Laborator 6

Cuprins

Problema 1

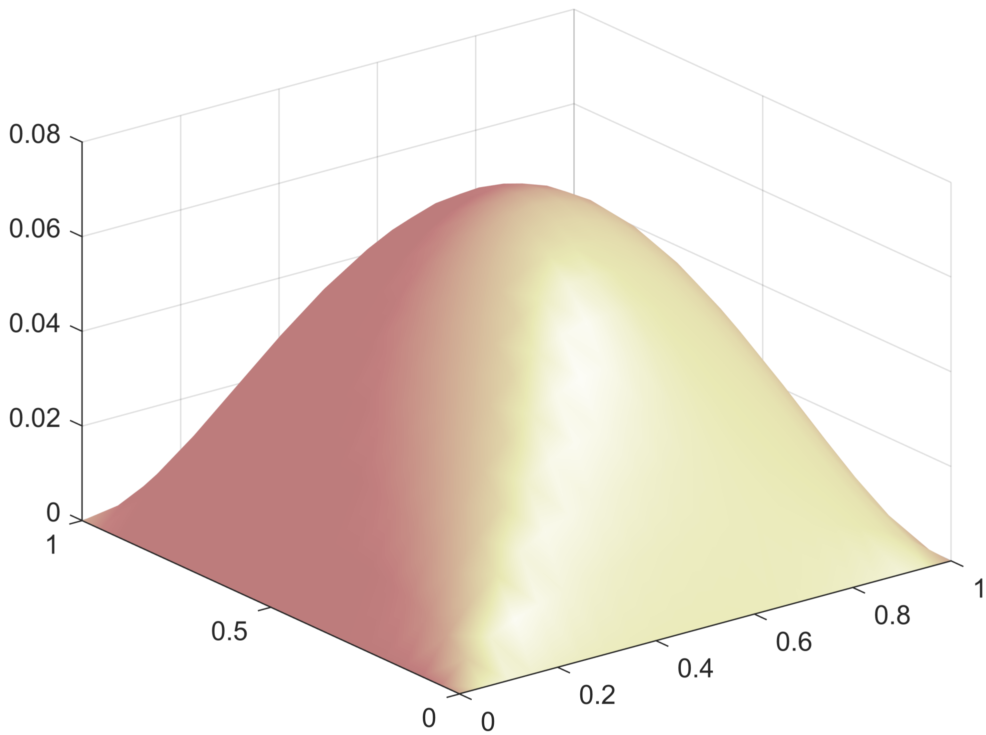
1. Solve the 2D heat equation problem

$$\frac{\partial T}{\partial t} = \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial x^2} + 1, \qquad t > 0, (x, y) \in D = [0,1] \times [0,1]$$

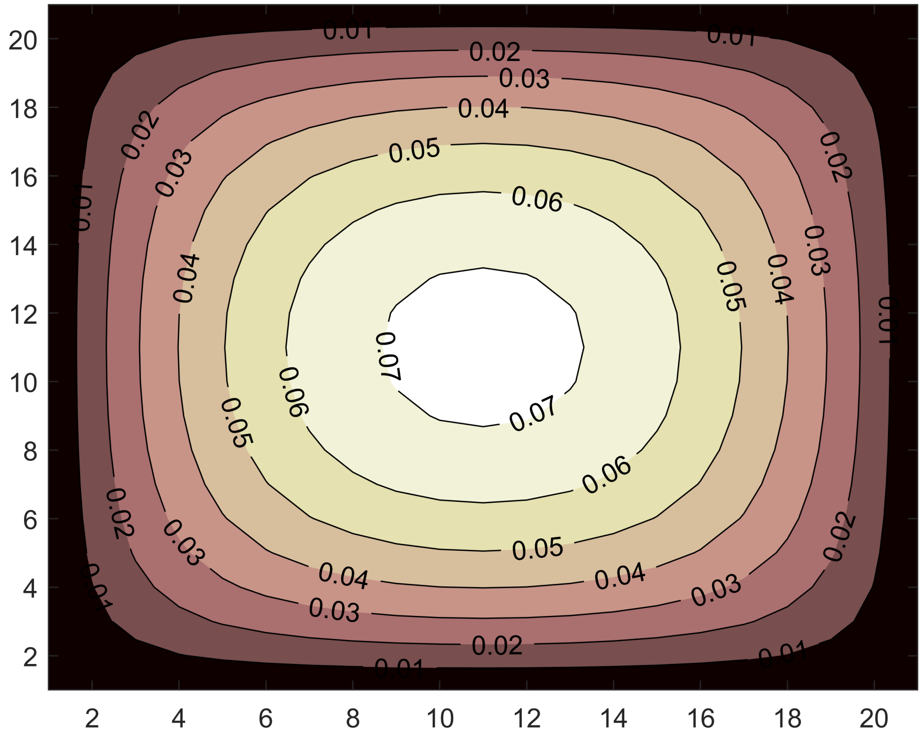
$$t = 0 : T(x,0) = 0;$$

$$t > 0 : T\big|_{\partial D} = 0;$$

```
N=21;
dx=1/(N-1);
dt=dx*dx/10;
niu=dt/dx/dx;
t_final=1;

Told=zeros(N,N);
Tnew=zeros(N,N);

nr_it=0;
t=0;
while (t<t_final)
    t=t+dt;
    nr_it=nr_it+1;
    for i=2:N-1
        for j=2:N-1
            Tnew(i,j)=Told(i,j)+niu*(Told(i+1,j)-2*Told(i,j)+Told(i-1,j))+...
                niu*(Told(i,j+1)-2*Told(i,j)+Told(i,j-1))+dt;
        end
    end
    Told=Tnew;


end

figure(1)
surfl(0:dx:1,0:dx:1, Tnew);
shading interp;
colormap(pink);
axis('on');
```




```
figure(2)
[c,h] = contourf(Tnew);
        clabel(c,h)
colormap(pink);
```



Problema 2

1. Rezolvați folosind metoda Jacobi, Gauss-Seidel și metoda relaxării ecuația:

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 4, \qquad 0 < x < 1, \quad 0 < y < 2;$$

$$u(x,0) = x^2, \quad u(x,2) = (x-2)^2, \quad 0 \le x \le 1;$$

$$u(0,y) = y^2, \quad u(1,y) = (y-1)^2, \quad 0 \le y \le 2.$$

Comparați cu soluția analitică:

$$u(x,y) = (x-y)^2.$$

```
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Nx=101;
Ny=201;
h=1/(Nx-1);
x=0:h:(Nx-1)*h;y=0:h:(Ny-1)*h;

u=zeros(Nx,Ny);
u_ex=u;
%conditii pe frontiera
u(:,1)=x.^2; u(:,Ny)=(x-2).^2;
```
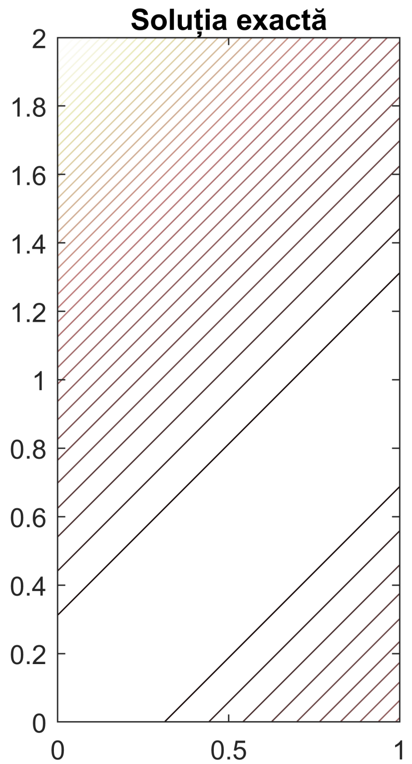
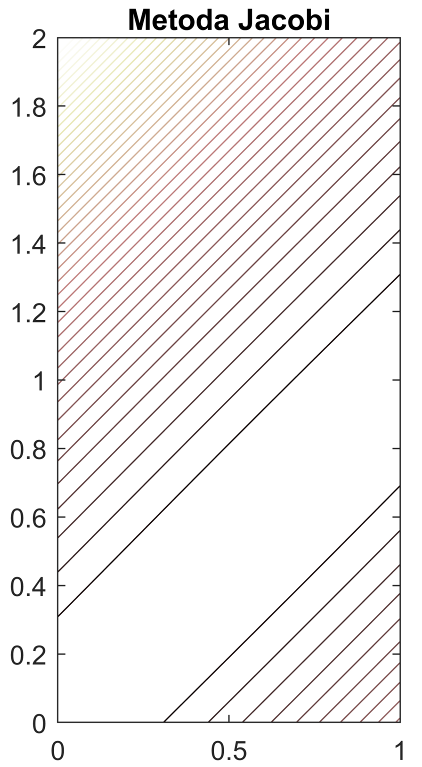

```
u(1,:)=y.^2; u(Nx,:)=(y-1).^2;
u_new=u;

%% Metoda Jacobi
nr_it=0;
stop=0;
while (stop~=1)
    nr_it=nr_it+1;

     err_u=0;
    for i=2:Nx-1
        for j=2:Ny-1
            u_new(i,j)=0.25*(u(i+1,j)+u(i-1,j)+u(i,j+1)+u(i,j-1)-4*h*h);
            if abs(u(i,j)-u_new(i,j))>err_u
                err_u=abs(u(i,j)-u_new(i,j));
            end

        end
    end
     if err_u<1e-6
            stop=1;
     end

    u=u_new;
end
for i=1:Nx
    for j=1:Ny
        u_ex(i,j)=((i-1)*h-(j-1)*h)^2;
    end
end

nr_it
```

```
nr_it =
       17838
```

```
[C,H]=contour(x,y,u_ex',40);
title('Soluția exactă')
axis equal
axis([0,1,0,2])
```




```
[C,H]=contour(x,y,u',40);
title('Metoda Jacobi')
axis equal
axis([0,1,0,2])
```

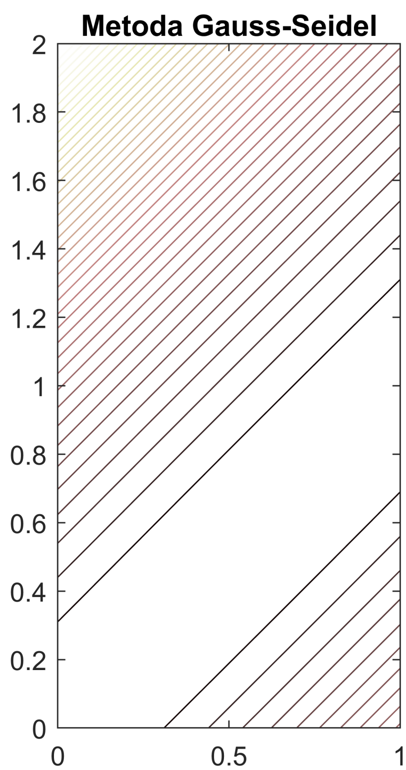



```
u=zeros(Nx,Ny);
u(:,1)=x.^2; u(:,Ny)=(x-2).^2;
u(1,:)=y.^2; u(Nx,:)=(y-1).^2;
u_new=u;

%%%%Metoda Gauss-Seidel
nr_it=0;
stop=0;
while (stop~=1)
    nr_it=nr_it+1;

     err_u=0;
    for i=2:Nx-1
        for j=2:Ny-1
            u_new(i,j)=0.25*(u(i+1,j)+u_new(i-1,j)+u(i,j+1)+u_new(i,j-1)-4*h*h);
            if abs(u(i,j)-u_new(i,j))>err_u
                err_u=abs(u(i,j)-u_new(i,j));
            end

        end
    end
     if err_u<1e-6
            stop=1;
     end

    u=u_new;
end
```

```
nr_it
```

```
nr_it =
       10050
```

```
[C,H]=contour(x,y,u',40);
title('Metoda Gauss-Seidel')
axis equal
axis([0,1,0,2])
```




```
u=zeros(Nx,Ny);
u(:,1)=x.^2; u(:,Ny)=(x-2).^2;
u(1,:)=y.^2; u(Nx,:)=(y-1).^2;
u_new=u;

%%%%%Metoda relaxării
k=0;
nr_it=0;
stop=0;
relax=1.95;
while (stop~=1)
    nr_it=nr_it+1;

     err_u=0;
    for i=2:Nx-1
```

```
        for j=2:Ny-1
            u_new(i,j)=(1-relax)*u(i,j)+relax*0.25*(u(i+1,j)+u_new(i-1,j)+u(i,j+1)+u_new(i,j-1)
            if abs(u(i,j)-u_new(i,j))>err_u
                err_u=abs(u(i,j)-u_new(i,j));
            end
        end
    end
     if err_u<1e-6
            stop=1;
     end

    u=u_new;
end

nr_it
```

```
nr_it =
   372
```

```
[C,H]=contour(x,y,u',40);
title('Metoda relaxării')
axis equal
axis([0,1,0,2])
```