

ICMC - Instituto de Ciências Matemáticas e da Computação

BCC - Bacharelado em Ciências de Computação

Aluno: Bernardo Marques Costa

Número USP: 11795551

Docente: Leonardo Pereira

Disciplina: Laboratório de Introdução a Ciência da Computação II

## RELATÓRIO 6 - SORTING DE POKÉMONS

### Introdução

Teremos um programa que realiza a ordenação de vetores de struct, sendo possíveis 3 diferentes campos para a ordenação: **mainType**, **atk** e **dexNumber**.

Ainda, deve ser implementado 3 diferentes funções de ordenação: **timsort** (algoritmo que utiliza a ideia de dois outros algoritmos - insertion sort e merge sort), **quicksort** e **heapsort**

Por fim, a conclusão a ser feita é sobre a estabilidade dos algoritmos de ordenação

### Capturas de tela da saída em cada caso

#### Quicksort

```
1
mainType
pokemonOrdem1.csv

Dex#: 84 Name: Doduo Type: normal\flying
HP: 35 Attack: 85 Defense: 45
Speed: 75 SpcAtk: 35 SpcDef: 35

Dex#: 241 Name: Miltank Type: normal
HP: 95 Attack: 80 Defense: 195
Speed: 100 SpcAtk: 40 SpcDef: 70

Dex#: 164 Name: Noctowl Type: normal\flying
HP: 100 Attack: 50 Defense: 50
Speed: 70 SpcAtk: 86 SpcDef: 96

Dex#: 486 Name: Regigigas Type: normal
HP: 110 Attack: 160 Defense: 110
Speed: 100 SpcAtk: 80 SpcDef: 110

Dex#: 242 Name: Blissey Type: normal
HP: 255 Attack: 10 Defense: 10
Speed: 55 SpcAtk: 75 SpcDef: 135

Dex#: 765 Name: Oranguru Type: normal\psychic
HP: 90 Attack: 60 Defense: 80
Speed: 60 SpcAtk: 90 SpcDef: 110

Dex#: 327 Name: Spinda Type: normal
HP: 60 Attack: 60 Defense: 60
Speed: 60 SpcAtk: 60 SpcDef: 60

Dex#: 628 Name: Braviary Type: normal\flying
HP: 100 Attack: 123 Defense: 75
Speed: 80 SpcAtk: 57 SpcDef: 75

Dex#: 132 Name: Ditto Type: normal
HP: 48 Attack: 48 Defense: 48
Speed: 48 SpcAtk: 48 SpcDef: 48

Dex#: 446 Name: Munchlax Type: normal
HP: 135 Attack: 85 Defense: 40
Speed: 5 SpcAtk: 40 SpcDef: 85
```

```
1
mainType
pokemonOrdem2.csv

Dex#: 731 Name: Pikipek Type: normal\flying
HP: 35 Attack: 75 Defense: 30
Speed: 65 SpcAtk: 30 SpcDef: 30

Dex#: 734 Name: Yungoos Type: normal
HP: 48 Attack: 70 Defense: 30
Speed: 45 SpcAtk: 30 SpcDef: 30

Dex#: 19 Name: Rattata Type: normal\dark
HP: 30 Attack: 56 Defense: 35
Speed: 72 SpcAtk: 25 SpcDef: 35

Dex#: 333 Name: Swablu Type: normal\flying
HP: 45 Attack: 40 Defense: 60
Speed: 50 SpcAtk: 40 SpcDef: 75

Dex#: 206 Name: Dunsparce Type: normal
HP: 100 Attack: 70 Defense: 70
Speed: 45 SpcAtk: 65 SpcDef: 65

Dex#: 335 Name: Zangoose Type: normal
HP: 73 Attack: 115 Defense: 60
Speed: 90 SpcAtk: 60 SpcDef: 60

Dex#: 277 Name: Swellow Type: normal\flying
HP: 60 Attack: 85 Defense: 60
Speed: 125 SpcAtk: 75 SpcDef: 50

Dex#: 115 Name: Kangaskhan Type: normal
HP: 78 Attack: 125 Defense: 100
Speed: 100 SpcAtk: 60 SpcDef: 100

Dex#: 264 Name: Linoone Type: normal
HP: 78 Attack: 70 Defense: 61
Speed: 100 SpcAtk: 50 SpcDef: 61

Dex#: 773 Name: Silvally Type: normal
HP: 95 Attack: 95 Defense: 95
Speed: 95 SpcAtk: 95 SpcDef: 95
```

```
1
mainType
pokemonOrdem3.csv

Dex#: 396 Name: Starly Type: normal\flying
HP: 40 Attack: 55 Defense: 30
Speed: 60 SpcAtk: 30 SpcDef: 30

Dex#: 676 Name: Furfrou Type: normal
HP: 75 Attack: 80 Defense: 60
Speed: 102 SpcAtk: 65 SpcDef: 90

Dex#: 441 Name: Chatot Type: normal\flying
HP: 76 Attack: 65 Defense: 45
Speed: 91 SpcAtk: 92 SpcDef: 42

Dex#: 264 Name: Linoone Type: normal
HP: 78 Attack: 70 Defense: 61
Speed: 100 SpcAtk: 50 SpcDef: 61

Dex#: 39 Name: Jigglypuff Type: normal\airy
HP: 115 Attack: 45 Defense: 20
Speed: 20 SpcAtk: 45 SpcDef: 25

Dex#: 531 Name: Audino Type: normal
HP: 103 Attack: 60 Defense: 126
Speed: 50 SpcAtk: 80 SpcDef: 126

Dex#: 520 Name: Tranquill Type: normal\flying
HP: 62 Attack: 77 Defense: 62
Speed: 65 SpcAtk: 50 SpcDef: 42

Dex#: 585 Name: Deerling Type: normal\grass
HP: 60 Attack: 60 Defense: 50
Speed: 75 SpcAtk: 40 SpcDef: 50

Dex#: 626 Name: Bouffalant Type: normal
HP: 95 Attack: 110 Defense: 95
Speed: 55 SpcAtk: 40 SpcDef: 95

Dex#: 52 Name: Meowth Type: normal\dark
HP: 40 Attack: 35 Defense: 35
Speed: 90 SpcAtk: 50 SpcDef: 40
```

## Heapsort

```
2
mainType
pokemonOrdem1.csv

Dex#: 288 Name: Vigloroth Type: normal
HP: 80 Attack: 80 Defense: 80
Speed: 90 SpcAtk: 55 SpcDef: 55

Dex#: 772 Name: Type: Null Type: normal
HP: 95 Attack: 95 Defense: 95
Speed: 59 SpcAtk: 95 SpcDef: 95

Dex#: 398 Name: Staraptor Type: normal\flying
HP: 85 Attack: 120 Defense: 70
Speed: 100 SpcAtk: 50 SpcDef: 60

Dex#: 293 Name: Whismur Type: normal
HP: 64 Attack: 51 Defense: 23
Speed: 28 SpcAtk: 51 SpcDef: 23

Dex#: 399 Name: Bidoof Type: normal
HP: 59 Attack: 45 Defense: 40
Speed: 31 SpcAtk: 35 SpcDef: 40

Dex#: 734 Name: Yungoos Type: normal
HP: 48 Attack: 70 Defense: 30
Speed: 45 SpcAtk: 30 SpcDef: 30

Dex#: 132 Name: Ditto Type: normal
HP: 48 Attack: 48 Defense: 48
Speed: 48 SpcAtk: 48 SpcDef: 48

Dex#: 628 Name: Braviary Type: normal\flying
HP: 100 Attack: 123 Defense: 75
Speed: 80 SpcAtk: 57 SpcDef: 75

Dex#: 427 Name: Buneary Type: normal
HP: 55 Attack: 66 Defense: 44
Speed: 85 SpcAtk: 44 SpcDef: 56

Dex#: 660 Name: Diggersby Type: normal\ground
HP: 85 Attack: 56 Defense: 77
Speed: 78 SpcAtk: 50 SpcDef: 77
```

```
2
mainType
pokemonOrdem2.csv

Dex#: 233 Name: Porygon2 Type: normal
HP: 85 Attack: 80 Defense: 90
Speed: 60 SpcAtk: 105 SpcDef: 95

Dex#: 20 Name: Raticate Type: normal\dark
HP: 75 Attack: 71 Defense: 70
Speed: 77 SpcAtk: 40 SpcDef: 80

Dex#: 398 Name: Staraptor Type: normal\flying
HP: 85 Attack: 120 Defense: 70
Speed: 100 SpcAtk: 50 SpcDef: 60

Dex#: 573 Name: Cincinno Type: normal
HP: 75 Attack: 95 Defense: 60
Speed: 115 SpcAtk: 65 SpcDef: 60

Dex#: 84 Name: Doduo Type: normal\flying
HP: 35 Attack: 85 Defense: 45
Speed: 75 SpcAtk: 35 SpcDef: 35

Dex#: 493 Name: Arcseus Type: normal
HP: 120 Attack: 120 Defense: 120
Speed: 120 SpcAtk: 120 SpcDef: 120

Dex#: 132 Name: Ditto Type: normal
HP: 48 Attack: 48 Defense: 48
Speed: 48 SpcAtk: 48 SpcDef: 48

Dex#: 735 Name: Gumshoos Type: normal
HP: 88 Attack: 110 Defense: 60
Speed: 45 SpcAtk: 55 SpcDef: 60

Dex#: 242 Name: Blissey Type: normal
HP: 255 Attack: 10 Defense: 10
Speed: 55 SpcAtk: 75 SpcDef: 135

Dex#: 504 Name: Patrat Type: normal
HP: 45 Attack: 55 Defense: 39
Speed: 42 SpcAtk: 35 SpcDef: 39
```

```
2
mainType
pokemonOrdem3.csv

Dex#: 440 Name: Happiny Type: normal
HP: 100 Attack: 5 Defense: 5
Speed: 30 SpcAtk: 15 SpcDef: 65

Dex#: 40 Name: Wigglytuff Type: normal\airy
HP: 140 Attack: 70 Defense: 45
Speed: 45 SpcAtk: 85 SpcDef: 50

Dex#: 20 Name: Raticate Type: normal\dark
HP: 75 Attack: 71 Defense: 70
Speed: 77 SpcAtk: 40 SpcDef: 80

Dex#: 298 Name: Azurill Type: normal\airy
HP: 50 Attack: 20 Defense: 40
Speed: 20 SpcAtk: 20 SpcDef: 40

Dex#: 734 Name: Yungoos Type: normal
HP: 48 Attack: 70 Defense: 30
Speed: 45 SpcAtk: 30 SpcDef: 30

Dex#: 164 Name: Noctowl Type: normal\flying
HP: 100 Attack: 50 Defense: 50
Speed: 70 SpcAtk: 86 SpcDef: 96

Dex#: 504 Name: Patrat Type: normal
HP: 45 Attack: 55 Defense: 39
Speed: 42 SpcAtk: 35 SpcDef: 39

Dex#: 174 Name: Iggybuff Type: normal\airy
HP: 90 Attack: 30 Defense: 15
Speed: 15 SpcAtk: 40 SpcDef: 20

Dex#: 264 Name: Linoone Type: normal
HP: 78 Attack: 70 Defense: 61
Speed: 100 SpcAtk: 50 SpcDef: 61

Dex#: 424 Name: Ambipom Type: normal
HP: 75 Attack: 100 Defense: 66
Speed: 115 SpcAtk: 60 SpcDef: 66
```

## Timsort

```
3
mainType
pokemonOrdem1.csv

Dex#: 733 Name: Toucannon Type: normal\flying
HP: 80 Attack: 120 Defense: 75
Speed: 60 SpcAtk: 75 SpcDef: 75

Dex#: 161 Name: Sentret Type: normal
HP: 35 Attack: 46 Defense: 34
Speed: 20 SpcAtk: 35 SpcDef: 45

Dex#: 277 Name: Swellow Type: normal\flying
HP: 60 Attack: 85 Defense: 60
Speed: 125 SpcAtk: 75 SpcDef: 50

Dex#: 731 Name: Pikipik Type: normal\flying
HP: 35 Attack: 75 Defense: 30
Speed: 65 SpcAtk: 30 SpcDef: 30

Dex#: 628 Name: Braviary Type: normal\flying
HP: 100 Attack: 123 Defense: 75
Speed: 80 SpcAtk: 57 SpcDef: 75

Dex#: 351 Name: Castform Type: normal
HP: 70 Attack: 70 Defense: 70
Speed: 70 SpcAtk: 70 SpcDef: 70

Dex#: 335 Name: Zangoose Type: normal
HP: 73 Attack: 115 Defense: 60
Speed: 90 SpcAtk: 60 SpcDef: 60

Dex#: 83 Name: Farfetch'd Type: normal\flying
HP: 52 Attack: 90 Defense: 55
Speed: 60 SpcAtk: 58 SpcDef: 62

Dex#: 463 Name: Lickilicky Type: normal
HP: 110 Attack: 85 Defense: 95
Speed: 50 SpcAtk: 80 SpcDef: 95

Dex#: 396 Name: Starly Type: normal\flying
HP: 40 Attack: 55 Defense: 30
Speed: 60 SpcAtk: 30 SpcDef: 30
```

```
3
mainType
pokemonOrdem2.csv

Dex#: 300 Name: Skitty Type: normal
HP: 50 Attack: 45 Defense: 45
Speed: 50 SpcAtk: 35 SpcDef: 35

Dex#: 627 Name: Rufflet Type: normal\flying
HP: 70 Attack: 83 Defense: 50
Speed: 60 SpcAtk: 37 SpcDef: 50

Dex#: 573 Name: Cincinno Type: normal
HP: 75 Attack: 95 Defense: 60
Speed: 115 SpcAtk: 65 SpcDef: 60

Dex#: 626 Name: Bouffalant Type: normal
HP: 95 Attack: 110 Defense: 95
Speed: 55 SpcAtk: 40 SpcDef: 95

Dex#: 298 Name: Azurill Type: normal\airy
HP: 50 Attack: 20 Defense: 40
Speed: 20 SpcAtk: 20 SpcDef: 40

Dex#: 333 Name: Swablu Type: normal\flying
HP: 45 Attack: 40 Defense: 60
Speed: 50 SpcAtk: 40 SpcDef: 75

Dex#: 164 Name: Noctowl Type: normal\flying
HP: 100 Attack: 50 Defense: 50
Speed: 70 SpcAtk: 86 SpcDef: 96

Dex#: 233 Name: Porygon2 Type: normal
HP: 85 Attack: 80 Defense: 90
Speed: 60 SpcAtk: 105 SpcDef: 95

Dex#: 143 Name: Snorlax Type: normal
HP: 160 Attack: 110 Defense: 65
Speed: 30 SpcAtk: 65 SpcDef: 110

Dex#: 217 Name: Ursaring Type: normal
HP: 90 Attack: 130 Defense: 75
Speed: 55 SpcAtk: 75 SpcDef: 75
```

```
3
mainType
pokemonOrdem3.csv

Dex#: 735 Name: Gumshoos Type: normal
HP: 88 Attack: 110 Defense: 60
Speed: 45 SpcAtk: 55 SpcDef: 60

Dex#: 133 Name: Eevee Type: normal
HP: 55 Attack: 55 Defense: 50
Speed: 55 SpcAtk: 45 SpcDef: 65

Dex#: 83 Name: Farfetch'd Type: normal\flying
HP: 52 Attack: 90 Defense: 55
Speed: 60 SpcAtk: 58 SpcDef: 62

Dex#: 396 Name: Starly Type: normal\flying
HP: 40 Attack: 55 Defense: 30
Speed: 60 SpcAtk: 30 SpcDef: 30

Dex#: 161 Name: Sentret Type: normal
HP: 35 Attack: 46 Defense: 34
Speed: 20 SpcAtk: 35 SpcDef: 45

Dex#: 18 Name: Pidgeot Type: normal\flying
HP: 83 Attack: 80 Defense: 80
Speed: 121 SpcAtk: 135 SpcDef: 80

Dex#: 506 Name: Lillipup Type: normal
HP: 45 Attack: 60 Defense: 45
Speed: 55 SpcAtk: 25 SpcDef: 45

Dex#: 648 Name: Meloetta Type: normal\psychic
HP: 100 Attack: 128 Defense: 90
Speed: 128 SpcAtk: 77 SpcDef: 77

Dex#: 264 Name: Linoone Type: normal
HP: 78 Attack: 70 Defense: 61
Speed: 100 SpcAtk: 50 SpcDef: 61

Dex#: 441 Name: Chatot Type: normal\flying
HP: 76 Attack: 65 Defense: 45
Speed: 91 SpcAtk: 92 SpcDef: 42
```

## Conclusão

**Resposta: sim! Houve diferença.**

Analisando os CSV utilizados para cada algoritmo utilizado, temos a seguinte relação obtida:

- **Quicksort:** o quicksort mostra-se como um algoritmo não estável, uma vez que após verificar o CSV, o primeiro pokémon de mainType Normal é o Toucannon, seguido por Sentret. Contudo, a ordenação por meio do quicksort utilizando este campo como comparação não nos retorna esta mesma ordem, como possível ver na captura de tela acima.  
A mesma análise ocorre com os demais casos testes (demais arquivos CSV)
- **Heapsort:** assim como o quicksort, a lista de pokémons ordenada não nos retorna no primeiro teste o primeiro pokémon de tipo Normal (Toucannon), o que nos mostra que se trata de um algoritmo não estável de ordenação  
Mais uma vez, a mesma conclusão pode ser obtida com os demais arquivos de teste
- **Timsort:** por fim, o timsort é um algoritmo que se mostra estável, uma vez que não desordena a relação dos pokémons que possuem o mesmo mainType

O.b.s: a mesma análise poderia ser feita com os outros campos da struct pokémon, mas como o campo mainType é aquele em que mais ocorre repetição, haverá maior interferência da estabilidade ou não estabilidade do pokémon