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```
% dftcs - Program to solve the diffusion equation
% using the Forward Time Centered Space (FTCS) scheme.
```

initialize parameters

```
%* Initialize parameters (time step, grid spacing, etc.).
tau = 1e-4;
N = 61;
L = 1.; % The system extends from x=-L/2 to x=L/2
h = L/(N-2); % Grid size
kappa = 1.; % Diffusion coefficient
coeff = kappa*tau/h^2;
if( coeff < 0.5 )
    disp('Solution is expected to be stable');
else
    disp('WARNING: Solution is expected to be unstable');
end

%* Set initial and boundary conditions.
tt = zeros(N,1); % Initialize temperature to zero at all
points
tt(round(3*N/4)) = 1/h; % Initial cond. is delta function in
center
% The boundary conditions are tt(1) = tt(N) = 0

Solution is expected to be stable
```

numerical solution

```
%* Set up loop and plot variables.
xplot = (0:N-1)*h - L/2 - h/2; % Record the x scale for plots
iplot = 1; % Counter used to count plots
nstep = 150; % Maximum number of iterations
nplots = 50; % Number of snapshots (plots) to take
plot_step = nstep/nplots; % Number of time steps between plots

%* Loop over the desired number of time steps.
for istep=1:nstep %% MAIN LOOP %%
```

```

    %* Compute new temperature using FTCS scheme.
    tt(2:(N-1)) = tt(2:(N-1)) + ...
        coeff*(tt(3:N) + tt(1:(N-2)) - 2*tt(2:(N-1)));

    % conform to boundary conditions
    tt(1) = tt(2);
    tt(N) = tt(N-1);

    %* Periodically record temperature for plotting.
    if( rem(istep,plot_step) < 1 )    % Every plot_step steps
        ttplot(:,ipplot) = tt(:);      % record tt(i) for plotting
        tplot(ipplot) = istep*tau;      % Record time for plots
        ipplot = ipplot+1;
    end
end

```

moi sol'n at t = 0.015

```

x0 = L/4 * N;
t=[1e-8 0.001:0.001:1];
x = linspace(-0.5*L, 0.5*L, length(xplot));
sig=sqrt(2*kappa*t);
TG=zeros(length(x),length(t));
nimag = 30;
Timag=zeros([size(TG) nimag+1]);
Timag(:, :, 1)=(ones(length(x),1)*(1./sig)).*exp(-(x-x0)'.^2*(1./
sig.^2)/2)/sqrt(2*pi);
for ii=1:nimag
    Timag(:, :, ii+1)=Timag(:, :, ii)+(ones(length(x),1)*(1./sig)).*exp(-(x
    +(ii*L-(-1)^ii*x0))'.^2*(1./sig.^2)/2)/sqrt(2*pi)+...
        (ones(length(x),1)*(1./sig)).*exp(-(x-(ii*L+(-1)^ii*x0))'.^2*(1./
    sig.^2)/2)/sqrt(2*pi);
end

```

find numerical solution at t = 0.015

query vector of times to find which index contains value

```

tplot(25)
idx = find(abs(tplot - 0.015) <= 1e-5);
tni = ttplot(:, idx);

```

ans =

0.0075

make plots

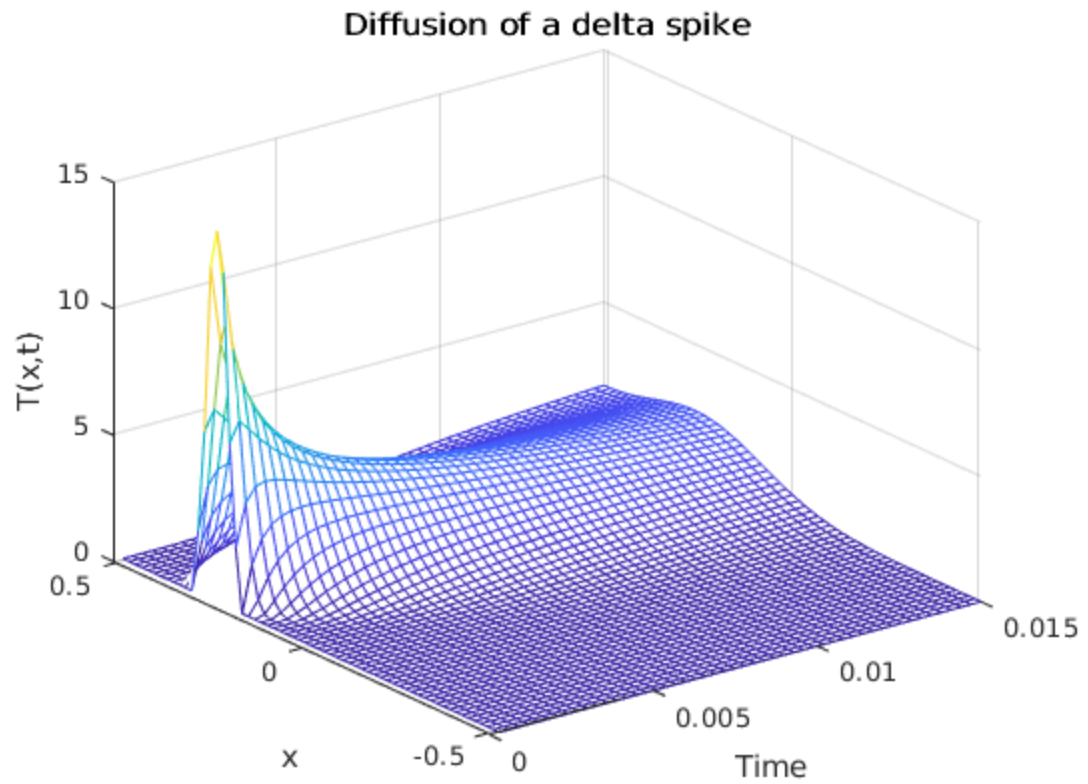
```

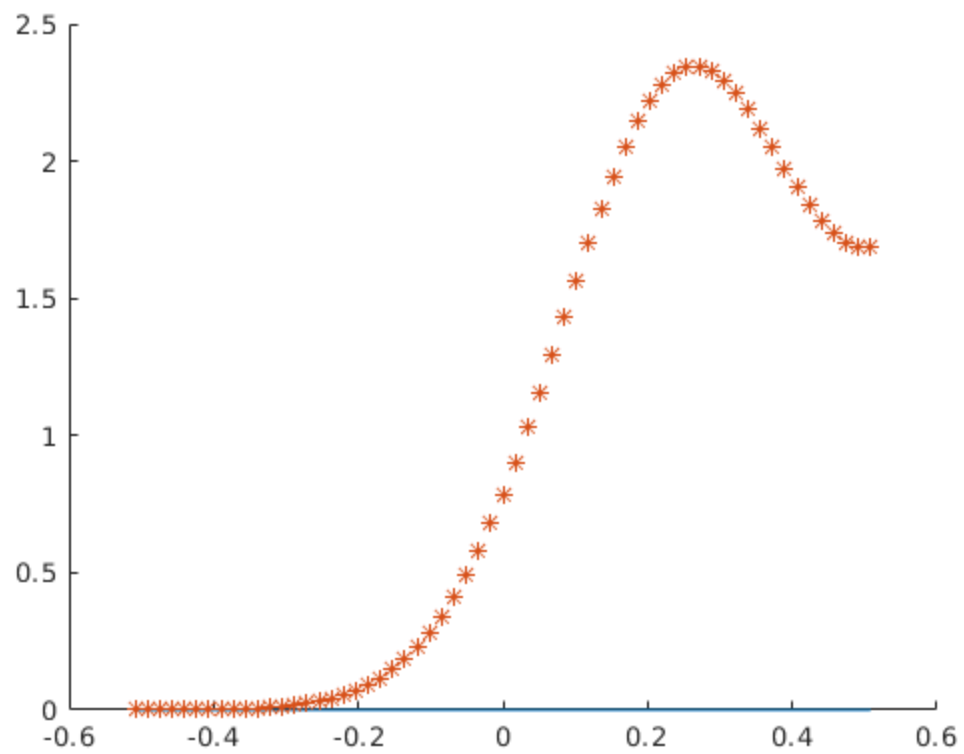
%* Plot temperature versus x and t as wire-mesh and contour plots.

```

```
figure(1); clf;
mesh(tplot,xplot,ttplot); % Wire-mesh surface plot
xlabel('Time'); ylabel('x'); zlabel('T(x,t)');
title('Diffusion of a delta spike');
pause(1);

figure(2); clf;
hold on
plot(xplot, Timag(:,16,1), '-')
plot(xplot, tni, '*')
hold off
```





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