Numerical Methods II. Problems solved in class

22.02.2020

Example 1. Solve the problem

$$-u''(x) + 3u(x) = 3 - 8\sin x, \quad x \in (0, \pi),$$

$$u(0) = 1, \quad u'(\pi) = 2$$

by means of the finite difference method with number of subintervals $n = 100$.

```
clear
L=pi;
a=1;
b=2;
p=1;
q=3;
f=@(x)3-8*sin(x);
n=100;
%%%
h=L/n;
x=0:h:L+h;
A=zeros(n+2,n+2);
A(1,1)=1;
y(1)=a;
for i=2:n+1
    A(i,i-1)=-p/h^2;
    A(i,i)=2*p/h^2+q;
    A(i,i+1)=-p/h^2;
    y(i)=f(x(i));
end
A(n+2,n)=-1/(2*h);
A(n+2,n+2)=1/(2*h);
y(n+2)=b;
%%%
u=A\y';
plot(x(1:n+1),u(1:n+1))
xlabel('x')
```

```
ylabel('u')
grid on
```

Exercise 1. Solve the problem

$$-u''(x) + 2u(x) = x, \quad x \in (0, 1),$$

$$u'(0) = u'(1) = 0$$

by means of the finite difference method with number of subintervals $n = 50$.

```
clear
L=1;
a=0;
b=0;
p=1;
q=2;
f=@(x)x;
n=50;
%%%
h=L/n;
x=-h:h:L+h;
A=zeros(n+3,n+3);
A(1,1)=-1/(2*h);
A(1,3)=1/(2*h);
y(1)=a;
for i=2:n+2
    A(i,i-1)=-p/h^2;
    A(i,i)=2*p/h^2+q;
    A(i,i+1)=-p/h^2;
    y(i)=f(x(i));
end
A(n+3,n+1)=-1/(2*h);
A(n+3,n+3)=1/(2*h);
y(n+3)=b;
%%%%
u=A\y';
plot(x(2:n+2),u(2:n+2))
xlabel('x')
ylabel('u')
grid on
```