



Rogue-Like Algebra

by the Gold Team

Design Presentation

“Gamify algebra—turn problem-solving into an adventure!”



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Team Bio



Brennen Gabriel

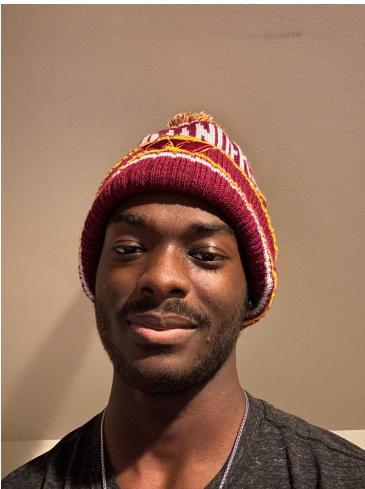


Gabriel Lugo



Jillian Cequeria

Team Bio



Brandon Thomas



Jacob Thompson



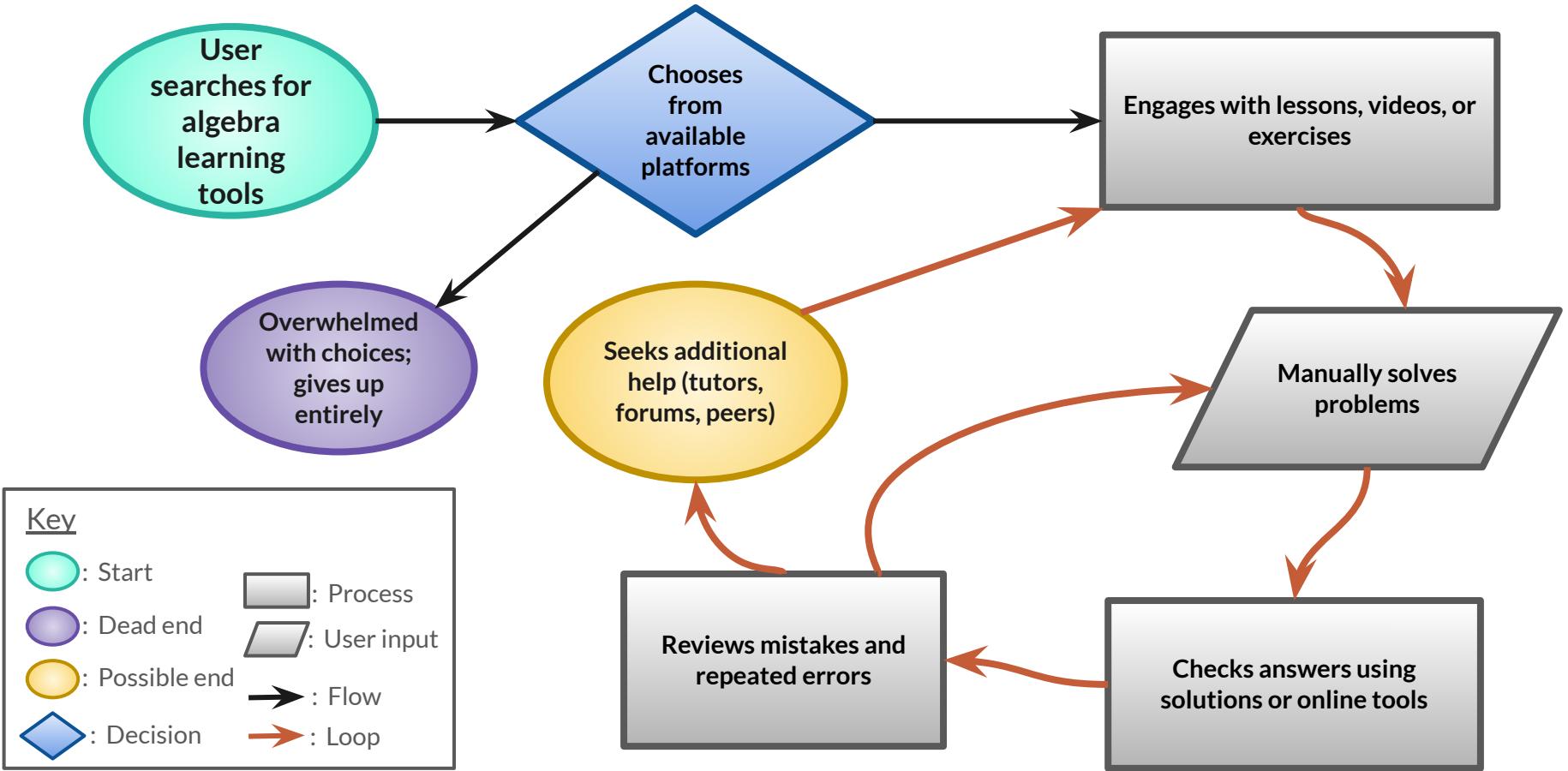
Bryan Baker

Pitch

We aim to develop a game to help those who struggle to understand algebra. Our game will be a *turn-based, rogue-like adventure* through algebra. With dungeons, bosses, and power-ups all throughout, you'll be engaged in the world as much as you are with the math.

But be sure to calculate your next step carefully. Damage is dealt to the reckless, and penalties will be incurred for wrong answers. Find hints and collect extra lives to survive your mathematical journey.

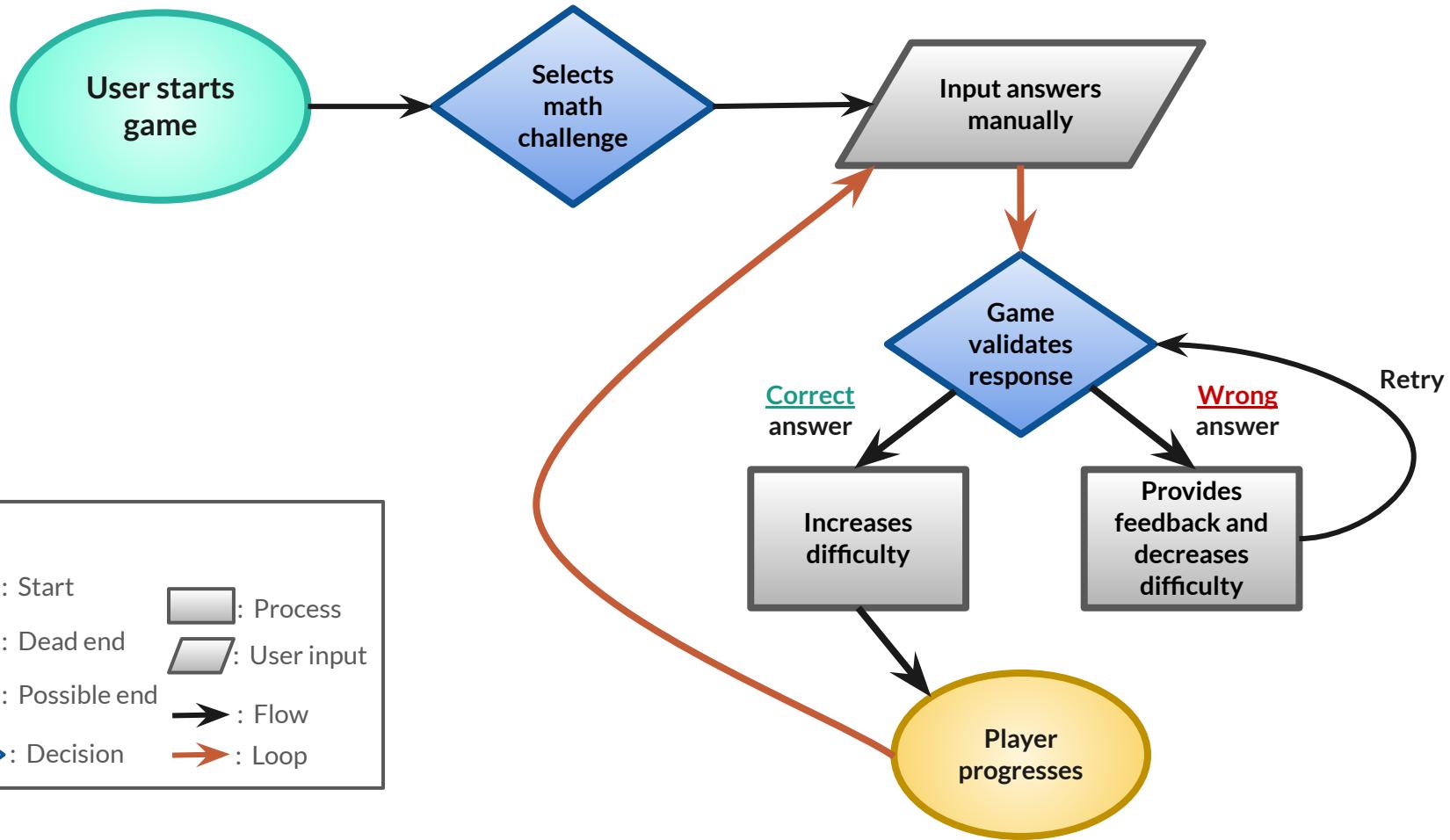
Problem



Solution

Solution Statement

- **Turn-based, rogue-like adventure game** - the player solves math puzzles to progress through procedurally generated dungeons.
- **Efficiency-focused gameplay** - Players are incentivized to solve problems efficiently and mistakes cause damage.
- **Upgrades** - Upgrades, such as hints, energy, or health, can be found or bought.
- **Platforms** - Mobile / Web



Issues

- **Tedious:**
 - Manually adjusting difficulty
 - Re-entering answers
- **Error-prone:**
 - Mistyped answers
 - Misreading feedback
- **Shortcomings:**
 - No adaptive learning
 - Limited engagement
 - UI inefficiencies

Opportunities

- **Automate:**
 - Generate math challenges
 - Adjust difficulty automatically
 - Real-time validation
- **Partially Automate:**
 - Hints for incorrect answers
 - Real-time feedback
- **Repetition:**
 - Manual input every time
 - Re-validating similar problems



What it Will Do

- **Turn-based Combat** - Solve algebra problems to attack, defend, and use abilities.
- **Rogue-like Gameplay** - When you lose, you have to start again from the beginning.
- **Procedural Dungeons** - Unlock skills and items by solving math challenges.
- **Penalties for Mistakes** - Wrong answers lead to in-game consequences.
- **Optimization Puzzles** - Try to find the best solutions, not just any solution.
- **Adaptive Difficulty** - The game adjusts to the player's skill level.
- **Exploration & Rewards** - Solve puzzles to unlock new areas and items.
- **Minimalist UI & Hints** - Clear interface with optional hints for guidance.



What it Will Not Do

- **Traditional Gamification** - No forced lessons or boring drills.
- **Multiple-Choice Questions** - Players solve open-ended problems, not just pick provided answers.
- **Instant Failure for Mistakes** - Errors have penalties, but players can recover.
- **Overly Complex UI** - The interface stays clean and intuitive.
- **Rote Memorization** - Focus is on problem-solving, not rote learning.
- **Strict Single Solutions** - Multiple valid algebraic approaches are allowed.
- **Pay-to-Win Mechanics** - No microtransactions that impact gameplay.

Competition Matrix

Feature	Rogue-Like Algebra	IXL	ProdigyGame Math	DragonBox Algebra 12+
Integration with Learning Management Systems	Yes	Yes	Yes	
Web Integration	Yes	Yes	Yes	
Mobile Integration	Maybe	Yes	Yes	Yes
Leaderboard and Challenge System	Yes	**Challenge System Only	Unsure	Unsure
Comprehensive Curriculum Based		Yes	Yes	Unsure
Available Free Subscription	Yes (with Ads)			
Rogue-Like Gameplay	Yes			
Adaptive Difficulty	Yes	Unsure	Yes	Unsure

Competition Matrix (cont.)

Feature	Rogue-Like Algebra	IXL	ProdigyGame Math	DragonBox Algebra 12+
Turn-based Combat	Yes		Yes	Yes
Procedural Dungeons	Yes			
Optimization Puzzles	Yes			
Exploration & Rewards	Yes		Yes	

For the unsure labels, it is behind a paywall and that is not within our team's budget

Key Features



Core Gameplay Concepts

Turn-Based Combat with Algebra Challenges

- Incorrect answers leads to penalties (e.g., weaker attacks, enemy advantages)
- Players solve algebra problems to attack, defend, or use abilities

Inventory & Equipments System

- Weapons, armour, and consumables provide tactical advantages

Difficulty Scaling

- Problems given to the player will increase in difficulty as the player progresses

Minigames

- Different areas of algebra will be split up into different events throughout the game, such as potion crafting and item enchanting



Algebra-Based Puzzles & Problem-Solving

Contextual Algebra Challenges

- Solving for unknowns, simplifying expressions, or graphing functions in an immersive way

Dynamic Difficulty Scaling

- Difficulty adapts based on the player's performance to maintain engagement

Multi-Step Problems for Special Moves

- More complex algebra unlocks powerful attacks



Narrative & Worldbuilding

A Mysterious Lore-Driven Dungeon

- Players explore an ancient world where algebraic knowledge holds power.

NPC Mentor

- Players may receive help from a mentor to get hints if they are stuck.



Progression & Reward Systems

XP and Leveling Up via Problem Solving

- Solving harder problems earns better XP

Achievements & Streaks for Engagements

- Rewards for continuous answers, no hints used, etc.

Background & Statistics



“Hierarchical linear modeling analyses of the final analytic sample (N = 1,850) showed significantly higher posttest scores for students who used From Here to There and DragonBox 12+ compared to the Active Control condition.”

- Quote from “The Impacts of Three Educational Technologies on Algebraic Understanding in the Context of COVID-19”

SteamDB Search... Sales Charts Calculator Calendar Patches Find games Bluesky

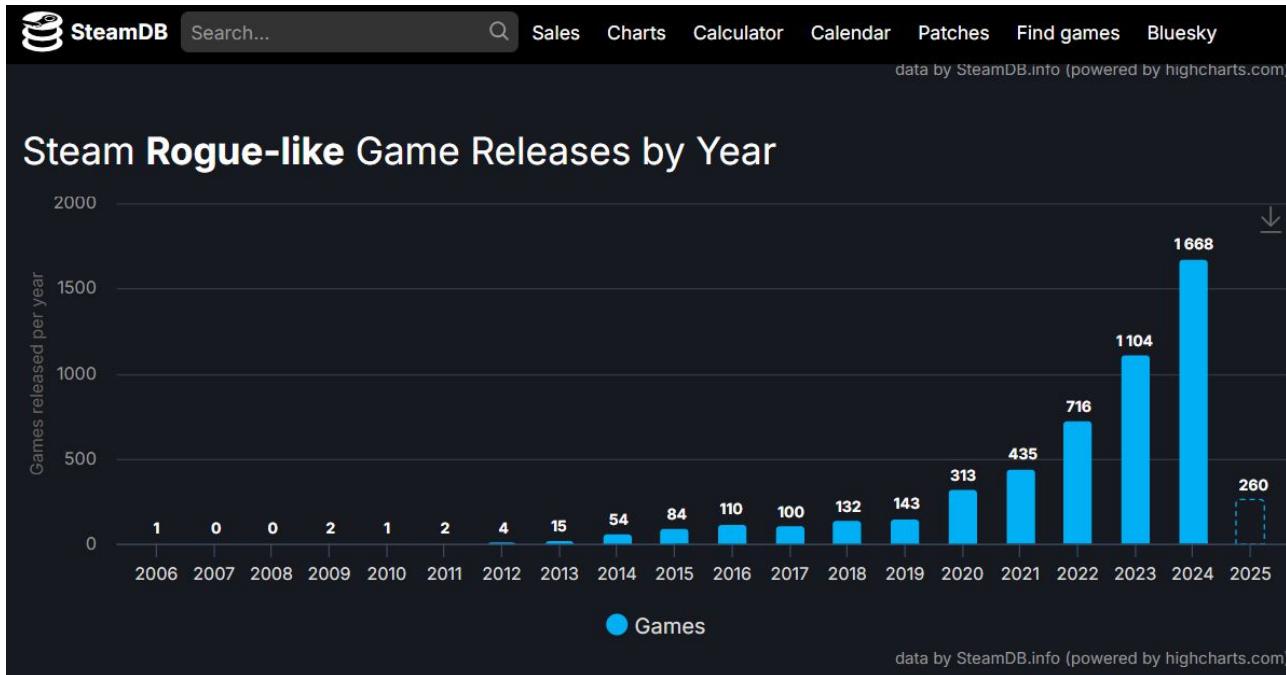
Most played Rogue-like games

100 entries per page. Hold Shift to sort by multiple columns.

Search...

SteamDB.info	Name ↑	Current ↕	24h Peak ↑↓	All-Time Peak ↑↓	
	The Binding of Isaac: Rebirth	25,044	28,907	70,701	+
	Balatro	21,741	23,438	43,905	+
	Don't Starve Together	16,649	55,703	115,925	+
	Slay the Spire	10,629	19,596	33,086	+
	Hades II	7,215	8,015	103,567	+
	Brotato	6,185	10,712	38,905	+
	Risk of Rain 2	5,898	7,295	75,406	+
	Alpha League HD	4,535	5,253	10,252	+
	Hades	3,356	3,755	54,240	+
	Vampire Survivors	3,334	3,508	77,061	+

SteamDB Screenshot from 3/5/2025 with the filter set to “Rogue-like” games



SteamDB Screenshot from 3/5/2025

Design | 25

Results

Found 8523 games. It's 6.5% of all Steam games

[Export to Excel](#)  [Pro](#)

#	Title	Release	Price	Tags	Followers	Reviews	Score	Net Revenue
1	 Hades Steam  Publisher: Supergiant Games Developer: Supergiant Games	Sep 17, 2020 4 years, 5 months ago	\$24.99	Action Action RPG Action Roguelike Atmospheric Difficult Dungeon Crawler Great Soundtrack Hack and Slash Hand-drawn	291,414	255,246	10/10	~\$120 million
2	 Risk of Rain 2 Steam  Publisher: Gearbox Publishing Developer: Hopoo Games	Aug 11, 2020 4 years, 6 months ago	\$24.99	Action Action Roguelike Bullet Hell Co-op Difficult Early Access Great Soundtrack Indie Loot Loot Shooter Multiplayer Online Co-Op	320,685	207,277	9/10	~\$99 million
3	 Don't Starve Together Steam  Publisher: Klei Entertainment Developer: Klei Entertainment	Apr 21, 2016 8 years, 10 months ago	\$14.99	2D Action Adventure Atmospheric Co-op Crafting Difficult Funny Horror Indie Multiplayer Online Co-Op Open World	701,060	334,900	10/10	~\$96 million
4	 The Binding of Isaac: Rebirth Steam  Publisher: Nicalis, Inc. Developers: Edmund McMillen, Nicalis, Inc.	Nov 4, 2014 10 years, 4 months ago	\$14.99	2D Action Action Roguelike Atmospheric Co-op Dark Difficult Dungeon Crawler Gore Great Soundtrack Horror Indie Local Co-Op	341,273	300,613	10/10	~\$86 million
5	 Slay the Spire Steam  Publisher: Mega Crit Developer: Mega Crit	Jan 23, 2019 6 years, 1 month ago	\$24.99 \$8.49 -66%	2D Card Battler Card Game Casual Deckbuilding Difficult Dungeon Crawler Fantasy Great Soundtrack Indie Mouse only	221,514	152,244	10/10	~\$73 million
6	 Dead Cells Steam  Publisher: Motion Twin Developer: Motion Twin	Aug 6, 2018 6 years, 7 months ago	\$24.99	2D Action Action Roguelike Adventure Atmospheric Dark Fantasy Difficult Funny Hack and Slash Indie Metroidvania	382,701	140,502	10/10	~\$67 million

Games-Stats.com Screenshot from 3/5/2025 with the filter “Rogue-like” games



Target Audience

Primary Audience

- Middle School and High School Students
(Ages 12-18)
- STEM-Oriented Gamers & Puzzle Enthusiasts

Secondary Audience

- Parents and Educators
- Casual & Indie Game Players
- Games with an Interest in Logic & Strategy

Engagement Strategies



Gamification of Learning

Time-Based Combos and Multipliers

- Solving within a time limit increases attack damage

Boss Battles with Complex Algebra Challenges

- Require multiple algebraic steps to defeat



Adaptive Learning

Hints and Adaptive Challenges

- Struggling players get guided help without “hand-holding”

Procedurally Generated Problems for Replayability

- Problems change dynamically, ensuring fresh experiences



Social & Competitive Elements

Leaderboards & Speedruns

- Track best problems-solving times and dungeons cleared

PVP & Co-Op Modes

- Battle friends or solve cooperative algebraic puzzles

Guilds & Team Challenges

- Players work together to solve harder problems



Rewarding Risk & Creativity

Risk-Rewarding System

- Players can attempt harder problems for greater loot

Multiple Solution Paths

- Creativity encouraged in problem-solving approaches
- Encourage avoiding rote memorization

Development Tools



Integrated Development Environment (IDE)

Visual Studio Code

We will use VS Code because it is **powerful, extensible**, and, most importantly, **free**.



Version Control

Git / GitHub

We will use Git through GitHub because it is an **industry-standard** tool for version control.



Continuous Integration (CI) & Continuous Deployment (CD)

GitHub Actions & Workflows

We will use GitHub Actions because it is directly integrated with GitHub.



Database

SQLite via Rusqlite

We will use SQLite for the database for the prototype as it allows for storing data on a local database rather than a remote server.

Rusqlite provides idiomatic Rust bindings for SQLite.



Dependencies

godot-rust

- Rust bindings for the Godot game engine.

rstest

- Testing framework to allow for easier creation and extension of code tests in Rust.

rusqlite

- Rust bindings for SQLite, a simple relational database engine.

Major Functional Components



Operating System

Windows / Linux

Windows is the most widespread end-user platform, while Linux is what powers Android and the Steam Deck.



Engine

Godot

Godot is free and open source software, which gives us a lot of flexibility.

It is easy to use due to the intuitive interface and prevalence of tutorials and documentation.



Language

Rust / GDScript

We will primarily use the Rust programming language as it is **fast, modern, and safe.**

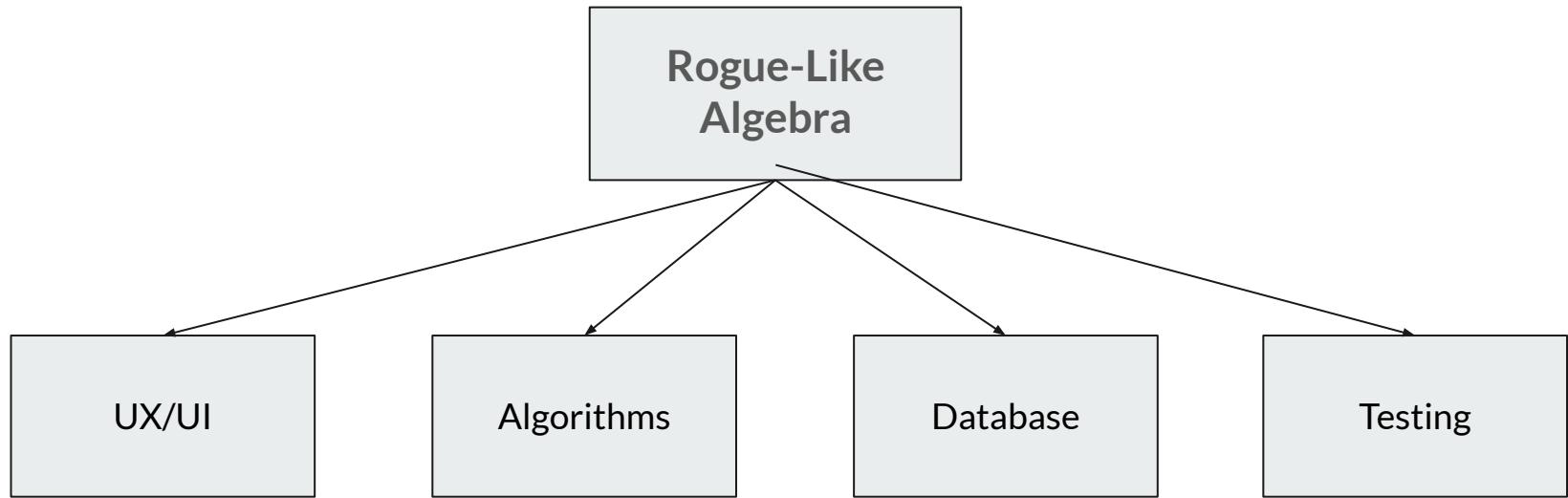
We may also be using GDScript for features that aren't covered by Rust in Godot.

Required Components

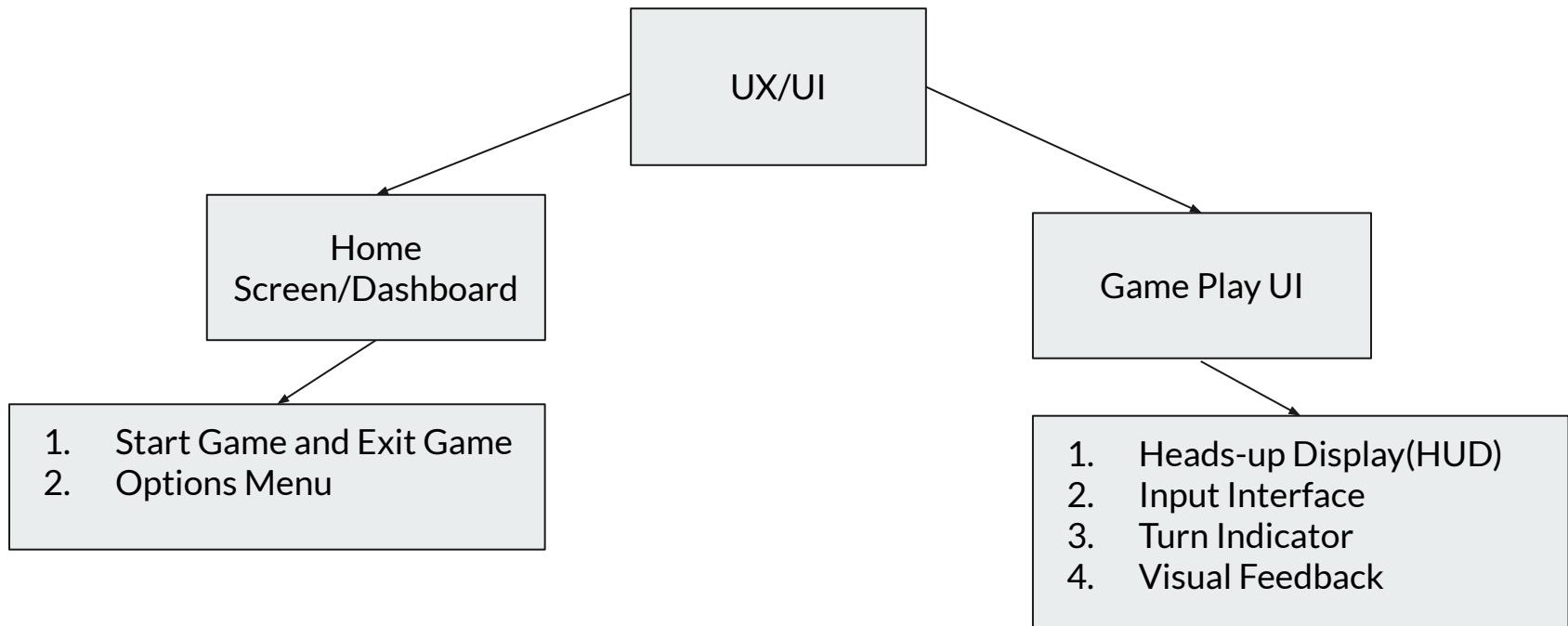
Technology	Must be built
Godot	
Audio Subsystem	
Networking Subsystem	
Character Controller	Yes
Leaderboard System	Yes
Procedural Dungeon Generator	Yes
Enemy AI and Pathfinding	Yes
Procedural Problem Generator	Yes

Design

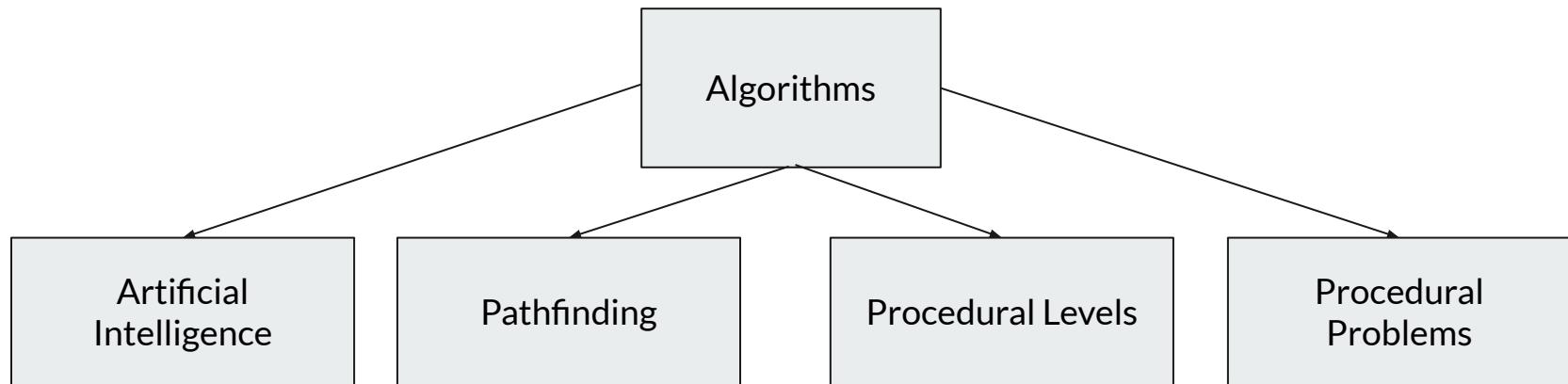
Work Breakdown Structure



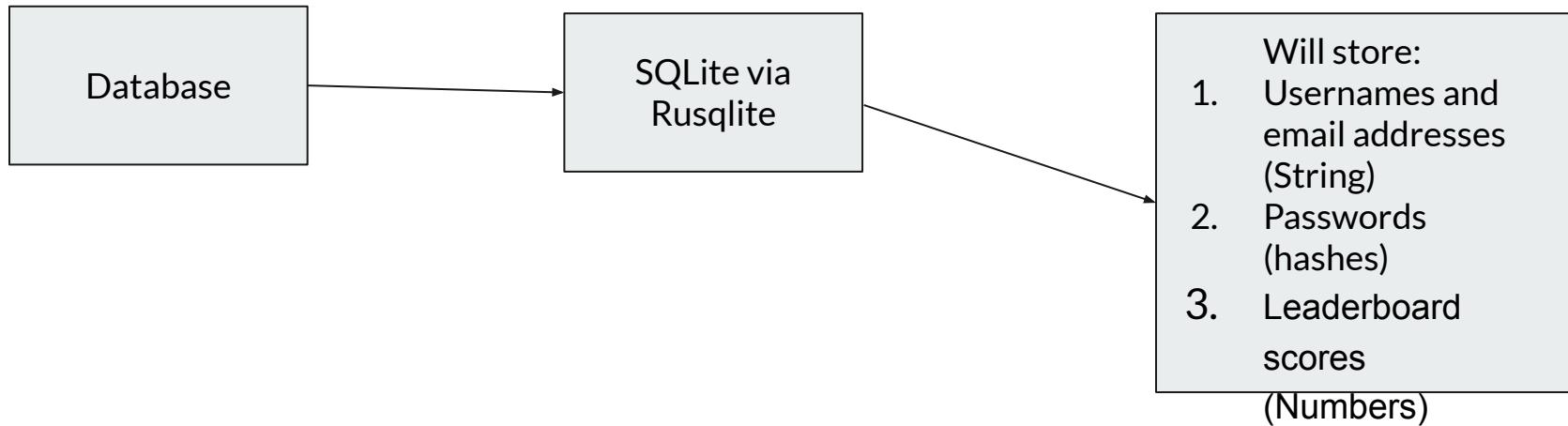
Work Breakdown Structure: UX/UI



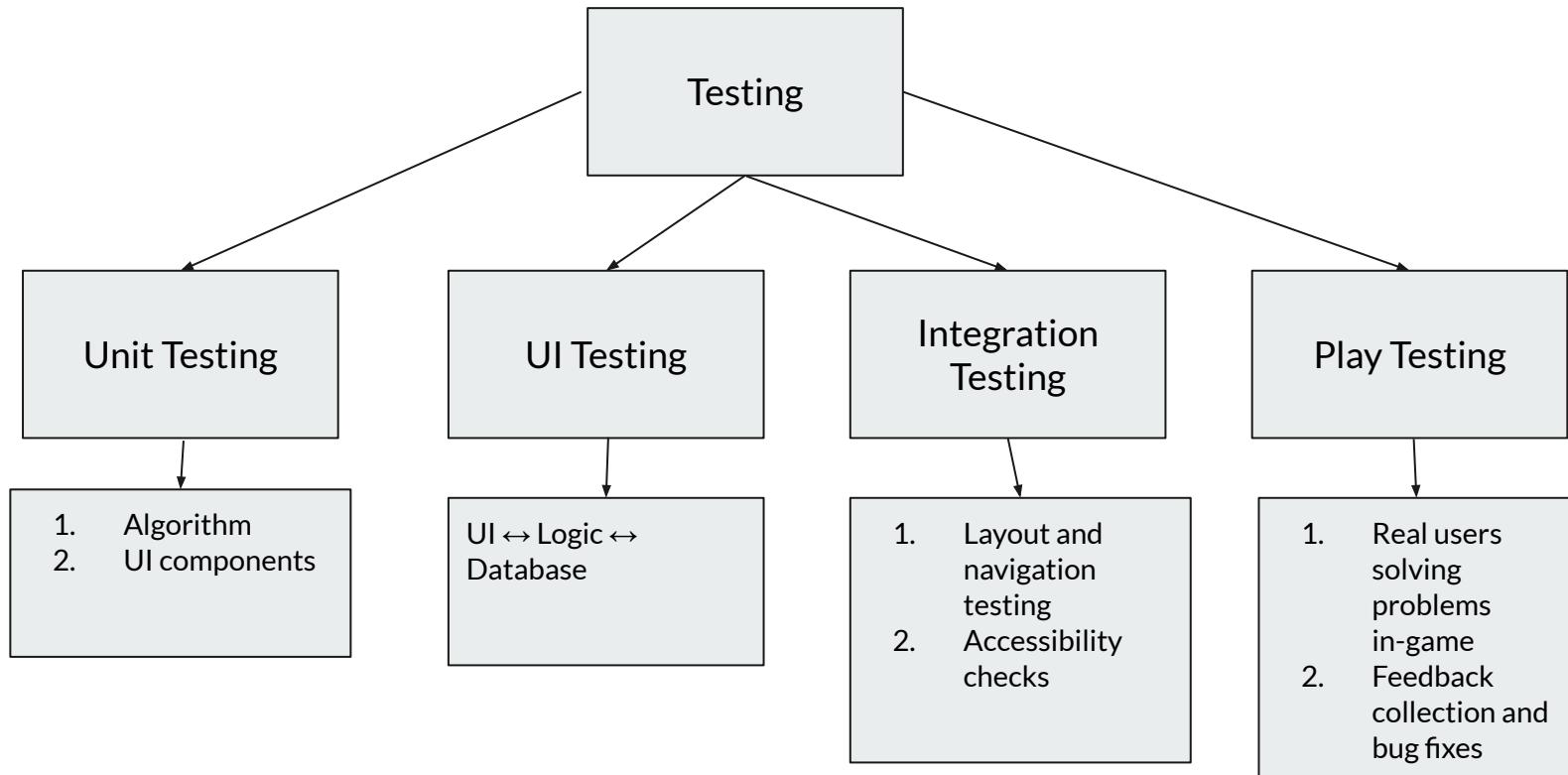
Work Breakdown Structure: Algorithms



Work Breakdown Structure: Database



Work Breakdown Structure: Testing



Development Model

Agile. The Agile development process is a looping design process.

In general, a flow might look something like:

1. Design
2. Develop
3. Test
4. Review

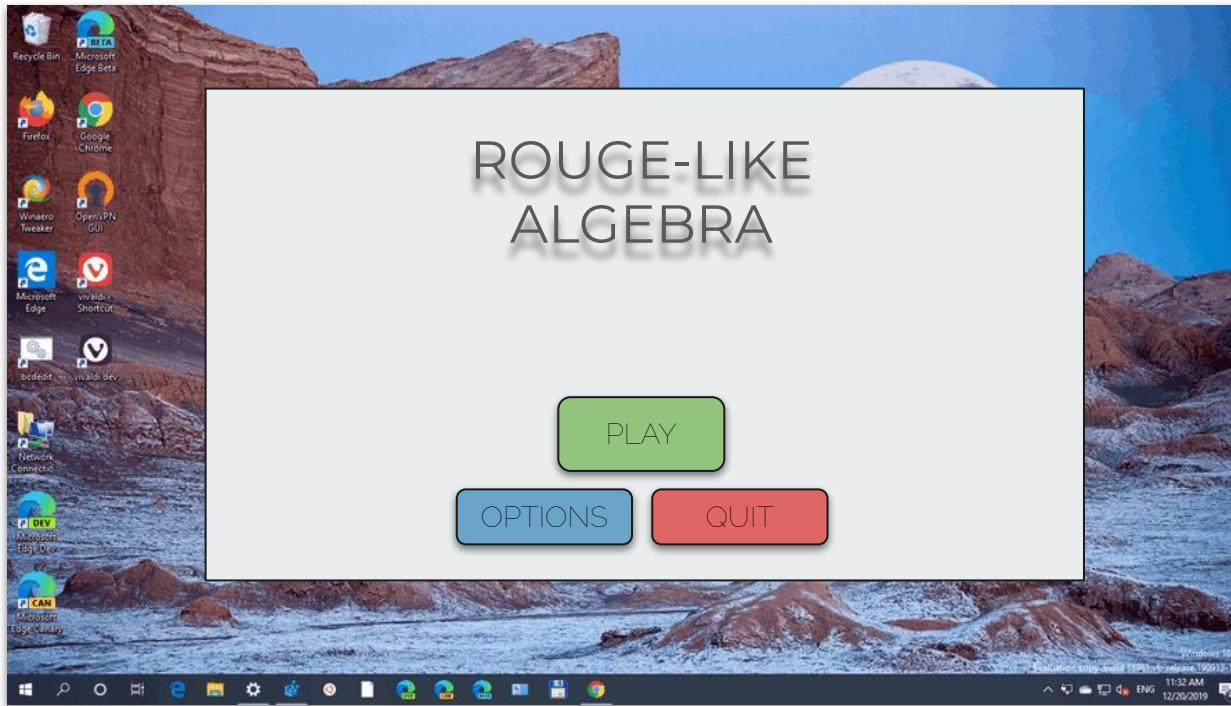


Database Schema

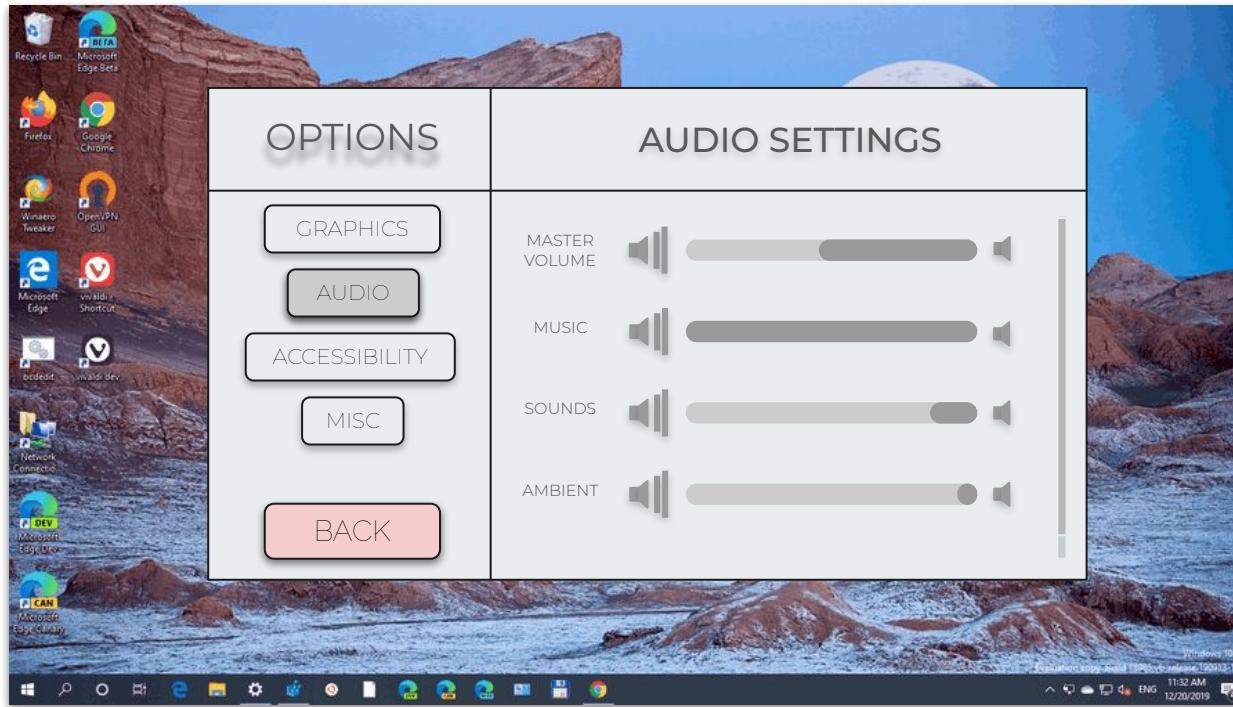
We will store...

- **Usernames** (Strings)
- **Emails** (Strings)
- **Passwords** (Hashes)
- **Leaderboards** (Numbers)

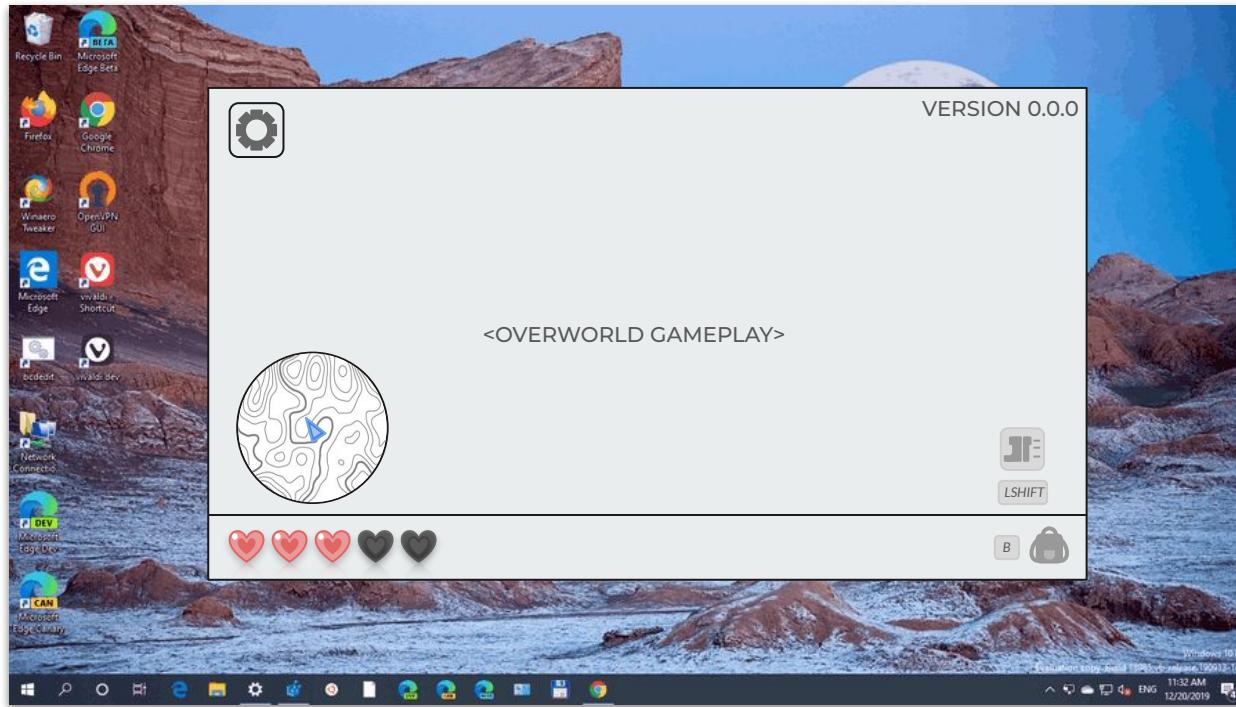
GUI Mockup - Title Screen



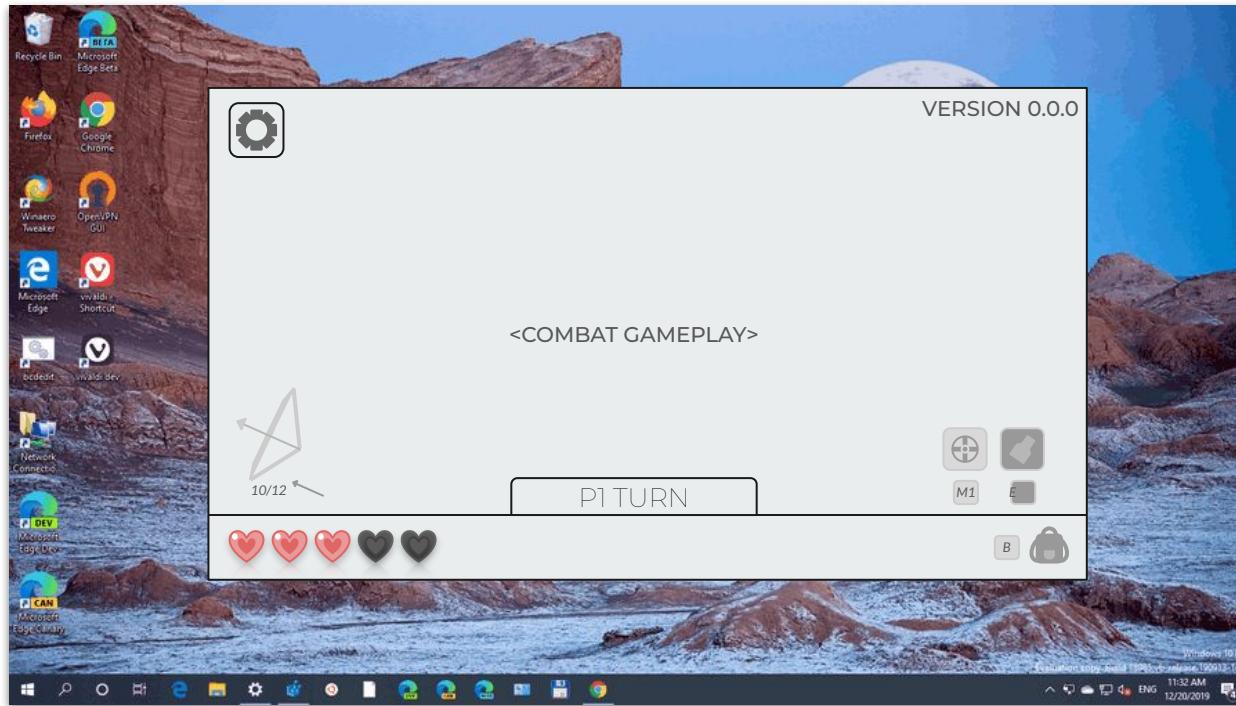
GUI Mockup - Options Screen



GUI Mockup - Gameplay (Overworld)



GUI Mockup - Gameplay (In-Combat)





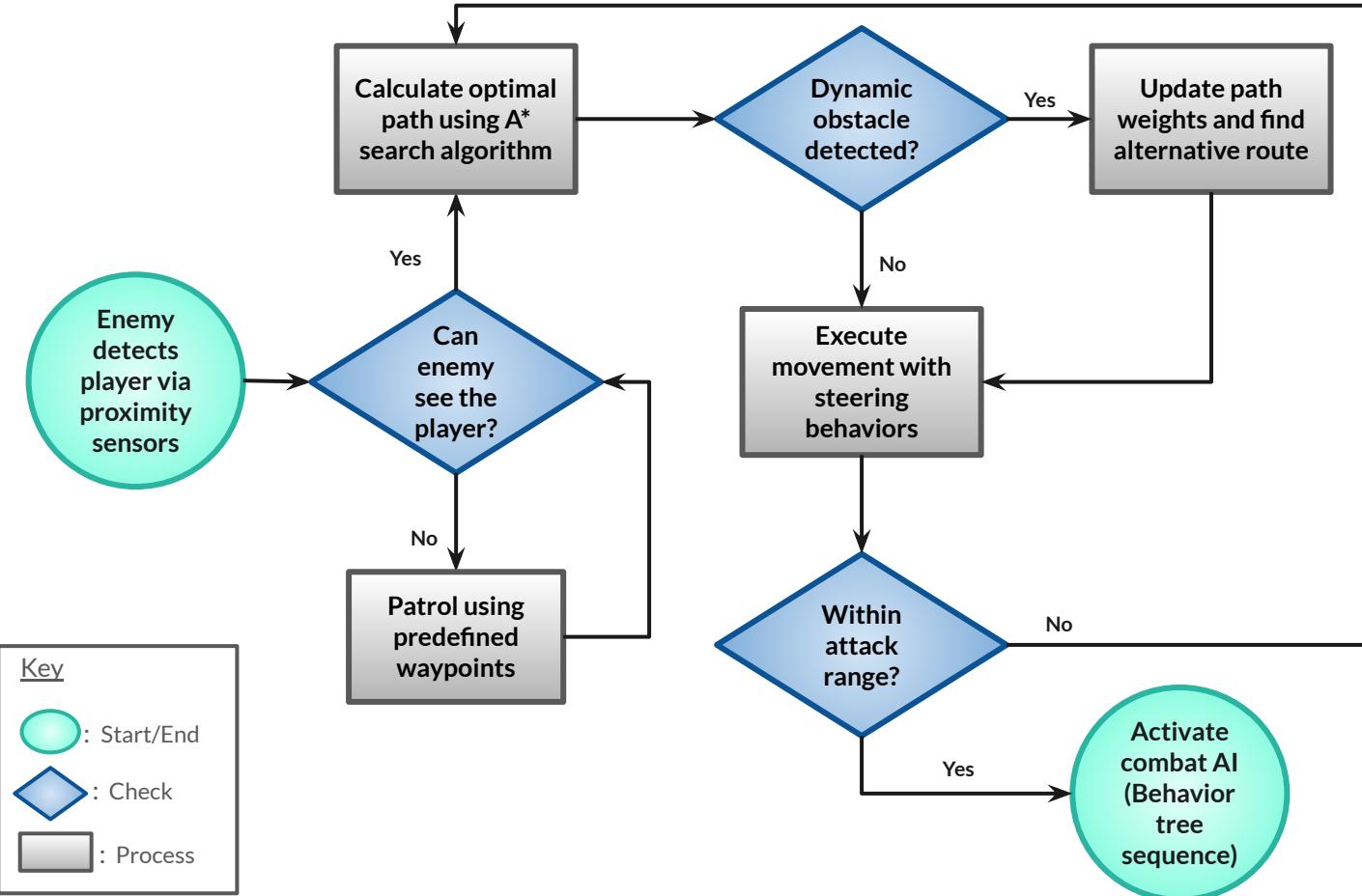
Algorithms

AI. Characters require pathfinding which can be accomplished via algorithms such as A* (A-star).

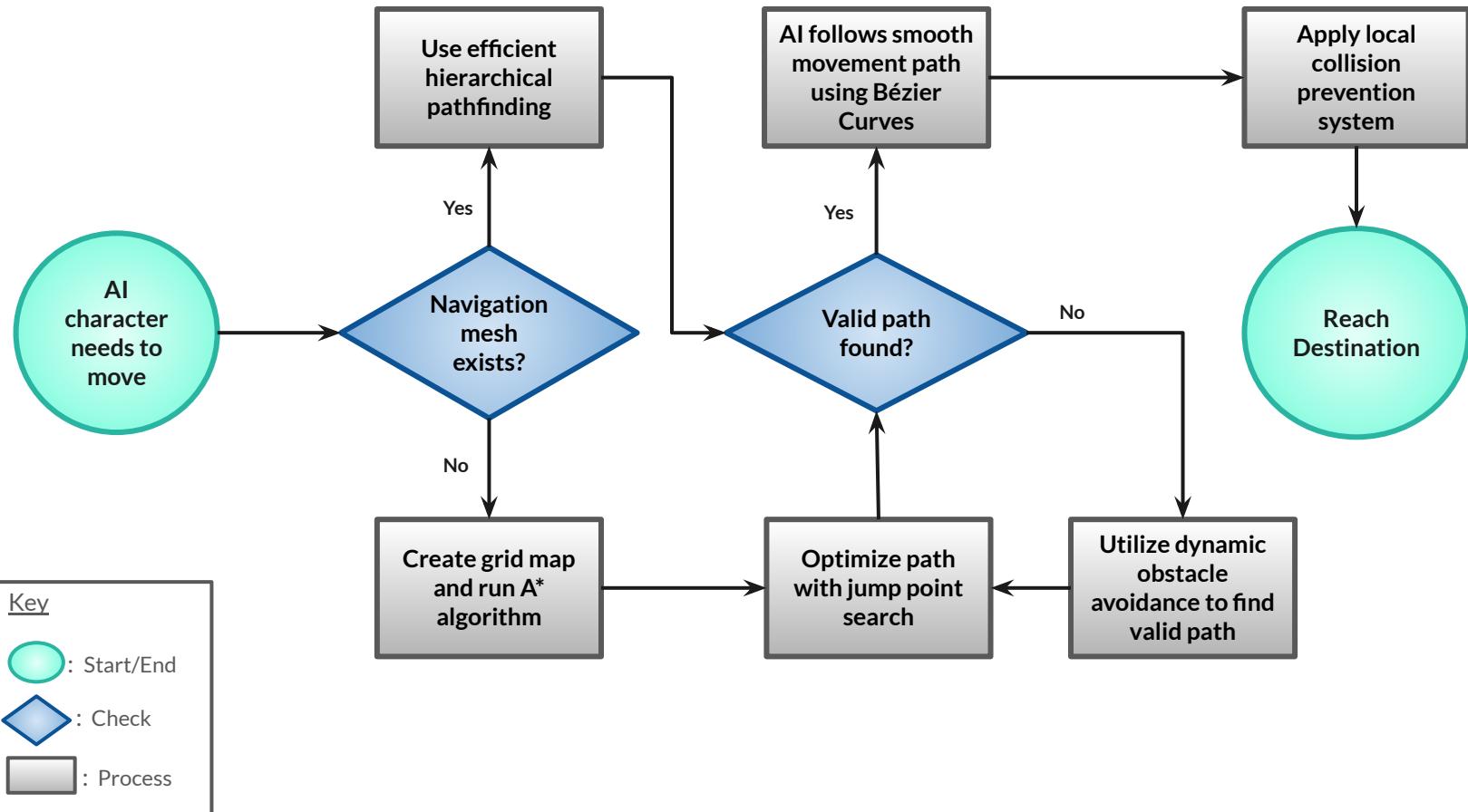
Procedural Generation. Many features in the design require procedural generation of assets, such as math problems and level layouts.

Character Controller. While it may seem simple at first glance, controllers can get quite complicated with multiple states depending on the desired capabilities for the particular character.

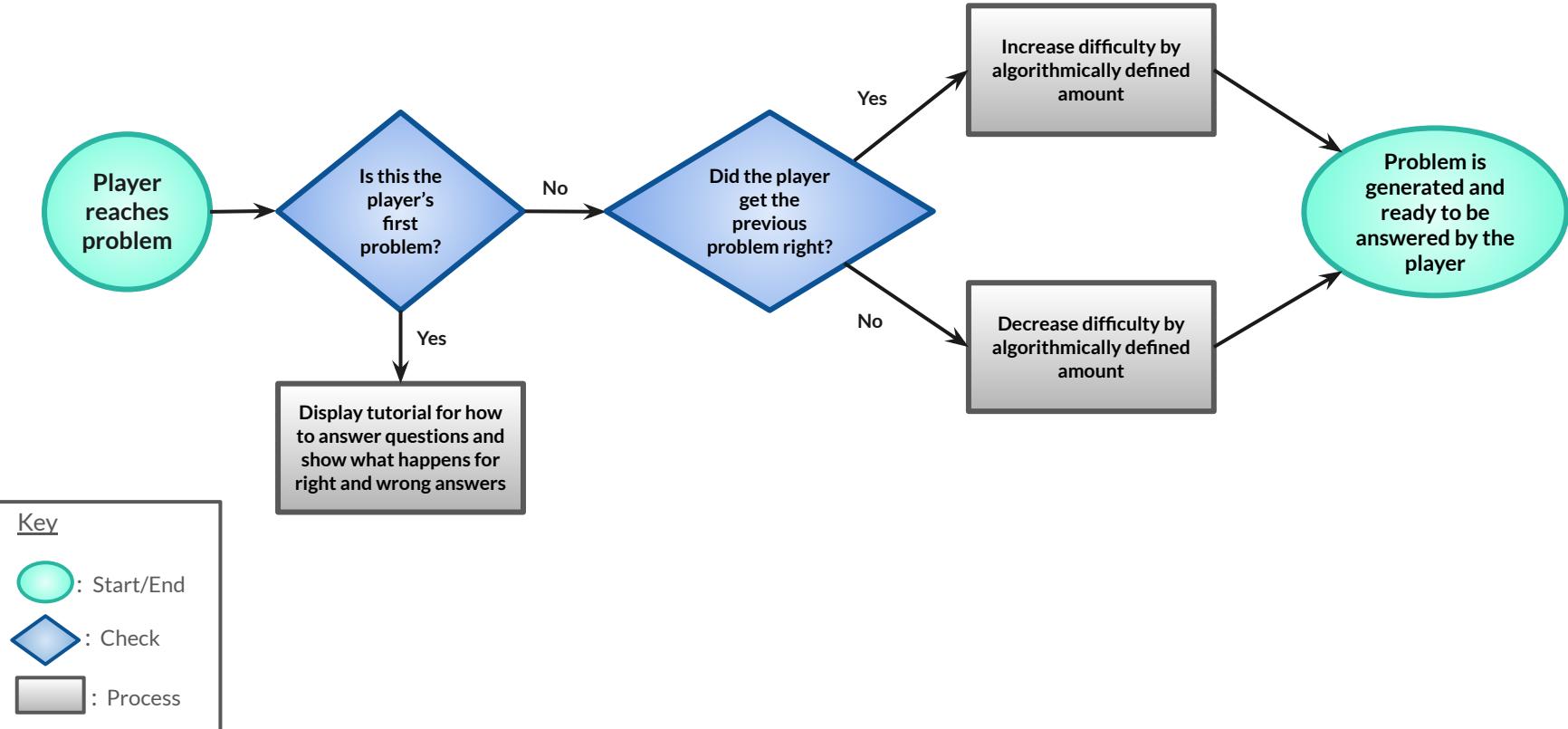
AI



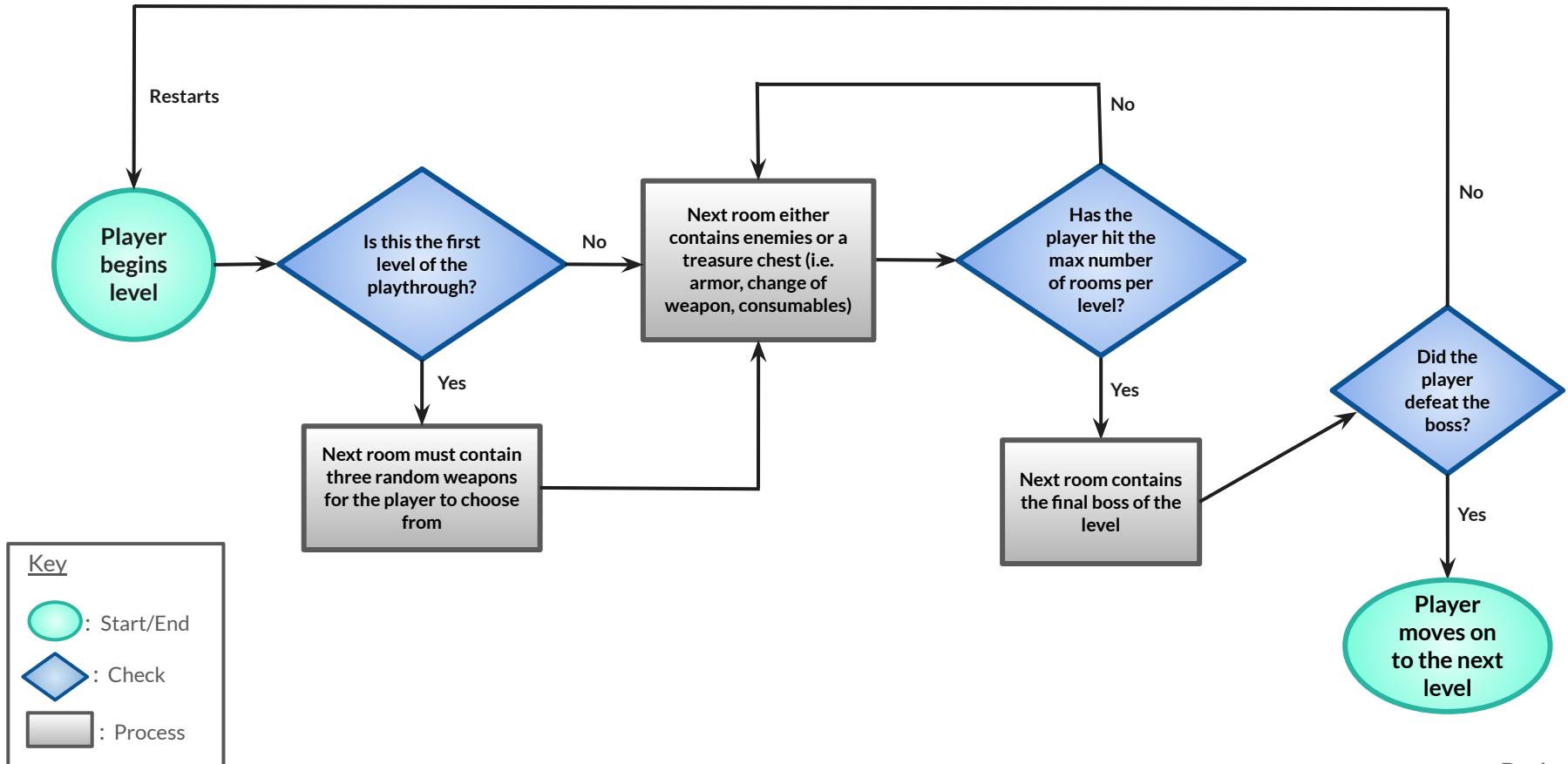
Pathfinding



Procedural Problems



Procedural Level Layouts



Real World Product vs. Prototype

	RWP	Prototype
Character Controller	Yes	Yes
Leaderboard System	Yes	
Procedural Dungeons	Yes	
Enemy AI	Yes	Yes
Pathfinding	Yes	Yes
Procedural Problems	Yes	Yes
Adaptive Difficulty	Yes	
Web Integration	Yes	Yes

Real World Product vs. Prototype (cont.)

	RWP	Prototype
PvP	Yes	
Co-op	Yes	
Guilds	Yes	
Hint system	Yes	
Equipment	Yes	Yes
Enchanting / Power-ups	Yes	Yes

Risks



Technical

Players “Sandbagging.” When done poorly, players can easily circumnavigate the adaptive difficulty by sandbagging their progress.

To mitigate this, we can slowly raise the difficulty when stagnation is detected. To prevent falling behind, review practice can be offered.

- Probability: 5
- Impact: 4

Cheating. If we want leaderboards, we would need to prevent players from uploading scores that are impossible to attain fairly.

To mitigate this, an anti-cheat system will need to be implemented.

- Probability: 5
- Impact: 5



Technical (cont.)

GDScript. While many features of Godot support Rust, there are a select few which still do not. These would require us to implement them via GDScript.

There is no mitigation available other than being mindful of which features require which language.

- Probability: 4
- Impact: 2



Security

Data Leakage. Privacy is important, so we must ensure that anything collected (names, passwords, emails, phone numbers, etc.) are properly stored and protected from leaks.

This can be done by using secure, encrypted methods of storage and communication via clients, databases, and servers.

- Probability: 3
- Impact: 5



Legal

Data Leakage. As mentioned before, data privacy is extremely important and legally protected. In certain regions, such as the US and EU, there are specific data protection laws that must be followed.

To prevent legal action, we would need to review data handling laws in any regions we plan to release in.

- Probability: 3
- Impact: 5



Customer & End User

Boredom. If math problems aren't balanced, players may get frustrated or bored.

To mitigate this, problems should be varied and gameplay engaging.

- Probability: 4
- Impact: 4

Poor Motivation. Weak rewards or progress systems could make players quit (motivation to keep playing).

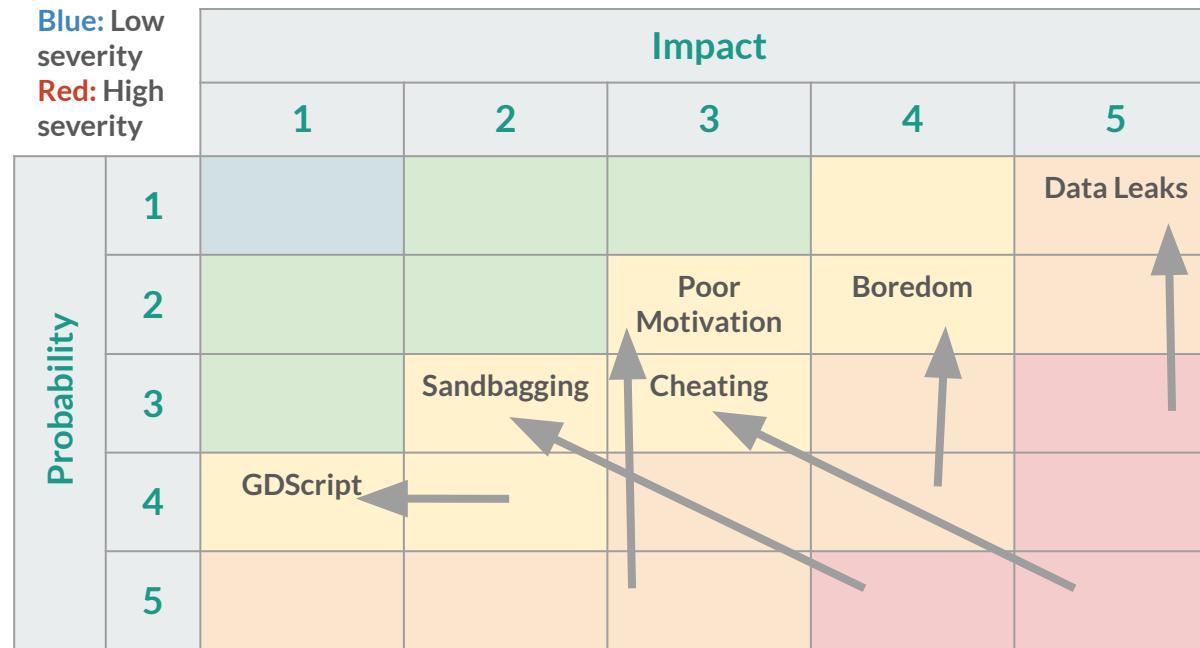
As a solution, rewards should be designed to directly assist the player and keep them engaged.

- Probability: 5
- Impact: 3

Risk Matrix (Pre-Mitigation)

Probability	Impact				
	1	2	3	4	5
1					
2					
3					Data Leaks
4		GDScript		Boredom	
5			Poor Motivation	Sandbagging	Cheating

Risk Matrix (Post-Mitigation)



Conclusion

While algebra may a difficult subject for some to learn, through the fun of gaming, anyone can defeat this math monster.

Appendix

References



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