

Blog Entry © Monday, September 8, 2025, by James Pate Williams, Jr., Comparison of Two Applications to Find the Minima of Classical Objective Functions

The first app was written in C# on May 16, 2015, and the Microsoft Visual Studio 2008 Pro project was posted to the Microsoft TechNet. On Sunday, September 7, 2025, I translated the C# source code to Win32 Desktop C++ x64 Release Configuration using Microsoft Visual Studio 2022 Community Version.

| PRAXIS Results                      |                |                |                |       |
|-------------------------------------|----------------|----------------|----------------|-------|
| f#                                  | Minimum        | x              | y              | Evals |
| 1                                   | +8.813152E+000 | -9.927672E-001 | -3.970918E+000 | 91    |
| 2                                   | +1.920702E-024 | +3.000000E+000 | +5.000000E-001 | 109   |
| 3                                   | 0.000000E+000  | +1.000000E+000 | +3.000000E+000 | 133   |
| 4                                   | +2.147756E-023 | +1.000000E+000 | +1.000000E+000 | 551   |
| 5                                   | -2.346576E+000 | +4.971242E+000 | +3.316439E+000 | 82    |
| 6                                   | -1.913223E+000 | -5.471976E-001 | -1.547198E+000 | 115   |
| Particle Swarm Optimization Results |                |                |                |       |
| f#                                  | Minimum        | x              | y              | Evals |
| 1                                   | +1.073662E-001 | +1.243343E+000 | +5.537199E-001 | 10000 |
| 2                                   | +8.447032E-004 | +1.119009E+000 | +4.983479E-001 | 10000 |
| 3                                   | +2.162476E-003 | +2.486686E+000 | +1.107440E+000 | 10000 |
| 4                                   | +4.305409E-001 | +2.486686E+001 | +1.107440E+001 | 10000 |
| 5                                   | -1.919670E+001 | +2.486686E+000 | +1.107440E+000 | 10000 |
| 6                                   | -1.732814E+000 | +9.946743E-001 | +4.429759E-001 | 10000 |
| Evolutionary Hill-Climber Results   |                |                |                |       |
| f#                                  | Minimum        | x              | y              | Evals |
| 1                                   | +3.226415E-002 | +7.846138E-003 | -6.812959E-003 | 10000 |
| 2                                   | +2.594447E-002 | +3.521722E+000 | +6.031769E-001 | 10000 |
| 3                                   | +3.437165E-001 | +7.450221E-001 | +3.416910E+000 | 10000 |
| 4                                   | +5.378876E-003 | +9.273993E-001 | +8.611088E-001 | 10000 |
| 5                                   | -1.893379E+001 | -8.021982E+000 | -9.500724E+000 | 10000 |
| 6                                   | -1.906871E+000 | -4.780969E-001 | -1.539332E+000 | 10000 |
| FLEMIN Results                      |                |                |                |       |
| f#                                  | Minimum        | x              | y              | Evals |
| 4                                   | +4.513461E-018 | +1.000000E+000 | +1.000000E+000 | 109   |
| 6                                   | -1.913223E+000 | -5.471976E-001 | -1.547198E+000 | 10    |

```
MinimumCPP (c) Sunday, September 7, 2025 by James Pate Williams, Jr., BA, BS, MSwE, PhD
File Help

PRAXIS Results

f#    Minimum      x          y          Evals    % Error
1      +1.025797e+01  -4.974498e+00  +9.949204e-01    141    1.02579744e+03
2      +4.550362e-01  -5.039944e+02  +1.001962e+00   10011    4.55036209e+01
3      0.000000e+00  +1.000000e+00  +3.000000e+00    134    0.00000000e+00
4      +2.608171e-29  +1.000000e+00  +1.000000e+00    372    2.60817137e-27
5      -1.280503e+01  -1.130374e+01  +9.389227e-10    162    3.33366524e+01
6      -1.913223e+00  -5.471976e-01  -1.547198e+00    171    4.02681330e-03

Particle Swarm Optimization Results

f#    Minimum      x          y          Evals    % Error
1      +5.773245e-01  +6.256294e-03  +2.817927e+00   10000    5.77324483e+01
2      +5.737478e-04  +5.630665e-03  +2.536134e+00   10000    5.73747769e-02
3      +1.564373e-02  +1.251259e-02  +5.635853e+00   10000    1.56437338e+00
4      +7.642637e+00  +1.251259e-01  +5.635853e+01   10000    7.64263686e+02
5      -1.916816e+01  +1.251259e-02  +5.635853e+00   10000    2.10036362e-01
6      +9.631891e-01  +5.005036e-03  +2.254341e+00   10000    1.50341769e+02

Evolutionary Hill-Climber 1 Results

f#    Minimum      x          y          Evals    % Error
```

```
MinimumCPP (c) Sunday, September 7, 2025 by James Pate Williams, Jr., BA, BS, MSwE, PhD
File Help

Evolutionary Hill-Climber 1 Results

f#    Minimum      x          y          Evals    % Error
1      +5.818444e-02  +1.416059e-02  -1.052889e-02   10000    5.81844383e+00
2      +2.544230e-04  +2.962966e+00  +4.895932e-01   10000    2.54422973e-02
3      +4.015574e-02  +9.244057e-01  +2.983184e+00   10000    4.01557401e+00
4      +4.650773e-03  +9.825434e-01  +9.719840e-01   10000    4.65077306e-01
5      -1.915009e+01  +7.992492e+00  +9.620350e+00   10000    3.04074348e-01
6      -1.912213e+00  -5.758080e-01  -1.554369e+00   10000    5.68236076e-02

Evolutionary Hill-Climber 2 Results

f#    Minimum      x          y          Evals    % Error
4      +1.797573e-02  +8.671834e-01  +7.501755e-01   10000    1.79757306e+00
6      -4.941710e+00  -3.428251e+00  -4.457976e+00   10000    1.58282030e+02

FLEMIN Results

f#    Minimum      x          y          Evals    % Error
4      +4.930381e-32  +1.000000e+00  +1.000000e+00    33    4.93038066e-30
6      -1.913223e+00  -5.471976e-01  -1.547198e+00    8    4.02681330e-03
```

See the accompanying C++ header and source code files that are attached to this blog entry for more information about the functions.