

# Relatório Implementação do Projeto Newton-Raphson em OpenMp

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Valor de  $x_0$  considerado nos testes = 10.000.000.000

## Teste 01 - Versão Sequencial (1 thread):

```
wesley.ifma@cluster:~  
10000000000.000000  
Thread = 0 | Iteracao = 1 | f(x) = 25000000501021933568.000000  
Thread = 0 | Iteracao = 2 | f(x) = 6250000125255483392.000000  
Thread = 0 | Iteracao = 3 | f(x) = 1562500031313870848.000000  
Thread = 0 | Iteracao = 4 | f(x) = 390625007828467712.000000  
Thread = 0 | Iteracao = 5 | f(x) = 97656251957116928.000000  
Thread = 0 | Iteracao = 6 | f(x) = 24414062989279232.000000  
Thread = 0 | Iteracao = 7 | f(x) = 6103515210448896.000000  
Thread = 0 | Iteracao = 8 | f(x) = 1525879071047680.000000  
Thread = 0 | Iteracao = 9 | f(x) = 381469700653056.000000  
Thread = 0 | Iteracao = 10 | f(x) = 95367441940480.000000  
Thread = 0 | Iteracao = 11 | f(x) = 23841862582272.000000  
Thread = 0 | Iteracao = 12 | f(x) = 5960465645568.000000  
Thread = 0 | Iteracao = 13 | f(x) = 1490116411392.000000  
Thread = 0 | Iteracao = 14 | f(x) = 372529102848.000000  
Thread = 0 | Iteracao = 15 | f(x) = 93132275712.000000  
Thread = 0 | Iteracao = 16 | f(x) = 23283068928.000000  
Thread = 0 | Iteracao = 17 | f(x) = 5820767232.000000  
Thread = 0 | Iteracao = 18 | f(x) = 1455191808.000000  
Thread = 0 | Iteracao = 19 | f(x) = 363797952.000000  
Thread = 0 | Iteracao = 20 | f(x) = 90949488.000000  
Thread = 0 | Iteracao = 21 | f(x) = 22737372.000000  
Thread = 0 | Iteracao = 22 | f(x) = 5684342.500000  
Thread = 0 | Iteracao = 23 | f(x) = 1421085.750000  
Thread = 0 | Iteracao = 24 | f(x) = 355271.437500  
Thread = 0 | Iteracao = 25 | f(x) = 88817.773438  
Thread = 0 | Iteracao = 26 | f(x) = 22204.382812  
Thread = 0 | Iteracao = 27 | f(x) = 5551.033203  
Thread = 0 | Iteracao = 28 | f(x) = 1387.695923  
Thread = 0 | Iteracao = 29 | f(x) = 346.861481  
Thread = 0 | Iteracao = 30 | f(x) = 86.652908  
Thread = 0 | Iteracao = 31 | f(x) = 21.600910  
Thread = 0 | Iteracao = 32 | f(x) = 5.338444  
Thread = 0 | Iteracao = 33 | f(x) = 1.274906  
Thread = 0 | Iteracao = 34 | f(x) = 0.266474  
Thread = 0 | Iteracao = 35 | f(x) = 0.034371  
Thread = 0 | Iteracao = 36 | f(x) = 0.001039  
Thread = 0 | Iteracao = 37 | f(x) = 0.000002  
Thread = 0 | Iteracao = 38 | f(x) = 0.000000  
  
Time OpenMp = 0.000226 seconds  
  
Convergiu apos 38 iteracoes para a raiz = 2.999999
```

Tempo Gasto = 0.000226 segundos

## Teste 02 - Versão Sequencial (2 threads):

```
wesley.ifma@cluster:~  
10000000000.000000  
Thread = 1 | Iteracao = 1 | f(x) = 250000000501021933568.000000  
Thread = 1 | Iteracao = 2 | f(x) = 6250000125255483392.000000  
Thread = 1 | Iteracao = 1 | f(x) = 1562500031313870848.000000  
Thread = 1 | Iteracao = 3 | f(x) = 390625007828467712.000000  
Thread = 1 | Iteracao = 2 | f(x) = 97656251957116928.000000  
Thread = 1 | Iteracao = 4 | f(x) = 24414062989279232.000000  
Thread = 1 | Iteracao = 3 | f(x) = 6103515210448896.000000  
Thread = 1 | Iteracao = 5 | f(x) = 1525879071047680.000000  
Thread = 1 | Iteracao = 4 | f(x) = 381469700653056.000000  
Thread = 1 | Iteracao = 6 | f(x) = 95367441940480.000000  
Thread = 1 | Iteracao = 5 | f(x) = 23841862582272.000000  
Thread = 1 | Iteracao = 7 | f(x) = 5960465645568.000000  
Thread = 1 | Iteracao = 8 | f(x) = 1490116411392.000000  
Thread = 1 | Iteracao = 6 | f(x) = 372529102848.000000  
Thread = 1 | Iteracao = 9 | f(x) = 93132275712.000000  
Thread = 1 | Iteracao = 7 | f(x) = 23283068928.000000  
Thread = 1 | Iteracao = 10 | f(x) = 5820767232.000000  
Thread = 1 | Iteracao = 11 | f(x) = 1455191808.000000  
Thread = 1 | Iteracao = 8 | f(x) = 363797952.000000  
Thread = 1 | Iteracao = 9 | f(x) = 90949488.000000  
Thread = 1 | Iteracao = 12 | f(x) = 22737372.000000  
Thread = 1 | Iteracao = 13 | f(x) = 5684342.500000  
Thread = 1 | Iteracao = 10 | f(x) = 1421085.750000  
Thread = 1 | Iteracao = 11 | f(x) = 355271.437500  
Thread = 1 | Iteracao = 14 | f(x) = 88817.773438  
Thread = 1 | Iteracao = 15 | f(x) = 22204.382812  
Thread = 1 | Iteracao = 12 | f(x) = 5551.033203  
Thread = 1 | Iteracao = 13 | f(x) = 1387.695923  
Thread = 1 | Iteracao = 16 | f(x) = 346.861481  
Thread = 1 | Iteracao = 17 | f(x) = 86.652908  
Thread = 1 | Iteracao = 14 | f(x) = 21.600910  
Thread = 1 | Iteracao = 15 | f(x) = 5.338444  
Thread = 1 | Iteracao = 18 | f(x) = 1.274906  
Thread = 1 | Iteracao = 19 | f(x) = 0.266474  
Thread = 1 | Iteracao = 16 | f(x) = 0.034371  
Thread = 1 | Iteracao = 17 | f(x) = 0.001039  
Thread = 1 | Iteracao = 20 | f(x) = 0.000002  
Thread = 1 | Iteracao = 21 | f(x) = 0.000000  
Thread = 1 | Iteracao = 18 | f(x) = 0.000000  
  
Time OpenMp = 0.000262 seconds
```

Tempo Gasto = 0.000262 segundos

### Teste 03 - Versão Sequencial (4 threads):

```
wesley.ifma@cluster:~  
Thread = 3 | Iteracao = 1 | f(x) = 25000000501021933568.000000  
Thread = 2 | Iteracao = 1 | f(x) = 6250000125255483392.000000  
Thread = 2 | Iteracao = 1 | f(x) = 1562500031313870848.000000  
Thread = 2 | Iteracao = 2 | f(x) = 390625007828467712.000000  
Thread = 2 | Iteracao = 2 | f(x) = 97656251957116928.000000  
Thread = 2 | Iteracao = 2 | f(x) = 24414062989279232.000000  
Thread = 2 | Iteracao = 3 | f(x) = 6103515210448896.000000  
Thread = 2 | Iteracao = 1 | f(x) = 1525879071047680.000000  
Thread = 2 | Iteracao = 3 | f(x) = 381469700653056.000000  
Thread = 2 | Iteracao = 3 | f(x) = 95367441940480.000000  
Thread = 2 | Iteracao = 4 | f(x) = 23841862582272.000000  
Thread = 2 | Iteracao = 5 | f(x) = 5960465645568.000000  
Thread = 2 | Iteracao = 4 | f(x) = 1490116411392.000000  
Thread = 2 | Iteracao = 2 | f(x) = 372529102848.000000  
Thread = 2 | Iteracao = 5 | f(x) = 93132275712.000000  
Thread = 2 | Iteracao = 3 | f(x) = 23283068928.000000  
Thread = 2 | Iteracao = 4 | f(x) = 5820767232.000000  
Thread = 2 | Iteracao = 6 | f(x) = 1455191808.000000  
Thread = 2 | Iteracao = 7 | f(x) = 363797952.000000  
Thread = 2 | Iteracao = 4 | f(x) = 90949488.000000  
Thread = 2 | Iteracao = 5 | f(x) = 22737372.000000  
Thread = 2 | Iteracao = 6 | f(x) = 5684342.500000  
Thread = 2 | Iteracao = 6 | f(x) = 1421085.750000  
Thread = 2 | Iteracao = 7 | f(x) = 355271.437500  
Thread = 2 | Iteracao = 7 | f(x) = 88817.773438  
Thread = 2 | Iteracao = 8 | f(x) = 22204.382812  
Thread = 2 | Iteracao = 8 | f(x) = 5551.033203  
Thread = 2 | Iteracao = 9 | f(x) = 1387.695923  
Thread = 2 | Iteracao = 5 | f(x) = 346.861481  
Thread = 2 | Iteracao = 9 | f(x) = 86.652908  
Thread = 2 | Iteracao = 10 | f(x) = 21.600910  
Thread = 2 | Iteracao = 6 | f(x) = 5.338444  
Thread = 2 | Iteracao = 8 | f(x) = 1.274906  
Thread = 2 | Iteracao = 10 | f(x) = 0.266474  
Thread = 2 | Iteracao = 9 | f(x) = 0.034371  
Thread = 2 | Iteracao = 11 | f(x) = 0.001039  
Thread = 2 | Iteracao = 7 | f(x) = 0.000002  
Thread = 2 | Iteracao = 8 | f(x) = 0.000000  
Thread = 2 | Iteracao = 12 | f(x) = 0.000000  
Thread = 2 | Iteracao = 11 | f(x) = 0.000000  
Thread = 2 | Iteracao = 10 | f(x) = 0.000000  
Time OpenMp = 0.000364 seconds
```

Tempo Gasto = 0.000364 segundos

#### Teste 04 - Versão Sequencial (8 threads):

```
wesley.ifma@cluster:~  
Thread = 3 | Iteracao = 1 | f(x) = 97656251957116928.000000  
Thread = 3 | Iteracao = 1 | f(x) = 24414062989279232.000000  
Thread = 3 | Iteracao = 2 | f(x) = 6103515210448896.000000  
Thread = 3 | Iteracao = 3 | f(x) = 1525879071047680.000000  
Thread = 3 | Iteracao = 1 | f(x) = 381469700653056.000000  
Thread = 3 | Iteracao = 3 | f(x) = 95367441940480.000000  
Thread = 3 | Iteracao = 4 | f(x) = 23841862582272.000000  
Thread = 3 | Iteracao = 2 | f(x) = 5960465645568.000000  
Thread = 3 | Iteracao = 5 | f(x) = 1490116411392.000000  
Thread = 3 | Iteracao = 4 | f(x) = 372529102848.000000  
Thread = 3 | Iteracao = 1 | f(x) = 93132275712.000000  
Thread = 3 | Iteracao = 6 | f(x) = 23283068928.000000  
Thread = 3 | Iteracao = 3 | f(x) = 5820767232.000000  
Thread = 3 | Iteracao = 5 | f(x) = 1455191808.000000  
Thread = 3 | Iteracao = 2 | f(x) = 363797952.000000  
Thread = 3 | Iteracao = 6 | f(x) = 90949488.000000  
Thread = 3 | Iteracao = 4 | f(x) = 22737372.000000  
Thread = 3 | Iteracao = 3 | f(x) = 5684342.500000  
Thread = 3 | Iteracao = 3 | f(x) = 1421085.750000  
Thread = 3 | Iteracao = 4 | f(x) = 355271.437500  
Thread = 3 | Iteracao = 5 | f(x) = 88817.773438  
Thread = 3 | Iteracao = 7 | f(x) = 22204.382812  
Thread = 3 | Iteracao = 2 | f(x) = 5551.033203  
Thread = 3 | Iteracao = 8 | f(x) = 1387.695923  
Thread = 3 | Iteracao = 1 | f(x) = 346.861481  
Thread = 3 | Iteracao = 9 | f(x) = 86.652908  
Thread = 3 | Iteracao = 6 | f(x) = 21.600910  
Thread = 3 | Iteracao = 1 | f(x) = 5.338444  
Thread = 3 | Iteracao = 2 | f(x) = 1.274906  
Thread = 3 | Iteracao = 4 | f(x) = 0.266474  
Thread = 3 | Iteracao = 7 | f(x) = 0.034371  
Thread = 3 | Iteracao = 3 | f(x) = 0.001039  
Thread = 3 | Iteracao = 2 | f(x) = 0.000002  
Thread = 3 | Iteracao = 10 | f(x) = 0.000000  
Thread = 3 | Iteracao = 4 | f(x) = 0.000000  
Thread = 3 | Iteracao = 8 | f(x) = 0.000000  
Thread = 3 | Iteracao = 7 | f(x) = 0.000000  
Thread = 3 | Iteracao = 5 | f(x) = 0.000000  
Thread = 3 | Iteracao = 3 | f(x) = 0.000000  
Thread = 3 | Iteracao = 5 | f(x) = 0.000000  
Thread = 3 | Iteracao = 3 | f(x) = 0.000000  
Time OpenMp = 0.000508 seconds
```

Tempo Gasto = 0.000508 segundos

Para 1 Threads -> **0.000226 segundos**  
 Para 2 Threads -> **0.000262 segundos**  
 Para 4 Threads -> **0.000364 segundos**  
 Para 8 Threads -> **0.000508 segundos**

$$\text{Speedup} = \frac{T(1)}{TP}$$

$T(1)$  é o tempo de execução com um processador  
 $T(p)$  é o tempo de execução com  $p$  processadores

	1 CPU	2 CPUs	4 CPUs	8 CPUs
$T(p)$	<b>0.000226</b>	<b>0.000262</b>	<b>0.000364</b>	<b>0.000508</b>
$S(p)$		0.86	0.62	0.44

Cálculo da Eficiência:

$$E(p) = \frac{S(p)}{p} = \frac{T(1)}{p \times T(p)}$$

$S(p)$  é o speedup para  $p$  processadores

	2 CPUs	4 CPUs	8 CPUs
$S(p)$	0.86	0.62	0.44
$E(p)$	<b>0.43</b>	<b>0.15</b>	<b>0.05</b>

Verifica-se, portanto, que a utilização de OpenMP nesse algoritmo não teve um aumento de desempenho, mas sim uma queda de desempenho. Isso ocorre porque o método de Newton-Raphson já é bem rápido na versão sequencial.