Bachelor Thesis

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Design, Implementation and evaluation of different strategies for playing Pokémon battles

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Abstract

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Zusammenfassung

Contents

1. Introduction

1.1. What is Pokémon

To Be Done (TBD)

2. Related Work

[?]

3. Approach

3.1. Basic rules

(Game is turn based) **ToDo**
(Each player has 6 Pokémon) **ToDo**
(If a Pokémon has no HP left, it faints) **ToDo**
(If all Pokémon of a player fainted, the player loses) **ToDo**

3.2. Battling

One of the key aspects of the Pokémon game is to battle other Pokémon. In the mainline games, you can have up to six Pokémon in your team, also known as party. There is the option to swap a Pokémon with another Pokémon, but you can't have more than six Pokémon at any point in your team. When playing the original Games, you can explore the world to find more Pokémon and use your team to defeat wild Pokémon and other Pokémon trainer. This thesis however focus on random battles taking place on Pokémon Showdown. In a random battle, both you and your opponent get a team of six random Pokémon. At the start of the battle, you know each of your six Pokémon but only the currently active enemy Pokémon.
Every turn, both players can choose to either use a Move of their currently active Pokémon or switch their active Pokémon to another Pokémon. Moves can either deal direct damage to the enemy Pokémon or yield other advantages like increasing the damage dealt by the next move. Moves will be covered in more detail in section 3.2.2. Each Pokémon has an amount of hit points (hp). The hp of a Pokémon can be dropped by attacking it with a Move. If the hp of a Pokémon drops to zero, it faints and can't be used in this battle anymore. A player wins, if all Pokémon of the enemy are fainted.
Note: In the mainline games there is the possibility to heal or even revive a fainted Pokémon during battle using *Healing Items* like *Revive* or *Hyper Potion*. In competitive Play, only *Held items* like *Leftovers* are allowed. Items will be explained in depth in section 3.2.5.

3.2.1. Types

Pokémon implements a *Rock-Paper-Scissors*-like system. Each Pokémon has eihter one or two of 18 types. For example, a *Fire*-type Pokémon is weak against *Water*-type Pokémon

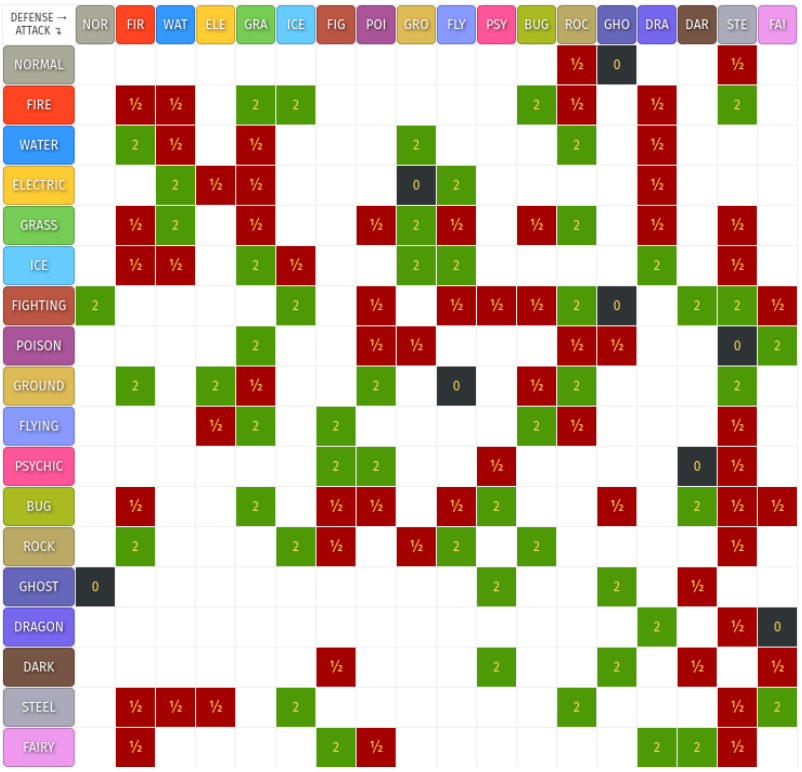

Figure 3.1.: Pokémon type chart [1]

whereas a *Water*-type Pokémon is weak against *Grass*-type Pokémon. Lastly, a *Grass*-type Pokémon is weak against *Fire*-type Pokémon. The figure 3.1 shows how different Pokémon types interact with each other. It is important to note, that the type modifiers will be multiplied if a Pokémon has two types. For example, a *Fire*-type attack will deal 4 times the damage against *Parasect* as *Parasect* has the types *Grass* and *Bug* [2].

3.2.2. Moves

Moves can be split up into three categories: *Physical*-, *Special*- and *Status*-Moves. While *Physical*- and *Special*-moves usually deal damage to the opponent Pokémon, *Status*-Moves can for example change the weather, which plays a role in damage calculation explained in section 3.2.7, inflict status effects, raise or lower the stats of a Pokémon. Just as Pokémon, each Move has one of the 18 possible types.

3.2.2.1. Move Categories

ToDo **(Physical and Special moves)**

3.2.3. Pokémon

As stated in 3.2, each Pokémon has a given amount of hp. However, two Pokémon of the same *species*, meaning two Pokémon with the same name, can have different starting hp values. The figure 3.2 shows the different *stats* for the Pokémon *Charizard*.

3.2.3.1. Explanation of stats

HP: The hp determines how much damage a Pokémon can receive before fainting.
Attack: The attack stat (atk) determines how much damage a Pokémon will deal when using a *Physical*-Move.

Stat		Range	
		At Lv. 50	At Lv. 100
HP: 78		138 - 185	266 - 360
Attack: 84		80 - 149	155 - 293
Defense: 78		74 - 143	144 - 280
Sp. Atk: 109		102 - 177	200 - 348
Sp. Def: 85		81 - 150	157 - 295
Speed: 100		94 - 167	184 - 328
Total: 534	Other Pokémon with this total		

- Minimum stats are calculated with 0 EVs, IVs of 0, and (if applicable) a hindering nature.
- Maximum stats are calculated with 252 EVs, IVs of 31, and (if applicable) a helpful nature.
- This Pokémon's Special base stat in Generation I was **85**.

Figure 3.2.: Charizard's stats [3]

Defense: The defense stat (def) determines how well a Pokémon can resist against physical attacks.
Sp. Atk: The special Attack stat (spa) determines how much damage a Pokémon will deal when using a *Special*-Move.
Sp. Def: The special Defense stat (spd) determines how well a Pokémon can resist against special attacks.
Speed: The speed stat (spe) determines how fast a Pokémon can act. This is important as instead of both Pokémon moving at the same time, the Pokémon with the higher spe will move first. After the faster Pokémon moved, the slower Pokémon will move. Therefore, the faster Pokémon is usually at an advantage. **(Cover priority moves and trickroom)** **ToDo**
(Cover evasion / accuracy, context to showdown) **ToDo**

3.2.3.2. Determination of stats

The total stat of a Pokémon is calculated as described in equation 3.1 and equation 3.2 [4].

$$HP = \left\lfloor \frac{(2 \times Base + IV + \lfloor \frac{EV}{4} \rfloor) \times Level}{100} \right\rfloor + Level + 10 \tag{3.1}$$

$$OtherStat = \left\lfloor \left(\frac{2 \times Base + IV + \lfloor \frac{EV}{4} \rfloor) \times Level}{100} + 5 \right) \times Nature \right\rfloor \tag{3.2}$$

Base: Refers to the base stat of a Pokémon. Two Pokémon of the same species will always have the same base-stats. As seen in figure 3.2, a *Charizard* will always have a base-atk of 84.

Level: As mentioned in section 3.2, the goal of the mainline games is to create a team of six Pokémon and to make that team stronger by fighting other Pokémon. If a Pokémon defeats enough other Pokémon, it grows a Level. The maximum level of a Pokémon is 100. If the level of a Pokémon increases, so will its stats. For each level gained (ignoring Nature), stats will increase by 1/50 the base stat value, and 1/100 the combined individual values (iv) and effort values (ev) values [4]. In Pokémon Showdown, the level of a Pokémon is set at the start of the battle and won't increase [5].

Nature: A Pokémon has a nature. Most natures enhance the growth of one stat, while hindering the growth of another. After all other calculations are finished, the stat that

the Nature enhances will be 100% of what it would be without the Nature, and the stat hindered will be 90% of its normal value [4]. Nature can be neglected in this thesis as all Pokémon in random battles have a neutral nature, meaning no stat is enhanced or hindered [5].

IV: Refers to the iv of a Pokémon. These cause two Pokémon of the same species to have different Stats [4]. Pokémon in Pokémon Showdown will always have the best possible iv stat, 31, unless it is a disadvantage for the Pokémon, then it will be zero [5].

EV: These are the ev of the Pokémon. ev are what causes a trained Pokémon to have higher stats than an untrained counterpart of the same level. For every 4 ev gained, a level 100 Pokémon will have 1 extra point in the given stat. A Pokémon can earn up to 510 ev, but can't have more than 255 ev in a single stat [4]. Random Pokémon on Showdown will always have 85 ev in each stat, or 0 in the case that having a high stat being detrimental [5].

3.2.4. Switching

3.2.5. Items

3.2.6. Field Conditions

ToDo **(Weather conditions)**

3.2.7. Damage calculation

The damage dealt by a move mainly depends on the *level* of the Pokémon that uses the move, its effective Attack or Special Attack stat, the opponent's effective Defense or Special Defense stat and the move's effective power.

Precisely, the damage is calculated as follows[6]:

$$\text{Damage} = \left(\frac{\left(\frac{2\times\text{Level}}{5}\right) \times \text{Power} \times \text{A} \;/\; \text{D}}{50} + 2 \right) \times Targets \times Weather \times Badge \times Critical \times random \times STAB \times Type \times Burn \times other \tag{3.3}$$

The only exception for this are moves that deal direct damage. A list of these moves can be found at [7].

3.2.7.1. Level

Level refers to the level of the attacking Pokémon[6]. In Pokémon Showdown, the level is
ToDo displayed next to the name of the Pokémon. **(Mainline games leveling)**

3.2.7.2. A / D

A is the effective Attack stat of the attacking Pokémon if the used move is a physical move,
ToDo **(Reference to physical moves)**
or the effective Special Attack stat of the attacking Pokémon if the used move is a special
ToDo move. **(Reference to special moves)**
D is likewise the effective Defense stat of the target if the used move is a physical move, or the effective Special Defense of the target if the used move is a special move[6].

There are four moves that use stats from different categories, more Information can be found at [8].

3.2.7.3. Power

ToDo

Power is the effective power of the used move. **(When is the power not equal to the base power)** The *Base Power* of a move in Showdown can be seen when hovering over a move in the move list.
Note: The same move will always have the same base power. For example, *Fire Punch* will always have a base power of 75[9].

3.2.7.4. Weather

The *Weather* modifier is 1.5 if a *Water-type* move is used during *rain* or a *Fire-type* move during *Harsh Sunlight*. The modifier is 0.5 if a *Water-type* move is used during *Harsh Sunlight* or a *Fire-type* move during *rain* [6]. **(Reference to weather section)** ToDo

3.2.7.5. Critical

In the latest Generation, a critical hit (crit) deals 1.5 times the damage compared to a normal hit. If the crit rate is not increased, the chance of landing a crit is 1/24 [10]. Increasing crit rate, as well as other stats, will be explained in chapter 3.2.8.1.
Note: In earlier games, crits worked different, see [10] for more details.

3.2.7.6. Random

Random is a random integer percentage between 85% and 100%. Because of this, the same move may deal different damage in the same scenario [6].

3.2.7.7. STAB

STAB stands for *Same Type Attack Bonus*. It is a multiplier of 1.5 if the used move is of the same type as the attacking Pokémon. Otherwise, it is 1.0 [6].

3.2.7.8. Type

This is the in section **??** described type modifier [6].

3.2.7.9. Burn

Burn is 0.5 if the attacking Pokémon is burned, and the used move is a physical move[1]. Otherwise, it is 1.0 [6].

3.2.7.10. Other

The *other* modifier is usually 1. A list of exceptions can be found at [6].

3.2.8. Effective Stats

3.2.8.1. Boosting

(Boosting critical rate) ToDo

3.3. Hazards

An *entry hazard* is a condition that affects a side of the field that causes any Pokémon that is sent into battle on that side of the field to be afflicted by a negative effect. Entry hazards are created by moves, usually status moves [11].
(This paragraph is copied word by word from Bulbapedia) ToDo

[1] This does not apply if the attacking Pokémon has the Ability *Guts* or the used move is *Facade*

3.3.1. List of entry hazards

Currently, there are five moves that create an entry hazard

3.3.1.1. Spikes

Spikes is a *Ground*-type entry hazard that causes the opponent to lose 1/8% of their maximum hp when they enter the field. This effect can be stacked up to three times. Two layers of spikes will deal 1/6% and three layers will deal 1/4% of the enemies maximum hp.

ToDo **(Removal and Immunity of Spikes)** Spikes are created by the move *Spikes*[12].

3.3.1.2. Stealth Rock

The move *Stealth Rock* sets an entry hazard around the target Pokémon causing Pokémon on the target's field to receive damage upon being switched in. The amount of damage inflicted is affected by the effectiveness of the type *Rock* against the target. Unlike Spikes, this entry hazard does not stack. The damage taken from the victim's maximum is denoted in table 3.3.1.2[13]. *Note:* Stealth Rocks can also be created by the move *G-Max Stonesurge*. This damage-dealing Water-type G-Max move is exclusive to Gigantamax Drednaw [14].

Type effectiveness	**Damage (Max. hp)**
0.25x	3.125%
0.5x	6.25%
1x	12.5%
2x	25%
4x	50%

Table 3.1.: Damage dealt to Pokémon by Stealth Rocks[13]

ToDo **(Does this move exist in Showdown)**

3.3.1.3. Sticky Web

The entry hazard set by the *Bug*-type move *Sticky Web* lowers the opponents speed stat by one stage upon switching in [15].

ToDo **(Pokémon that are not affected by this)**

3.3.1.4. Poison spikes

Poison Spikes set by the *Poison*-type move *Toxic Spikes* cause the opponent to become poisoned. If two layers of spikes are set, the Pokémon instead becomes badly poisoned [16].

ToDo **(Pokémon not affected)**

ToDo **(Explain (badly) poisoning)**

3.3.1.5. Sharp steel

This entry hazard works very similar to Stealth Rock described in 3.3.1.2. However, Sharp steel can only be set by the *Steel*-type move *G-Max Steelsurge* which is the exclusive G-Max Move of Gigantamax Copperhead. The damage dealt by Sharp steel does not stack, the amount of damage dealt is based on the Type effectiveness of the *Steel*-type against the target. Exact damage modifiers can be found in table 3.3.1.5 [17].

ToDo **(Unaffected Pokémon)**

Type effectiveness	Damage (Max. hp)
0.25x	3.125%
0.5x	6.25%
1x	12.5%
2x	25%
4x	50%

Table 3.2.: Damage dealt to Pokémon by Sharp Steel[17]

3.3.2. Hazard counterplay

There are some moves that can remove entry hazards. *Rapid Spin* [18] removes entry hazards from the user's side of the field and *Defog*[19] removes entry hazards on both sides of the field[2]. In addition, *Court Change*[20] will exchange the entry hazards on each side of the field, along with other one-sided field conditions. **(What other one-sided field conditions are there?)** ToDo If a grounded[3] *Poison*-type Pokémon enters the battle, it will remove Toxic Spikes, described in 3.3.1.4, from its side of the field. Lastly, Pokémon holding the item *Heavy-Duty Boots*[22] are unaffected by entry hazards, but grounded *Poison*-type Pokémon can still remove Toxic Spikes even if they hold the boots[11]. There are various exceptions and special cases to hazards. **(Special cases of hazards)** ToDo

[2]In older games *Defog* would only remove Hazards on the target's side of the field. But as we only investigate the latest version, this won't be covered in detail.

[3]The term *grounded* is used to describe a Pokémon that can't be affected by damaging *Ground*-type moves and several other associated effects[21].

4. Evaluation

5. Conclusion

List of Figures

List of Tables

Listings

Acronyms

TBD To Be Done

hp hit points

atk attack stat

def defense stat

spa special Attack stat

spd special Defense stat

spe speed stat

crit critical hit

iv individual values

ev effort values

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Appendix

A. First Appendix Section

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Figure A.1.: A figure

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Ich versichere, dass ich die vorstehende Arbeit selbstständig und ohne fremde Hilfe angefertigt und mich keiner anderer als der in den beigefügten Verzeichnissen angegebenen Hilfsmittel bedient habe. Alle Textstellen, die wörtlich oder sinngemäß aus Veröffentlichungen Dritter entnommen wurden, sind als solche kenntlich gemacht. Alle Quellen, die dem World Wide Web entnommen oder in einer digitalen Form verwendet wurden, sind der Arbeit beigefügt.

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Die Arbeit wurde bisher keiner anderen Prüfungsbehörde vorgelegt und auch nicht veröffentlicht. Ich bin mir bewusst, dass eine unwahre Erklärung zur Versicherung der selbstständigen Leistungserbringung rechtliche Folgen haben kann.

Place, XX. Month 20YY

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(Julian Schubert)