Forward Difference Method

al = 1;

h = 0.1;

v = 0.0005;

t = 0.5;

FDM_12_2_A(al,h, v, t)

```
x_w_u_e =

        0.1    0.0022865    0.0022224   6.4107e-05
        0.2    0.0043492    0.0042273   0.00012194
        0.3    0.0059862    0.0058184   0.00016783
        0.4    0.0070372    0.0068399    0.0001973

        0.5    0.0073993    0.0071919   0.00020745
        0.6    0.0070372    0.0068399    0.0001973
        0.7    0.0059862    0.0058184   0.00016783
        0.8    0.0043492    0.0042273   0.00012194
        0.9    0.0022865    0.0022224   6.4107e-05
```

FDM_12_2_A(1,0.1,0.01,0.5)

```
x_w_u_e =

         0.1    3.454e+05    0.0022224    3.454e+05
         0.2  -6.5593e+05    0.0042273   6.5593e+05
         0.3   9.0053e+05    0.0058184   9.0053e+05
         0.4  -1.0552e+06    0.0068399   1.0552e+06
         0.5   1.1056e+06    0.0071919   1.1056e+06
         0.6  -1.0477e+06    0.0068399   1.0477e+06
         0.7   8.8837e+05    0.0058184   8.8837e+05
         0.8  -6.4378e+05    0.0042273   6.4378e+05
         0.9   3.3789e+05    0.0022224   3.3789e+05
```

Source Code

language-matlab

```matlab
clear;
clc;
close all;

format shortg

al = 1;
h = 0.1;
v = 0.0005;
t = 0.5;
```

```
FDM_12_2_A(al,h, v, t)
FDM_12_2_A(1,0.1,0.01,0.5)

function FDM_12_2_A(al, h, v, t)
    m = 1/h;
    iterations = t/v;
    s = al^2*v/h^2;
    x = zeros(m-1,1);

    %go horizontal
    for i =1:m-1
        x(i) = i*h;
    end

    w = sin(pi*x);
    wn = zeros(m-1,1);

    %go vertical
    A = compute_A(m-1, al, v, h);

    for j = 1:iterations
        wn = A * w;
        w = wn;
    end

    %compute true solution
    u = true_solution(x,t);
```

```
    e = abs(u-w);
    x_w_u_e = [x,w,u,e]

end

function [u] = true_solution(x,t)
    u = exp(-pi^2*t)*sin(pi*x);
end

function [A] = compute_A(iters, alpha, t, h)
    A = zeros(iters);

    lambda = alpha^2*(t/h^2);

    A(1,1) = (1 - 2*lambda);
    A(1,2) = lambda;

    for k = 2:iters-1
        A(k,k+1) = lambda;
        A(k,k) = (1 - 2*lambda);
        A(k,k-1) = lambda;
        continue;
    end

    A(iters,iters-1) = lambda;
    A(iters,iters) = (1 - 2*lambda);
```

```
end
```