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```
clear all; close all; clc
```

## Problem 1

Solve the 1D heat equation

$$\frac{d^2 T}{dx^2} = f(x) \text{ for}$$

$$0 \leq x \leq 1$$

## Construct matrix A

```
h1=figure();
ax=axes('units','pixels');
set([h1,ax],'Visible','off')
marker=['.','x','s','+'];
for i=2:5

    N=2^i; % Size
    h=1/N; % dx
    x_values=[h:h:1-h].';
    A=(1/h^2) * (diag(ones(N-1,1)*-2) + diag(ones(N-2,1),-1) +
    diag(ones(N-2,1),1));
```

## Construct b vector

```
BC_a=0; % left Dirichlet BC
BC_b=2; % right Dirichlet BC
% initialize and set BCs
b=zeros(N-1,1);
b(1)=-1/h^2 * BC_a;
b(end)=(-1/h^2 * BC_b);
% add f(x) to b
b=b+-10*sin(3*pi/2*x_values);

x=A\b; %solve the Ax=b problem

plot(x_values,x,marker(i-1))
hold all
```

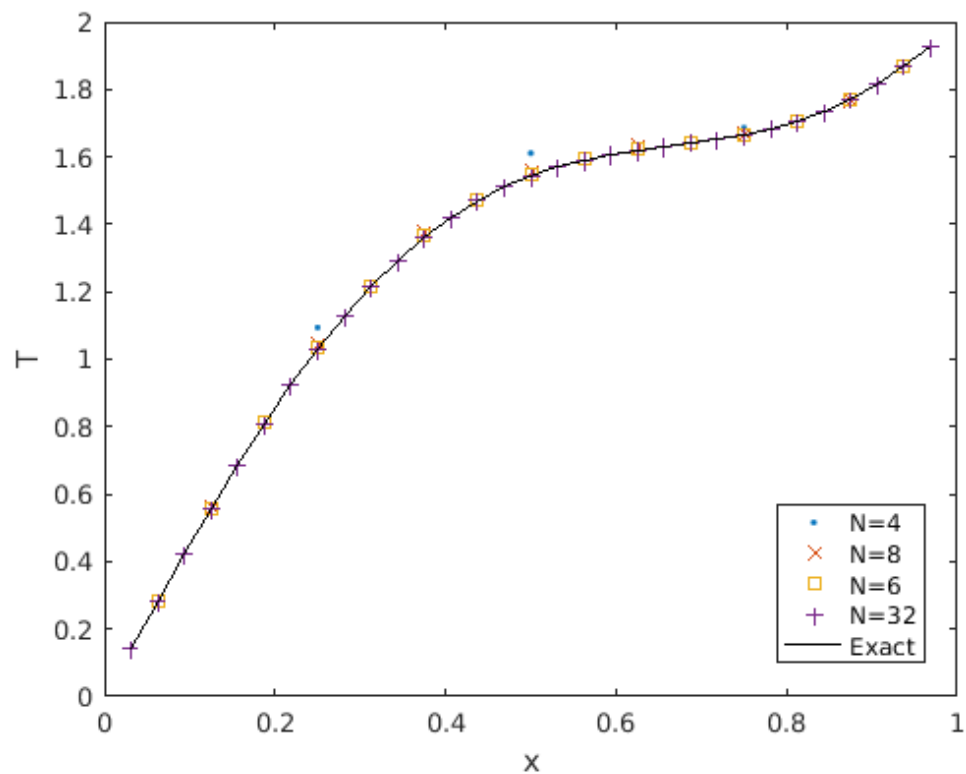
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```
end
```

```
xlabel('x')  
ylabel('T')
```

## Exact solution anonymous function

```
T=@(x) (2+40/(9*pi^2)).*x + 40/(9*pi^2).*sin(3*pi.*x/2);  
plot(x_values,T(x_values),'k-')  
legend('N=4','N=8','N=6','N=32','Exact','Location','best')  
set([h1,ax],'Visible','on')
```



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