Computação Evolucionária

Arcabouço do AG e Comparação ao Random Walk

Alexandre Farias

Agenda

- Introdução
- Objetivo
- Diagramas UML
- Algoritmo Genético Vs Caminhada Aleatória (Random Walk)
- Conclusão
- Agradecimento

Introdução

- Este trabalho tem a função de desenvolver um arcabouço para o Algoritmo Genético (AG).
- Um algoritmo de Caminhada Aleatória também é desenvolvido para fins de comparação com o desempenho do AG.

Objetivo

- A implementação tem como objetivo fazer com que tanto o AG como o Random Walk sejam capazes de acertar uma palavra-alvo de acordo seus *n* primeiros caracteres (10, 20 e 30), para populações de 50 a 100 cromossomos, ao longo de 5 execuções.
- Gráficos e tabelas são utilizados para a ilustrar os resultados obtidos.

Palavra-Alvo (Com os 30 Caracteres)
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647 , 101.71, 106.75, 110.37, 72.082, 104.38, 102.41, 63.009, 59.52, 89.869, 126.78, 77.231, 96.821, 67.905, 110.1

Diagrama UML - AG

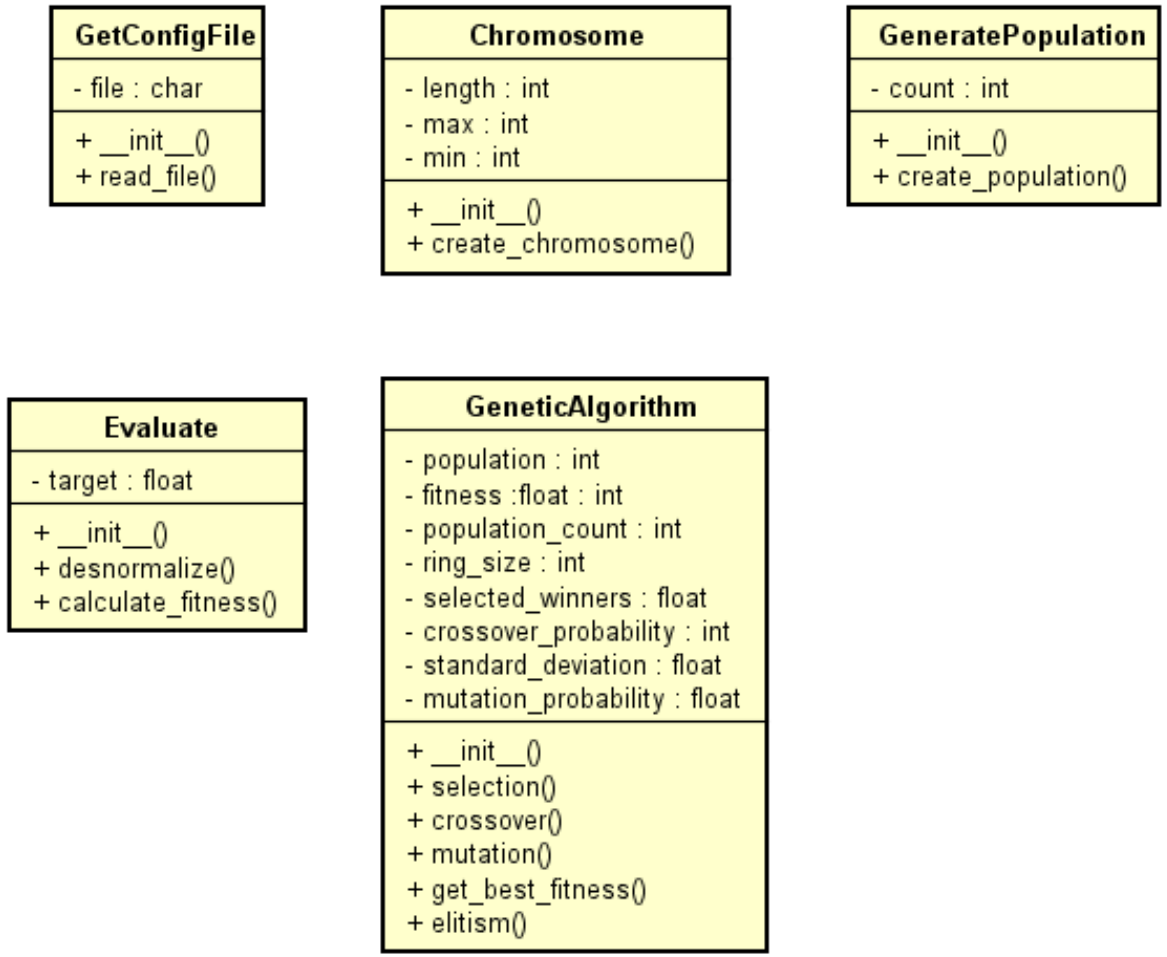
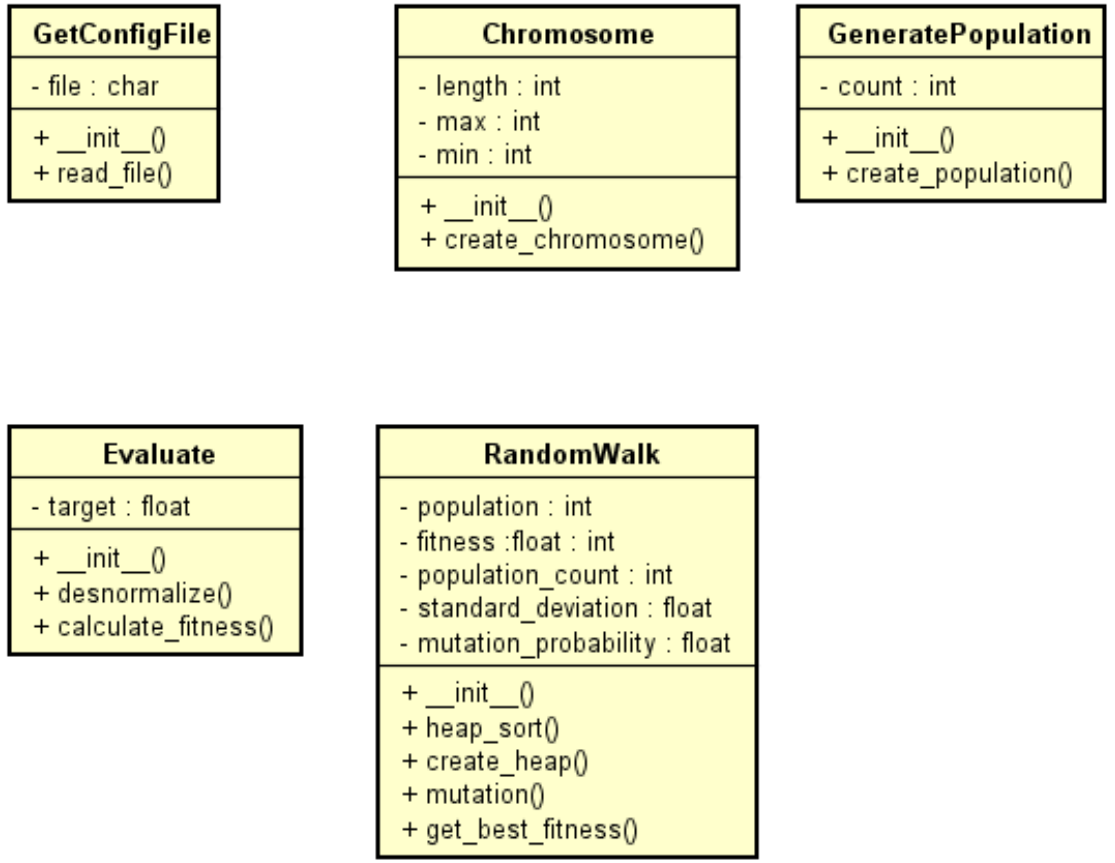


Diagrama UML – Random Walk



Algoritmo Genético Vs Random Walk

- Quanto a demonstração dos resultados em gráficos:

- Colocar no mesmo gráfico a evolução do RW e AG (Calcular a média e o desvio padrão por geração das R execuções do fitness do melhor indivíduo)
- Avaliar o desvio padrão das soluções finais encontras nas R execuções (precisão)
- Fazer um gráfico de barra com a média e desvio padrão de número de acertos de valores da palavra alvo
- Avaliar a média e desvio padrão do desvio da palavra encontrada da alvo (acurácia)

Algoritmo Genético Vs Random Walk

Parâmetro	10/50	20/50	30/50	10/100	20/100	30/100
Tamanho do Ring	5	5	5	5	5	5
Probabilidade de Cruzamento	0.7	0.7	0.7	0.7	0.7	0.7
Probabilidade de Mutação	0.03	0.03	0.03	0.03	0.03	0.03
Desvio-Padrão	0.01	0.01	0.01	0.01	0.01	0.01
Número de Gerações	3000	4000	6000	3000	4000	6000

Seleção: Torneio
Cruzamento: Aritmético
Mutação: Gaussiana
Troca de População: Geracional
Elitismo: Sim

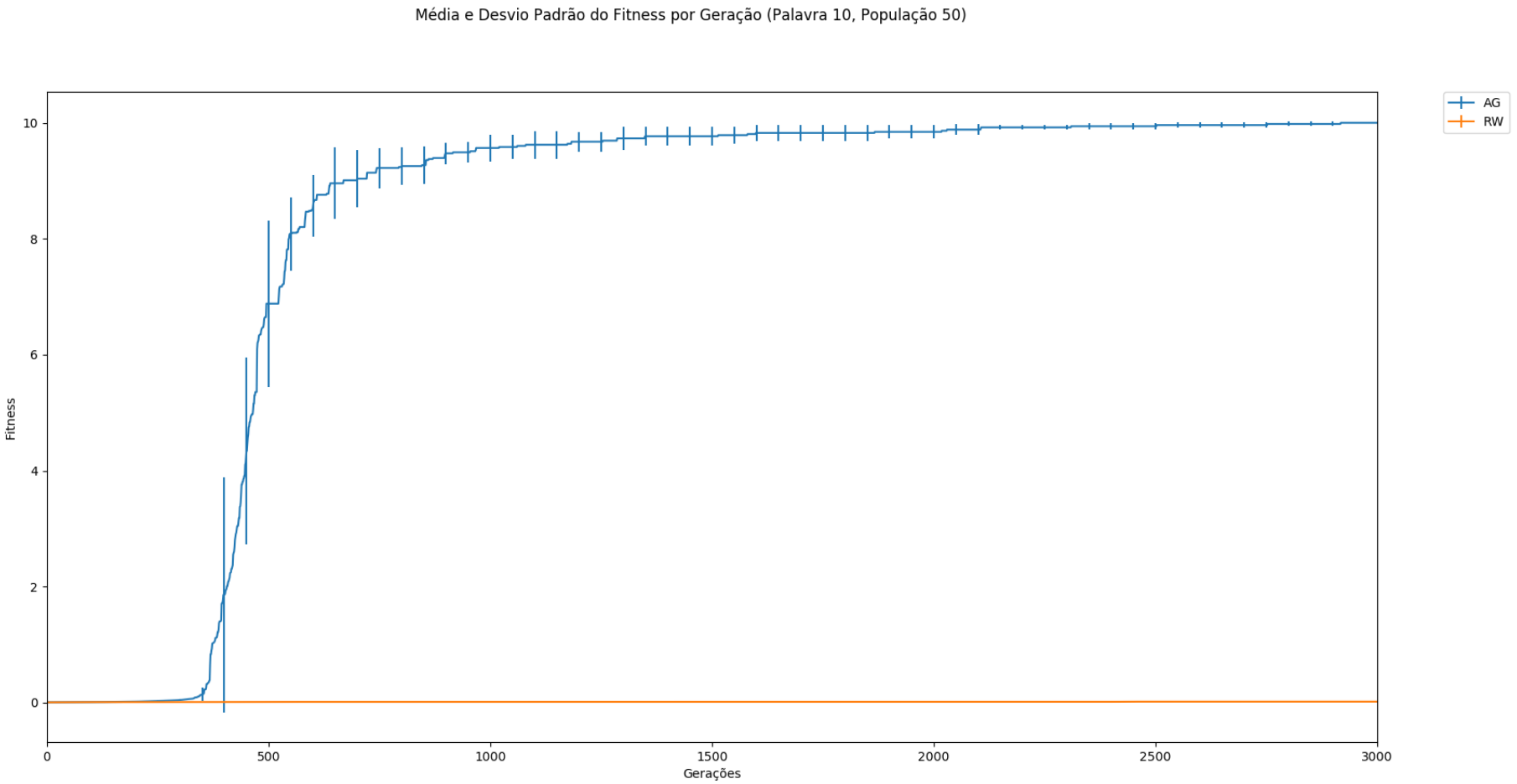
Algoritmo Genético Vs Random Walk

Soluções Encontradas para 10 caracteres da Palavra Alvo (AG, População 50)
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1

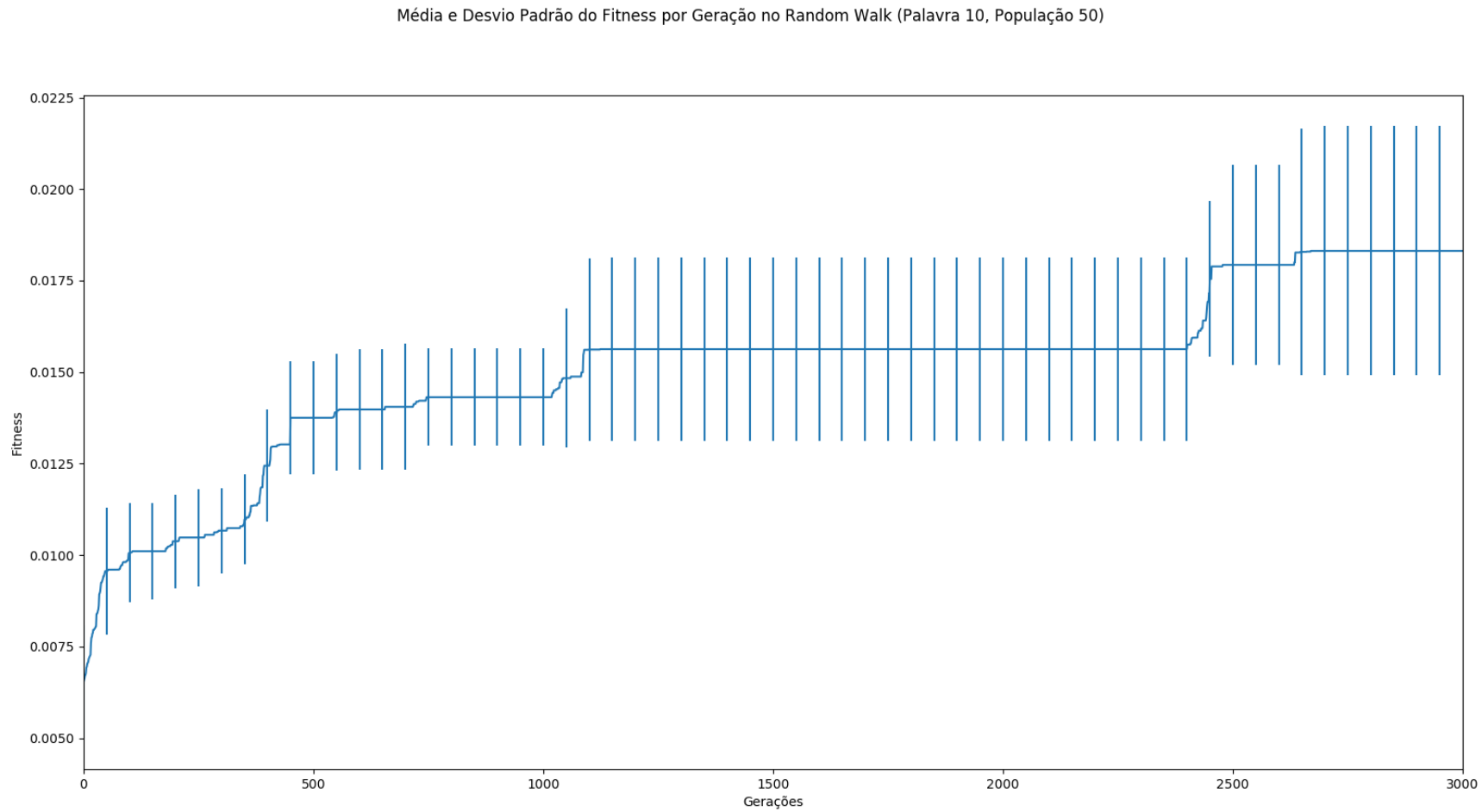
Algoritmo Genético Vs Random Walk

Soluções Encontradas para 10 caracteres da Palavra Alvo (Random Walk, População 50)
52.732, 82.238, 52.591, 66.476, 106.637, 105.501, 75.594, 105.05, 52.558, 87.07
57.301, 61.854, 51.889, 57.654, 117.893, 102.462, 79.39, 115.049, 52.776, 88.776
52.486, 69.391, 55.91, 54.542, 97.037, 107.31, 82.451, 109.434, 61.402, 86.172
52.778, 52.274, 60.324, 59.07, 112.418, 97.007, 78.354, 117.761, 52.395, 89.974
58.738, 52.182, 52.322, 52.281, 110.554, 109.5, 76.448, 113.858, 61.638, 89.571

Algoritmo Genético Vs Random Walk



Algoritmo Genético Vs Random Walk



Algoritmo Genético Vs Random Walk

- Observa-se um desvio-padrão próximo de zero logo no inicio do AG, porém este valor não é zero, mas sim próximo de zero, sendo assim acaba não aparecendo no gráfico, como mostra a tabela.

	0	1	2	3	4
0	0.005	0.006	0.006	0.006	0.006
1	0.007	0.007	0.007	0.007	0.007
2	0.007	0.007	0.007	0.007	0.007
3	0.007	0.008	0.008	0.008	0.008
4	0.005	0.006	0.006	0.006	0.006

Desvio-Padrão das 5 primeiras geração com Palavra 10 e População 50
8.735201856926767556e-04
8.42573666048506819 0e-04
8.08238678156668159 7e-04
8.06690734465118596 0e-04
7.93285244275741580 2e-04

- Esse comportamento se repete para os outros casos do AG.

Algoritmo Genético Vs Random Walk

Soluções Encontradas para 20 caracteres da Palavra-Alvo (AG, População 50)
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647, 101.71, 106.75, 110.37, 72.082
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647, 101.71, 106.75, 110.37, 72.082
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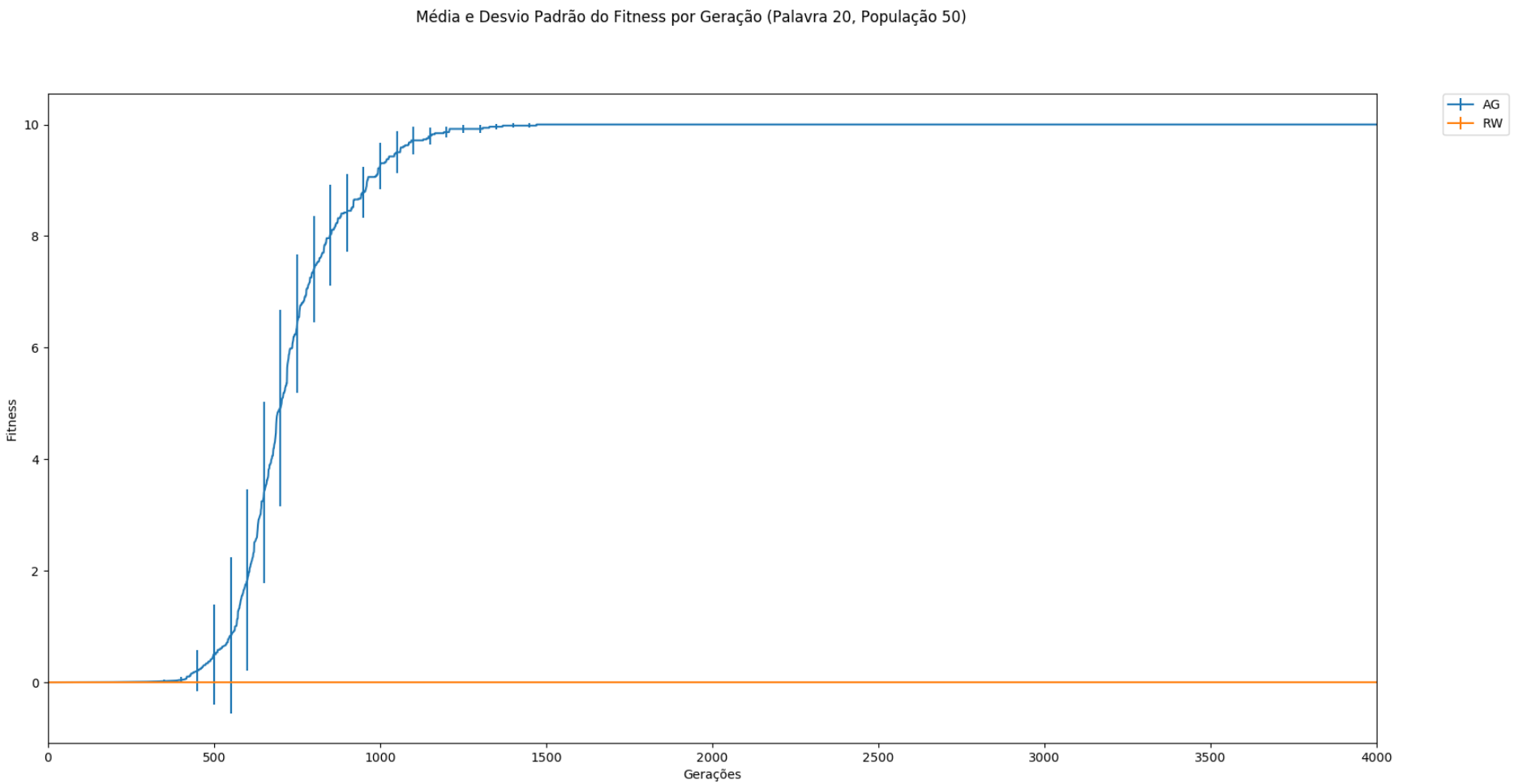
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647, 101.71, 106.75, 110.37, 72.082

Algoritmo Genético Vs Random Walk

Soluções Encontradas para 20 caracteres da Palavra-Alvo (Random Walk, População 50)
52.046, 76.91, 52.546, 58.572, 107.802, 102.557, 82.675, 115.783, 56.561, 82.476, 96.082, 122.356, 81.572, 82.836, 104.6, 72.081, 123.255, 124.258, 104.132, 68.263
78.128, 65.933, 53.529, 61.787, 116.977, 102.489, 63.134, 122.552, 57.448, 65.138, 58.092, 114.942, 117.57, 77.719, 102.918, 96.722, 108.535, 105.372, 101.415, 68.574
67.116, 70.266, 63.55, 62.643, 115.689, 77.168, 86.848, 101.192, 70.47, 86.127, 71.462, 107.138, 106.171, 76.984, 74.029, 100.186, 104.49, 103.712, 107.896, 74.955
72.546, 56.898, 75.223, 90.719, 112.351, 105.638, 71.309, 123.529, 61.138, 97.984, 88.765, 124.439, 107.294, 64.923, 100.926, 82.166, 80.944, 95.038, 120.294, 68.466
67.815, 73.984, 50.413, 51.085, 120.244, 103.68, 70.052, 97.825, 53.857, 82.368, 69.25, 104.047, 101.44, 68.077, 79.573, 115.715, 108.679, 107.133, 115.585, 80.434

Algoritmo Genético Vs Random Walk



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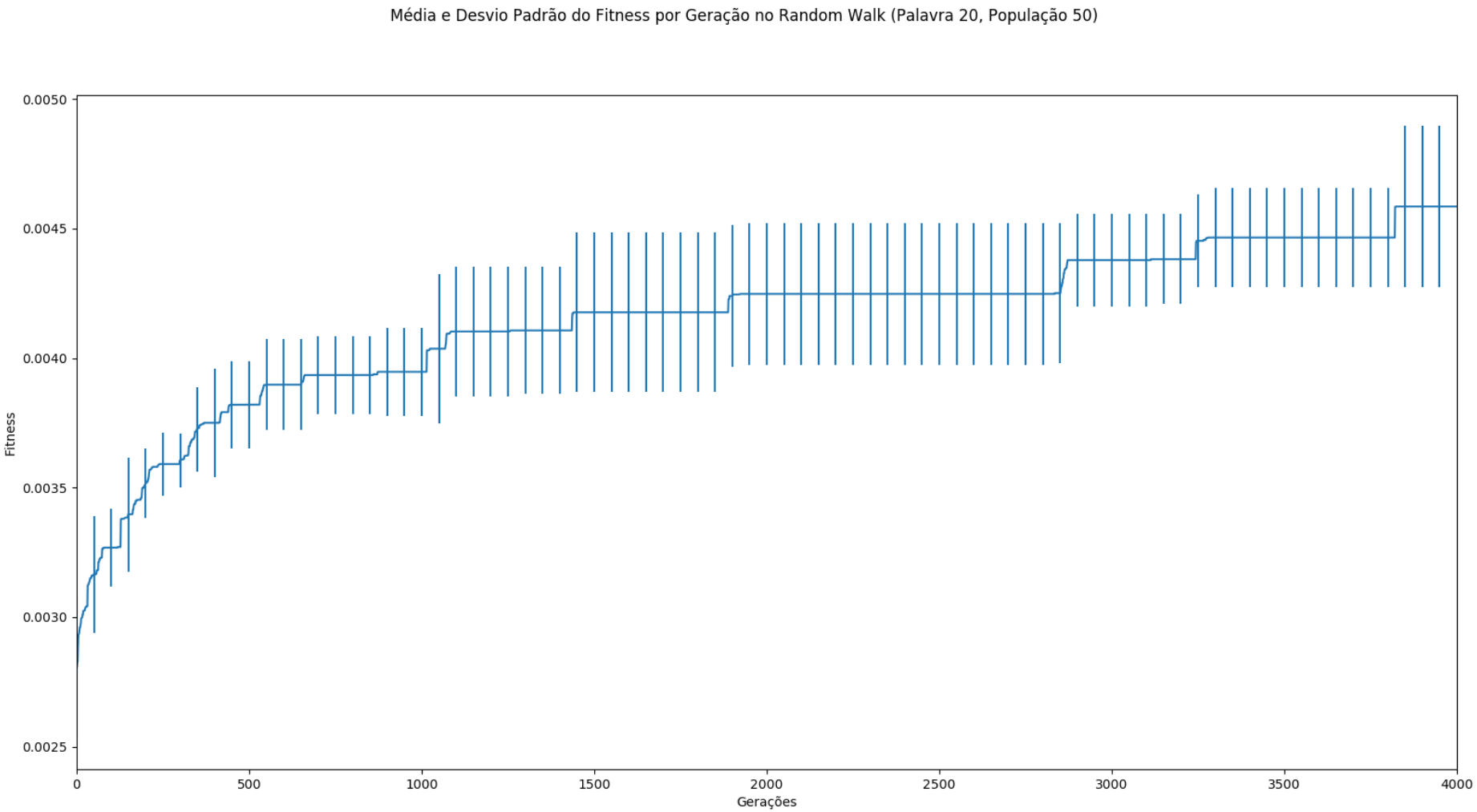

Algoritmo Genético Vs Random Walk

Soluções Encontradas para 30 caracteres da Palavra-Alvo (AG, População 50)
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647, 101.71, 106.75, 110.37, 72.082, 104.38, 102.41, 63.009, 59.52, 89.869, 126.78, 77.231, 96.821, 67.905, 110.1
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647, 101.71, 106.75, 110.37, 72.082, 104.38, 102.41, 63.009, 59.52, 89.869, 126.78, 77.231, 96.821, 67.905, 110.1
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52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647, 101.71, 106.75, 110.37, 72.082, 104.38, 102.41, 63.009, 59.52, 89.869, 126.78, 77.231, 96.821, 67.905, 110.1
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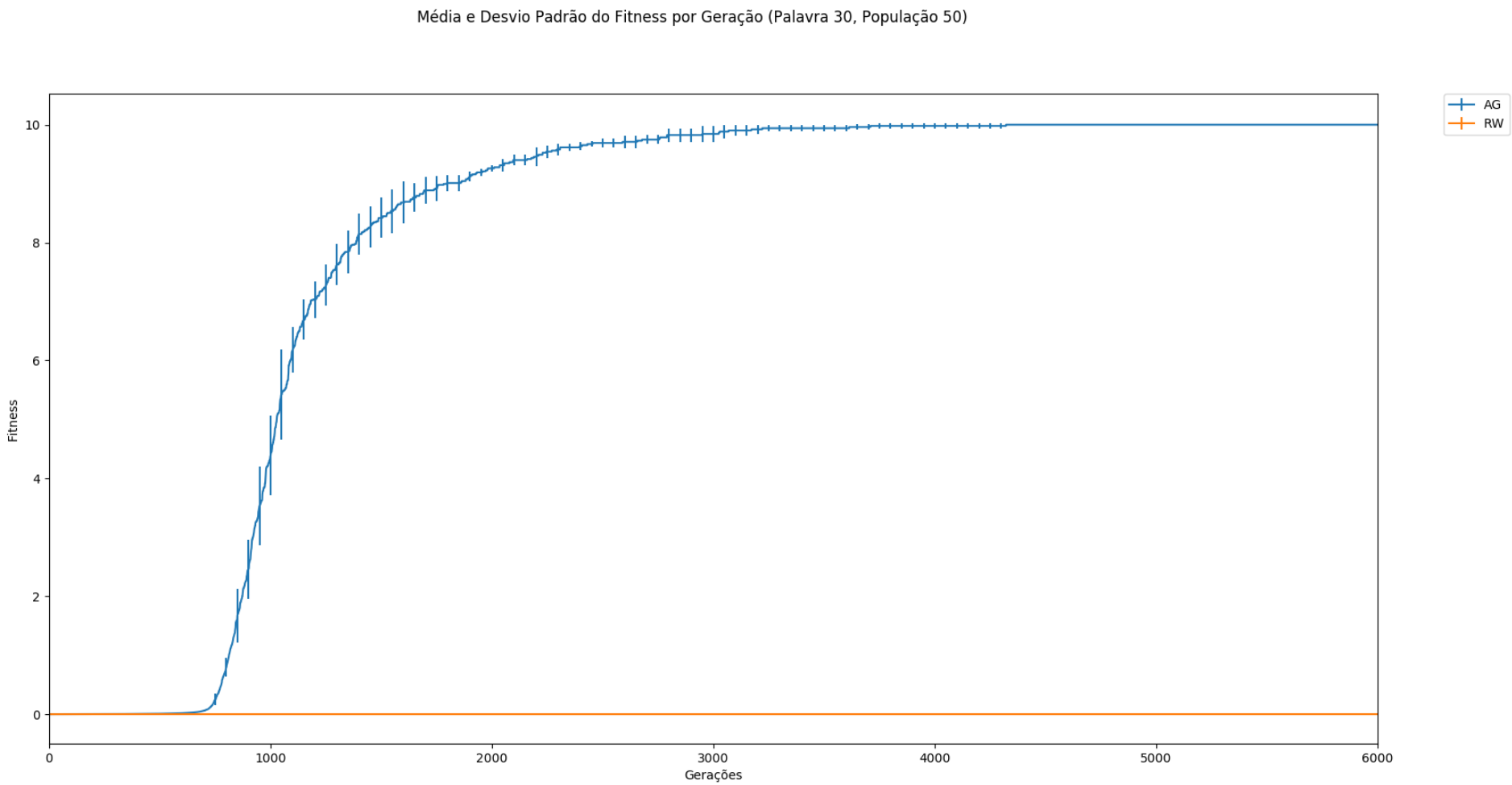
Algoritmo Genético Vs Random Walk

Soluções Encontradas para 30 caracteres da Palavra-Alvo (Random Walk, População 50)
106.634, 63.878, 54.576, 62.442, 81.316, 105.466, 77.386, 95.453, 57.571, 88.146, 79.65, 117.936, 94.497, 64.972, 105.177, 65.55, 76.649, 99.733, 124.101, 74.866, 106.546, 83.006, 66.95, 57.065, 93.524, 120.854, 83.372, 78.896, 58.095, 74.496
57.357, 80.252, 59.239, 57.118, 77.752, 95.085, 53.859, 116.312, 88.829, 62.946, 84.214, 93.296, 75.999, 68.996, 70.222, 71.735, 93.969, 106.934, 122.18, 78.663, 115.984, 63.973, 72.394, 67.67, 74.813, 112.916, 83.602, 106.978, 94.12, 108.463
57.158, 72.32, 97.516, 55.823, 59.485, 122.269, 67.273, 97.19, 106.106, 84.882, 80.358, 103.732, 125.702, 68.313, 105.005, 82.672, 111.896, 109.501, 96.081, 126.351, 104.29, 114.379, 65.746, 56.133, 88.375, 121.211, 107.387, 92.294, 81.8, 109.884
51.959, 70.19, 70.624, 83.522, 61.779, 108.659, 87.156, 121.424, 90.41, 91.734, 63.514, 90.882, 100.458, 66.006, 93.542, 104.866, 118.85, 101.281, 106.622, 65.657, 97.692, 121.827, 51.826, 73.17, 91.129, 71.66, 81.226, 70.979, 65.827, 112.021
59.977, 53.541, 71.266, 67.213, 80.03, 93.373, 85.794, 112.594, 60.689, 72.091, 95.05, 107.652, 124.238, 65.406, 73.993, 90.968, 79.877, 114.053, 99.002, 50.866, 108.439, 116.294, 115.043, 72.994, 87.748, 114.328, 74.958, 74.314, 79.304, 108.899

Algoritmo Genético Vs Random Walk



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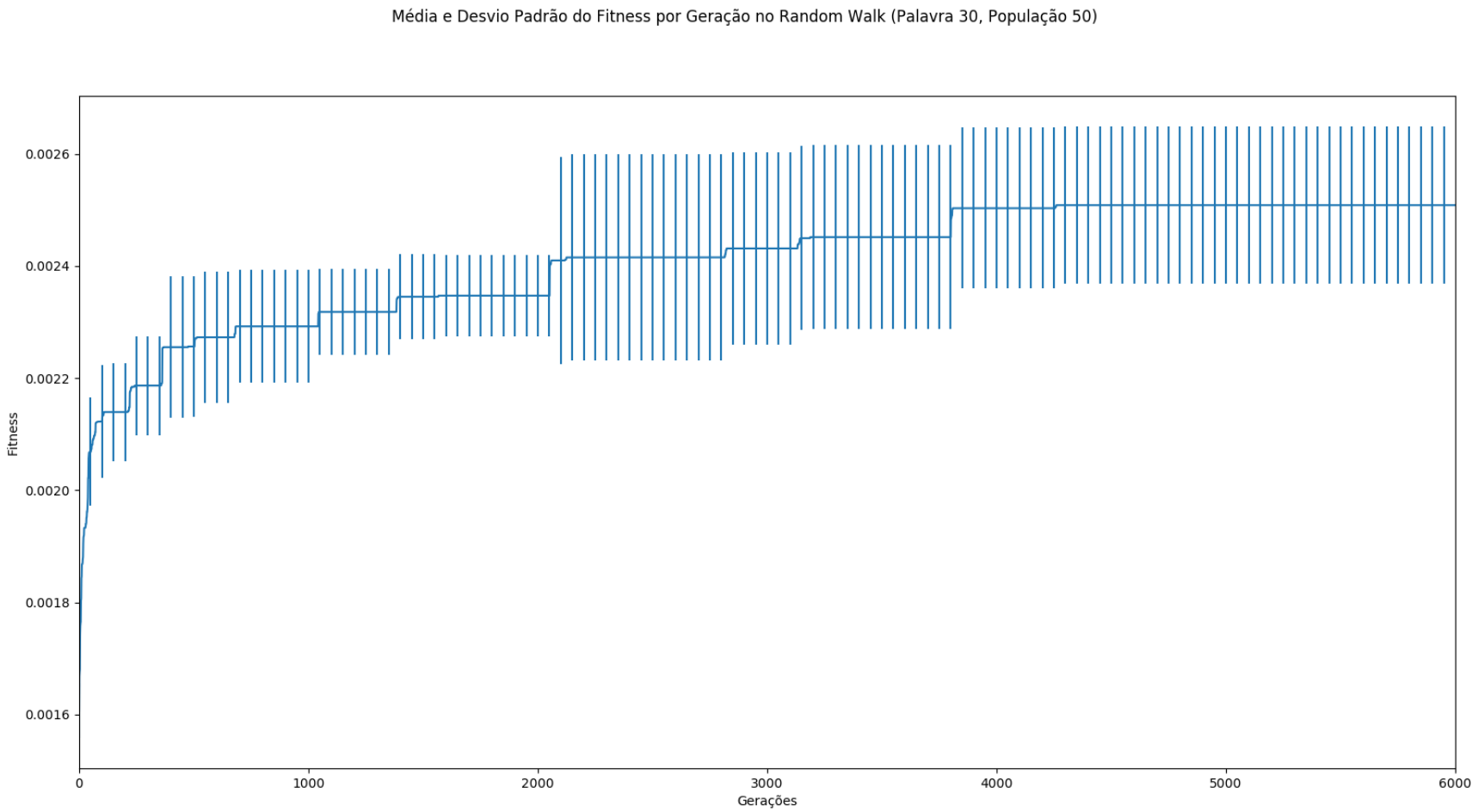
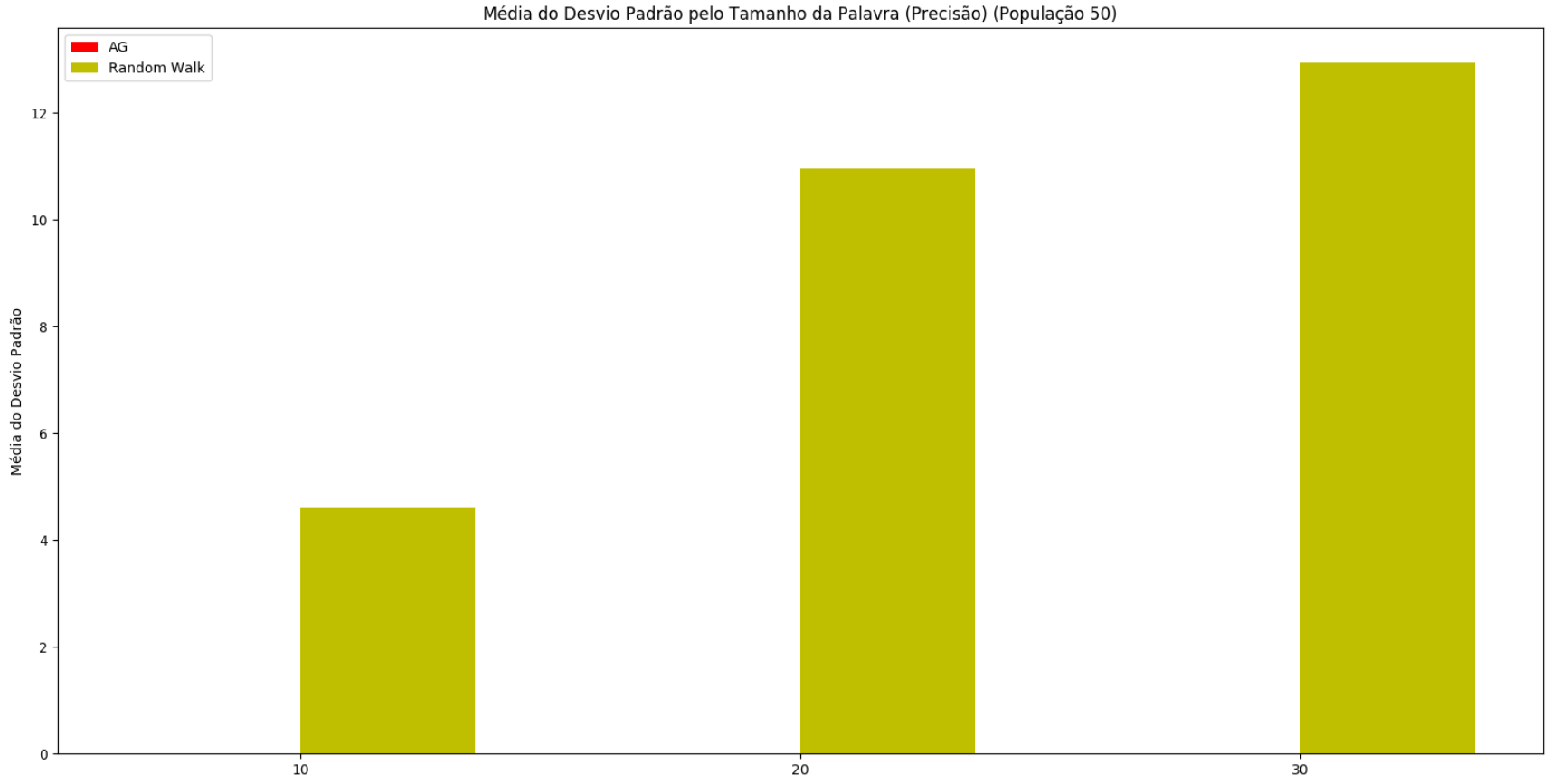


Algoritmo Genético Vs Random Walk



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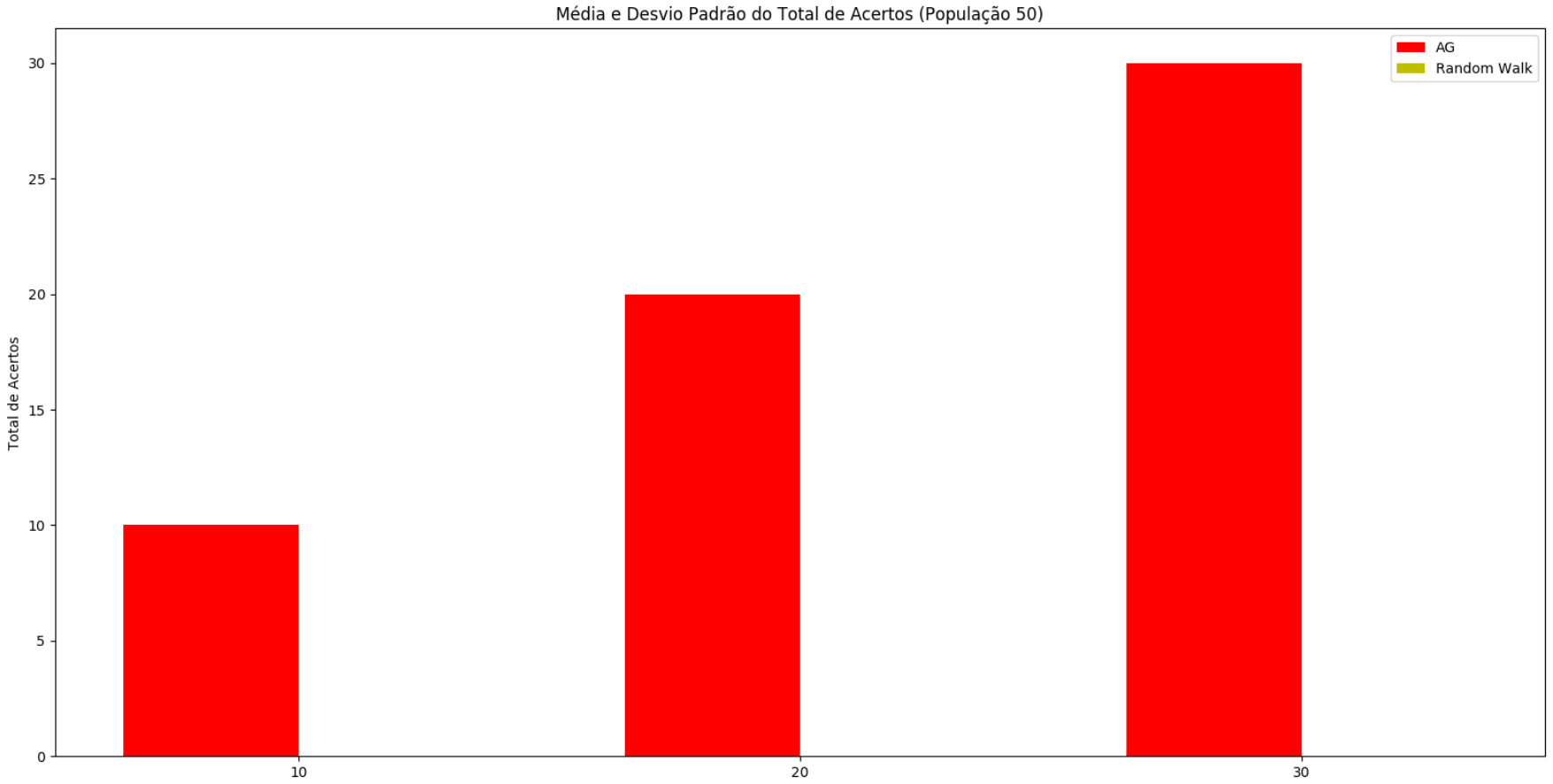

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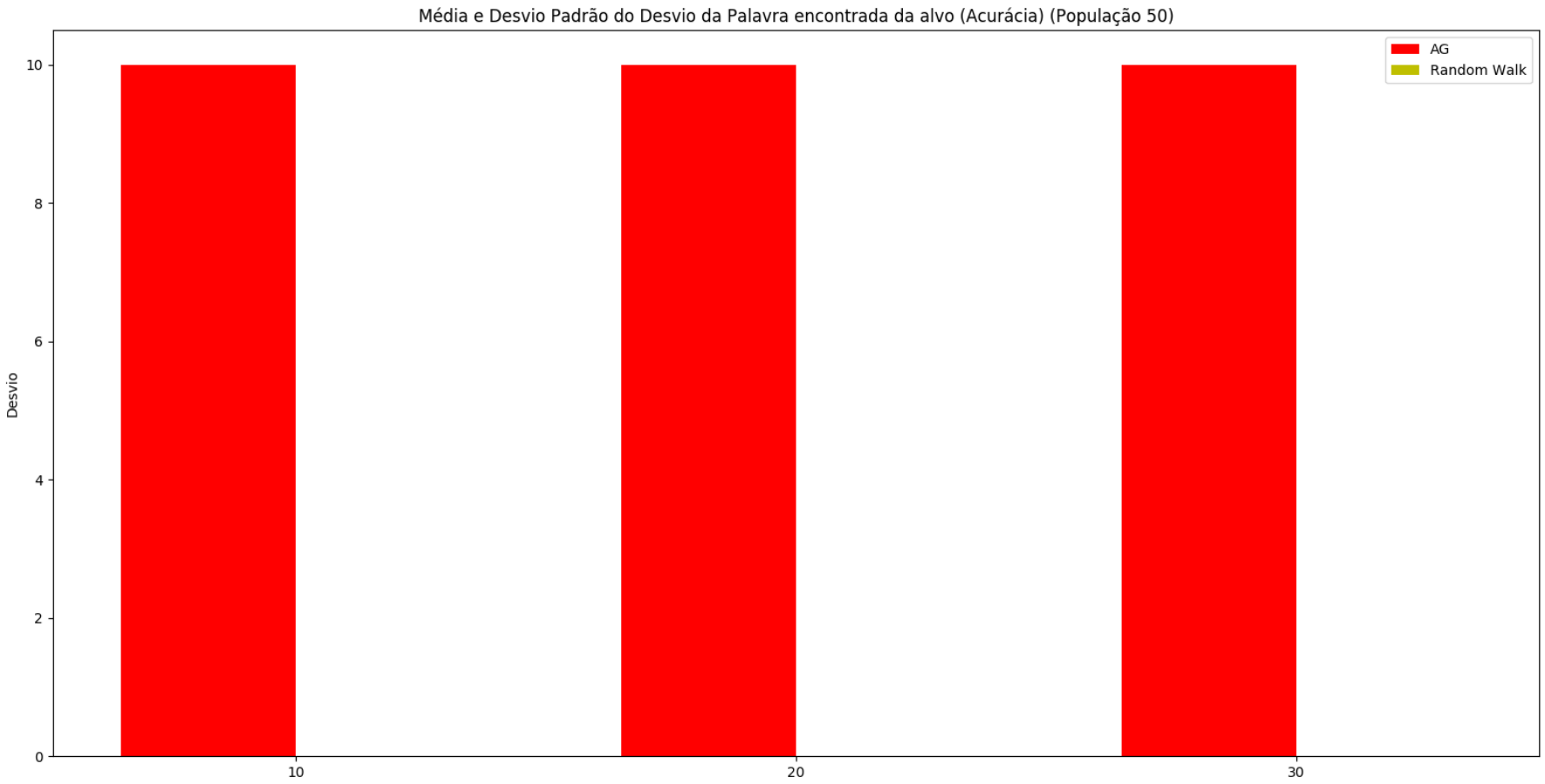


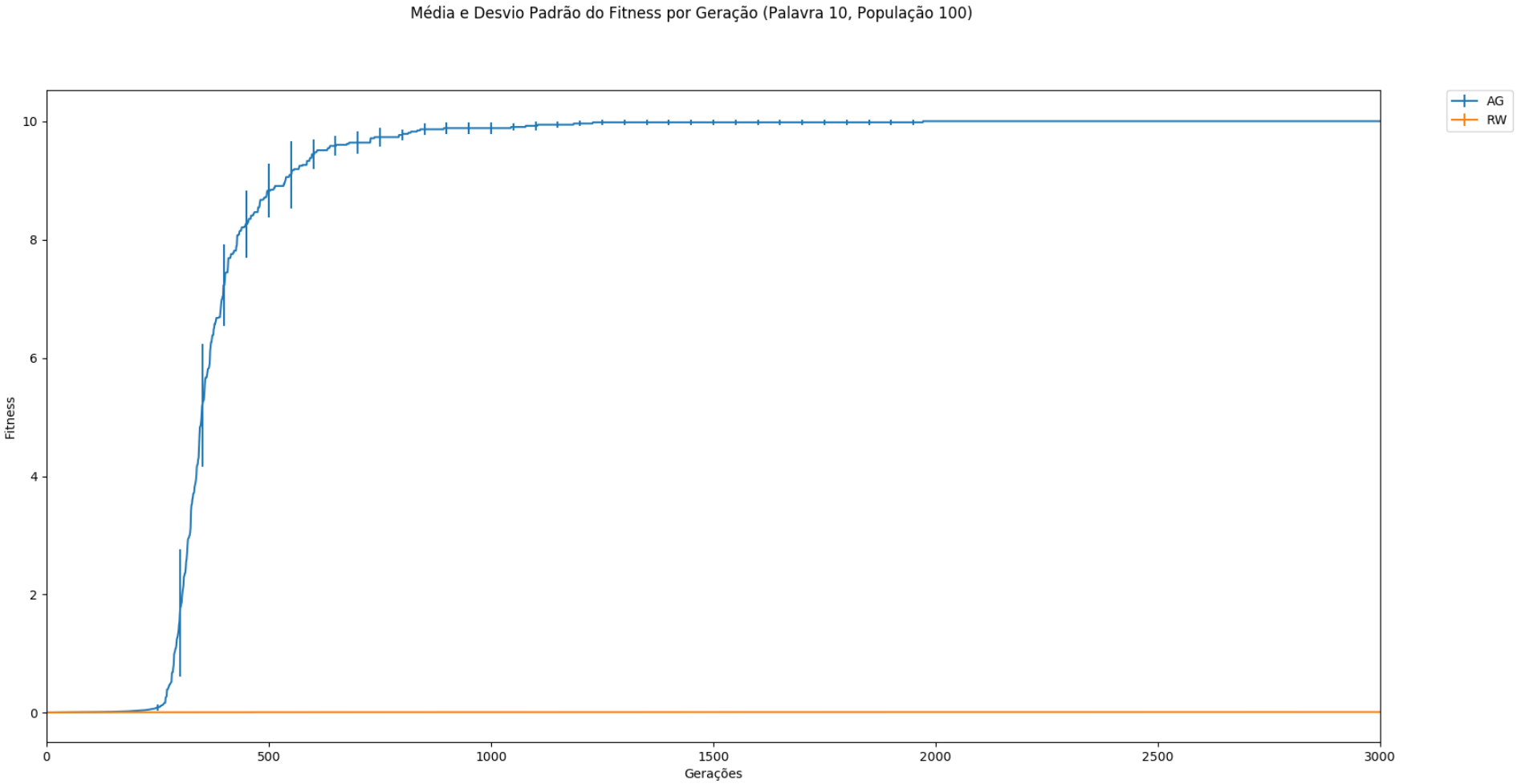
Algoritmo Genético Vs Random Walk

Soluções Encontradas para 10 caracteres da Palavra-Alvo (AG, População 100)
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1

Algoritmo Genético Vs Random Walk

Soluções Encontradas para 10 caracteres da Palavra-Alvo (Random Walk, População 100)
53.338, 75.327, 56.934, 57.54, 117.423, 105.382, 71.132, 93.331, 74.82, 84.526
52.912, 75.692, 69.053, 53.842, 98.087, 96.809, 83.986, 118.304, 51.746, 86.122
56.303, 72.131, 55.578, 52.494, 118.347, 108.81, 53.755, 119.686, 52.315, 98.874
50.937, 62.859, 53.093, 58.882, 113.311, 107.515, 75.952, 114.414, 68.207, 110.226
72.029, 81.588, 54.653, 53.272, 118.699, 102.322, 74.358, 108.43, 57.013, 74.891

Algoritmo Genético Vs Random Walk



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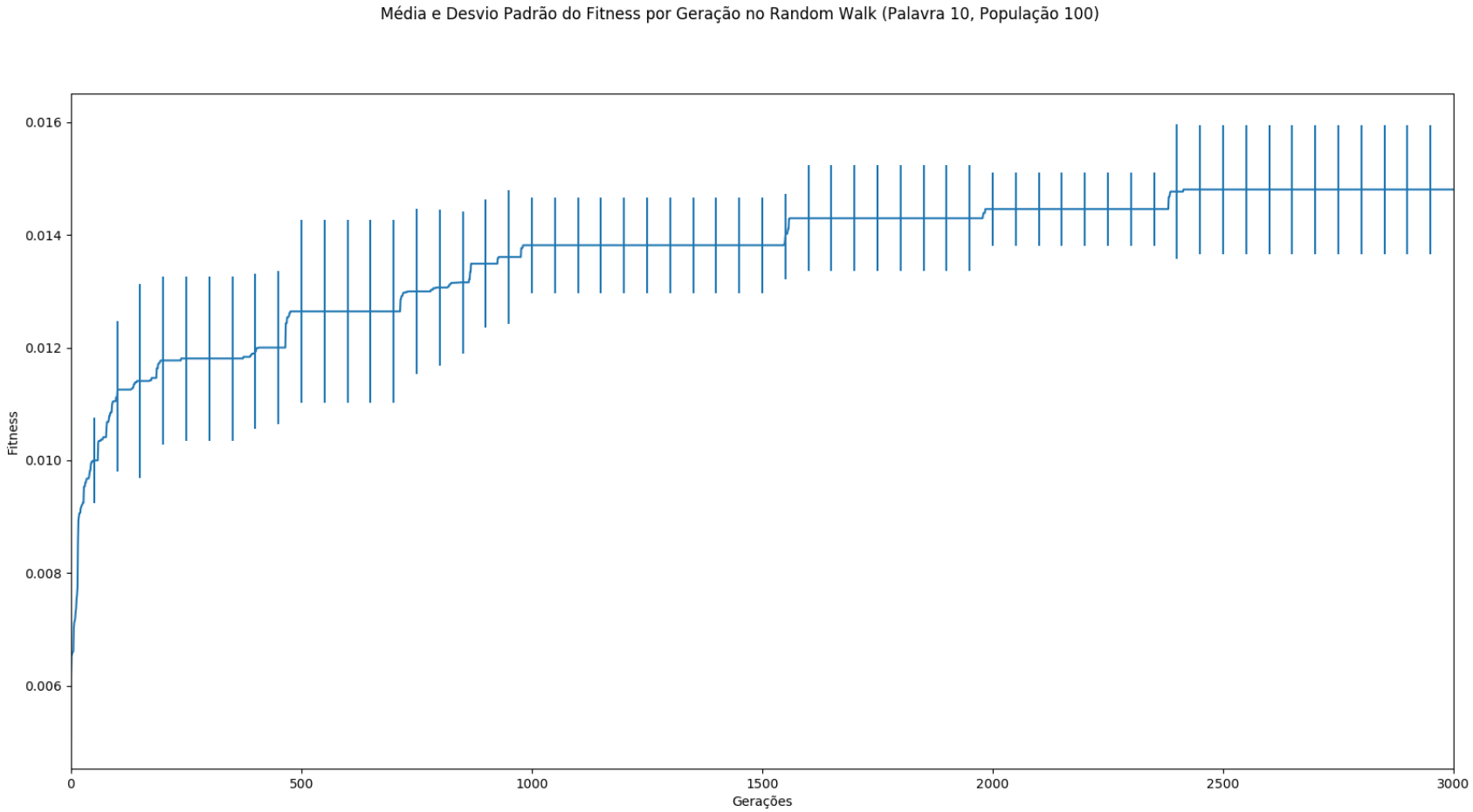

Algoritmo Genético Vs Random Walk

Soluções Encontradas para 20 caracteres da Palavra-Alvo (AG, População 100)
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647, 101.71, 106.75, 110.37, 72.082
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647, 101.71, 106.75, 110.37, 72.082
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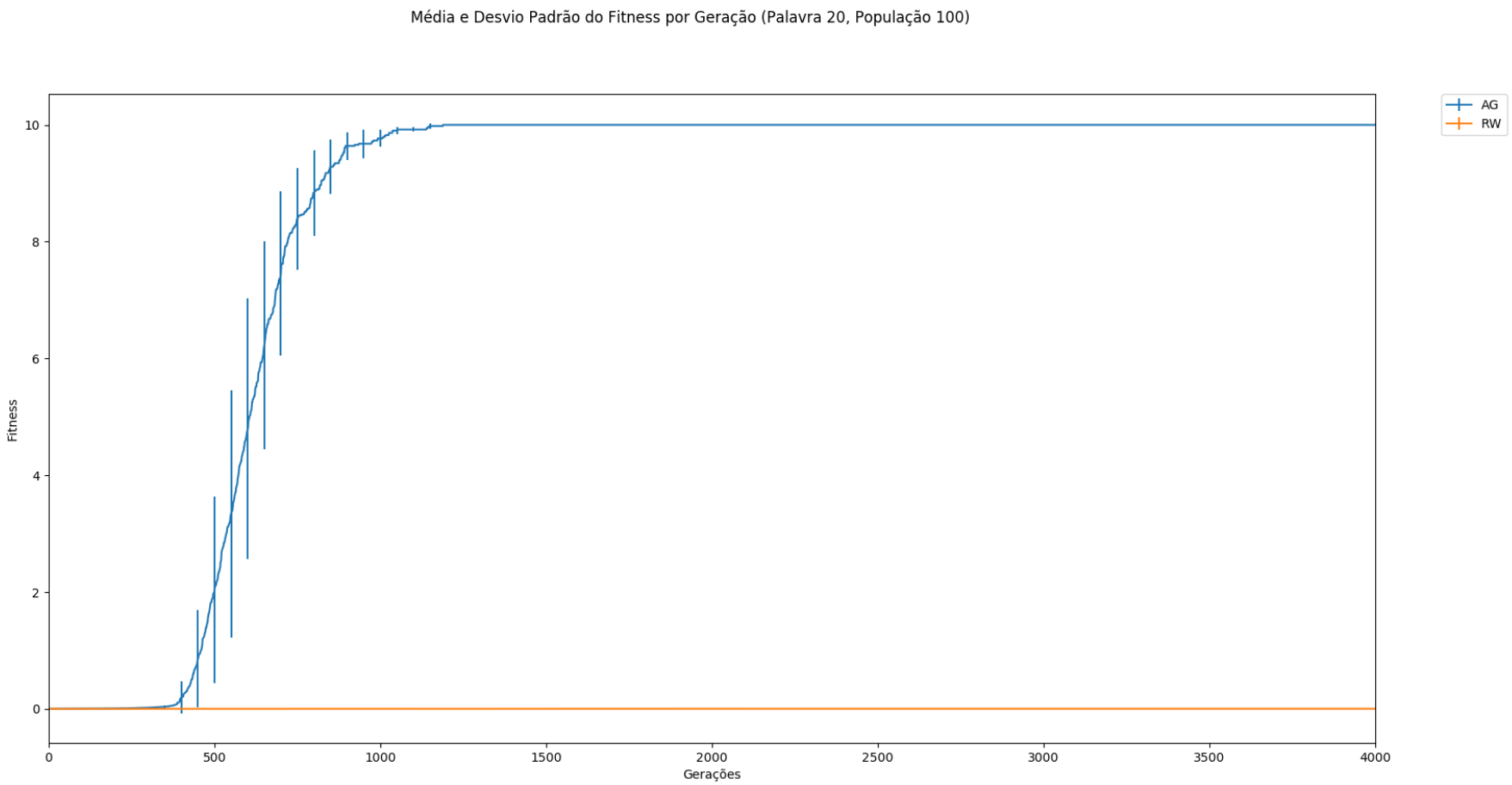
Algoritmo Genético Vs Random Walk

Soluções Encontradas para 20 caracteres da Palavra-Alvo (Random Walk, População 100)
56.664, 54.189, 70.707, 58.27, 90.83, 127.394, 71.664, 129.095, 54.444, 75.413, 57.343, 93.348, 110.926, 93.261, 84.589, 96.684, 106.283, 115.165, 109.602, 71.671
53.099, 59.356, 52.593, 57.827, 120.474, 122.314, 72.607, 116.925, 52.785, 113.321, 95.323, 81.762, 113.23, 61.019, 94.27, 87.411, 120.362, 91.557, 105.126, 64.778
79.891, 66.929, 52.57, 52.851, 109.838, 53.282, 85.39, 107.613, 52.826, 97.639, 83.533, 111.13, 112.574, 52.967, 115.477, 87.951, 107.198, 120.938, 95.245, 76.705
51.445, 59.026, 71.682, 71.593, 115.848, 115.255, 77.071, 116.802, 88.448, 63.765, 95.597, 115.338, 111.858, 51.839,102.722, 51.455, 106.538, 106.798, 105.8, 66.738
75.948, 71.405, 93.179, 59.212, 123.194, 102.255, 54.772, 116.417, 73.303, 87.913, 78.677, 127.019, 104.19, 60.899, 115.84, 85.18, 97.546, 111.782, 98.002, 73.632

Algoritmo Genético Vs Random Walk



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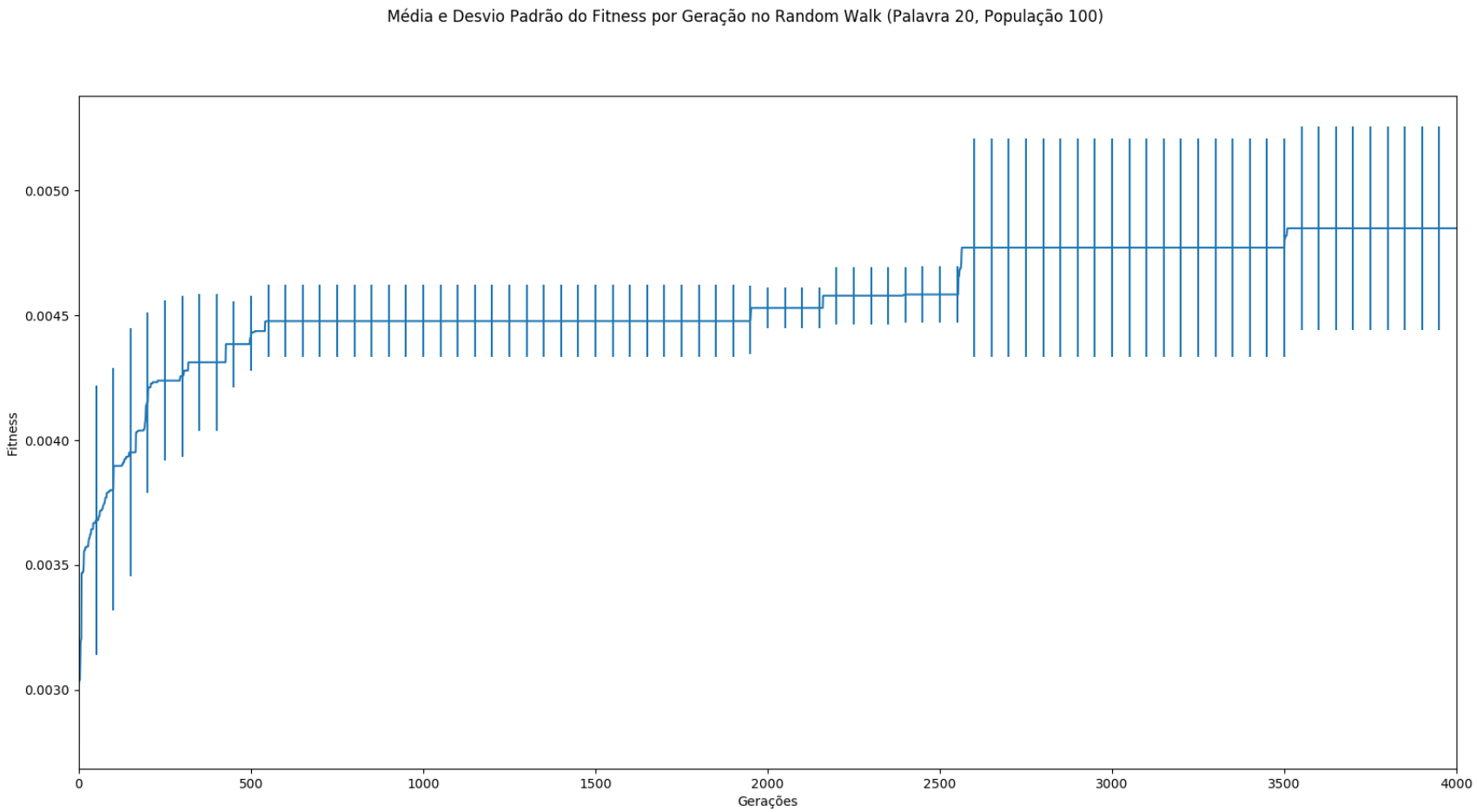

Algoritmo Genético Vs Random Walk

Soluções Encontradas para 30 caracteres da Palavra-Alvo (AG, População 100)
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647, 101.71, 106.75, 110.37, 72.082, 104.38, 102.41, 63.009, 59.52, 89.869, 126.78, 77.231, 96.821, 67.905, 110.1
52.547, 72.15, 53.694, 57.771, 115.88, 105.59, 75.368, 126.02, 52.756, 85.1, 80.525, 111.24, 113.62, 64.95, 89.181, 85.647, 101.71, 106.75, 110.37, 72.082, 104.38, 102.41, 63.009, 59.52, 89.869, 126.78, 77.231, 96.821, 67.905, 110.1
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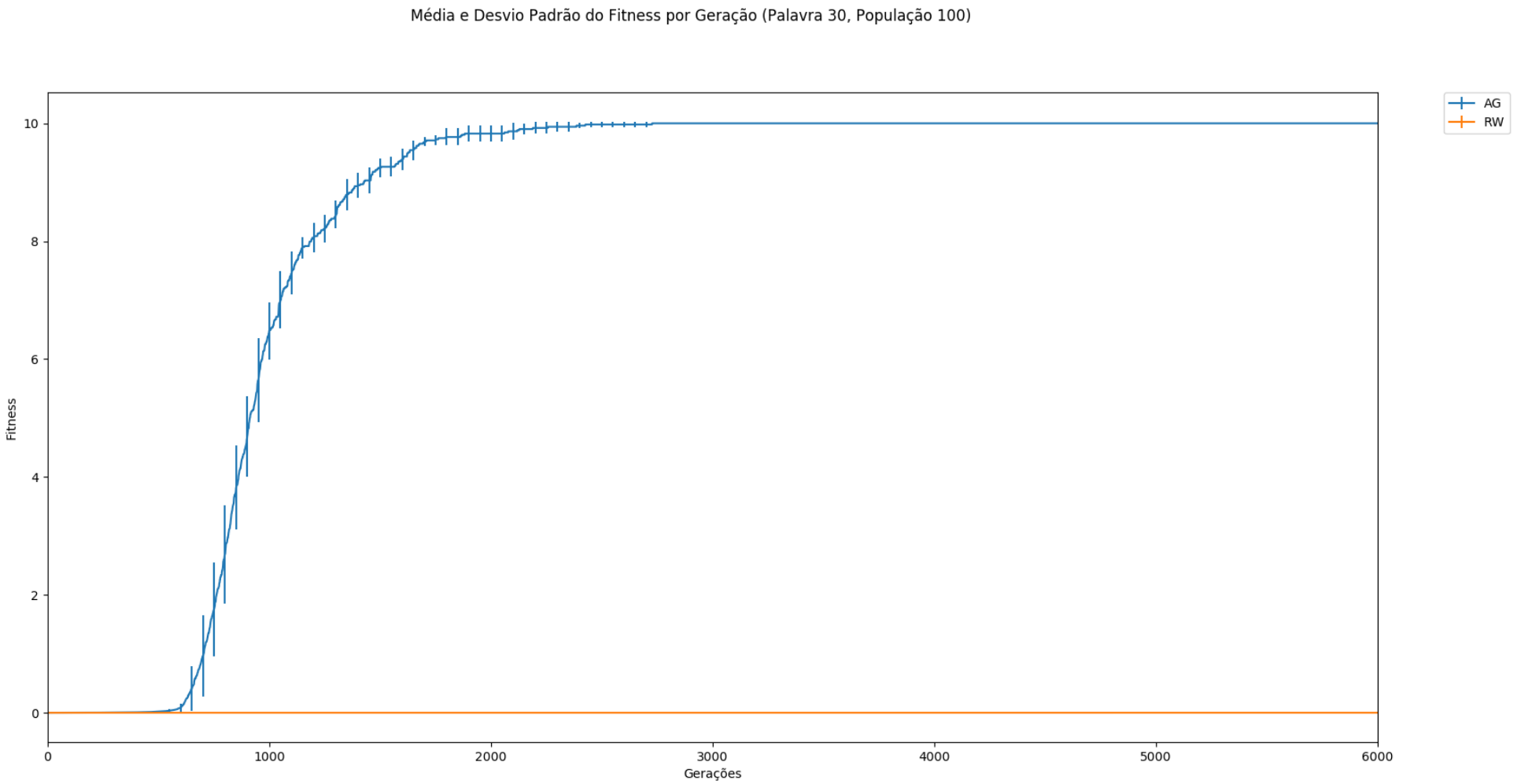
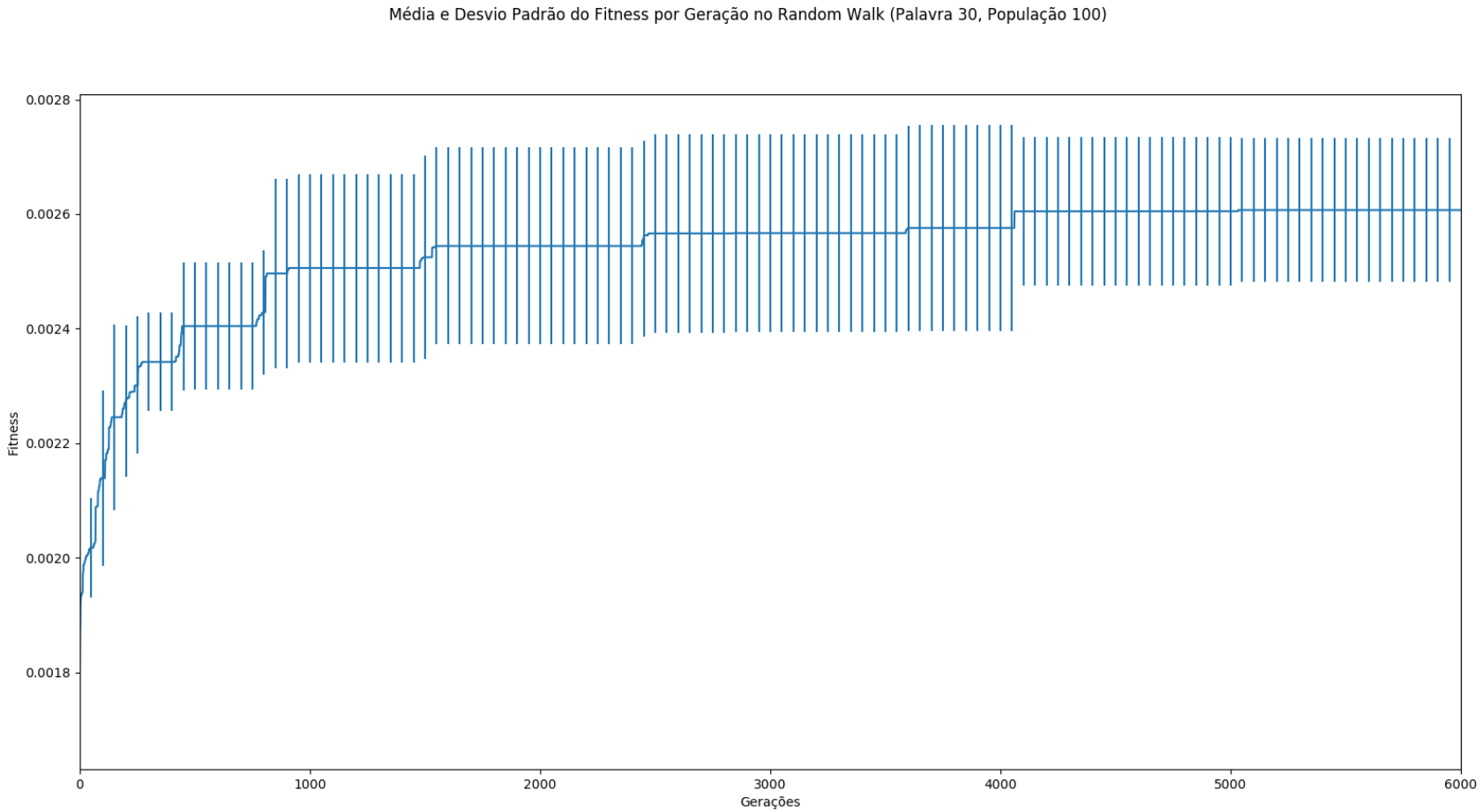
Algoritmo Genético Vs Random Walk

Soluções Encontradas para 30 caracteres da Palavra-Alvo (Random Walk, População 100)
57.708, 90.096, 92.017, 62.804, 98.15, 118.046, 67.356, 120.123, 56.688, 50.959, 74.289, 103.658, 118.573, 66.177, 100.815, 50.996, 100.764, 107.374, 112.106, 56.781, 98.81, 97.378, 64.704, 52.844, 90.847, 85.176, 97.467, 60.939, 105.083, 103.555
68.126, 53.475, 56.305, 85.574, 126.972, 76.354, 81.894, 122.897, 51.566, 113.227, 101.274, 95.812, 121.234, 79.294, 71.18, 82.855, 72.378, 99.857, 115.566, 70.216, 107.354, 110.774, 79.127, 55.093, 82.633, 127.874, 69.638, 121.618, 61.298, 91.459
52.027, 82.047, 86.514, 77.587, 102.549, 103.601, 97.273, 114.595, 52.115, 98.382, 51.945, 119.609, 92.19, 87.627, 101.094, 96.007, 99.361, 99.25, 109.594, 63.366, 82.184, 112.283, 95.038, 61.15, 93.198, 102.774, 74.739, 97.478, 101.354, 106.802
52.546, 98.211, 56.79, 61.515, 98.929, 75.237, 71.986, 115.706, 74.742, 72.595, 82.832, 102.122, 121.055, 79.201, 94.854, 101.708, 114.058, 100.572, 100.377, 69.339, 86.026, 103.852, 53.237, 87.472, 79.81, 102.342, 111.826, 108.73, 67.913, 96.45
82.906, 97.782, 62.562, 66.871, 72.059, 99.862, 58.822, 126.546, 51.641, 113.533, 75.261, 122.574, 119.234, 63.264, 71.06, 77.862, 100.122, 99.486, 61.417, 72.231, 106.935, 95.552, 54.209, 105.529, 103.79, 97.378, 86.426, 92.39, 74.36, 119.682

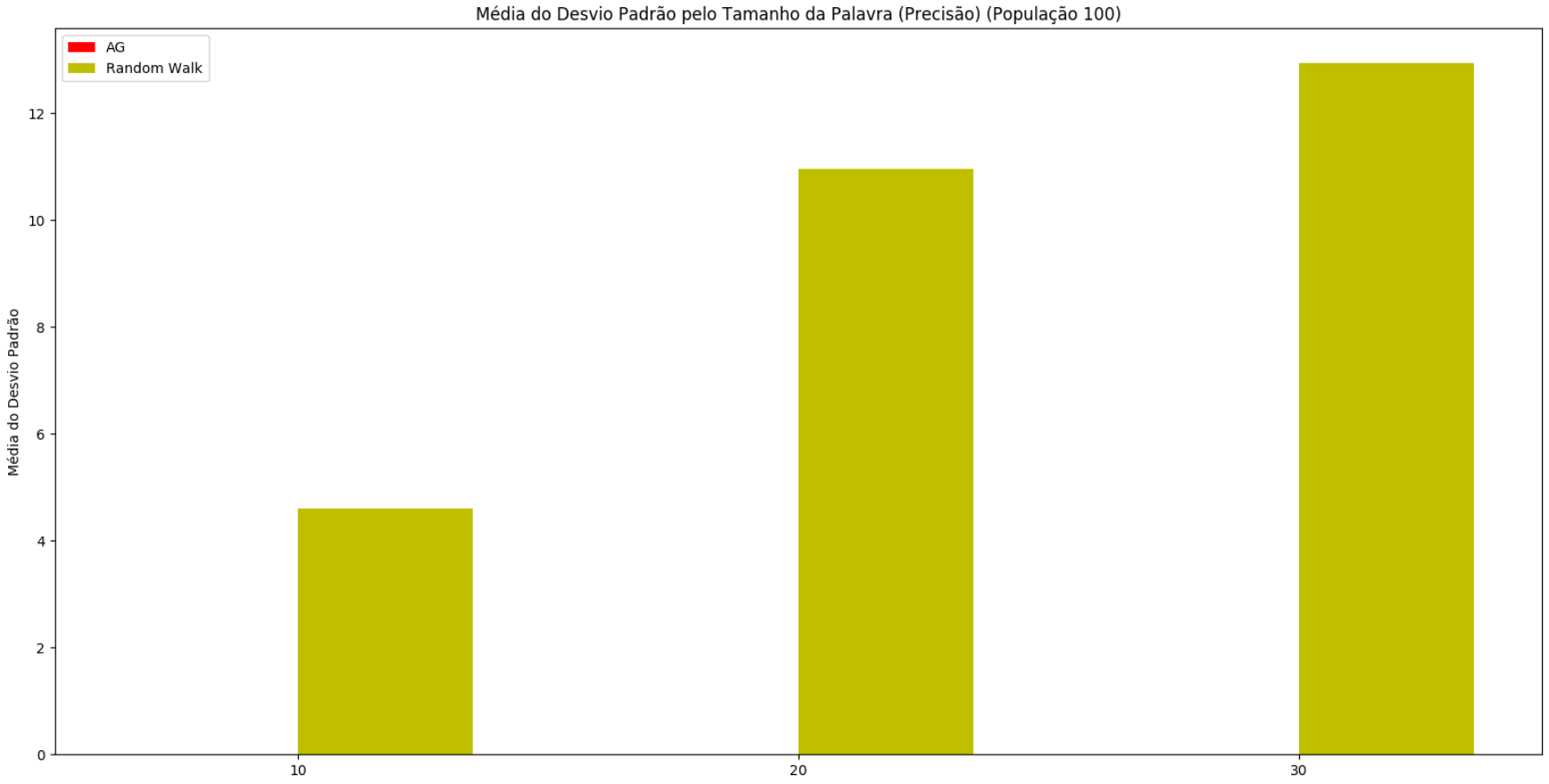
Algoritmo Genético Vs Random Walk



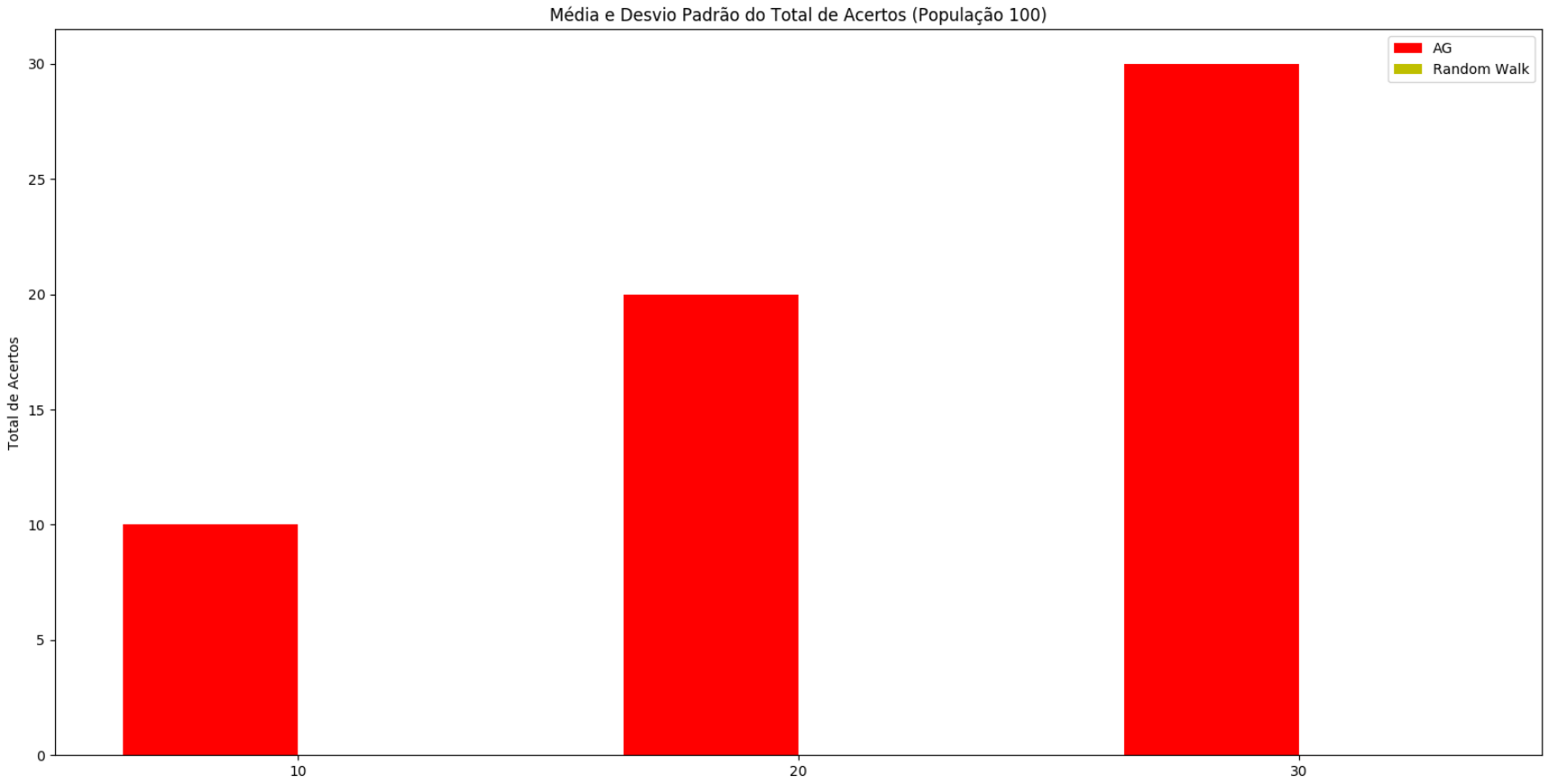
Algoritmo Genético Vs Random Walk



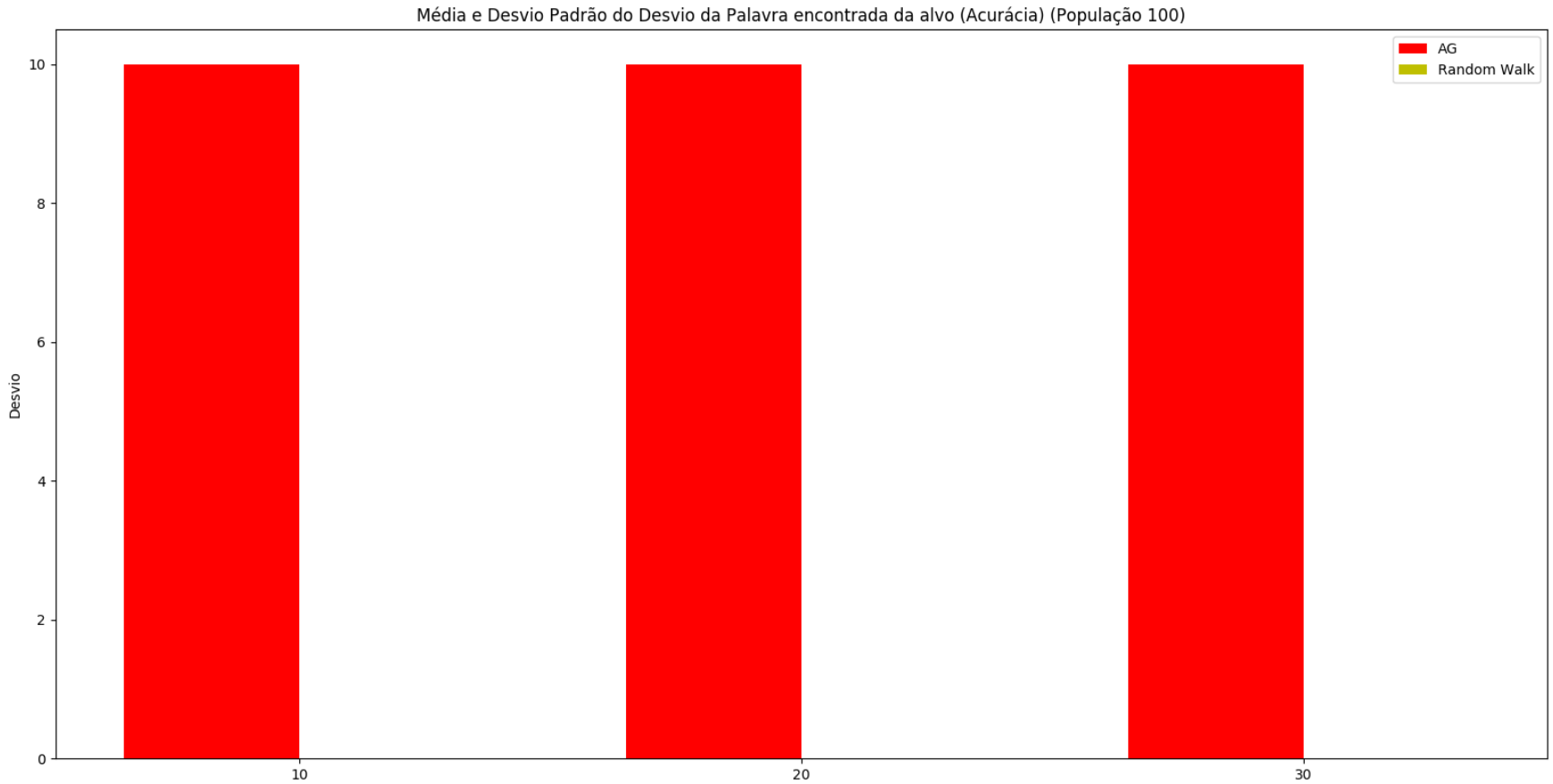
Algoritmo Genético Vs Random Walk



Algoritmo Genético Vs Random Walk



Algoritmo Genético Vs Random Walk



Conclusão

- O AG mostrou-se eficiente para encontrar a palavra-alvo, acertando por completo em todos os testes, neste quesito o Random Walk falhou em todos.

- Neste trabalho, o AG estava inicialmente com um alto desvio-padrão a cada geração, dificultando sua compreensão. O problema foi resolvido reduzindo a taxa de mutação e desvio-padrão.

Agradecimento

- Obrigado pela atenção!