

```
message = "A3FZ9YBQ" * 100 # 6400 BITOW
```

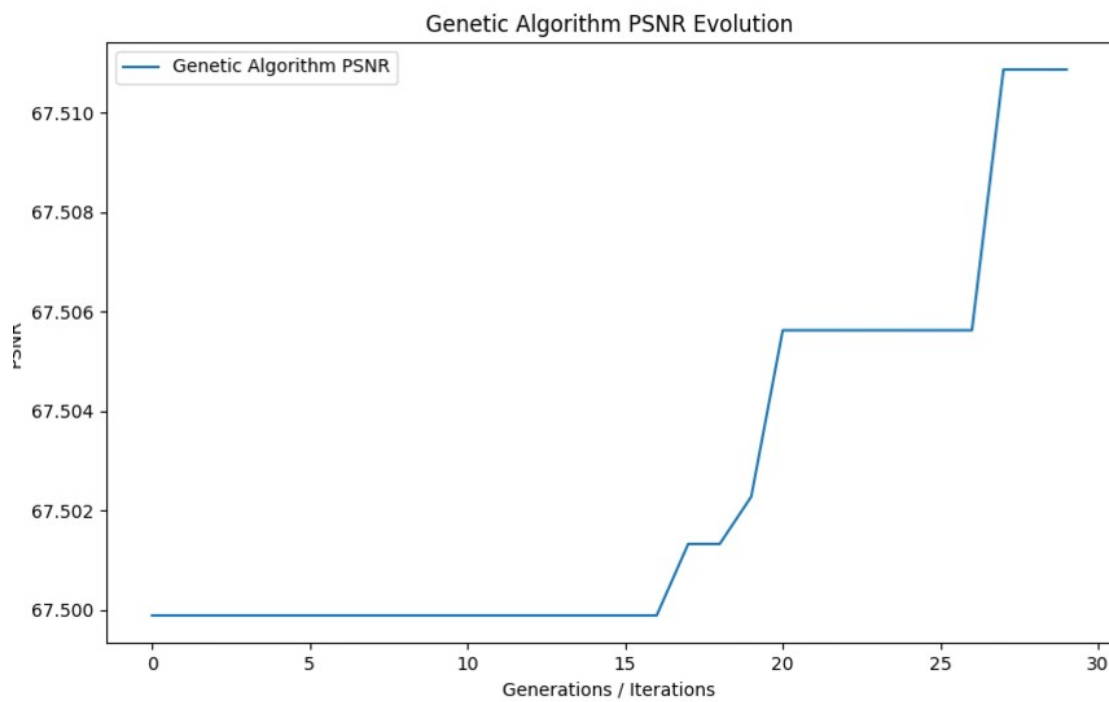
```
num_particles = 30
```

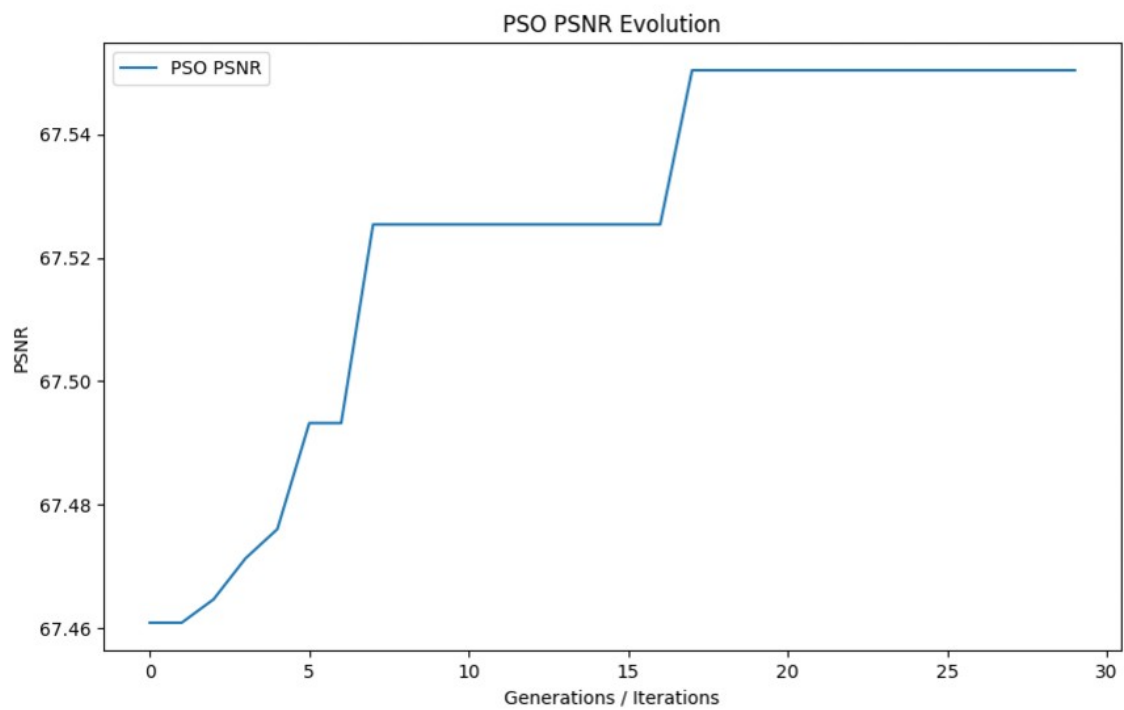
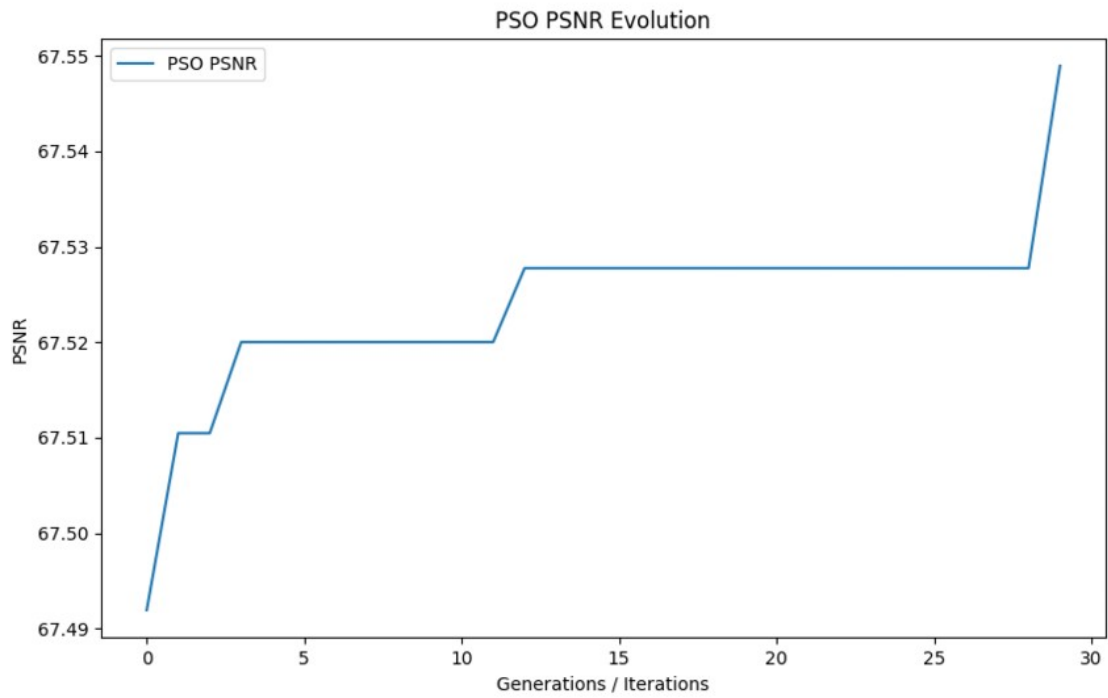
```
max_iterations = 30
```

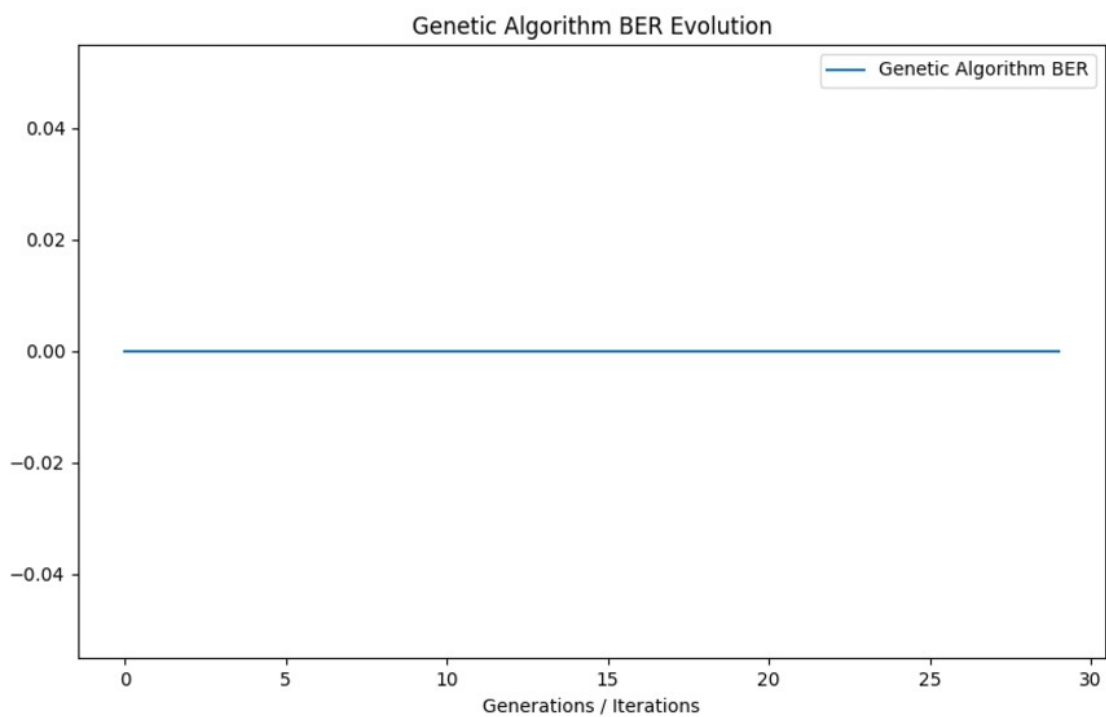
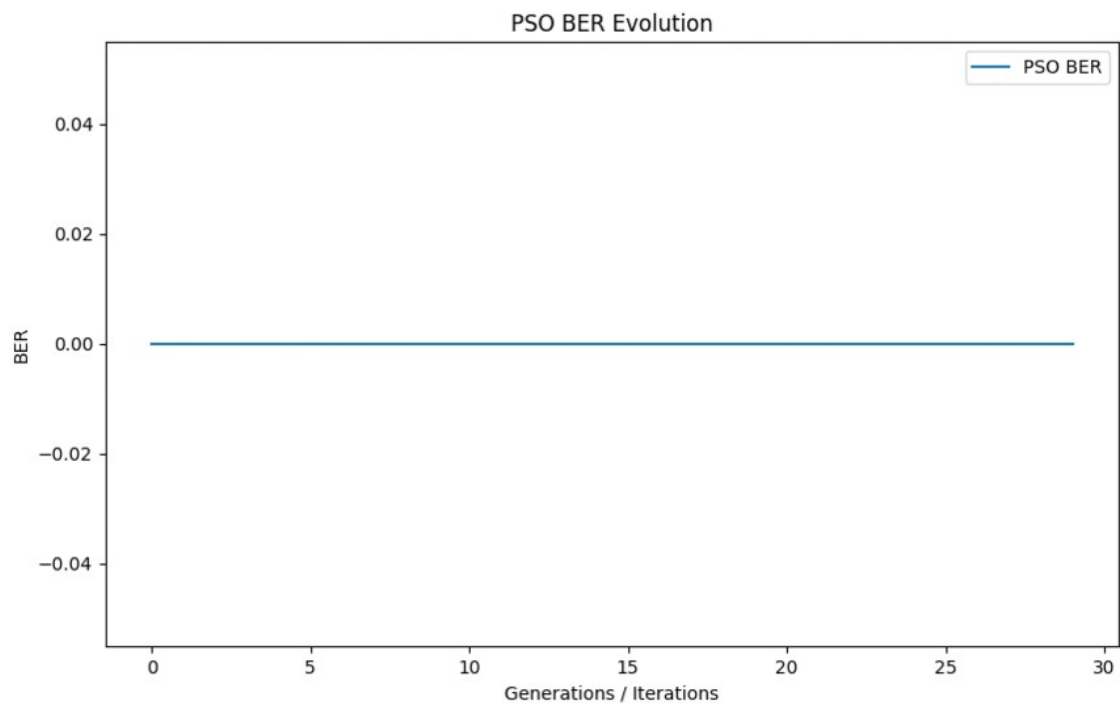
```
population_size = 30
```

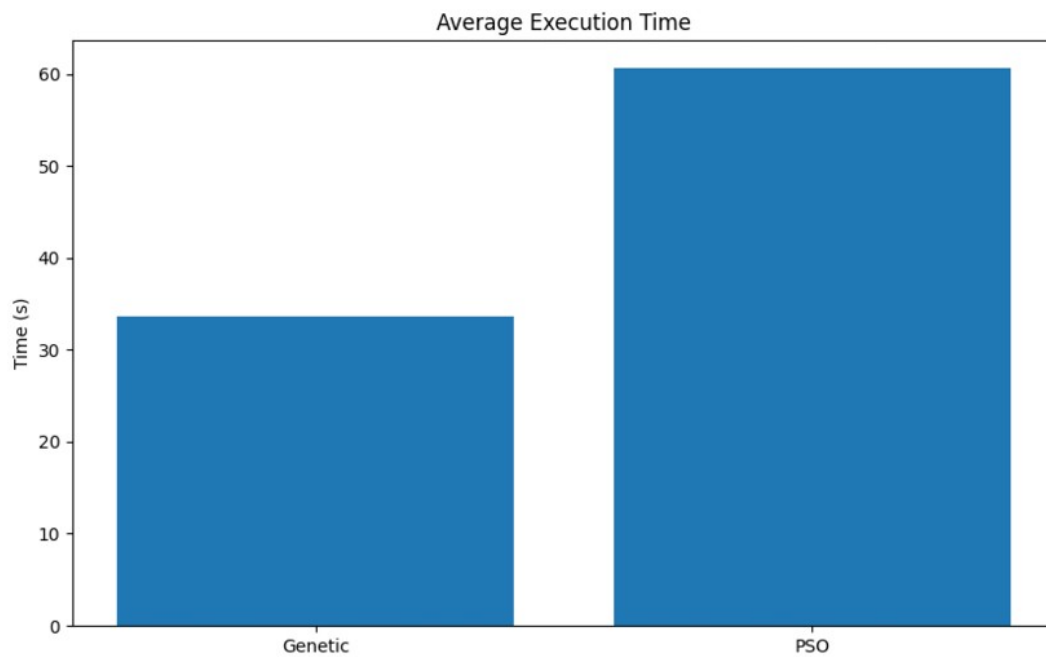
```
num_generations = 30
```

```
mutation_rate = 0.3
```

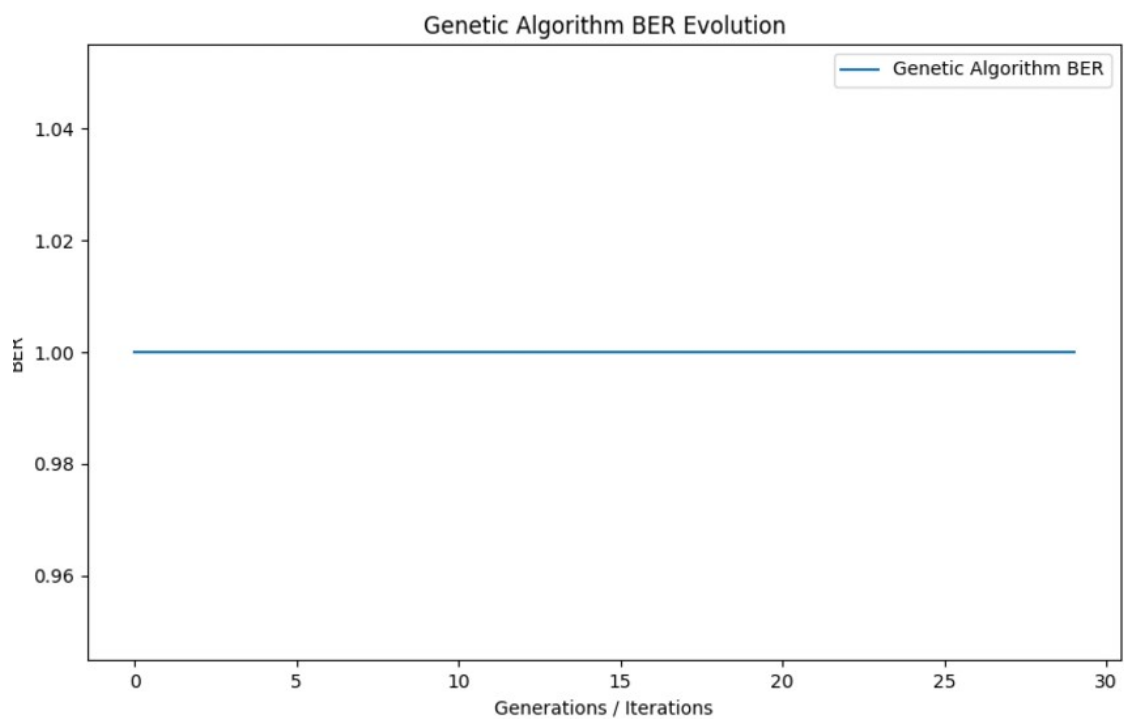
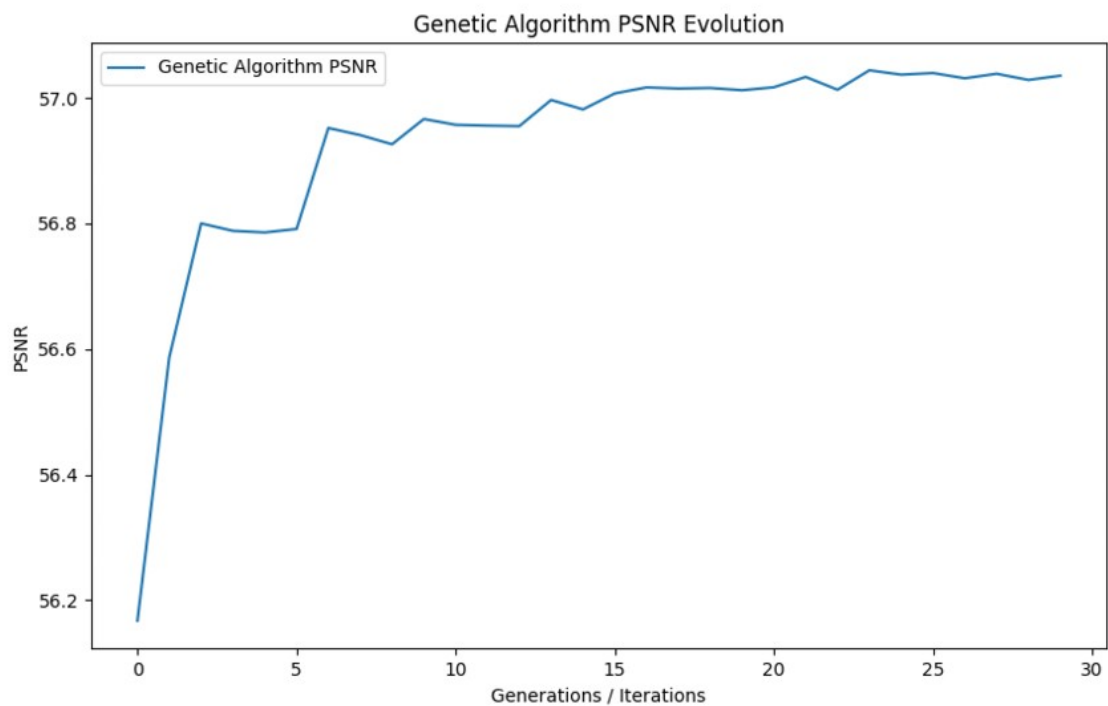


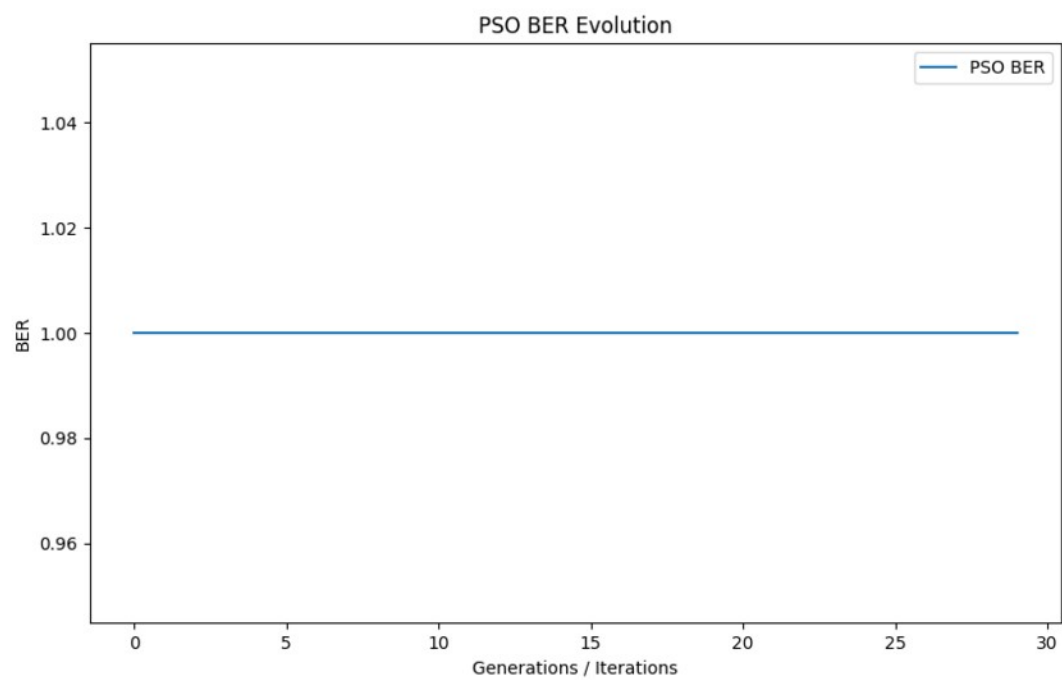
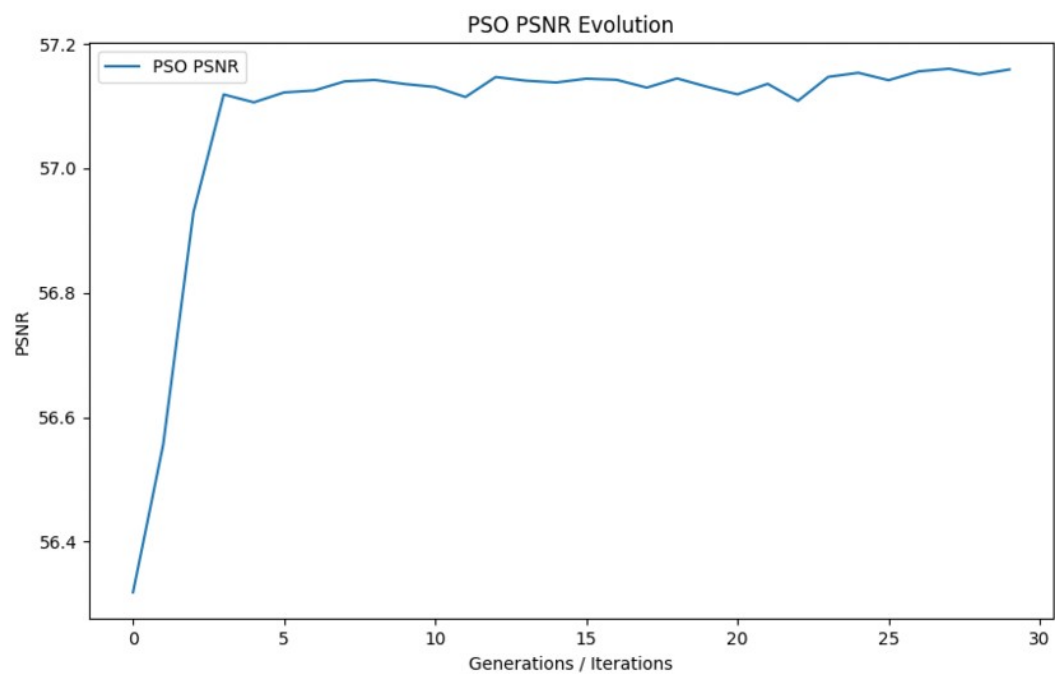


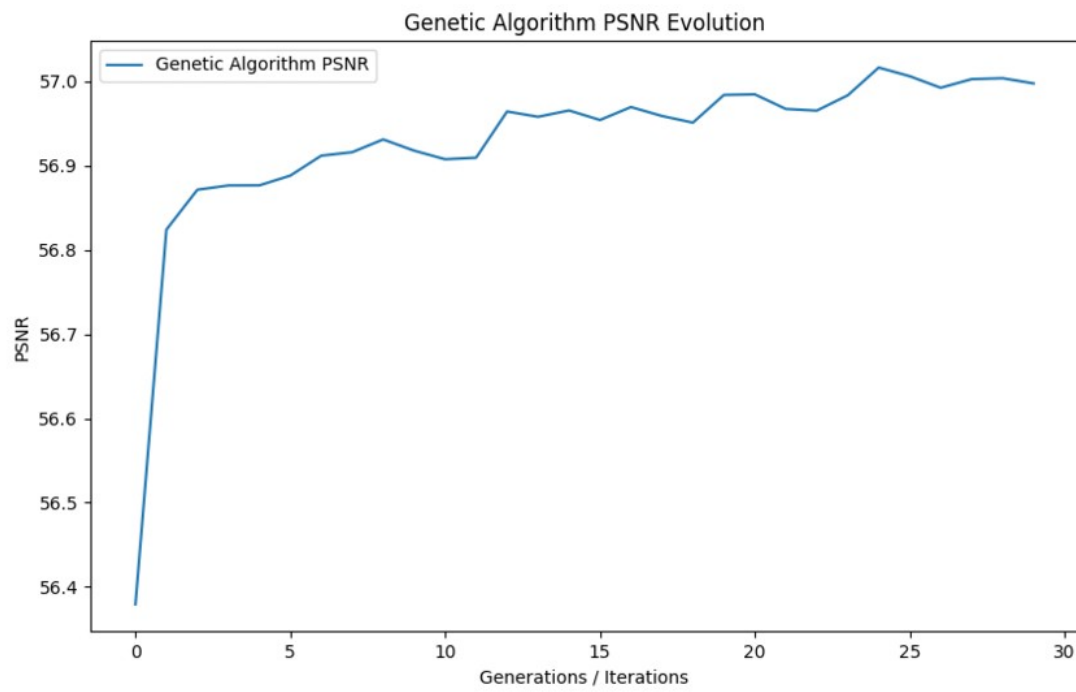
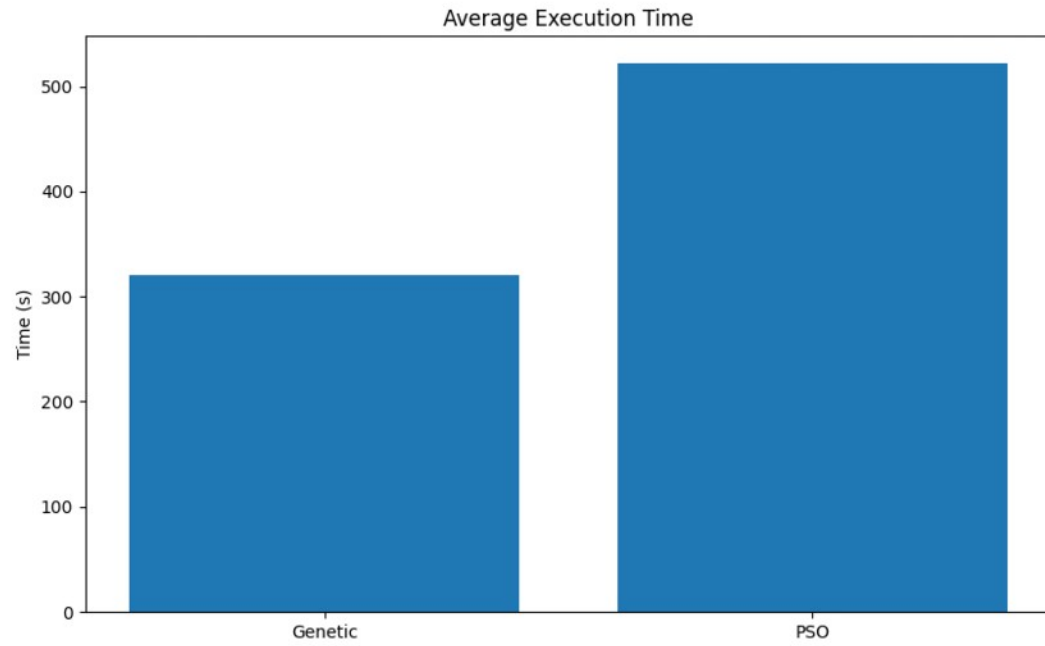


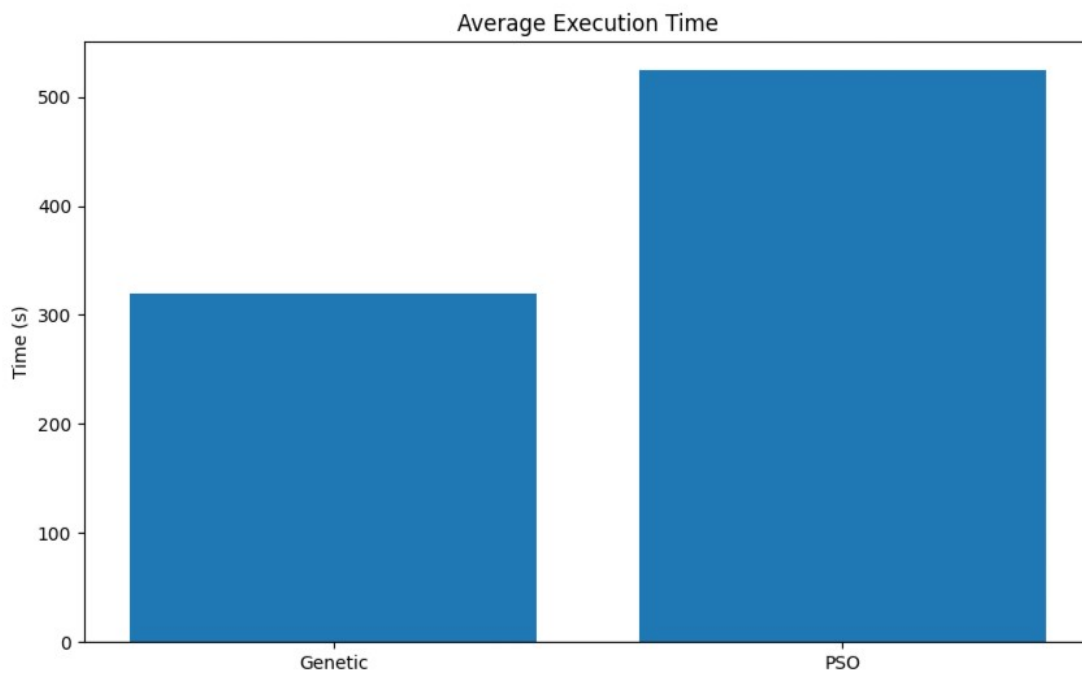
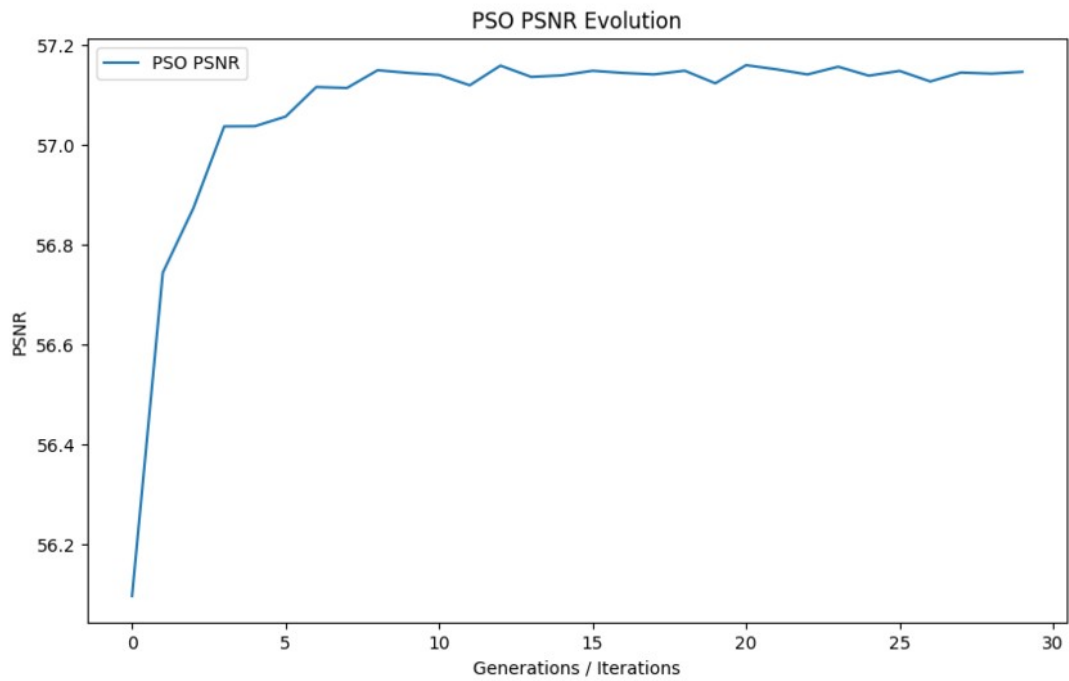


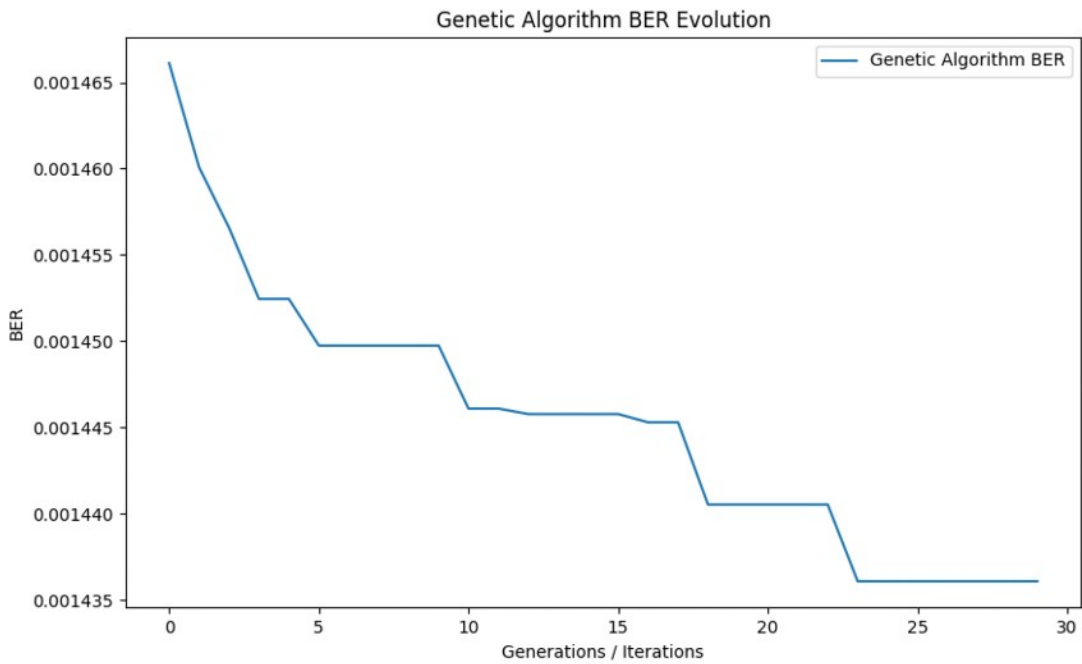
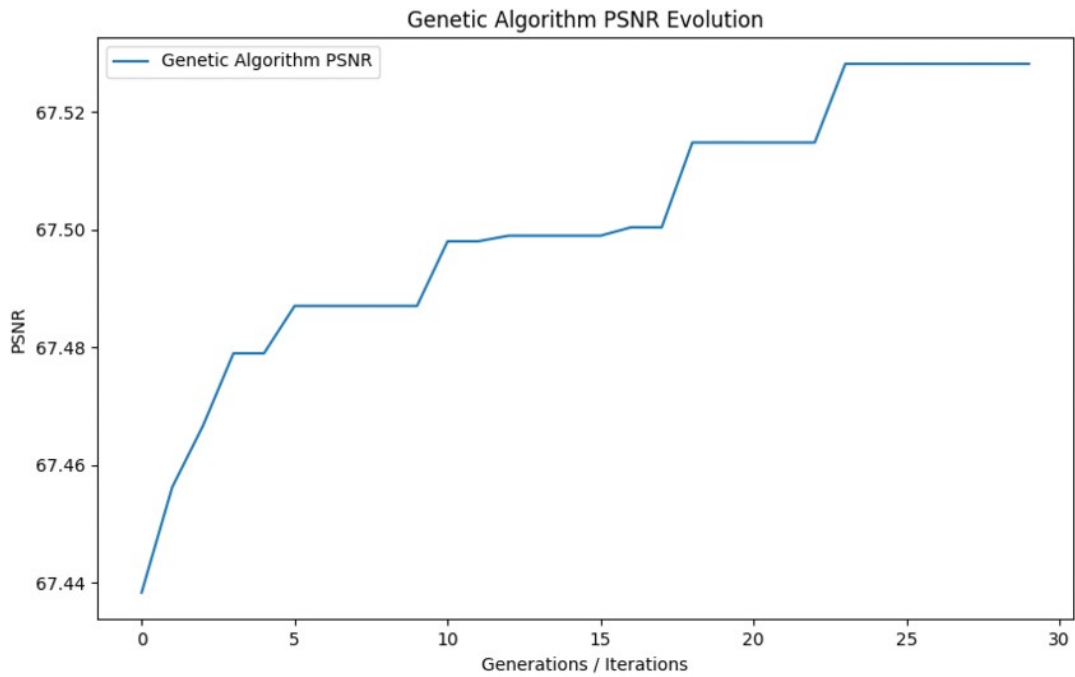
```
binary_data = ''.join(random.choice(['0', '1']) for _ in range(131072)) 131072 BITS (POLOWA ZDJECIA 512X512)
```

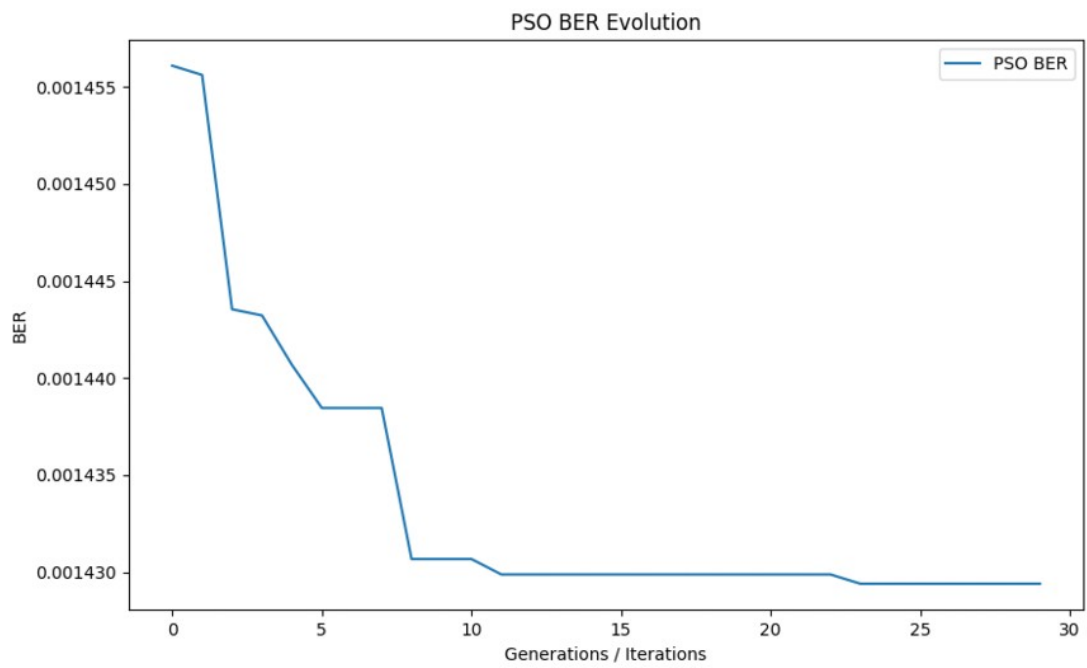
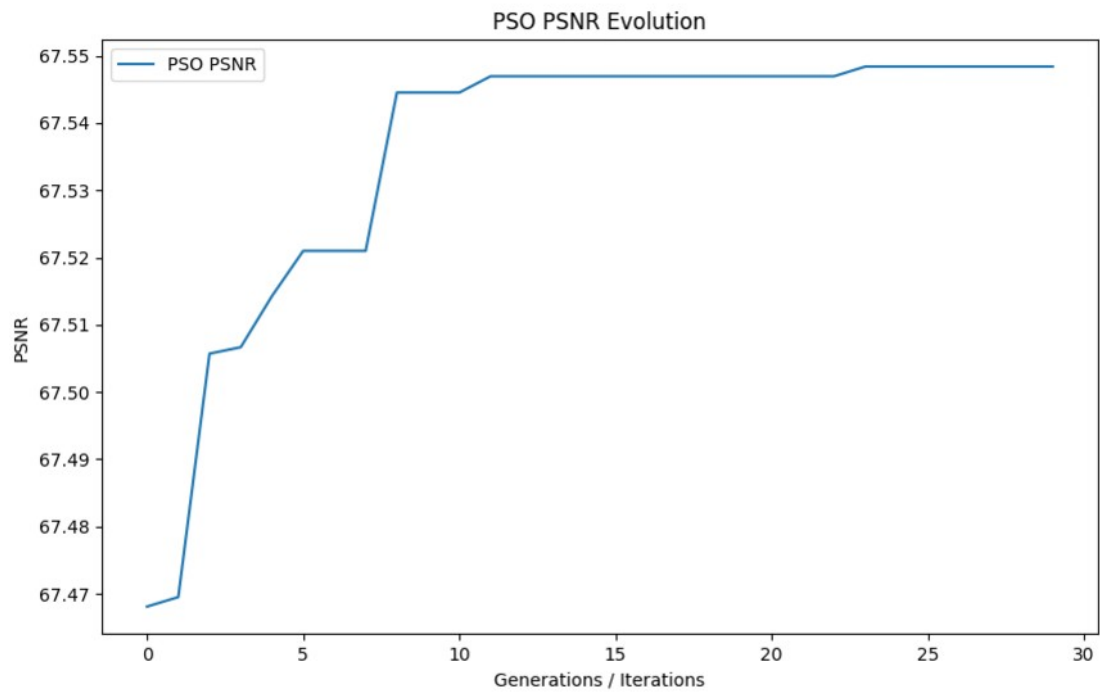


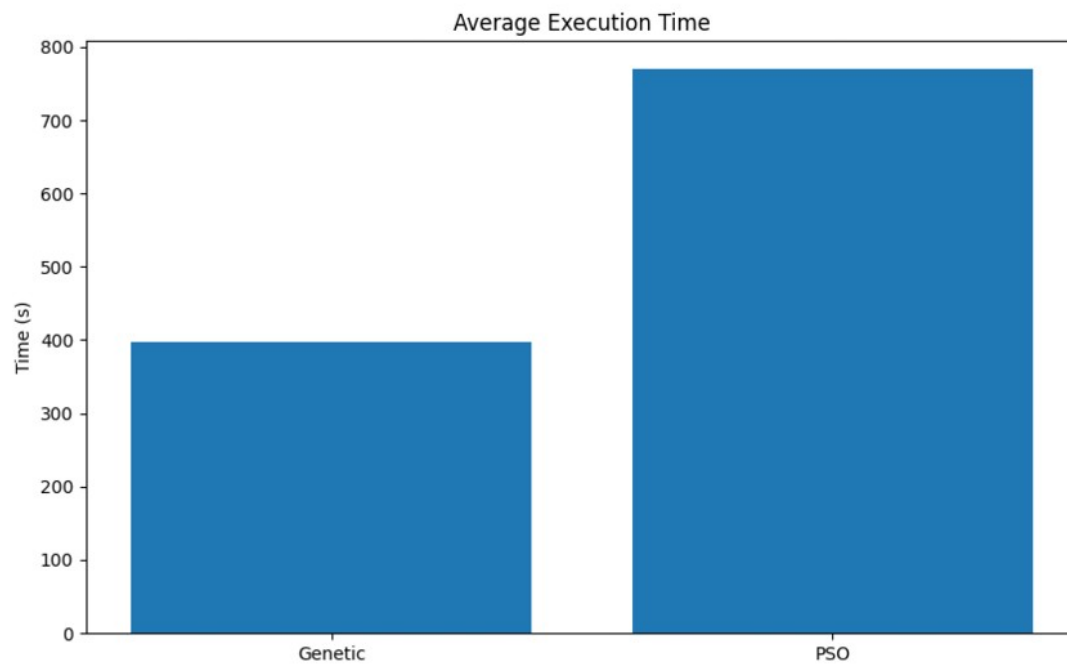




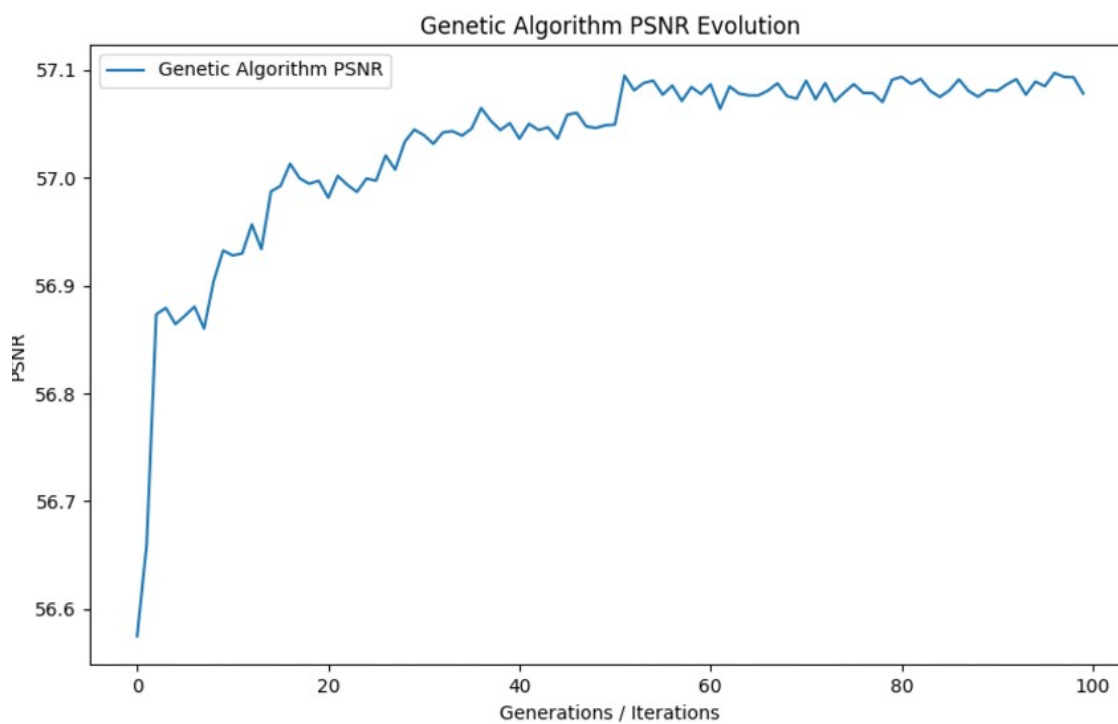


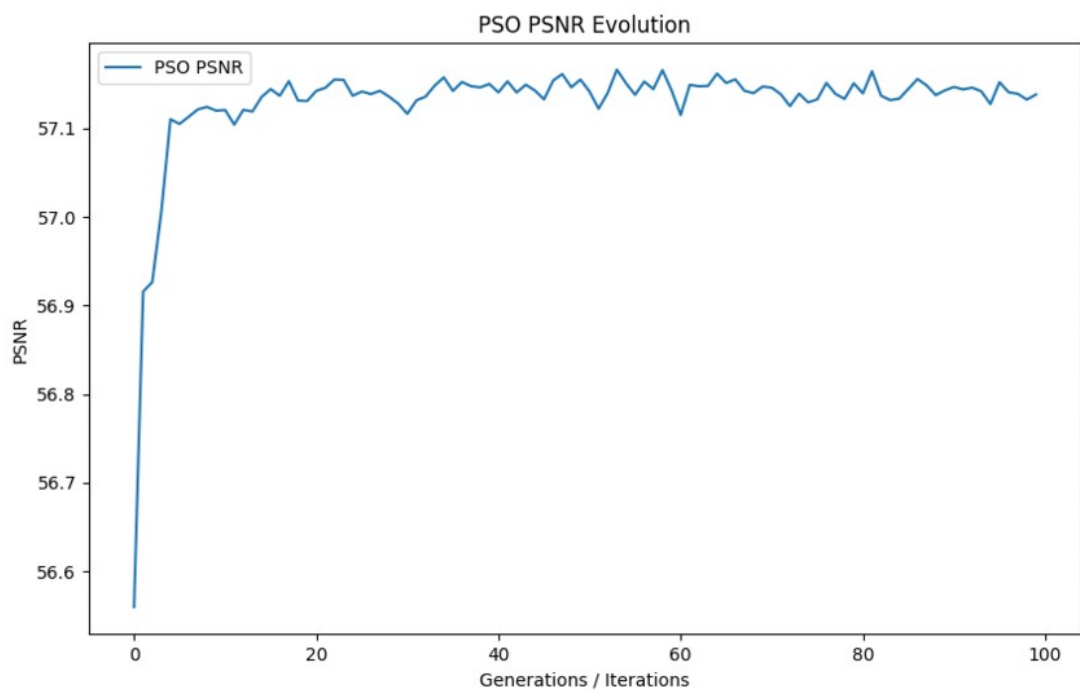
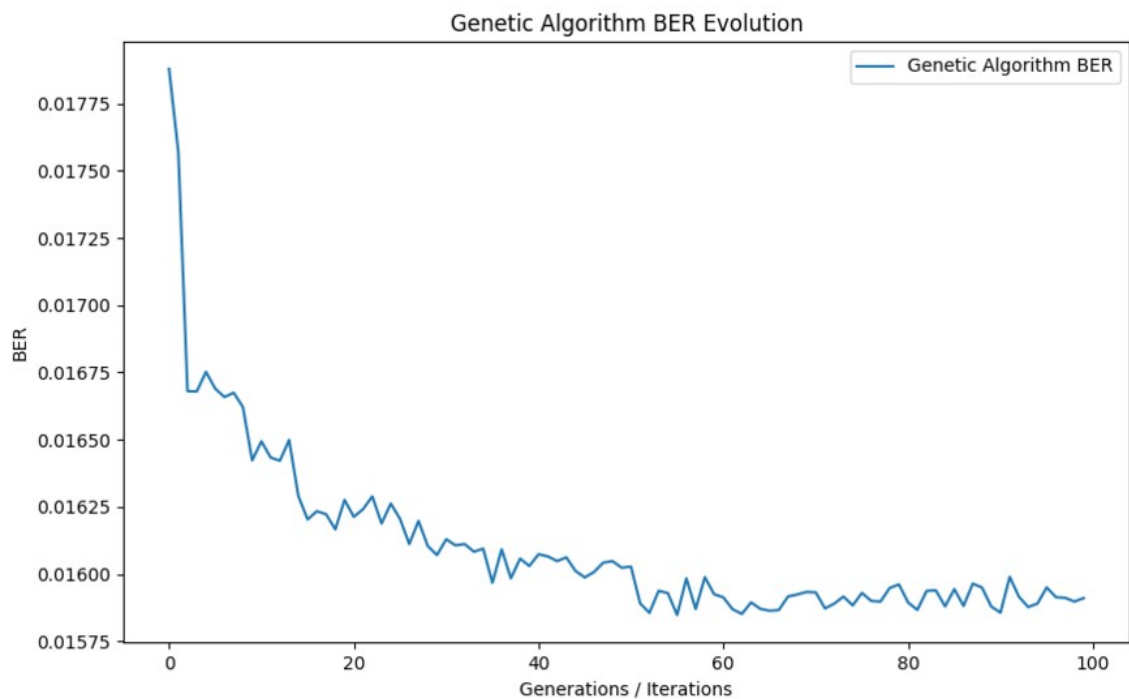


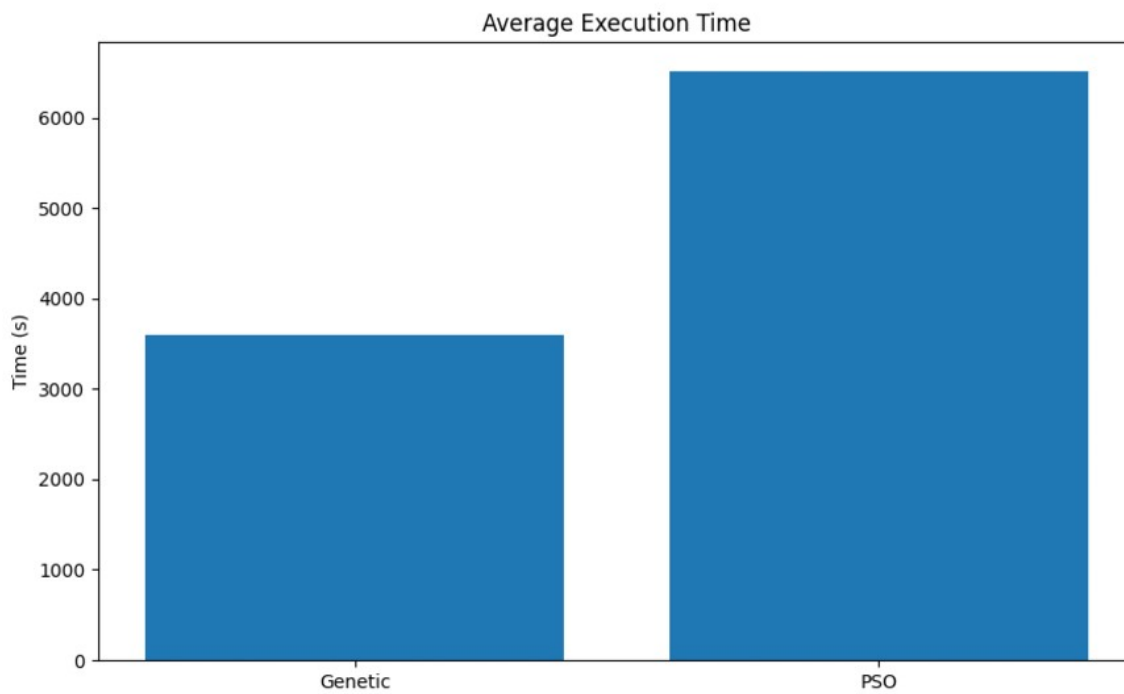
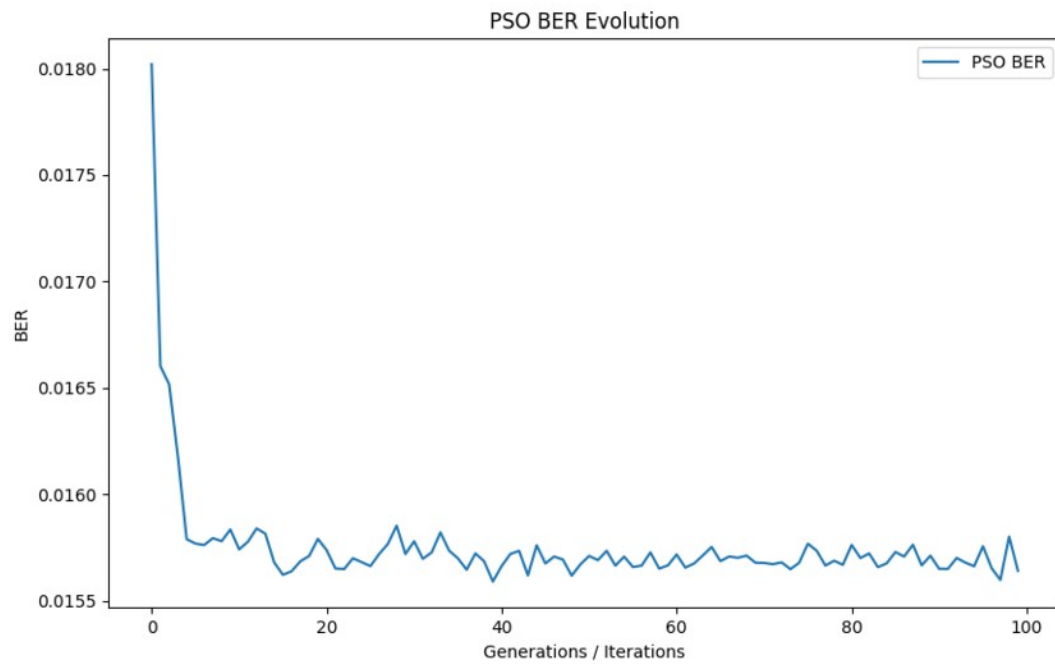




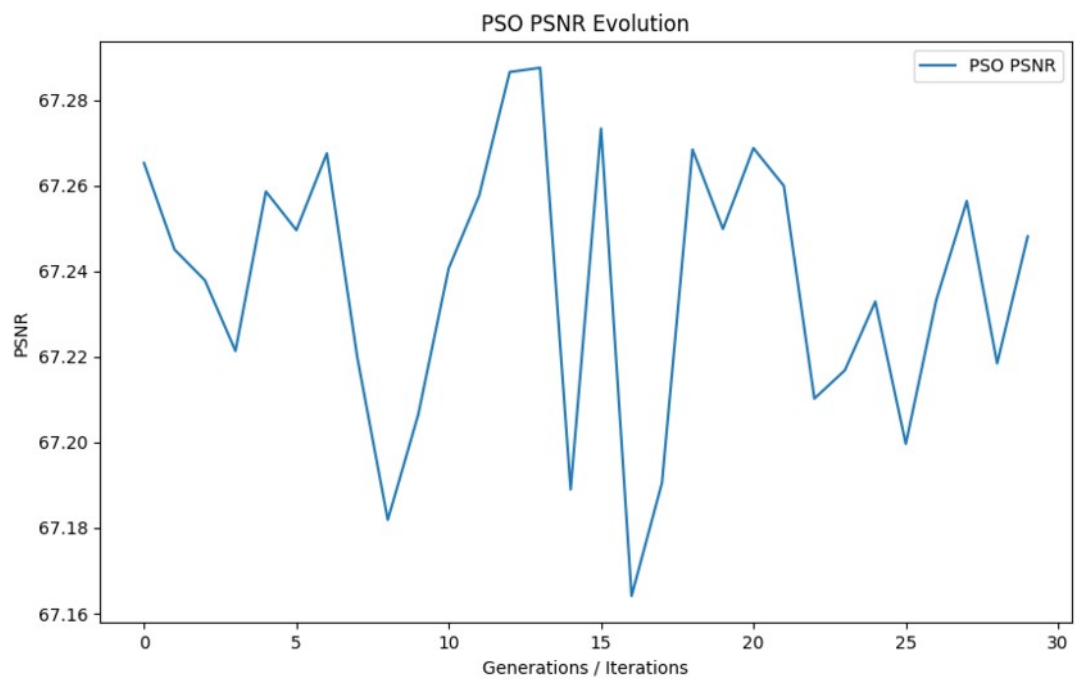
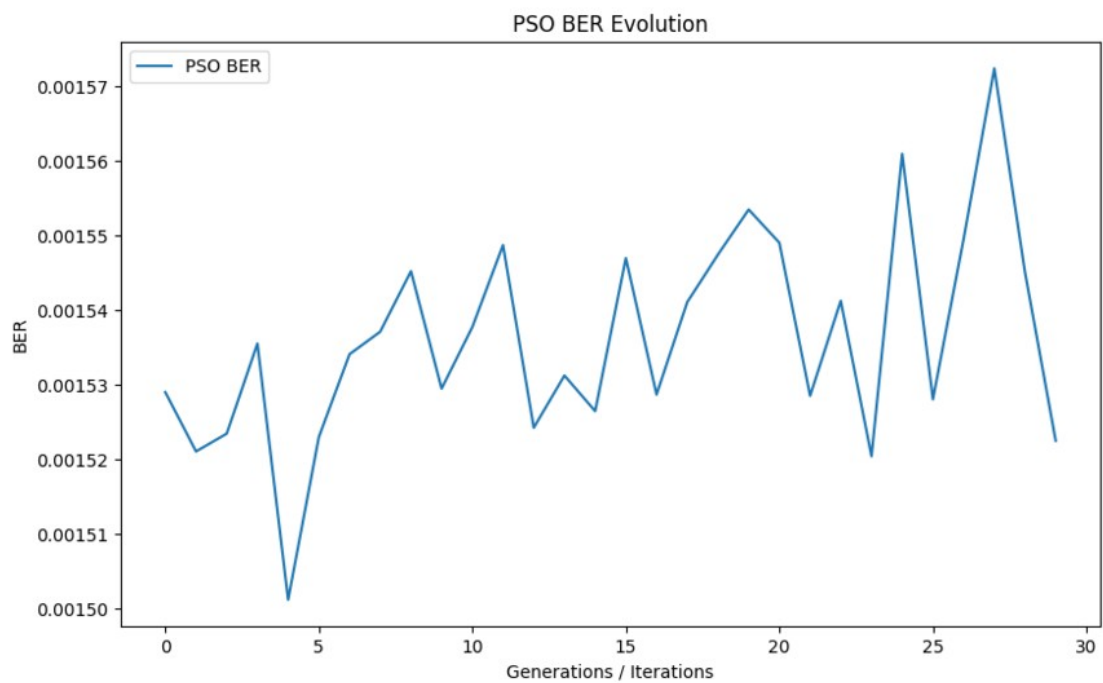
ZWIEKSZONO POPULACJE DO 50 oraz epoki do 100



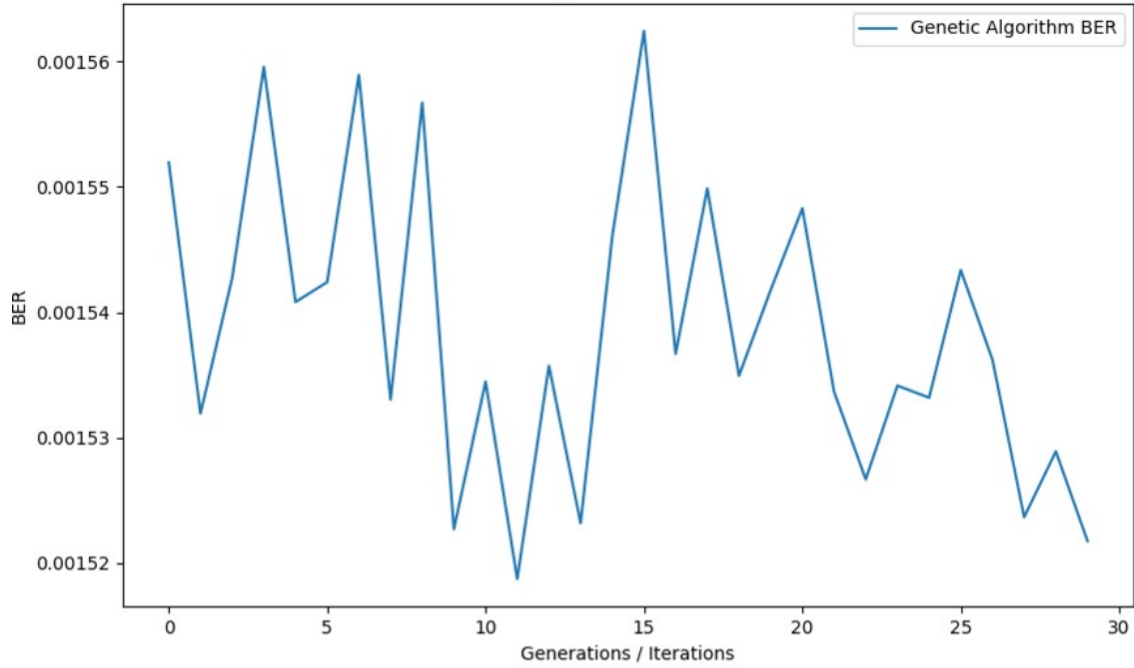




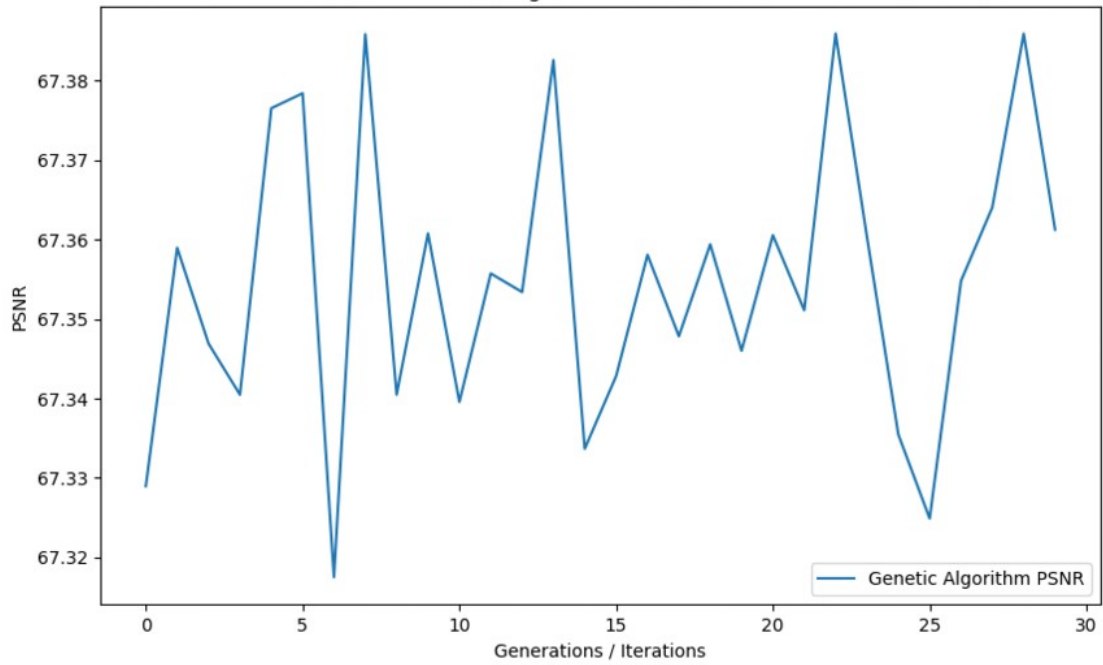
Po optymalizacji 30 epok, 30 populacja, 6400 bitow

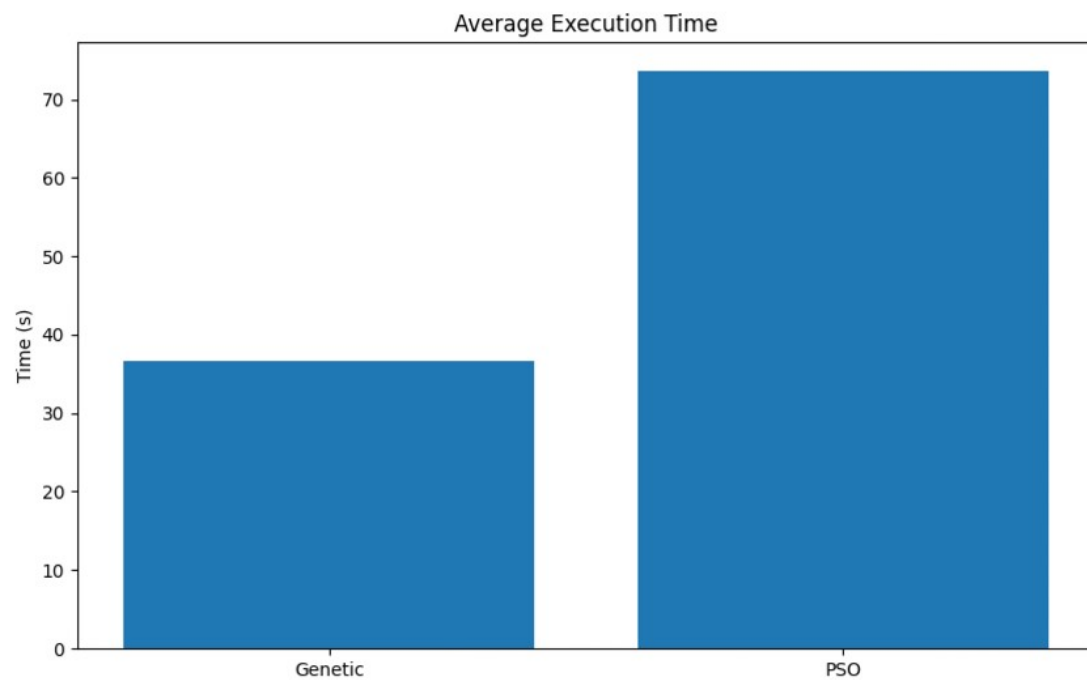


Genetic Algorithm BER Evolution



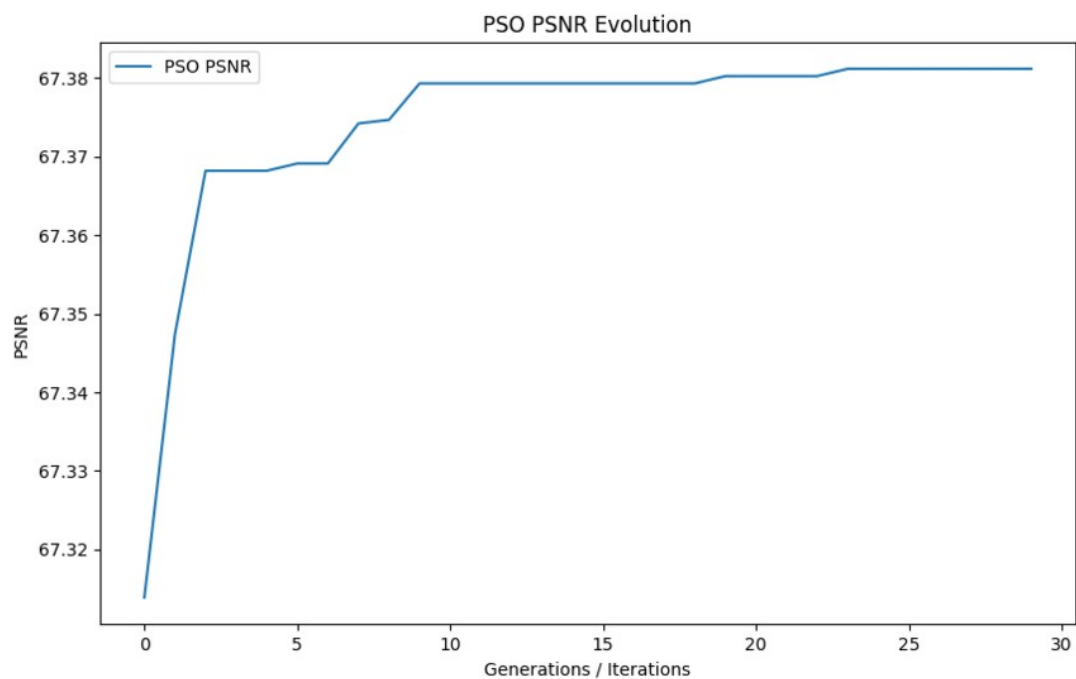
Genetic Algorithm PSNR Evolution

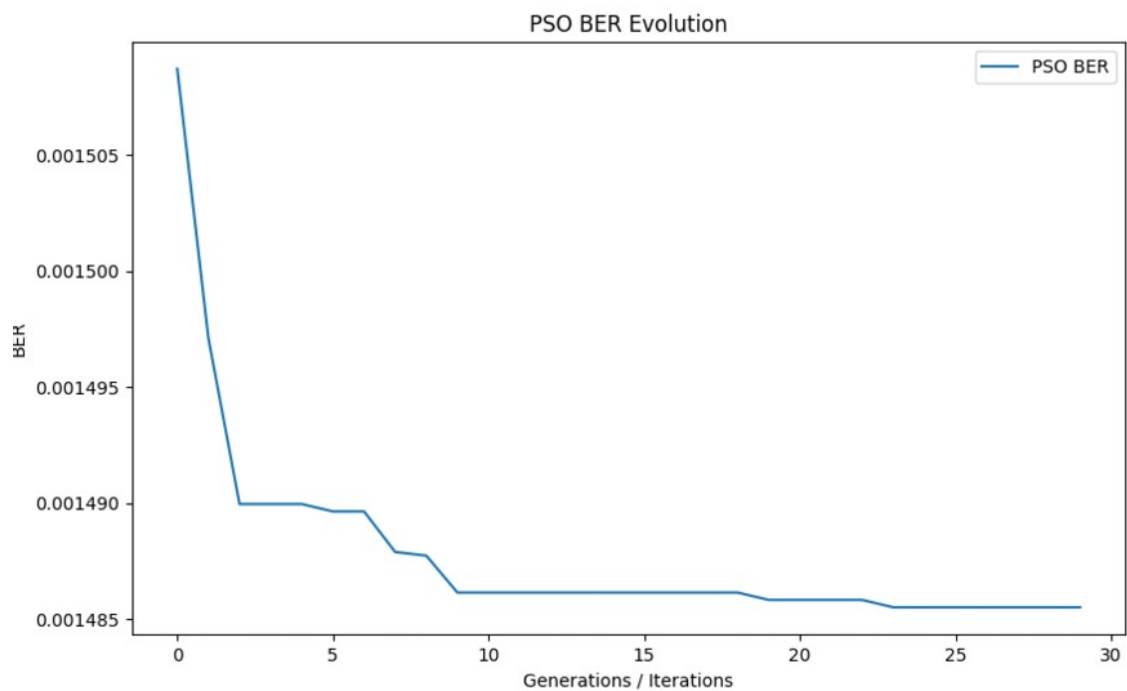
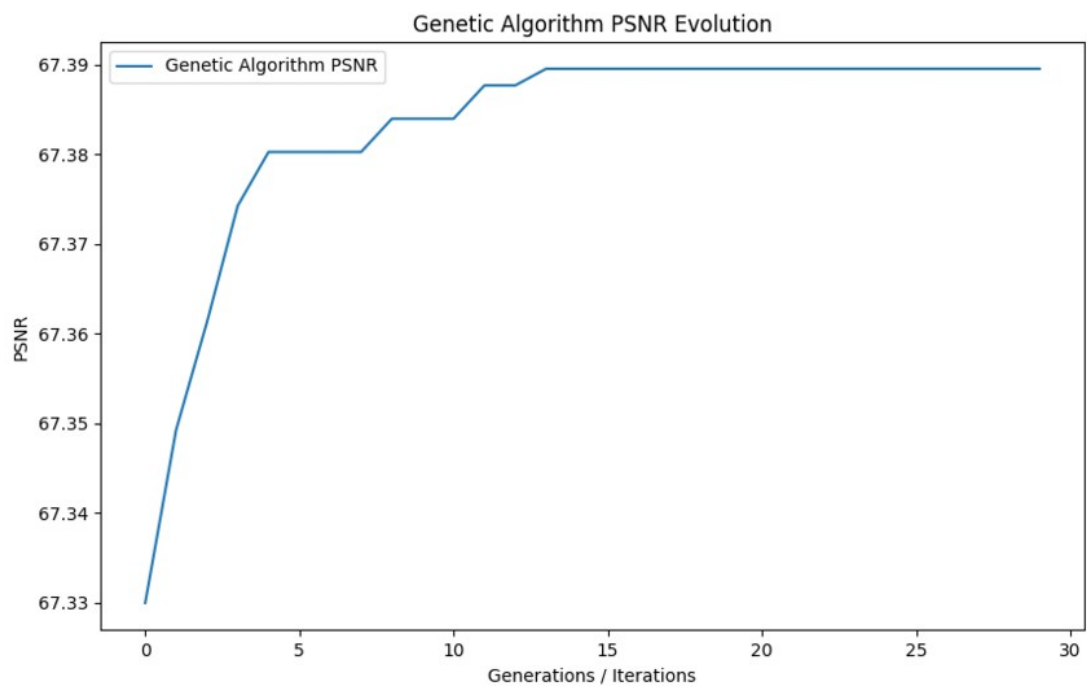


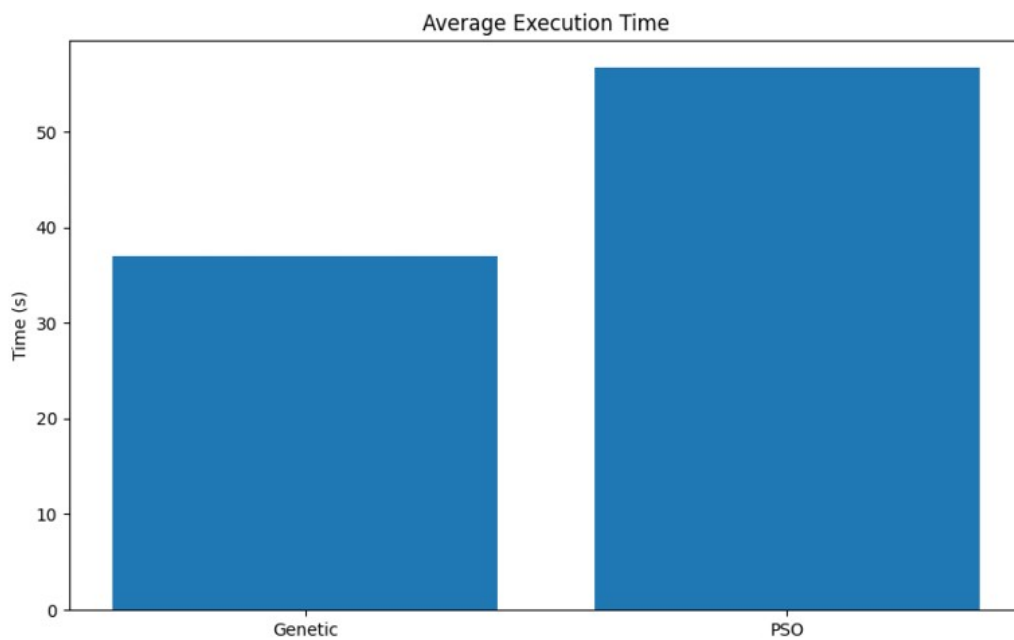
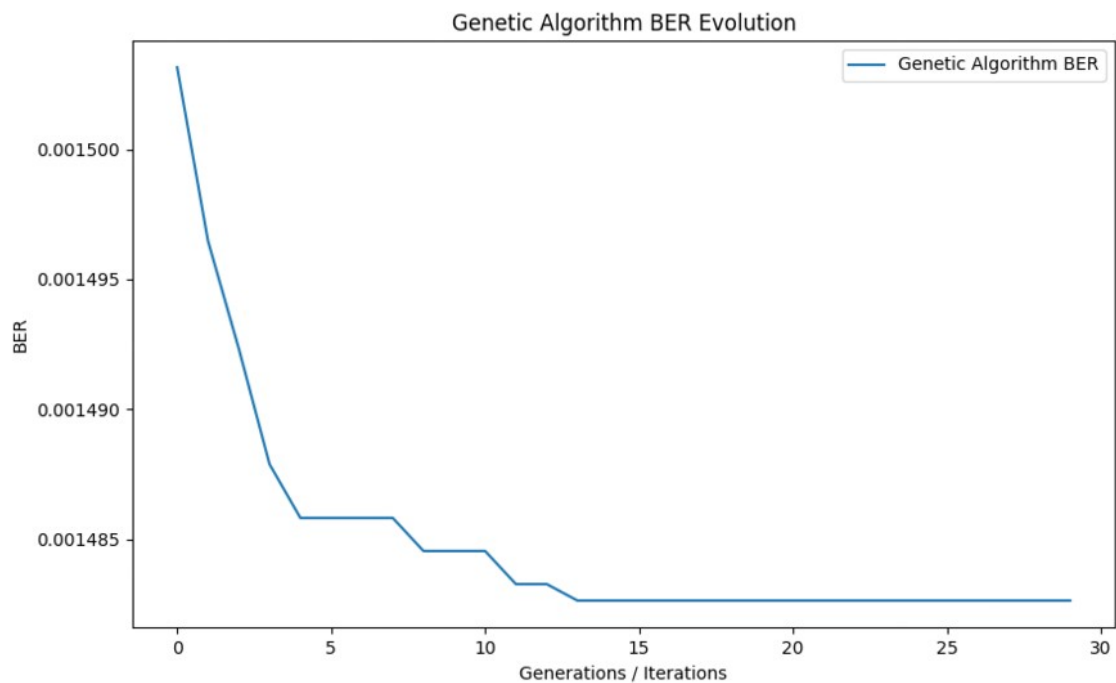


Dane do ukrycia byly losowo generowane dla kazdej generacji!!!!

W PSO BRAKOWALO .copy() przy przypisywaniu najlepszej czastki







x=PSO y=56.2

Ok. 5 sekund poprawy sredniego czasu po przepisaniu ze stringow na array[0,1]

TESTY

populacja : 30

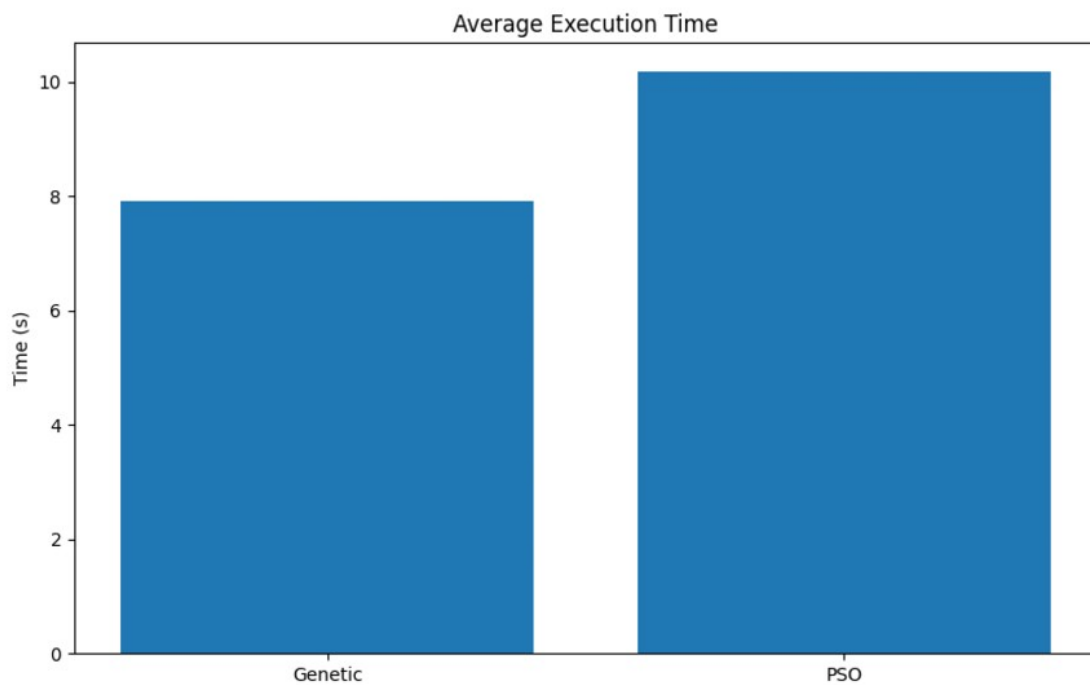
generacje : 30

mutation_rate = 0.3

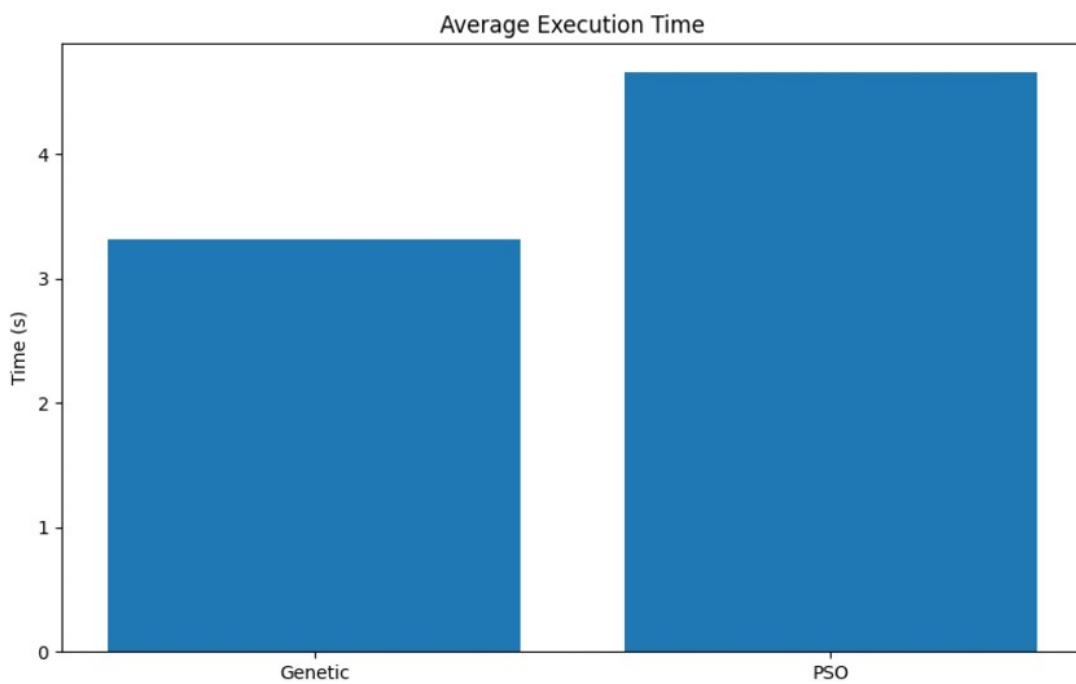
zdjecie : $256 \times 256 = 65,536$ bits

ukryte = 20000 bits

czasy : PSO 10s GENETIC 8s



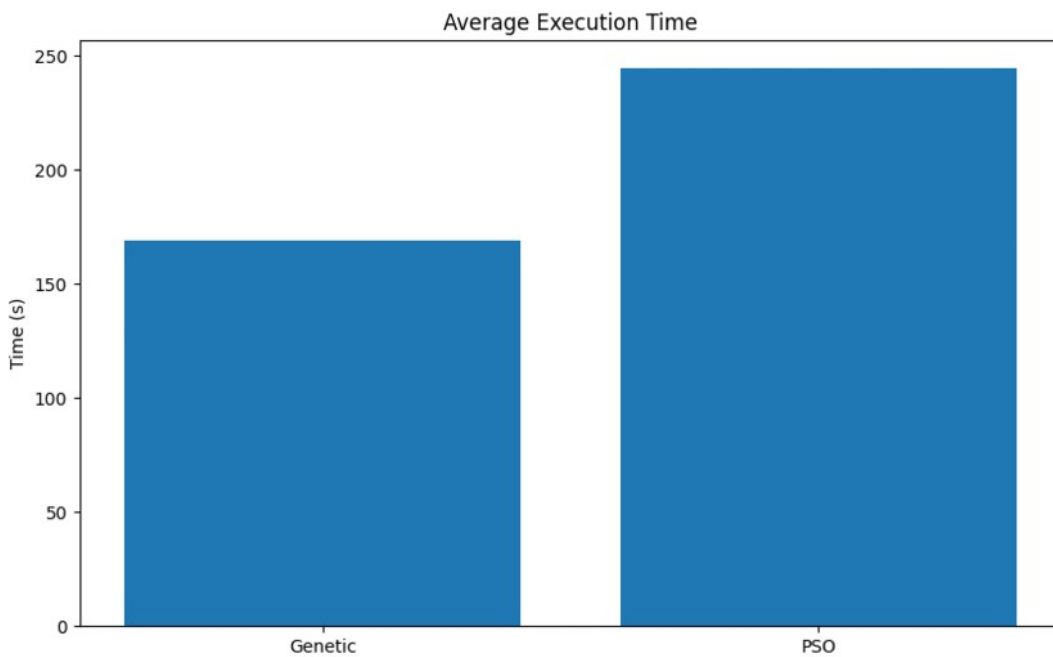
Po zakomentowaniu czesci od Dekodowania (wykorzystywana do teraz jako sprawdzenie poprawnosci odczytanych danych)



PSO : 4.64 GENETYK : 3.25

TE SAME DANE WIEKSZY OBRAZ 512x512 = 262,144 bits

UKRYTE : $\frac{1}{3} * 262,144 \text{ bits} = 87400 \text{ bits}$



PSO : 243.4 GENETIC : 169.5

populacja : 50

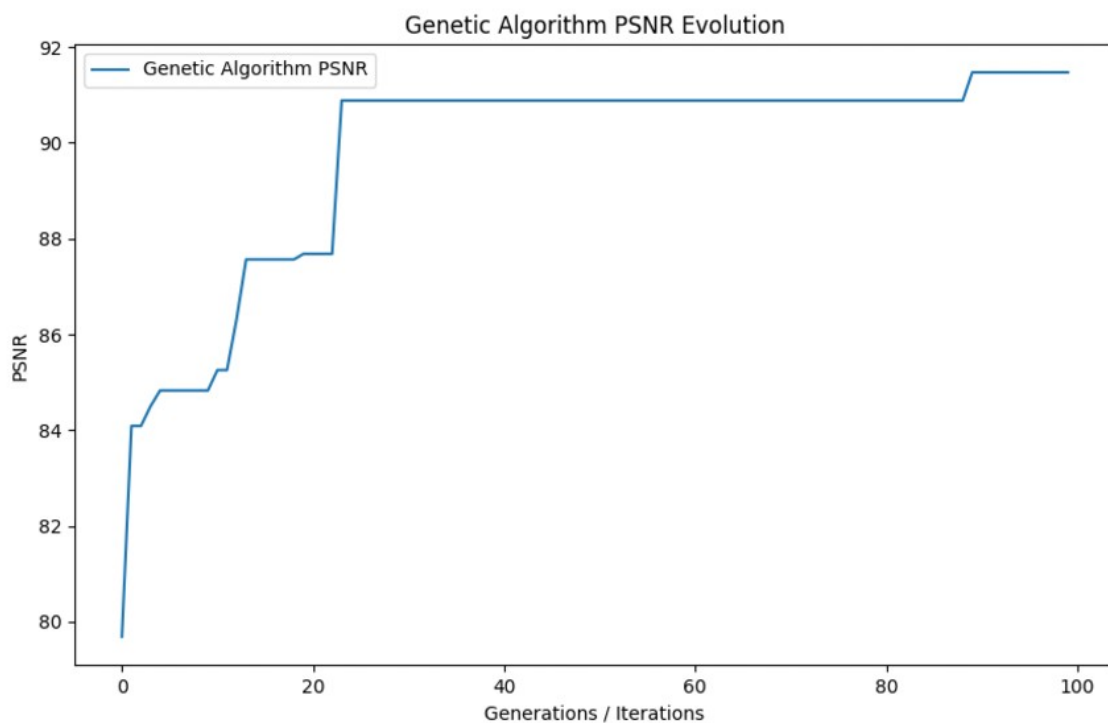
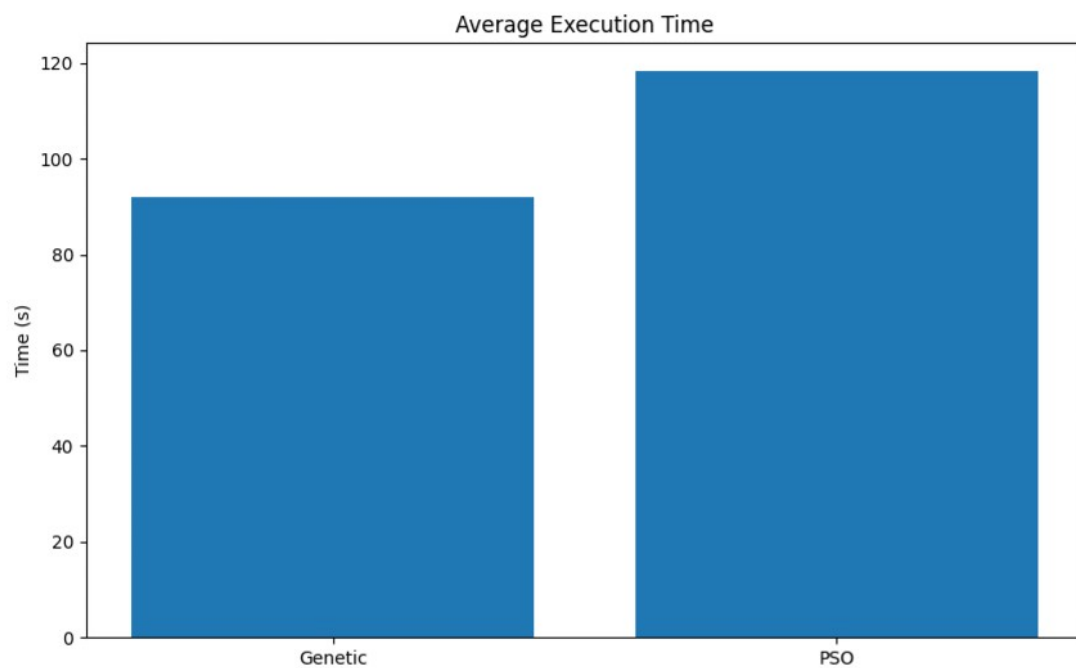
generacje : 100

mutation_rate = 0.3

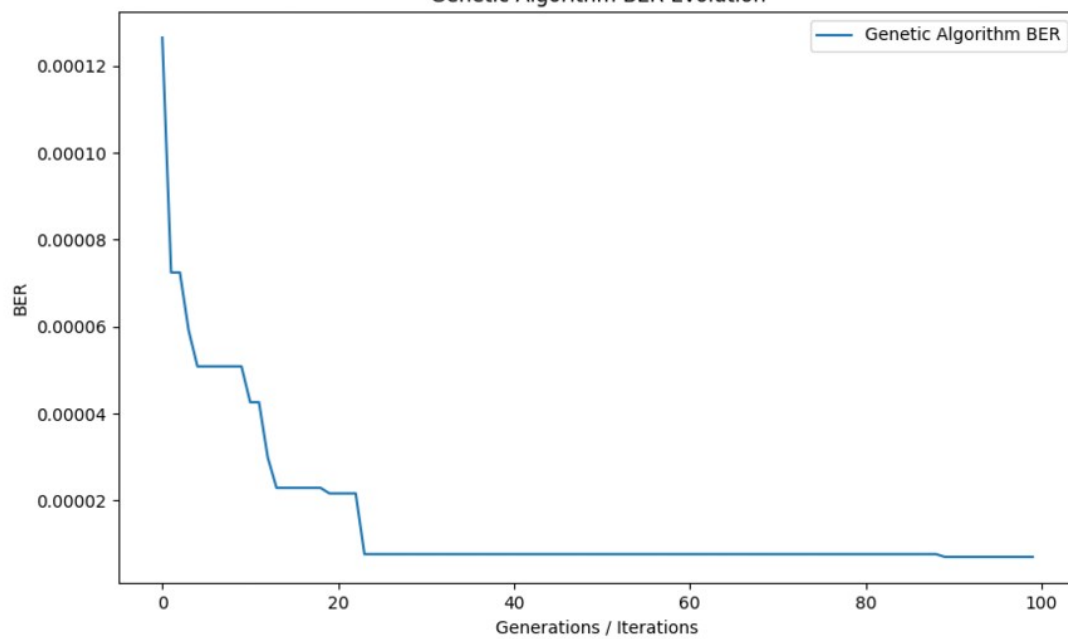
zdjecie : 256x256 = 65,536 bits

ukryte = 20000 bits

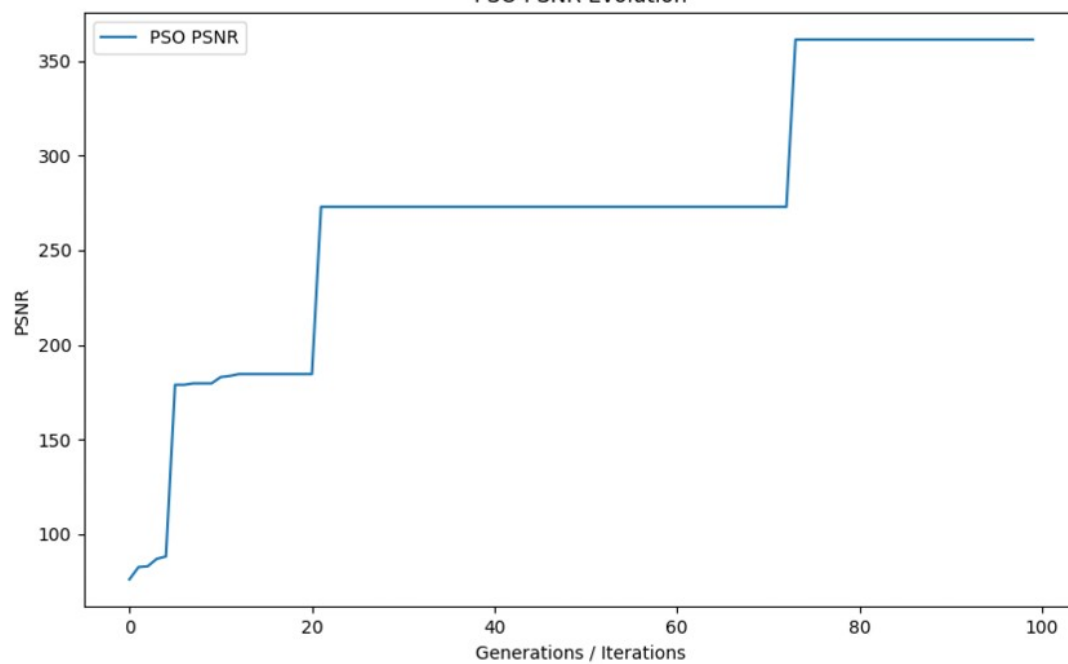
CZASY : PSO : 119.5 GENETIC : 91.5

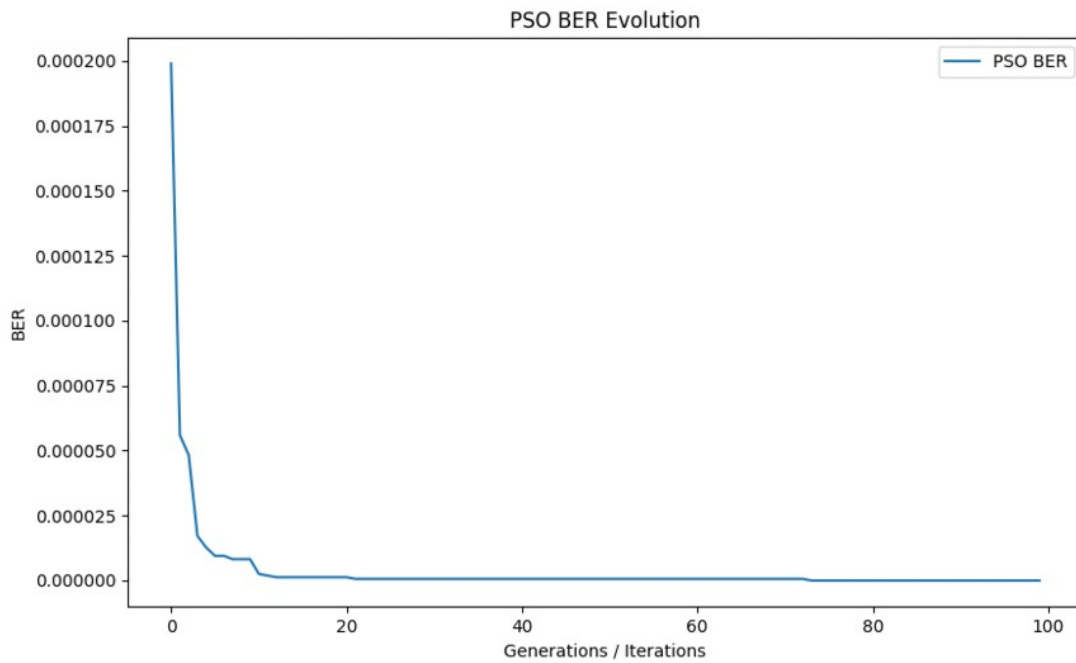


Genetic Algorithm BER Evolution



PSO PSNR Evolution





zdjecie : 512x512 = 262,144 bits

ukryte = 87500 bits

CZASY : PSO : 119.5 GENETIC : 91.5

PO ZROWNOLEGLNIU:

* DODANO Pooling

```
def parallel_fitness(population, image, binary_data, delimiter):
    with Pool() as pool:
        fitness_scores = pool.map(fitness_function_array,
                                   [(chromosome, image, binary_data, delimiter) for chromosome in population])
    return fitness_scores
```

* zmieniono z Threading.Thread na multiprocessing.Process

* przekazano wiele atrybutow jako parametr, w celu zniwelowania ponownych obliczen

Epoki : 30

Populacje : 30

zdjecie : $512 \times 512 = 262,144$ bits

ukryte = 87500 bits

Genetic Time: 63.429412841796875 seconds

PSO Time: 63.681725025177 seconds

Epoki : 100

Populacje : 50

Genetic Time: 258.55763602256775 seconds

PSO Time: 259.01299810409546 seconds

Testy porównawcze na 4 procesach dla populacji = 50 oraz epok = 100 wykazały, że równoleglenie nie ma sensu dla małych populacji – czas sekwencyjny był niższy niż zrownoleglony:

Starting comparison of algorithms across different image sizes...

Running for matrix size: 120

Starting run for matrix size 120 with 4 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 0.2876 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 0.7161 seconds.
- Starting parallel genetic algorithm with 4 processes...
- Parallel genetic algorithm completed in 35.9950 seconds.
- Starting parallel PSO algorithm with 4 processes...
- Parallel PSO algorithm completed in 36.4752 seconds.

Running for matrix size: 240

Starting run for matrix size 240 with 4 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 2.1905 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 3.8687 seconds.
- Starting parallel genetic algorithm with 4 processes...
- Parallel genetic algorithm completed in 37.8793 seconds.
- Starting parallel PSO algorithm with 4 processes...
- Parallel PSO algorithm completed in 39.1787 seconds.

Running for matrix size: 360

Starting run for matrix size 360 with 4 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 5.7399 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 11.7645 seconds.
- Starting parallel genetic algorithm with 4 processes...
- Parallel genetic algorithm completed in 38.8018 seconds.
- Starting parallel PSO algorithm with 4 processes...
- Parallel PSO algorithm completed in 39.4111 seconds.

Running for matrix size: 480

Starting run for matrix size 480 with 4 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 9.3823 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 18.9872 seconds.
- Starting parallel genetic algorithm with 4 processes...
- Parallel genetic algorithm completed in 40.1139 seconds.
- Starting parallel PSO algorithm with 4 processes...
- Parallel PSO algorithm completed in 40.3677 seconds.

Running for matrix size: 512

Starting run for matrix size 512 with 4 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 13.5925 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 27.5920 seconds.
- Starting parallel genetic algorithm with 4 processes...
- Parallel genetic algorithm completed in 42.3531 seconds.
- Starting parallel PSO algorithm with 4 processes...
- Parallel PSO algorithm completed in 41.6634 seconds.

Starting comparison of algorithms across different image sizes...

Running for matrix size: 120

Starting run for matrix size 120 with 16 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 0.2754 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 0.7055 seconds.
- Starting parallel genetic algorithm with 16 processes...
- Parallel genetic algorithm completed in 49.9150 seconds.
- Starting parallel PSO algorithm with 16 processes...
- Parallel PSO algorithm completed in 52.5241 seconds.

Running for matrix size: 240

Starting run for matrix size 240 with 16 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 2.1962 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 3.8179 seconds.
- Starting parallel genetic algorithm with 16 processes...

- Parallel genetic algorithm completed in 51.5110 seconds.
- Starting parallel PSO algorithm with 16 processes...
- Parallel PSO algorithm completed in 53.5832 seconds.

Running for matrix size: 360

Starting run for matrix size 360 with 16 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 6.0521 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 12.1577 seconds.
- Starting parallel genetic algorithm with 16 processes...
- Parallel genetic algorithm completed in 54.8246 seconds.
- Starting parallel PSO algorithm with 16 processes...
- Parallel PSO algorithm completed in 55.6844 seconds.

Running for matrix size: 480

Starting run for matrix size 480 with 16 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 9.5145 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 19.2747 seconds.
- Starting parallel genetic algorithm with 16 processes...
- Parallel genetic algorithm completed in 55.6263 seconds.
- Starting parallel PSO algorithm with 16 processes...
- Parallel PSO algorithm completed in 57.2177 seconds.

Running for matrix size: 512

Starting run for matrix size 512 with 16 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 13.7368 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 28.0355 seconds.
- Starting parallel genetic algorithm with 16 processes...
- Parallel genetic algorithm completed in 58.0518 seconds.
- Starting parallel PSO algorithm with 16 processes...
- Parallel PSO algorithm completed in 58.7831 seconds.

Zwiększono populacje do 100

Starting comparison of algorithms across different image sizes...

Running for matrix size: 120

Starting run for matrix size 120 with 2 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 0.5155 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 1.3163 seconds.
- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 35.4095 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 36.0597 seconds.

Running for matrix size: 240

Starting run for matrix size 240 with 2 processes...

- Starting sequential genetic algorithm...

- Sequential genetic algorithm completed in 4.3160 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 7.4325 seconds.
- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 38.5903 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 39.1616 seconds.

Running for matrix size: 360

Starting run for matrix size 360 with 2 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 11.5744 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 23.2328 seconds.
- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 41.0582 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 42.1270 seconds.

Running for matrix size: 480

Starting run for matrix size 480 with 2 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 19.4041 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 38.4898 seconds.
- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 45.1577 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 45.9768 seconds.

Running for matrix size: 512

Starting run for matrix size 512 with 2 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 27.3253 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 54.6740 seconds.
- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 50.3200 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 50.1486 seconds.

Do 1000:

Starting comparison of algorithms across different image sizes...

Running for matrix size: 120

Starting run for matrix size 120 with 2 processes...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 5.0681 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 12.6751 seconds.
- Starting parallel genetic algorithm with 2 processes...

```

- Parallel genetic algorithm completed in 38.8783 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 48.0434 seconds.
Running for matrix size: 240
Starting run for matrix size 240 with 2 processes...
- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 43.1790 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 74.6257 seconds.
- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 62.1749 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 71.1949 seconds.
Running for matrix size: 360
Starting run for matrix size 360 with 2 processes...
- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 112.9713 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 231.4169 seconds.
- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 94.8493 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 102.4244 seconds.
Running for matrix size: 480
Starting run for matrix size 480 with 2 processes...
- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 189.3037 seconds.
- Starting sequential PSO algorithm...

```

Dla rozmiaru obrazu 360 pierwsze zyski urownoleglenia.

```

- Starting sequential PSO algorithm
...Starting run for matrix size 360 with 4 processes... -
Starting sequential genetic algorithm... -
Sequential genetic algorithm completed in 116.3955 seconds. -
Starting sequential PSO algorithm... -
Sequential PSO algorithm completed in 237.6956 seconds. -
Starting parallel genetic algorithm with 4 processes... -
Parallel genetic algorithm completed in 71.9046 seconds. -
Starting parallel PSO algorithm with 4 processes... -
Parallel PSO algorithm completed in 78.4662 seconds.

```

Po testach zapisu pliku time_seq vs. time_par

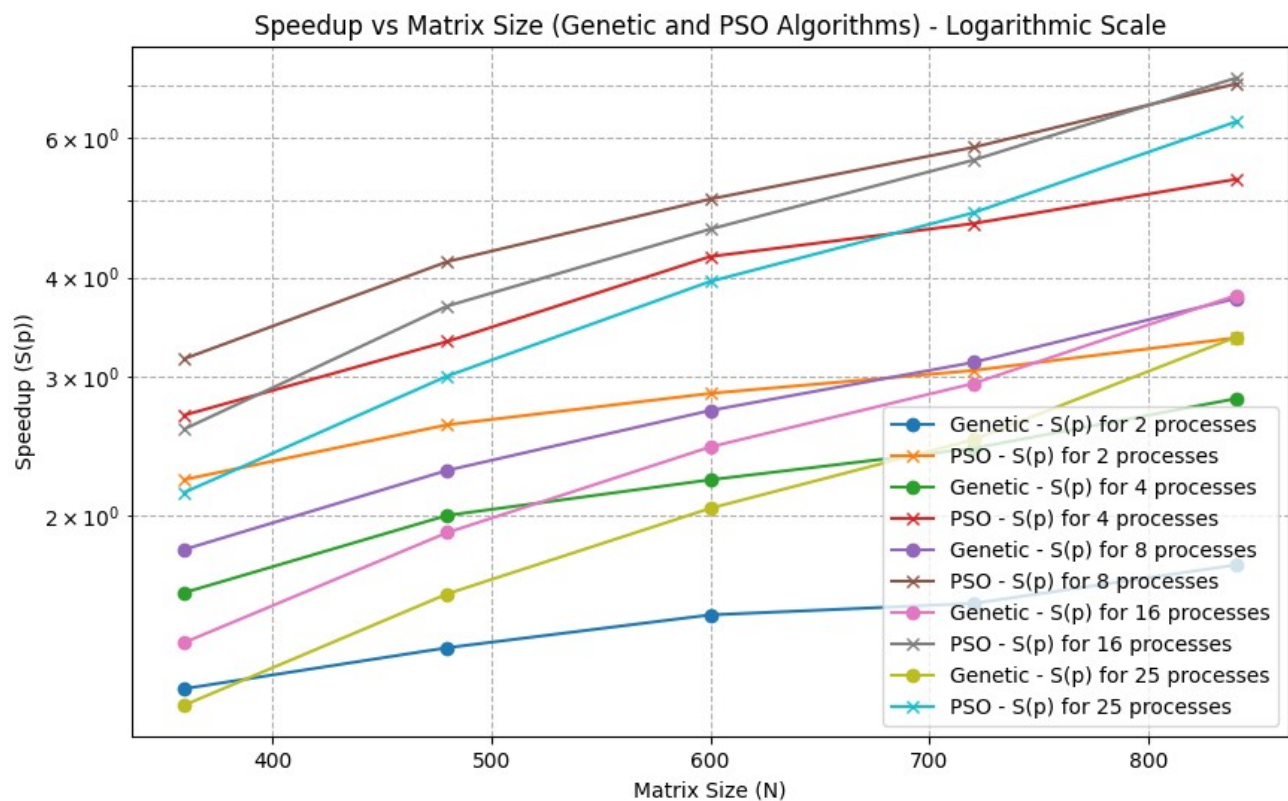
Dodano skrypt testowy dla następujących danych w celu obliczenia wydajności:

Rozmiary obrazu: [360, 480, 512, 640, 720]

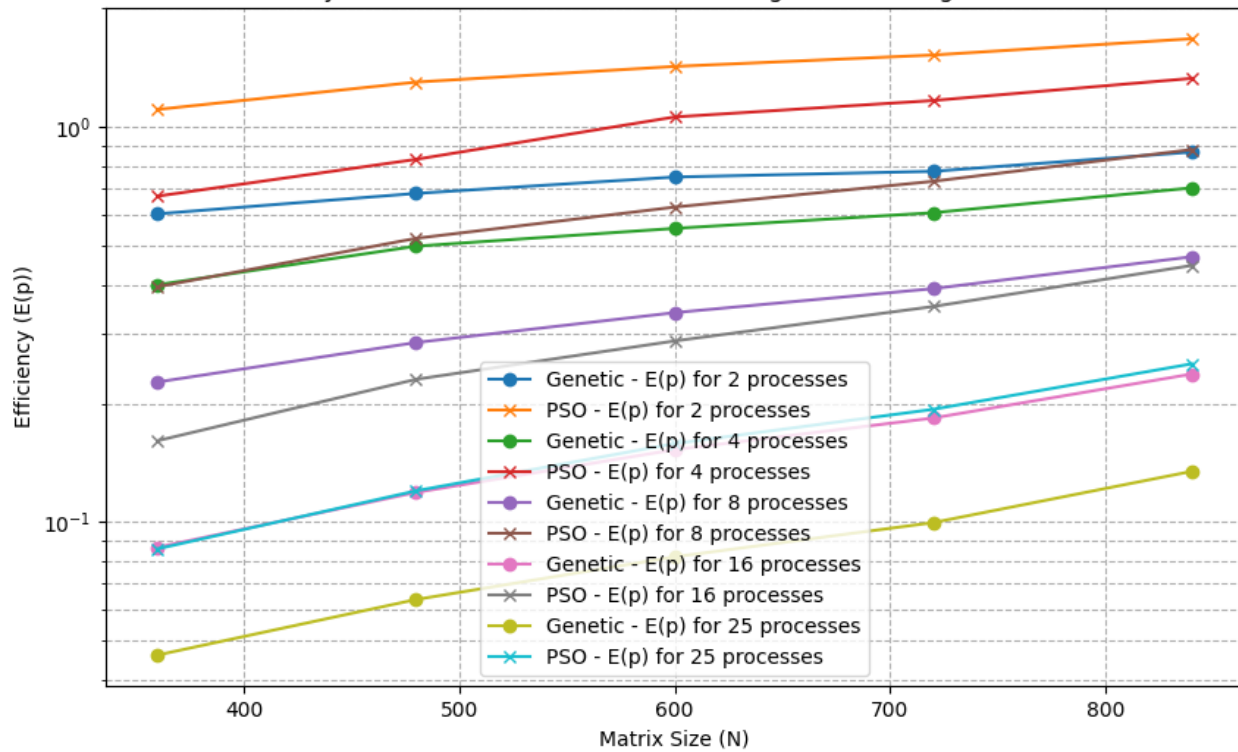
Liczba procesow: [2, 4, 8, 16, 25]

Populacje : 1000

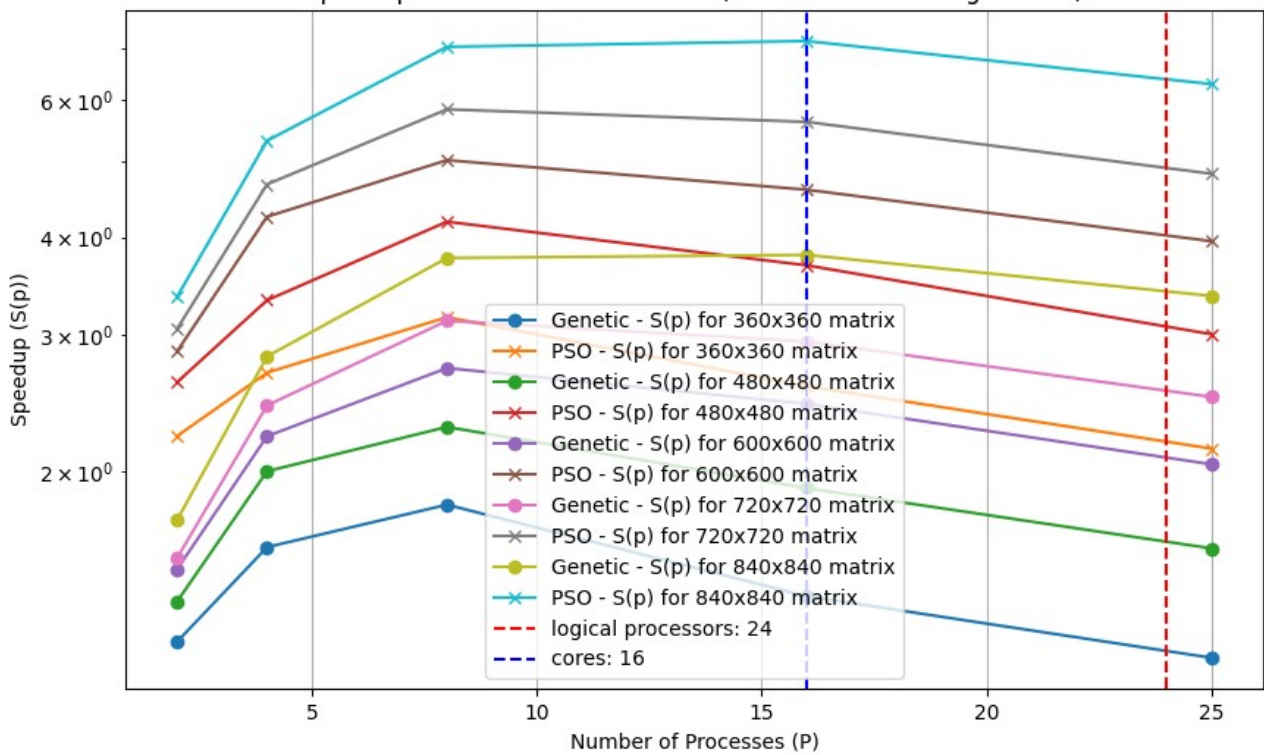
Epoki : 100



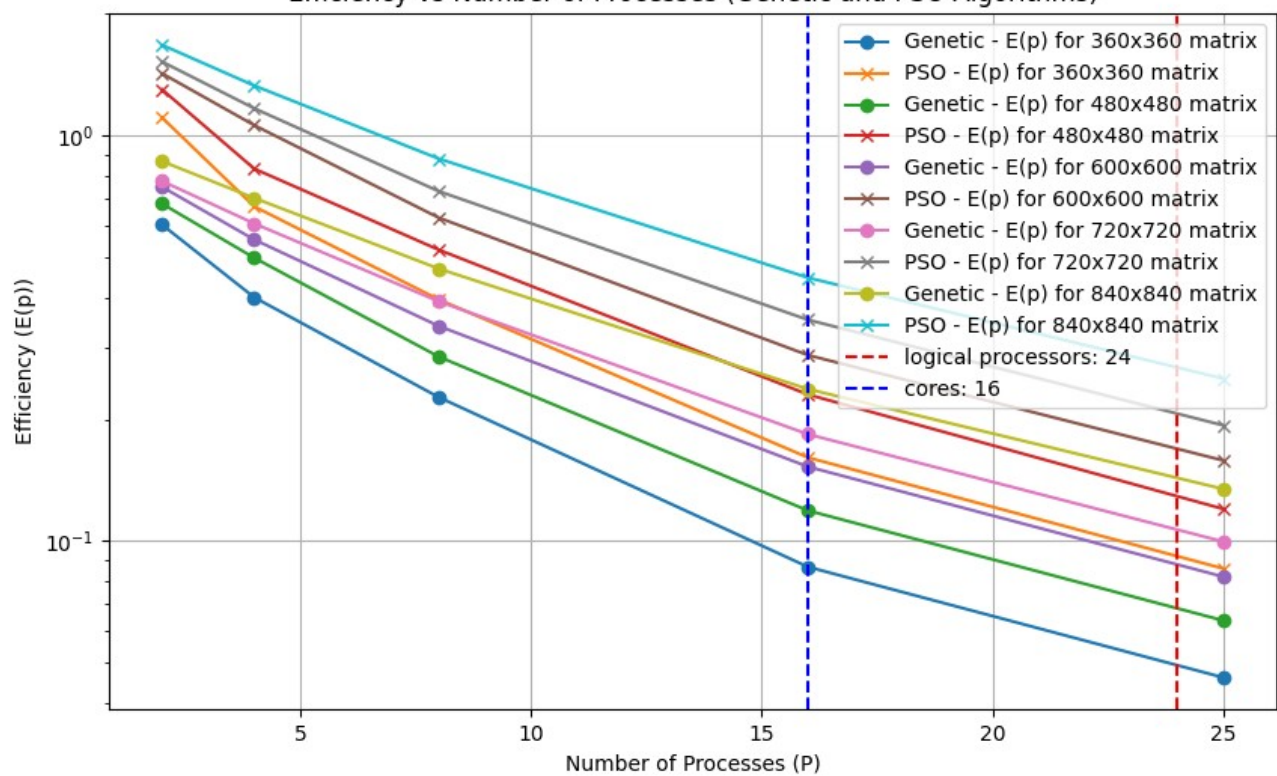
Efficiency vs Matrix Size (Genetic and PSO Algorithms) - Logarithmic Scale



Speedup vs Number of Processes (Genetic and PSO Algorithms)



Efficiency vs Number of Processes (Genetic and PSO Algorithms)



BACKUP CMD:

Starting comparison of algorithms across different image sizes...

Running sequential algorithms for matrix size: 360

Starting sequential run for matrix size 360...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 114.8637 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 231.9453 seconds.

Running sequential algorithms for matrix size: 480

Starting sequential run for matrix size 480...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 183.8182 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 373.4458 seconds.

Running sequential algorithms for matrix size: 600

Starting sequential run for matrix size 600...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 275.7816 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 554.8547 seconds.

Running sequential algorithms for matrix size: 720

Starting sequential run for matrix size 720...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 387.9285 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 789.9013 seconds.

Running sequential algorithms for matrix size: 840

Starting sequential run for matrix size 840...

- Starting sequential genetic algorithm...
- Sequential genetic algorithm completed in 602.4391 seconds.
- Starting sequential PSO algorithm...
- Sequential PSO algorithm completed in 1194.8779 seconds.

Running for matrix size: 360 and num_processes: 2

Starting parallel run for matrix size 360 with 2 processes...

- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 95.0529 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 104.4107 seconds.

Running for matrix size: 480 and num_processes: 2

Starting parallel run for matrix size 480 with 2 processes...

- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 135.0131 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 143.3092 seconds.

Running for matrix size: 600 and num_processes: 2

Starting parallel run for matrix size 600 with 2 processes...

- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 184.0997 seconds.

- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 194.3363 seconds.

Running for matrix size: 720 and num_processes: 2

Starting parallel run for matrix size 720 with 2 processes...

- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 250.4942 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 258.8205 seconds.

Running for matrix size: 840 and num_processes: 2

Starting parallel run for matrix size 840 with 2 processes...

- Starting parallel genetic algorithm with 2 processes...
- Parallel genetic algorithm completed in 347.6599 seconds.
- Starting parallel PSO algorithm with 2 processes...
- Parallel PSO algorithm completed in 356.0165 seconds.

Results saved to result_2.txt

Running for matrix size: 360 and num_processes: 4

Starting parallel run for matrix size 360 with 4 processes...

- Starting parallel genetic algorithm with 4 processes...
- Parallel genetic algorithm completed in 71.8516 seconds.
- Starting parallel PSO algorithm with 4 processes...
- Parallel PSO algorithm completed in 86.5523 seconds.

Running for matrix size: 480 and num_processes: 4

Starting parallel run for matrix size 480 with 4 processes...

- Starting parallel genetic algorithm with 4 processes...
- Parallel genetic algorithm completed in 91.8388 seconds.
- Starting parallel PSO algorithm with 4 processes...
- Parallel PSO algorithm completed in 112.4498 seconds.

Running for matrix size: 600 and num_processes: 4

Starting parallel run for matrix size 600 with 4 processes...

- Starting parallel genetic algorithm with 4 processes...
- Parallel genetic algorithm completed in 124.2159 seconds.
- Starting parallel PSO algorithm with 4 processes...
- Parallel PSO algorithm completed in 130.4708 seconds.

Running for matrix size: 720 and num_processes: 4

Starting parallel run for matrix size 720 with 4 processes...

- Starting parallel genetic algorithm with 4 processes...
- Parallel genetic algorithm completed in 159.4746 seconds.
- Starting parallel PSO algorithm with 4 processes...
- Parallel PSO algorithm completed in 168.7484 seconds.

Running for matrix size: 840 and num_processes: 4

Starting parallel run for matrix size 840 with 4 processes...

- Starting parallel genetic algorithm with 4 processes...
- Parallel genetic algorithm completed in 214.2276 seconds.
- Starting parallel PSO algorithm with 4 processes...
- Parallel PSO algorithm completed in 224.3370 seconds.

Results saved to result_4.txt

Running for matrix size: 360 and num_processes: 8

Starting parallel run for matrix size 360 with 8 processes...

- Starting parallel genetic algorithm with 8 processes...
- Parallel genetic algorithm completed in 63.3691 seconds.
- Starting parallel PSO algorithm with 8 processes...
- Parallel PSO algorithm completed in 73.4422 seconds.

Running for matrix size: 480 and num_processes: 8

Starting parallel run for matrix size 480 with 8 processes...

- Starting parallel genetic algorithm with 8 processes...
- Parallel genetic algorithm completed in 80.5510 seconds.
- Starting parallel PSO algorithm with 8 processes...
- Parallel PSO algorithm completed in 89.1278 seconds.

Running for matrix size: 600 and num_processes: 8

Starting parallel run for matrix size 600 with 8 processes...

- Starting parallel genetic algorithm with 8 processes...
- Parallel genetic algorithm completed in 101.5211 seconds.
- Starting parallel PSO algorithm with 8 processes...
- Parallel PSO algorithm completed in 110.3614 seconds.

Running for matrix size: 720 and num_processes: 8

Starting parallel run for matrix size 720 with 8 processes...

- Starting parallel genetic algorithm with 8 processes...
- Parallel genetic algorithm completed in 124.1439 seconds.
- Starting parallel PSO algorithm with 8 processes...
- Parallel PSO algorithm completed in 135.1624 seconds.

Running for matrix size: 840 and num_processes: 8

Starting parallel run for matrix size 840 with 8 processes...

- Starting parallel genetic algorithm with 8 processes...
- Parallel genetic algorithm completed in 160.0736 seconds.
- Starting parallel PSO algorithm with 8 processes...
- Parallel PSO algorithm completed in 169.9084 seconds.

Results saved to result_8.txt

Running for matrix size: 360 and num_processes: 16

Starting parallel run for matrix size 360 with 16 processes...

- Starting parallel genetic algorithm with 16 processes...
- Parallel genetic algorithm completed in 83.0929 seconds.

- Starting parallel PSO algorithm with 16 processes...
- Parallel PSO algorithm completed in 90.1175 seconds.

Running for matrix size: 480 and num_processes: 16

Starting parallel run for matrix size 480 with 16 processes...

- Starting parallel genetic algorithm with 16 processes...
- Parallel genetic algorithm completed in 96.5525 seconds.
- Starting parallel PSO algorithm with 16 processes...
- Parallel PSO algorithm completed in 101.4189 seconds.

Running for matrix size: 600 and num_processes: 16

Starting parallel run for matrix size 600 with 16 processes...

- Starting parallel genetic algorithm with 16 processes...
- Parallel genetic algorithm completed in 112.8883 seconds.
- Starting parallel PSO algorithm with 16 processes...
- Parallel PSO algorithm completed in 120.4560 seconds.

Running for matrix size: 720 and num_processes: 16

Starting parallel run for matrix size 720 with 16 processes...

- Starting parallel genetic algorithm with 16 processes...
- Parallel genetic algorithm completed in 132.0229 seconds.
- Starting parallel PSO algorithm with 16 processes...
- Parallel PSO algorithm completed in 140.2886 seconds.

Running for matrix size: 840 and num_processes: 16

Starting parallel run for matrix size 840 with 16 processes...

- Starting parallel genetic algorithm with 16 processes...
- Parallel genetic algorithm completed in 158.6276 seconds.
- Starting parallel PSO algorithm with 16 processes...
- Parallel PSO algorithm completed in 167.0454 seconds.

Results saved to result_16.txt

Running for matrix size: 360 and num_processes: 25

Starting parallel run for matrix size 360 with 25 processes...

- Starting parallel genetic algorithm with 25 processes...
- Parallel genetic algorithm completed in 99.6992 seconds.
- Starting parallel PSO algorithm with 25 processes...
- Parallel PSO algorithm completed in 108.3729 seconds.

Running for matrix size: 480 and num_processes: 25

Starting parallel run for matrix size 480 with 25 processes...

- Starting parallel genetic algorithm with 25 processes...
- Parallel genetic algorithm completed in 115.4085 seconds.
- Starting parallel PSO algorithm with 25 processes...
- Parallel PSO algorithm completed in 124.3585 seconds.

Running for matrix size: 600 and num_processes: 25

Starting parallel run for matrix size 600 with 25 processes...

- Starting parallel genetic algorithm with 25 processes...
- Parallel genetic algorithm completed in 134.9761 seconds.
- Starting parallel PSO algorithm with 25 processes...
- Parallel PSO algorithm completed in 140.2825 seconds.

Running for matrix size: 720 and num_processes: 25

Starting parallel run for matrix size 720 with 25 processes...

- Starting parallel genetic algorithm with 25 processes...
- Parallel genetic algorithm completed in 155.5092 seconds.
- Starting parallel PSO algorithm with 25 processes...
- Parallel PSO algorithm completed in 163.5454 seconds.

Running for matrix size: 840 and num_processes: 25

Starting parallel run for matrix size 840 with 25 processes...

- Starting parallel genetic algorithm with 25 processes...

- Parallel genetic algorithm completed in 179.1087 seconds.
- Starting parallel PSO algorithm with 25 processes...
- Parallel PSO algorithm completed in 189.7299 seconds.

Results saved to result_25.txt