**حل مسئله کوله پشتی با الگوریتم مورچه ACO در متلب**

فرض کنید یک کوله‌پشتی با حجمی ثابت و مجموعه‌ای از اشیاء دارید که هر کدام از آن ها حجمی و ارزشی دارند. می‌خواهید کوله‌پشتی خود را به نحوی پرکنید که حجم اشیا برداشته شده از حجم کوله‌پشتی بیشتر نباشد و مجموع ارزش اشیا بیشینه باشد.

**صورت مسئله:**

یک کوله پشتی به حجم 500 داریم و 20 تا شی داریم که ارزش اشیابه صورت زیر است:

v = [391 444 250 330 246 400 150 266 268 293 471 388 364 493 202 161 410 270 384 486];

و وزن اشیا به صورت زیر است:

w = [55 52 59 24 52 46 45 34 34 59 59 28 57 21 47 66 64 42 22 23];

می خواهیم این اشیا را به نحوی در کوله پشتی قرار دهیم که ارزش اشیا در کوله پشتی ماکزیمم شود و حجم اشیا درون کوله پشتی از حجم کل کوله پشتی بیشتر نشود.

**شرح کد:**

این سورس کد شامل 5 فایل می باشد.

ابتدا تابع ()CreateModel را پیاده سازی می کنیم که اطلاعات مسیله داخل یک مدل پیاده سازی می شود برای اینکه به پارامترهای مسیله به صورت یکجا دسترسی داشته باشیم.

function model=CreateModel()

ارزش هر کدام از اشیا

v = [391 444 250 330 246 400 150 266 268 293 471 388 364 493 202 161 410 270 384 486];

وزن هر کدام از اشیا

w = [55 52 59 24 52 46 45 34 34 59 59 28 57 21 47 66 64 42 22 23];

تعداد کل اشیا

n = numel(v);

حداکثر وزنی که کوله پشتی می تواند تحمل کند

W = 500;

اینجا هم اطلاعات مسیله را ذخیره کردیم.

model.n = n;

model.v = v;

model.w = w;

model.W = W;

end

تابع MyFit(x, model) برای محاسبه فیتنس بکار می رود

function [z, sol] = MyFit(x, model)

ارزش و حجم اشیایی که برداشتیم و ظرفیت حجم کوله پشتی را نیاز داریم

v=model.v;

w=model.w;

W=model.W;

مجموع اشیایی که انتخاب شده اند ضرب در ارزش شان

V1 = sum(v.\*x);

W1 = sum(w.\*x);

مجموع اشیایی که انتخاب نشده اند ضرب در ارزش شان

V0 = sum(v.\*(1-x));

W0 = sum(w.\*(1-x));

میزان تخلف(باید حجم کتر از ظرفیت حجم کوله پشتی باشه)

Violation = max(W1/W-1, 0);

هزینه تخلف

z = V0\*(1+100\*Violation);

sol.V1 = V1;

sol.W1 = W1;

sol.V0 = V0;

sol.W0 = W0;

sol.Violation = Violation;

sol.z = 1/(1+z);

sol.IsFeasible = (Violation == 0);اگر تخلف نداشته باشیم جواب قابل قبول است.

end

**RouletteWheelSelection(P):**چرخ رولت

function j = RouletteWheelSelection(P)

r = rand;

C = cumsum(P);

j = find(r <= C, 1, 'first');

end

**:aco.m** کد الگوریتم مورچه به همراه تعریف مسیله و تابع بالا

clc;

clear;

close all;

تعریف مسیله

model = CreateModel(); ایجاد مدل

FitFunction = @(x) MyFit(x, model); تابع برازندگی

nVar = model.n;تعداد متغیرها

پارامترهای الگوریتم مورچه

MaxIt = 300; تعداد ماکزیمم تکرار

nAnt = 40; تعداد مورچه هااندازه جمعیت

Q = 1;

tau0 = 0.1; فورون اولیه

alpha = 1; وزن نمایی فورون

beta = 0.02; وزن نمایی هیوریستسک

rho = 0.1; میزان تبخیر

مقداردهی اولیه

N = [0 1];

eta = [model.w./model.v

model.v./model.w]; اطلاعات هیوریستسک

tau = tau0\*ones(2, nVar); ماتریس فورون

BestFit = zeros(MaxIt, 1); آرایه نگه داری ارزش بهترین برازندگی

مورچه خالی

empty\_ant.Tour = [];

empty\_ant.x = [];

empty\_ant.Fit = [];

empty\_ant.Sol = [];

ماتریس کلونی مورچه

ant = repmat(empty\_ant, nAnt, 1);

بهترین مورچه

BestSol.Fit = 0;

حلقه اصلی مورچه

for it = 1:MaxIt

حرکت مورچه

for k = 1:nAnt

ant(k).Tour = [];

for l = 1:nVar

P = tau(:, l).^alpha.\*eta(:, l).^beta;

P = P/sum(P);

j = RouletteWheelSelection(P);

ant(k).Tour = [ant(k).Tour j];

end

ant(k).x = N(ant(k).Tour);

[ant(k).Fit, ant(k).Sol] = FitFunction(ant(k).x);

if ant(k).Fit>BestSol.Fit

BestSol = ant(k);

end

end

بروزرسانی فورون ها

for k = 1:nAnt

tour = ant(k).Tour;

for l = 1:nVar

tau(tour(l), l) = tau(tour(l), l)+Q/ant(k).Fit;

end

end

تبخیر

tau = (1-rho)\*tau;

ذخیره بهترین برازندگی

BestFit(it) = BestSol.Fit;

اطلاعات تکرار را نمایش بده

if BestSol.Sol.IsFeasible

FeasiblityFlag = '\*';

else

FeasiblityFlag = '';

end

disp(['Iteration ' num2str(it) ': Best Fit = ' num2str(BestFit(it)) ' ' FeasiblityFlag]);

end

نتایج

figure;

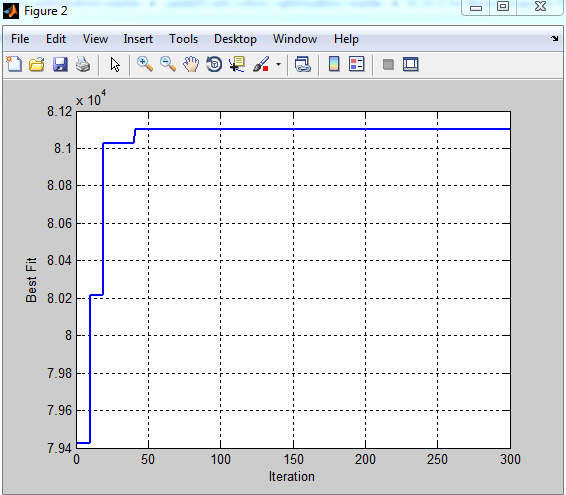
plot(BestFit, 'LineWidth', 2);

xlabel('Iteration');

ylabel('Best Fit');

grid on;

**نتایج:**

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**Iteration 1: Best Fit = 79424**

**Iteration 2: Best Fit = 79424**

**Iteration 3: Best Fit = 79424**

**Iteration 4: Best Fit = 79424**

**Iteration 5: Best Fit = 79424**

**Iteration 6: Best Fit = 79424**

**Iteration 7: Best Fit = 79424**

**Iteration 8: Best Fit = 79424**

**Iteration 9: Best Fit = 79424**

**Iteration 10: Best Fit = 80215.8**

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**Iteration 19: Best Fit = 81028.8**

**Iteration 20: Best Fit = 81028.8**

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**>> BestSol.Sol**

**ans =**

**V1: 4363**

**W1: 671**

**V0: 2304**

**W0: 218**

**Violation: 0.3420**

**z: 1.2330e-05**

**IsFeasible: 0**

**>> BestSol**

**BestSol =**

**Tour: [2 1 2 2 2 1 2 2 2 2 2 1 2 2 1 2 2 2 1 1]**

**x: [1 0 1 1 1 0 1 1 1 1 1 0 1 1 0 1 1 1 0 0]**

**Fit: 8.1101e+04**

**Sol: [1x1 struct]**

**>>**