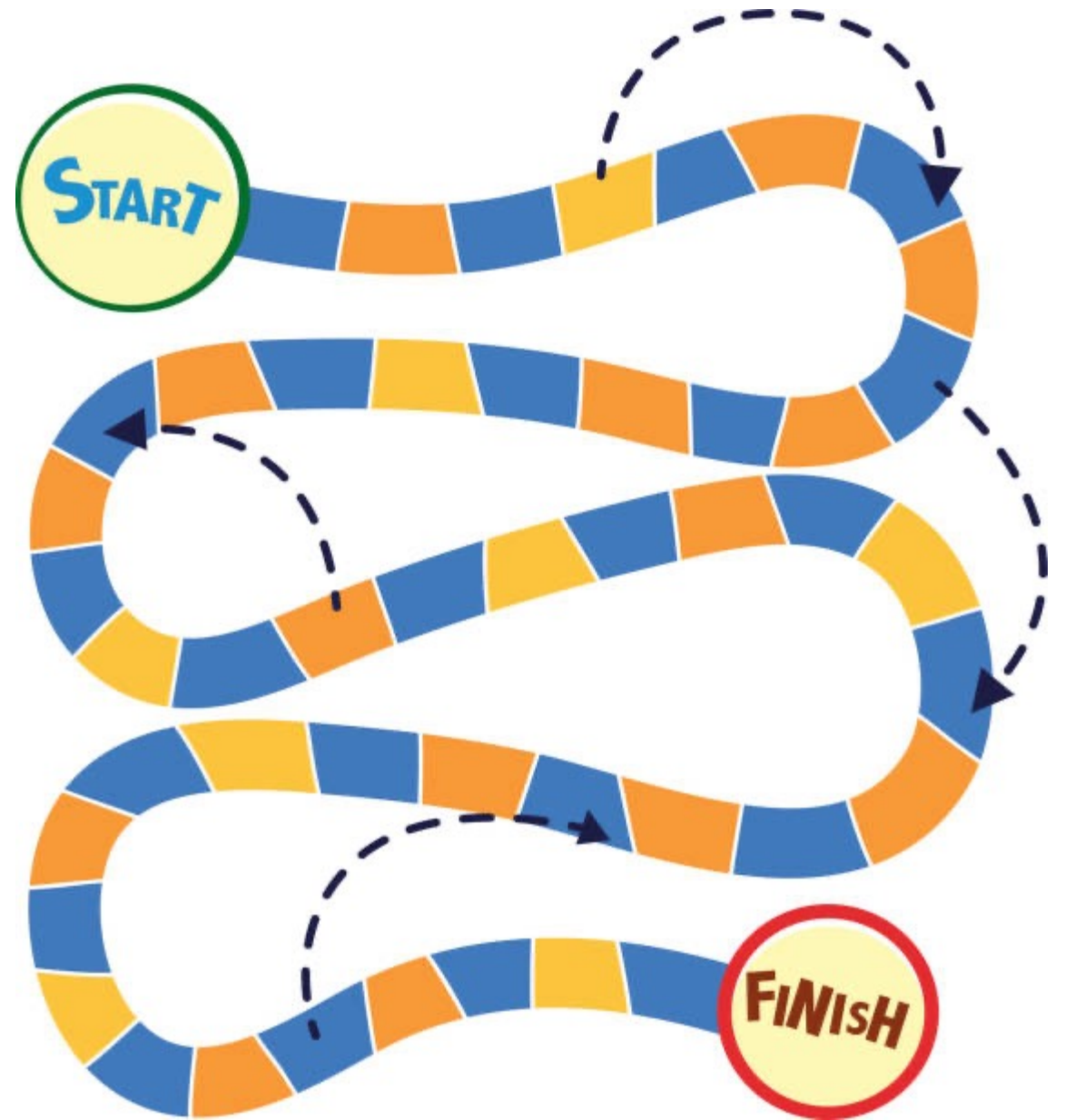


Processamento paralelo de cálculo de consumo de estoque

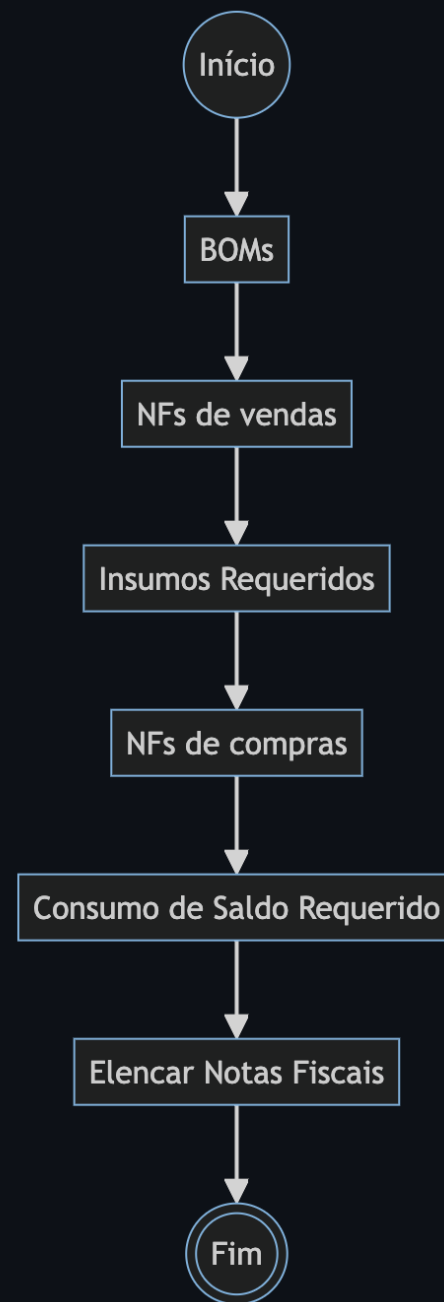
Maxmiliano Andriani
Programação Paralela Avançada - PPGCA - CCT
Profº Guilherme Koslovski
26/06/2024

- **Algoritmo**
- **Inputs**
- **Resultados**
- **Conclusões**



Algoritmo

1. Carregar Bills of Materials
2. Carregar Notas Fiscais de venda.
3. Consolidar insumos e saldos requeridos.
4. Carregar Notas Fiscais de compras.
5. Ordenar Notas pela data de emissão.
6. Calcular consumo do saldo requerido.
7. Retornar a lista discriminada de Notas Fiscais de compras usadas para consumir o saldo.



Inputs

Equipamento

Apple M3 Pro

1 CPU, 12 logical and 12 physical cores

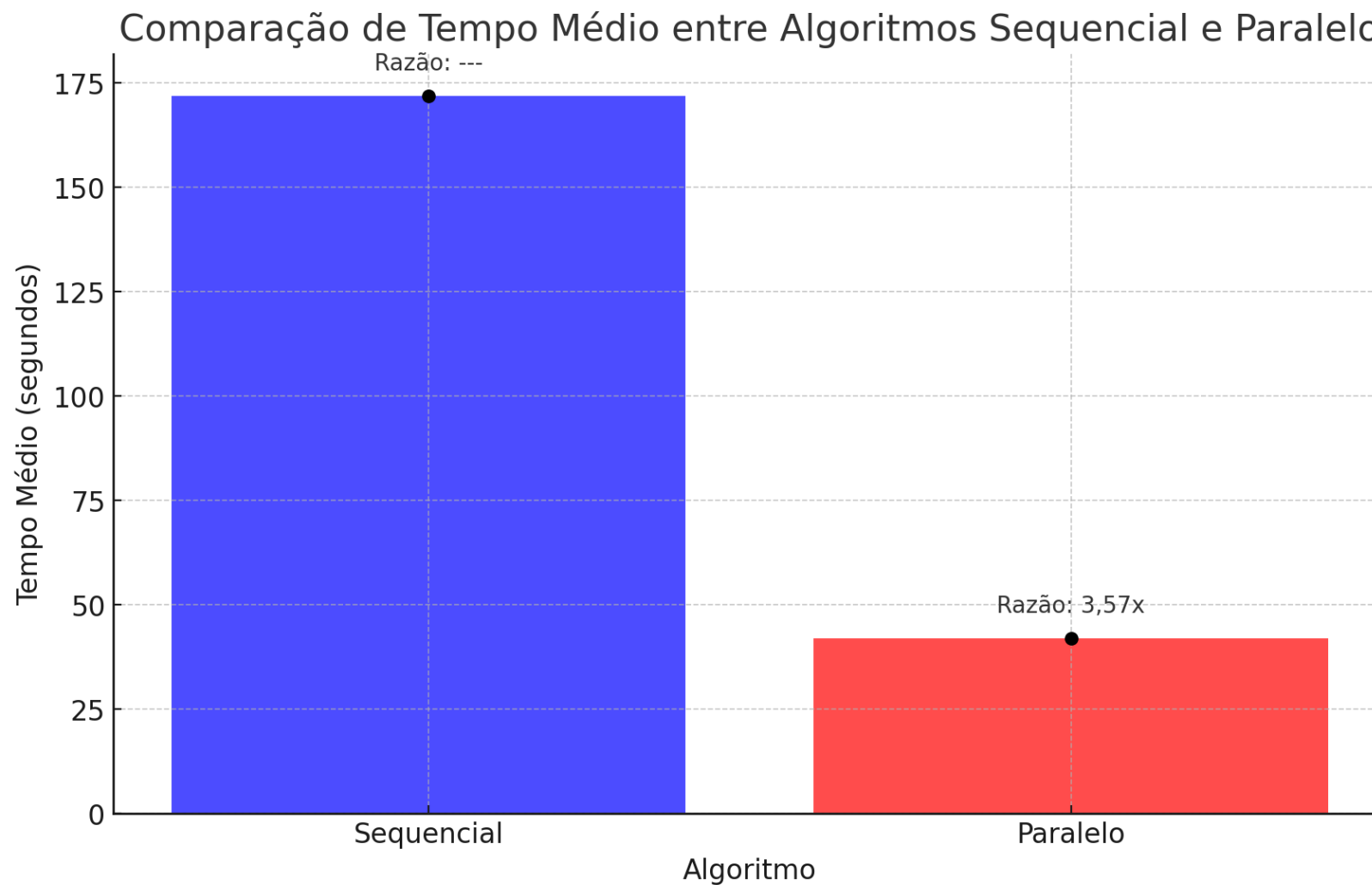
.NET SDK 8.0.302

.NET 8.0.6 Arm64 RyuJIT AdvSIMD

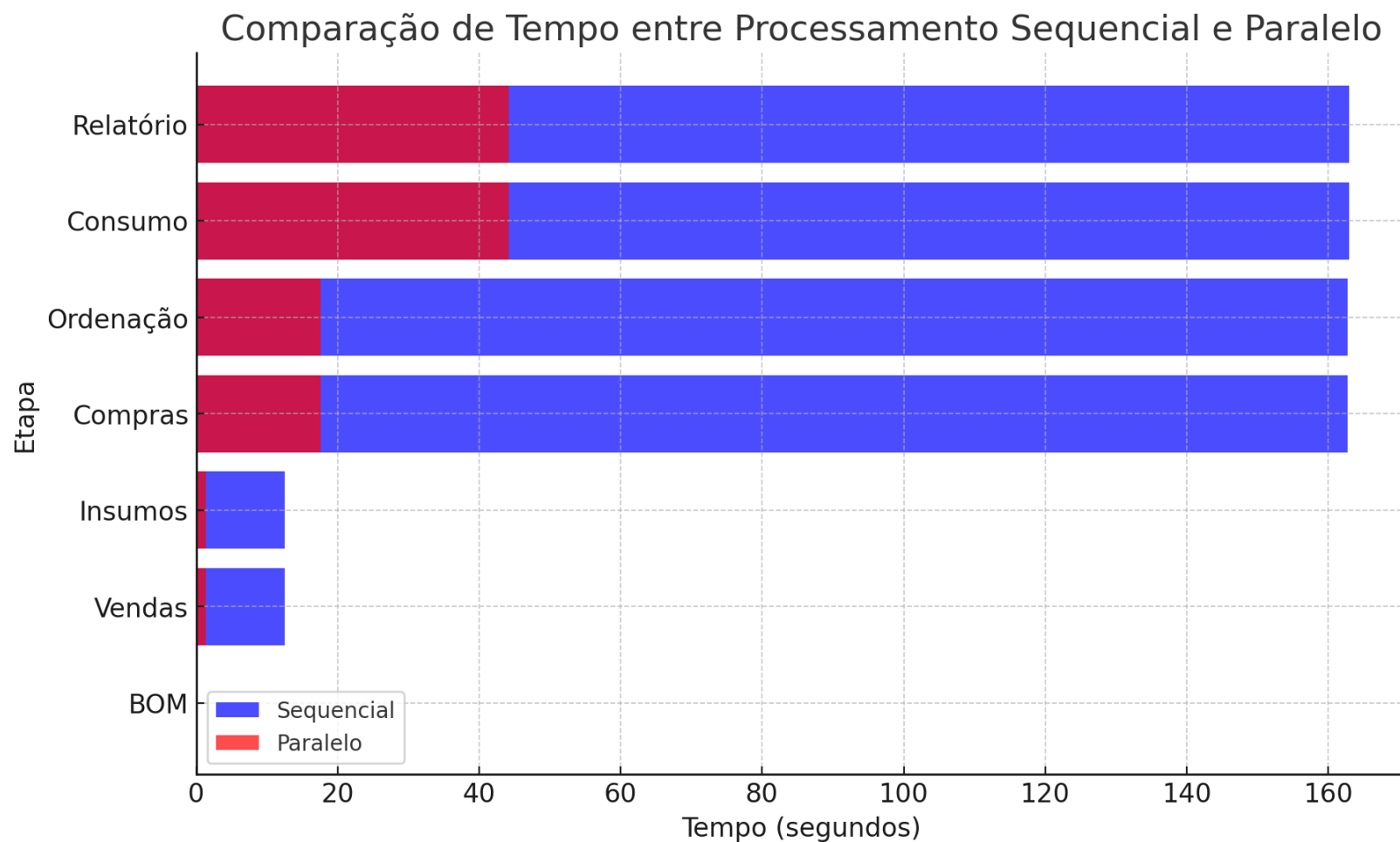
Dados

- **10 Bills of Material** (10 Tipos de produtos).
- **100 mil** Notas Fiscais de Vendas distribuídas em 30 dias (Um período de apuração).
- **776 mil** Notas Fiscais de Compras de insumos distribuídas em um intervalo de 365 dias.
- **36 mil** Insumos distintos distribuídos como materiais de 10 Produtos.
- **1.3GB** de dados brutos.

Resultados



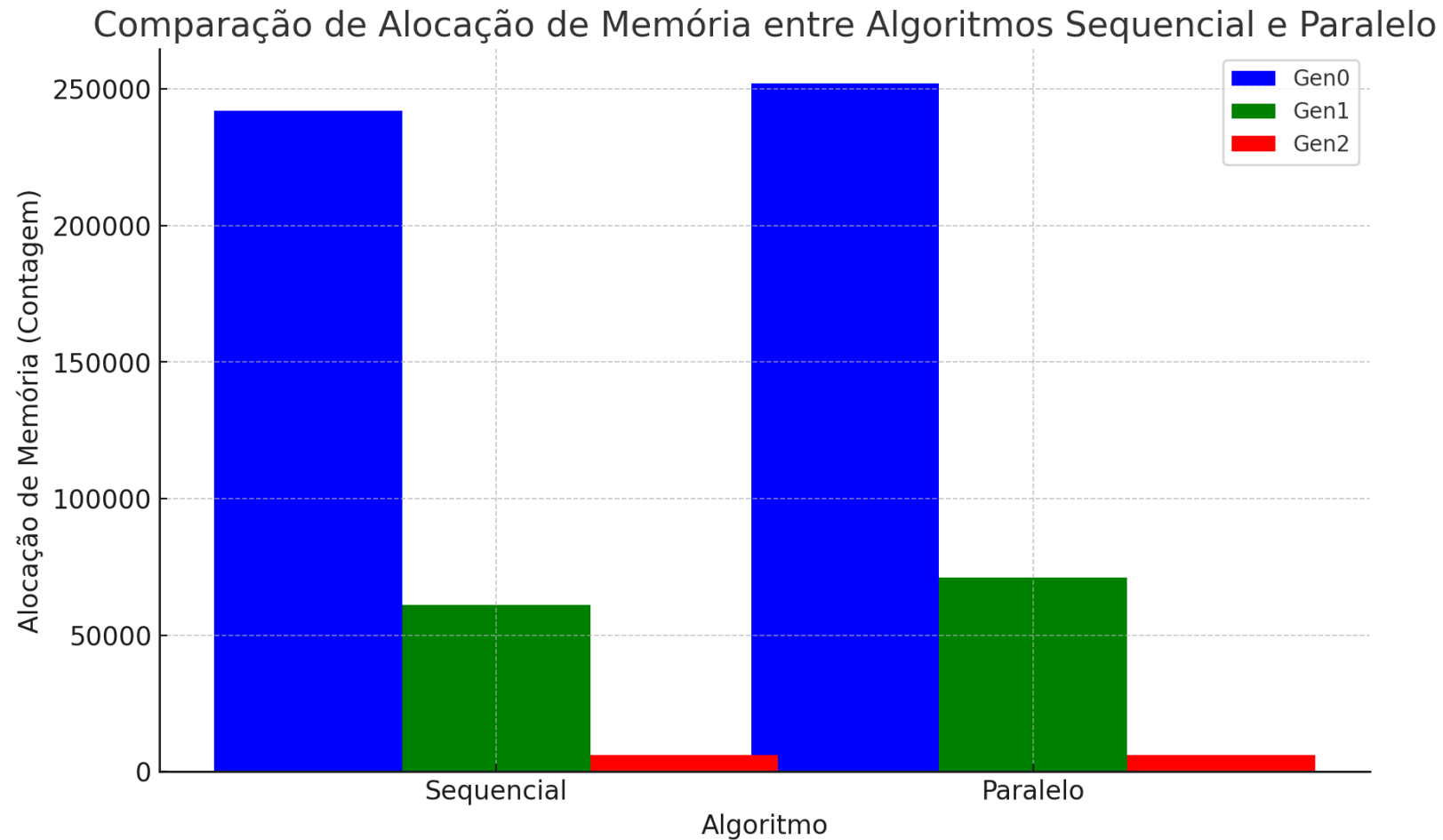
Resultados



Resultados

Razão: 9% Pior

Razão: ---



Resultados

Algoritmo	Tempo médio	Erro Amostral	Desvio	Razão
Sequencial	02m 52s	1,291s	1,144s	---
Paralelo	42s	0,238s	0,186s	3,57x

Algoritmo	Alocação	Gen0	Gen1	Gen2	Razão
Sequencial	1,95 GB	242.000	61.000	6.000	---
Paralelo	2,12 GB	252.000	71.000	6.000	9% Pior

Resultados

Sequencial

```
maxandriani — htop — 120x34

0[|||||] 11.1%] 3[|||] 3.3%] 6[|||] 2.0%] 9[||||] 6.7%]
1[|||||] 6.9%] 4[|||] 1.3%] 7[||||] 8.1%] 10[|||||] 10.7%]
2[|||||] 5.0%] 5[|||] 1.3%] 8[||||] 0.7%] 11[||||] 0.7%]
Mem[|||||] 15.7G/36.0G Tasks: 869, 2891 thr, 0 kthr; 2 running
Swp[|||||] 0K/0K Load average: 1.65 1.66 1.57
Uptime: 12 days, 09:57:19

Main
PID USER PRI NI VIRT RES S CPU% MEM% TIME+ Command
61120 maxandriani 17 0 393G 170M ? 20.9 0.5 0:07.00 /Users/maxandriani/Projects/udesc-ppgca-ppa-tf/src/App.Cli/bi
59161 maxandriani 16 0 411G 567M ? 2.0 1.5 0:27.00 /usr/local/share/dotnet/dotnet /Users/maxandriani/.vscode/ext
36915 maxandriani 17 0 424G 577M ? 1.6 1.6 1h41:40 /Applications/Google Chrome.app/Contents/MacOS/Google Chrome
629 maxandriani 24 0 394G 439M ? 1.3 1.2 6h15:22 /System/Applications/Utilities/Terminal.app/Contents/MacOS/Te
644 maxandriani 17 0 393G 120M ? 0.8 0.3 10:57.00 /System/Library/CoreServices/ControlCenter.app/Contents/MacOS
60140 maxandriani 17 0 1522G 255M ? 0.7 0.7 0:07.00 /Applications/Google Chrome.app/Contents/Frameworks/Google Ch
13653 maxandriani 17 0 393G 130M ? 0.6 0.4 1:25.00 /System/Applications/Calendar.app/Contents/MacOS/Calendar
36922 maxandriani 17 0 424G 235M ? 0.6 0.6 1h17:59 /Applications/Google Chrome.app/Contents/Frameworks/Google Ch
662 maxandriani 17 0 391G 14176 ? 0.5 0.0 3:51.00 /System/Library/Frameworks/ApplicationServices.framework/Fram
58992 maxandriani 17 0 1522G 250M ? 0.3 0.7 0:23.00 /Applications/Google Chrome.app/Contents/Frameworks/Google Ch
641 maxandriani 17 0 424G 276M ? 0.3 0.7 1h14:09 /Applications/Spotify.app/Contents/MacOS/Spotify
49058 maxandriani 17 0 1522G 223M ? 0.3 0.6 0:33.00 /Applications/Google Chrome.app/Contents/Frameworks/Google Ch
59066 maxandriani 17 0 1522G 178M ? 0.3 0.5 0:05.00 /Applications/Visual Studio Code.app/Contents/Frameworks/Code
61208 maxandriani 17 0 392G 22880 ? 0.3 0.1 0:00.00 /usr/sbin/screencapture -pdi -z keyboard.selection
1974 maxandriani 0 0 393G 38448 R 0.2 0.1 1h06:47 htop
36923 maxandriani 8 0 423G 132M ? 0.1 0.4 18:47.00 /Applications/Google Chrome.app/Contents/Frameworks/Google Ch
30294 maxandriani 17 0 424G 144M ? 0.1 0.4 2:27.00 /Applications/Microsoft Teams.app/Contents/Helpers/Microsoft
94564 maxandriani 17 0 392G 64144 ? 0.1 0.2 0:20.00 /System/Library/CoreServices/Dock.app/Contents/XPCServices/co
78324 maxandriani 17 0 1522G 205M ? 0.1 0.6 1:43.00 /Applications/Google Chrome.app/Contents/Frameworks/Google Ch
94559 maxandriani 17 0 393G 64160 ? 0.1 0.2 2:39.00 /System/Library/CoreServices/Dock.app/Contents/MacOS/Dock
996 maxandriani 21 0 393G 31728 ? 0.1 0.1 2:06.00 /System/Library/CoreServices/Siri.app/Contents/MacOS/Siri lau
660 maxandriani 17 0 391G 51568 ? 0.1 0.1 9:56.00 /usr/libexec/sharingd
46214 maxandriani 17 0 1522G 199M ? 0.1 0.5 1:30.00 /Applications/Google Chrome.app/Contents/Frameworks/Google Ch
F1Help F2Setup F3Search F4Filter F5Tree F6SortBy F7Nice F8Nice F9Kill F10Quit
```

Resultados

Sequencial

```
maxandriani — htop — 120x34

0[|||||||||||||100.0%] 3[|||||||||||||100.0%] 6[|||||||||||||100.0%] 9[|||||||||||||100.0%]
1[|||||||||||||100.0%] 4[|||||||||||||100.0%] 7[|||||||||||||100.0%] 10[|||||||||||||100.0%]
2[|||||||||||||100.0%] 5[|||||||||||||100.0%] 8[|||||||||||||100.0%] 11[|||||||||||||100.0%]
Mem[|||||||||||||16.3G/36.0G] Tasks: 849, 2818 thr, 0 kthr; 12 running
Swp[|||||||||||||0K/0K] Load average: 2.40 1.76 1.61
Uptime: 12 days, 10:00:29

Main
PID USER PRI NI VIRT RES S CPU% MEM% TIME+ Command
61584 maxandriani 16 0 395G 773M ? 1173.4 2.1 0:54.00 /Users/maxandriani/Projects/udesc-ppgca-ppa-tf/src/App.Cli/b
59161 maxandriani 16 0 411G 567M ? 2.3 1.5 0:30.00 /usr/local/share/dotnet/dotnet /Users/maxandriani/.vscode/ex
59044 maxandriani 17 0 1526G 498M ? 1.7 1.4 0:16.00 /Applications/Visual Studio Code.app/Contents/Frameworks/Cod
629 maxandriani 24 0 394G 446M ? 1.5 1.2 6h15:26 /System/Applications/Utilities/Terminal.app/Contents/MacOS/T
60140 maxandriani 17 0 1522G 256M ? 0.5 0.7 0:08.00 /Applications/Google Chrome.app/Contents/Frameworks/Google C
641 maxandriani 17 0 424G 276M ? 0.4 0.7 1h14:10 /Applications/Spotify.app/Contents/MacOS/Spotify
58866 maxandriani 24 0 1522G 210M ? 0.4 0.6 0:08.00 /Applications/Visual Studio Code.app/Contents/MacOS/Electron
36923 maxandriani 17 0 423G 132M ? 0.2 0.4 18:48.00 /Applications/Google Chrome.app/Contents/Frameworks/Google C
1974 maxandriani 24 0 393G 38528 R 0.2 0.1 1h06:48 htop
36915 maxandriani 8 0 424G 577M ? 0.2 1.6 1h41:41 /Applications/Google Chrome.app/Contents/MacOS/Google Chrome
678 maxandriani 17 0 391G 54992 ? 0.2 0.1 2:44.00 /usr/libexec/knowledge-agent
58992 maxandriani 17 0 1522G 250M ? 0.2 0.7 0:23.00 /Applications/Google Chrome.app/Contents/Frameworks/Google C
29164 maxandriani 17 0 391G 8624 ? 0.1 0.0 1:58.00 /usr/sbin/cfprefsd agent
36922 maxandriani 17 0 424G 235M ? 0.1 0.6 1h18:00 /Applications/Google Chrome.app/Contents/Frameworks/Google C
996 maxandriani 21 0 393G 31696 ? 0.1 0.1 2:06.00 /System/Library/CoreServices/Siri.app/Contents/MacOS/Siri la
44698 maxandriani 17 0 1522G 179M ? 0.1 0.5 0:30.00 /Applications/Google Chrome.app/Contents/Frameworks/Google C
59066 maxandriani 24 0 1522G 179M ? 0.1 0.5 0:06.00 /Applications/Visual Studio Code.app/Contents/Frameworks/Cod
983 maxandriani 17 0 424G 98.1M ? 0.1 0.3 12:20.00 /Applications/Spotify.app/Contents/Frameworks/Spotify Helper
58869 maxandriani 17 0 424G 99.2M ? 0.1 0.3 0:04.00 /Applications/Visual Studio Code.app/Contents/Frameworks/Cod
622 maxandriani 40 0 391G 6832 ? 0.1 0.0 1:16.00 /System/Library/Frameworks/ApplicationServices.framework/Ver
647 maxandriani 17 0 393G 29568 ? 0.1 0.1 0:02.00 /System/Library/CoreServices/SystemUIServer.app/Contents/Mac
644 maxandriani 17 0 393G 120M ? 0.1 0.3 10:57.00 /System/Library/CoreServices/ControlCenter.app/Contents/MacO
61611 maxandriani 17 0 392G 42176 ? 0.0 0.1 0:00.00 /System/Library/CoreServices/screencaptureui.app/Contents/Ma
F1Help F2Setup F3Search F4Filter F5Tree F6SortBy F7Nice -F8Nice +F9Kill F10Quit
```

Conclusões

Performance (Tempo médio):

A implementação paralela é significativamente mais rápida, cerca de 3,6x mais rápida que sua versão sequencial.

Erro e Desvio Padrão:

As taxas de erro e desvio padrão foram relativamente baixas, o que indica a estabilidade da mensuração de performance entre as iterações.

Alocação de Memória:

O algoritmo paralelo consumiu cerca de 9% mais memória, provavelmente devido a sobrecarga do paralelismo.

Garbage Collector

Ambos os modelos apresentaram pressões de alocação similares na Gen0 e Gen1. A presença de um volume substancial de dados na Gen2 indica possibilidade de otimização de alocação ao remover objetos de longa duração.

Lock Connections

O modelo paralelo apresentou 2382 threads e produziu 3289 eventos de retenção de lock. É um indicador de possibilidade de otimização em remover uso de recursos conflitantes.



Obrigado

**UDESC – Universidade do Estado de
Santa Catarina**

max.andriani@gmail.com

github.com/maxandriani

linkedin.com/in/maxandriani