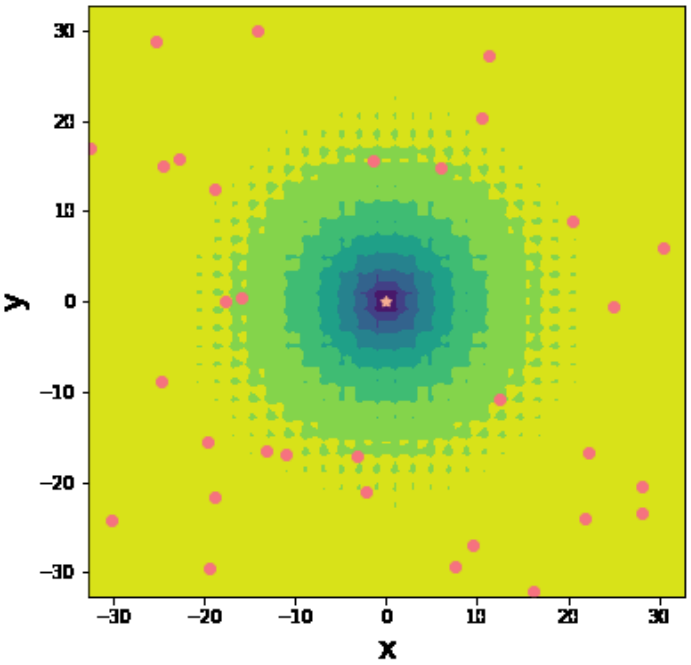
# Differential Evolution (DE) & Cross Entropy Method (CEM)

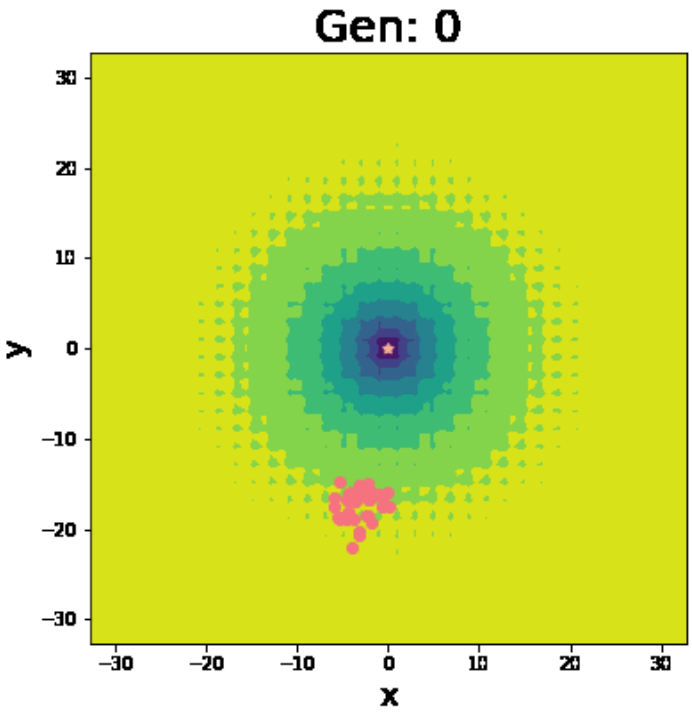
## Ackley

### Dimension 2

| Size | DE | CEM |
|---|---|---|
| 32 | 4.44e-16 (±0.0) | 19.65 (±2.81) |
| 64 | 4.44e-16 (±0.0) | 19.56 (±2.70) |
| 128 | 4.44e-16 (±0.0) | 19.28 (±3.02) |
| 256 | 4.44e-16 (±0.0) | 18.84 (±2.71) |
| 512 | 4.44e-16 (±0.0) | 18.61 (±2.61) |
| 1024 | 5.86e-09 (±2.68e-09 | 18.89 (±2.2912) |

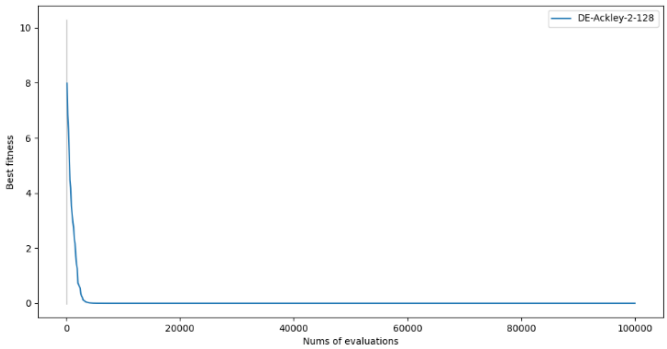



DE

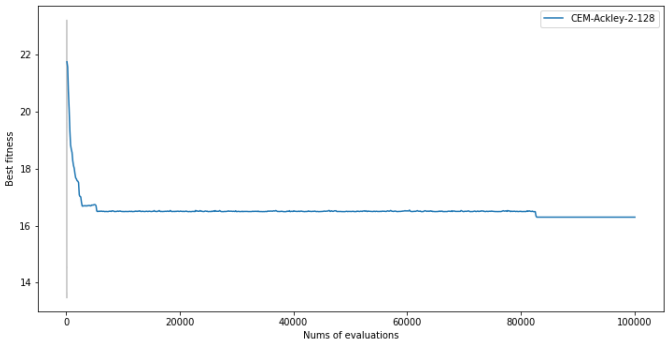



CEM

*Pop size 128*

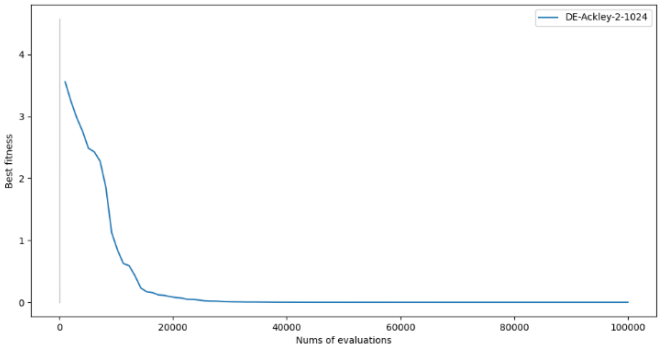



DE

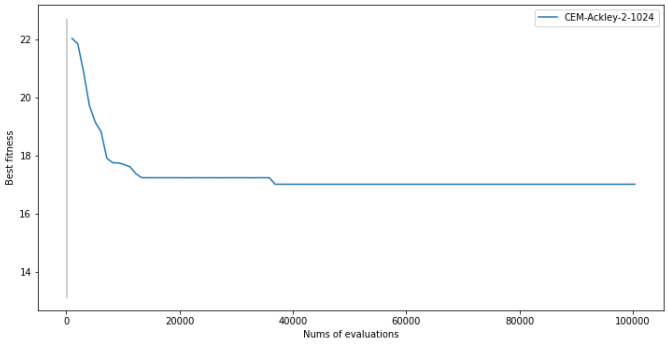



CEM

*Pop size 1024*




DE

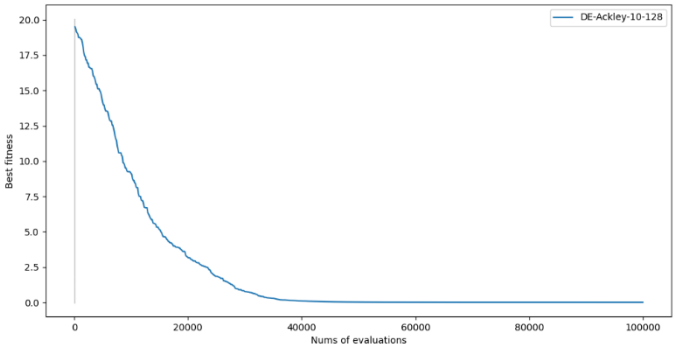



CEM

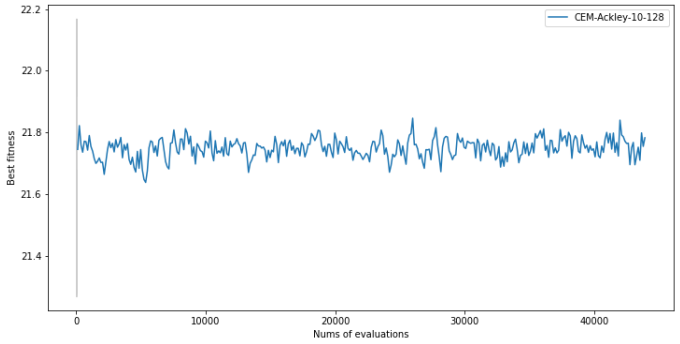
## Dimension 10

| Size | DE | CEM |
|---|---|---|
| 32 | 3.28e-15 (±1.49e-15) | 21.66 (±0.66) |
| 64 | 2.93e-15 (±1.72e-15) | 21.37 (±0.67) |
| 128 | 3.28e-15 (±1.50e-15) | 20.99 (±0.35) |
| 256 | 3.64e-15 (±1.12e-15) | 20.84 (±0.55) |
| 512 | 3.99e-15 (±0.0) | 20.67 (±0.50) |
| 1024 | 4.35e-08 (±6.51e-09) | 20.77 (±0.45) |

### *Pop size 128*

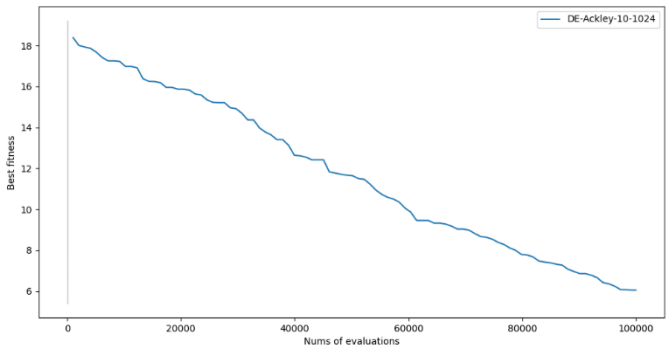



DE

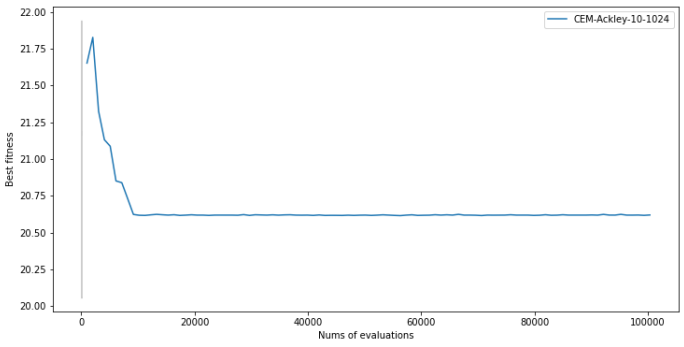



CEM

### *Pop size 1024*




DE

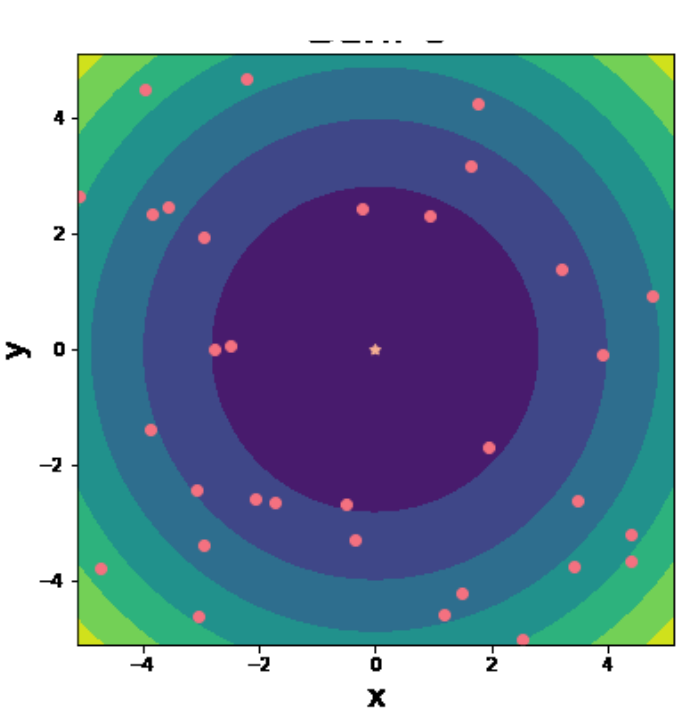



CEM

## Sphere

### Dimension 2

| Size | DE | CEM |
|---|---|---|
| 32 | 0.0 (±0.0) | 5.33 (±6.891812475313413) |
| 64 | 2.80e-282 (±0.0) | 3.58 (±5.86) |
| 128 | 3.62e-141 (±7.82e-141) | 1.75 (±3.07) |
| 256 | 4.28e-72 (±6.30e-72) | 1.07 (±1.90) |
| 512 | 4.51e-37 (±4.05e-37) | 0.77 (±1.82) |
| 1024 | 1.04e-19 (±7.90e-20) | 0.56 (±1.41) |

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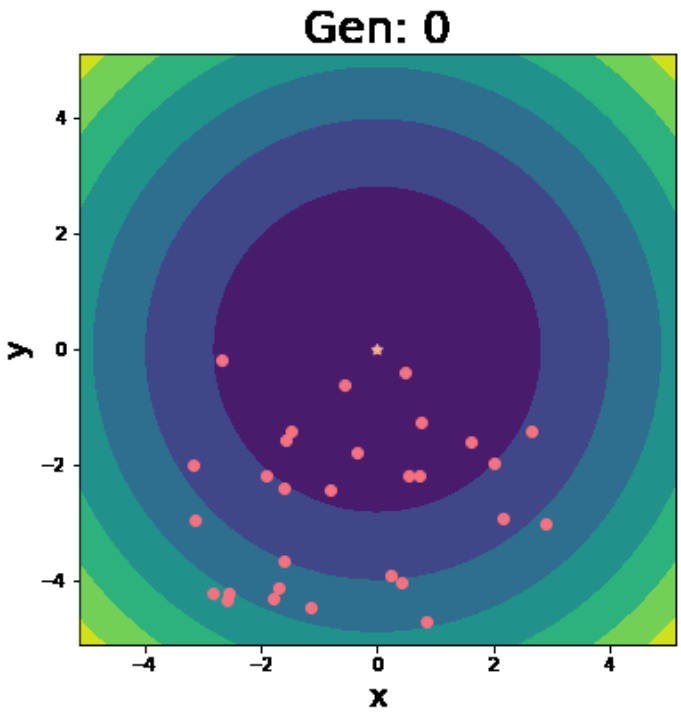
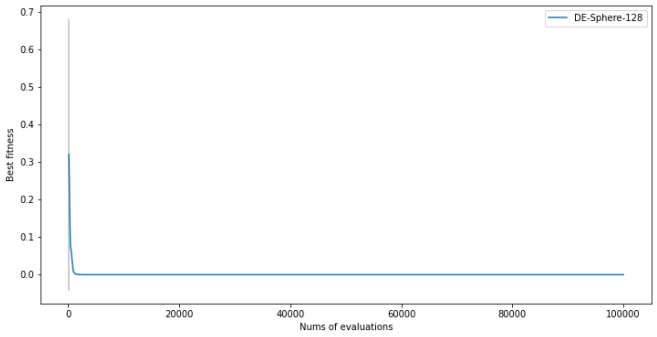



CEM

*Pop size 128*

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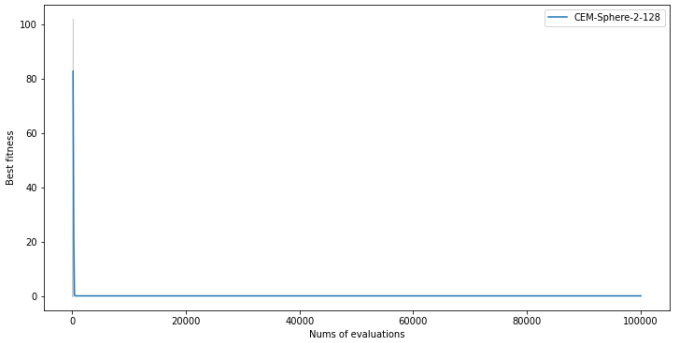
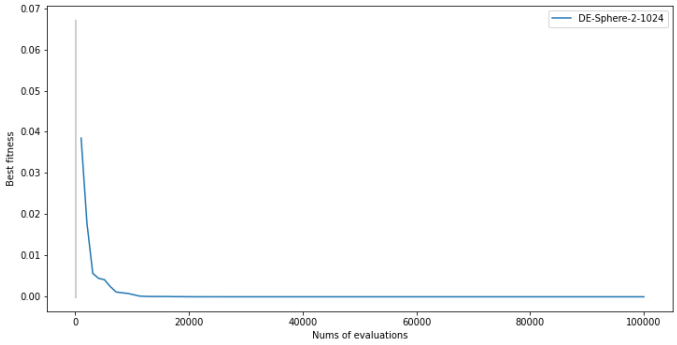
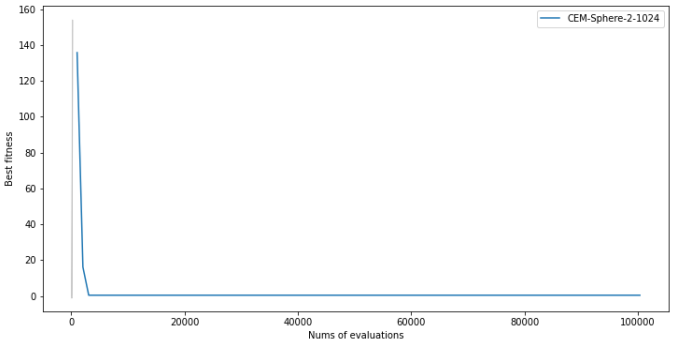



CEM

*Pop size 1024*




DE

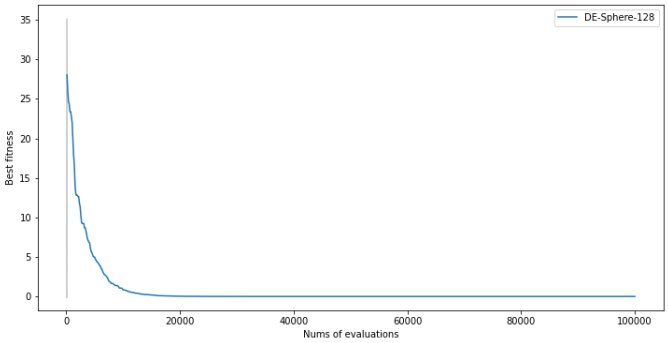



CEM

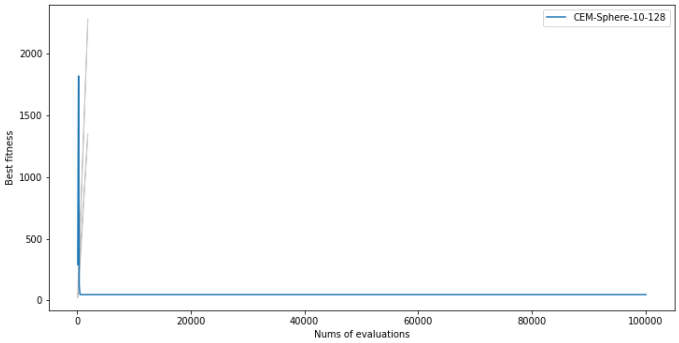
Dimension 10

| Size | DE | CEM |
|---|---|---|
| 32 | 0.0 (±0.0) | 53.88 (±21.95) |
| 64 | 2.66e-298 (±0.0) | 42.02 (±17.83) |
| 128 | 1.42e-146 (±1.43e-146) | 33.38 (±14.86) |
| 256 | 2.48e-72 (±1.84e-72) | 27.68 (±12.80) |
| 512 | 1.00e-35 (±4.27e-36) | 24.14 (±13.26) |
| 1024 | 1.29e-17 (±4.52e-18) | 20.39 (±10.25) |

*Pop size 128*

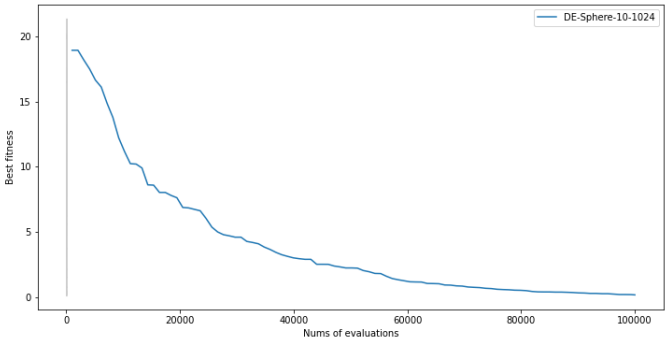


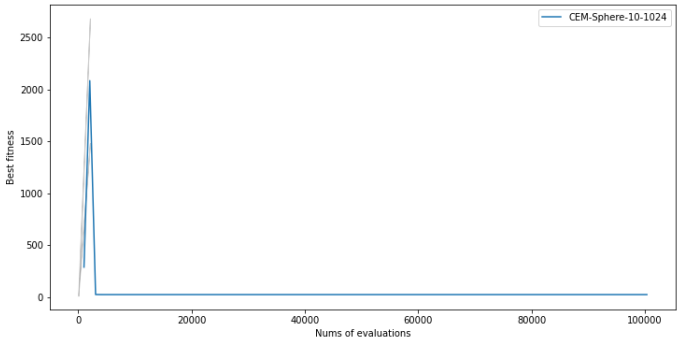

DE




CEM

*Pop size 1024*



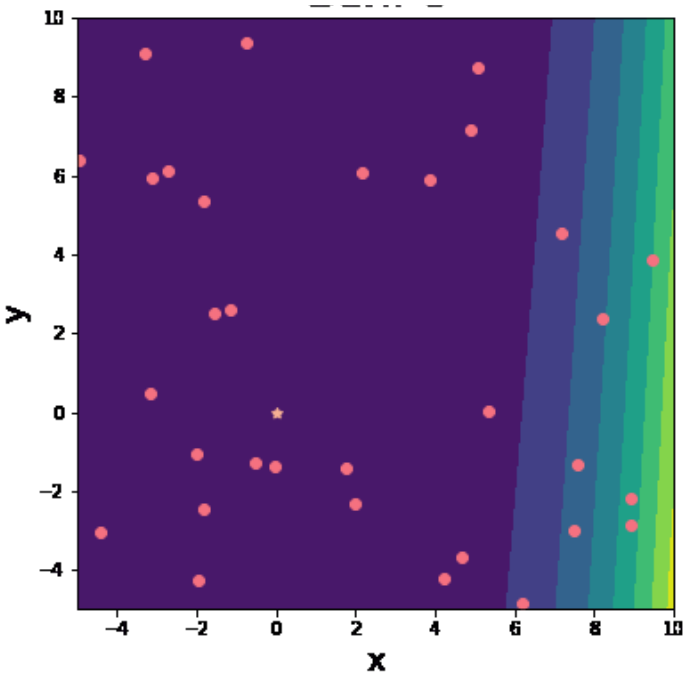

CEM

## Rosenbrock

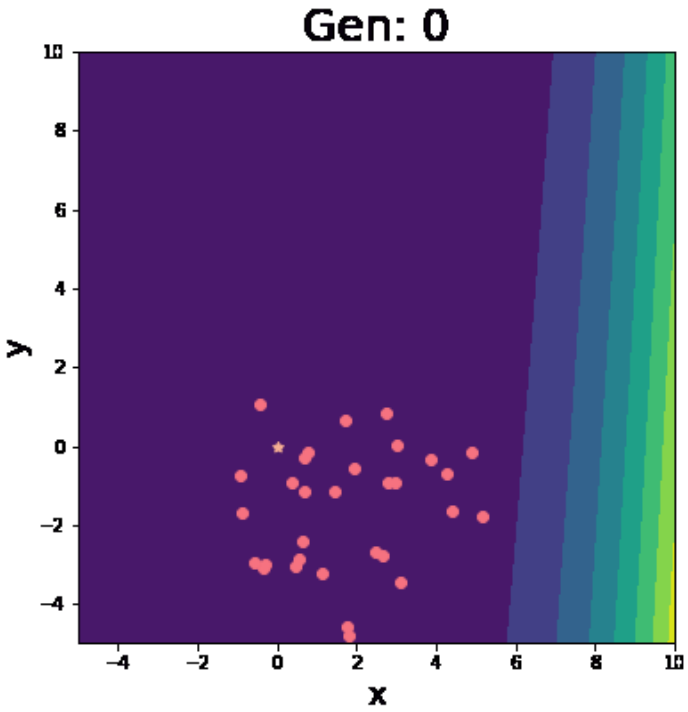
### Dimension 2

| Size | DE | CEM |
|---|---|---|
| 32 | 0.0 (±0.0) | 1855.07 (±2586.32) |
| 64 | 0.0 (±0.0) | 1501.39 (±2173.40) |
| 128 | 0.0 (±0.0) | 1204.14 (±1918.93) |
| 256 | 8.01e-32 (±2.49e-31) | 799.18 (±1138.31) |

| | | |
|---|---|---|
| 512 | 3.28e-15 (±3.83e-15) | 590.28 (±932.36) |
| 1024 | 3.60e-07 (±3.28e-07) | 426.72 (±667.71) |

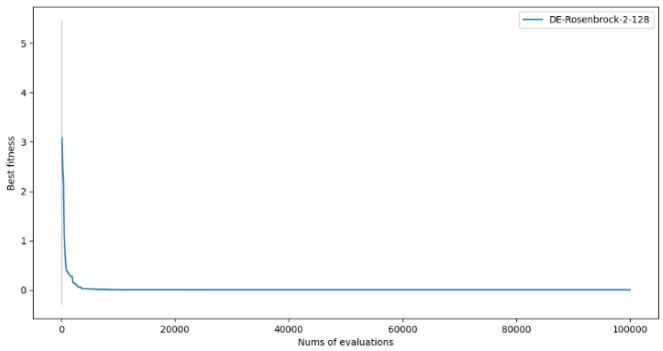



DE

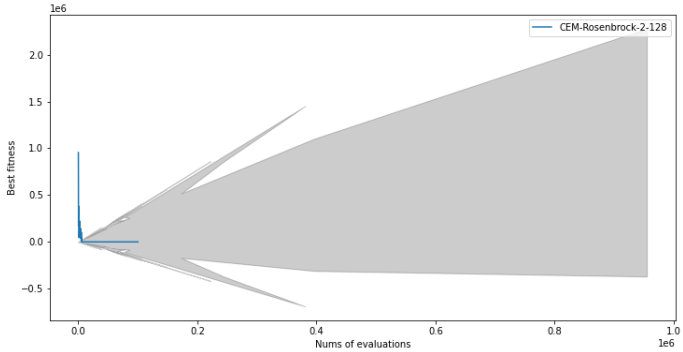



CEM

*Pop size 128*

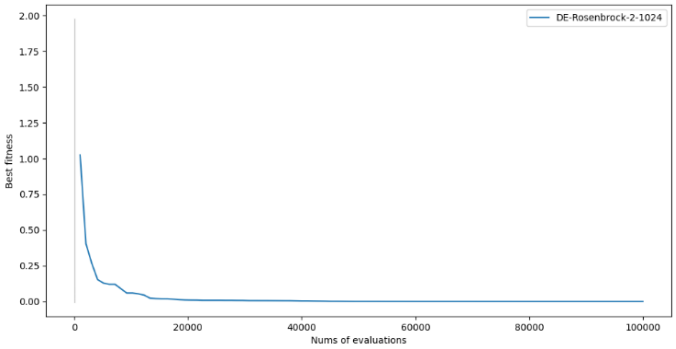



DE

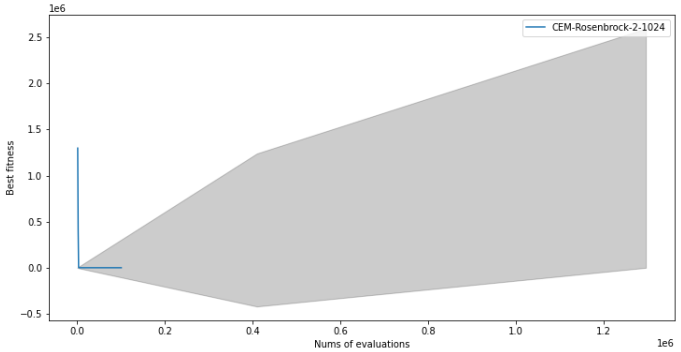



CEM

*Pop size 1024*




DE

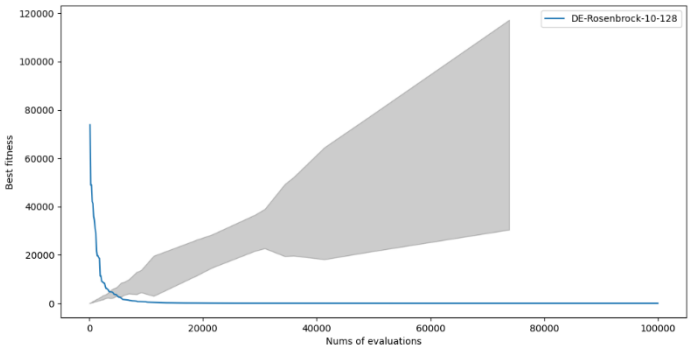



CEM

Dimension 10

| Size | DE | CEM |
|---|---|---|
| 32 | 0.0 (±0.0) | 337736.83 (±228714.52) |
| 64 | 0.0 (±0.0) | 254071.70 (±161677.86) |
| 128 | 2.51e-23 (±1.9e-23) | 198738.52 (±147964.84) |
| 256 | 1.34e-10 (±5.37e-11) | 160042.42 (±131077.37) |
| 512 | 0.00 (±4.73e-05) | 0 (±0) |
| 1024 | 0.411 (±0.06) | 0 (±0) |

*Pop size 128*

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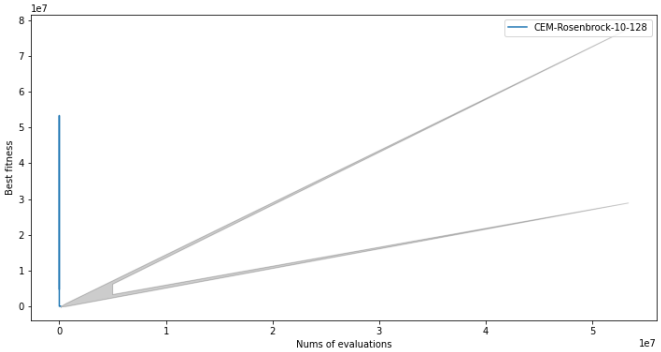
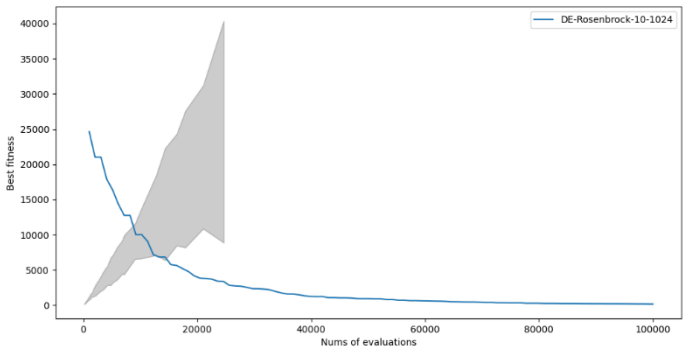
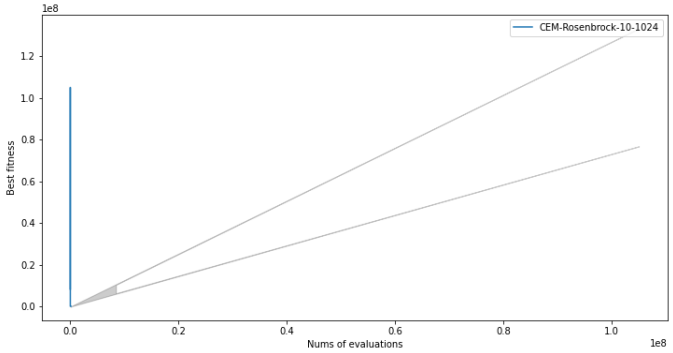



CEM

*Pop size 1024*




DE

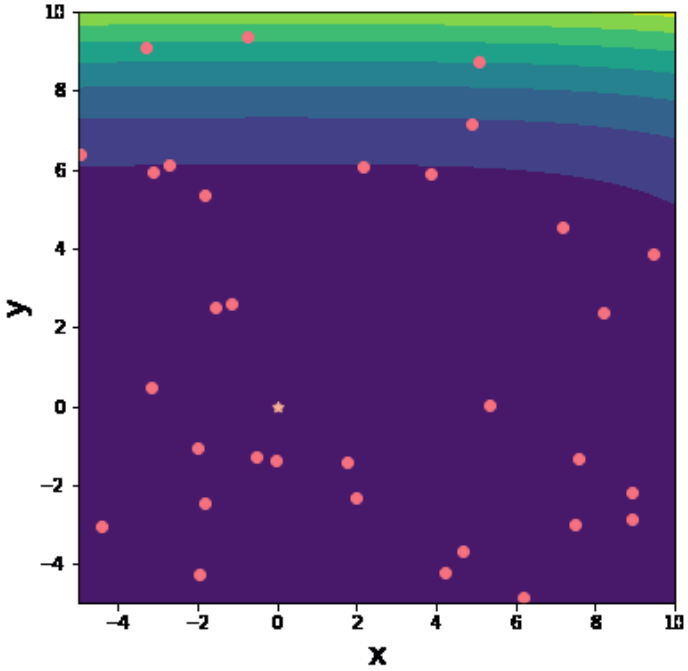


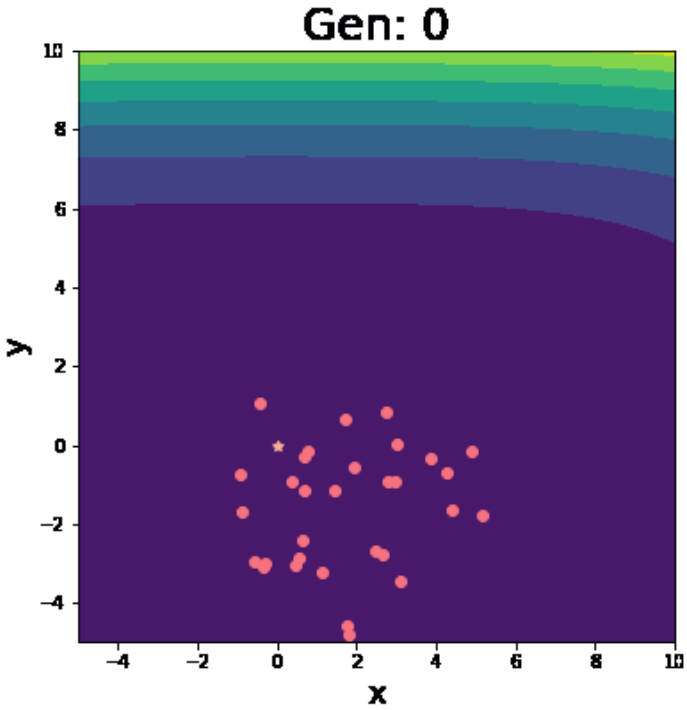

CEM

## Zakharov

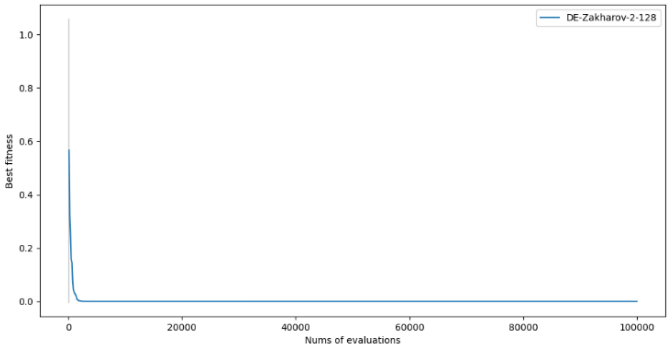
### Dimension 2

| Size | DE | CEM |
|---|---|---|
| 32 | 0.0 (±0.0) | 100.60 (±190.77) |
| 64 | 1.37e-280 (±0.0) | 97.12 (±223.37) |
| 128 | 6.47e-142 (±9.60e-142) | 51.52 (±110.46) |
| 256 | 2.20e-71 (±4.69e-71) | 35.89 (±77.73) |
| 512 | 1.77e-36 (±1.22e-36) | 27.04 (±59.55) |
| 1024 | 1.45e-19 (±1.00e-19) | 24.06 (±51.74) |

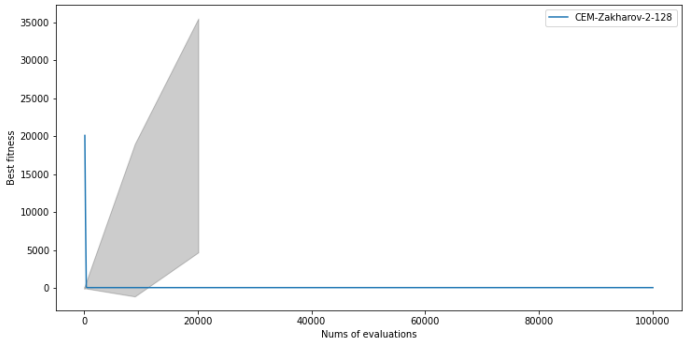



*Pop size 128*

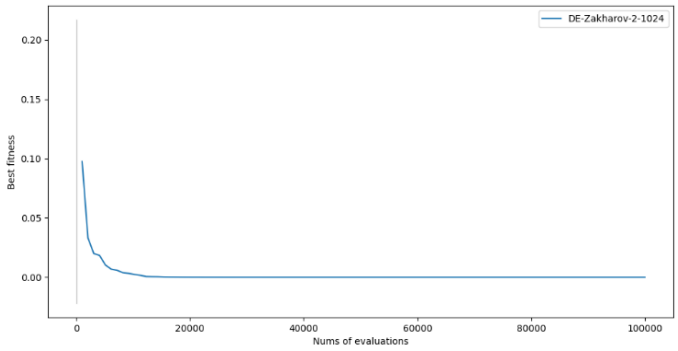



DE

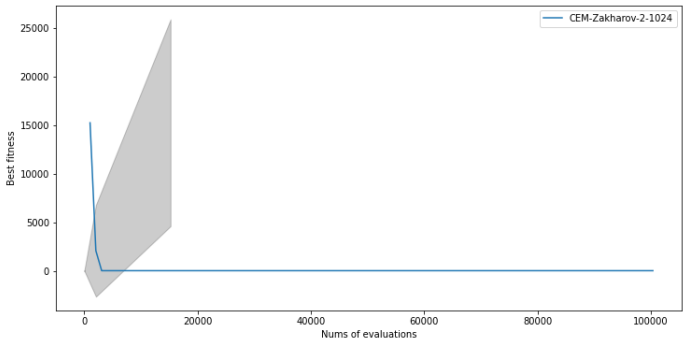



CEM

*Pop size 1024*




DE

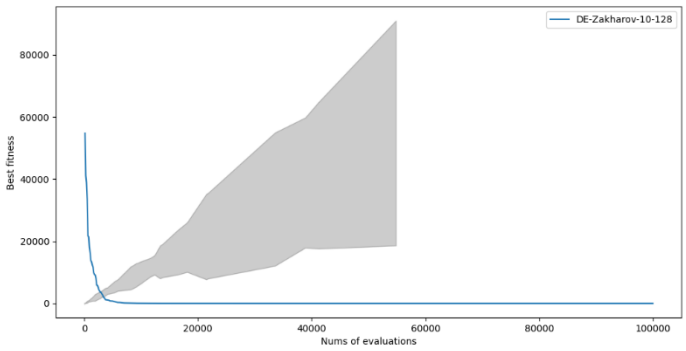



CEM

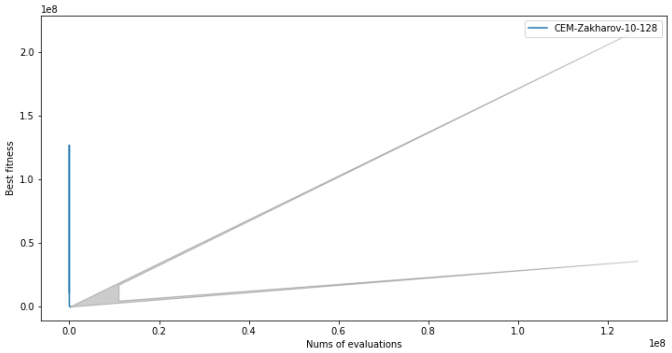
Dimension 10

| Size | DE | CEM |
|---|---|---|
| 32 | 0.0 (±0.0) | 284614.07 (±248447.45) |
| 64 | 5.75e-298 (±0.0) | 235854.43 (±255299.27) |
| 128 | 7.29e-145 (±9.63e-145) | 165648.56 (±142403.32) |
| 256 | 1.25e-70 (±1.39e-70) | 125381.85 (±107065.25) |
| 512 | 2.57e-34 (±1.15e-34) | 0 (±0) |
| 1024 | 3.36e-16 (±1.26e-16) | 0 (±0) |

*Pop size 128*

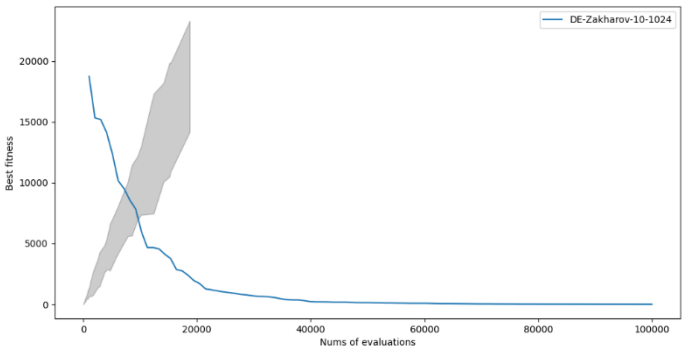



DE




CEM

*Pop size 1024*

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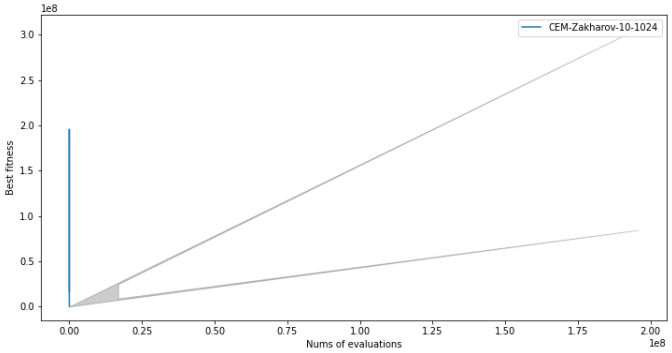
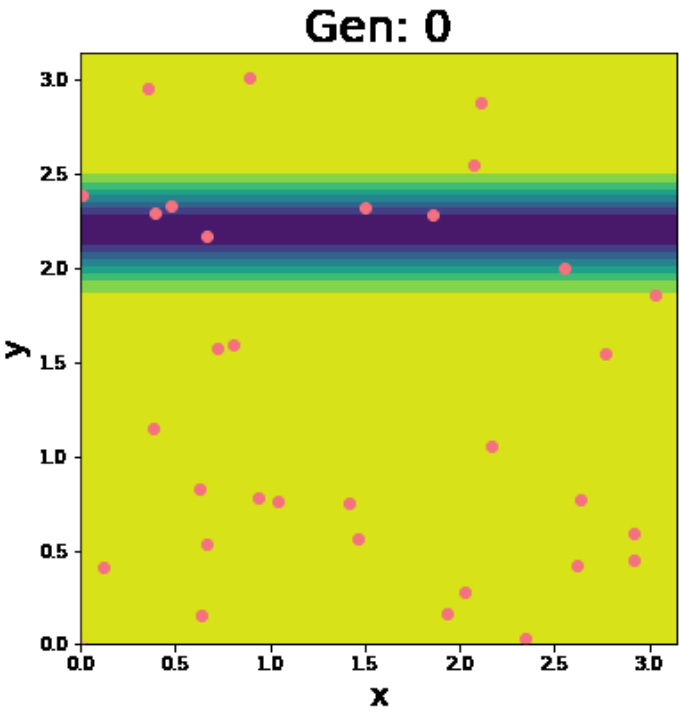



CEM

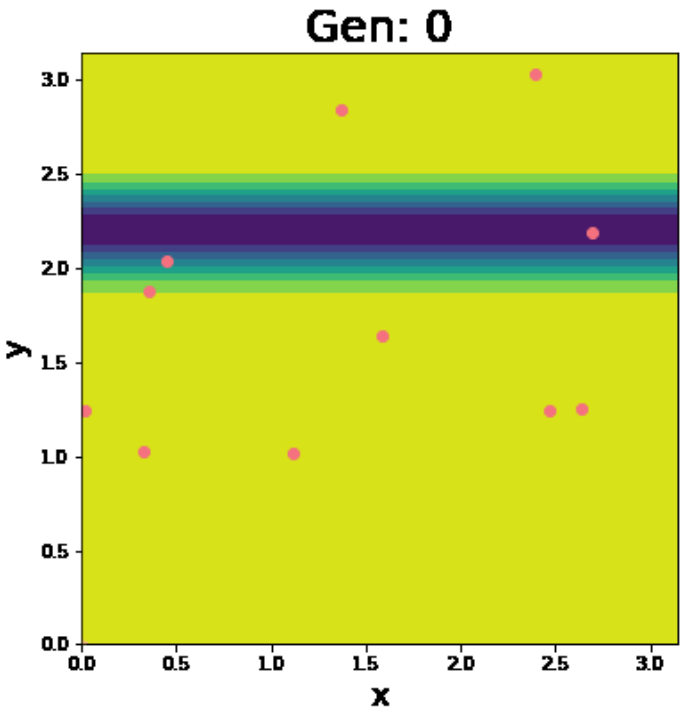
## Michaelwicz

### Dimension 2

| Size | DE | CEM |
|---|---|---|
| 32 | -0.80 (±3.70e-17) | -0.38 (±0.41) |
| 64 | -0.80 (±1.04e-16) | -0.45 (±0.35) |
| 128 | -0.80 (±9.79e-17) | -0.58 (±0.44) |
| 256 | -0.80 (±1.04e-16) | -0.79 (±0.01) |
| 512 | -0.80 (±5.23e-17) | -0.63 (±0.35) |
| 1024 | -0.80 (±1.04e-16) | -0.67 (±0.36) |

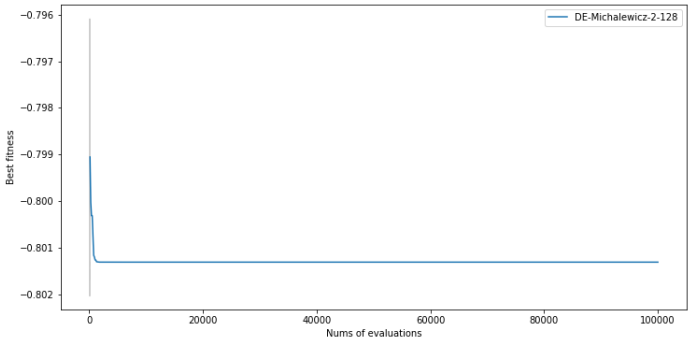



DE

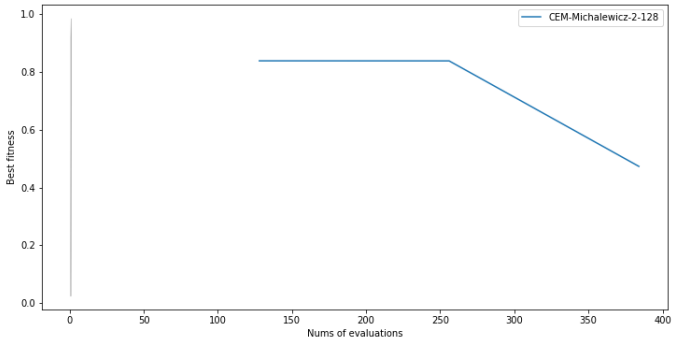



CEM

*Pop size 128*

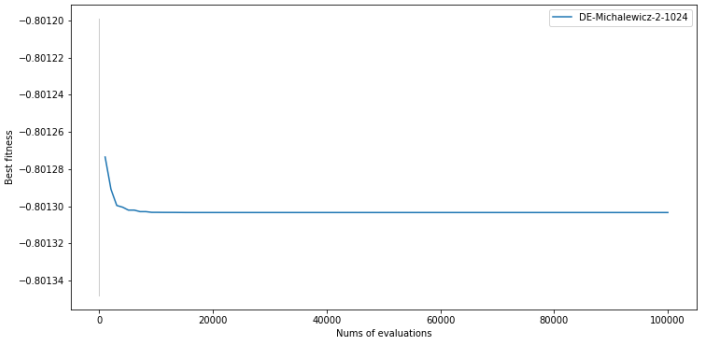



DE

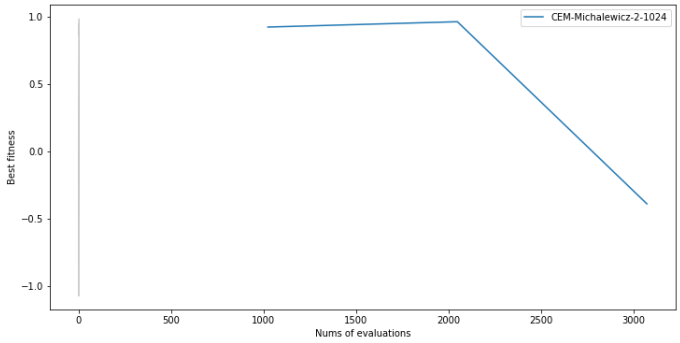



CEM

*Pop size 1024*




DE

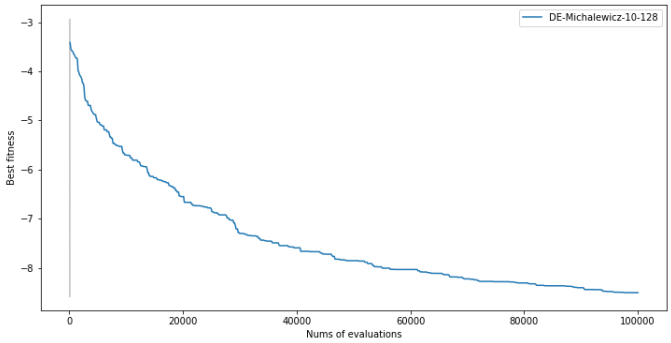



CEM

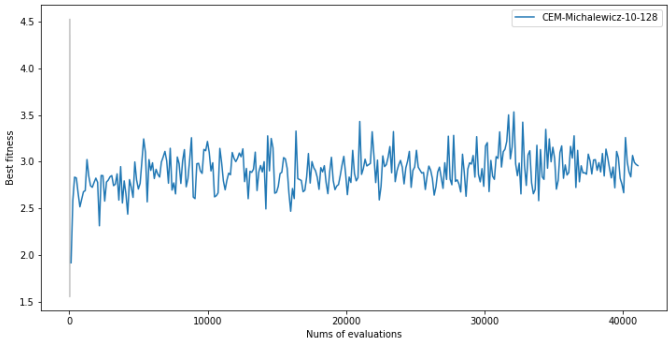
## Dimension 10

| Size | DE | CEM |
|---|---|---|
| 32 | -8.64 (±0.02) | -0.45 (±1.04) |
| 64 | -8.66 (±5.92e-16) | 0..02 (±1.03) |
| 128 | -8.65 (±0.0015) | -0.04 (±1.01) |
| 256 | -8.66 (±0.0) | -0.08 (±0.95) |
| 512 | -8.66 (±0.0) | -0.19 (±1.60) |
| 1024 | -8.64 (±0.01) | -0.18 (±1.65) |

### *Pop size 128*

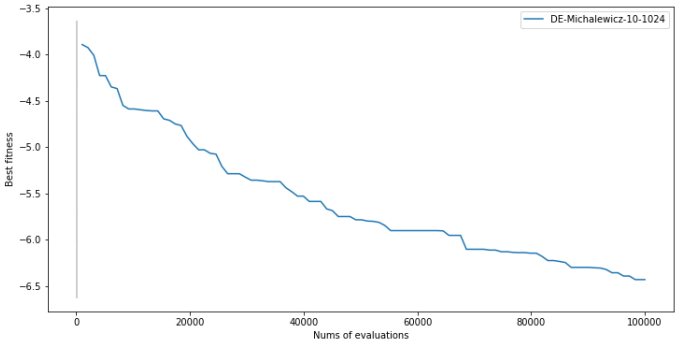



DE

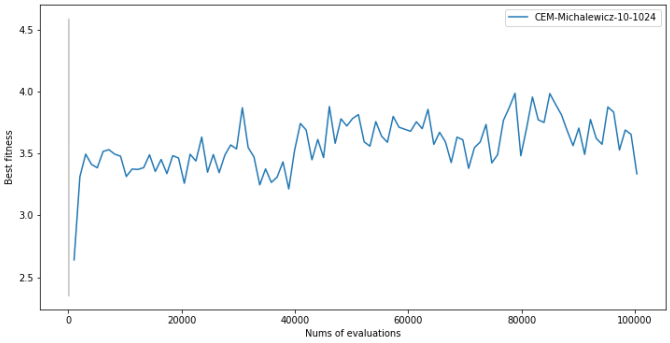



CEM

### *Pop size 1024*




DE




CEM

# Nhận xét:

- Thời gian chạy: CEM nhanh hơn so với DE
- FITNESS: trong hầu hết trường DE đều hội tụ lại gần 1 điểm tối (tối ưu toàn cục hoặc sai số không nhiều) nhưng đối với CEM (2 trường hợp cuối) không hội tụ để tìm được điểm tối ưu.
- Trên tổng thể: CEM và DE đều có những mặt tốt và mặt hạn chế. Đối với CEM thì thời gian hội tụ của bài toán nhanh nhưng độ chính xác (trong thực nghiệm trên) là không tốt. Các đồ thị của DE đều hội tụ tốt hơn CEM, do đó kết quả của DE là tốt hơn trong trường hợp này nhưng bù lại thời gian chạy của DE là rất lâu.