

Lecture 7: Resources

Game Design
Fall 2023

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What are resources?

- Quantities that affect gameplay
- Can usually be both acquired and consumed

Things to think about

- Where do they come from?
- Where do they go?

(Where do they come from, Cotton-Eye Joe?)

- How do they interact?
- Are they all useful?

Money + Currency

- . Production target met: TRUST INCREASED, additional processor/memory capacity granted
 - . Memory added, max operations increased
 - . Investment engine unlocked
- > Lifetime investment revenue report: \$0

Paperclips: 252,000

Make Paperclip

Business

Available Funds: \$ 5,071.25

Avg. Rev. per sec: \$ 0.00

Avg. Clips Sold per sec: 0

Unsold Inventory: 0

lower raise Price per Clip: \$ 0.20

Public Demand: 1,286%

Marketing Level: 9

Cost: \$ 25,600.00

Manufacturing

Clips per Second: 0

Wire 0 inches

Cost: \$ 28

AutoClippers 79

Cost: \$ 1,867.18

Computational Resources

Trust: 15

+1 Trust at: 377,000 clips

Processors 5

Memory 10

Operations: 224 / 10,000

Creativity: 189

Projects

WireBuyer (7,000 ops)
Automatically purchases wire when you run out

Quantum Computing (10,000 ops)
Use probability amplitudes to generate bonus ops

Spectral Froth Annealment (12,000 ops)
200% more wire supply from every spool

HypnoDrones (70,000 ops)
Autonomous aerial brand ambassadors

Investments

Low Risk

Deposit Cash: \$0

Withdraw Stocks: \$0

Total: \$0

Stock	Amt.	Price	Total	P/L

Upgrade Investment Engine Level: 0

Cost: 100 Yomi

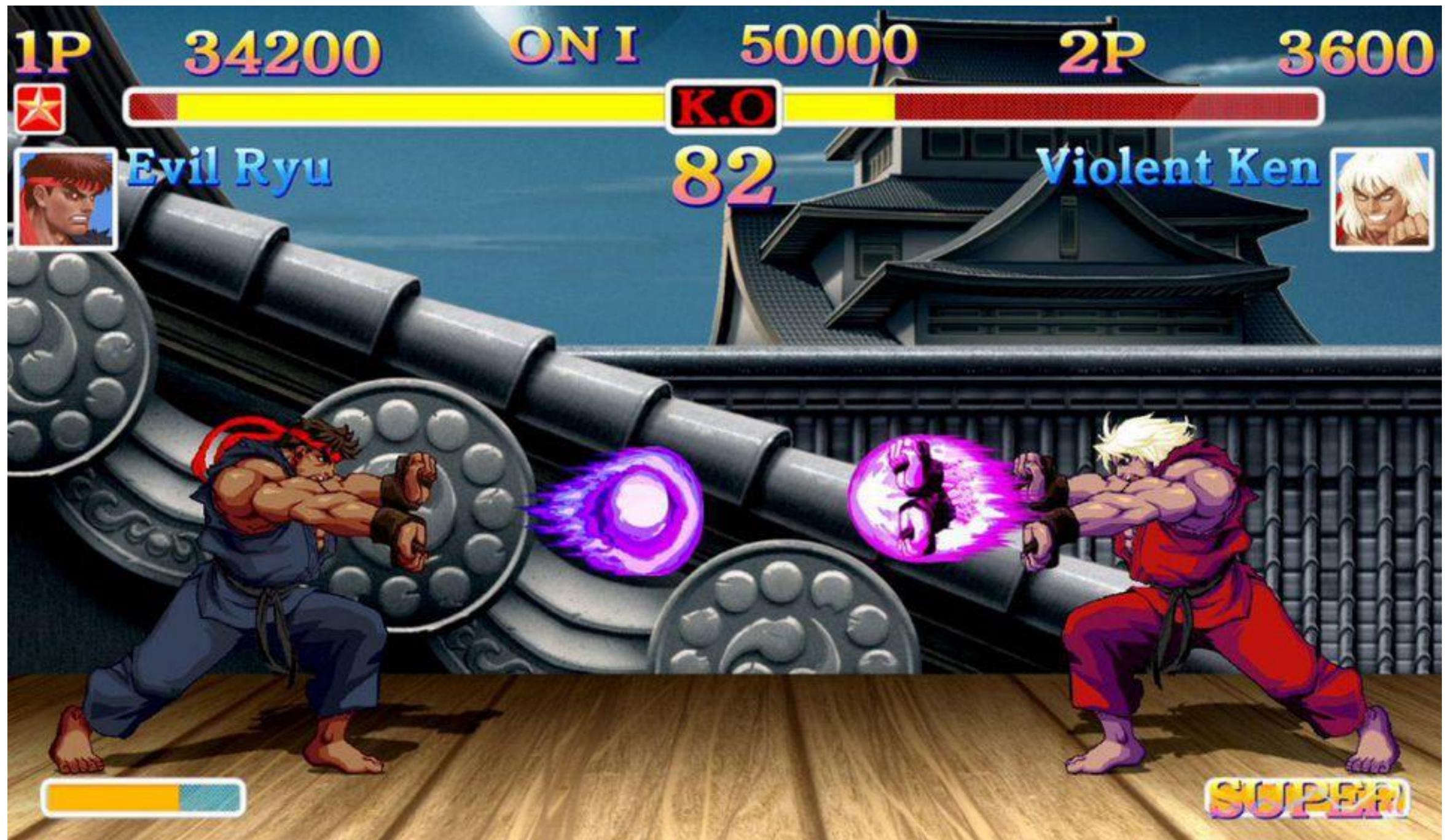
Business (Universal Paper Clips)

Alternative Money



Runes for money + leveling up
(Elden Ring)

Health + Charge Bars



Health + Super Combo Gauge
(Street Fighter series)

Lives



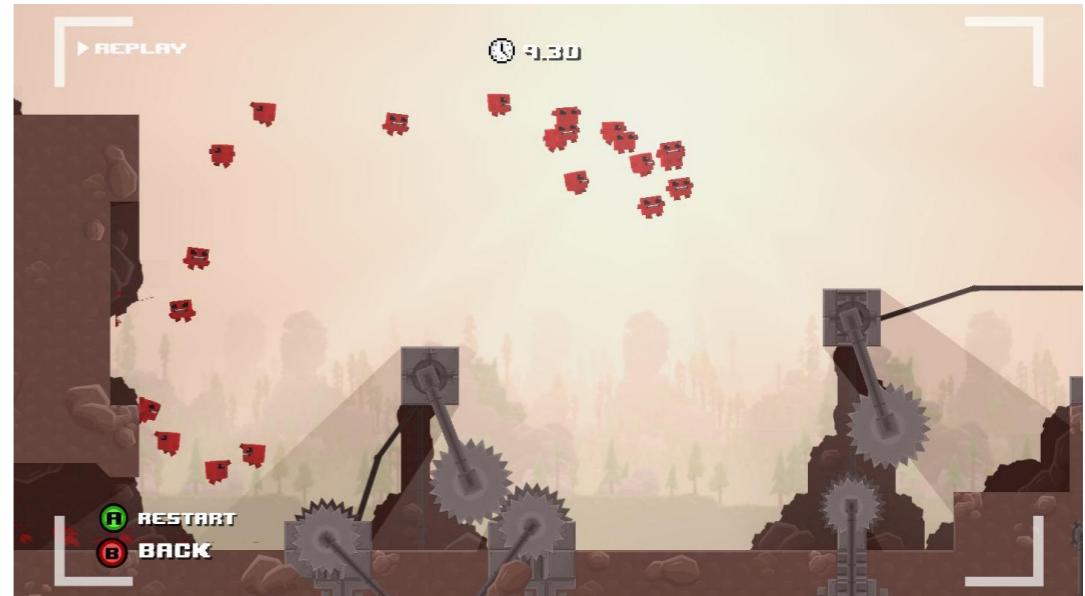
1-UPS (Super Mario World)

Types of Lives



Limited
(Pacman + Mario series)

VS



Infinite
(Super Meatboy +
Shovel Knight)

Endurance + Energy



Stamina wheel
(Zelda: Breath of the Wild)

Ammo + Shields



Bullets + Armor Level
(Halo series)

Literal resources



Time + AI Resources



Turns + Party members
(Fire Emblem series)

Time + System Resources



Turns + resource conversions
(Century card game franchise)

Items, Tools, + Weapons

The screenshot shows the game's inventory interface. On the left, there is a list of items with their names, weights, and values. On the right, a detailed view of the selected item, "Dragon's Talon (Legendary)", is displayed, showing its stats and special effects.

ALL

NAME	WEIGHT	VALUE
Common Soul Gem (4)	0.3	50
Common Soul Gem (Common) (37)	0.3	150
Contract	0	0
Cracked Tusk Vault Key	0	0
Craglane Chest Key	0	0
Craglane Dog Cage Key	0	0
Cure Disease Potion Recipe	0	10
Cure Poison (2)	0.5	31
Curious Silver Mold	1	250
Dainty Sload Footlocker Key	0	0
Damage Health Poison Recipe	0	20
Damage Health Poison Recipe	0	20
Dark Brotherhood Assassin's Note	0	0
Dark Brotherhood Assassin's Note (2)	0	0
Deepwood Redoubt Key	0	0
Delphine's Secret Door Key	0	0
Diamond (9)	0.1	800
Dragon Investigation: Current Status	0	0
Dragon's Fang (Legendary) ♦ ★ ⚡	16	5422
Dragon's Scale (Legendary) ♦ ★	12	1978
Dragon's Talon (Legendary) ♦ ★ ⚡	23	9995
Draught of Pickpocketing (2)	0.5	151

DRAGON'S TALON (LEGENDARY)

DAMAGE **64** WEIGHT **23** VALUE **9995**

Absorb 10 points of stamina. Target takes 24 points of shock damage, and half as much Magicka damage.

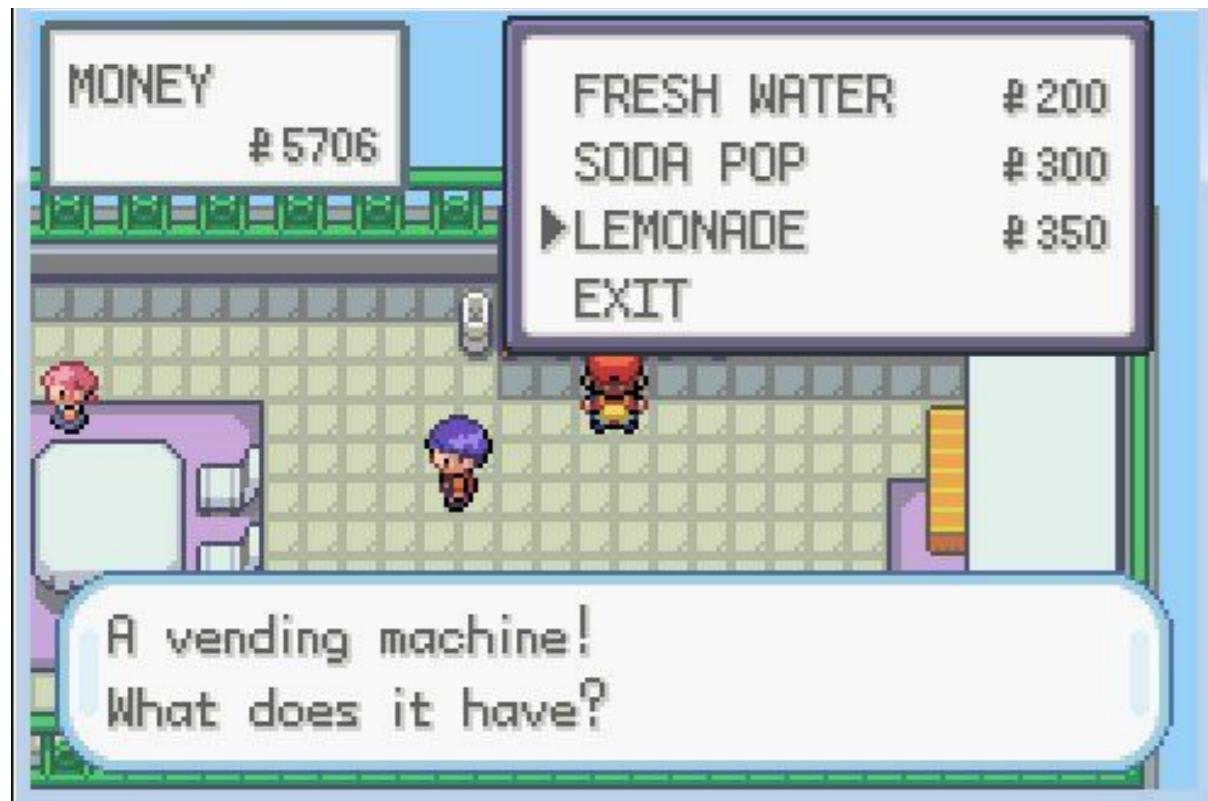
M1 M2 Equip R Drop F Unfavorite T Charge

Damage 239 (+1) Carry Weight 243/465 Gold 92257

Game Inventory
(The Elder Scrolls V: Skyrim)

Item Types

Pokemon



Replenishable

Pokeballs, Potions, Repels



Single-Use

Elixirs, TMs, Rare Candies

Beware! Item Hoarding



Beware! Item Redundancy

OVERWATCH	LEGENDARY / ICONIC	OVERWATCH	LEGENDARY / ICONIC	OVERWATCH	LEGENDARY / ICONIC
Power Sniper Rifle		Power Sniper Rifle		Power Sniper Rifle	
1,772.8 DPS	■ 99	1,598.5 DPS	■ 99	1,598.5 DPS	■ 99
1819-2223 damage		1819-2223 Damage		1819-2223 damage	
0.30 Attacks Per Second	+	0.30 Attacks Per Second	+	0.30 Attacks Per Second	+
POWER Bullets can ricochet off surfaces.		POWER Bullets can ricochet off surfaces.		POWER Bullets can ricochet off surfaces.	
+1313-1605 Physical Damage		+1313-1605 Physical Damage		+1313-1605 Physical Damage	
+78.75% Crit Chance		+78.75% Crit Chance		+78.75% Crit Chance	
+246.75% Crit Damage		+210.00% Crit Damage		+210.00% Crit Damage	
+115.00% Bonus Ricochet Damage		+105.00% Bonus Ricochet Damage		+10% Bleeding Chance	
+10% Bleeding Chance		+10% Bleeding Chance		+10% Bleeding Chance	
3 Headshot Damage Multiplier		2.10 Headshot Damage Multiplier		3.97 Headshot Damage Multiplier	
Increases reload speed. Comes with a custom silencer.		Increases reload speed. Comes with a custom silencer.		Increases reload speed. Comes with a custom silencer.	
• HPO Mk.77 Kanone MAX Empty Mod Slot Empty Mod Slot Empty Mod Slot Empty Mod Slot		• HPO Mk.77 Kanone MAX Empty Mod Slot Empty Mod Slot Empty Mod Slot Empty Mod Slot		• HPO Mk.77 Kanone MAX Empty Mod Slot Empty Mod Slot Empty Mod Slot Empty Mod Slot	

Stat + RPG Points

DUNGEONS & DRAGONS®

CHARACTER NAME		Fighter 1 CLASS & LEVEL	Noble BACKGROUND	PLAYER NAME	
		Human RACE	Lawful neutral ALIGNMENT	EXPERIENCE POINTS	
STRENGTH +3 16	INSPIRATION +2 PROFICIENCY BONUS	17 ARMOR CLASS	-1 INITIATIVE	30 feet SPEED	
DEXTERITY -1 9					
CONSTITUTION +2 15					
INTELLIGENCE +0 11					
WISDOM +1 13					
CHARISMA +2 14					
SAVING THROWS		CURRENT HIT POINTS			
		TEMPORARY HIT POINTS			
		Total 1d10	SUCCESES ○○○	FAILURES ○○○	
		HIT DICE	DEATH SAVES		
SKILLS		ATTACKS & SPELLCASTING			
<input type="radio"/> -1 Acrobatics (Dex) <input type="radio"/> +1 Animal Handling (Wis) <input type="radio"/> +0 Arcana (Int) <input checked="" type="radio"/> +5 Athletics (Str) <input type="radio"/> +2 Deception (Cha) <input type="radio"/> +2 History (Int) <input type="radio"/> +1 Insight (Wis) <input type="radio"/> +2 Intimidation (Cha) <input type="radio"/> +0 Investigation (Int) <input type="radio"/> +1 Medicine (Wis) <input type="radio"/> +0 Nature (Int) <input checked="" type="radio"/> +3 Perception (Wis) <input type="radio"/> +2 Performance (Cha) <input checked="" type="radio"/> +4 Persuasion (Cha) <input type="radio"/> +0 Religion (Int) <input type="radio"/> -1 Sleight of Hand (Dex) <input type="radio"/> -1 Stealth (Dex) <input type="radio"/> +1 Survival (Wis)		NAME Greataxe Javelin*		ATK BONUS +5 +5	DAMAGE/TYPE 1d12 + 3 slashing 1d6 + 3 piercing
		<small>*See your equipment.</small>		<small>*You can throw a javelin 30 feet, or up to 120 feet with disadvantage on the attack roll.</small>	
OTHER PROFICIENCIES & LANGUAGES		EQUIPMENT		FEATURES & TRAITS	
Proficiencies. All armor, shields, simple weapons, martial weapons, playing cards Languages. Common, Draconic, Dwarvish		Chain mail,* greataxe, 3 javelins, backpack, blanket, tinderbox, 2 days of rations, waterskin, set of fine clothes, signet ring, scroll of pedigree		Second Wind. You have a limited well of stamina you can draw on to protect yourself from harm. You can use a bonus action to regain hit points equal to 1d10 + your fighter level. <small>Once you use this feature, you must finish a short or long rest before you can use it again.</small> Fighting Style (Defense). While you are wearing armor, you gain a +1 bonus to AC. This bonus is already included in your AC. Position of Privilege. Thanks to your noble birth, people are inclined to think the best of you. You are welcome in high society, and people assume you have the right to be wherever you are. The common folk make every effort to accommodate you and avoid your displeasure, and other people of high birth treat you as a member of the same social sphere. You can secure an audience with a local noble if you need to.	
		*While wearing this armor, you have disadvantage on Dexterity (Stealth) checks.			

Human fighter (noble), page 1 of 2

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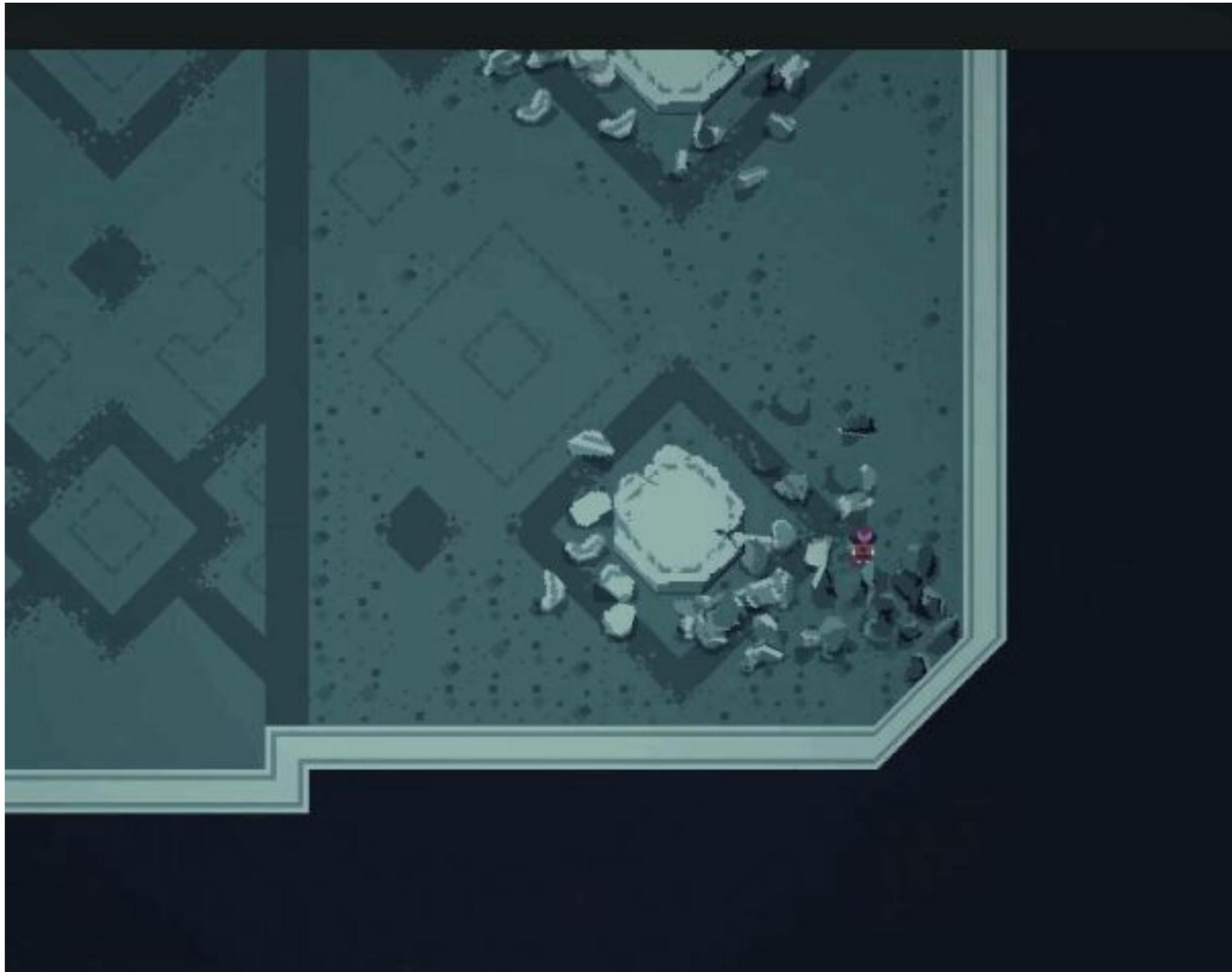
Stats (Dungeons and Dragons 5e)

Everything!



Civilization series

Just One Thing!



Titan Souls

A Few Particular Things?



Command Set
(Kingdom Hearts: Birth by Sleep)

The screenshot shows Cloud Strife's character status. He is at Level 31 with HP 1623/1654 and MP 256/256. His equipment includes a Buster Sword (Weapon), Silver Armlet (Arm), and a set of materia. Below the status bar, it says 'Equips "Lightning" magic'. A table lists the Lightning magic moves and their effects:

Magic	Effect	AP Cost
Lightning	Strength -01	12428
Lightning	Magic +01	5572
To next level	MaxHP -02%	
Bolt	MaxMP +02%	
Bolt2		
Bolt3		

Move set + Weapon slots
(Final Fantasy 7)

Resource Systems in Games: An Analytical Approach

Tróndur Justinussen, Peter Hald Rasmussen, Alessandro Canossa and Julian Togelius

Abstract— We describe an approach to using standard data mining algorithms to help analyse recurring themes in game design across several games, and to help suggest novel game design ideas. This is illustrated with the analysis of 119 different resource systems across 20 games. Clustering is used to validate the assignment of resources into archetypes; frequent pattern mining is used to find commonly co-occurring resource attributes; and decision tree induction is used to visualize the relations between resource archetypes. We discuss the relation between qualitative and quantitative analysis of game design and suggest that qualitative analysis is necessary but that quantitative methods can be of invaluable help.

When presented with resources such as health, mana, money and ammunition, players immediately have a notion of the dynamics of the resource based on past experience. This is because patterns in dynamics exist between resources, even across very different games. The term dynamics refers to the game-play that emerges from the player's interaction with the resource system. Similar to the term described in the MDA [9].

A framework has been created that is able to deconstruct individual resources into a number of attributes, that combined describe the resource pattern.

The resource systems have been encoded in an instance

TABLE I
PROPERTIES FRAMEWORK

Gain			Store		Spend				
Non-Spatial	Generator	Focus Loci	Storage Cap	Entity	Conversion	Options	Produces	Purpose	Consequence
Regenerates	Enemy (Kill)	Unit	Limited	Virtual	Trade	Multi	Object	Enhance	Diminish
Non-Temporal	Being (Action)	Avatar	Unlimited	Object	Craft	Single	Effect	Inflict	Constant
RM	Pick-Up	God's Finger		Abstract	Exchange	Degenerates	Abstract		Invest
Reward	Recharger				Consumable	Lost	Unit		Vital
Starting	Lim. Vendor								
Ally	Vendor								
Exchange	Mine								
Consumable	Supplier								
Craft									
Trade									

This table includes all the possible properties and specifications that can be used to describe resources.

TABLE III
ARCHETYPE FRAMEWORK

	Gain			Store		Spend				
	Non-Spatial	Generator	Focus Loci	Storage cap	Entity	Conversion	Options	Produces	Purpose	Consequence
Action	+ Non-Temp. + Starting	÷ Generator		Limited	Virtual		Single		Enhance	
Ammo		Generator	÷ Unit	Limited				Effect	+ Inflict	Diminish
Currency				+ Unlimited	Virtual		Multi		Enhance	Constant
Health	Starting			Limited	Virtual	- None -	Lost			+ Vital
Mana	+ Regenerates			Limited	Virtual	÷ Trade		Effect		Diminish
Material		Generator	Avatar		+ Abstract	Trade	Multi	÷ Virtual	Enhance	Constant
Physical		Generator			÷ Virtual		Single	+ Object	Enhance	Constant
Potion		Generator	Avatar	Limited		Conversion	÷ Multi		Enhance	+ Diminish
Rage		+ Being (Action)	Avatar	Limited	Virtual	- None -		Effect		Diminish
Skill Point	+ Reward			Unlimited	Virtual	- None -	Multi	Effect	Enhance	Constant
Rune	Craft				Abstract	Craft	Single	Effect	Enhance	+ Constant

In this table, each resource archetype is defined using a combination of attributes. A resource system must contain each attribute in order to belong to any of the existing archetypes.

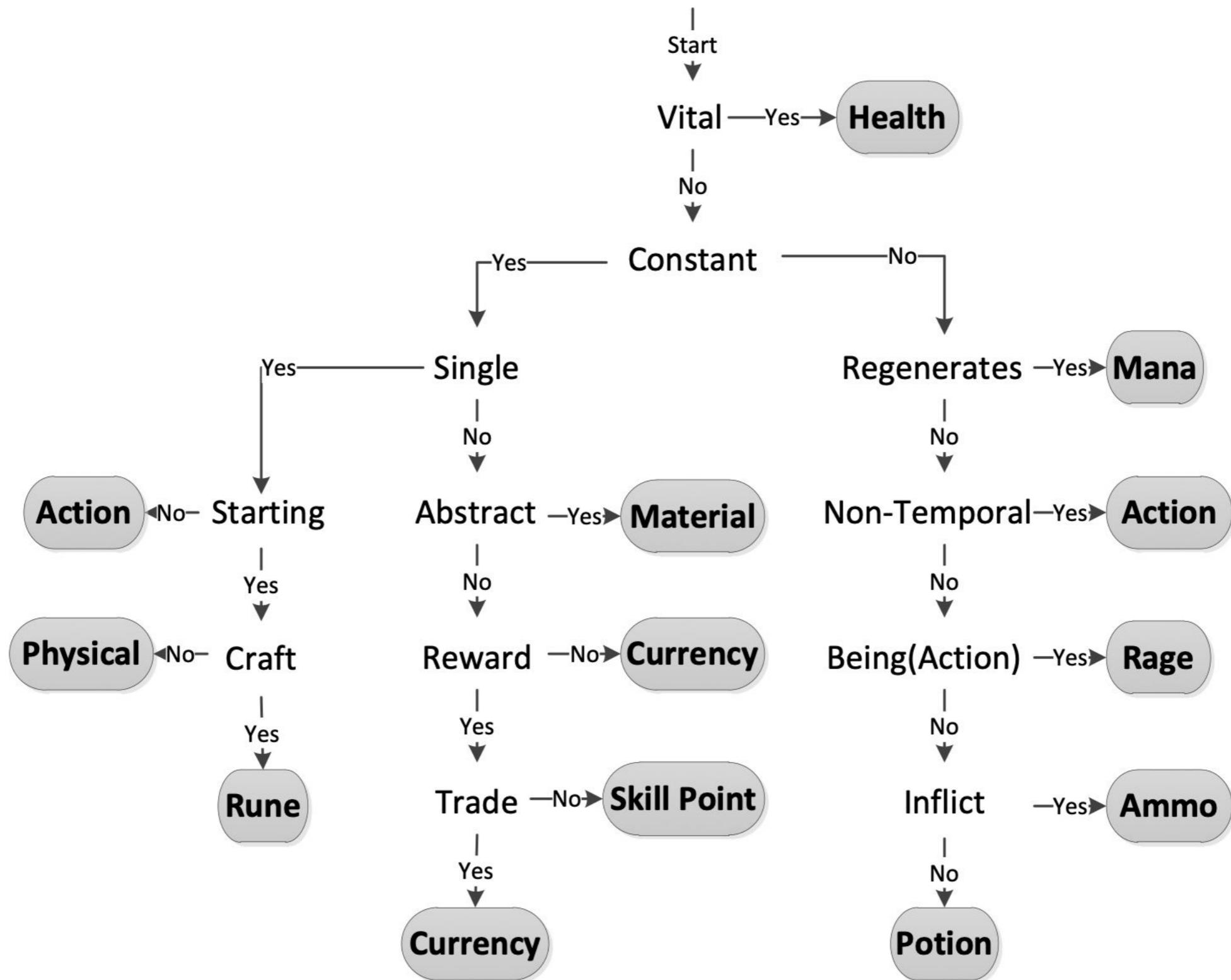


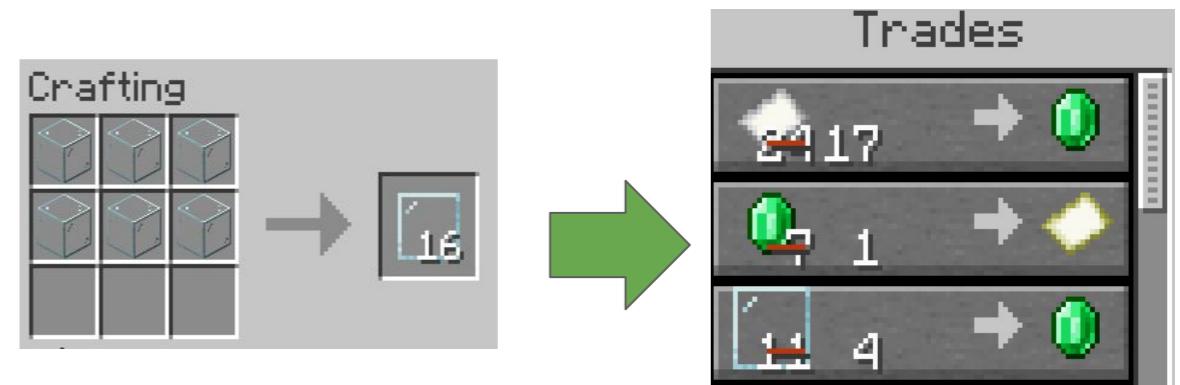
Fig. 3: J48 Decision Tree classification of archetypes.

Balancing resource systems

- There is likely to be feedback loops, positive and/or negative



- How can you avoid the emergence of degenerate strategies?



- How can you ensure all systems stay relevant and nothing is exploited or ignored?



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(Minecraft trading)

Machinations

- Game design abstraction/simulation, originally by Joris Dormans
- Since developed into complete game simulation framework
- Formal way of thinking about resources

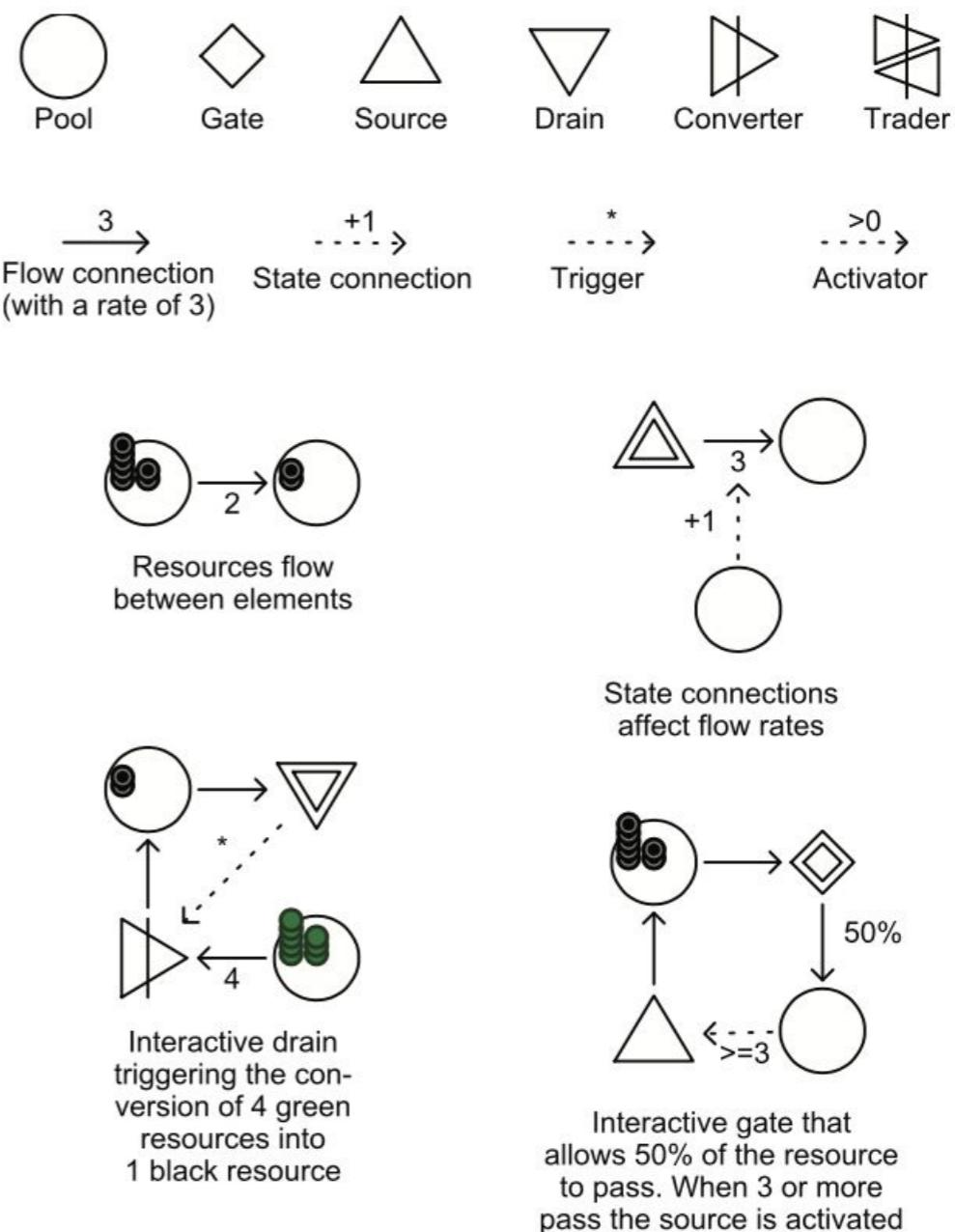


Figure 1: Elements of Machinations diagrams and example constructions.

League of Legends Hextech Chest Gatcha v2 - Automated

1

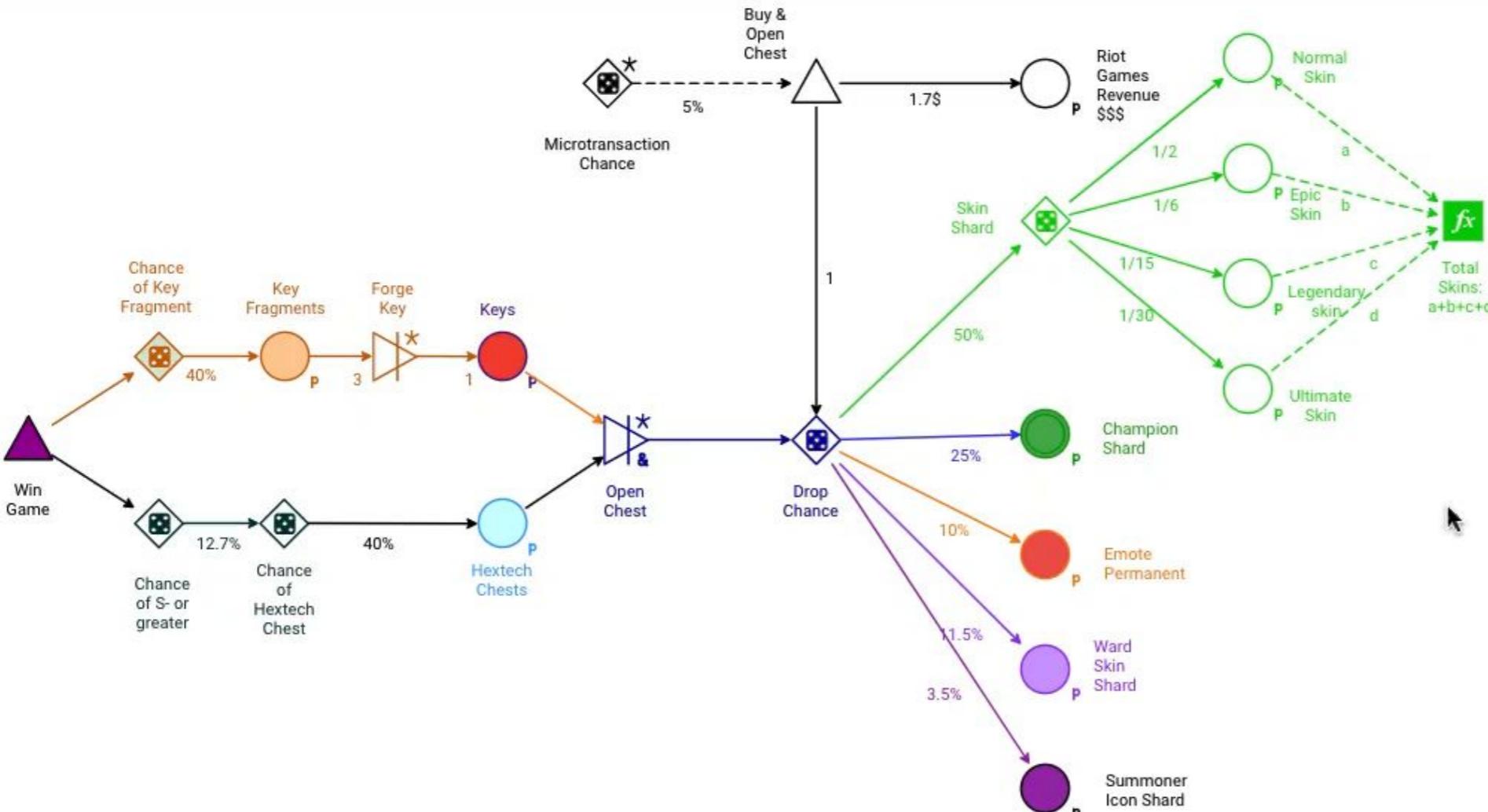
Saving...



Live Editing



Share



Diagram

Global properties

- D6 [D] Dice
- [S] Skill
- [M] Multilayer
- [St] Strategy

View

- Grid
- Page view

Options

- Connection arrows
- Guides

Run mode
animated

Speed
1 s

Steps
50



70%



Some considerations regarding resources

- Availability (run n' gun vs survivor games, “grinding” for resources)
- Conversion (is there a focus on converting between resources?)
- Relative value & obfuscation (how easy is it to tell the relative value?) - *more advanced*

Quick and dirty tricks to resource balancing

- Auction systems
- Bonus for low usage
- “Seasonality”
- Real-time delays
- Consumable limitation

