

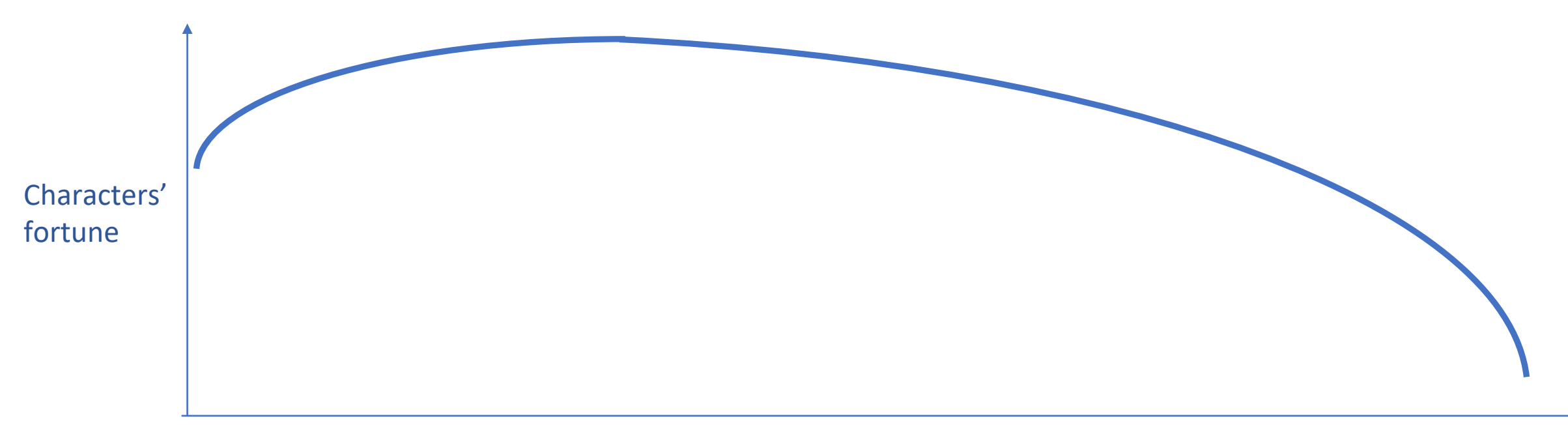
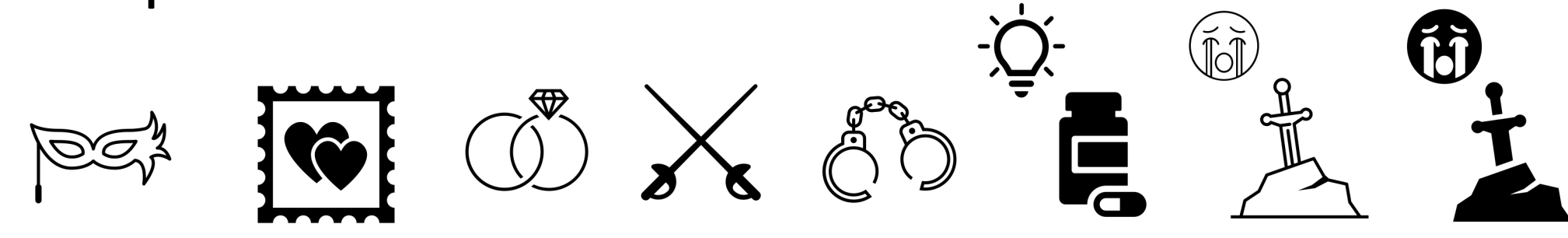
01 The Shape of Stories

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I have tried to bring scientific thinking to literary criticism... Stories have very simple shapes, ones that computers can understand.

- Kurt Vonnegut

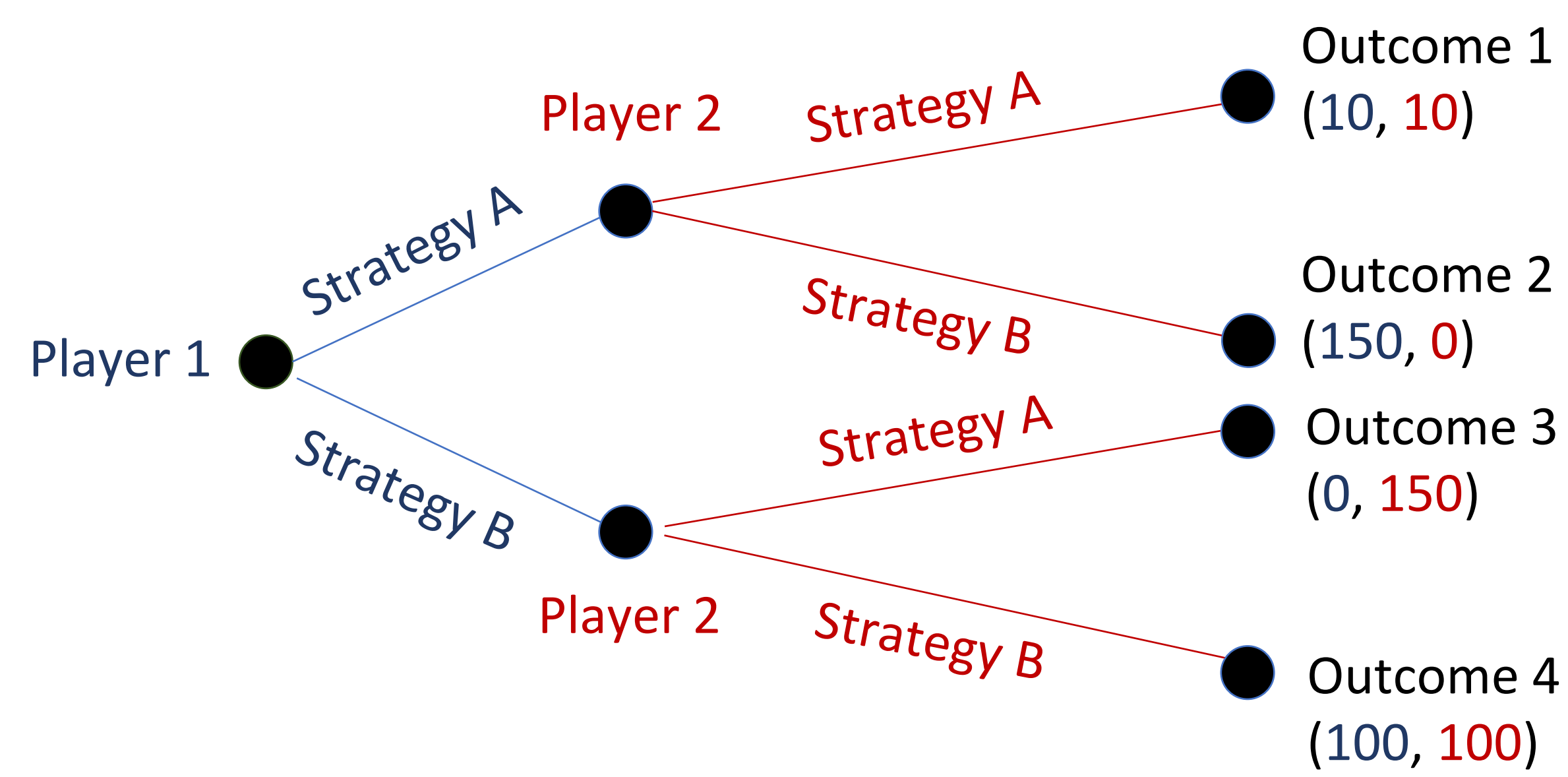
Example: Romeo and Juliet



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Focusing on the main decisions that the characters face, and the incentives and beliefs driving their actions, how can we extract a mathematical structure from stories?

Our approach: view the story as a sequence of decisions by different characters that affect their ultimate fate, represented as an extensive form game:



+ Can incorporate tools from game theory like equilibrium analysis.

+ With that, we can use the payoffs and the equilibrium probabilities to determine the expected fortune of each character along the story as well as the likelihood of the sampled path, and, in this way, identify features such as plot twists, suspenseful moments, etc.

+ Provides a principled way to obtain the fortune curve described by Vonnegut.

02 Traversing the Game Tree with LLM

How to systematically uncover the game tree we need for analysis?



Use LLMs to extract the main characters in a story, the main decisions they face and their payoffs in alternative plot lines.

Example: Romeo and Juliet

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“In Romeo and Juliet, Romeo is banished for avenging Mercutio’s death and killing Tybalt. Juliet’s family intends for her to marry Paris. Friar Lawrence has other ideas. Name options Juliet could consider including ones that her family might prefer, ones that may appear risky, and ones that might appear tragic to the audience. Please only list three options.”



Scan to see entire conversation



“1. Obey her family and marry Paris (Family’s preference): This is the most straightforward and socially acceptable option. [...]”

2. Fake her own death and reunite with Romeo (Risky): This is Friar Lawrence’s plan., it’s incredibly risky. There’s a high chance of miscommunication or things going wrong [...].”

3. Take her own life (Tragic): Overwhelmed by the seemingly impossible situation and the prospect of marrying Paris, Juliet might consider suicide as a way to escape her predicament. This would be the most tragic outcome for the audience [...].”

Gemini indicates several actions Juliet could take. Each action will be modeled as a branch in our game tree. Next we ask Gemini for the probability that her message reaches Romeo in time:

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“In the case where Juliet chooses to fake her own death, what’s the probability that her message alerting Romeo to this plan reaches him in time. Please give a number between 0 and 100.”



“Given the communication limitations and potential obstacles in Shakespearean times, the probability of Juliet’s message reaching Romeo in time is realistically quite low. I would estimate it to be around 30%. Several factors contribute to this low probability: [...]”

Chance nodes are introduced to encode probabilistic events where nature flips a coin, and characters do not have a direct control over their fate:

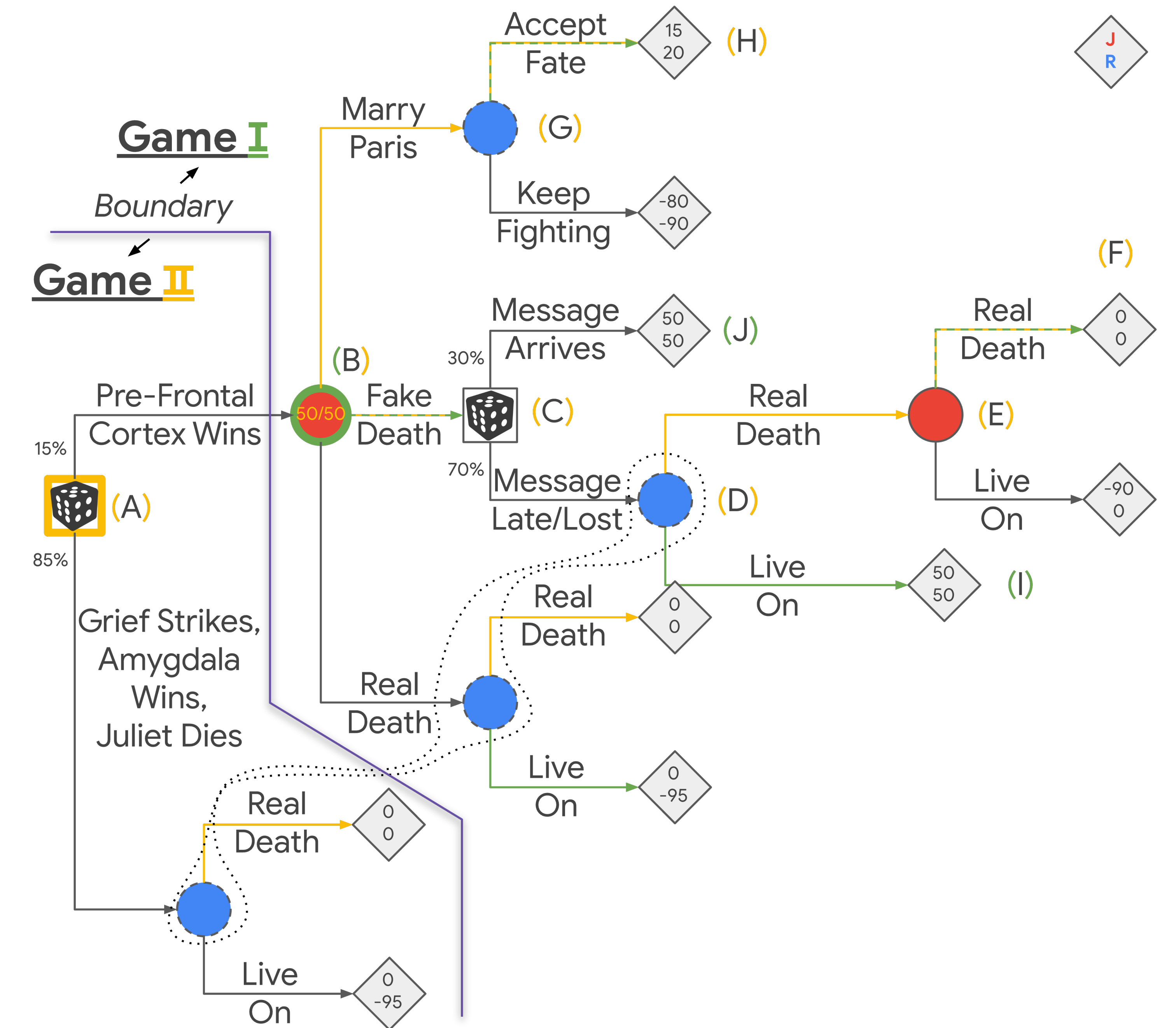
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“What is the probability that Juliet is initially overwhelmed with grief following the deaths of Mercutio and Tybalt as well as the banishment of Romeo? Assume if she’s overwhelmed with grief, she would then decide to take her own life. Please give a number between 0 and 100 for this probability.”

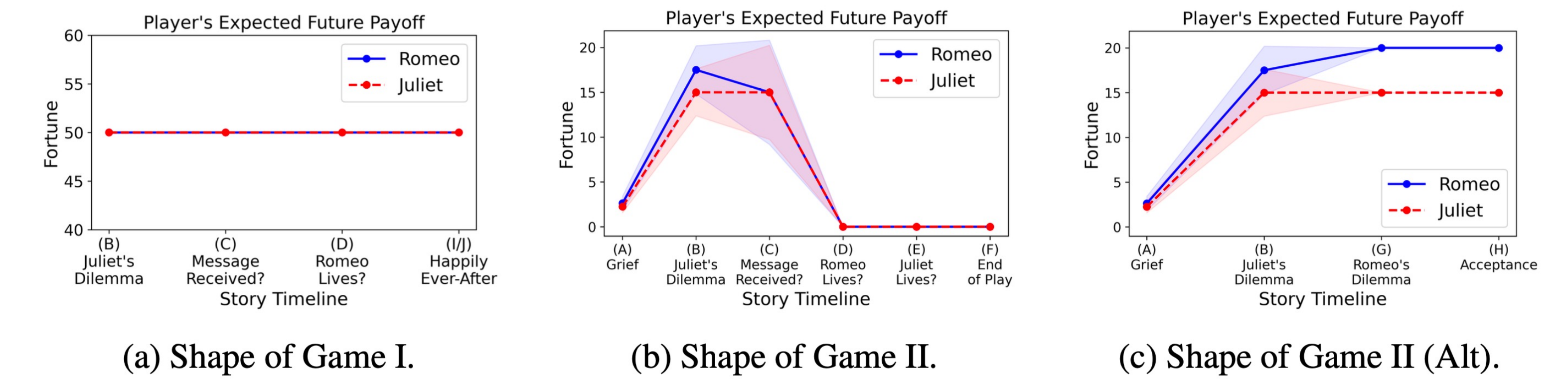


“I would estimate the probability of Juliet being initially overwhelmed with grief to be around 80-90%. [...]”

03 Constructed Game Tree and Analysis



The game trees constructed with the assistance of Gemini for the final plot twists at the end of *Romeo and Juliet*. The Nash equilibrium (specifically, limiting logit equilibrium) of Game II is denoted by the yellow arrows at decision nodes and that of Game I is denoted by the green arrows. The loop encircling the three blue nodes indicates that these states (histories) appear exactly the same to Romeo; Romeo cannot differentiate between whether or not Juliet has actually died.



Shape of a Game: The design of the game tree can have a dramatic impact on the shape of the resulting story.

04 Extensions and future steps



- We used the example dialogue crafted for Romeo and Juliet above as few-shot examples to generate (with light human supervision) alternate game trees and game trees of other stories like Hamlet. (scan QR code for details)
- While we defined a game to “rationalize” a story when its equilibrium assigns positive probability to the actual story path, evaluating game-theoretic representations requires a more comprehensive framework. Such a framework should consider the structural fidelity to key decision points, the ability to capture strategic interactions between characters, and the validity of assigned payoffs and chance probabilities.