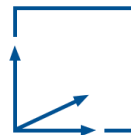


Game Design Principles for Multiplicative Gameplay

Katharina Seitz

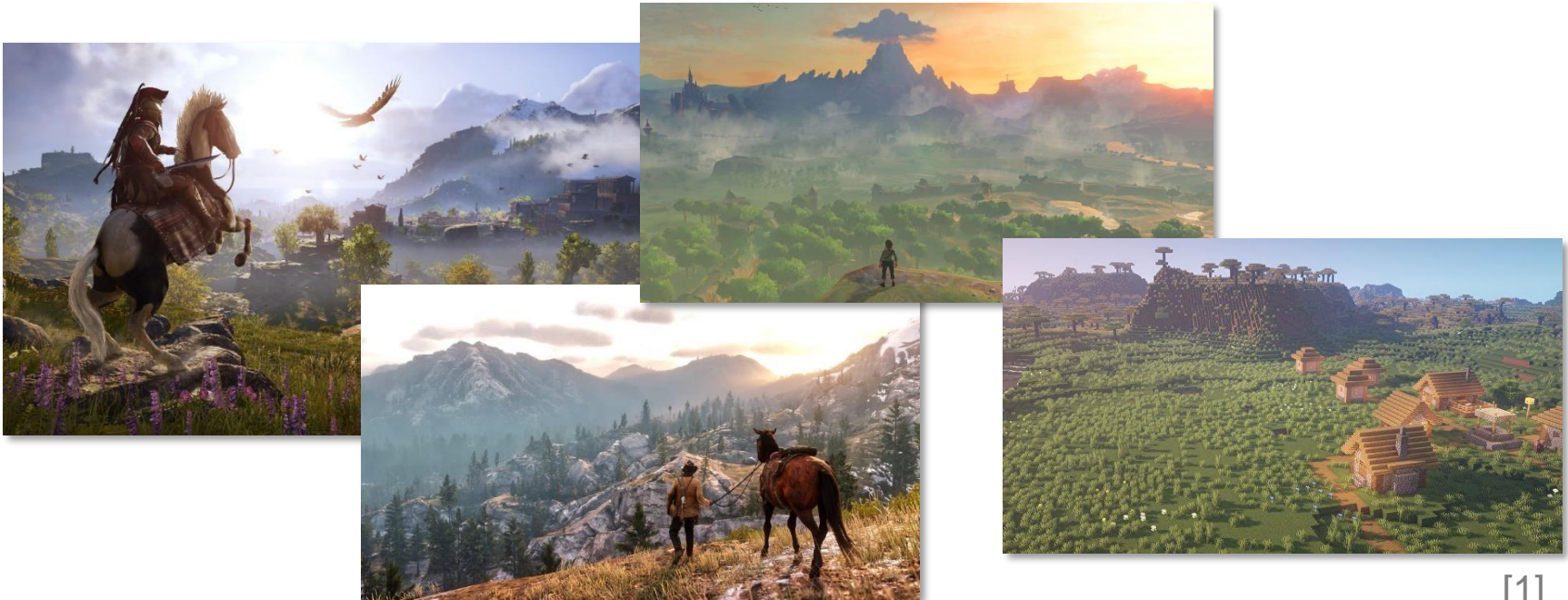
23.09.2021



Final: Bachelor Informatics: Games Engineering
Supervisor: Prof. Gudrun Klinker, Ph.D.
Advisor: Daniel Dyrda, M.Sc.

Introduction / Motivation

1. Trend to games that feature more freedom for players
2. Search for more formalized game design methods



[1]

Problem Description: Issues

1. Games with vast player freedom take away control of the developers to some degree
→ still a challenge to build these games
2. Designers have little support or tools when formulating games in general

Goals of this Thesis

1. Define a coherent game concept and provide principles and guidelines to support designers
→ *Multiplicative Gameplay/Design*
2. Push forward research on more standardized and formalized methods for designing games by proposing design matrices as a framework for Multiplicative Design



Part I: Multiplicative Gameplay

Part I: Multiplicative Gameplay

What is Multiplicative Gameplay?

- made known by Nintendo at GDC 2017 presenting *The Legend of Zelda: Breath of the Wild* [2]



Multiplication:
player actions *
play field *
objects =
possibility space

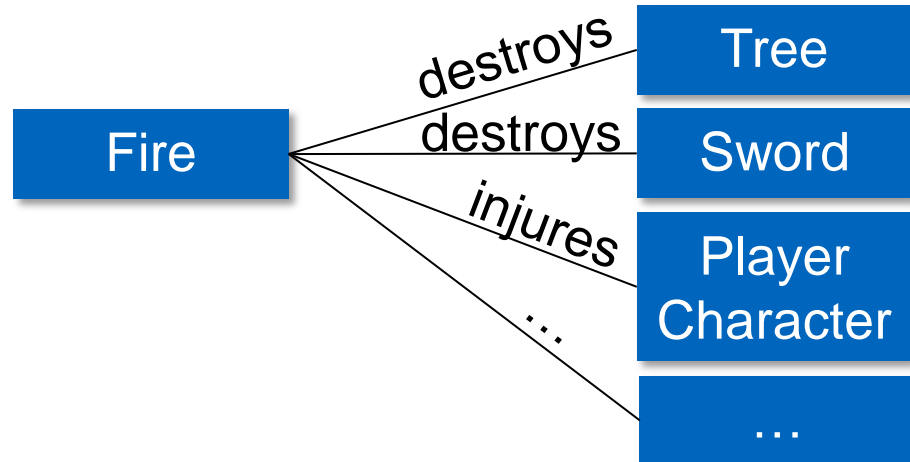
Part I: Multiplicative Gameplay

What is Multiplicative Gameplay?

Additive Design:

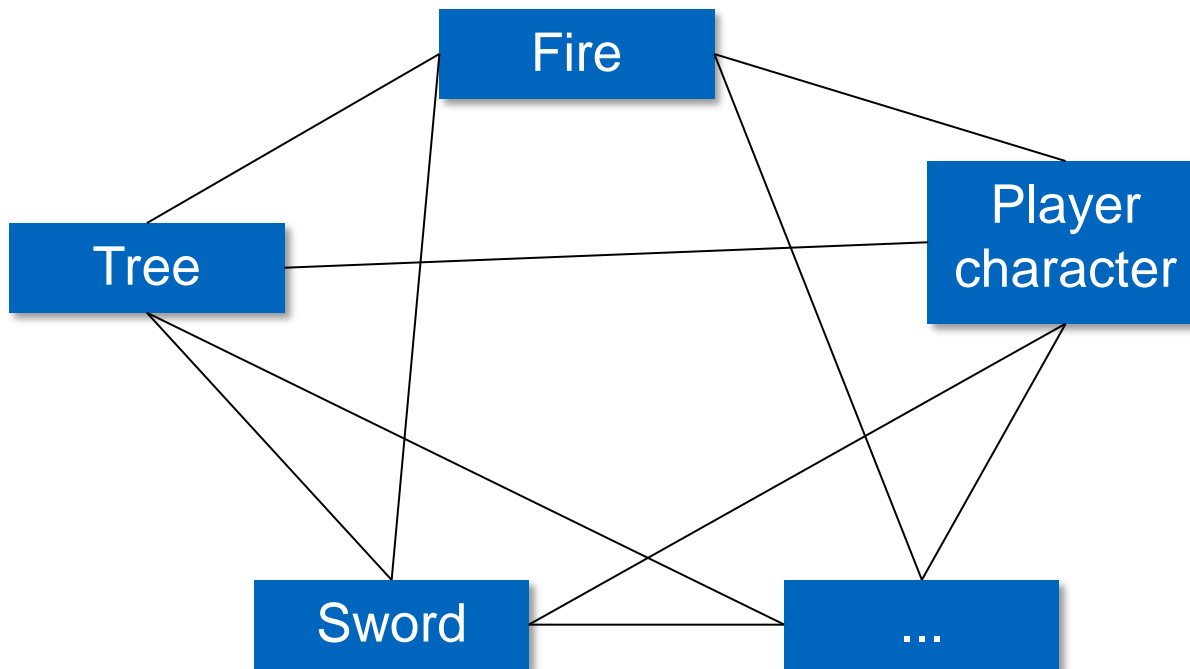


Multiplicative Design:



Part I: Multiplicative Gameplay

What is Multiplicative Gameplay?



Part I: Multiplicative Gameplay

What is Multiplicative Gameplay?

Main points:

- Behavior through connectedness of elements
- Player freedom
- Consistency of the game world

→ I took Nintendo's approach and developed it into a practical concept to apply in Game Design

Part I: Multiplicative Gameplay

Examples of existing games



Thorough use



Partial use

[3]



Part II: Matrix concept

Part II: Matrix concept

- **Proposition:** Design matrices to create and fill out to support Multiplicative Design
- Making use of natural language:
SPO: **S**ubject, **P**redicate, **O**bject

o \ s	subject	subject
object	rule	rule
object	rule	rule
object	rule	rule

o \ s	fire
tree	tree burns and gets destroyed after 5 sec

destroys-matrix

A scenario-based matrix for a **predicate**

Part II: Matrix concept

Purposes

1. Support the connectedness of elements, the consistency of their behavior and creation of new elements.
2. Provide a graphical overview over the game elements and their interactivity
3. Enable easy feedback about the current design
4. Support the communication between designers and programmers

Part II: Matrix concept

The design process presented on an example:

Designers' first vision of the game:



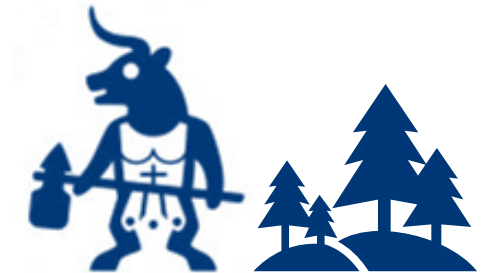
Single player



Open world



Goal



Obstacles



Items

Part II: Matrix concept

The design process presented on an example:

1. Create a list of all physical elements that are currently present in the game.

- Darius
- enemy
- figurine
- smaller rock
- tree
- river
- sword
- bow
- arrow
- bomb

Part II: Matrix concept

The design process presented on an example:

2. *Think of a scenario that could appear in the game.*

- scenario = a situation that can be encountered in the game
- E.g.: “Darius throws a bomb into a tree which causes it to get destroyed.”

Part II: Matrix concept

The design process presented on an example:

3. *Determine which parts of the scenario make up sets of subject, predicate, and object.*

“Darius throws a bomb into a tree which causes it to get destroyed.”

↓↓

2 sets:

- Darius throws bomb.
- Bomb destroys tree.

Repeat Steps 2 & 3

Part II: Matrix concept

The design process presented on an example:

4. Create a matrix for every predicate and find more subjects and objects.

S	Darius
O	
bomb	activates bomb; only if Darius has ≥ 1 bomb in the inventory; subtract 1 from number of bombs in inventory

Darius throws bomb.

S	bomb
O	
tree	tree turns into rigid body log

Bomb destroys tree.

“Scenario-based matrices”

Part II: Matrix concept

The design process presented on an example:

4. Create a matrix for every predicate and find more subjects and objects.

→ Extend “throws”-matrix:

S	
O	Darius
bomb	activates bomb; only if Darius has ≥ 1 bomb in the inventory; subtract 1 from number of bombs in inventory



S		
O	Darius	enemy
bomb	activates bomb; only if Darius has ≥ 1 bomb in the inventory; subtract 1 from number of bombs in inventory	activates bomb; enemies can only throw bombs they picked up in the environment
Darius	/	enemies can load Darius on their backs and throw him
enemy	Darius can load them on his back and throw them	enemies can load each other on their backs and throw them in Darius' direction
figurine		
smaller rock		
wooden sword		
metal sword		
wooden bow		
metal bow		

Part II: Matrix concept

The design process presented on an example:

5. Create master-matrix for overview.

O \ S	Darius	enemy	figurine	smaller rock	tree	river	wooden sword	metal sword	wooden bow	metal bow	arrow	bomb	log
Darius		throws											
enemy	throws	throws											
figurine	throws	throws						de- stroys				de- stroys	
smaller rock	throws	throws										de- stroys	
tree							de- stroys	de- stroys				de- stroys	
river													
wooden sword	throws	throws					de- stroys	de- stroys				de- stroys	
metal sword	throws	throws											
wooden bow	throws	throws					de- stroys	de- stroys				de- stroys	
metal bow	throws	throws											
arrow				de- stroys			de- stroys	de- stroys			de- stroys	de- stroys	de- stroys
bomb	throws	throws		de- stroys			de- stroys	de- stroys			de- stroys	de- stroys	de- stroys
log							de- stroys	de- stroys				de- stroys	



O \ S	Darius	enemy	figurine	smaller rock	tree	river	wooden sword	metal sword	wooden bow	metal bow	arrow	bomb	log
Darius	/	throws, punches, carries, picks up, puts down	hits	hits		drowns	injures	injures	hits	hits	injures	injures, kicks	hits, kicks
enemy	throws, punches, carries, picks up, puts down	throws, punches, carries, picks up, puts down	hits	hits		drowns	injures	injures	hits	hits	injures	injures, kicks	hits, kicks
figurine	throws, carries, picks up, puts down	throws, carries, picks up, puts down	/			transports	/	de-stroys			sticks in	de-stroys	kicks
smaller rock	throws, carries, picks up, puts down	throws, carries, picks up, puts down				drowns	kicks	kicks				de-stroys	kicks
tree	climbs on	climbs on				/	de-stroys	de-stroys			sticks in	de-stroys	/
river	falls into	falls into	falls into	falls into		/	falls into	falls into	falls into	falls into	falls into	falls into	falls into
wooden sword	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				transports	de-stroys	de-stroys				de-stroys	kicks
metal sword	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				drowns		kicks				kicks	kicks
wooden bow	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				transports	de-stroys	de-stroys				de-stroys	kicks
metal bow	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				drowns		kicks				kicks	kicks
arrow	collects, climbs on	collects		de-stroys		transports	de-stroys	de-stroys	shoots	shoots	de-stroys	de-stroys	de-stroys
bomb	throws, carries, picks up, puts down, collects	throws, carries, picks up, puts down		de-stroys		transports	de-stroys	de-stroys			de-stroys	de-stroys	de-stroys
log	rolls	rolls			turns into	transports	de-stroys	de-stroys			sticks in	de-stroys	kicks



Part III: Guidelines

Part III: Guidelines

1. Filling out many entries and setting different priorities

- More filled entries of importance → better interactivity

2. Keeping consistency

- Use categories

3. Cultivating emergence

- Emergence cannot be engineered straight forward, but the probability of its appearance can be increased

4. Depth vs. complexity

- Get the maximum amount of **depth** out of the minimum amount of **complexity** [4]

5. Guiding the player and preventing dominant strategies

- Not forcing players into certain behavior, but loosely guiding them to provide them with a more engaging play experience



Part IV: Evaluation methods

Part IV: Evaluation methods

O \ S	Darius	enemy	figurine	smaller rock	tree	river	wooden sword	metal sword	wooden bow	metal bow	arrow	bomb	log
Darius	/	throws, punches, carries, picks up, puts down	hits	hits		drowns	injures	injures	hits	hits	injures	injures, kicks	hits, kicks
enemy	throws, punches, carries, picks up, puts down	throws, punches, carries, picks up, puts down	hits	hits		drowns	injures	injures	hits	hits	injures	injures, kicks	hits, kicks
figurine	throws, carries, picks up, puts down	throws, carries, picks up, puts down	/			transports	/	de-roys			sticks in	de-roys	kicks
smaller rock	throws, carries, picks up, puts down	throws, carries, picks up, puts down				drowns	kicks	kicks				de-roys	kicks
tree	climbs on	climbs on				/	de-roys	de-roys			sticks in	de-roys	/
river	falls into	falls into	falls into	falls into		/	falls into	falls into	falls into	falls into	falls into	falls into	falls into
wooden sword	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				transports	de-roys	de-roys				de-roys	kicks
metal sword	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				drowns		kicks				kicks	kicks
wooden bow	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				transports	de-roys	de-roys				de-roys	kicks
metal bow	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				drowns		kicks				kicks	kicks
arrow	collects, climbs on	collects		de-roys		transports	de-roys	de-roys	shoots	shoots	de-roys	de-roys	de-roys
bomb	throws, carries, picks up, puts down, collects	throws, carries, picks up, puts down		de-roys		transports	de-roys	de-roys			de-roys	de-roys	de-roys
log	rolls	rolls			turns into	transports	de-roys	de-roys			sticks in	de-roys	kicks

- Filled entries in relation to all cells:
 $109/169 \approx 65\%$
- Interactivity of individual subjects/objects:
 subject wooden sword: $11/13 \approx 85\%$
- Resemblance of 2 elements:
 wooden bow and metal bow:
 resemblance = 85%

Part IV: Evaluation methods

O \ S	Darius	enemy	figurine	smaller rock	tree	river	wooden sword	metal sword	wooden bow	metal bow	arrow	bomb	log
Darius	/	throws, punches, carries, picks up, puts down	hits	hits		drowns	injures	injures	hits	hits	injures	injures, kicks	hits, kicks
enemy	throws, punches, carries, picks up, puts down	throws, punches, carries, picks up, puts down	hits	hits		drowns	injures	injures	hits	hits	injures	injures, kicks	hits, kicks
figurine	throws, carries, picks up, puts down	throws, carries, picks up, puts down	/			transports	/	de-roys			sticks in	de-roys	kicks
smaller rock	throws, carries, picks up, puts down	throws, carries, picks up, puts down				drowns	kicks	kicks				de-roys	kicks
tree	climbs on	climbs on				/	de-roys	de-roys			sticks in	de-roys	/
river	falls into	falls into	falls into	falls into		/	falls into	falls into	falls into	falls into	falls into	falls into	falls into
wooden sword	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				transports	de-roys	de-roys				de-roys	kicks
metal sword	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				drowns		kicks				kicks	kicks
wooden bow	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				transports	de-roys	de-roys				de-roys	kicks
metal bow	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				drowns		kicks				kicks	kicks
arrow	collects, climbs on	collects		de-roys		transports	de-roys	de-roys	shoots	shoots	de-roys	de-roys	de-roys
bomb	throws, carries, picks up, puts down, collects	throws, carries, picks up, puts down		de-roys		transports	de-roys	de-roys			de-roys	de-roys	de-roys
log	rolls	rolls			turns into	transports	de-roys	de-roys			sticks in	de-roys	kicks

- Information content:
 $I(\text{throws}) \approx 0.87$

- Entropy of the matrix:
 $H(X) \approx 0.858$

Part IV: Evaluation methods

O \ S	Darius	enemy	figurine	smaller rock	tree	river	wooden sword	metal sword	wooden bow	metal bow	arrow	bomb	log
Darius	/	throws, punches, carries, picks up, puts down	hits	hits		drowns	injures	injures	hits	hits	injures	injures, kicks	hits, kicks
enemy	throws, punches, carries, picks up, puts down	throws, punches, carries, picks up, puts down	hits	hits		drowns	injures	injures	hits	hits	injures	injures, kicks	hits, kicks
figurine	throws, punches, carries, picks up, puts down	throws, punches, carries, picks up, puts down	/			trans-ports	/	de-stroys			sticks in	de-stroys	kicks
smaller rock	throws, carries, picks up, puts down	throws, carries, picks up, puts down				drowns	kicks	kicks				de-stroys	kicks
tree	climbs on	climbs on				/	de-stroys	de-stroys			sticks in	de-stroys	/
river	falls into	falls into	falls into	falls into		/	falls into	falls into	falls into	falls into	falls into	falls into	falls into
wooden sword	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				trans-ports	de-stroys	de-stroys				de-stroys	kicks
metal sword	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				drowns		kicks				kicks	kicks
wooden bow	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				trans-ports	de-stroys	de-stroys				de-stroys	kicks
metal bow	throws, carries, picks up, puts down, uses	throws, carries, picks up, puts down, uses				drowns		kicks				kicks	kicks
arrow	collects, climbs on	collects		de-stroys		trans-ports	de-stroys	de-stroys	shoots	shoots	de-stroys	de-stroys	de-stroys
bomb	throws, carries, picks up, puts down, collects	throws, carries, picks up, puts down	de-stroys			trans-ports	de-stroys	de-stroys			de-stroys	de-stroys	de-stroys
log	rolls	rolls			turns into	trans-ports	de-stroys	de-stroys			sticks in	de-stroys	kicks

- Weighting the entries by importance:
Subject wooden sword:
 $12.5/14.5 \approx 86\%$

Discussion and Conclusions

Multiplicative Gameplay

- Concept valuable for games of every genre
- Principles can be used to enhance the whole game concept or only parts
- Is not better than linear design; combination of both seems to be a good choice in most cases
- Concept is not new
- Research in this area could give direction for future game concepts

Discussion and Conclusions

Design matrices

- Initiative to further explore more formal and guided game design techniques
- Matrices are intuitive and represent the multiplicative character
- But: potential to be further developed
 - Problem: The momentary stage still depends widely on human consideration.
 - *Future work:*
 - Further formalizing of the procedure
 - Digitalizing the system as a computer program
 - Advancing the evaluation methods for better feedback
 - Proving its usefulness by being reviewed by experienced game designers and used to develop an experimental game



Thank You

List of References

[1] Pictures taken from:

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- Nintendo, Breaking Conventions with The Legend of Zelda: Breath of the Wild, 2017. [Online]. Available: <https://www.gdcvault.com/play/1024562/Change-and-Constant-Breaking-Conventions>.

[3] Pictures taken from:

- <https://play.google.com/store/apps/details?id=com.mojang.minecraftpe&hl=de&gl=US>
- https://www.teahub.io/viewwp/iiwTmii_red-dead-redemption-2-pc-release-date-announced/

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- Extra Credits, Depth vs Complexity - Why More Features Don't Make a Better Game - Extra Credits, YouTube, 2013. [Online]. Available: <https://www.youtube.com/watch?v=jVL4st0bIGU> (visited on 07/12/2021).