# Video Game Economics (Reality Check)

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# Introduction

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  - or YRE03
- From Fortaleza, Ceará - Brazil ☺
- Background in Computer Sciences (Bachelor and Master), especially Computer Graphics (OpenGL with C++)
  - Scientific Research on Games and Computer Graphics

- Things I do:
  - Startup Company & Fund Raising
  - Opinion Pieces & Freelance Technical Articles
  - Game Design Articles & Book
  - Participate in multiple game jams per year

# Economics is not (only) about Money

- Regarding Video Games (or just Games), Economics is the study of **Resources** and their relations
- Resources are numerical concepts
  - Gold and Wood are resources, e.g.
  - Strategic Position in the map is also
- Anything **numerically measured** is a resource
- Studying Game Economies (for short), we can better approach many aspects of Game Design:
  - Balancing & Fairness
  - Determining Goals & Sub-Goals
  - Elevating Mechanics
  - Improving the Game
- We use a lot of math for this
  - Useful: Excel & Machinations

# Exploring Where Resources Are

- Classic *Doom* example. Which resources can we identify?
  - Ammo
  - Health
  - Armor
  - Shell
  - Enemies on the Screen
  - Stage in the Game

# Types of Resources

- **Tangible**
  - Have physical properties
  - Belong the Game World
- **Intangible**
  - Do not exist physically in the Game
  - Usually belong to the UI
- **Concrete**
  - Visible in the game
  - Recognized by players and systems
- **Abstract**
  - Do not “exist” in the Game World
  - Usually used within the game systems and mechanics

For more: https://tinyurl.com/3c9f72e7

# Exploring Where Resources Are (Again)


https://tinyurl.com/yvupmku8


https://9gag.com/gag/a5ojDjo

# A Game is a System of Resources

- Most games can be understood and broken down into systems of resources
- Technically speaking, a game can be loosely defined as: a **playful activity** with a **set of rules**, in which **one or more players** have to follow to **achieve victory**
- The victory condition itself can be understood as a Resource
  - A **Win or Victory Resource**
- Some games are a literal collection of the victory resources
  - If you have 5 diamonds, you win
- While others are more complex
  - Defeat the final boss, which is **zero the final boss HP resource**

# Collecting / Killing / Building Resources

- In fact, it is a great Game Economy exercise to break down game objectives as to find which one is the **Victory Resource**
  - Also, many mechanics, besides collecting, such as killing and building, can be used to achieve victory

- *Counter Strike* x *Civilization*
  - Killing x Building

# Resources Influence Each Other

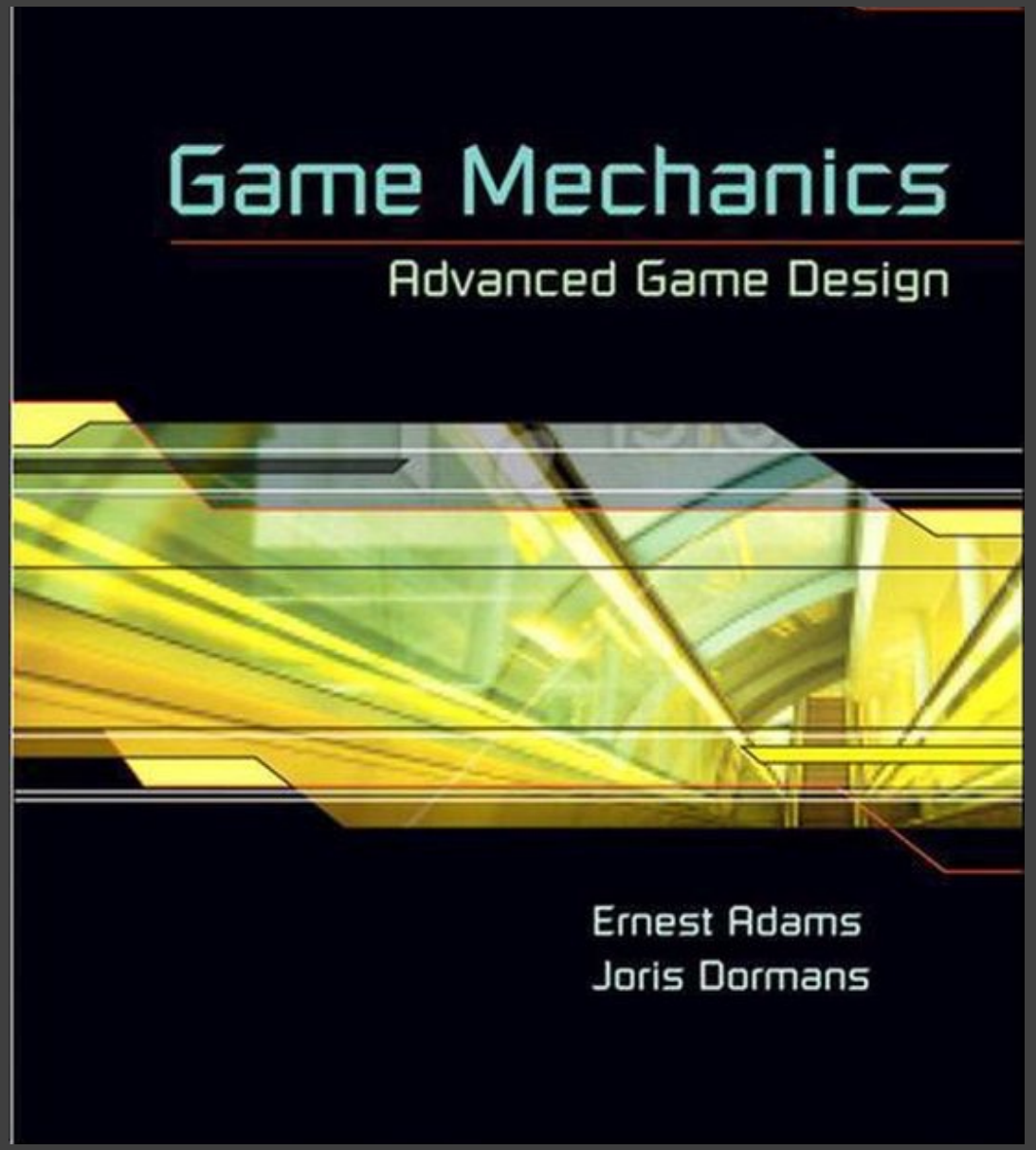
- Resources can influence each other in various ways
  - Change their interactions with the players and other game elements
  - Power Up (or Upgrades)
  - Unlock parts of the game

- Collecting the Stars in *Super Mario 64* unlock other stages, and even other stars in the same stage

# The 4 Mechanisms

- Player and resources interactions, though are mostly categorized as under 4 different mechanisms
  - Sources
  - Drains
  - Converters
  - Trades

- Ernest and Joris (2012) use them as the base to explain the entire theory of Video Game Economics in their book
- This lecture is based on this book, as many of our discussions and definitions arise from the book's content



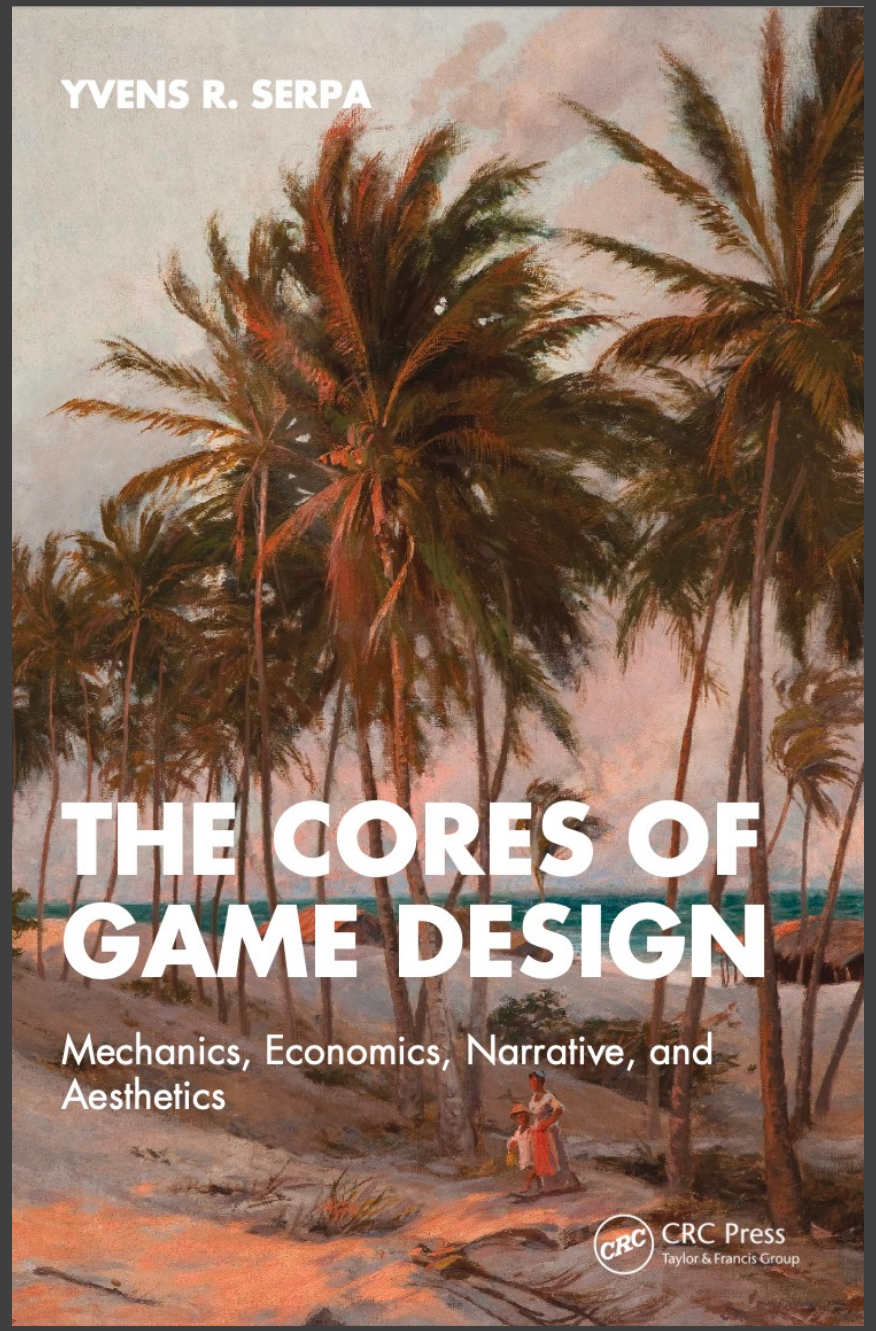

For more: https://tinyurl.com/3c9f72e7

# Upcoming: The Cores of Game Design

- Many of this points and discussions are also based on the theory and practice I wrote in my upcoming book, The Cores of Game Design

- Applying principles of the Economy as a starting point for the game design/development process

- Connecting mechanics, narrative, and aesthetics through economy processes



# Time for Some Theory

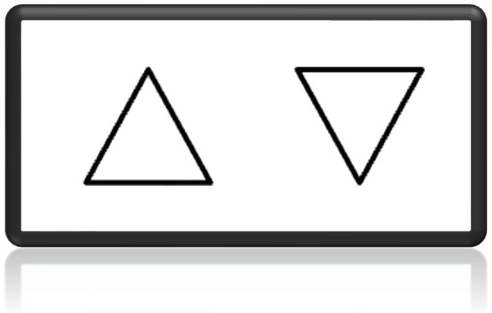
# Sources & Drains

**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**



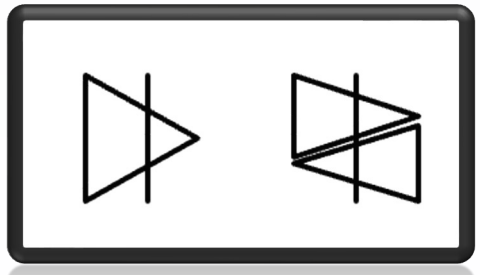
# Converters & Traders

**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**




Bok Choy
6

# Mechanisms

- Sources:
  - Soil generate 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 from Mechanisms

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

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

# Questions?

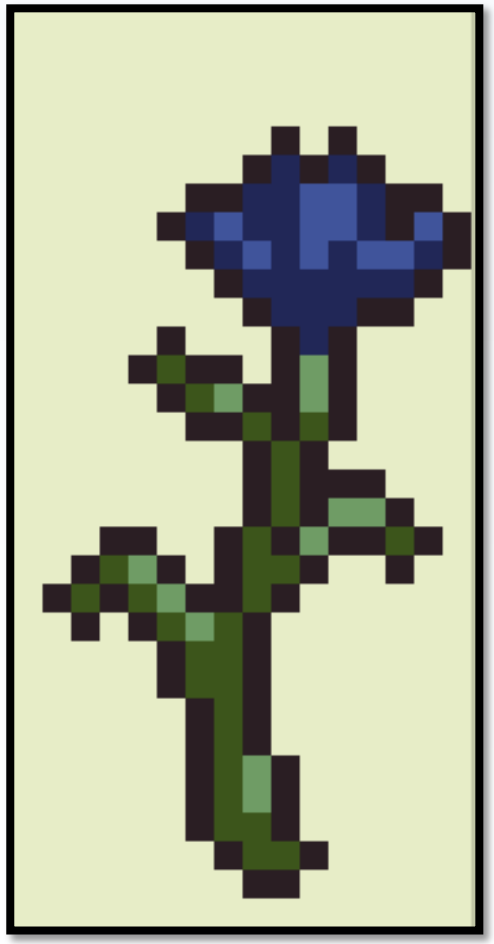
# Conceptual Game about Flowers

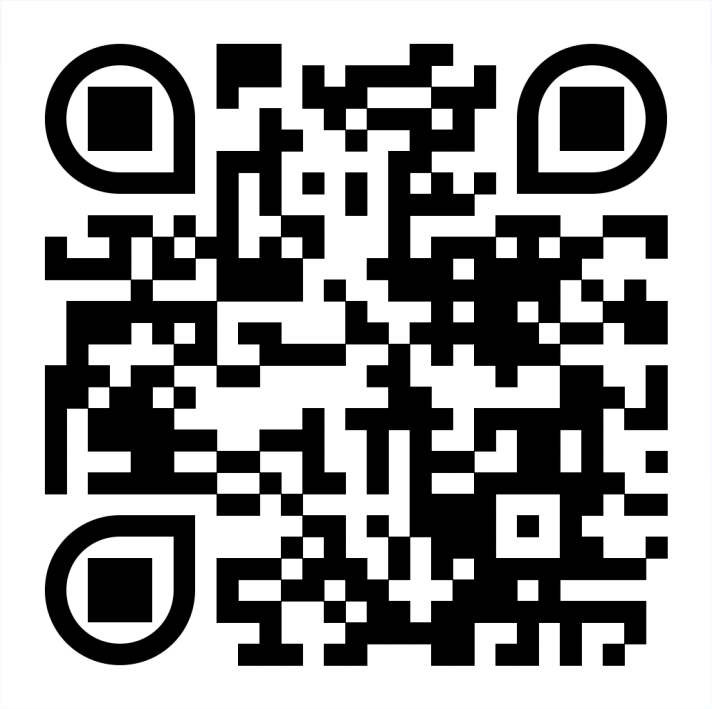
- Let us explore the game economic concepts and ideas using a conceptual game:
  - The player can buy flower seeds
  - The player can plant flower seeds
  - After grown, the flowers can be sold

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

# Iris: Resources & Values

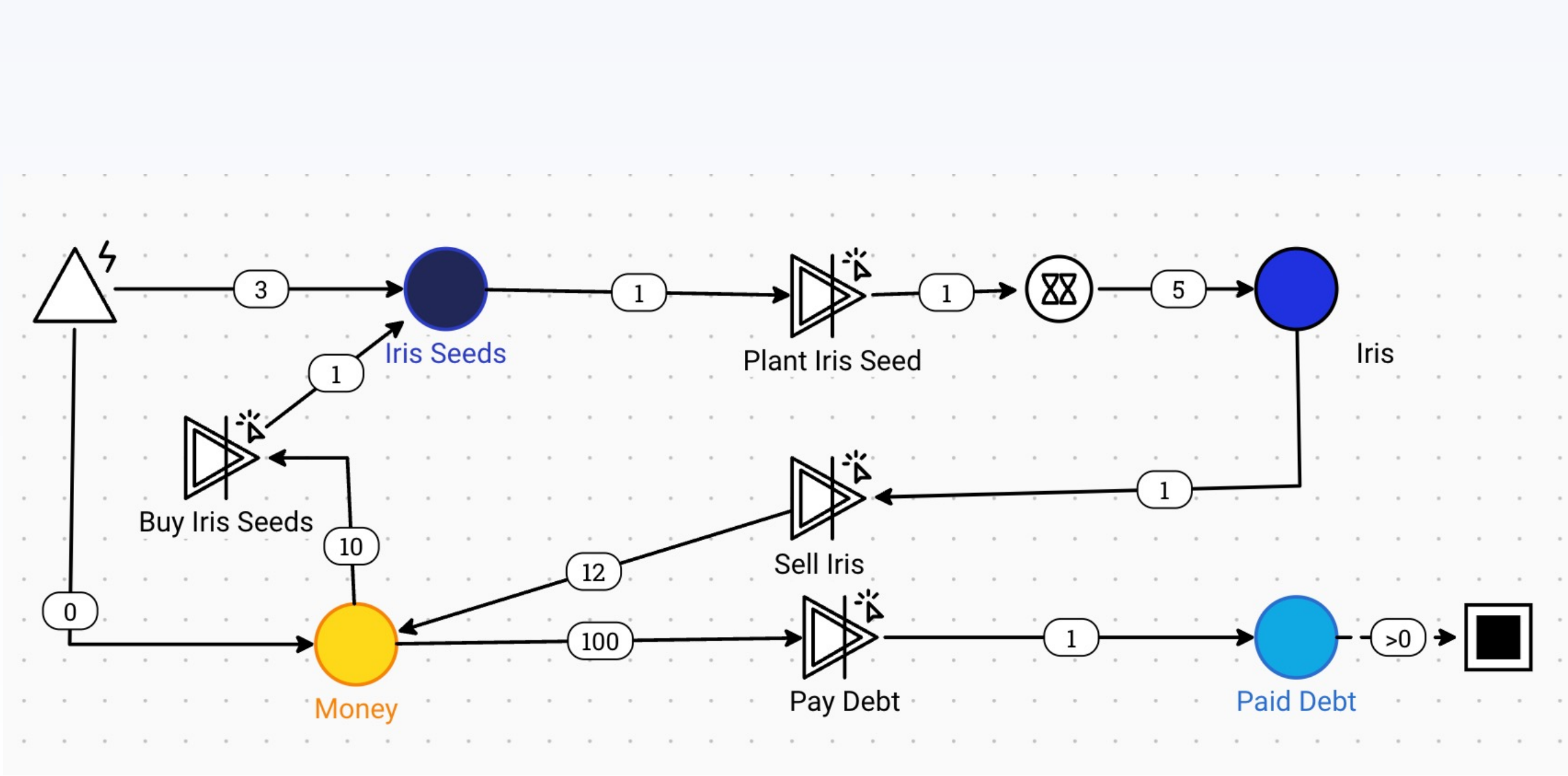
- We need to establish initial values
  - Player starts with 3 seeds
- **Iris:**
  - Iris seed is sold by 10g
  - Iris flower is sold by 12g
    - Sell for more than we buy = profit!
  - Iris takes 5 turns to grow
- **Some calculations:**
  - Takes ~9 Irises to reach 100g
  - Given 9 seeds, it would take 45 turns





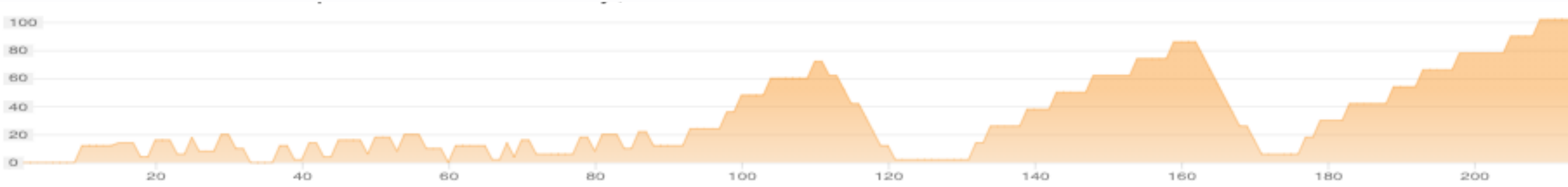
# https://tinyurl.com/iris-only

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
Money
100
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**

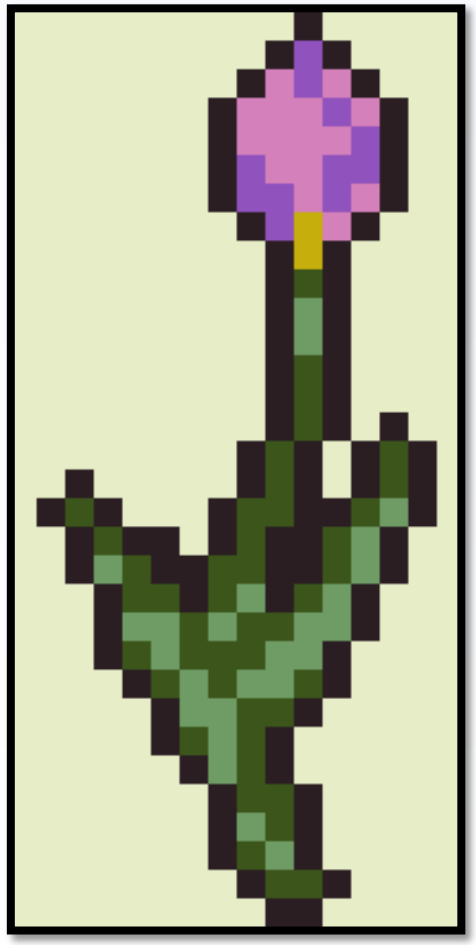


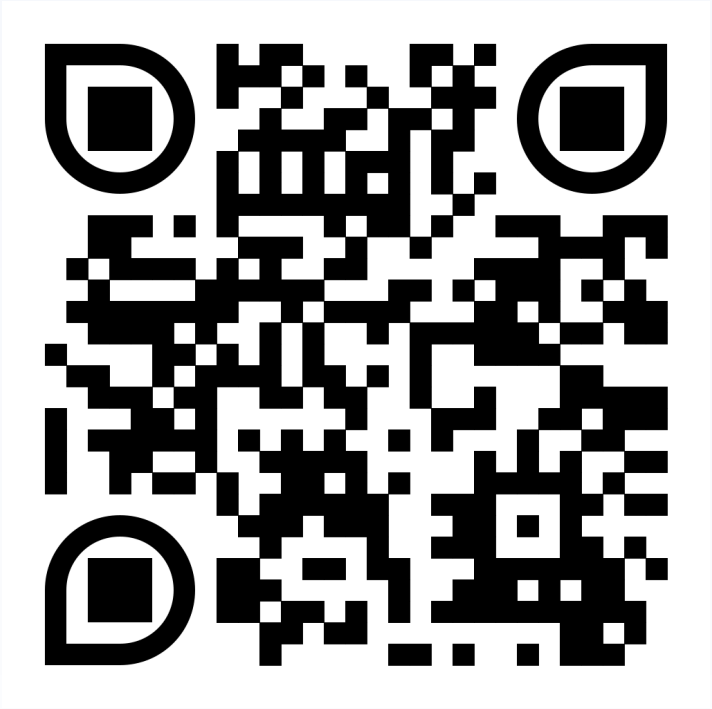
# Tulip: Resources & Values

- Adding a new resource

- **Tulip:**
  - Tulip bulb is sold by 8g
  - Tulip flower is sold by 16g
  - Tulip takes 10 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

Machinations Diagram with the current game (iris + tulips)

Which one is better?

# Tulips x Irises: Estimating Value

- Beware: We are going to use MATH!

- Profit Over Time Equation:
  - Seed($S$), Flower ($F$), Turns ($T$)

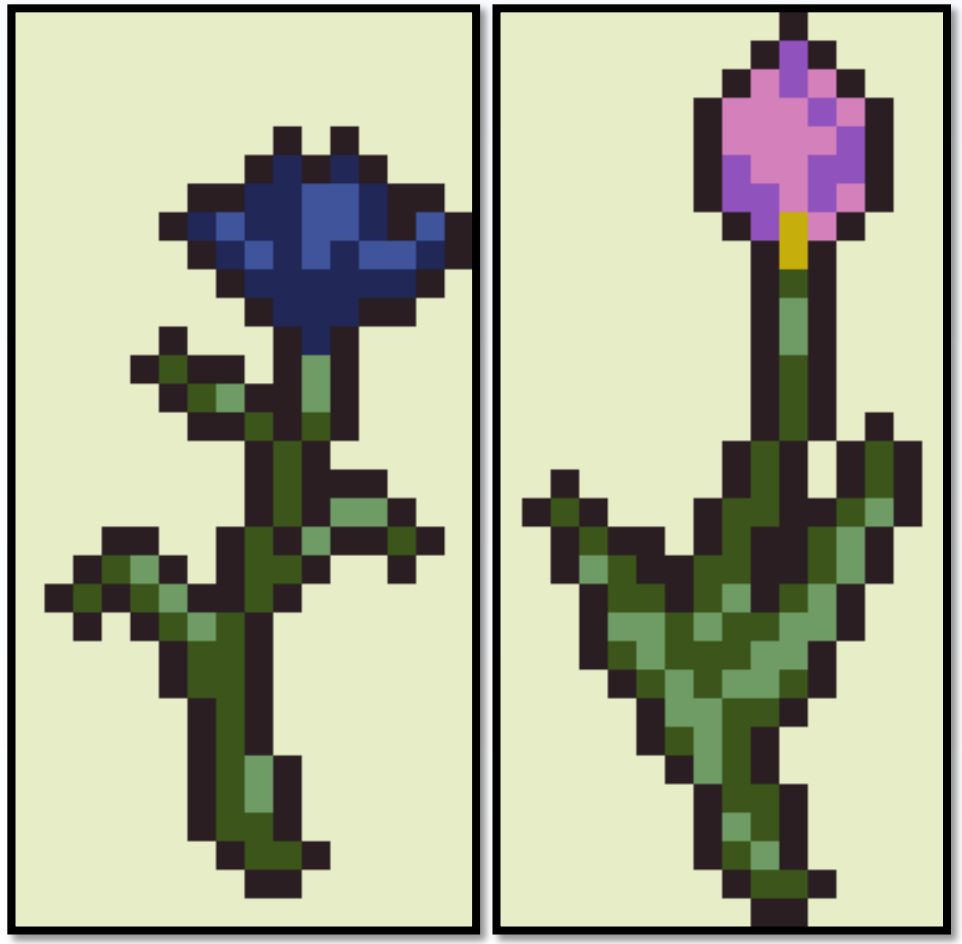
$$Profit(S, F, T) = \frac{F - S}{T}$$

- Iris profit:

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

- Tulip profit:

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



# 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 might still work for a while
  - While still giving options

Simulation with only Tulips*


Simulation using both Flowers

# Tulips x Iris: Trying to Balance the Values

- Iris profit $= 0.4g$
- Regular Tulip:

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

- Longer Tulip:

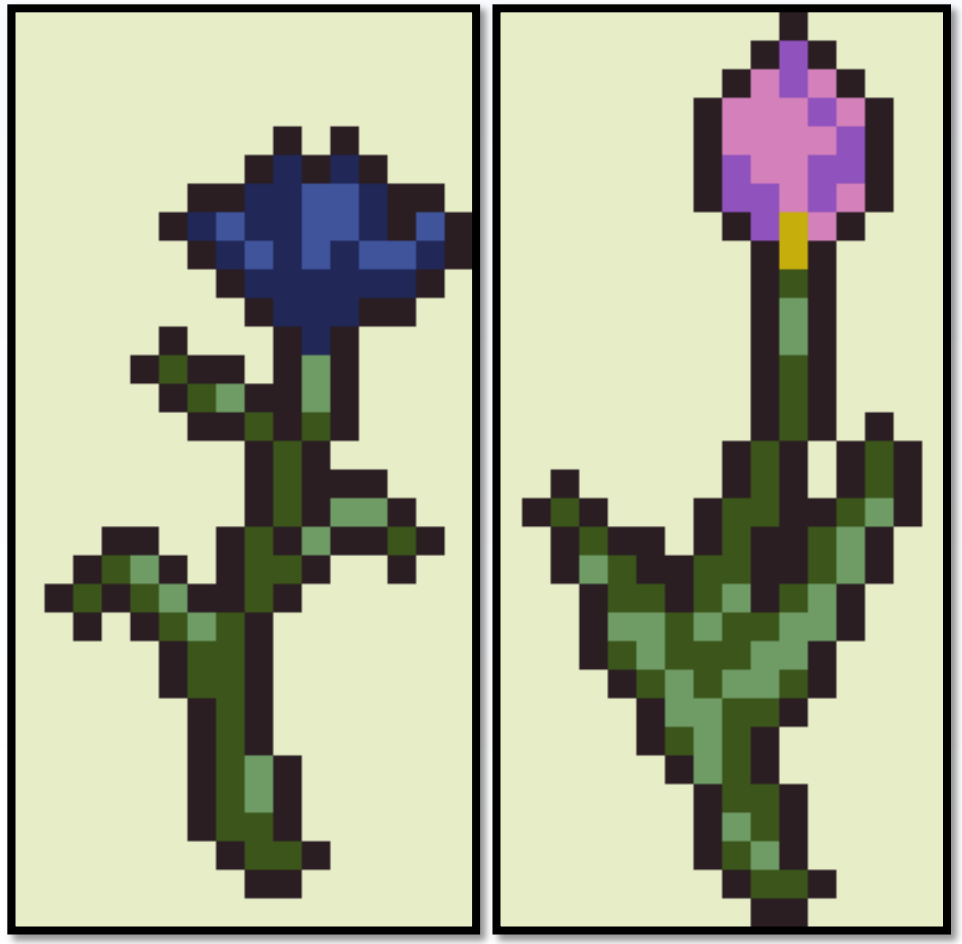
$$Profit(8,16,20) = \frac{16-8}{20} = 0.4g$$

- 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
- Can make the gameplay boring

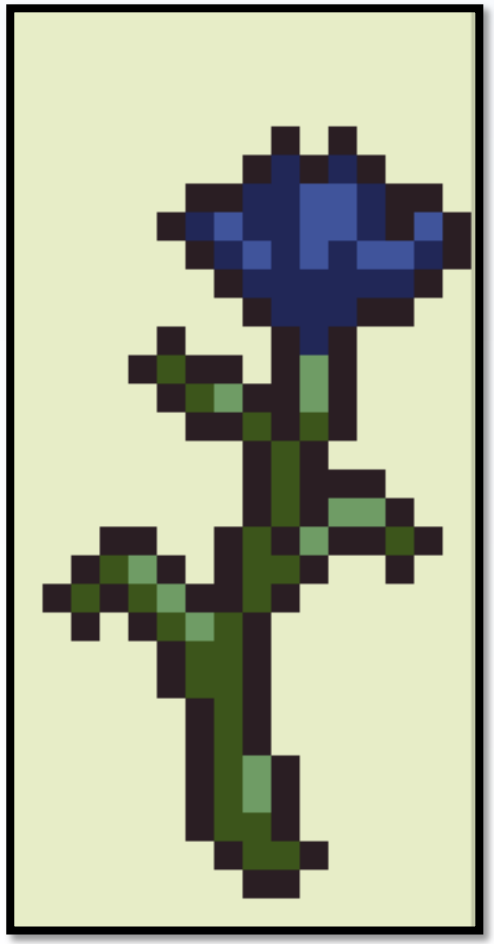

- As stated by Jeff Kaplan, former Overwatch's Game Director:

  "The perception of balance is more powerful than balance itself."

# Iris: Resources & Values Re-evaulated

- **Iris:**
  - Iris seed is sold by 10g
  - Iris flower is sold by 12g
    - Sell for more than we buy = profit!
  - Iris takes 5 turns to grow
  - Iris flowers have a 40% chance of generating a new Iris Seed

- **Some calculations:**
  - Takes ~9 Iris to reach 100g
  - Given 9 seeds, it would take 45 turns



# New Mechanics opposed to Balancing

- Due to the new mechanic added to the Iris, it is now a more viable option
  - Just using Tulips does not seem to be the only good strategy
- Now, it is also a matter of choice
  - Strictly follow the numbers with Tulips, or take a lucky chance using Irises?
- Surely, each new addition like this can make the game even more **unbalanced**
  - Besides adding new mechanics, it is important to care on balancing them
  - But not as to create a perfect equilibrium

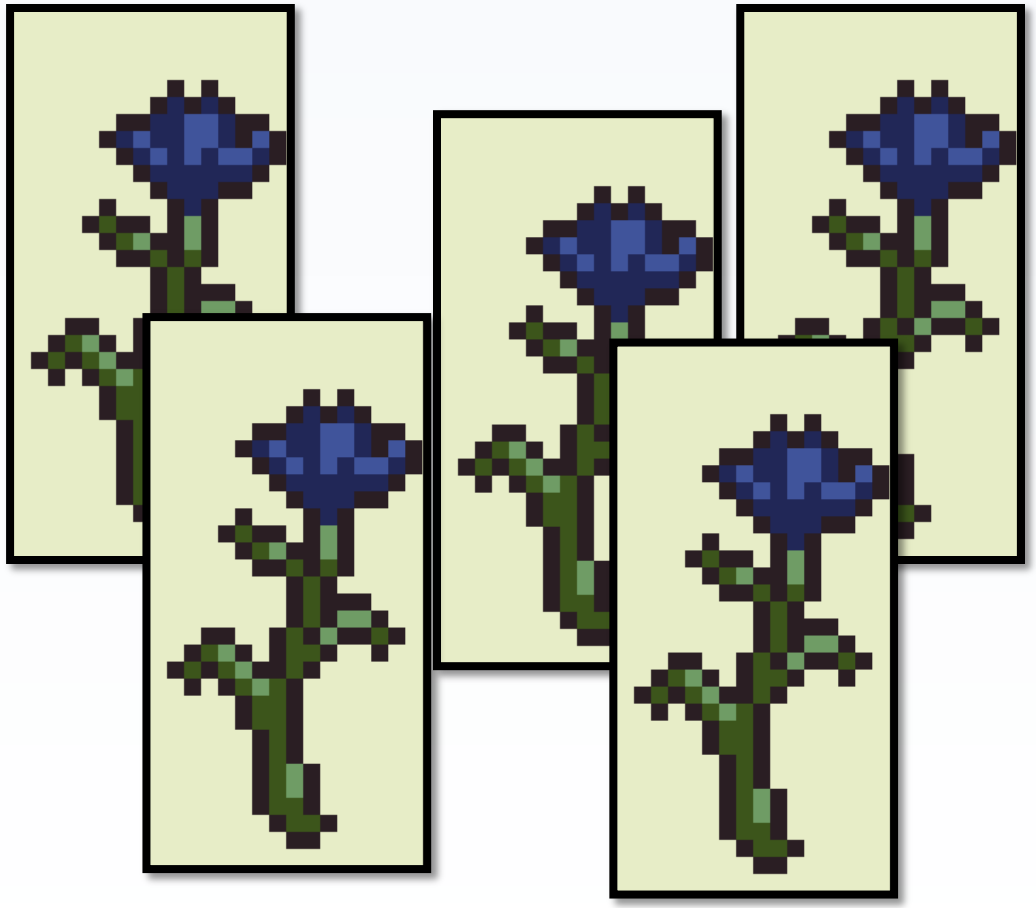
# Mechanics, Balancing, and Fairness

- Reaching an equilibrium or a good balanced state is very hard
- 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 victory
- More options also lead to
  - More replay value
  - More work balancing

# Questions?

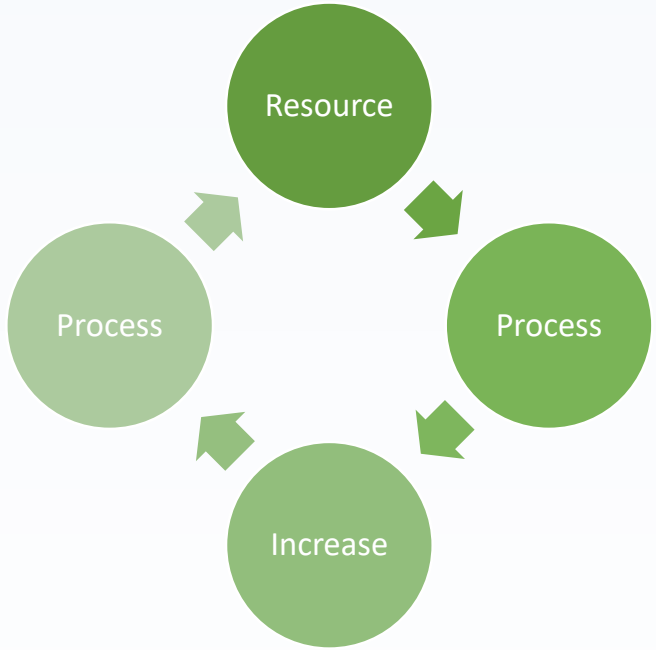
# More Profit Overtime due to Feedback Loops

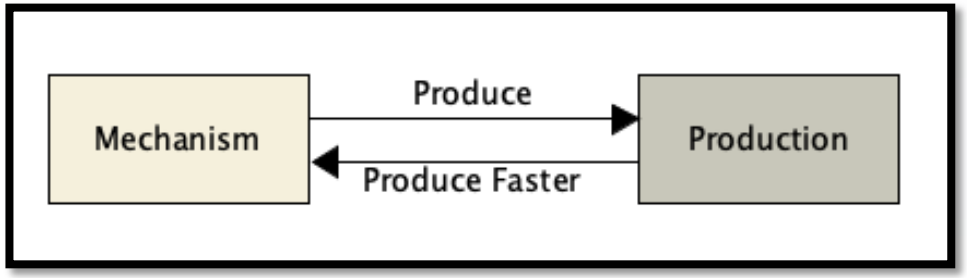
- So far, the example has not explored any sort of relation between the resources
  - Seeds and Flowers only relate to Money
- However, due to profit, we can see that has we proceed, more flowers can be planted
  - More profit overtime
- This is a **Feedback Loop**



# Feedback Loop

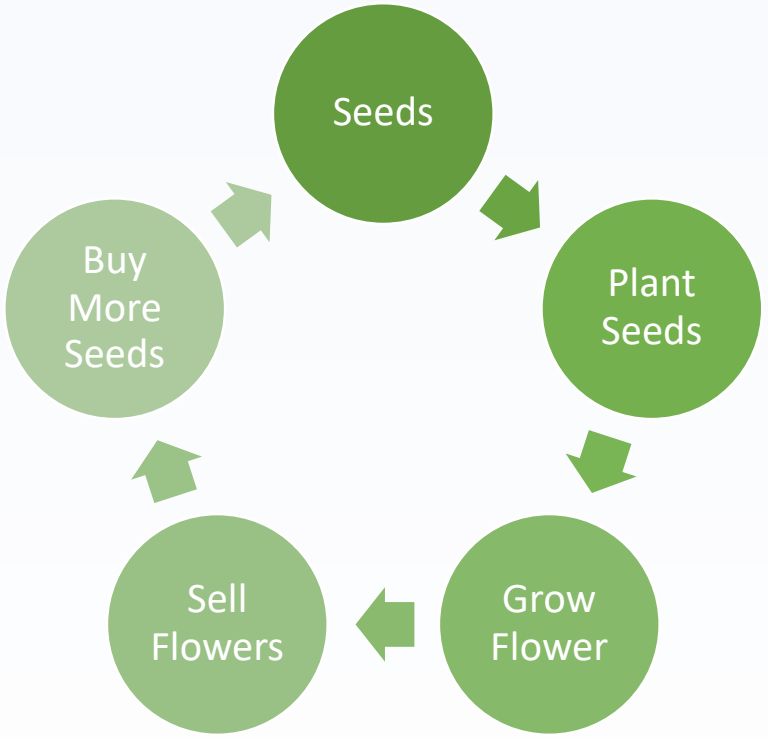
- A feedback loop is a process in which one or more mechanisms are influenced by themselves
- Not all mechanisms are part of the feedback loop, but most will be
- Feedback loops can span over various other mechanisms




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

# Feedback Loop: Flowers

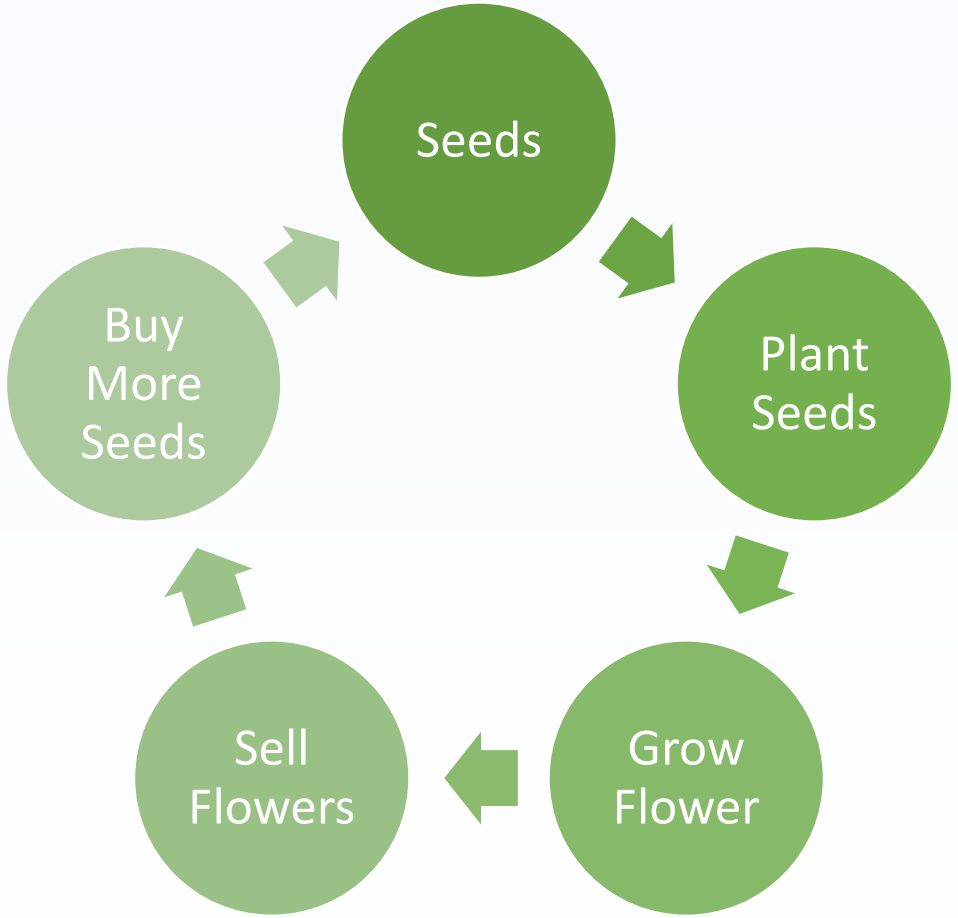



# Positive Feedback Loop

- When a feedback loop increases the results of its related mechanisms, it is considered a **Positive Feedback Loop**

- Positive Feedback Loop destabilize the game economy
  - Escalation

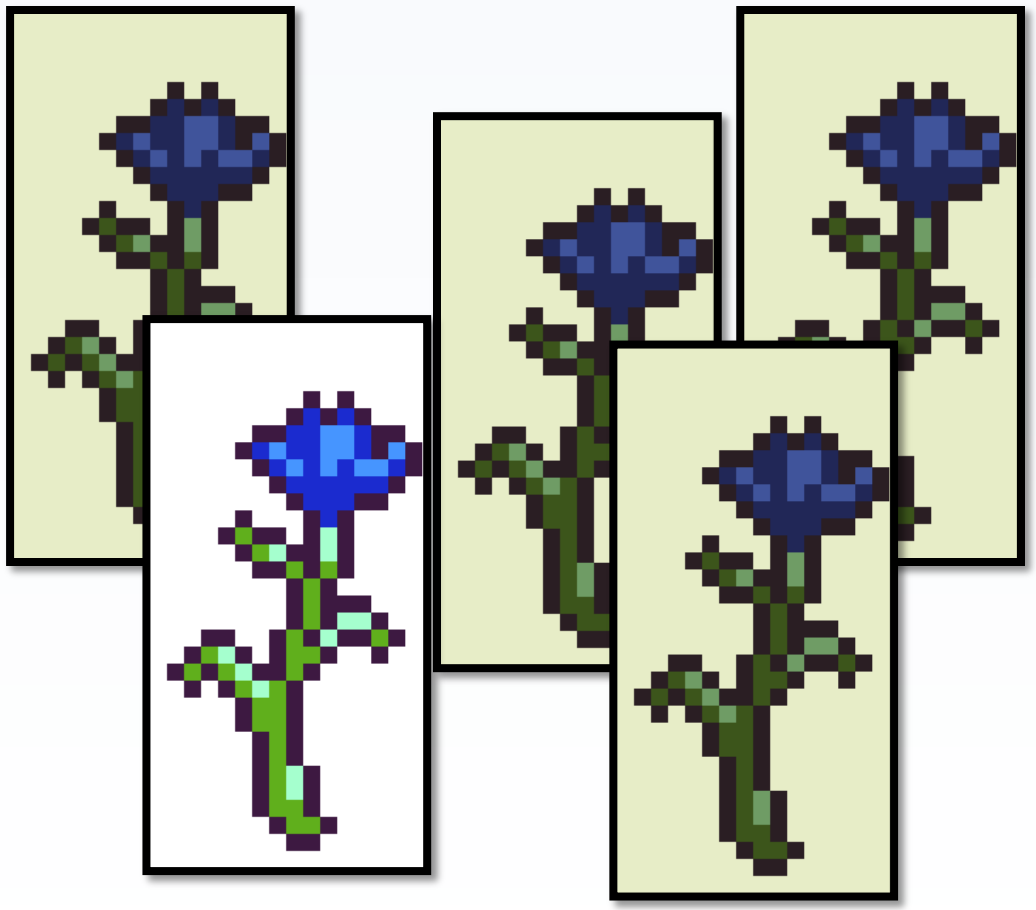
- Empower the player, but at a cost



# Positive Feedback Loops & Upgrades

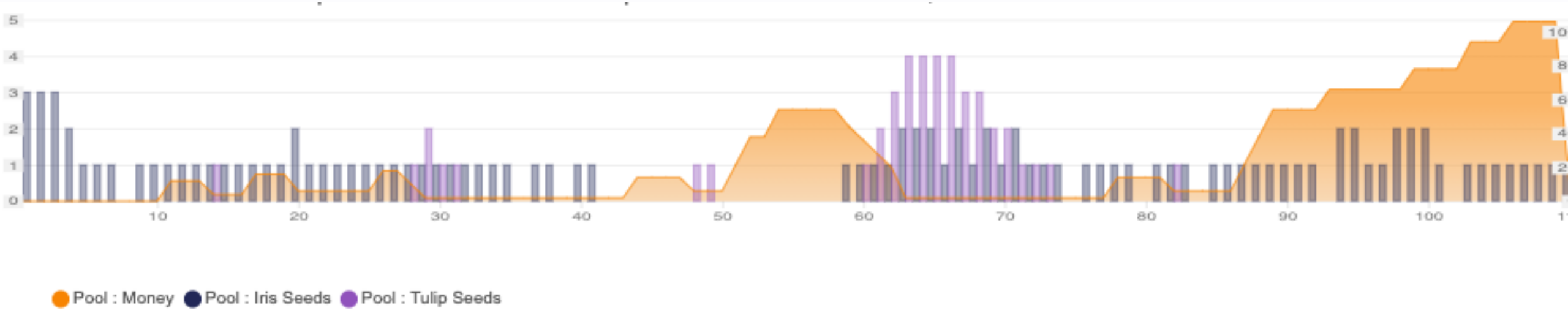
- Positive Feedback Loops can also be created by the addition of Upgrades and related Mechanics

- 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



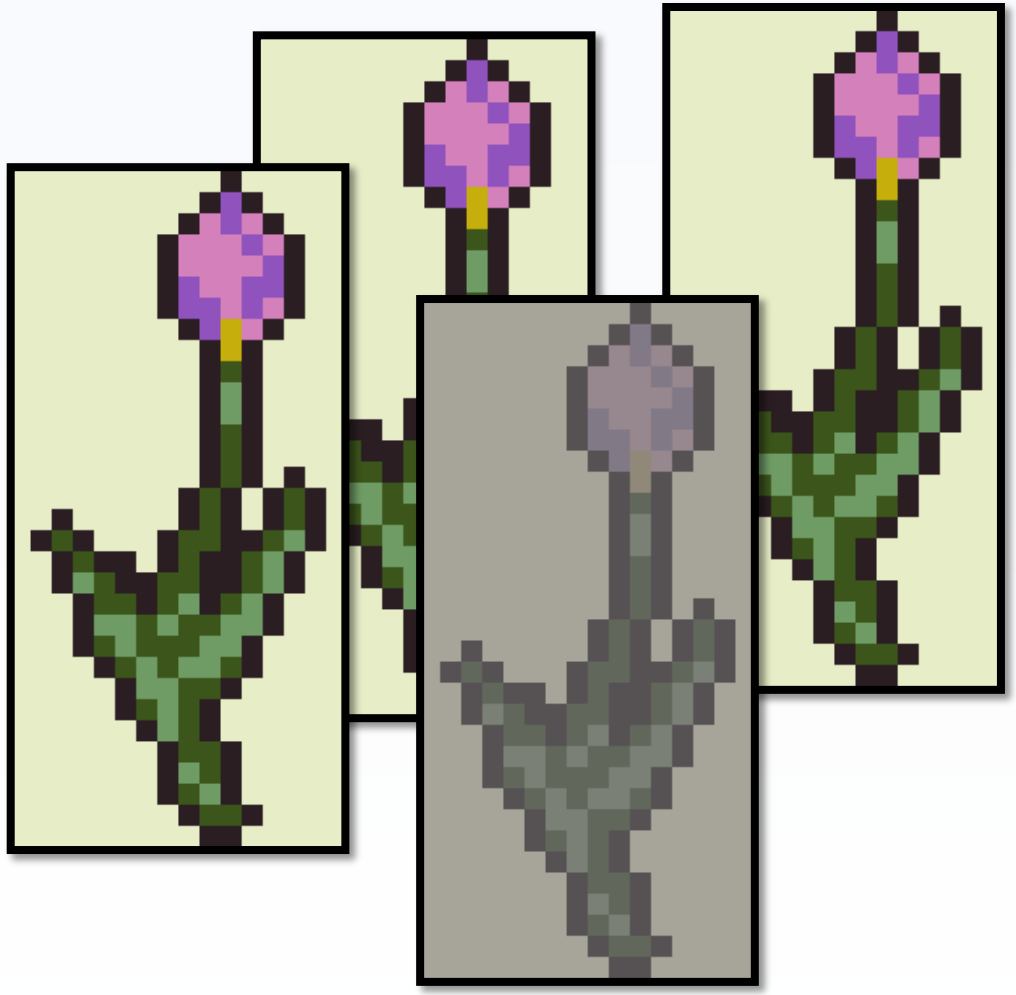
# Simulating Positive Feedback Loops

- Positive Feedback Loops can highly increase how a certain resource is perceived by the players, as well as expand the strategy options and decisions
- But, they tend to destabilize the game quite quickly
  - After handing in 12 Irises, each Iris has a 100% chance of generating another free 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**



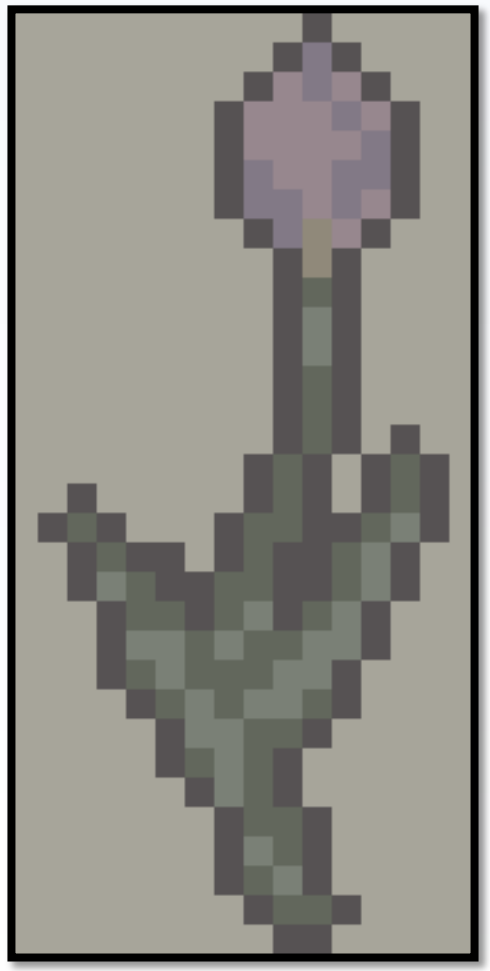
# Negative Feedback Loops & Downgrades

- On the other hand, a negative feedback loop weaken or decrease the effectiveness of mechanisms and resources
- Negative feedback loops stabilize 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



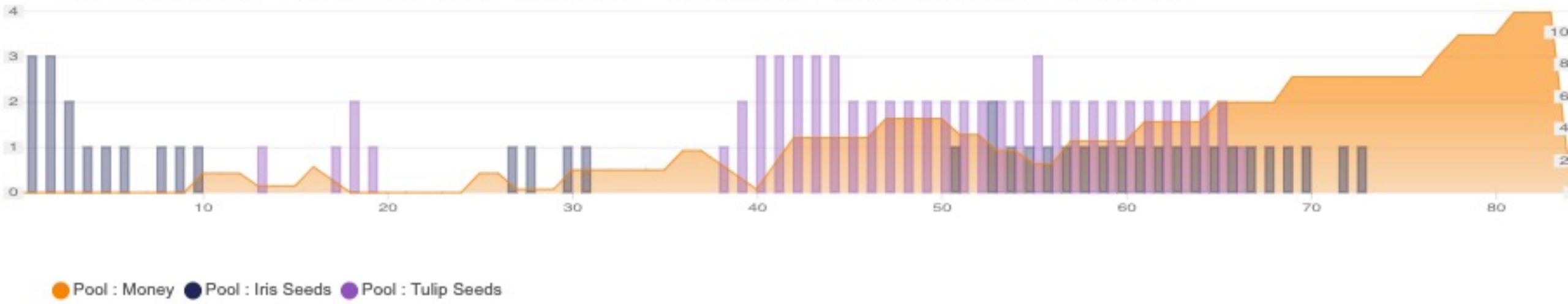
# Tulips are not that hot anymore

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



# 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 stabilize the game over a period of time
  - After selling 3 consecutive Tulips, their value is reduced to 10, which results in 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
  - All options (and players) have a reasonably good chance to win the game



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

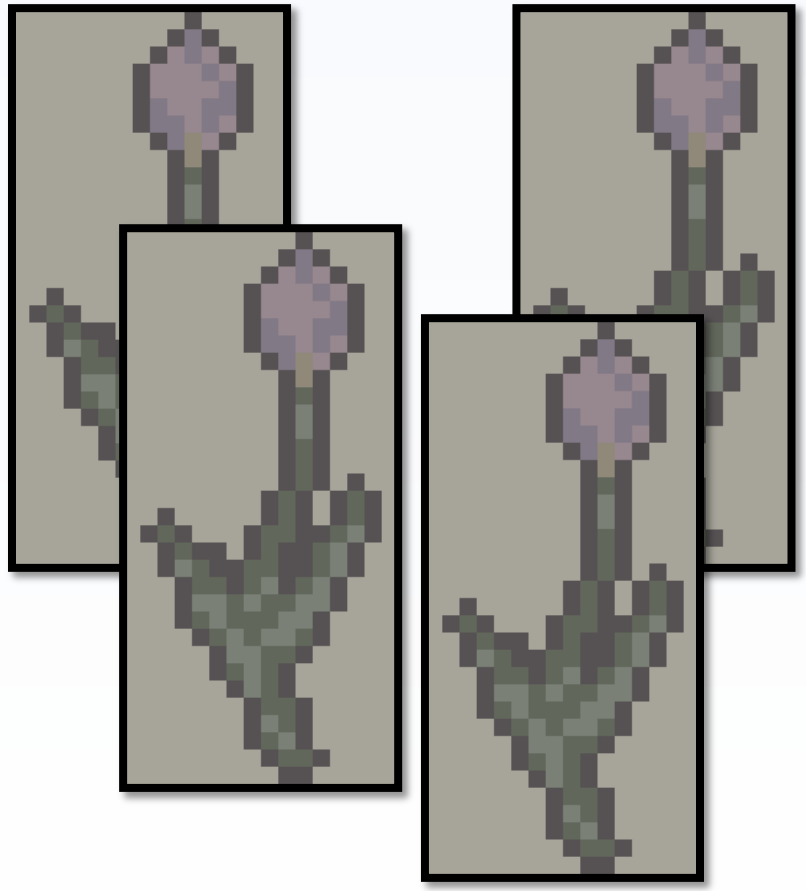
Machinations Diagram with the current game (iris + tulips + feedback loops)

# Deadlocks & Game Over

- While Negative Feedback Loops are a powerful tool a Game Designer can use to keep the game interesting, they can also cause issues

- Negative Feedback Loops can cause or increase the chances of a **deadlock**

- A deadlock is when a mechanism is stopped due to the lack of a specific resource
  - Tulips can devalue so much the player has no money to buy any other seed: game over!




650
100
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50
25
175
Menu

# Free Resouces & More Mechanics

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

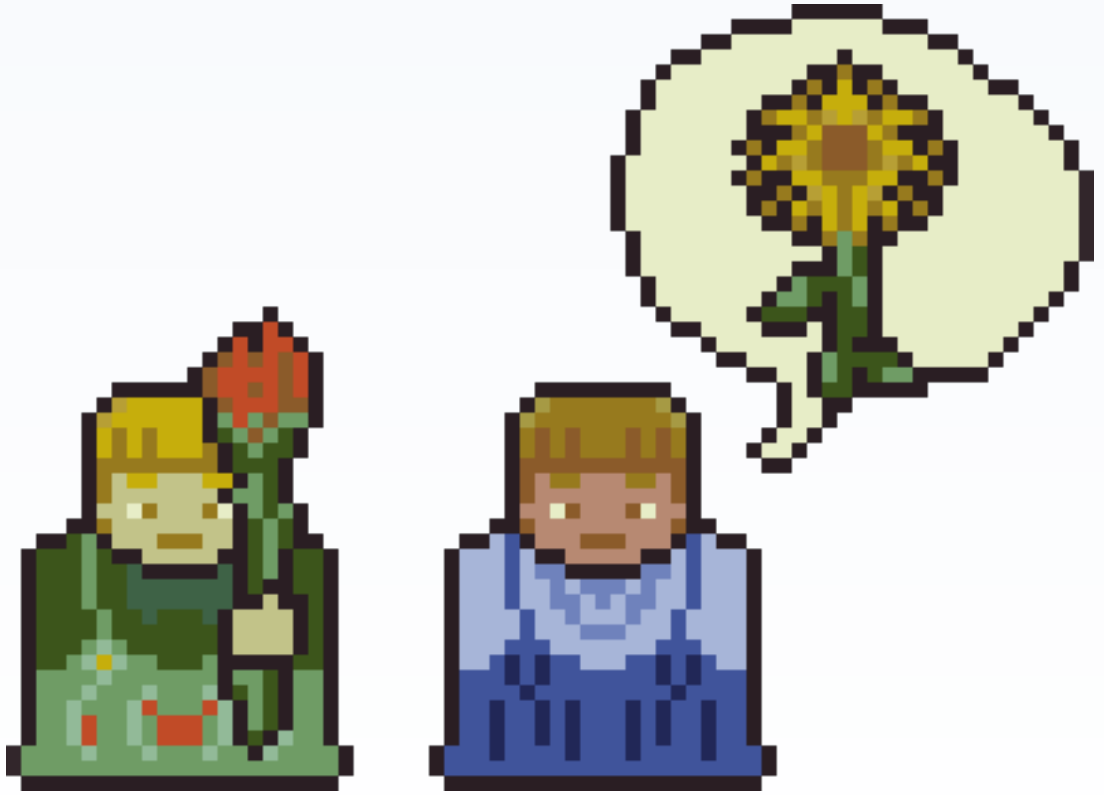
# Randomness is a Friend

- As we saw, 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)
  - Tends to create a **Meta Game**
- However, if the mechanics are not so clearly deterministic, these strategies can fall short
- Random elements can allow different strategies to be viable
  - Can change the game’s course
- Add risk to the game
  - Excitement & Engagement

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

# Motivation & Storytelling

- Regardless of the mathematical discussions, the game economy is directly related to the game's mechanics
- They can be used to motivate
  - Empower players
  - Give them options
- And as Storytelling tools
  - Activating specific mechanics
  - Justifying mechanisms



# Narrative through Numbers

- The Tulip Devaluation mechanic can be understood as a storytelling device, that is, a Negative Feedback Loop

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

# Questions?

# Thank You ☺

https://dagongraphics.com/workshops/