《机械工程中的数值分析技术》

作业

学　　生：易弘睿

学　　号：20186103

专业班级：机械一班

作业编号：2021052101

重庆大学-辛辛那提大学联合学院

二〇二一年五月

【BASIC PART】

Some problems about programming

(1) Use “for loop” to implement 1+2+…+n (use input or function);

(2) Use “for loop” to implement 1*2*…*n (use input or function);

(3) use for /while loop to obtain the multiplication of two matrix (element by element);

(4) normalize a vector by using for/while loop (write this as a function);

(5) use for/while loop to solve a upper triangular linear equation set;

(6) use for/while loop to solve a lower triangular linear equation set;

(7) use for/while loop to implement the rectangular method of integration of function;

(8) use for/while loop to implement all vector/matrix’ s operations element by element;

(9) Use for/while loop to implement the operation of polynomials;

```
%% HW1
% Name: Horace
% Date: 11 May 2021
% Description: HW 1 basic part
```

【Question_1】

```
%% P1
clear;clc;
n = input('n = ?')
sum=0;
for i=1:n
    sum=sum+i;
end
disp('The implement of 1+2+¡-+n is');disp(sum);
```

【Question_2】

```
%% P2
clear;clc;
n = input('n = ?')
product=0;
for i=1:n
    product=product*i;
end
disp('The product of 1*2+¡-*n is');disp(sum);
```

【Question_3】

```
%% P3
clear;clc;
```

```
M1 = input('The first matrix you want to input is');
M2 = input('The second matrix you want to input is');
[a1,b1]=size(M1);
[a2,b2]=size(M2);
if b1==a2
    for i = 1:a1
        for j = 1:b2
            temp=0;
            for k=1:b1
                temp=temp+M1(i,k)*M2(k,j);
            end
            M(i,j)=temp;
        end
    end
end
disp(M);
```

【Question_4】

```
%% P4
clear;clc;
M=input('Enter a vector:');
norm=normalization(M);
disp('The normallization of the vector is');disp(norm);
function norm = normalization(M)
    L=length(M);
    sum=0;
    for i = 1:L
        sum=sum+M(i)^2;
    end
sum=sum^0.5;
norm=M/sum;
end
```

【Question_5】

```
%% P5
clear;clc;
A=input('A=?');
B=input('B=?');
X=backsub(A,B);
disp('X is');disp(X);
function X=backsub(A,B)
n=length(B);
X=zeros(n,1);
X(n)=B(n)/A(n,n);
```

```
    for k=n-1:-1:1
        X(k)=(B(k)-A(k,k+1:n)*X(k+1:n))/A(k,k);
    end
end
```

【Question_6】

```
%% P6
clear;clc;
A=input('A=?');
B=input('B=?');
X=low_triangular(A,B);
disp('X is');disp(X);
function output = low_triangular(A, B)
    size_A = size(A);
    output = zeros([1, size_A(1)]);
    output(1) = B(1) / A(1, 1);
    for i = 2:1:size_A(1)
        sub_B = B(i);
        for j = 1:1:i-1
            sub_B = sub_B - A(i, j) * output(j);
        output(i) = sub_B /A(i,i);
        end
    end
end
```

【Question_7】

```
%% P7
clear;clc;
func=input('func=?');
a=input('a=?');
b=input('b=?');
output=cal_integration(func, a, b);
disp('The output is');disp(output);
function output = cal_integration(func, a, b)
    output = 0;
    distance = 0.01;
    interval = a:distance:b;
    total_length = length(interval);
    for i = 1:1:total_length
        output = output + func(interval(i)) * distance;
    end
end
```

【Question_8】

```
%% P8
clc;clear all;
A=input('A=?');
B=input('B=?');
output=vec_plus(A, B);
disp('The sum of A and B is');disp(output);
function output = vec_plus(A,B)
    size_1 = size(A);
    size_2 = size(B);
    if ~all(size_1 == size_2)
        errordlg("Dimension mismatch", "vec_plus");
    end
    output = zeros(size_1);
    if size_1(1) == 1
        for i = 1:1:size_1(2)
            output(i) = A(i) + B(i);
        end
    else
        for i = 1:1:size_1(1)
            for j = 1:1:size_1(2)
                output(i,j) = A(i,j) + B(i,j);
            end
        end
    end
end
```

命令行窗口

```
A=?[1,2]
B=?[3,4]
The sum of A and B is
     4     6
```

```
clc;clear all;
A=input('A=?');
B=input('B=?');
output=vec _minus(A, B);
disp('The difference of A and B is');disp(output);
function output = vec_minus(A, B)
    size_1 = size(A);
    size_2 = size(B);
    if ~all(size_1 == size_2)
        errordlg("Dimension mismatch", "vec_minus");
    end
    output = zeros(size_1);
```

```
    if size_1(1) == 1
        for i = 1:1:size_1(2)
            output(i) = A(i) - B(i);
        end
        for i = 1:1:size_1(1)
            for j = 1:1:size_1(2)
                output(i,j) = A(i,j) - B(i,j );
            end
        end
    end
end
```

命令行窗口

```
A=?[3,4]
B=?[1,2]
The difference of A and B is
     2     2
```

```
clc;clear all;
A=input('A=?');
B=input('B=?');
output=vec _mul(A, B);
disp('The product of A and B is');disp(output);
function output = vec_mul(A, B)
    size_1 = size(A);
    size_2 = size(B);
    if size_1(2) ~= size_2(1)
        errordlg("Dimension mismatch", "vec_mul");
    end
    output = zeros(size_1(1), size_2(2));
    if size_1(1) == 1 && size_2(2) == 1
        temp = 0;
        for i = 1:1:size_1(2)
            temp = temp + A(i)*B(i);
        end
        output = output + temp;
    elseif size_1(1) == 1 && size_2(2) ~= 1
        for i = 1:1:size_2(2)
            temp = 0;
            for j = 1:1:size_2(1)
                temp = temp + A(j)*B(j,i);
            end
            output(i) = output(i) + temp;
        end
    elseif size_1(1) ~= 1 && size_2(2) == 1
```

```
        for i = 1:1:size_1(1)
            temp = 0;
            for j = 1:1:size_1(2)
                temp = temp + A(i,j)*B(j);
            end
            output(i) = output(i) + temp;
        end
    else
        for i = 1:1:size_1(1)
            for j = 1:1:size_2(2)
                temp = 0;
                for k = 1:1:size_2(1)
                    temp = temp + A(i,k) * B(k,j);
                end
                output(i,j) = output(i,j) + temp;
            end
        end
    end
end
```

命令行窗口

```
A=?[1,2]
B=?[1;2]
The product of A and B is
     5
```

【Question_9】

```
clc;clear all;
A=input('A=?');
B=input('B=?');
output=poly_plus(A, B);
disp('The sum of A and B is');disp(output);
function output = poly_plus(A, B)
    size_1 = size(A);
    size_2 = size(B);
    if size_1(2) > size_2(2)
        padding_size = size_1(2) - size_2(2);
        padding = zeros(1, padding_size);
        B = [padding, B];
        output = A + B;
    elseif size_1(2) < size_2(2)
        padding_size = size_2(2) - size_1(2);
        padding = zeros(1, padding_size);
        A = [padding, A];
        output = A + B;
```

```
    else
        output = A + B;
    end
    index = 1;
    while output(index) == 0
        output(index) = [];
    end
end
```

命令行窗口

```
A=?[2,1]
B=?[3,5]
The sum of A and B is
     5     6
```

```
clc;clear all;
A=input('A=?');
B=input('B=?');
output=poly_minus(A, B);
disp('The difference of A and B is');disp(output);
function output = poly_minus(A, B)
    size_1 = size(A);
    size_2 = size(B);
    if size_1(2) > size_2(2)
        padding_size = size_1(2) - size_2(2);
        padding = zeros(1, padding_size);
        B = [padding, B];
        output = A - B;
    elseif size_1(2) < size_2(2)
        padding_size = size_2(2) - size_1(2);
        padding = zeros(1, padding_size);
        A = [padding, A];
        output = A - B;
    else
        output = A - B;
    end
    index = 1;
    while output(index) == 0
        output(index) = [];
    end
end
```

命令行窗口

```
A=?[4,5]
B=?[7,9]
The difference of A and B is
    -3    -4
```

```
clc;clear all;
A=input('A=?');
B=input('B=?');
output=poly_mul(A, B);
disp('The product of A and B is');disp(output);
function output = poly_mul(A, B)
    size_1 = size(A);
    size_2 = size(B);
    highest = size_1(2)-1 + size_2(2)-1;
    output = zeros(1, highest + 1);
    for i = 1:1:size_1(2)
        for j = 1:1:size_2(2)
            index = highest - ((size_1(2) - i) + (size_2(2)-j)) + 1;
            output(index) = output(index) + A(i) * B(j);
        end
    end
end
```

命令行窗口

```
A=?[3,5]
B=?[4,2]
The product of A and B is
    12    26    10
```

```
clc;clear all;
A=input('A=?');
B=input('B=?');
output=poly_div(A, B);
disp('The division of A and B is');disp(output);
function [quotients, remainder] = poly_div(A, B)
    index = 1;
    while A(index) == 0
        A(index) = [];
    end
    while B(index) == 0
        B(index) = [];
    end
    size_1 = size(A);
    size_2 = size(B);
    if size_1(2) < size_2(2)
        quotients = [0];
        remainder = A;
        return
    end
    dif_length = size_1(2)-size_2(2);
```

```
    quotients = zeros(1, dif_length+1);
    for i=1:1:dif_length+1
        quotients(i) = A(i) / B(1);
        subresult = quotients(i)*B;
        index = i;
        for j=1:1:size_2(2)
            A(index) = A(index) - subresult(j);
            index = index + 1;
        end
    end
    remainder = A;
    while remainder(1) == 0
        remainder(1) = [];
    end
end
```

命令行窗口

```
A=?[7,9,8,4]
B=?[2,3]
The division of A and B is
    3.5000   -0.7500    5.1250
```

【Advanced PART】

Some simulations about movement

(1) one-dimensional walk: a point located on x-axis, t=0, x(t)=0, and suppose x(t), the location x(t+1)=x(t)+a with proportion p and x(t+1)=x(t)-a with proportion 1-p.

(2) Two-dimensional walk: with the same form with problem (1) , a is a vector with direct.

(3) 一只失明的小猫不幸掉进山洞里，山洞有三个门，一个门进去后走 2h 可以到地面，从第二个门进去后走 4h 又回到原始出发点，不幸的是从第三个门进去后走 6h 还是回到原始出发点。小猫由于眼睛失明，每次都是随机地选择其中一个门走。那么可怜的小猫走出山洞的平均时间是多少？

(4) Calculate the pi value by simulation.

(5) Chase game:在正多边形的顶点处各站一人，在某一时刻，四人同时以匀速 v 沿顺时针方向追逐下一个人，并且在任意时刻他们始终保持追逐的方向是对准追逐目标。试改变多边形的边数，画出追逐的轨迹。

(6) 直径为 0.6 米的车轮上一点在下面几种情况下的运动。（a）沿直线向前匀速运动，速度为 30m/s；（b）沿直线进行的加速运动，初速度为 0，加速度为 $2m/s^2$，在 0 到 10 秒的情况；（c）汽车在半径为 50 米的轨道进行匀速的圆周运动，角速度为 1 弧度/s。

(7) Simulate the spread of contacts and spread on epidemic.

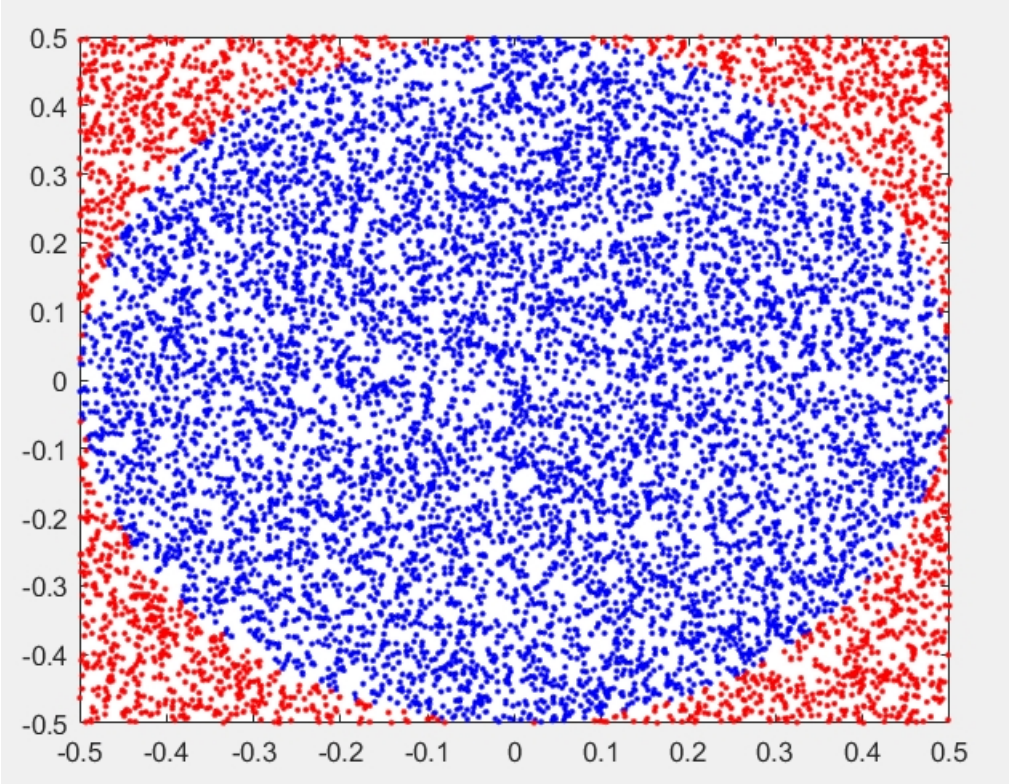
(8) Compute the finite difference and higher order finite difference.

```
%% HW1
% Name: Horace
```

```
% Date: 11 May 2021
% Description: HW 1 advanced part
```

【Question_4】

```
%% P4
% Caculate the value of pi by simulation
clear;clc;
nmax = 10000;
x = rand(nmax,1);
y = rand(nmax,1);
x1 = x - 0.5;
y1 = y - 0.5;
r = sqrt(x1.^2 + y1.^2) ;
% get logicals
inside = r <= 0.5 ;
outside = r > 0.5 ;
% plot
plot(x1(inside),y1(inside),'b.');
hold on
plot(x1(outside),y1(outside),'r.');
% get pi value
thepi = 4*sum(inside)/nmax ;
fprintf('%8.4f\n',thepi)
```



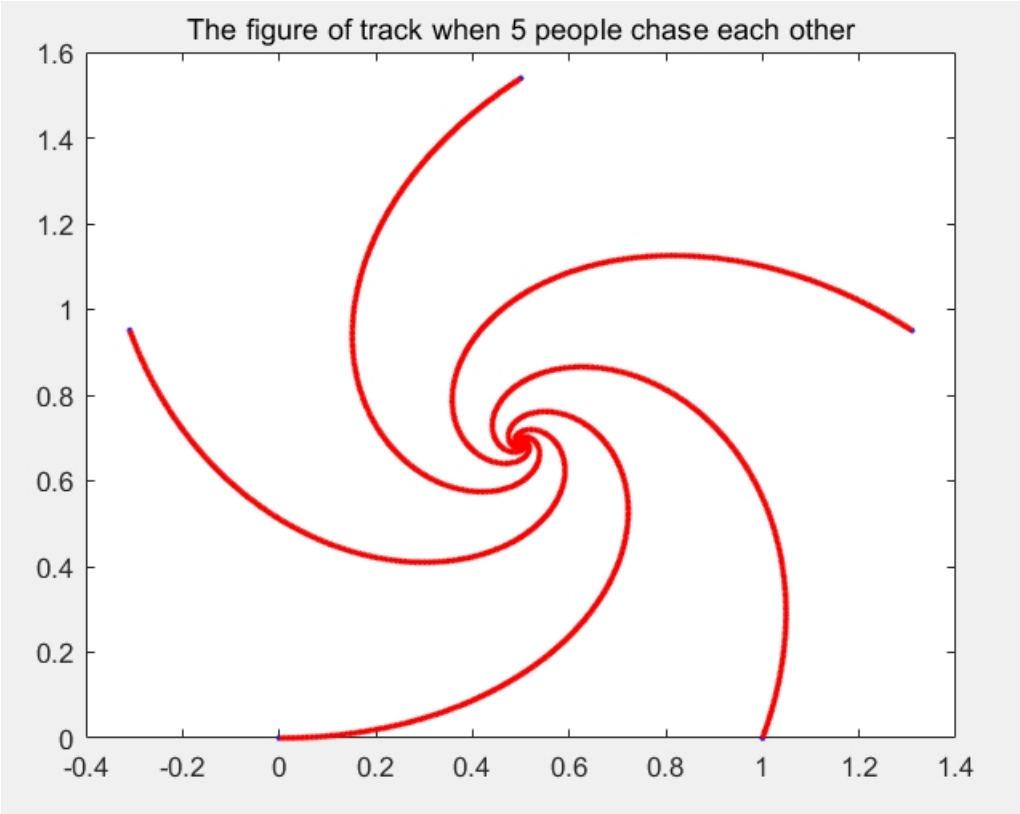
命令行窗口

```
The value of pi by this simulation is   3.1280
```

【Question_5】

```
%% P5
clear;clc;
num_edge=input('The number of the edges is ?');
speed=input('The speed is ?');
chasing(num_edge, speed);
function chasing(num_edge, speed)
    time = 0.001;
    distance = speed * time;
    total_people = zeros(num_edge, 2);
    rotating_angle = 2*pi / num_edge;
    cur_angle = 0;

    for i = 2:1:num_edge
        total_people(i, 1) = total_people(i-1, 1) + cos(cur_angle);
        total_people(i, 2) = total_people(i-1, 2) + sin(cur_angle);
        cur_angle = cur_angle + rotating_angle;
    end
    plot(total_people(:, 1), total_people(:, 2), 'b.')
    hold on
    new_total_people = zeros(num_edge, 2);
    for t = 0:time:1
        for i = 1:1:num_edge-1

            vec_from_i = zeros(2);
            vec_from_i(1) = total_people(i+1, 1) - total_people(i, 1);
            vec_from_i(2) = total_people(i+1, 2) - total_people(i, 2);

            total_distance = (vec_from_i(1)^2 + vec_from_i(2)^2)^0.5;

            new_total_people(i, 1) = total_people(i, 1) + (distance /
total_distance) * vec_from_i(1);
            new_total_people(i, 2) = total_people(i, 2) + (distance /
total_distance) * vec_from_i(2);
        end

        vec_from_i = zeros(2);
        vec_from_i(1) = total_people(1, 1) - total_people(num_edge, 1);
        vec_from_i(2) = total_people(1, 2) - total_people(num_edge, 2);

        total_distance = (vec_from_i(1)^2 + vec_from_i(2)^2)^0.5;

        new_total_people(num_edge, 1) = total_people(num_edge, 1) + (distance /
```

```
total_distance) * vec_from_i(1);
        new_total_people(num_edge, 2) = total_people(num_edge, 2) + (distance /
total_distance) * vec_from_i(2);

        total_people = new_total_people;
        plot(total_people(:, 1), total_people(:, 2), 'r.')
        hold on
    end
    title("The figure of track when "+ string(num_edge) + " people chase each
other")
end
```



命令行窗口

```
The number of the edges is ?5
The speed is ?5
```

【Question_6】

```
%% P6
clc;clear;clear all;
tire_a();
function tire_a()
    t = 0.001;
    r = 0.3;
    speed = 30;
```

```
    rotation = 30 / r;
    location = [0, 0];
    plot(location(1) ,location(2), 'r.')
    hold on
    cg = [0, r];
    angle = pi;
    for t = 0:t:0.25
        cg(1) = cg(1) + t * speed;
        angle = angle + t * rotation;
        location(1) = cg(1) + r * sin(angle);
        location(2) = cg(2) + r * cos(angle);
        comet(location(1),location(2))
        hold on
    end
    title("The figure of question 6 (a)")
end

clc;clear;clear all;
tire_b();
function tire_b()
    time = 0.001;
    r = 0.3;
    speed = 0;
    rotation = speed / r;
    a = 2;
    angular_acceleration = a / r;
    location = [0, 2*r];
    plot(location(1) ,location(2), 'r.')
    hold on
    cg = [0, r];
    angle = 0;
    for t = 0:time:10
        cg(1) = cg(1) + time * speed;
        angle = angle + time* rotation;
        location(1) = cg(1) + r * sin(angle);
        location(2) = cg(2) + r * cos(angle);
        comet(location(1),location(2))
        hold on
        speed = speed + time * a;
        rotation = rotation + time * angular_acceleration;
    end
    title("The figure of question 6 (b)")
end
```

```
clc;clear;clear all;
tire_c();
function tire_c()
    time = 0.001;
    cg = [0, 100, 0.3];
    location = [0, 100, 0.6];
    rolling_center = [0, 50, 0];
    Angle = 0;
    angle = 0;
    R = 50;
    r = 0.3;
    w = 1;
    for t = 0:time:10
        cg(1) = rolling_center(1) + R*sin(Angle);
        cg(2) = rolling_center(2) + R*cos(Angle);
        distance_1 = r * sin(angle);
        location(1) = cg(1) + distance_1 * cos(Angle);
        location(2) = cg(2) - distance_1 * sin(Angle);
        location(3) = cg(3) + r * cos(angle);
        comet3(location(1),location(2),location(3))
        hold on
        Angle = Angle + time * w;
        distance = time * w * R;
        angle = angle + distance /r;
    end
    title("The figure of question 6 (c)")
end
```