ZMOG: Od przeszukiwania lokalnego do globalnej adaptacji

Michał Okulewicz

Wydział Matematyki i Nauk Informacyjnych
Politechnika Warszawska

Od przeszukiwania lokalnego do globalnej adaptacji

Benchmark functions

- Rosenbrock's:

$$f(x) = \sum_{i=1}^{N-1} \left((1 - x_i)^2 + 100(x_{i+1} - x_i^2)^2\right)$$

- Rastrigin's

$$f(x) = 10N + \sum_{i=1}^{N} \left(x_i^2 - 10\cos(2\pi x_i)\right)$$

Rosenbrock's function

```
#funkcja Rosenbrocka
f <- function(x) {
  if (!is.matrix(x)) {
    x = matrix(x,ncol = length(x))
  }
  values <- rowSums((1-matrix(x[,1:(ncol(x)-1)],ncol =
       ncol(x)-1))^2 +
                        100*(matrix(x[,2:(ncol(x))],ncol
                             = ncol(x)-1)
                              -matrix(x[,1:(ncol(x)-1)],
                                  ncol = ncol(x)-1)^2)^2)
  fsamples <<- c(fsamples,values)
  values
}
```

Rastrigin's function

```
#funkcja Rastrigina
f <- function(x) {
  if (!is.matrix(x)) {
    x = matrix(x,ncol = length(x))
  }
  values <- rowSums(x^2)-rowSums(cos(2*pi*x))+
     ncol(x)
  fsamples <<- c(fsamples,values)
  values
}
```

Hill climbing

```
current.val = f(init.sample)
current.location = init.sample
for (samp.idx in 1:samples.count) {
  #move from the current location
  move = matrix(rnorm(dim,0,init.sigma),ncol=
      dim)
  current.location = current.location + move
  #test new location
  temp.val = f(current.location)
  if (temp.val > current.val) {
    #retract if necessary
    current.location = current.location - move
  } else {
    current.val = temp.val
  }
}
```

Simulated Annealing

```
T = InitTemp
for (samp.idx in 1:samples.count) {
  move = matrix(rnorm(dim,0,init.sigma),ncol=dim)
  current.location = current.location + move
  temp.val = f(current.location)
  #Accept with Metropolis rule
  if (exp((current.val-temp.val)/T) <= runif(1,0,1))
      {
    current.location = current.location - move
  } else {
    current.val = temp.val
  }
  if (samp.idx %% steady.state.iterations == 0) {
  #Cool the temperature of the system
    T = T * CoolingFactor
  }
}
```

Variable Neighbourhood Search

```
for (samp.idx in 1:samples.count) {
  move = matrix(rnorm(dim,0,sigma),ncol=dim)
  current.location = current.location + move
  temp.val = f(current.location)
  if (temp.val > current.val) {
    current.location = current.location - move
    failures = failures + 1
  } else {
    failures = 0
    sigma = init.sigma
    current.val = temp.val
  }
  #change random variable variation
  if (failures > max.failures) {
    failures = 0
    sigma = 1.05 * sigma
  }
}
```

Evolution Strategies

```
for (samp.idx in 1:(samples.count/single.sample.size
    )) {
  move = matrix(rnorm(dim*single.sample.size,0,sigma
      ),ncol=dim,nrow=single.sample.size)
  sample = sample + move
  temp.val = f(sample)
  success.rate = mean(temp.val < current.val)
  sample = ifelse(temp.val > current.val,sample -
      move, sample)
  current.val = ifelse(temp.val > current.val,
      current.val, temp.val)
  #adapt according to 1/5 success rule
  if (success.rate > 0.2) {
    sigma = sigma * 1.1
  } else {
    sigma = sigma / 1.1
  }
}
```

Praca domowa

- Dodać do trywialnej strategii ewolucyjnej różne rodzaje selekcji (ruletkowa, ruletkowa-równomierna, elitarna, rangowa, jednostajna)
- Zweryfikować szybkość zbieżności dla różnych wariantów

Bibliografia I


Hans-Georg Beyer and Hans-Paul Schwefel.
Evolution strategies–a comprehensive introduction.
Natural computing, 1(1):3–52, 2002.


Kenneth Alan De Jong.
An Analysis of the Behavior of a Class of Genetic Adaptive Systems.
PhD thesis, Ann Arbor, MI, USA, 1975.
AAI7609381.


S. Kirkpatrick, C. D. Gelatt, and M. P. Vecchi.
Optimization by simulated annealing.
Science, 220(4598):671–680, 1983.

Bibliografia II


Melanie Mitchell, John H Holland, and Stephanie Forrest.
When will a genetic algorithm outperform hill climbing.
In *Advances in neural information processing systems*, pages 51–58, 1994.


Nenad Mladenović and Pierre Hansen.
Variable neighborhood search.
Computers & operations research, 24(11):1097–1100, 1997.


Peter J. M. van Laarhoven and Emile H. L. Aarts.
Simulated annealing, pages 7–15.
Springer Netherlands, Dordrecht, 1987.