

Python ile kodlanmış “Simulated Annealing” ve “Whale Optimization algorithm” optimizasyon algoritmaları, “Ackley”, “Levi”, “Beale” ve “Goldstein - Price” fonksiyonları üzerinde uygulanmıştır. Optimizasyon sonuçları aşağıda verildiği gibi çıkmıştır

## Simulated annealing - Ackley Function



# Simulated annealing - Levi Function



# Simulated annealing - Beale Function



## Simulated annealing - Goldstein Function





## Whale Optimization Algorithm - Ackley Function

```
generation best solution history
([fitness], [solution])
(2.8000144658681805, array([-0.25997107,  0.26156885]))
(2.8000144658681805, array([-0.25997107,  0.26156885]))
(2.4298194849723096, array([-0.27254994,  0.17190102]))
(2.018188245237713, array([ 0.26817948, -0.07583262]))
(2.018188245237713, array([ 0.26817948, -0.07583262]))
(2.018188245237713, array([ 0.26817948, -0.07583262]))
(2.018188245237713, array([ 0.26817948, -0.07583262]))
(2.018188245237713, array([ 0.26817948, -0.07583262]))
(2.018188245237713, array([ 0.26817948, -0.07583262]))
(0.9485074995757898, array([-0.14173189,  0.05412091]))
(0.5170979286652191, array([0.00211317, 0.09843164]))
(0.4688008451070722, array([-0.09172807, -0.00164296]))
(0.4688008451070722, array([-0.09172807, -0.00164296]))
(0.30977189015777284, array([-0.05835489,  0.0343439 ]))
(0.249705239681564, array([0.03148246, 0.04832337]))
(0.249705239681564, array([0.03148246, 0.04832337]))
(0.058278055544864316, array([0.01550053, 0.00848526]))
(0.05369444177190985, array([-0.00047645, -0.01643693]))
(0.05369444177190985, array([-0.00047645, -0.01643693]))
(0.05369444177190985, array([-0.00047645, -0.01643693]))
(0.034582757480020376, array([-0.000107 ,  0.01107305]))
(0.034582757480020376, array([-0.000107 ,  0.01107305]))
(0.022477173233529157, array([ 0.0073539 , -0.00104447]))
(0.010599444441321992, array([-0.00291136, -0.00215783]))
(0.006215298783303069, array([-0.00146864, -0.00157538]))
(0.005362393330688775, array([-0.00108783, -0.00151267]))
(0.0005403375452139869, array([-0.00014257,  0.00012664]))
(0.00044703158834380474, array([-1.38159293e-04, -7.62732092e-05]))
(0.0002304104162682563, array([5.85381477e-05, 5.65618761e-05]))
(0.00019938430437349552, array([3.45314797e-05, 6.14023993e-05]))
```

```
best solution
([fitness], [solution])
(0.00019938430437349552, array([3.45314797e-05, 6.14023993e-05]))
```

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In [42]: |
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## Whale Optimization Algorithm - Levi Function

```
generation best solution history
([fitness], [solution])
(2.705449322351631, array([ 0.32829158, -0.12280272]))
(2.304221148532936, array([2.03588244, 0.83404465]))
(1.0785374784699207, array([1.14324559, 0.78603798]))
(1.0785374784699207, array([1.14324559, 0.78603798]))
(1.0785374784699207, array([1.14324559, 0.78603798]))
(1.0785374784699207, array([1.14324559, 0.78603798]))
(0.9879671815161204, array([1.42752038, 0.73185923]))
(0.9879671815161204, array([1.42752038, 0.73185923]))
(0.7678150791577794, array([1.24509723, 0.73472927]))
(0.7678150791577794, array([1.24509723, 0.73472927]))
(0.7678150791577794, array([1.24509723, 0.73472927]))
(0.7678150791577794, array([1.24509723, 0.73472927]))
(0.13340062255271415, array([1.33913705, 0.96232691]))
(0.13340062255271415, array([1.33913705, 0.96232691]))
(0.13340062255271415, array([1.33913705, 0.96232691]))
(0.13340062255271415, array([1.33913705, 0.96232691]))
(0.09834566162386718, array([0.96790535, 0.91914636]))
(0.09834566162386718, array([0.96790535, 0.91914636]))
(0.09834566162386718, array([0.96790535, 0.91914636]))
(0.09834566162386718, array([0.96790535, 0.91914636]))
(0.011490007560341249, array([1.01110319, 0.97893988]))
(0.011490007560341249, array([1.01110319, 0.97893988]))
(0.011490007560341249, array([1.01110319, 0.97893988]))
(0.011490007560341249, array([1.01110319, 0.97893988]))
(0.011490007560341249, array([1.01110319, 0.97893988]))
(0.011490007560341249, array([1.01110319, 0.97893988]))
(0.003172012550872059, array([1.00523042, 1.02638118]))
(0.003172012550872059, array([1.00523042, 1.02638118]))
(0.0012354081842852393, array([1.00219673, 1.02789304]))
(0.0012354081842852393, array([1.00219673, 1.02789304]))

best solution
([fitness], [solution])
(0.0012354081842852393, array([1.00219673, 1.02789304]))

In [43]:
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## Whale Optimization Algorithm - Beale Function

```
generation best solution history
([fitness], [solution])
(2.192769846800549, array([ 2.09281631, -0.36129586]))
(0.13462363707716116, array([4.5, 0.6999428]))
(0.13462363707716116, array([4.5, 0.6999428]))
(0.13462363707716116, array([4.5, 0.6999428]))
(0.13462363707716116, array([4.5, 0.6999428]))
(0.13462363707716116, array([4.5, 0.6999428]))
(0.13462363707716116, array([4.5, 0.6999428]))
(0.13462363707716116, array([4.5, 0.6999428]))
(0.12316065495047317, array([4.5, 0.73156452]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.10206109966335891, array([4.5, 0.71743145]))
(0.08927801663773538, array([4.04731943, 0.69148767]))
(0.08927801663773538, array([4.04731943, 0.69148767]))
(0.04627264927303028, array([3.72585566, 0.64414792]))
(0.015105925721962676, array([3.30731486, 0.57806681]))
(0.004106713349242726, array([2.9211813, 0.46760935]))
(0.004106713349242726, array([2.9211813, 0.46760935]))
(0.004106713349242726, array([2.9211813, 0.46760935]))
(0.004106713349242726, array([2.9211813, 0.46760935]))
(0.0007022550482891315, array([2.93799591, 0.48280777]))
(0.0006611682765807074, array([3.04832428, 0.51526467]))
```

```
best solution
([fitness], [solution])
(0.0006611682765807074, array([3.04832428, 0.51526467]))
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In [44]:

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## Whale Optimization Algorithm - Goldstein Function

```
generation best solution history
([fitness], [solution])
(33.572887893835805, array([-0.5848494 , -0.35832902]))
(15.940030156865951, array([ 0.19165011, -0.83628566]))
(13.049218469821875, array([-0.17516261, -1.05288418]))
(13.049218469821875, array([-0.17516261, -1.05288418]))
(13.049218469821875, array([-0.17516261, -1.05288418]))
(13.049218469821875, array([-0.17516261, -1.05288418]))
(8.188055462088649, array([ 0.04617546, -0.89356141]))
(5.764372689169622, array([-0.03989843, -0.92954204]))
(5.764372689169622, array([-0.03989843, -0.92954204]))
(5.764372689169622, array([-0.03989843, -0.92954204]))
(5.764372689169622, array([-0.03989843, -0.92954204]))
(5.764372689169622, array([-0.03989843, -0.92954204]))
(5.764372689169622, array([-0.03989843, -0.92954204]))
(5.58414224860276, array([ 0.10322814, -0.94523754]))
(5.58414224860276, array([ 0.10322814, -0.94523754]))
(5.58414224860276, array([ 0.10322814, -0.94523754]))
(3.3843096552247385, array([-0.02309062, -1.02967869]))
(3.3843096552247385, array([-0.02309062, -1.02967869]))
(3.3843096552247385, array([-0.02309062, -1.02967869]))
(3.3843096552247385, array([-0.02309062, -1.02967869]))
(3.28542356620554, array([-0.03480519, -1.01182598]))
(3.28542356620554, array([-0.03480519, -1.01182598]))
(3.1040631293505108, array([ 0.01429515, -1.00772513]))
(3.1040631293505108, array([ 0.01429515, -1.00772513]))
(3.1040631293505108, array([ 0.01429515, -1.00772513]))
(3.063695998845849, array([ 0.01085904, -0.9879304 ]))
(3.063695998845849, array([ 0.01085904, -0.9879304 ]))
(3.0026592314150142, array([-0.00290997, -1.00204216]))
(3.0026592314150142, array([-0.00290997, -1.00204216]))
(3.0026592314150142, array([-0.00290997, -1.00204216]))

best solution
([fitness], [solution])
(3.0026592314150142, array([-0.00290997, -1.00204216]))
```

In [48]: