Implementation of Decision Tree on Breeding Result in Dragon City Game

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Abstract— **Decision tree are considered to be one of the most popular for decide what we want after getting the results of breeding. Dragon city is a game that players breed their own dragons include decide what the results are. This paper presents the implementation of decision tree on breeding result in dragon city game. This paper show how decision tree can be used for understanding what the dragon breeding result from different elements.**

Keywords—**Tree, Decision Tree, Dragon City, Dragon City's Breeding.**

I. INTRODUCTION

Trees were used as long ago as 1857, when the English mathematician Arthur Cayley used them to count certain types of chemical compounds[1]. Tree is a part or mathematics knowledge and could be used to solve problems that exist today. One of the problems that can be solved with tree theory is Breeding Result in Dragon City Game with using decision tree.

Dragon City is a game online with adventure genre. The good point from this game is have a sub-genres, that is monster collection. This game released by Social Point in Facebook at May 20, 2012 and being best Facebook game at 2012 too. But released in app store iOS at October 2012 and in Android at Fall 2013. This pet breeding game makes player get to train, evolve, and cross-breed to discover rare monsters and take them to the battle. Not only that, players should create their own fantastic world of magical islands. Players can also combat against their friends with their team of dragons.

Fig. 1.1 Dragon City's logo
(Source: https://itunes.apple.com/us/app/dragon-city-mobile/id561941526?mt=8 access at December 9, 2014 20:46 WIB)

Dragon City lets the player create over 150 versions of the winged monstrosities by tossing two dragons into common pen and hoping for the best. Dragon City's monetization comes about primarily through its soft currency "gold," which is required for most tasks, including clearing "junk" items such as trees and rocks from the play area. There is no energy bar system in the game, so the main means of limiting free players' interaction with the game comes through this currency system. Successfully-bred dragons earn money over time, allowing the player to develop larger and larger income streams over time, theoretically allowing for gradual growth.

Moreover, this game can be accessed by android and iOS, and keep update every weeks. Once the player reaches level 10, they are able to enter the game's PvP (Player versus Player) component, known as Dragon League. Here, players are able to attack others up to three times every six hours and be rewarded with prizes including experience, soft and hard currency and dragons cannot be "lost" or injured during combat.

(Playing at December 9, 2014 20:35 WIB)

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II. Basis Theory

1. Tree

Tree is a connected graph that contains no simple circuits[1]. Unlike the graph which can be directed, has a ring, and has a weight, a tree belonging to the category of simple graph that does not have the above three aspects. The aspect that makes the tree has many advantages, which are very easy to apply in daily life with a variety of cases in and also it is easy to visualize[2].

1.1 The Properties of Tree

For example, we have a simple undirected graph whose vertices n, is G = (V, E). Then, all of these statements are equivalent :

1. G is a tree
2. Each pair of vertices in G are connected by a single trajectory
3. G is connected and has m = n-1 edges
4. G doesn't contain a circuit and have m = n-1 edges
5. G doesn't contain circuits and the addition of one side of the graph would make just one circuit
6. G is connected and all sides are bridges.

1.2 Terminology on rooted trees

1. Child or Children and Parent

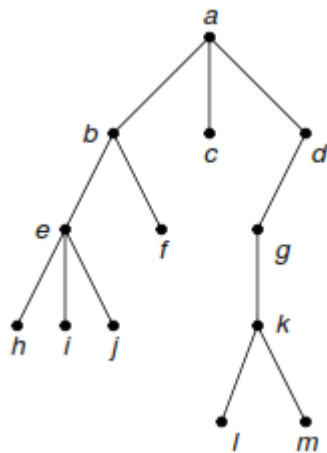$b,c,$ and d are children of vertex a, a is the parent of them.

Fig. 2.1 Example of Tree [2].

2. Path

Path from a to j are a, b, e, j. Length of the path from a to j is 3.

3. Sibling

f is sibling with e, but g isn't sibling with e, due to different parent.

4. Subtree

Subtree is vertex b and e then leaf f, h, i, j.

5. Degree

Degree from a vertex is sum of subtree (or number of children) in that vertex. Degree of a is 3, degree of b is 2, degree of d is 1 and degree of c is 0. So in here, degree that we mean is the degree-out. Maximum degree from all vertex is the degree of their own tree. In Fig 2.1, the degree of the tree is 3.

6. Leaf

If there is a degree of vertex had 0 values (didn't have child) then it is leaf. Vertex $h, i, j, f, c, l,$ and m is leaf.

7. Internal Nodes

Vertex that have child, called as internal nodes. Vertex $b, d, e, g,$ and k is internal nodes.
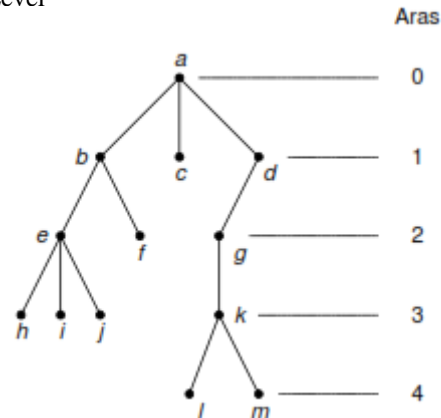
8. Level

Fig. 2.1 Example of Tree with their level [2].

9. Height or Depth

Maximum level from a tree called as height or depth of that tree. The height of the tree above is 4.

2. Decision Tree

One of the most fundamental application of the tree is a decision tree. Decision tree is a rooted tree in which each internal vertex corresponds to a decision, with a subtree at these vertices for each possible outcome of the decision. The possible solutions of the problem correspond to the paths to the leaves of this rooted tree.

Decision tree made to assist users in determining the decisions to be taken in accordance with the circumtances and the situation. With this decision tree, users can take an efficient decision with low possibility of error because listed all combinations of circumtances and situations that could influence the decisions taken, so users are able to search that decisions with state of problem. The decision that focus on important things, logical, and consistent, acknowledge the subjective and objective thinking and combines intuitive and analytical thinking, need as much information and analysis to resolve the dilemma arising, directly, easy to use, reliable, and flexible, is called effective decisions.
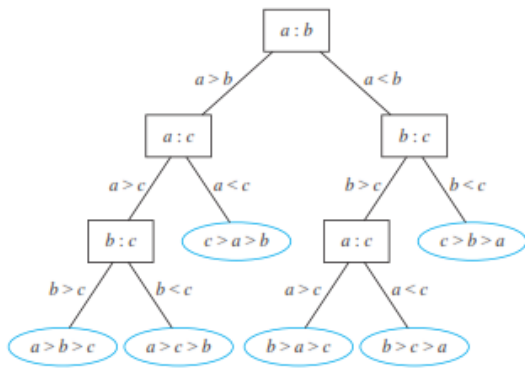
Fig. 2.2 Example of Decision Tree for Sorting Three Distinct Elements[1].

Simple application of the decision tree is already embedded itself in the human brain. Humans are creatures of God that rarely use instincts in making decisions, thus indirectly, the decision-making mechanism that is done based on the logic and facts by human beings.

However, with increasing complexity of factors that influence the decision-making, it's more difficult for human to take decisions efficiently if only using logic and only using their reason, especially if just sit only on instinct. Therefore, the decision tree into a central role in human life because that tends conical and characteristics have been able to produce an efficient decision[3].

III. IMPLEMENTATION OF DECISION TREE ON BREEDING RESULT IN DRAGON CITY GAME

In Dragon City game, we can breed two different elements contained in the dragon that we have. Elements owned by a dragon can affect the strength of the dragon during combat. Although the actual level of a dragon greatly affects the power of themselves, but the dragon that has two or more elements, or have the rare element can defeat the dragon although two levels above of them. In addition, element contained in the dragon is the origin of the formation of a new type of dragon or even a new element of a dragon. So we can conclude that the dragon can easily beat the other dragons due to good offspring.

As mentioned above, there is a dragon that would easily defeat the dragon's enemy will be very beneficial for the player, if player has a dragon like that. So player should know what kind of dragon that takes to beat the enemy's dragon and how to get that kind of dragon. In accordance with the type of game, dragon city game makes the player should breed their own dragon to get the desired dragon. Actually, some of the dragons may be discovered simply by hatching new eggs, some may be discovered by feeding a dragon enough for them to evolve and others may be found by breeding two different types of dragon together.

Any dragon can mate with another dragon to produce an egg, as there is no distinction between male and female dragons in Dragon City game. However, the success rate can differ a lot between species. The ground rules are :

1. Breeding any elemental dragon with another elemental type will always produce a new type of dragon.
2. In some cases, different dragons can be hatched by mating the same pair of dragons.
3. Breeding an Elemental dragon with a Hybrid dragon (the result of breeding two other dragons), or a Hybrid dragon with another Hybrid dragon, will only in some cases produce a new type of dragon.
4. If at first you don't succeed, try again. Certain types of dragons can be very hard to breed, but just keep trying and eventually you will be able to get the rarer types[4].

There are certain combinations of elemental dragons that can't breed. For instance, an Ice dragon can never breed with a Fire dragon, and there are a couple other match-ups that can't breed. Hybrids of incompatible dragons however, can still breed. For instance, an Ice dragon can still breed with a Laser dragon (fire + electricity). The offspring however, will be one of the basic elemental dragons.

Then how we know what the element of dragon that can match each other? Here, we use decision tree to know what kind of elements that can match each other. For example, terra can't be match with metal. Fire can't be match with ice and vice versa. Water can't be match with dark. Natural (or plant) can't be match with electric.

In this dragon city game, there is a feature to customize our dragon team and engage combat with opponents from all over the world. The basics of battle are simple: both of player and player's opponent have two or three dragons on player's team. Player take turns attacking the other dragon, doing damage, until one team has lost all its dragons and is defeated.

The strength and effectiveness of an attack, depends on the element of the attack, and the element of the dragon being attacked. For instance, when using a Fire attack on an Ice dragon, it will count as a critical attack, since these are opposite elements. A 'critical attack' does 2x damage, a 'normal attack' does 1x damage, a 'weak attack' does half damage, while a 'no effect attack' does no damage. As in Fig. 3.1, we can have a critical attack between water and dark, between plant (or natural) with electric, between metal and eath, and between fire and ice.

Fig. 3.1 Element and their opponent[4].

Thus, we can found a rare hybrids after breeding two dragon. The facts are:

1. Rare hybrids can no longer be bred if one parent is an elemental (only have 1 element). The updated breeding system currently requires both parents to be hybrids.
2. Rare hybrids can be obtained when one of the parents is legend.
3. There are no combinations that will always produce a rare hybrid, even if the parents are rare hybrids themselves.
4. In the case of treasure dragon and fire+ice dragon, both parents must have the level requirement
5. Possible to get if bred with pures that contain the dragon element[5].
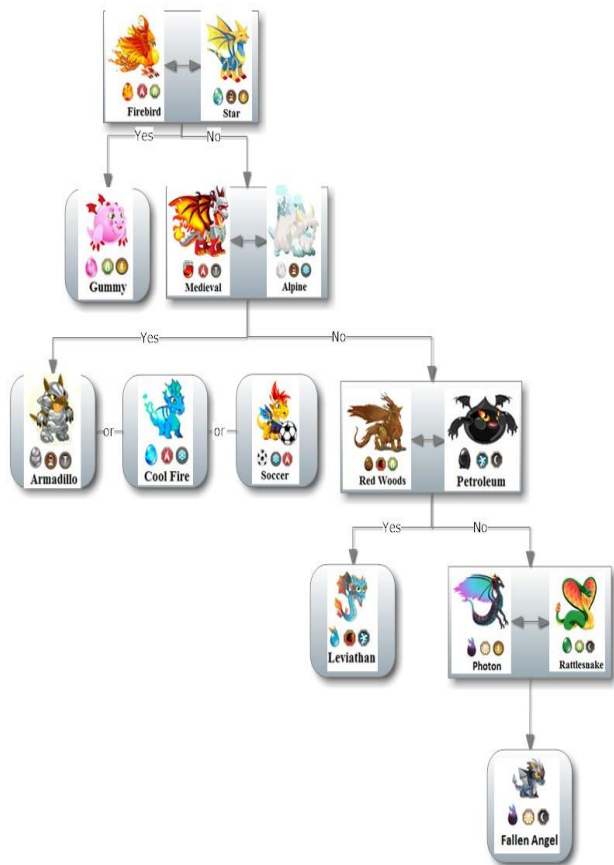
Fig. 3.2 Decision tree for breeding rare hybrids.

Some of the player have a goal, that is the journey to become the ultimate dragon collector, while others simply focus on creating the strongest team possible to battle against others in multiplayer environment. These objectives are somewhat linked since the rarer and harder to achieve dragons definitely have strength over the common one. And this decision tree help us to not waste our time with unconfirmed breeding pair and achieve that kind of dragon.

Dragon city game focus on creating cool dragon designs. Dragon city also packs some features like the animations in dragon breaths which has blown most player away. This breeding features make many player love it.

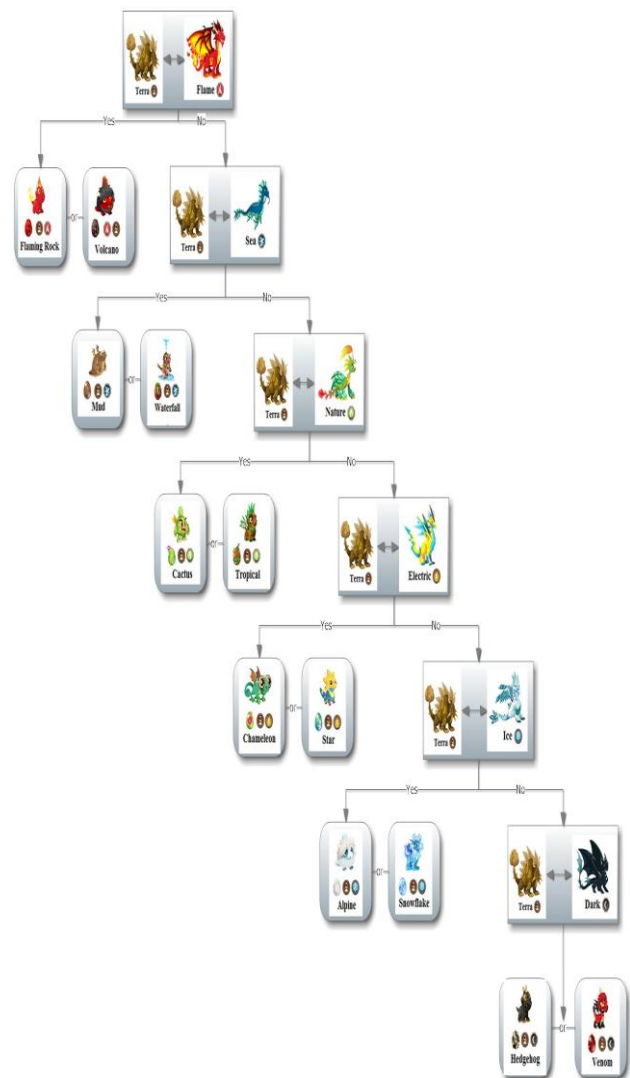Here are some decision tree for breeding some basic elements.

Fig. 3.3 Decision tree for breeding terra element.

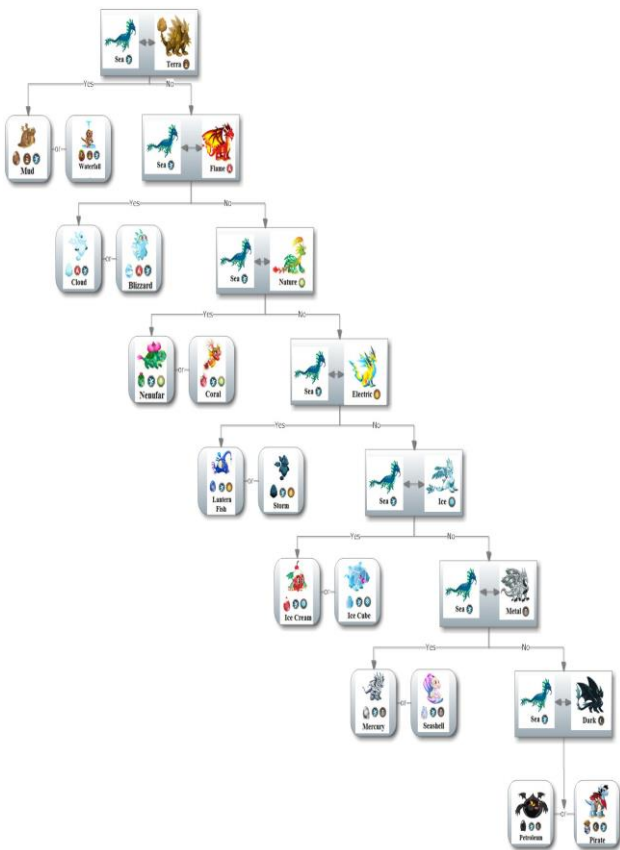**Fig. 3.3 Decision tree for breeding nature (plant)**

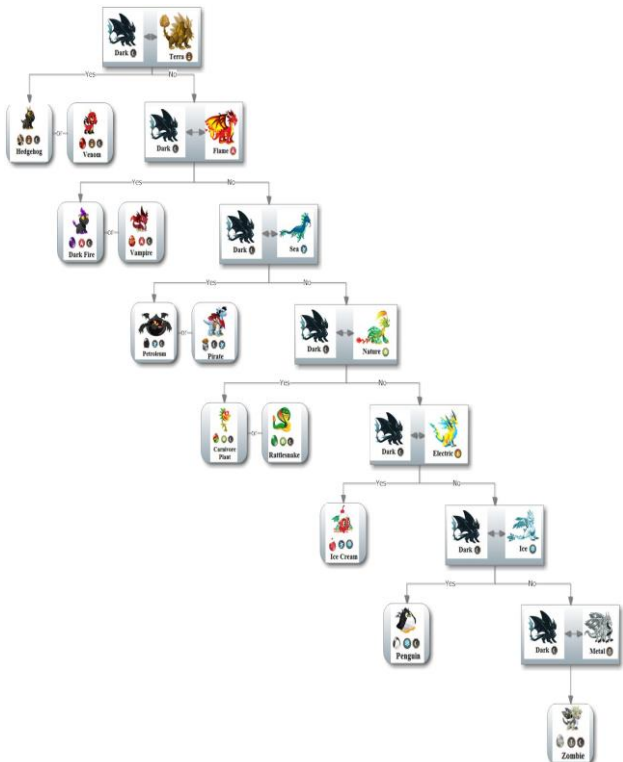**Fig. 3.4 Decision tree for breeding Sea Element.**

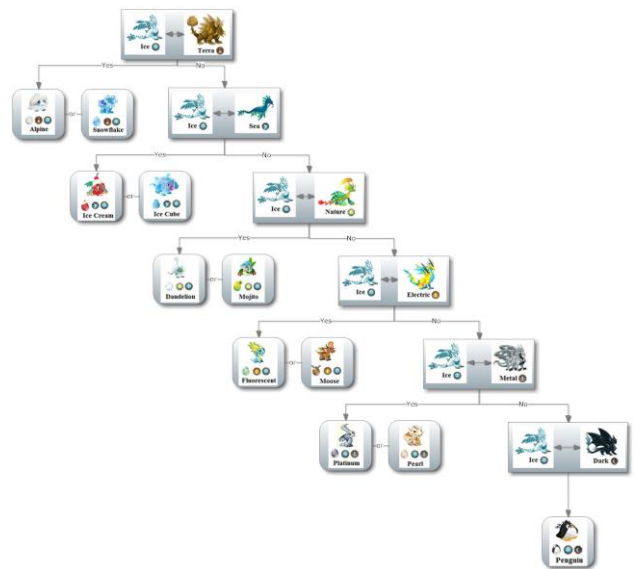**Fig. 3.5 Decision tree for breeding Dark element.**

Fig. 3.5 Decision tree for breeding Dark element.

Fig. 3.7 Decision tree for breeding Flame Element.
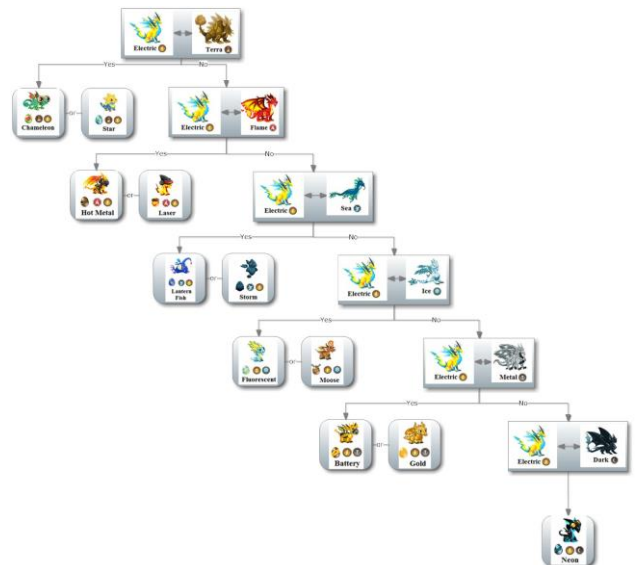

Fig. 3.8 Decision tree for breeding Electric Element.

IV. CONCLUSION

From here, we know that decision tree is very useful in the dragon city. By using decision tree, we know what kind of dragon that can we get from breeding two different elements of dragon, what element that can't be match each other, help us to decide what dragon that should we have for battle, and we use decision tree for breeding rare hybrids. The implementation of decision tree in dragon city game can be applied directly to obtain effective and efficient decisions. Because if we just gambling to breed the dragon, we can spent much time for nothing. Decision tree help us to analyze problem and if there is another problem coming, we don't need to analyze from begin again.

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DECLARATION

With this I declare that my paper is originally by myself, not a transliteration, translation, nor plagiarism of another paper.

Bandung, 11 Desember 2014

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