Game Economics

Yvens Rebouças Serpa (Graphics Engineer in Audio and Lecturer/Researcher at Saxion)

Introduction

- **Yvens Rebouças Serpa**
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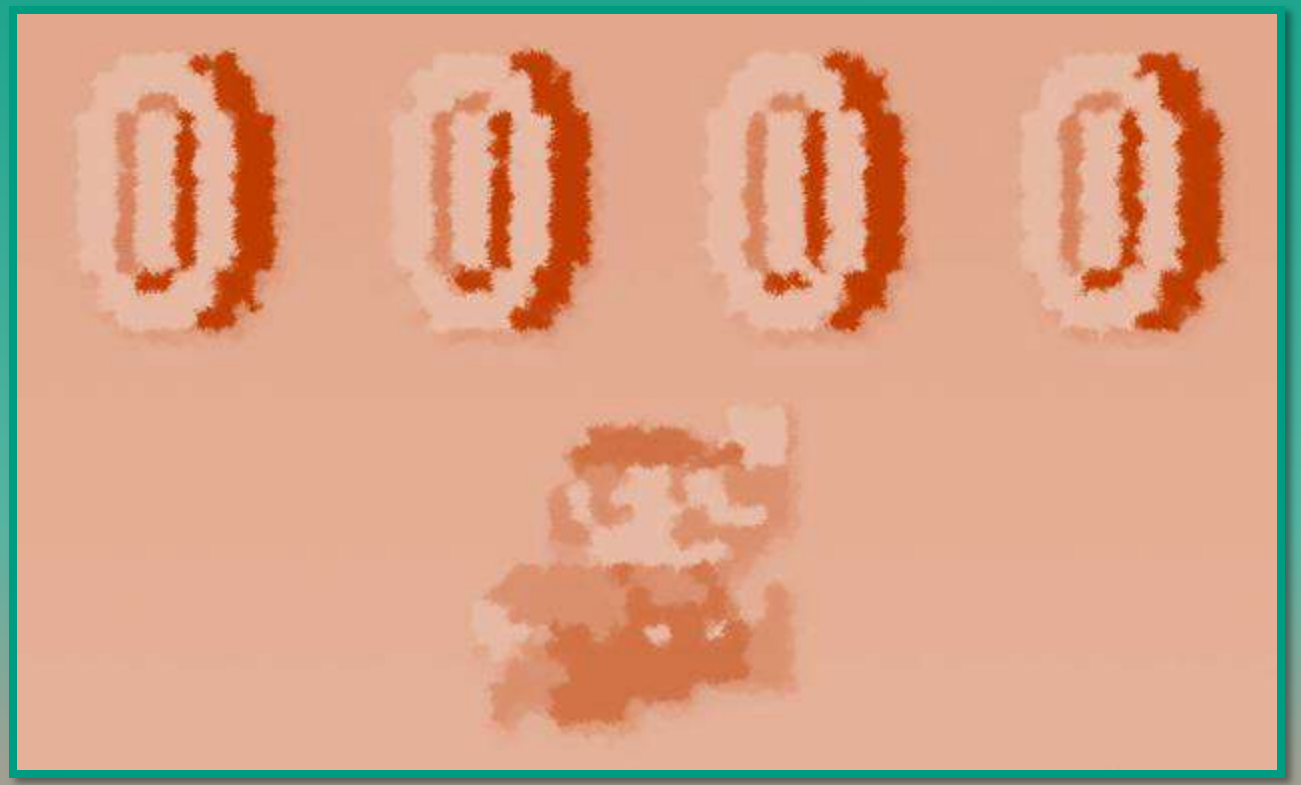
  - From Fortaleza, Ceará - Brazil ☺
- **Chair of the Curcom & Lecturer/Researcher**
  - Saxion University of Applied Sciences (Enschede, NL)
- **Graphics Engineer & CSO**
  - Audo Health & Technology (Fortaleza, CE, Brazil)
- **Indie Game Developer & Writer**
  - Dagon Graphics (dagongraphics.com)
  - The Cores of Game Design (CRC Press, London, 2024)

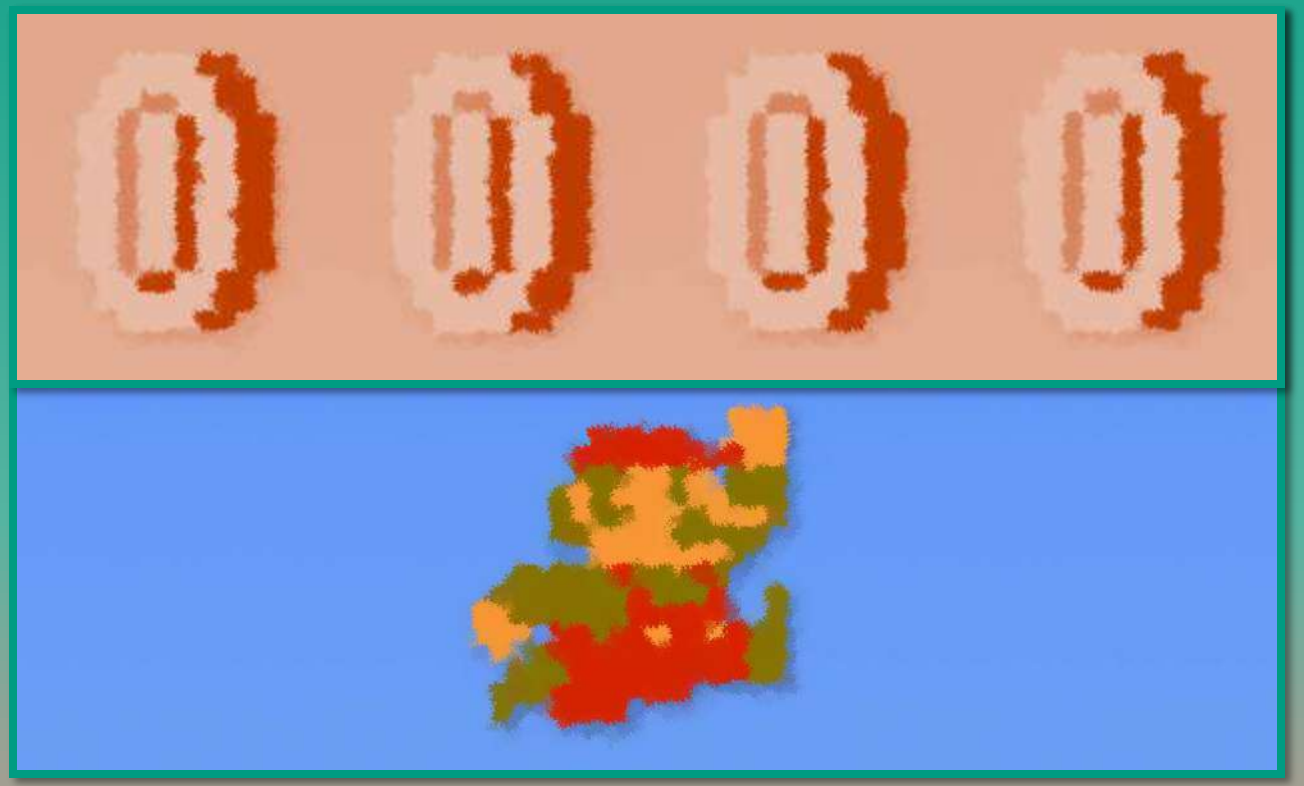
(Video) Game Economics

- A game design branch/field focused on the use of **resources** and **mechanisms** in games
- Usually, with the objective of **balancing** the game
- Also, it is a powerful tool to **motivate** and **engage** players



Resources

- Resources are numerical concepts
  - Coins and Lives are sources, e.g.
  - Material resources, like Wood and Stones
  - Abstract resources, like a strategic position or knowledge
- Anything **numerically measured** is a resource



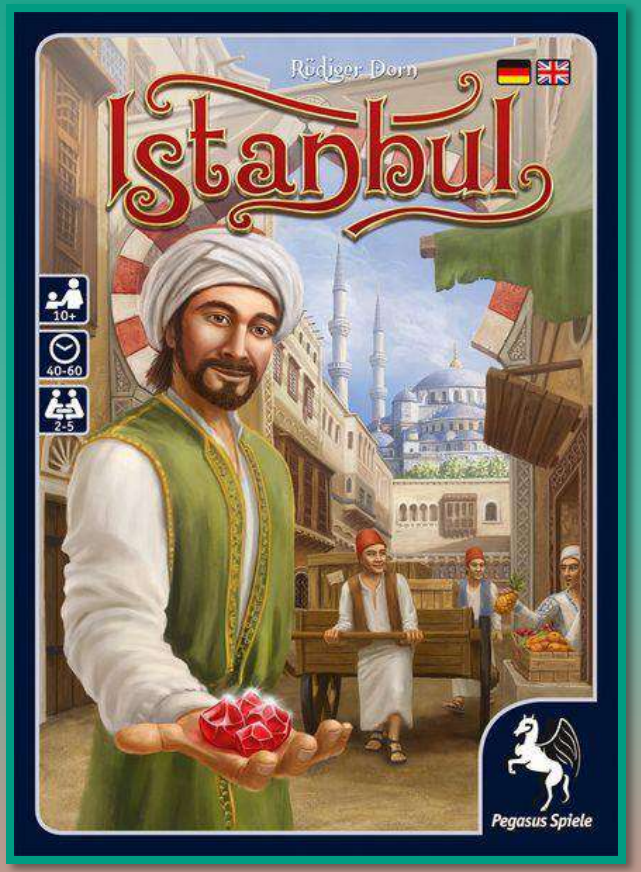
Resources are Varied

- Tangible / Intangible:
  - Do they exist physically in the game or not?
- Abstract / Concrete
  - Do the game systems acknowledge them?
- Context-Sensitive or Free
  - How do the players evaluate them?

Photo by Piotr Makowski on Unsplash

A Game as Systems of Resources

- Most games can be understood and broken down into **systems of resources**
- Which resources do we need to **win**? **What do we do** with the resources?
- Some games are literal **collections of resources**
  - Get **five** rubies to win
- Others are more **complex**
  - Defeat the end boss
  - Te end boss' health is still a resource!



Multitude of Objectives

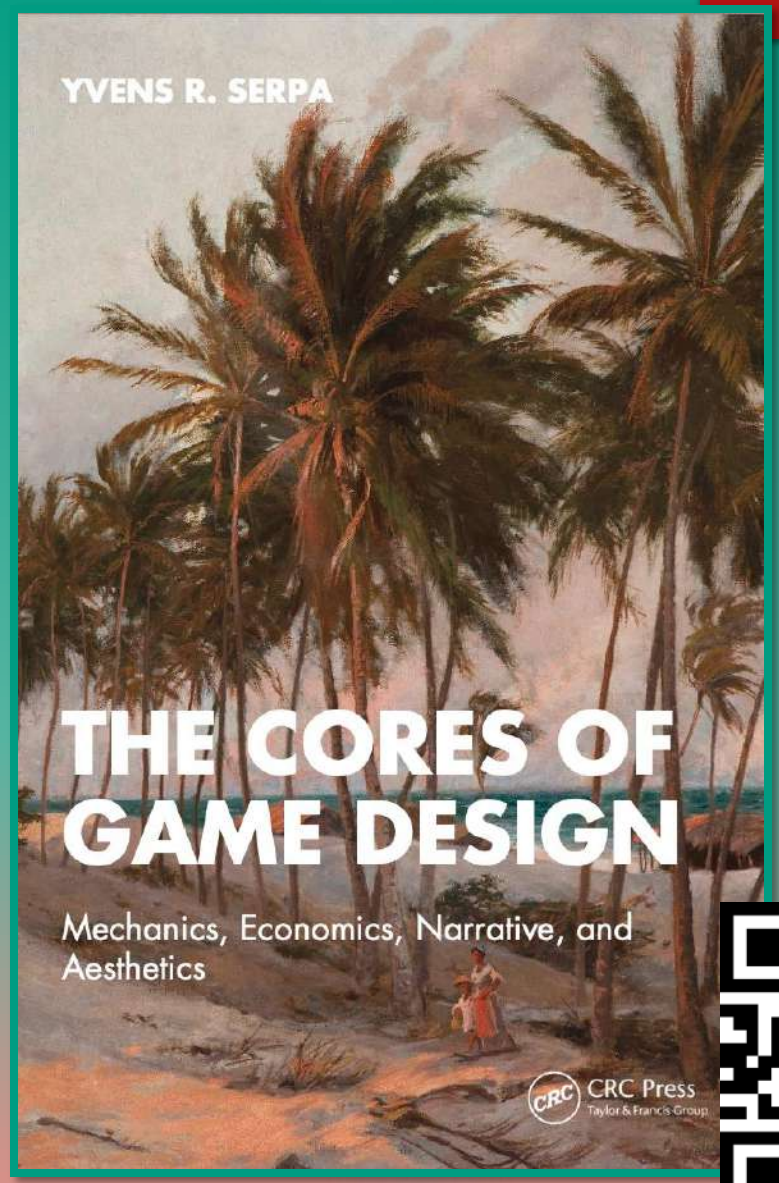
- Not everything needs to be about killing or collecting
- Resources can be explored in a variety of ways, even in the same game
- Building and learning, e.g.

Resources Influence Each Other

- Resources can influence each other
  - Change their interactions with the players and other game elements
  - Power Up (or Upgrades)
  - Unlock parts of the game
  - Prevent other players' actions and mechanics

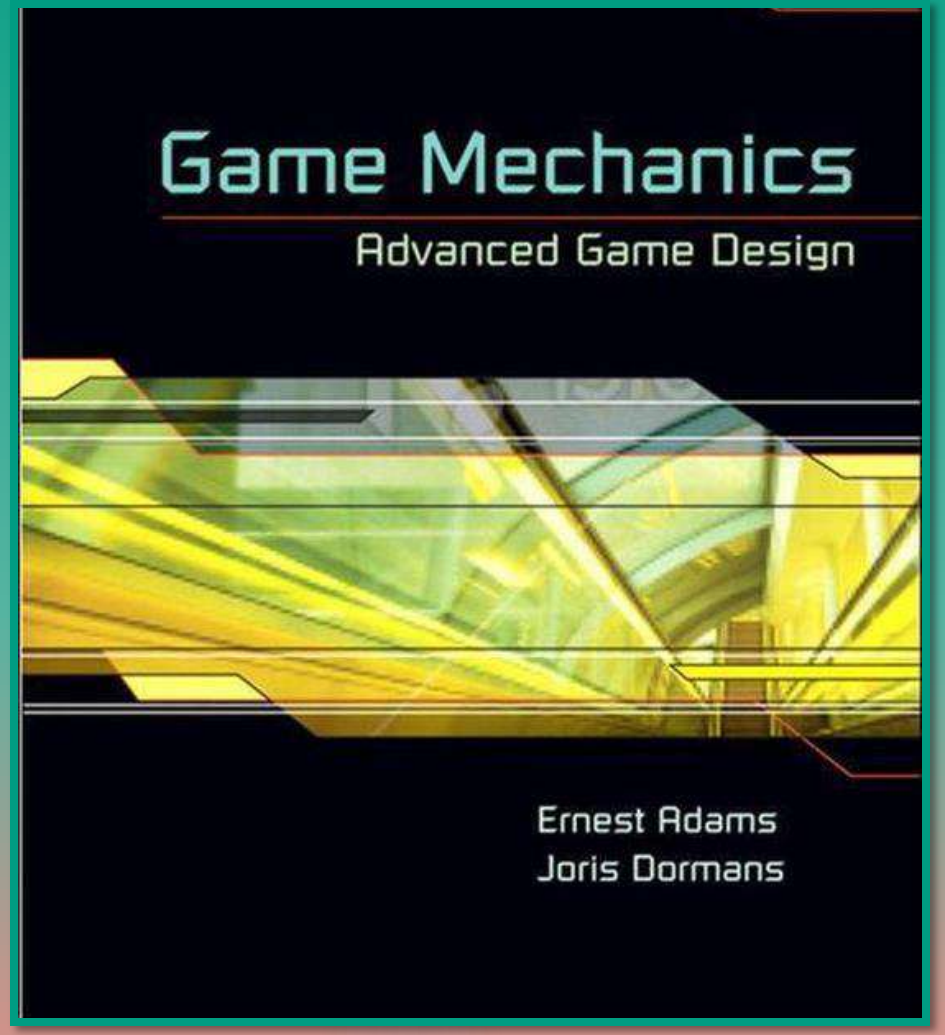
Cores of Game Design

- Most of this lecture is based on the theory presented in my book
- Understanding the principles of Game Economics
- Connecting them to the other cores: Mechanics, Aesthetics, and Narrative



Origins of the Theory

- Most of the theory is actually first presented in the Game Mechanics book
  - Ernest Adams and Joris Dormans
- Introduce the concepts of economic mechanisms
  - Creator of the Machinations tool



Questions?

Time for Some Practice

Choose a Game and Make a List of its Resources

- Choose any game, digital, physical, card game, tabletop, or whatever
- Make a list of at least ten different resources in the game
- Try to identify which one resource is the **winning** resource (if there are any)
- Try not to pick resources that are too similar to each other
  - For example, resources that serve the same purpose
- If you have trouble finding resources for a game, start another list from another
- Don't forget to consider abstract resources!

Time for Some Theory

Sources & Drains

Sources

- Mechanisms that generate resources out of nothing
- Can be timed or activated upon a certain condition
- Ruled by a **Production Rate**

Drains

- Mechanisms that destroy resources completely
- Can be timed or activated upon a certain condition
- Rule by a **Destruction Rate**

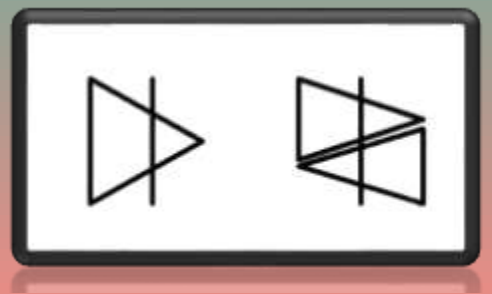
Sources & Drains

Converters

- Mechanisms that transform a resource of one type into another
- Mix of a Source and a Drain
- Ruled by a **Conversion Rate**

Traders

- Mechanisms that exchange resources into different entities
- Resources are neither destroyed nor created
- Ruled by a **Trade Rate**



Conversion and Trading

- Conversion transforms resources into others
  - Resource Equilibrium
- Trading exchange resources ownership
  - Player Equilibrium


Bok Choy
6

Mechanisms

- Sources:
  - Soil generates mushrooms overnight
  - Trees generate apples every day
- Drains:
  - Acting drains stamina
  - Being hit drains health
- Converters:
  - Eating vegetables to restore
  - Watering plants
- Traders:
  - Exchanging items between players
  - Placing items in a chest

Resources are Independent

- Any resources can be used by any of the mechanisms in the game
  - **Source:** Cauliflowers can be received via mail (out of nothing)
  - **Drain:** Cauliflowers can be thrown into the trash (destroying them)
  - **Converter:** Cauliflowers can be sold (converted into gold), eaten (stamina/health), etc.
  - **Trader:** Cauliflowers can be traded with other players (exchange between entities) and placed in chests (exchanged current ownership)

Seeds	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Harvest	Sells For	Restores	Used In
 Cauliflower Seeds Pierre's: 80g JojaMart: 100g							 175g 218g 262g 350g	 ✚ 75 H 33 ✚ 105 H 47 ✚ 135 H 60 ✚ 195 H 87	 Cheese Cauliflower  Spring Crops Bundle  "Jodi's Request" Quest  Maru (Loved gift)
	1 day	2 days	4 days	4 days	1 day	Total: 12 days	≈ 7.92g/d		

Questions?

Time for Some Practice

Choose a Game and Make a List of its Mechanisms

- Choose any game, digital, physical, card game, tabletop, or whatever
  - You can reuse the one from the previous moment
- Make a list of at least one of each mechanism
  - Sources, Drains, Converters, Traders
- Try to find resources that are simultaneously used by all four mechanisms
  - Like the Cauliflower in Stardew Valley
- If you cannot find an example of trading, consider a multiplayer game

Time for Some Theory

Conceptual Game about Flowers

- Let us explore the game's economic concepts and ideas using a **conceptual** game:
  - The player can buy flower seeds
  - The player can plant flower seeds
  - After grown, the flowers can be sold for money

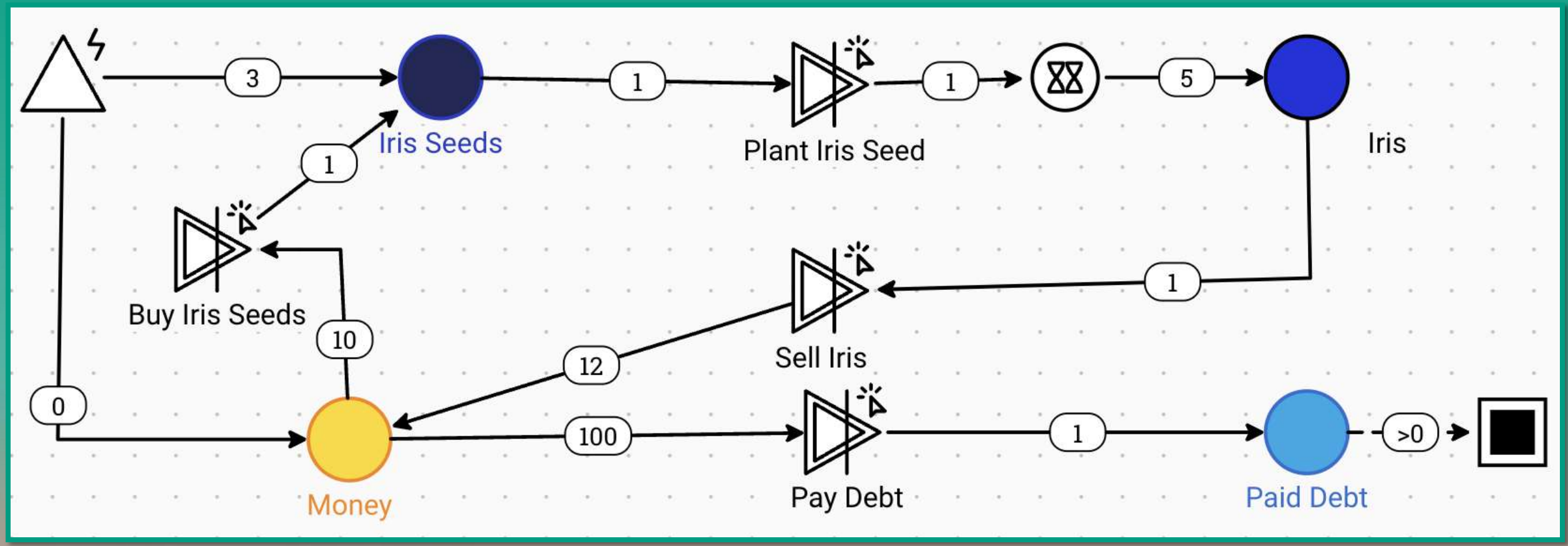
- **Objective:** The player must pay a debt of **X** (100**g**) to win
  - **Always use defined values!**

Iris: Resources & Values

- We need to establish initial values
  - The player starts with three seeds
- **Iris:**
  - An iris seed is sold by 10g
  - An iris flower is sold for 12g
  - An iris takes five turns to grow
- **Some calculations:**
  - Takes ~9 Irises to reach 100g
  - Given 9 seeds, it would take 45 turns

https://tinyurl.com/iris-only

MACHINATIONS DIAGRAM WITH THE CURRENT GAME

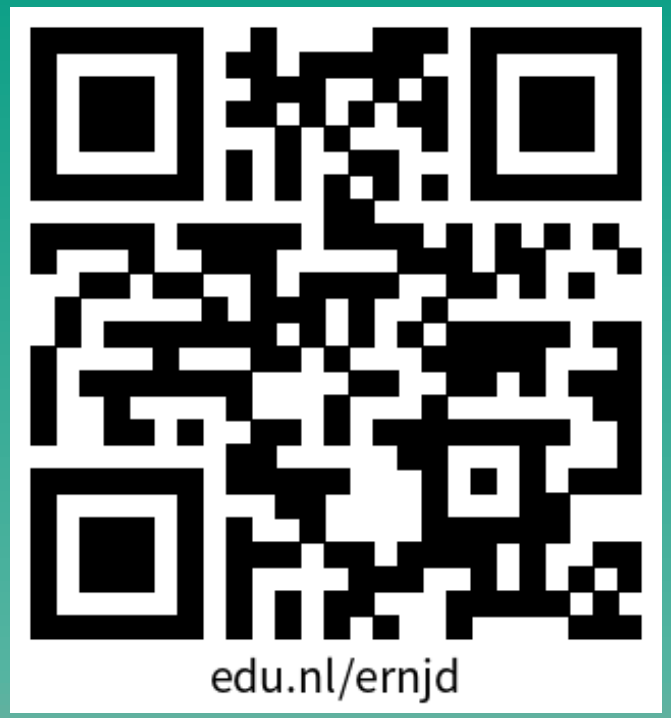

3
Iris Seeds
1
Plant Iris Seed
1
5
Iris
1
Buy Iris Seeds
10
1
Sell Iris
12
0
100
Money
Pay Debt
1
Paid Debt
>0

Simulating: Iris Only Version

- If we were to simulate this game with only the values discussed previously, we would have a similar chart to the one below (Simulated in Machinations)
- It is quite "well-behaved" and seems rather monotonous
- Besides, it lacks **options**
- There is a bit of strategy to it, but not enough to give the player **alternatives**

Tulip: Resources & Values

- Adding a new resource
- **Tulip:**
  - A tulip bulb is sold by 8g
  - A tulip flower is sold for 16g
  - A tulip takes ten turns to grow
    - Balance measure based on the other values
- **Some calculations:**
  - Takes ~7 Tulips to reach 100g
  - Given 7 seeds, it would take 70 turns



https://tinyurl.com/iris-tulips

WHICH ONE IS BETTER? IRIS OR TULIPS?

Tulips x Irises: Estimating Value

- Beware: We are going to use MATH!
- Profit Over Time Equation:
  - Seed(S), Flower (F), Turns (T)

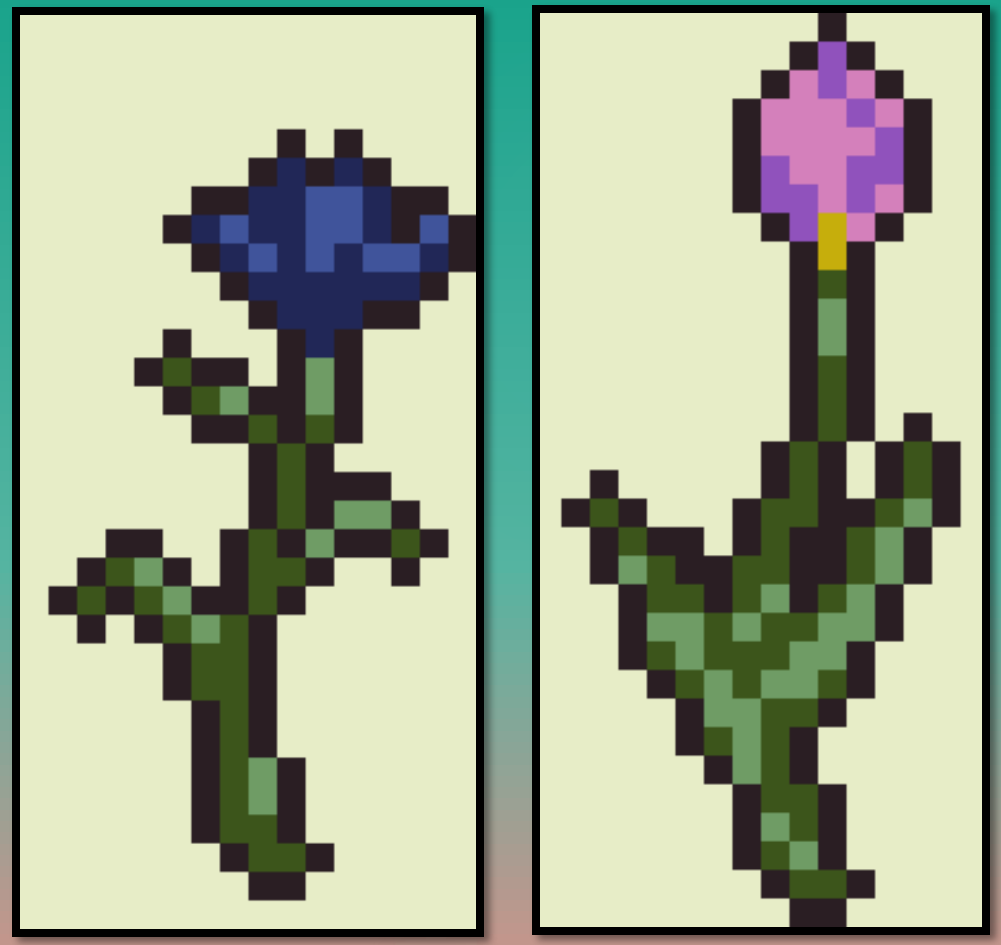
$$Profit(S,F,T) = \frac{F-S}{T}$$

- **Iris profit:**

$$Profit(10,12,5) = \frac{12-10}{5} = 0.4g$$

- **Tulip profit:**

$$Profit(8,16,10) = \frac{16-8}{10} = \boxed{0.8g}$$



The Game is Unbalanced, but…

- Given the equations used, we can clearly see that a strategy of using only **Tulips** is better than using **Irises**
- But this is not necessarily clear to the player at the start
  - And it might still work for a while
  - While still giving options

Simulation with only Tulips*

Simulation using both Flowers

Trying to Balance the Values

- **Regular Tulip:**

$$Profit(8,16,10) = \frac{16-8}{10} = 0.8g$$

- **Longer Tulip:**

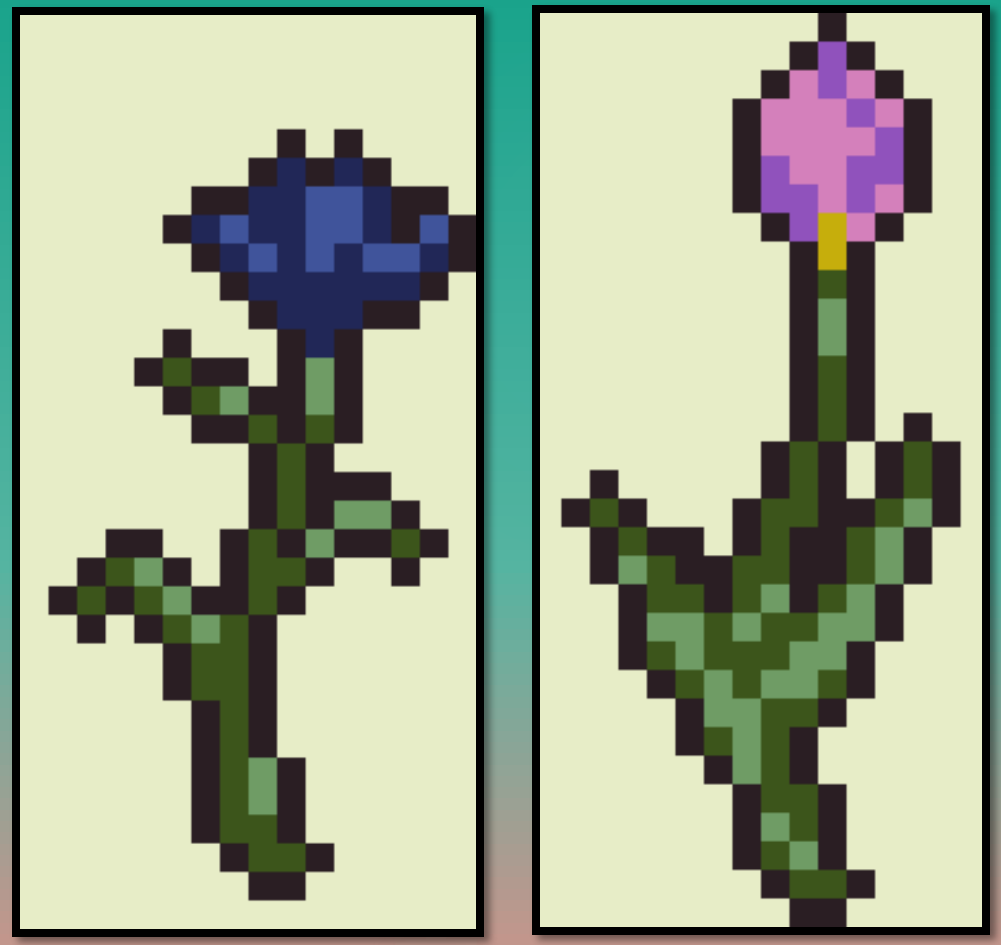
$$Profit(8,16,20) = \frac{16-8}{20} = 0.4g$$

- **More Expensive Tulip Bulb:**

$$Profit(12,16,10) = \frac{16-12}{10} = 0.4g$$

- **Reduced Flower Cost:**

$$Profit(8,12,10) = \frac{12-8}{10} = 0.4g$$

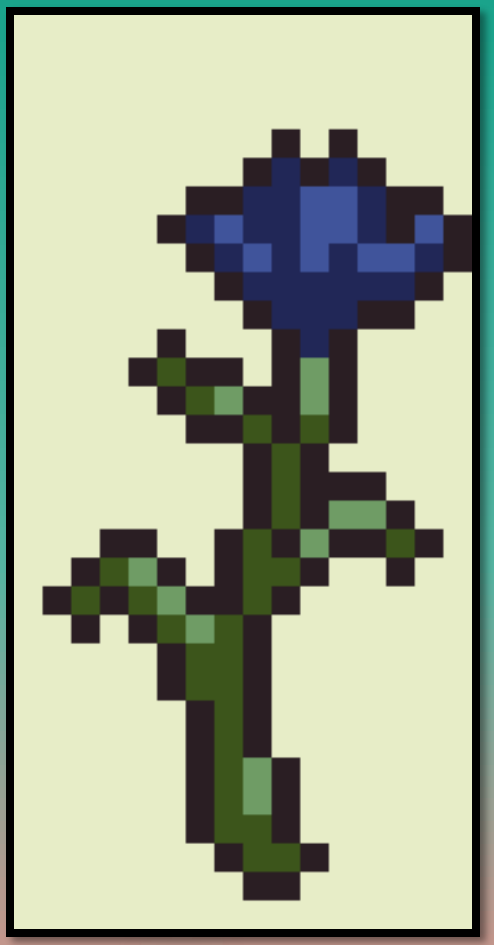


Perfect Balacing is Boring

- The problem with this approach is that there are no real options anymore
  - Both alternatives are pretty much the same in terms of **value**
- Some might take longer or require more money, but they will ultimately behave the same
- It can make the gameplay boring
- "The perception of balance is more powerful than balance itself." Jeff Kaplan

Resources & Values Re-evaulated

- Adding one new mechanic:
  - An iris seed is sold by 10g
  - An iris flower is sold for 12g
  - An iris takes five turns to grow
  - **An iris flower has a 40% chance of generating a new Iris Seed for free**
- **Some calculations:**
  - Takes ~9 Irises to reach 100g
  - Given 9 seeds, it would take 45 turns



New Mechanics and Balancing

- The new mechanic makes the Iris a viable option again
- Now, it is also a matter of choice
  - Strictly follow the numbers with Tulips, or take a **lucky** chance using Irises?
- Each new addition can make the game even more **unbalanced**
  - Besides adding new mechanics, it is important to care about balancing them
  - But not necessarily to perfectly balance the options (it is boring!)

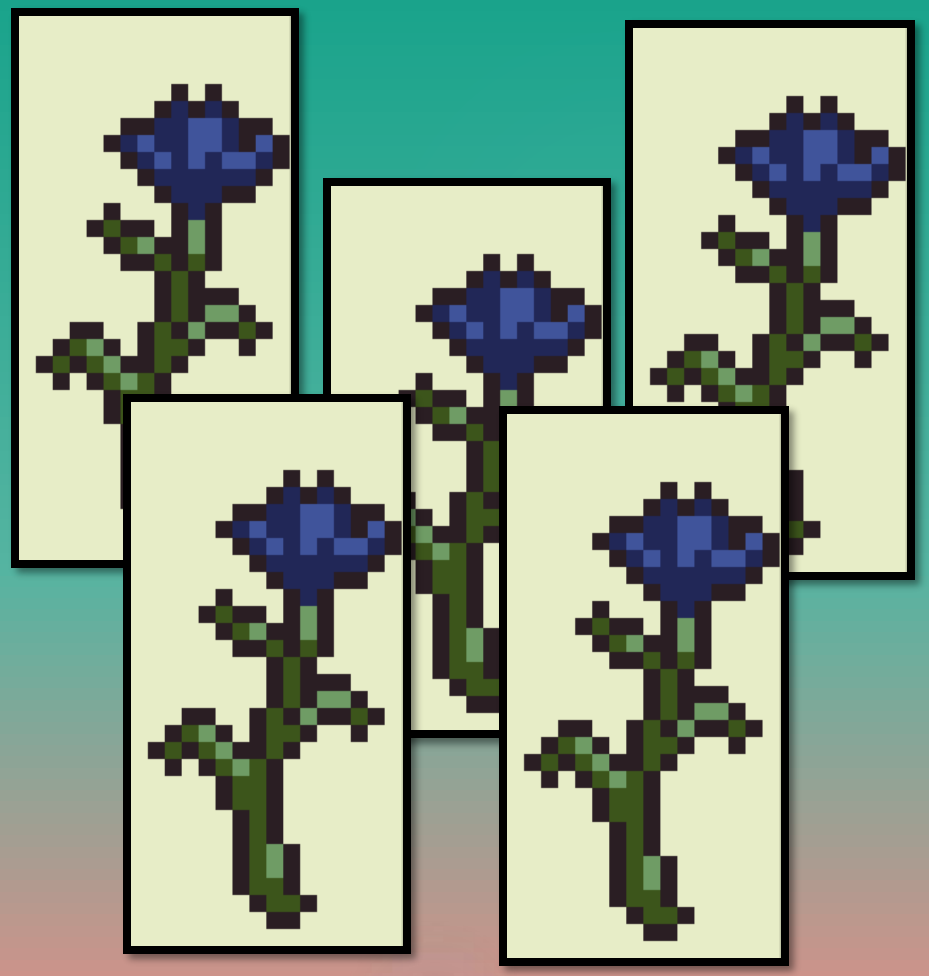
Mechanics, Balancing, and Fairness

- Reaching a **perfectly balanced state** is very hard and time-consuming
- Aiming for "**fairness**" is easier
  - Fair means that the player feels the **game is just**
  - **Different options seem viable,** i.e., that they can get you to win the game
- More options also lead to
  - More replay value
  - More work balancing

Questions?

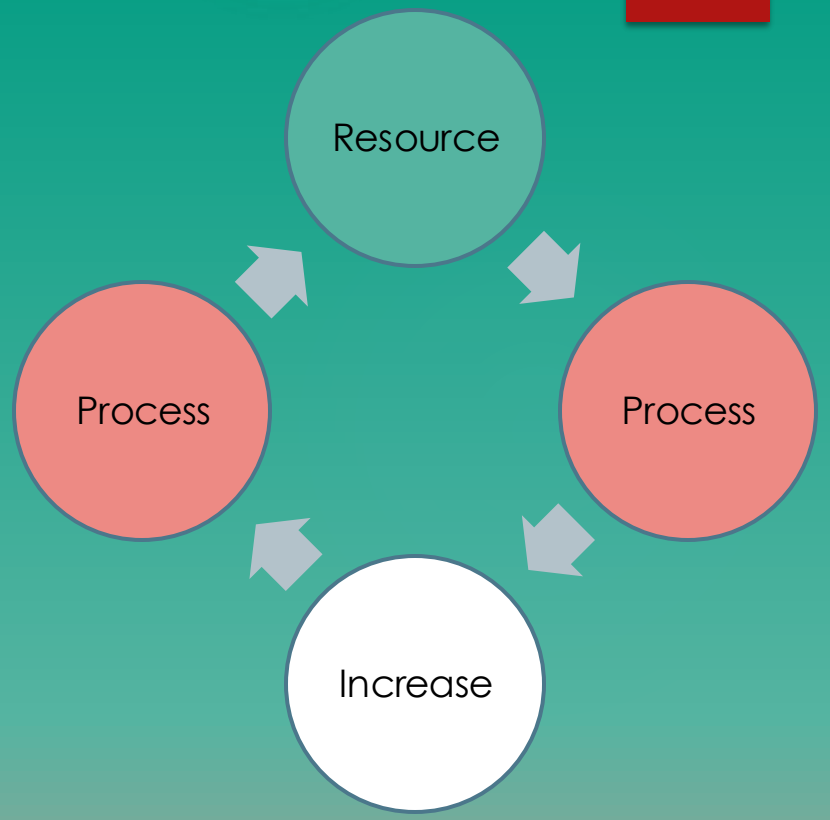
More Profit Overtime

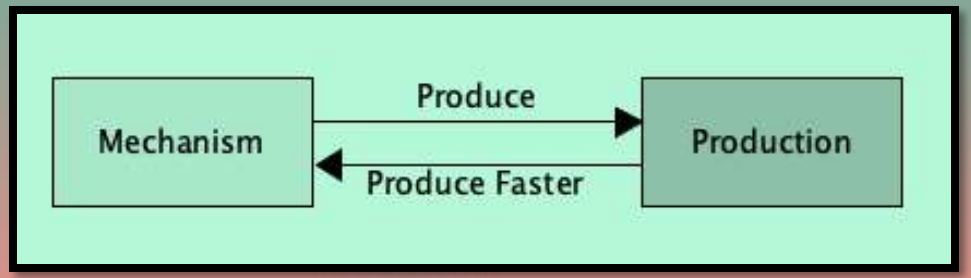
- So far, the example has not explored any sort of **relation** between resources
  - Seeds/Flowers relate to Money
- However, due to profit, we can see that as we proceed, more flowers can be planted
  - More profit **overtime**
- This is a **Feedback Loop**



Feedback Loop

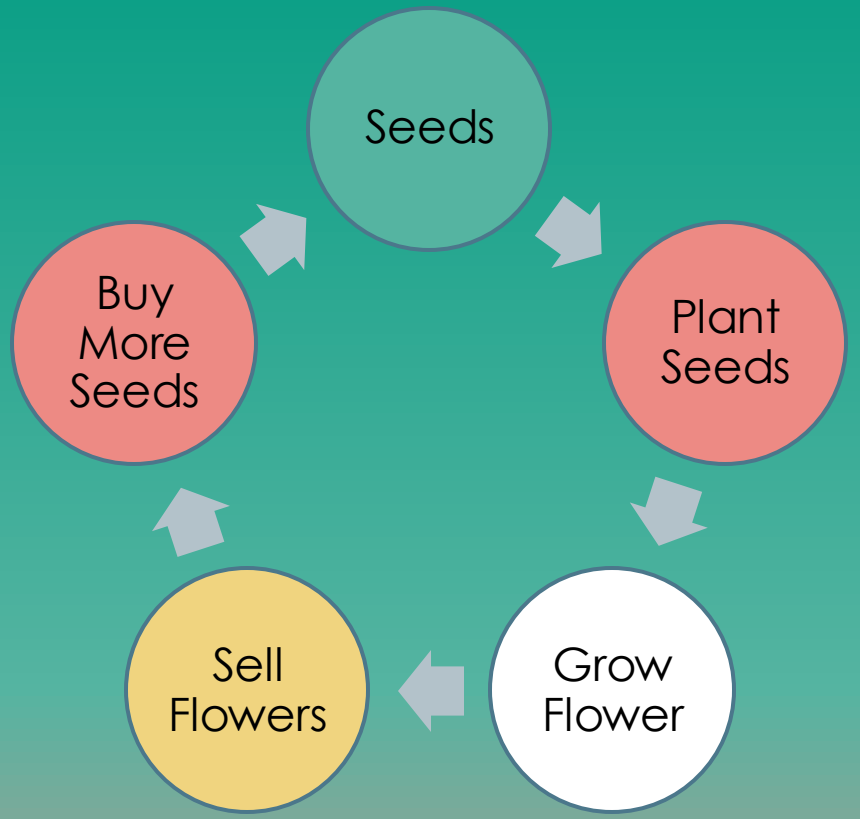
- A **feedback loop** is a process in which one or more mechanisms are influenced by themselves
- Not all mechanisms are part of the feedback loop, but **most will be**
- Feedback loops can span over various other mechanisms

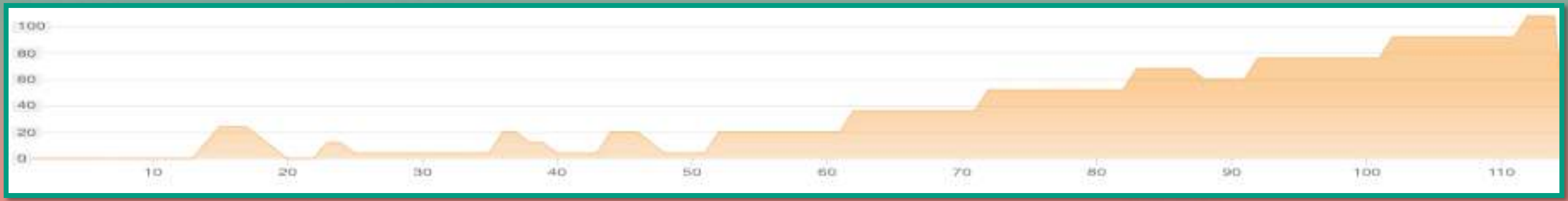




For more: https://tinyurl.com/8jss7ts2

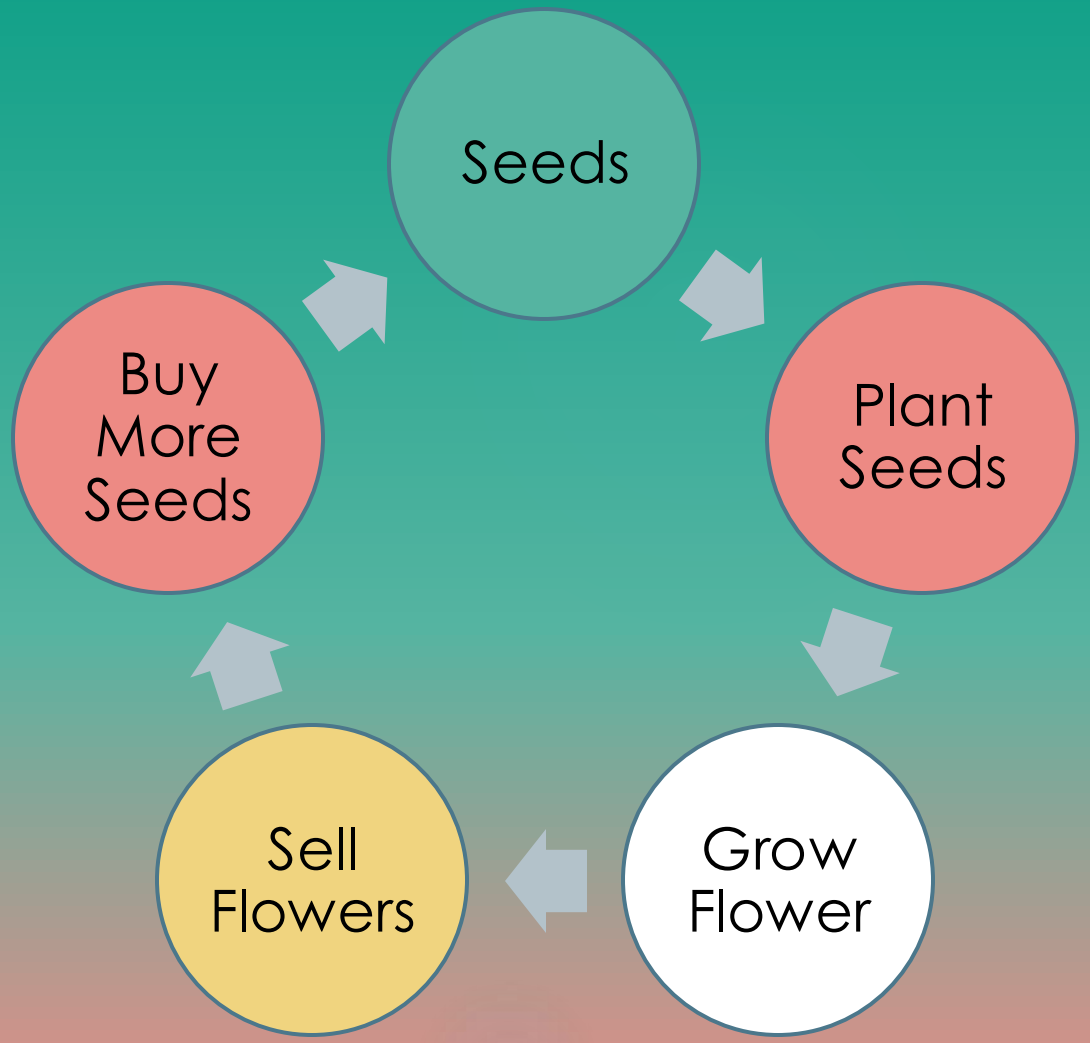
Feedback Loop: Flowers





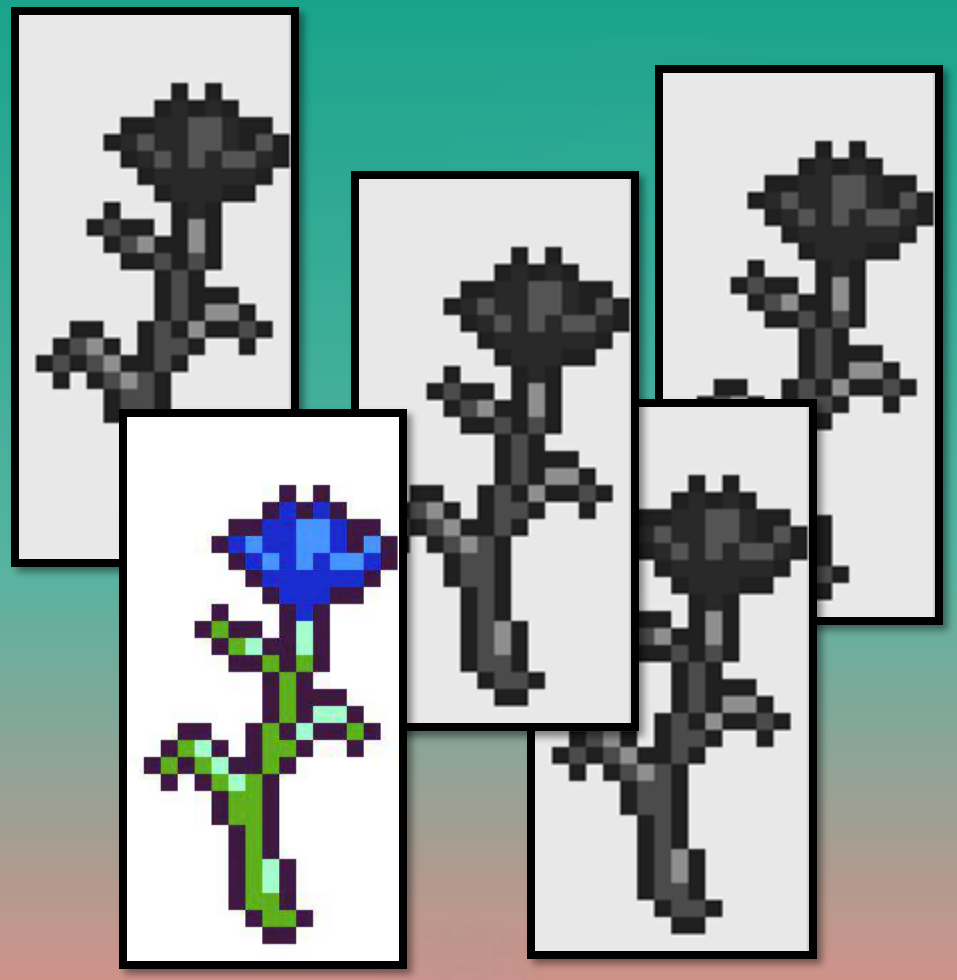
Positive Feedback Loop

- When a feedback loop increases the results of its related mechanisms, it is considered a **Positive Feedback Loop**
- Positive Feedback Loop destabilises the game economy
  - **Escalation**
- Empower the player but at a cost to the player(s)



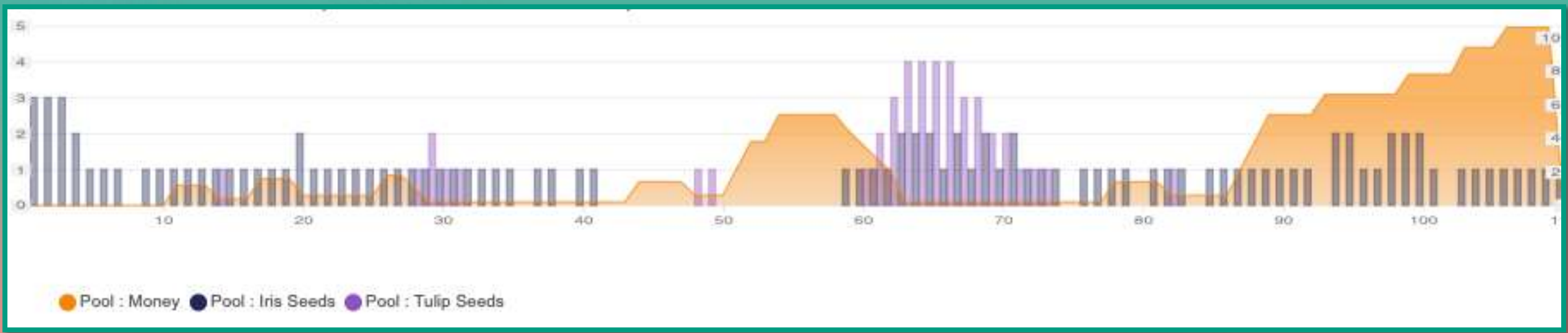
Positive Feedback Loops & Upgrades

- Positive Feedback Loops can also be created by the addition of **Upgrades** and related Mechanics
- For example, the **player can dissect Irises to understand it better and improve the chances of it generating more seeds when harvested**
  - Each Iris can be **converted** to +5% on the random extra seed chance



Simulating Positive Feedback Loops

- Positive Feedback Loops can highly increase how a certain resource is perceived by the players and expand the strategy options
- They tend to **destabilise the game quickly**
  - After handing in 12 Irises, each Iris has a 100% chance of generating another seed
- The game's goal might limit the effect of a positive feedback loop, **but this needs to be a decision, not a side effect**



Feedback Loops and Capitalism

BBC

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Monopoly was invented to demor the evils of capitalism

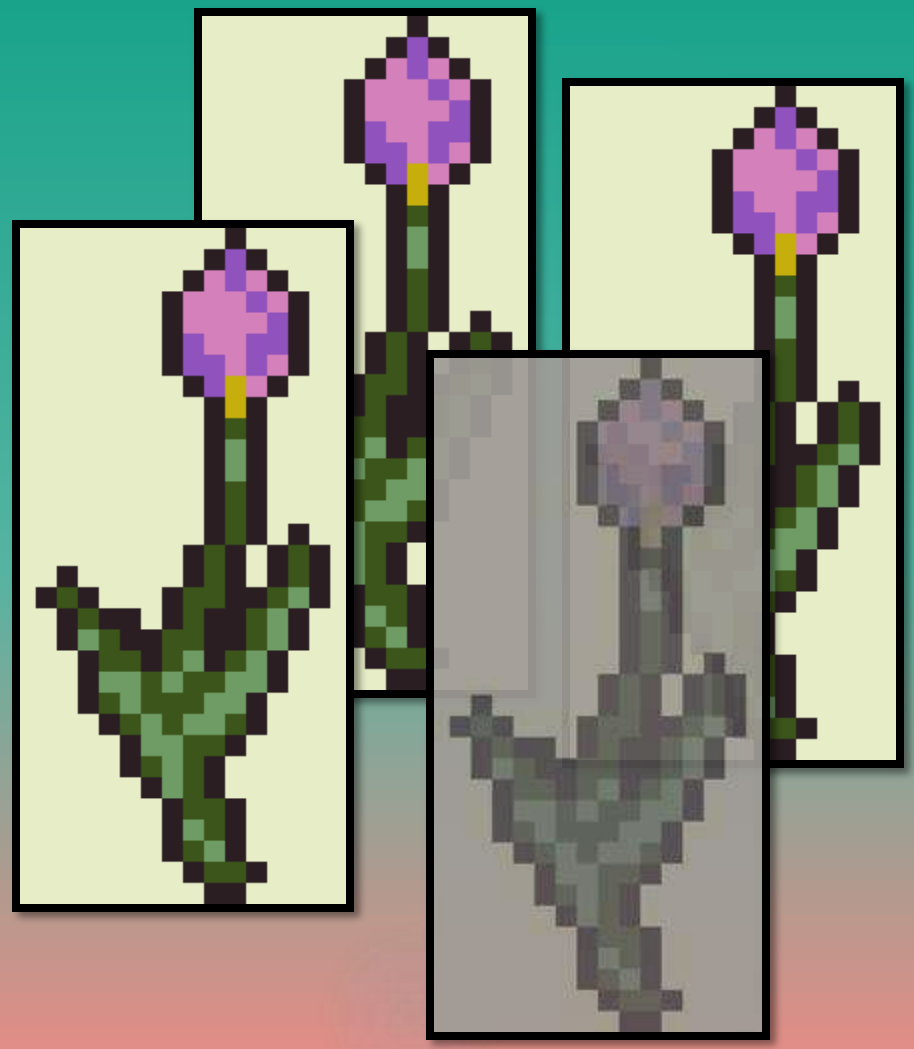
28 July 2017

Kate Raworth
Features correspondent

Under the 'Prosperity' set of rules, every player gained each time someone acquired a new property (designed to reflect George's policy of taxing the value of land), and the game was won (by all!) when the player who had started out with the least money had doubled it. Under the 'Monopolist' set of rules, in contrast, players got ahead by acquiring properties and collecting rent from all those who were unfortunate enough to land there – and whoever managed to bankrupt the rest emerged as the sole winner (sound a little familiar?)

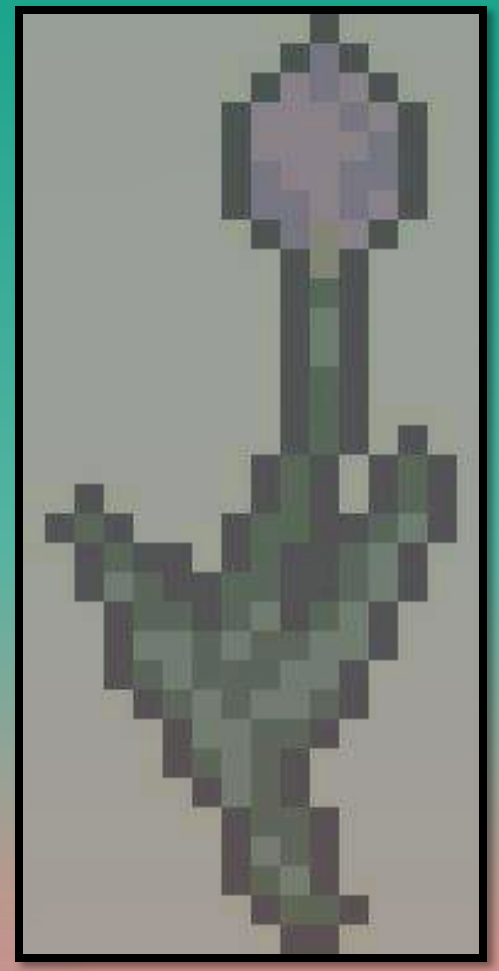
Negative Feedback Loops & Downgrades

- A negative feedback loop **weakens or decreases** the effectiveness of mechanisms and resources
- Negative feedback loops **stabilise** the game, getting it back to a more stable scenario
- Weaken the player at the cost of **balancing the experience** for other players and the game itself



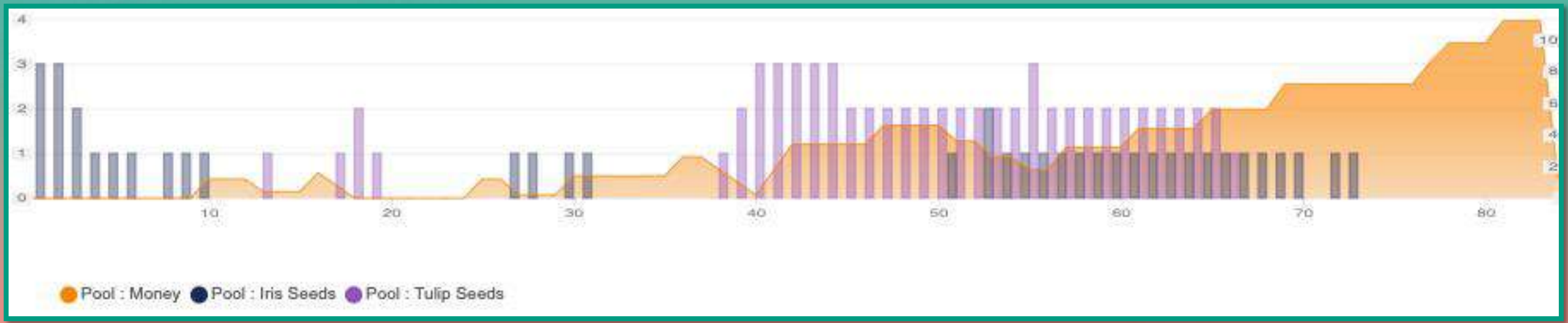
Tulips are not that hot anymore

- Inspired by the Tulip Mania in the Netherlands, let us add a **negative feedback loop**
- Every time a **Tulip is sold**, the value of the next Tulip is reduced by 2 (16, 14, 12, …, 0)
  - They have a high value, but they devalue over time
- The value is restored (+2) for every other flower (Irises, in our example) that is sold
  - Forces a "market" diversification
  - Strategy: sell one of each to keep high profits



Simulating Negative Feedback Loops

- Negative Feedback Loops **devalue and weaken relations** to stop and counter the growth caused by Positive Feedback Loops
- They tend to **stabilise** the game over a period of time
  - After selling three consecutive Tulips, their value is reduced to 10, which is a lower profit than regular Irises (**0.375g for Tulips**, compared to **0.4g from Irises**)
- This process helps to keep the game goal fair and maintain the sense of competition, **allowing other players to catch up** and win the game

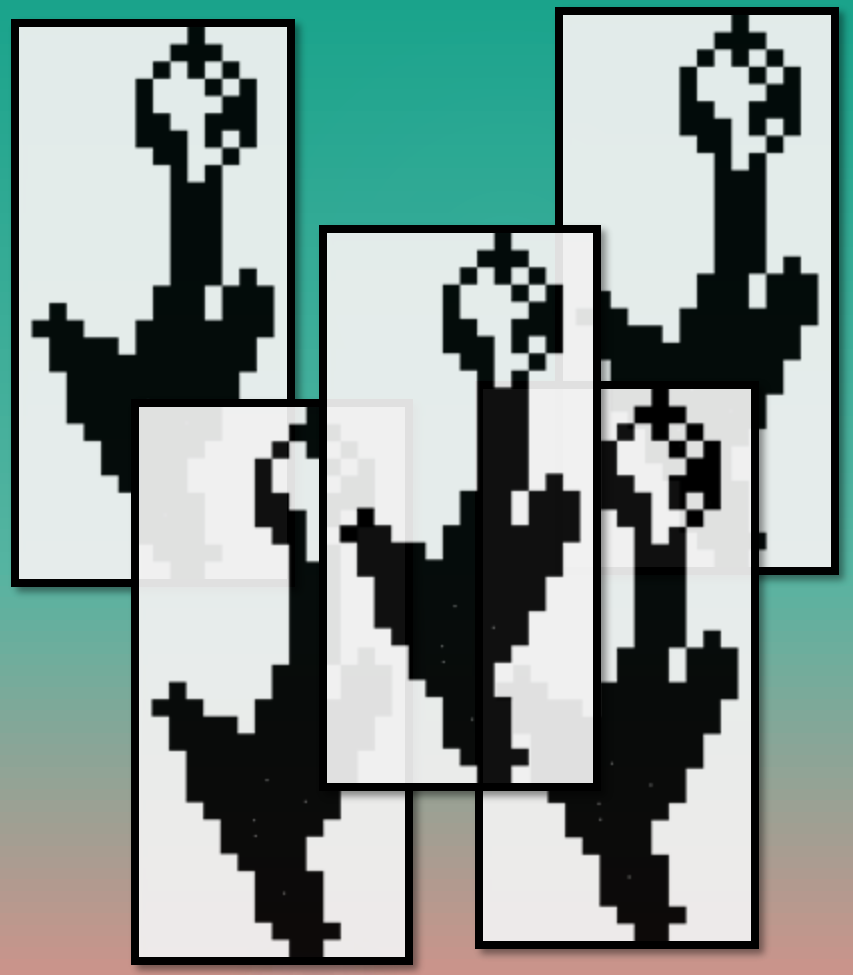


https://tinyurl.com/iris-flower-game

HOW FAST CAN YOU WIN?

Deadlocks & Game Over

- While Negative Feedback Loops are a powerful tool to keep the game interesting, they can cause **issues**
- Negative Feedback Loops can provoke or increase the chances of a **deadlock**
- A deadlock is when a mechanism is stopped due to the lack of resources
  - Tulips can devalue so much that the player has no money to buy any other seed.
  - Game Over!




650
100
50
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25
175
Menu

Free Resouces & More Mechanics

- Deadlocks are problematic when they can ultimately **prevent any action**
  - If the player naively spends all the money on Tulips and can not do anything else
- Giving away free resources or adding other alternative mechanics can ensure that the player always have alternatives to continue playing

Randomness is a Friend

- Many of these economic relations can be mapped to mathematical equations and formulae
- Ultimately, a "perfect" strategy could be calculated using the available data (and testing)
  - Creating a **Meta Game**
- However, if the mechanics are **not deterministic**, these strategies can fall short
- Random elements allow different strategies to be viable
- Add risk to the game
  - Excitement & Engagement

For more: https://tinyurl.com/svt8db56

Motivation & Storytelling

- The game economy relates to the game's mechanics. It can:
  - Empower players
  - Give them options
- Also, as a storytelling tools
  - Activating specific mechanics
  - Justifying mechanisms

Narrative through Numbers

- The Tulip Devaluation mechanic can be understood as a **storytelling device** to enable a Negative Feedback Loop

- As the player progresses, they unlock other flowers (Roses and Sunflowers, e.g.)
  - The story progresses by opening more mechanics in the economy
  - New relations = New stories

Questions?

Thank You ☺

and happy holidays

edu.nl/vfhk3

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