Application of Decision Trees on Picking Paths in Slay the Spire

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Abstract—**In Slay the Spire, picking the most optimal route is an important aspect to increase the chances of a successful run. With the amount of variables that changes after every floor, it is not an easy task. With a decision tree, this process could be linearized.**

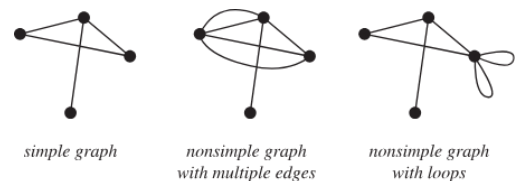*Keywords*— **Decision Tree, Graph, Slay the Spire, Random Number Generations.**

I. INTRODUCTION

Slay the Spire is a video game based on the fusion of roguelikes and card games. Slay the Spire was created by Mega Crit. Slay the Spire was released in 2019.

In Slay the Spire, you can choose between four characters to play with, each having different cards and relics to suit their own playstyles. After choosing your character and the subsequent Neow's Blessings, you are greeted with a map of your act. The map can be quite jarring to new players as they wouldn't know what awaits them on the next floor.

A decision tree is a rooted tree with each node a question and each branch an answer to the question, not to dissimilar to if-else statements. A decision tree can help with choosing the path of your Slay the Spire run based on the many conditions prior.

II. THEORITICAL BASIS

2.1 Graph

A graph G = (V,E) is a set of vertices and edges. A vertex is a unit in graphs and an edge is the connection between two nodes (an edge can start and end at the same node.

2.2 Types of Graphs

Based on the existence of extra edges per two vertices, a graph is divided into two types:

a. Simple Graph
   A simple graph is a graph that contains no loops and no multiple edge.

b. Nonsimple Graph
   A nonsimple graph is a graph that can contain a loop and/or multiple edges.

Figure 2.1. Simple and Nonsimple Graphs
(Source: https://mathworld.wolfram.com/SimpleGraph.html)

Based on the direction of the vertices, a graph is divided into two types:

a. Undirected Graph
   An undirected graph is a graph in which its vertices doesn't have a direction.

b. Directed Graph
   A directed graph is a graph which contains directions for each of its vertices.
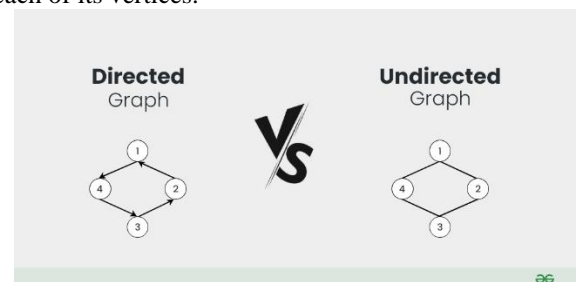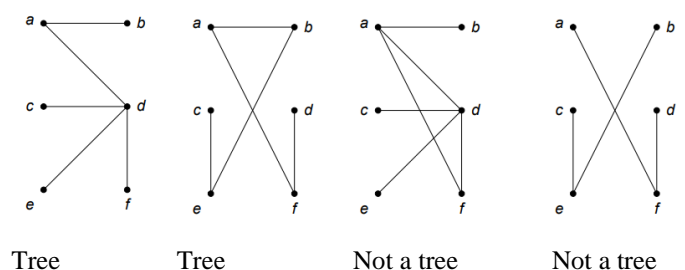

Figure 2.2. Directed and Undirected Graphs
(Source: https://www.geeksforgeeks.org/what-is-the-difference-between-an-undirected-and-a-directed-graph/)

2.3 Tree

A tree is a connected undirected graph that doesn't contain a circuit

Tree   Tree   Not a tree   Not a tree

Figure 2.3. Trees

2.4 Types of Trees

a. Spanning Tree
   A spanning tree is a spanning subgraph that is a tree.
   A spanning subgraph is a subgraph which contains every vertices in a graph.

b. Rooted Tree
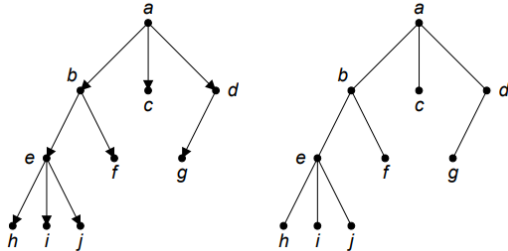   A rooted tree is a tree which assigns a node as the root and every edge given a direction.

Figure 2.4. Rooted Tree
(Source:
https://informatika.stei.itb.ac.id/~rinaldi.munir/Matdis/2023-2024/23-Pohon-Bag2-2023.pdf)

Terminologies for rooted trees:
- Child and Parent
  b is the child of a and b is the parent of e and f
- Path
  A path is the vertices visited going from one vertex to another e.g. b to h has the path b-e-h with length 2
- Sibling
  A sibling is a child with the same parent and depth
- Subtree
  Every child is a subtree and every parent is a subtree
- Degree
  Degree is the child count of a parent
- Leaf
  Every node that doesn't have a child (a degree of 0) is a leaf e.g. c,f,g,h,i,j
- Internal Nodes
  Every node that has at least one child is an internal node
- Level
  Level is the distance from the root node e.g. the level of node a is 0 and the level of node f is 2
- Depth
  Depth is the maximum distance from the root node

c. Ordered Tree
   An ordered tree is a rooted tree which its children is ordered

d. N-ary Tree
   An n-ary tree is a rooted tree where each branch has at most n number of childs

e. Binary Tree
   An n-ary tree with n=2

III. SLAY THE SPIRE

Slay the Spire is a deckbuilding roguelike video game. A run of Slay the Spire consists of 51 floors (56 if the player decides to fight the heart, one extra floor if the player is on ascension 20) divided into three (four if the player decides to fight the heart). Acts one to three has 17 floors (18 floors in act 3 if the player is on ascension 20), and act four always have four floors. Each act and floor will be explained in detail later.

A. Ascension

Ascension is a way to make the game harder. When the player wins against the act 3 boss, if they have ascension enabled, their ascension will get incremented. Ascension starts at ascension 0 (no modifiers) up to ascension 20 (modifiers listed below).

Figure 3.1. List of Ascension Modifiers
(Source: Author's Personal Collection)

B. Characters

Slay the Spire has four unique characters, each with their own cards and relics. The four characters are the ironclad, the silent, the defect, and the watcher. The silent starts with a 12 card deck, while the rest of the characters starts with a 10 card deck.

C. Cards

A card is a playable element that costs energy and affects combat. There are a multitude of ways to get cards in slay the spire. The most common are from combat rewards and the shop. A card consists of 6 elements which are color, cost, name, type, rarity, and description.

There are 3 types of cards, which are attacks, skills, and powers. There are 4 rarities of cards: Starter, which are cards that you start with when you begin a playthrough; common, which has a gray border; uncommon, which has a light blue border; rare, which has a golden border. There are 6 colors of card. One color for each of the character, colorless/gray for cards that are accessible by all characters or non raondom cards that are created by another card, and curse/black for cards that have a negative effect.

Every card in the game, other than curses and statuses, can be upgraded by the player. Upgrading a card usually increases the numerical value of a card e.g. upgrading a strike makes it deal 9 damage instead of six. An upgraded card has a plus sign beside its name and its name will be green.

Fig 3.2 Card Elements. 1. Cost, 2. Name, 3. Type, 4. Description, 5. Color, 6. Rarity
(Source: Author's Personal Collection)

D. Relics

Relics are permanent buffs in the form of a collectible item. Every character starts with a unique relic. The most common way to obtain relics are treasure rooms and elite rooms.

E. Neow's Blessings

When the player starts a new run, the player will get neow's blessings, which is a starting bonus to help the player progress through the spire. Neow's blessings differs whether the player reached the act 1 boss on the previous run. If the player failed to reach the act 1 boss on the previous run, neow would always offer two bonuses, which are Neow's Lament and Bonus Max HP (8 on the ironclad, 6 on the silent, 7 on both the defect and the watcher). Neow's Lament modifies the next three fights so that the enemies in those fights has 1 HP.

Figure 3.3. List of Neow's Blessings if the player failed to reach the act 1 boss
(Source: Author's Personal Collection)

If the player manages to reach the act 1 boss, there are 4 available options to choose from. The first option is chosen from a list of card-related blessings, The second option is chosen from a list of non card-related blessings. The third option is a disadvantage and a reward. The fourth option is swapping your starting relic for a boss relic.

Figure 3.4. List of Neow's Blessings if the player reached the act 1 boss
(Source: Author's Personal Collection)

Figure 3.5. List of Card-Related blessings (First option)
(Source: https://slay-the-spire.fandom.com/wiki/Neow)

Figure 3.6. List of non Card-Related blessings (Second option)
(Source: https://slay-the-spire.fandom.com/wiki/Neow)

Figure 3.7. List of possible Disadvantages and Rewards. If not noted, it's a possible combination (Third Option)
(Source: https://slay-the-spire.fandom.com/wiki/Neow)

F. Map

The map contains the floor layout of an act of Slay the Spire. The map is generated randomly with a seed.
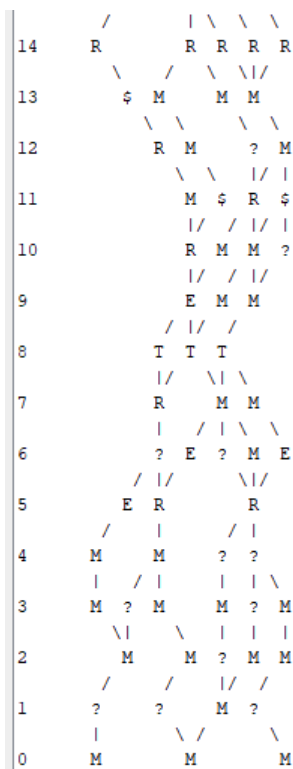
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Figure 3.8. The Act 1 Map with Seed - 7261604713996201042. Legend: R-Rest, $-Merchant, M-Monster, ?-Unknown, E-Elite. T-Treasure.
(Source: Author's Personal Collection)

H. Floor

In an act, other than the boss room and subsequent boss treasure room, there are 6 different floors with each floor containing a room with its own risk and rewards.

The first type of room, and the most common one, is the monster/enemy room. The first floor for any map is always an enemy room. Each act has a different enemy and/or combinations of enemies. But, the first three (two on act 2 and 3) is always in the 'easy' pool. As in, these fights are selected from a different pool of enemies than the 'normal' fights. As such, it is recommended to take at least the easy fights before fighting an elite. The rewards from a normal fight are 10-20 gold, card reward, and a chance at a potion.

Figure 3.9. The rewards from an enemy room
(Source: Author's Personal Collection)

The second type of room is the elite room. In every act, there are three different elites. Elites are usually harder than normal enemies, but the rewards are greater than a normal fight. After fighting a certain elite, the next elite is guaranteed to not be the same elite e.g. if the player's first elite in act 1 is the Gremlin Nob, then their next elite will be guaranteed either the Lagavulin or the Three Sentries. The rewards from an elite room are 25-35 gold, a card reward with better chances for seeing higher rarity cards, a relic, and a chance at a potion.

Each act, if the player hasn't gotten the emerald key, a random elite room will be designated to be a burning elite. A burning elite is an elite with a modifier that buffs them. The possible modifiers are: 25% max HP, 1+Act# Strength, 2+2*Act# Metallicize, or 1+2*Act# Regeneration. Defeating a burning elite gives the player an emerald key.
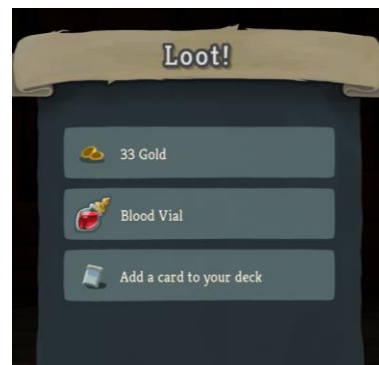
Figure 3.9. The rewards from an enemy room
(Source: Author's Personal Collection)

The third type of room is the shop/merchant. The shop is the place where you can spend your gold and buy cards, relics, potions, and/or a card remove. The shop always contains (from top left) 2 attacks, 2 skills, 1 power, uncommon colorless card, rare colorless card, 3 relics, 3 potions, and a card remove. The cards in the shop are never upgraded unless you have an egg relic (relic that upgrades cards whenever they are added to your deck)

Figure 3.11.A shop containing (from top left) 2 attacks, 2 skills, 1 power, uncommon colorless card, rare colorless card, 3 relics, 3 potions, and a card remove
(Source: Author's Personal Collection)

The fourth type of room is the treasure room. The treasure contains a chest with 3 possible sizes. 50% chance for a small chest, 33% for a medium chest, and 17% chance for a large chest. Each chest differs by the amount and chance of gold and possible rarity of relics. The relic in a chest is tied to the blue key. The blue key is needed to fight the heart.

Small Chests:	50%
Common Relic	75%
Uncommon Relic	25%
Gold Chance	50%
Gold Amount	25, 10% variance
Medium Chests:	33%
Common Relic	35%
Uncommon Relic	50%
Rare Relic	15%
Gold Chance	35%
Gold Amount	50, 10% variance
Large Chests:	17%
Uncommon Relic	75%
Rare Relic	25%
Gold Chance	50%
Gold Amount	75, 10% variance

Figure 3.12. The different chests and their contents
(Source: https://docs.google.com/spreadsheets/d/1ZsxNXebbELpcCi8N7FVOTNGdX_K9-BRC_LMgx4TORo4/edit#gid=113279270)

The fifth type of room is the unknown room. An unknown room can contain an event, a shrine, an enemy room, a shop, or a treasure room. The starting chances for each room is listed below. The ramping (increase if the unknown room isn't a particular room) of each room are as follows: Fight: 10%, Shop: 3%, Treasure: 2%. The chance of an event+ the chance of a shrine is:

$$100\% - (Fight\ Chance + Shop\ Chance + Treasure\ chance)$$

The chances for a shrine is ¼ the chance of an event + the chance of a shrine. After an encounter, the ramping of the encountered room is reset back to its starting chance e.g. after encountering an enemy room at 50% chance, the enemy room chance is reset back to 10%. Another quirk of the unknown room is that after encountering a shrine, the next room will never be an event/shrine. The chances of each room is reset back to its starting chance on every act start

Figure 3.13. The starting chances for each room
(Source: Author's Personal Collection)

The sixth type of room is the rest site. The rest site allows the player to rest (heal 30% of current max HP) , forge (upgrade a card), or recall (obtain the red key). There are certain relics which inhibits resting or forging and there are other relics that add possible actions at a rest site e.g. the Shovel: Allows the player to dig at a rest site (dig: get a random relic).

Figure 3.14. The Options At a Rest Site

I.   Potion Chance

When a run of Slay the Spire is started, the potion chance is 40%. When a potion is obtained, the chance decreases by 10%. When a potion is not obtained, increases by 10%.

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IV.   DECISION TREE APPLICATION

The first decision that has to be made starts at Neow's Blessings. If the player failed to reach the act 1 boss, then Neow's Lament is the obvious choice. It trivializes the first three fights and allows for an elite snipe. Sniping using a Neow's Lament is a method of pathing which maximizes the uses of Neow's Lament by going to unknown rooms, shops, and/or rest sites.

If the Player reached the act 1 boss, the choice becomes tougher. The player is given two risk free choices. But often times, these bonuses are not enough to get through the spire. If a snipe is possible and Neow's Lament is one of the options, then taking Neow's Lament is the obvious choice. The third option is the one that is usually taken considering the negligible disadvantages and powerful rewards, but some disadvantages are worse than others e.g. obtaining a curse. With the 250 gold and an early shop this downside can be negated, but the player will be a card remove down, having to remove the curse instead of a starter card.

Swapping to a boss relic could be an option. But considering some of the relics massive downside e.g. ectoplasm: gain an extra energy, removes the ability to gain gold. This option is the highest risk, highest reward a player can take. But it could be a risk worth taking if the other options are mediocre at best.
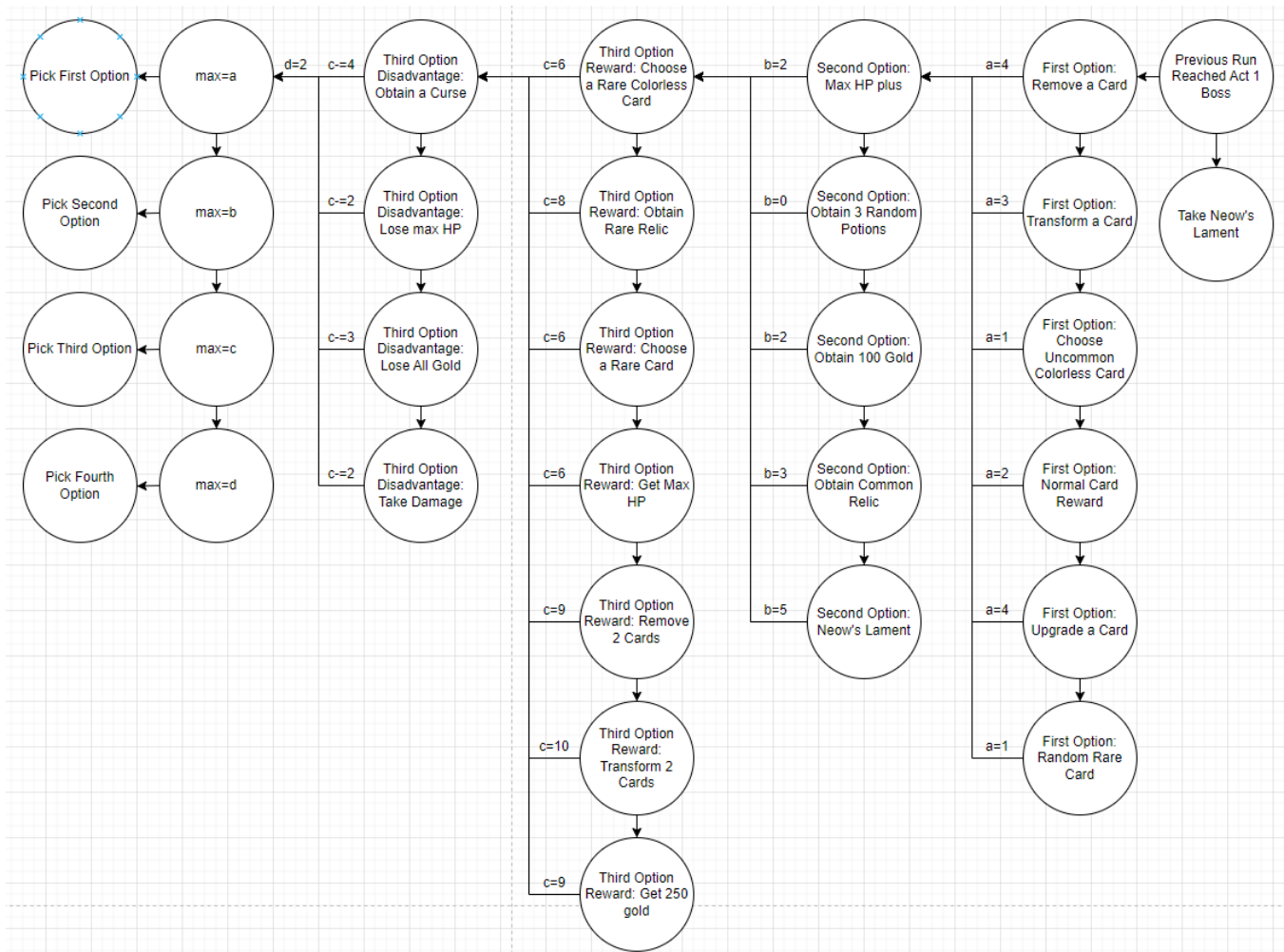
Figure 4.1. Decision Tree for Picking Neow's Blessings.
Legend: down arrow = No, left arrow = yes
(Source: Author's Personal Collection)

V. CONCLUSION

A decision tree is a very helpful tool to simplify the decision-making process. In a run of Slay the Spire, there are an insurmountable amount of factors that need to be taken into consideration before making an action. Using a decision tree can make this process easier, lifting the weights of your decision-making s

VI. ACKNOWLEDGMENT

I Would like to thank Dr. Rinaldi Munir and Mr. Monterico Adrian, being my Discrete Mathematics lecturer, for the opportunity and lessons given. I would also like to thank the Slay the Spire community for all the free resources that makes this paper possible in the first place. Last but not least, I would like to thank my friends and family for the support.

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PERNYATAAN

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Bandung, 3 Desember 2023

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