**Homework 07**

Mech307

Ekrem Yiğiter – 59721

1)



u(2.5,2) = 54.9626

2)



u(2,1) = 63.5780

3)



u(2.5,2) = 61.4179

4)

T = 16524.8 s



u(2.5,2) = 99.7556

5)

T = 3475.2 s



u(2,1) = 99.2183

6)

T = 33741.1 s



u(2.5,2) = 104.7156

Matlab Codes

1)

clc

clear all

close all

Lx = 5;

Ly = 4;

M = 51;

N = 41;

u = zeros(M,N);

u(:,1) = 100; u(1:11,41) = 20; u(11:41,31) = 20; u(41:51,41) = 20;

u(1,:) = 100; u(11,31:41) = 20; u(41,31:41) = 20; u(51,:) = 100;

h = Lx/(M-1);

tol = 0.0001;

err = 1;

while err > tol

uprev = u;

for i = 2:10

for j = 2:N-1

u(i,j) = 0.25\*(u(i,j-1)+u(i,j+1)+u(i-1,j)+u(i+1,j));

end

end

for i = 11:41

for j = 2:30

u(i,j) = 0.25\*(u(i,j-1)+u(i,j+1)+u(i-1,j)+u(i+1,j));

end

end

for i = 42:50

for j = 2:N-1

u(i,j) = 0.25\*(u(i,j-1)+u(i,j+1)+u(i-1,j)+u(i+1,j));

end

end

err = norm(u-uprev);

uprev = u;

end

u;

Uphysical = u';

Uphysical = Uphysical(end:-1:1,:);

figure(1)

[X,Y] = meshgrid(0:h:Lx,Ly:-h:0);

[p,q] = contourf(X,Y,Uphysical,[0:5:100]);

grid on, clabel(p,q), colorbar, xlabel('x'), ylabel('y')

u(26,21)

2)

clc

clear all

close all

Lx = 4;

Ly = 2;

M = 41;

N = 21;

u = zeros(M,N);

u(:,1) = 100;

for i = 1:21

u(i,i) = 50; u(20+i,22-i) = 50;

end

h = Lx/(M-1);

tol = 0.0001;

err = 1;

while err > tol

uprev = u;

for i = 2:21

for j = 2:N-(22-i)

u(i,j) = 0.25\*(u(i,j-1)+u(i,j+1)+u(i-1,j)+u(i+1,j));

end

end

for i = 22:M-1

for j = 2:N-(i-20)

u(i,j) = 0.25\*(u(i,j-1)+u(i,j+1)+u(i-1,j)+u(i+1,j));

end

end

err = norm(u-uprev);

uprev = u;

end

u;

Uphysical = u';

Uphysical = Uphysical(end:-1:1,:);

figure(1)

[X,Y] = meshgrid(0:h:Lx,Ly:-h:0);

[p,q] = contourf(X,Y,Uphysical,[0:5:100]);

grid on, clabel(p,q), colorbar, xlabel('x'), ylabel('y')

u(21,11)

3)

clc

clear all

close all

Lx = 5;

Ly = 4;

M = 51;

N = 41;

u = zeros(M,N);

u(:,1) = 100; u(:,41) = 50;

h = Lx/(M-1);

tol = 0.0001;

err = 1;

while err > tol

uprev = u;

for i = 2:M-1

for j = 2:N-1

u(i,j) = 0.25\*(u(i,j-1)+u(i,j+1)+u(i-1,j)+u(i+1,j));

end

end

u(51,:) = (-u(49,:) +4\*u(50,:) )/3;

err = norm(u-uprev);

uprev = u;

end

u;

Uphysical = u';

Uphysical = Uphysical(end:-1:1,:);

figure(1)

[X,Y] = meshgrid(0:h:Lx,Ly:-h:0);

[p,q] = contourf(X,Y,Uphysical,[0:5:100]);

grid on, clabel(p,q), colorbar, xlabel('x'), ylabel('y')

u(26,21)

4)

clc

clear all

close all

Lx = 5.0;

Ly = 4.0;

h = 0.1;

M = 51;

N = 41;

u = 200\*ones(M,N);

u(:,1) = 100; u(1:11,41) = 20; u(11:41,31) = 20; u(41:51,41) = 20;

u(1,:) = 100; u(11,31:41) = 20; u(41,31:41) = 20; u(51,:) = 100;

u(12:40,32:41) = 0;

c = 56.4\*10^(-6);

r = 0.1;

dt = r\*h^2/c;

unext = u;

TIME = 0;

while max(max(u))>125

for i = 2:10

for j = 2:N-1

unext(i,j) = (1-4\*r) \* u(i,j) + r\*(u(i,j+1)+u(i,j-1)+u(i+1,j)+u(i-1,j));

end

end

for i = 11:41

for j = 2:30

unext(i,j) = (1-4\*r) \* u(i,j) + r\*(u(i,j+1)+u(i,j-1)+u(i+1,j)+u(i-1,j));

end

end

for i = 42:50

for j = 2:N-1

unext(i,j) = (1-4\*r) \* u(i,j) + r\*(u(i,j+1)+u(i,j-1)+u(i+1,j)+u(i-1,j));

end

end

u = unext;

TIME = TIME + dt;

end

figure(1)

plot((1:51),u(:,2)); grid on; xlabel('x'), ylabel('u(x,2)')

u(26,21)

str = ['Time = ',num2str(TIME,'%8.1f'),' seconds'];

uphysical = u';

uphysical = uphysical(end:-1:1,:);

figure(2)

[X,Y]=meshgrid(0:h:Lx,Ly:-h:0);

[p,q]=contourf(X,Y,uphysical,[0:5:125]);

title(str)

grid on, clabel(p,q), colorbar, xlabel('x'), ylabel('y')

5)

clc

clear all

close all

Lx = 4;

Ly = 2;

h = 0.1;

M = 41;

N = 21;

u = zeros(M,N);

u(:,1) = 100;

for i = 2:21

for j = 2:N-(22-i)

u(i,j) = 200;

end

end

for i = 22:M-1

for j = 2:N-(i-20)

u(i,j) = 200;

end

end

c = 56.4\*10^(-6);

r = 0.1;

dt = r\*h^2/c;

unext = u;

TIME = 0;

while max(max(u))>125

for i = 2:21

for j = 2:N-(22-i)

unext(i,j) = (1-4\*r) \* u(i,j) + r\*(u(i,j+1)+u(i,j-1)+u(i+1,j)+u(i-1,j));

end

end

for i = 22:M-1

for j = 2:N-(i-20)

unext(i,j) = (1-4\*r) \* u(i,j) + r\*(u(i,j+1)+u(i,j-1)+u(i+1,j)+u(i-1,j));

end

end

u = unext;

TIME = TIME + dt;

end

figure(1)

plot((1:21),u(21,:)); grid on; xlabel('y'), ylabel('u(2,y)')

u(21,11)

str = ['Time = ',num2str(TIME,'%8.1f'),' seconds'];

uphysical = u';

uphysical = uphysical(end:-1:1,:);

figure(2)

[X,Y]=meshgrid(0:h:Lx,Ly:-h:0);

[p,q]=contourf(X,Y,uphysical,[0:5:125]);

title(str)

grid on, clabel(p,q), colorbar, xlabel('x'), ylabel('y')

6)

clc

clear all

close all

Lx = 5;

Ly = 4;

h = 0.1;

M = 51;

N = 41;

u = 200\*ones(M,N);

u(1,:) = 0; u(:,1) = 100; u(:,41) = 50;

c = 56.4\*10^(-6);

r = 0.1;

dt = r\*h^2/c;

unext = u;

TIME = 0;

while max(max(u))>125

for i = 2:M-1

for j = 2:N-1

unext(i,j) = (1-4\*r) \* u(i,j) + r\*(u(i,j+1)+u(i,j-1)+u(i+1,j)+u(i-1,j));

end

end

u = unext;

u(51,:) = (-u(49,:) +4\*u(50,:) )/3;

TIME = TIME + dt;

end

u(26,21)

str = ['Time = ',num2str(TIME,'%8.1f'),' seconds'];

uphysical = u';

uphysical = uphysical(end:-1:1,:);

figure(1)

[X,Y]=meshgrid(0:h:Lx,Ly:-h:0);

[p,q]=contourf(X,Y,uphysical,[0:5:125]);

title(str)

grid on, clabel(p,q), colorbar, xlabel('x'), ylabel('y')