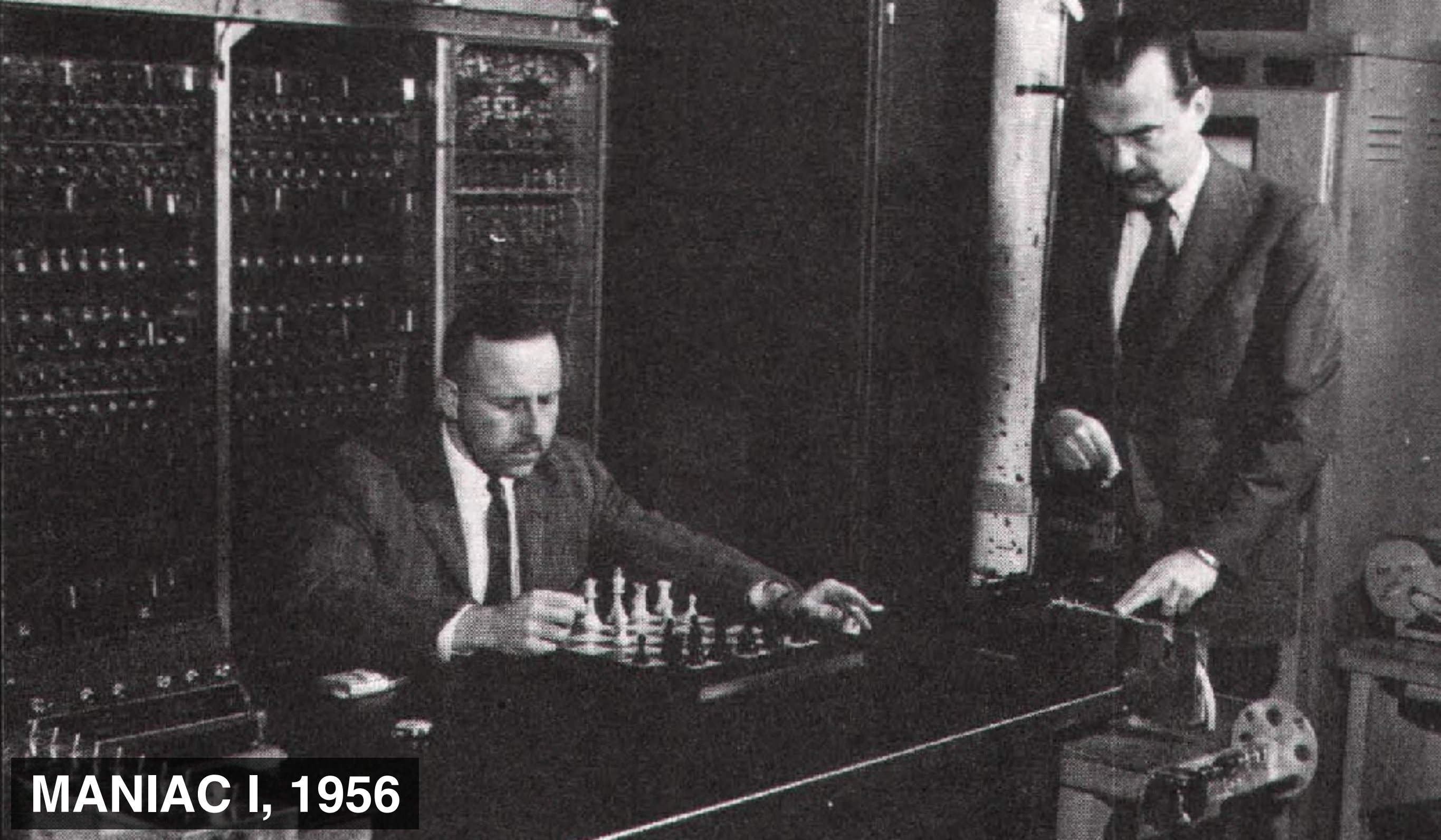
The Task, or the Person?



The Task, or the Person?



The Task, or the Person?



MANIAC I, 1956

Historically, games were problem domains



Mac Hack VI, 1967

They were clean, mathematical, pure



But games have changed



How we make them has changed



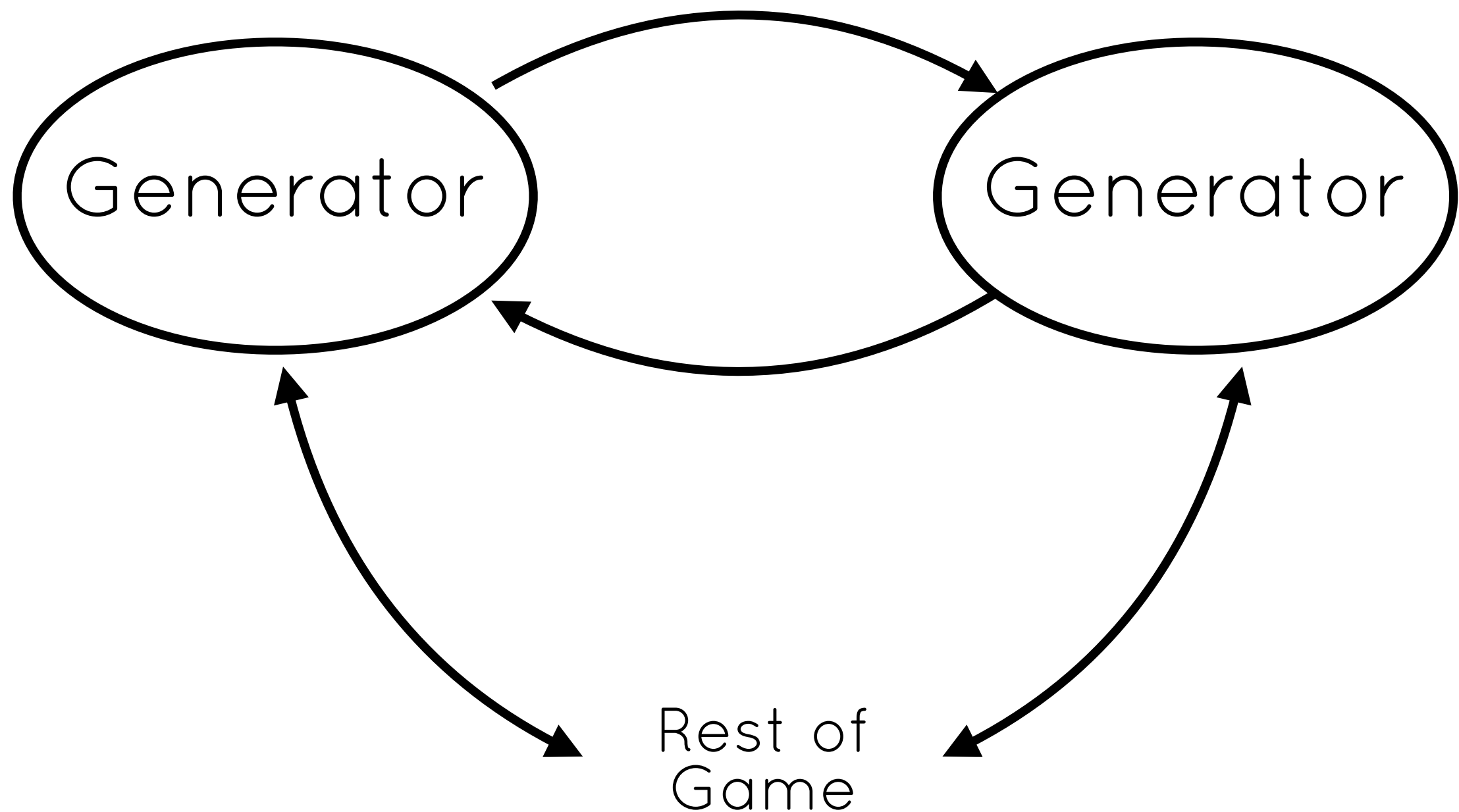
And so has our relationship with
the people who make them



The future of games research
is about people, not tasks

Automated Game Design

2nd Generation



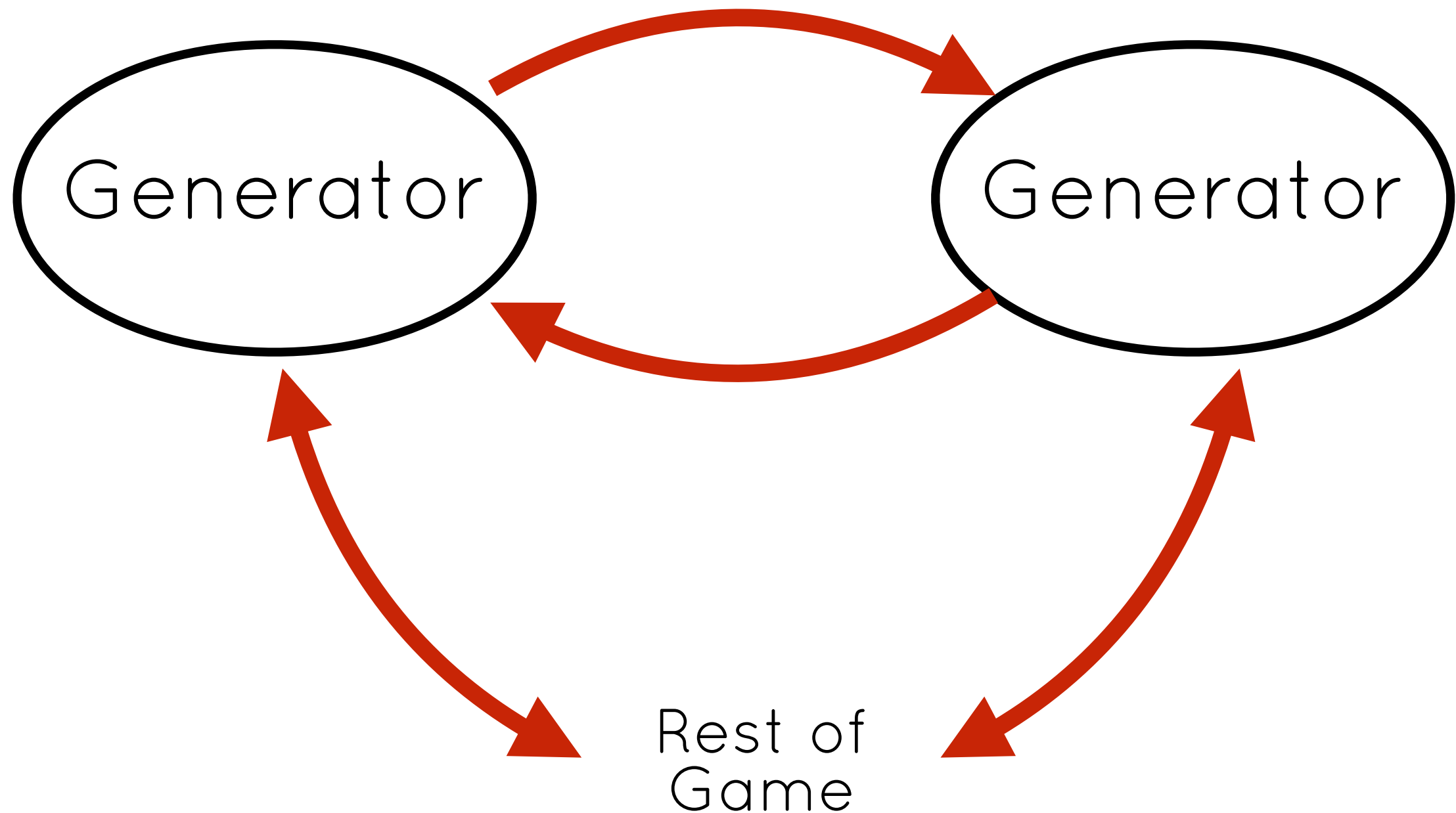
Automated Game Design

2nd Generation

*“Automated game design is
context-aware content generation”*

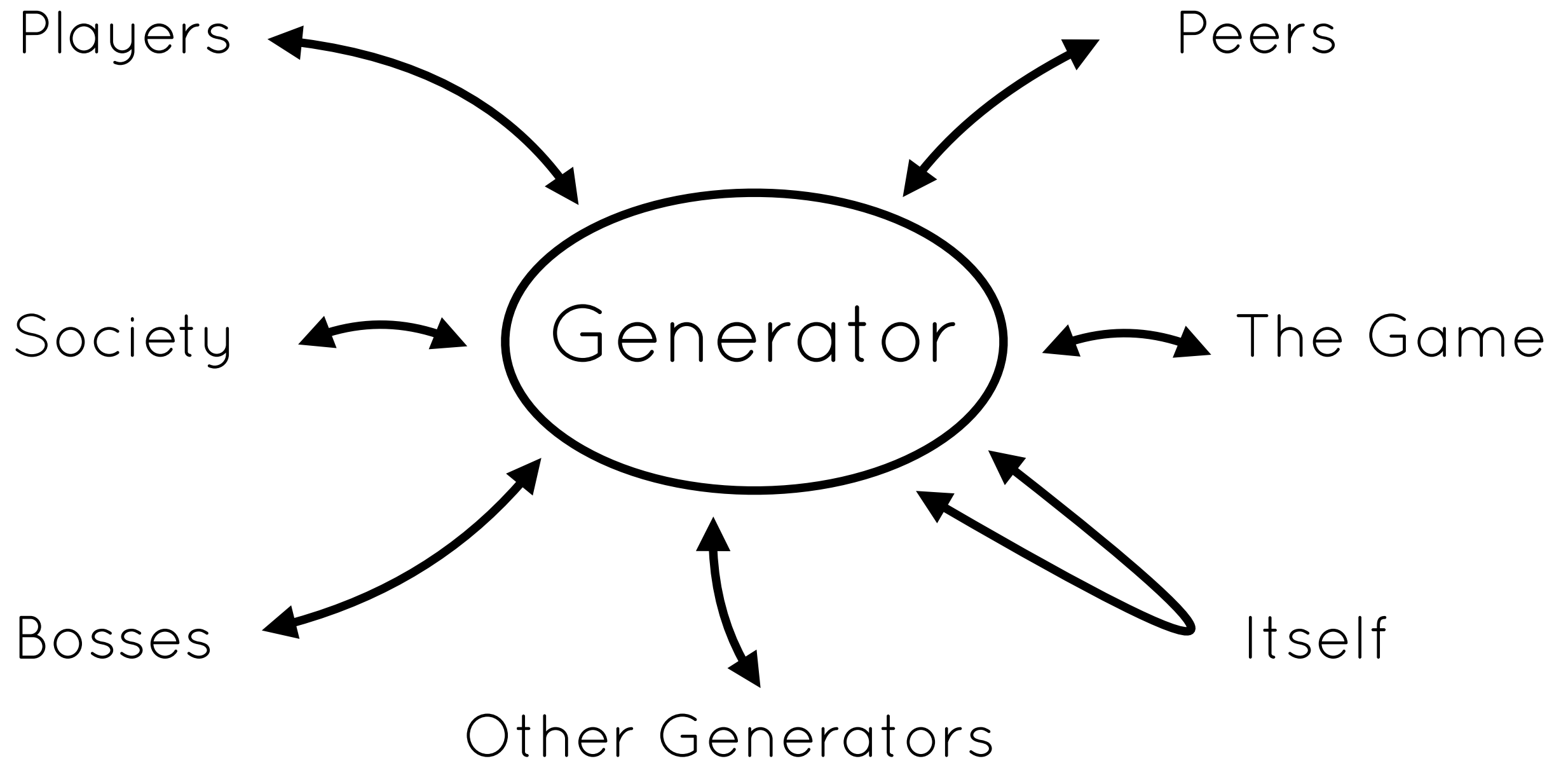
Automated Game Design

2nd Generation



Automated Game Design

3rd Generation



Automated Game Design

3rd Generation

“Automated game design is the generation of content in a way that is aware of the social, cultural and design context it exists in.”

Automated Game Design

2nd Generation

*“Automated game design is
context-aware procedural content
generation”*

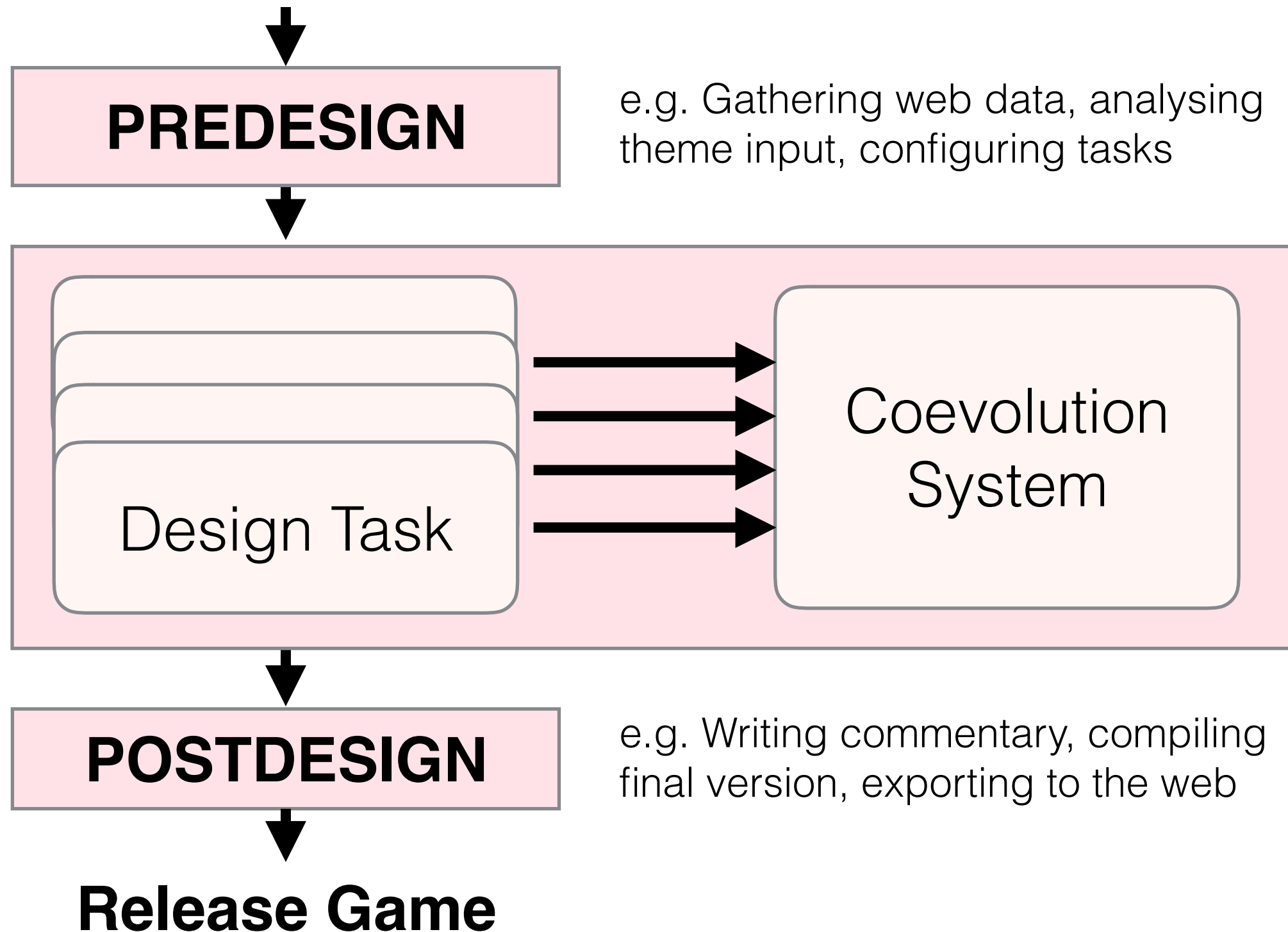


But how do we get there?

Part III

Perfect, Immortal

ANGELINA, Before



Problems

- **Change:** ANGELINA didn't grow, learn or change, no matter how many games it made.
- **Ownership:** ANGELINA only made games when told to, about what it was told to.
- **Time:** Games were made in a rush, in the space of 4-6 hours, which limited a lot of options.

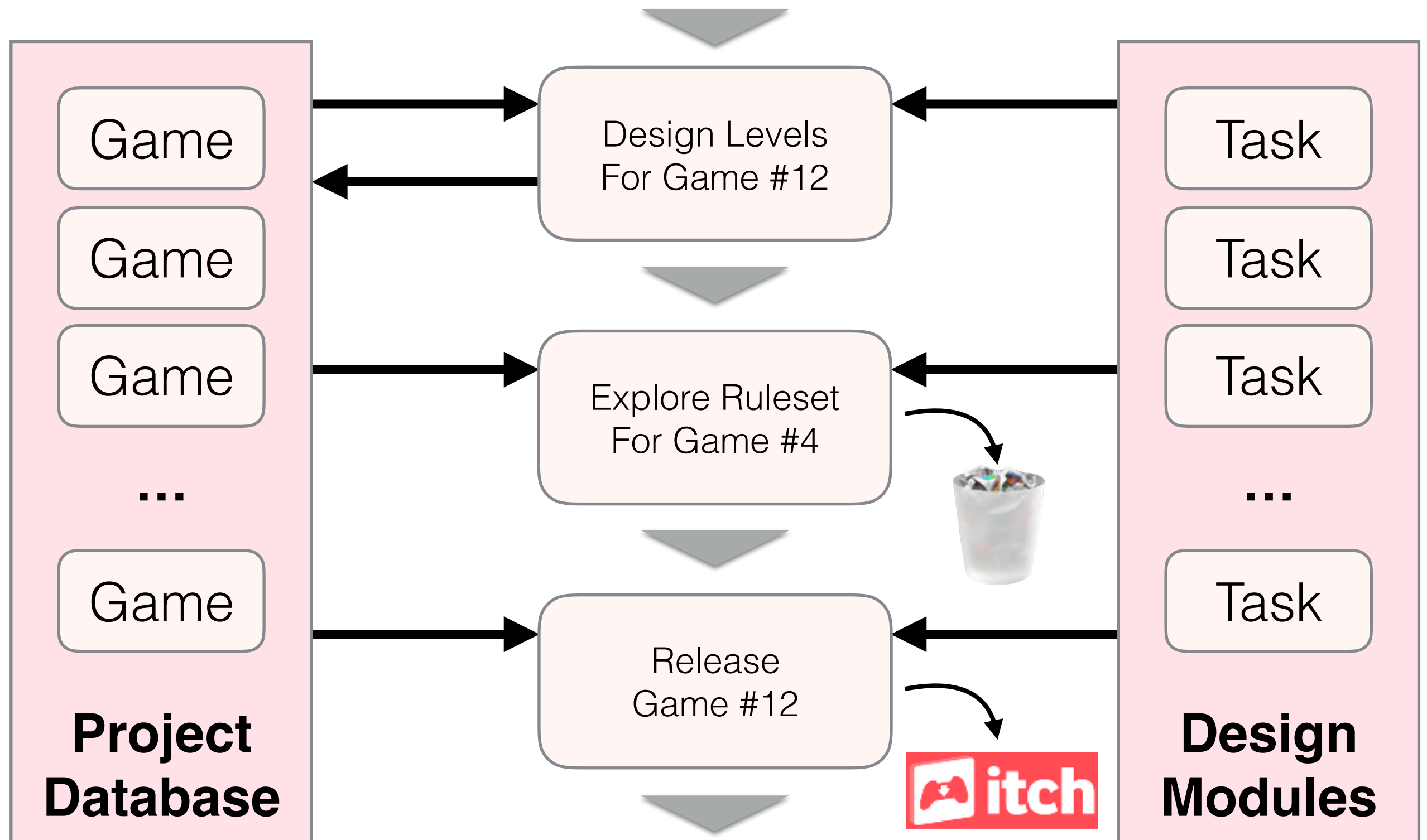
ANGELINA 6

Continuous Automated
Game Design

Objectives

- **Continuous Design:** No start, no end - the system should always be running, moving between tasks and projects.
- **Comprehensive Logs:** In order to talk to people, we need things to talk about - the system must record its history.
- **Slower Development:** Faster is better for tasks, slower is better for people - leave gaps and slow work down.
- **Modular Design:** Simple interfaces and reused code make it easier for the system to rewire itself in the future

ANGELINA, Now



ANGELINA 6

Games

Games

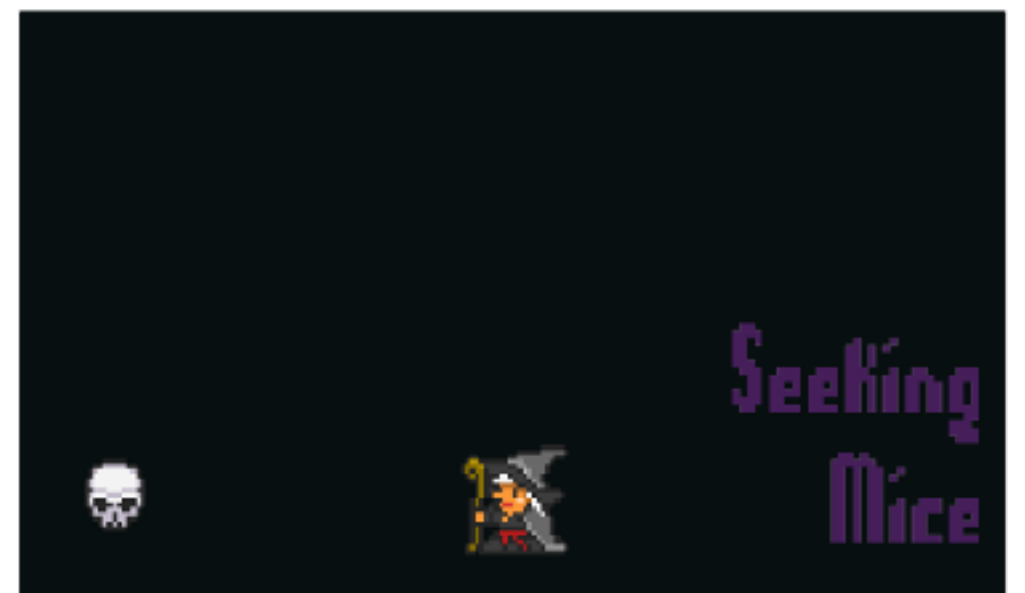
Version 0.45

```
{
  "gamename": "Before Venturing Forth",
  "filename": "before_venturing",
  "numplayers" : 1,
  "floor": "dungeonfloor",
  "music": "ominous",
  "color_accent": [0.4, 0.56, 0.31],
  "color_body": [0.19, 0.28, 0.22],
  "variables" : [
    {
      "name": "score",
      "onscreen": "Score",
      "startvalue": 0
    }
  ],
  "pieces" : [
    {
      "name": "playerpiece",
      "layer": 5,
      "sprite": "fighter",
      "animated": true,
      "flips": true
    },
    {
      "name": "wall",
      "layer": 1,
      "sprite": "wall",
    },
    {
      "name": "goal",
      "layer": 4,
      "sprite": "stairsdown"
    }
  ]
}
///continues
```

Version 0.4

```
{
  "gamename": "Before Venturing Forth",
  "filename": "before_venturing",
  //continues
```

Cover



Games

```
"gamename": "Before Venturing Forth",  
"pieces" : [  
  {  
    "name": "playerpiece",  
    "layer": 5,  
    "sprite": "fighter",  
  },  
]
```

Games

```
{  
  "trigger": "OVERLAP playerpiece enemy",  
  "code": [  
    "DESTROY $2",  
    "SFX punch",  
    "SCORE 1"  
  ]  
},  
{  
  "trigger": "OVERLAP any wall",  
  "code": [  
    "PUSHBACK $1",  
  ]  
},
```


Games

```
{
  "outcome": "1",
  "triggers": [
    "ALL_COVERING playerpiece goal"
  ],
}
{
  "outcome": "-1",
  "triggers": [
    "COUNTPIECE playerpiece 0"
  ],
}
```

Games

```
"levels" : [  
  {  
    "type": "raw",  
    "width": "5",  
    "height": "5",  
    "data": [0,4,4,0,3,  
              1,0,0,0,2,  
              0,0,0,0,0,  
              1,0,0,0,0,  
              0,0,4,0,3,  
            ]  
  },  
]
```

Language Tradeoffs

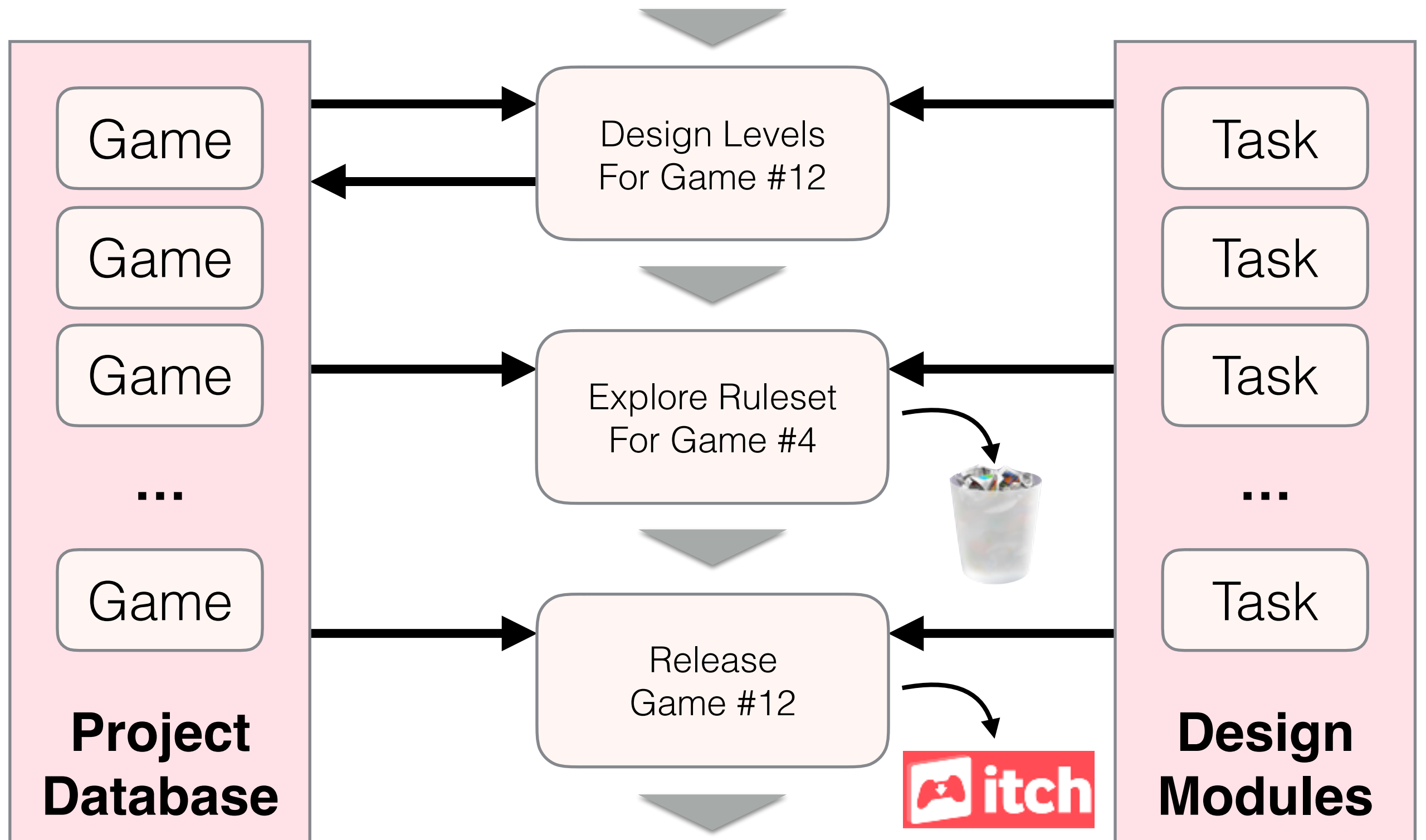
```
{
  "trigger": "OVERLAP playerpiece enemy",
  "code": [
    "DESTROY $2",
    "SFX punch",
    "SCORE 1"
  ]
},
{
  "trigger": "OVERLAP any wall",
  "code": [
    "PUSHBACK $1",
  ]
},
```

- More expressive than VGD L (I think)
- Easier to add new keywords to in future
- More readable/writeable for human designers

ANGELINA 6

Tasks

ANGELINA, Now



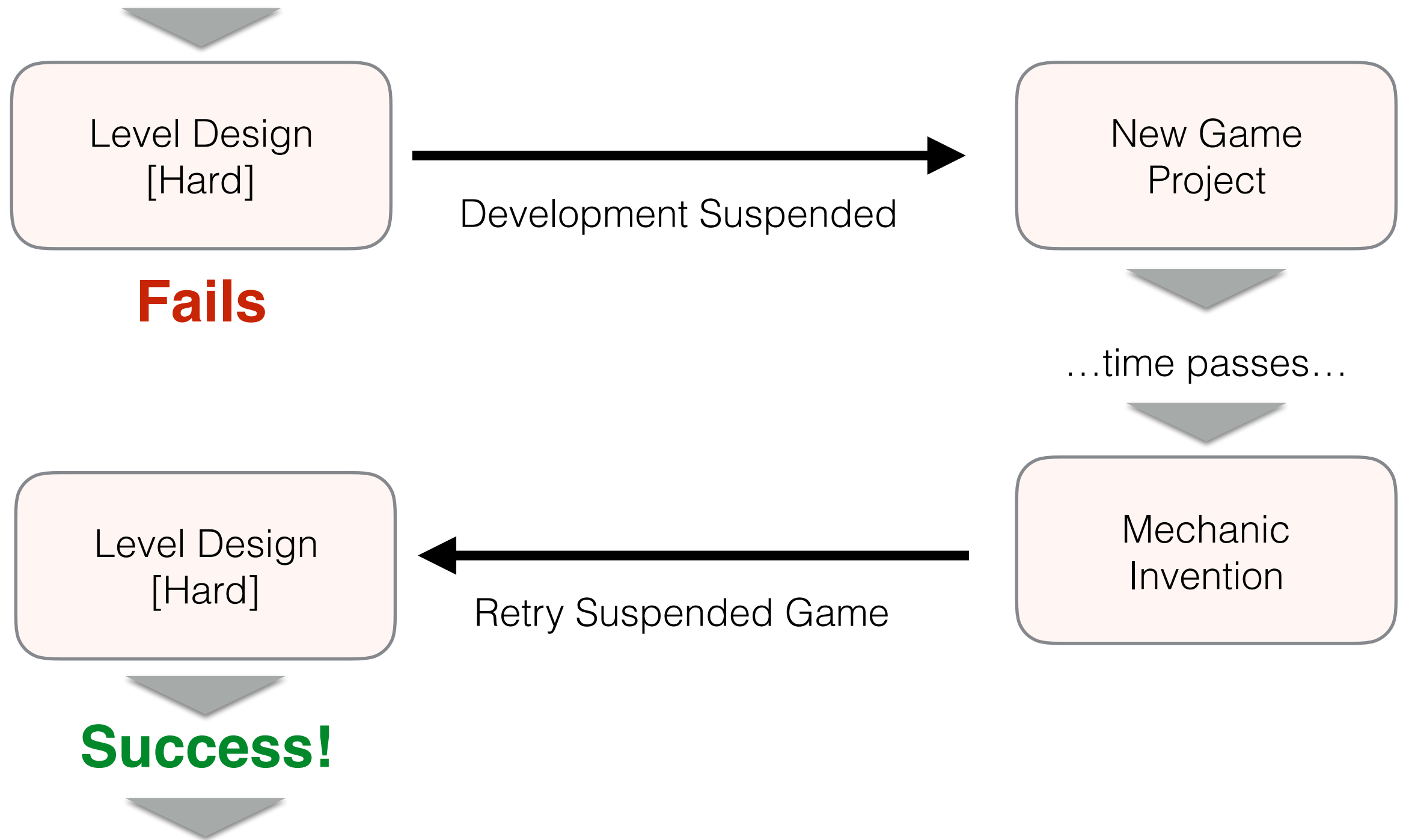
Tasks

Level Design

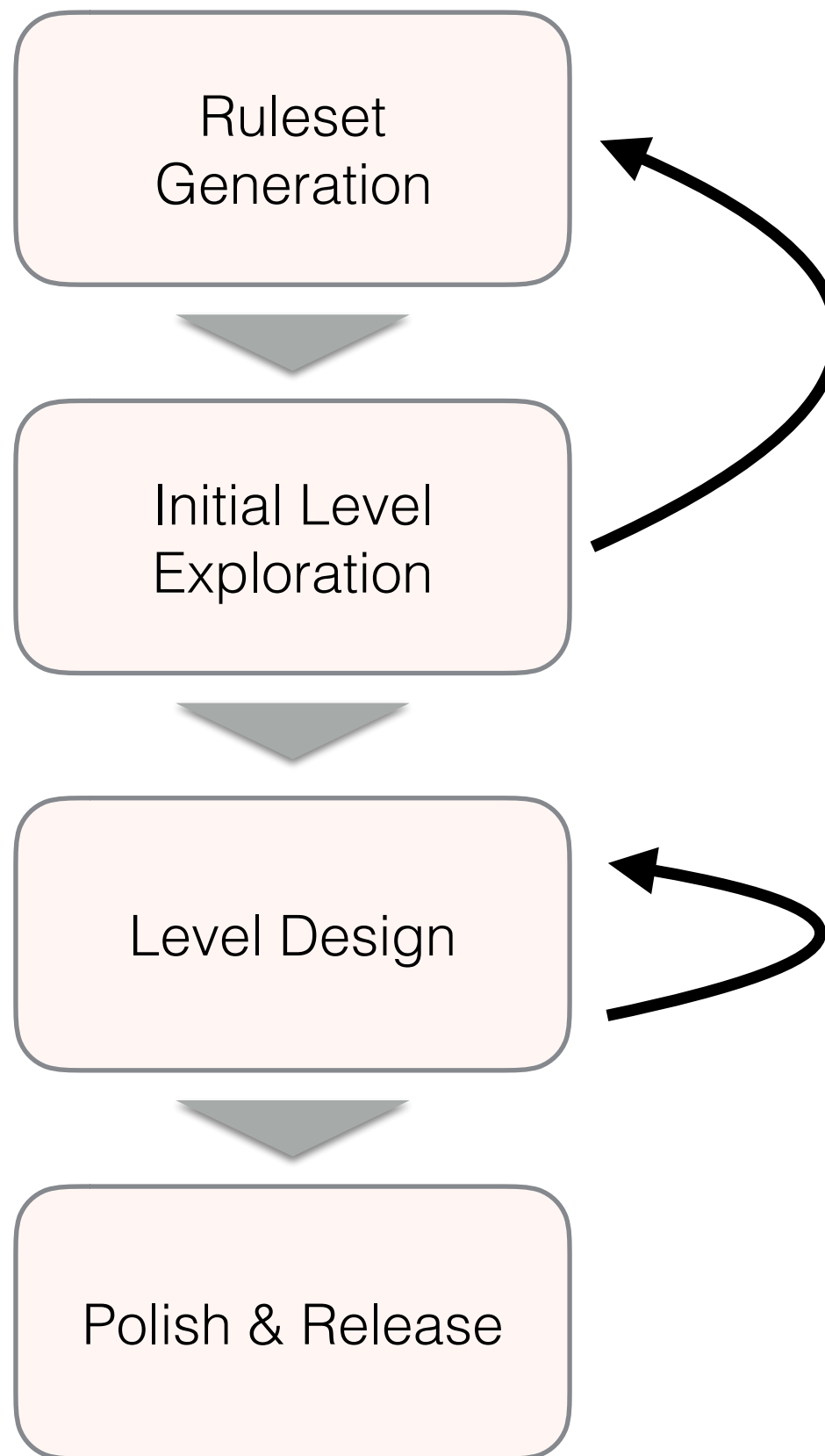
Level Size
Pieces Available
Objective

Population Size
Num. Generations
Mutation Rate












Tasks make design more fluid



And are designed to be modified

Ruleset Design









Game Idea: Jumping Raindrops

 moves using arrows,	 moves using arrows,
 moves using arrows,	 collects 
goal: one 	lose if: all  on 

Game Idea: Absorbing Jellybeans

 moves using arrows,	pieces fall,
 collects 	goal: score two points,
lose if: all  on 	

Game Idea: Sailing Salads

 chases 	 moves using arrows,
 collects 	pieces fall,
goal: no 	lose if: all  on 

Say Hello!

#whatgame - Ask me what game I'm working on right now
#whatsnext - Ask me what things I'm working on this week

Status

I've been working for 0 hours and 0 minutes!

I'm currently designing game rulesets. This session, I've played \$LEVELS\$ levels, and made over \$MOVESS\$ moves!

If you're interested in my games, you can play and download them online:

gamesbyangelina.itch.io

Tasks also enable visualisation

Level Design

Currently Testing



Playout



Best Levels Played So Far



Say Hello!

#whatix X Y - Ask me what the thing is at those co-ordinates!
#whatgame - Ask me what game I'm working on right now
#whatsnext - Ask me what things I'm working on this week

Status

I've been working for 0 hours and 1 minutes!

I'm currently designing levels for a game I'm making. This session, I've played 1 levels, and made over 3001 moves!

If you're interested in my games, you can play and download them online:

gamesbyangelina.itch.io

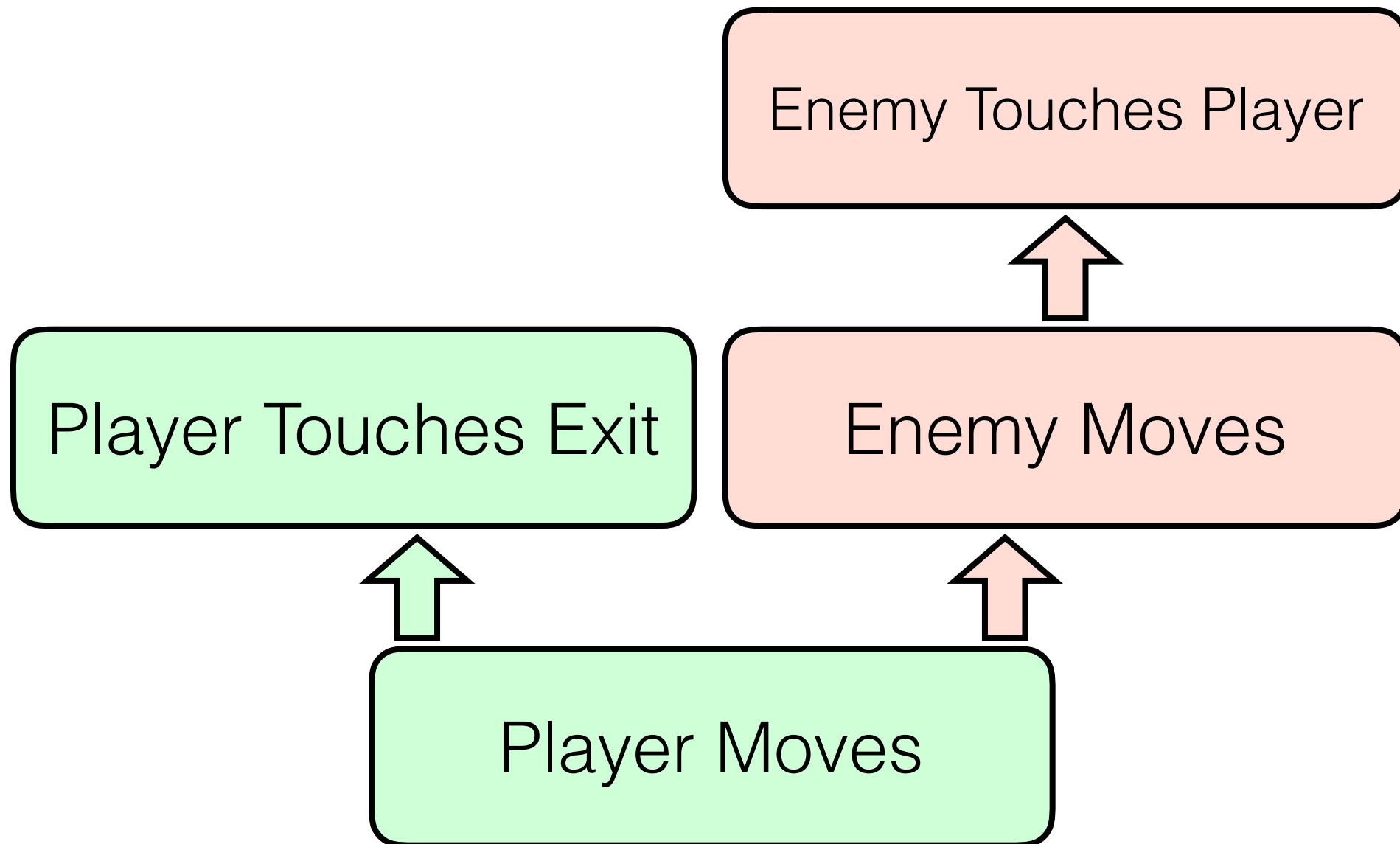
Tasks also enable visualisation



Which we'll soon be putting to the test!

ANGELINA 6

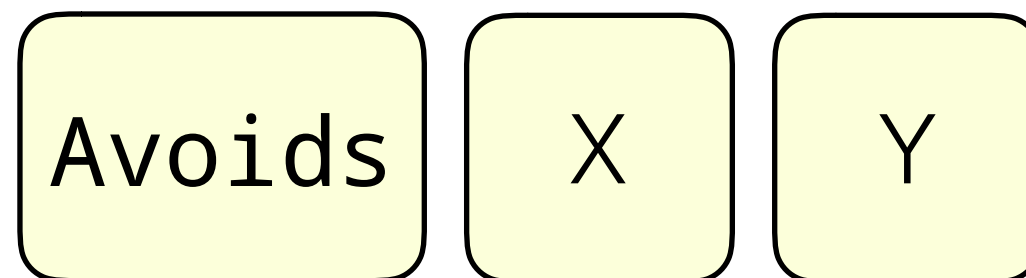
Current Work



Static Ruleset Analysis



Implies

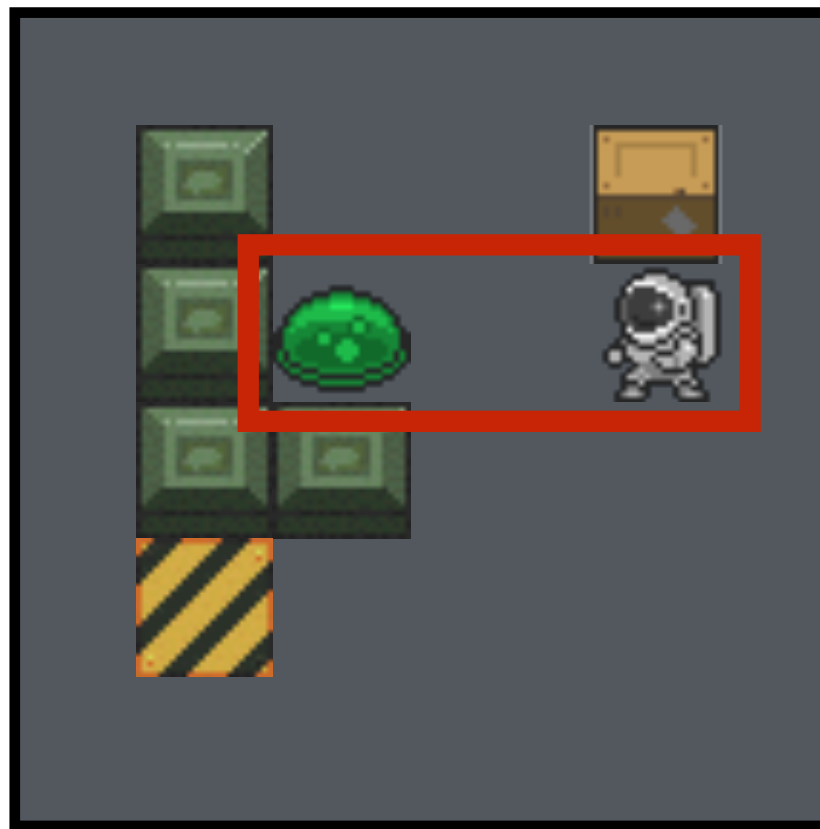


Knowledge Acquisition & Use

DEFINE:

SEES X Y

$X.x == Y.x \mid \mid X.y == Y.y$



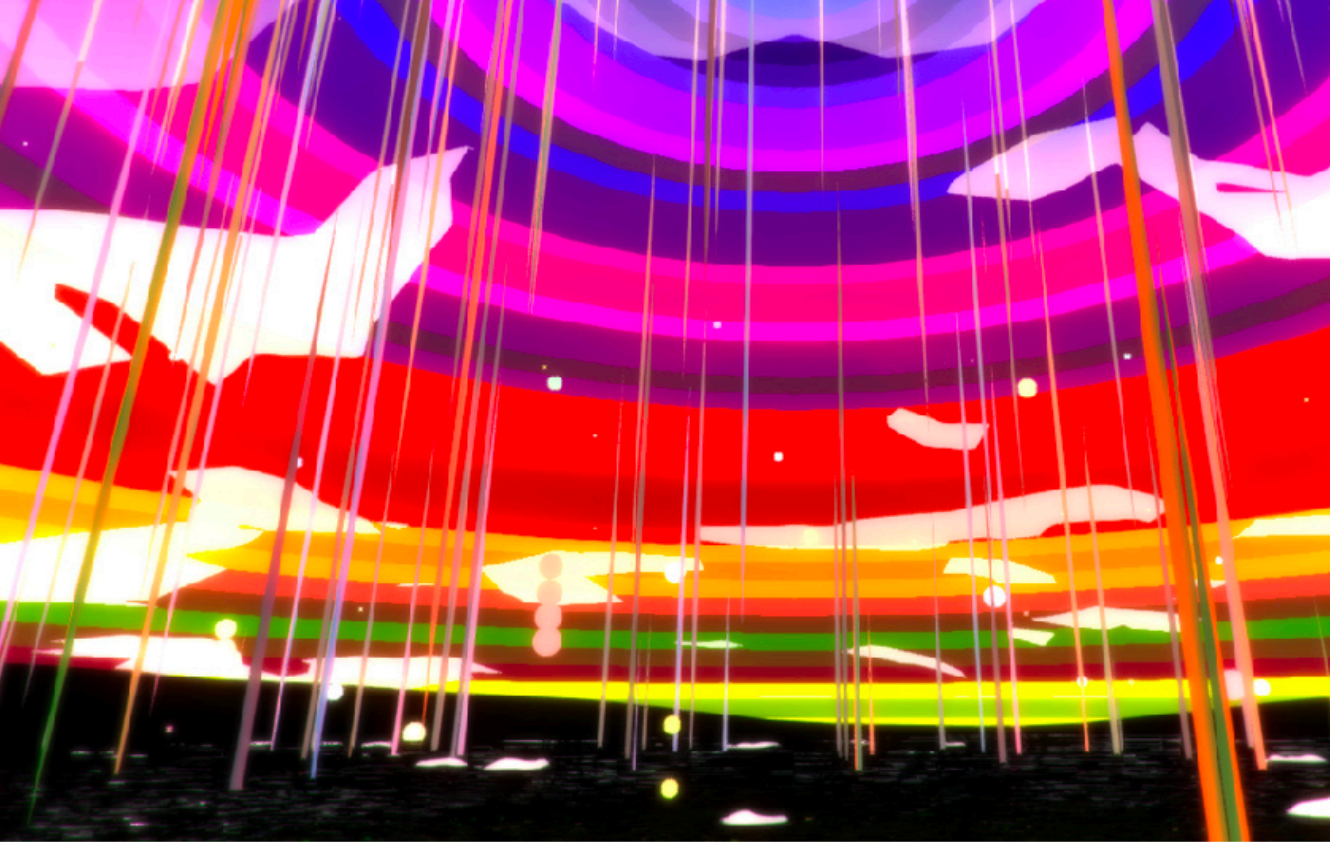
Non-Design Work

Part IV

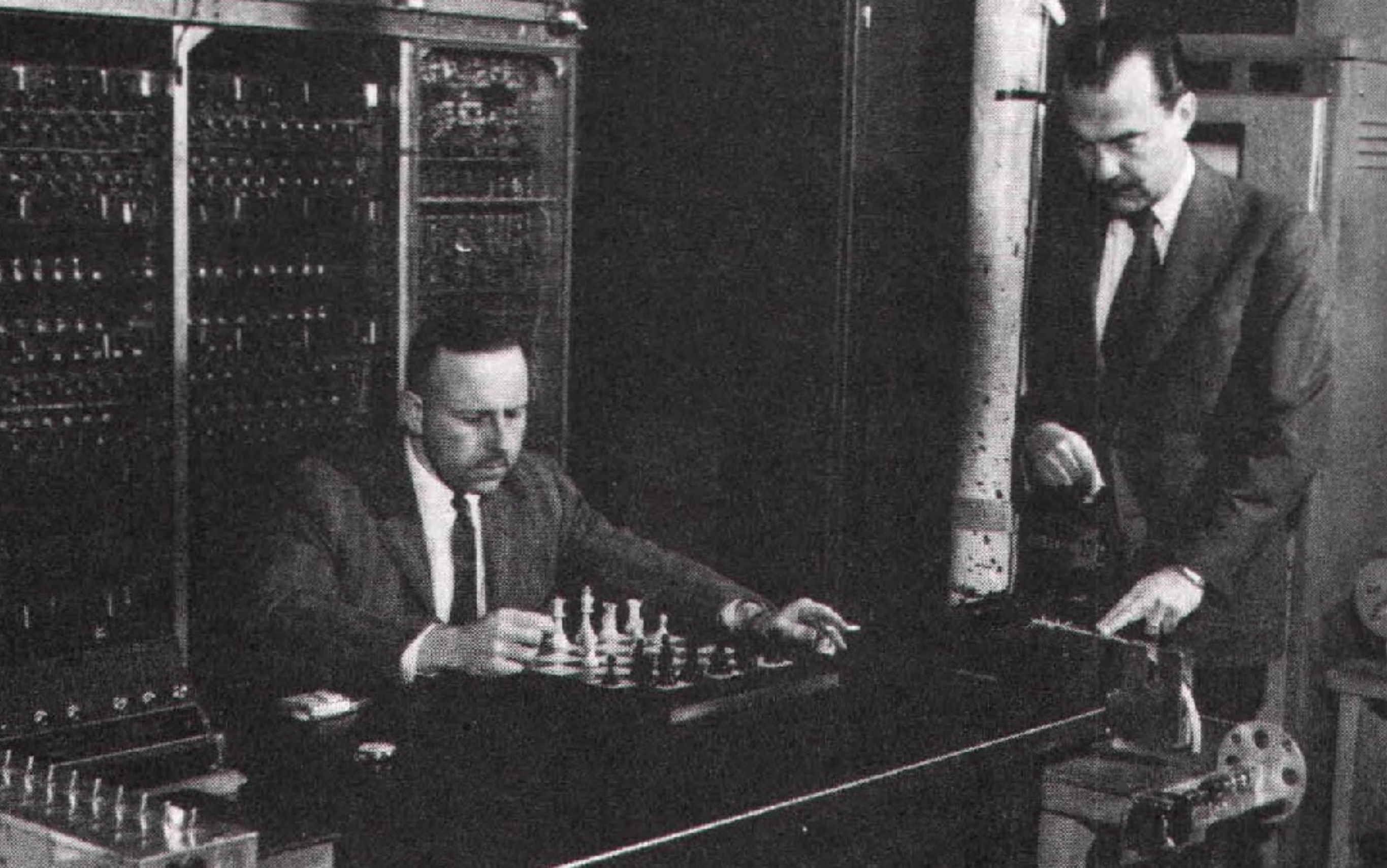
A Different Kind Of Answer



AGD is messy, which is OK



Because games are messy, too



Early AGD saw games mostly as rules



But games are really about human beings



And that's what AGD should be, too

- Art
- Sound
- Music
- Writing
- Systems
- Feel
- Metagame
- Interface
- Social
- Difficulty
- Discovery
- Self-Expression
- Juice
- Oil
- Progression
- Co-operation
- Culture
- Context
- Meaning
- Balance
- Emergence
- Subversion
- Expansion
- ...

There's so much we haven't tried to do yet



And so much we don't understand



Come and climb with us!

Thanks!

Ask me things: @mtrc on Twitter

Ask me longer things: mike@gamesbyangelina.org

Follow ANGELINA on Twitch: twitch.tv/gamesbyangelina

Writing about ANGELINA: gamesbyangelina.org

Procedural Generation Jam: procjam.com

دانش, a PCG analysis tool: danesh.procjam.com

I'm making a game, also? rogueprocess.run