

Dungeons & Dragons Fight Club

Using Monte Carlo Simulation to Determine Outcome of One-on-One Monster vs Player Character Engagements




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Introduction

- Dungeons & Dragons is a collaborative tabletop role-playing game where players create characters and work together to imagine and resolve adventures using storytelling and dice-based mechanics.
- This project developed a Monte Carlo-based Dungeons & Dragons combat simulator that integrates data from three different sources to model realistic combat outcomes between a player character (PC) and various monsters (non-player character or NPC).



Data Sources

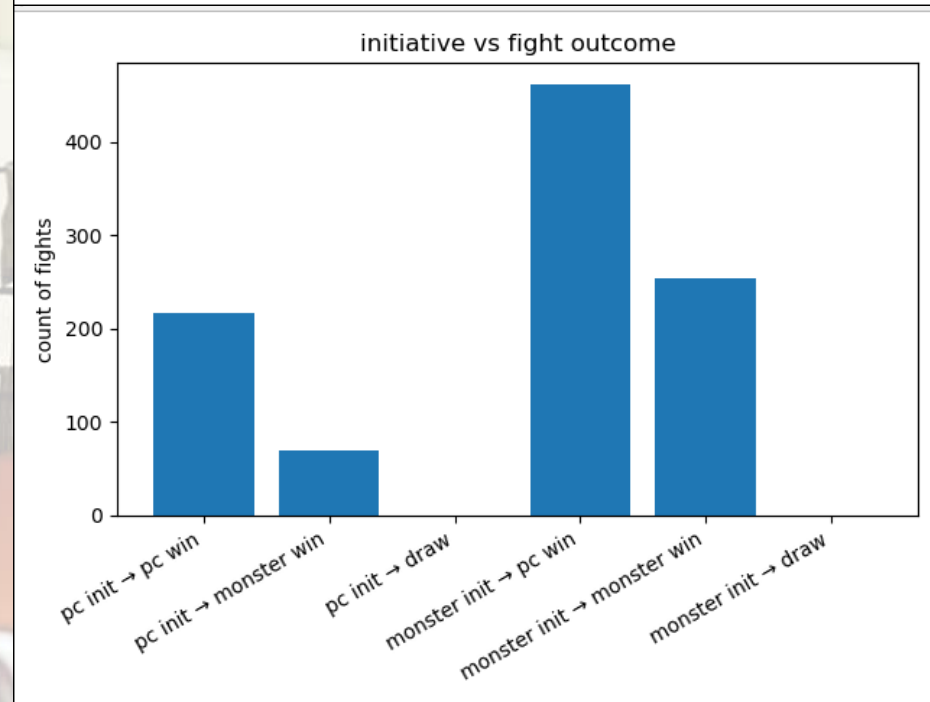
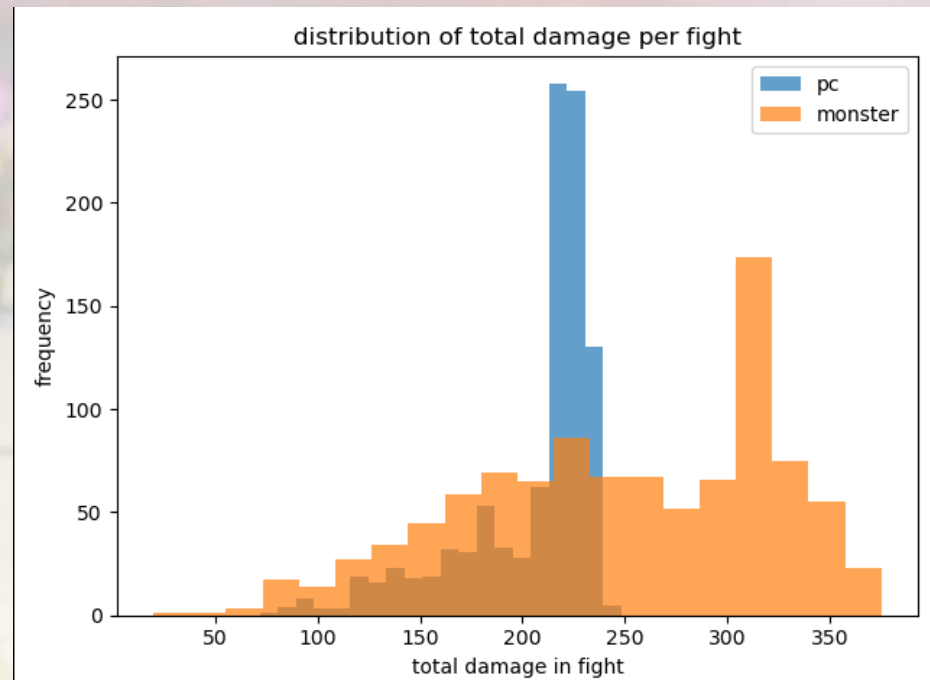
Name		Description	Processing Approach	Purpose
	Player Character XML File	Statistics, attacks, Armor Class, Hit Points, abilities, and bonuses	Parsed with XML parser; normalized attack strings; extracted AC, HP, proficiency, to-hit, and damage	Provides the player character's full combat profile
	Monster Statistics	Armor Class, Hit Points, attacks, recharge abilities, damage dice, and other attributes	Cleaned and extracted structured stat blocks with BeautifulSoup; added recharge logic for limited-use abilities	Defines enemy attack patterns and combat behavior
	Magic Item List Excel File	Item names, rarity, trade value, special	Loaded into dataframe with openpyxl and pandas to sort and count items	Provide item loadout for a specific character, count specific types of items

Methodology Overview

- Data Integration: Combined XML, Excel, and scraped text into structured data classes for characters, and monsters, each consisting of classes for attacks, abilities, actions, and so on.
- Combat Engine: turn-by-turn logic including initiative rolls, attack rolls & AC comparisons, rolling damage then reducing HP appropriately, and recharge rolls for limited-use abilities.
- Monte Carlo Simulation: runs independent combats, records win/loss, hits, misses, initiative outcomes, summarized per-fight averages and distributions.
- Statistical Analysis: Computed percentage hit rates, mean attacks per fight, average damage, etc.

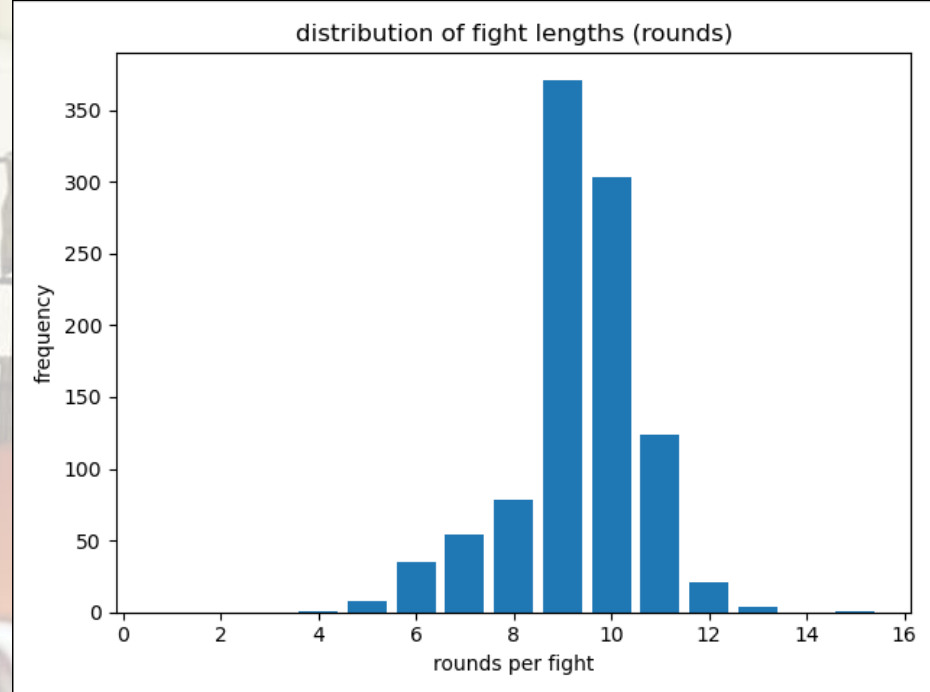
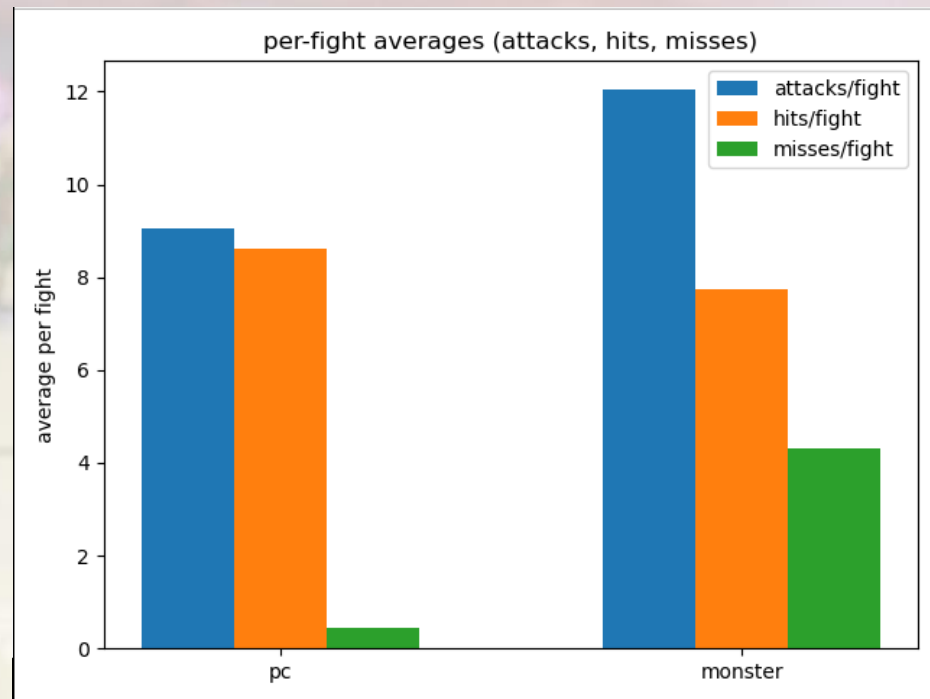
Combat Analysis Insights

- Hit Rate Comparison: PCs with optimized attack bonuses consistently outperform monsters with lower accuracy.
- Damage Distribution: High-damage monster actions (Breath Weapons, Multiattack, etc.) generate wins for monsters.
- Initiative Impact: A strong initiative bonus from items or class features significantly shifts survival odds in a close matchup.



Outlier Influence

- Monster Recharge Events: recharge rolls each round to model breath weapons or other limited-use powers had a large effect on fight outcome.
- Critical Hits: Rare but highly influential spikes in damage can swing a combat unexpectedly.
- Round 1 Volatility: Early monster alpha strikes significantly increase Character loss probability.
- Sustainability Checks: Longer combats favor PCs with high Armor Class and defensive measures.



Challenges & Future Work

- The most difficult part was the scrapping of D&D Beyond as their security actively prevented it from occurring. To complete the project a temporary copy of the monster html pages was stood up and used to scrape.
- The combat engine is very simple and assumes default action patterns.
- Only one PC is simulated at a time; no multi-character party logic.
- Add spellcasting, reactions, and legendary actions to the combat engine.

Questions?

