base script for virality example

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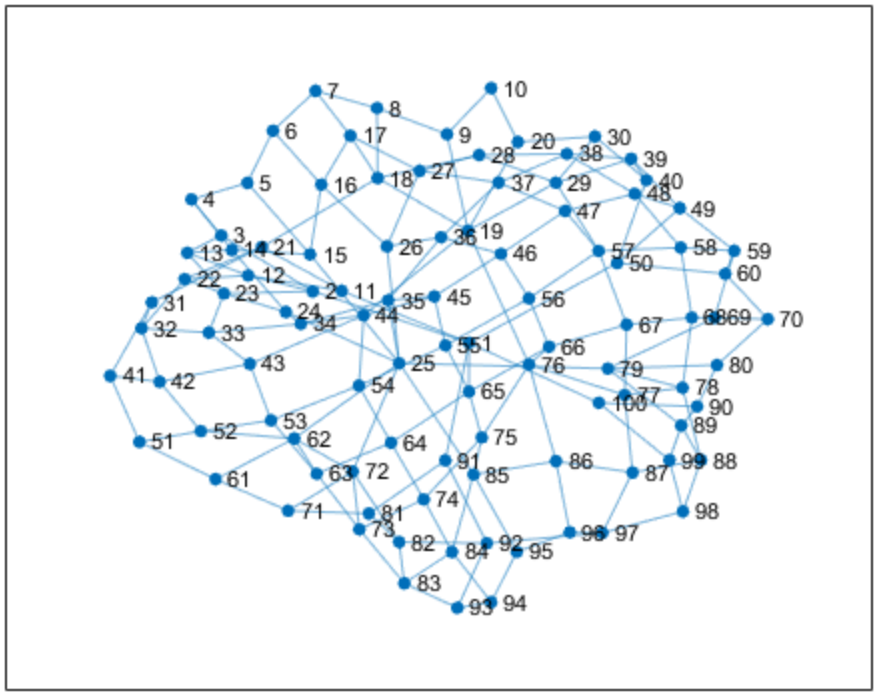
create 2-D 10x10 lattice network

```
n = 12;
A = delsq(numgrid('S',n));
G = graph(A,'omitselfloops');

% implement small-world topography, add some edges to G
% there is really good transportation, so many populations are
 connected.
G = addedge(G, 25, 79, 1);
G = addedge(G, 25, 62, 1);
G = addedge(G, 18, 21, 1);
G = addedge(G, 2, 23, 1);
G = addedge(G, 92, 97, 1);
G = addedge(G, 29, 57, 1);
G = addedge(G, 1, 65, 1);
G = addedge(G, 1, 91, 1);
G = addedge(G, 1, 50, 1);
G = addedge(G, 1, 100, 1);
G = addedge(G, 19, 76, 1);
G = addedge(G, 19, 44, 1);
G = addedge(G, 25, 85, 1);
G = addedge(G, 25, 72, 1);

figure();
plot(G);


% extract the adjacency matrix
ad = adjacency(G);

% establish the dimensions
n_dim = length(ad);
```



now we create a state transition matrix for our linear dynamical model

```
% set a self-decay factor
decayf = 0.9;                                   % originally 0.5

% scale strength of nodal interactions
Aff = ad*0.20;                                  % originally 0.16

% create the final dynamical matrix as sum of self-decay and nodal
% interactions
Aff = Aff + (eye(n_dim).*decayf);
```

simulate the network

```
% set the length of the simulation
Tf = 90;

% initialize an array to store the state of the network at each time
 point
x_out = zeros(n_dim,Tf);

% random positive initial conditions
% x_init = randn(n_dim,1).^2;
```

```
% zero initial condition
x_init = zeros(n_dim,1);

x_out(:,1) = x_init;

control_out = zeros(n_dim,Tf);
```

model some disturbance.

In this example, we will consider two short bursts of excitation applied at t = 25 (to node 25) and 50 (to node 45)

```
w_dist = zeros(n_dim, Tf);
w_dist(25,25) = 15;
w_dist(45,50) = 15;
```

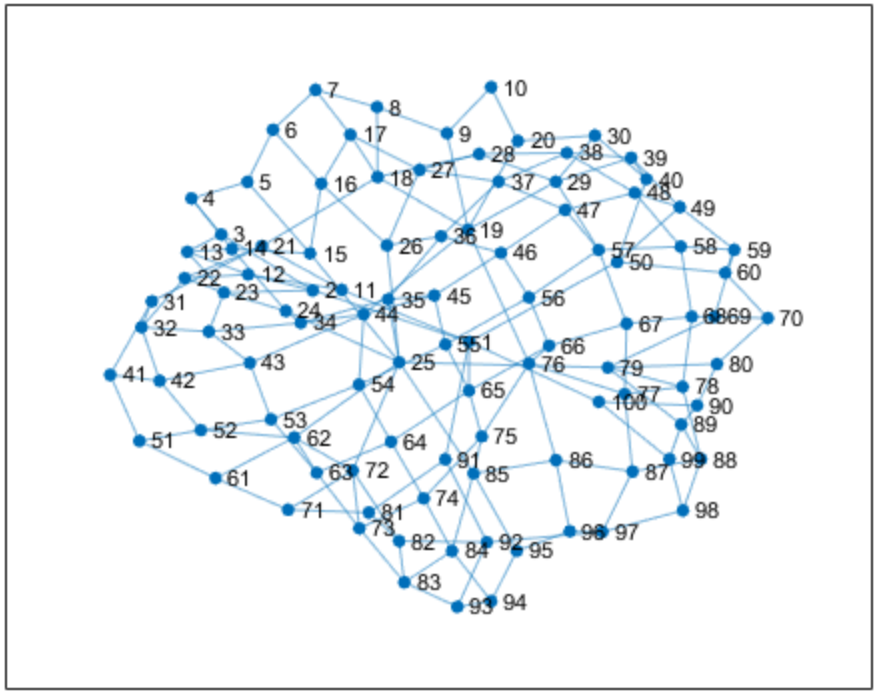
simulate

```
for ind = 2:Tf
    % we were originally inputting x_out(:,ind-1)
    % we changed it to x_out(:,1:ind-1)
    control_vector = find_cvec(x_out(:,1:ind-1));

    % without control
    % x_out(:,ind) = Aff*x_out(:,ind-1) + w_dist(:,ind);

    % with control
      x_out(:,ind) = Aff*x_out(:,ind-1) + w_dist(:,ind) +
 control_vector;
      control_out(:,ind) = control_vector;

      % keep x_out positive
      x_out = max(x_out, 0);

end

% anything over 10 is saturated
x_out = min(x_out,10);
```

plot a movie of the network state evolution

```
figure(2);
for ind = 1:Tf

    F = reshape(x_out(:,ind),[10 10]);
    F = min(F,10);
    figure(2);
    imagesc(F,[0 10]);
    title(strcat('t = ',num2str(ind)));
    colorbar;
```

```
    pause(0.1);
end
```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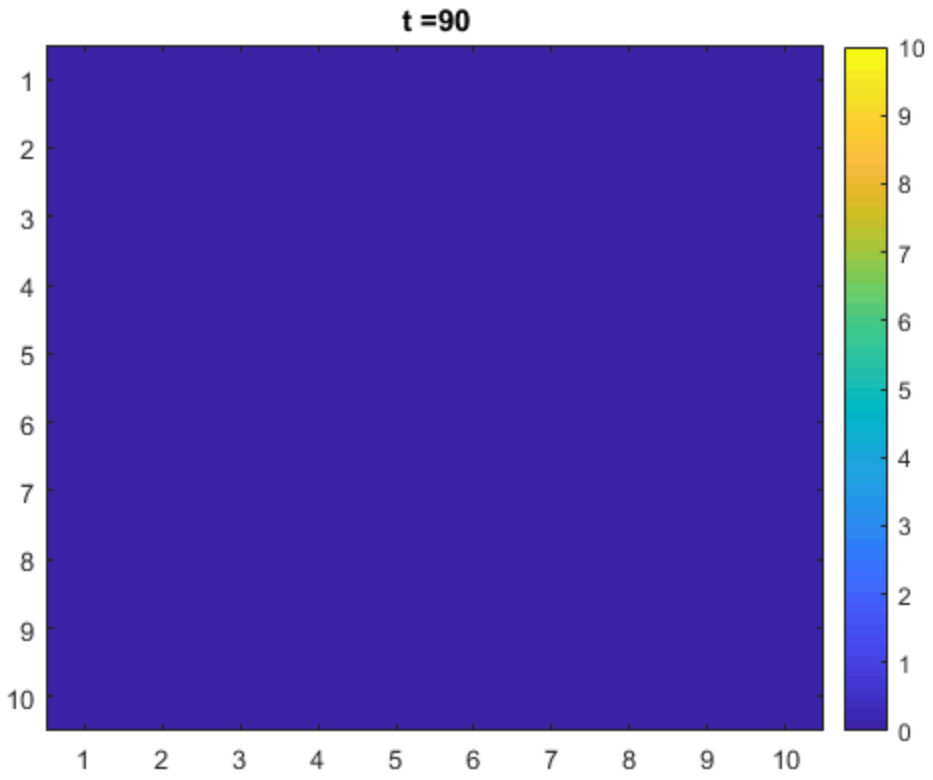
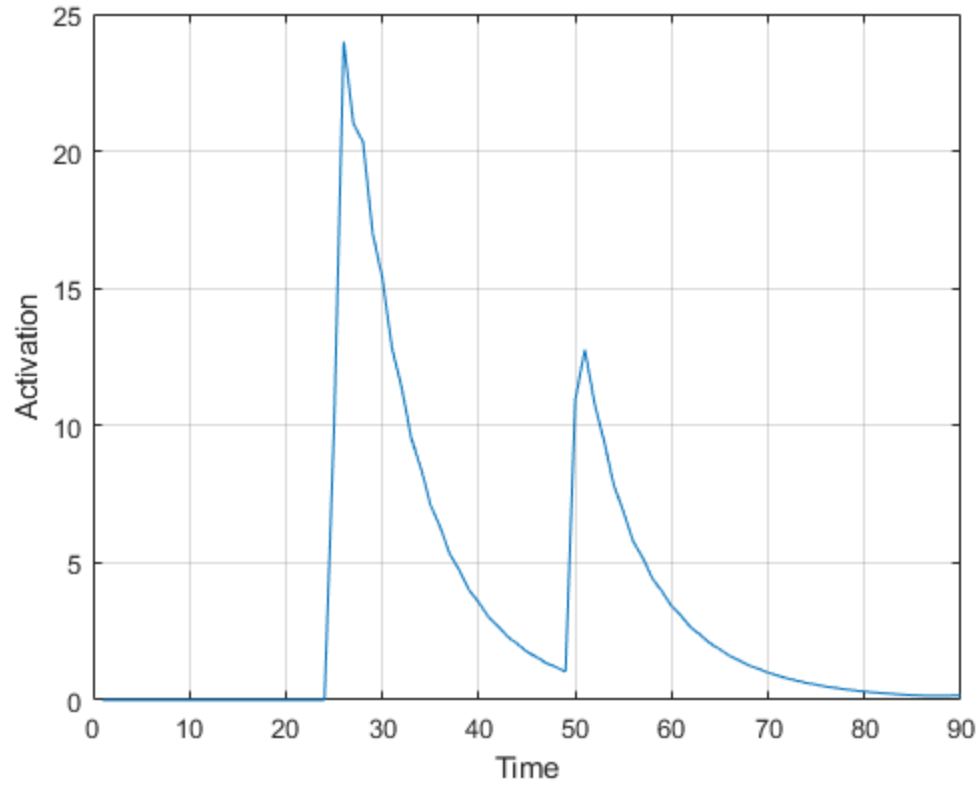
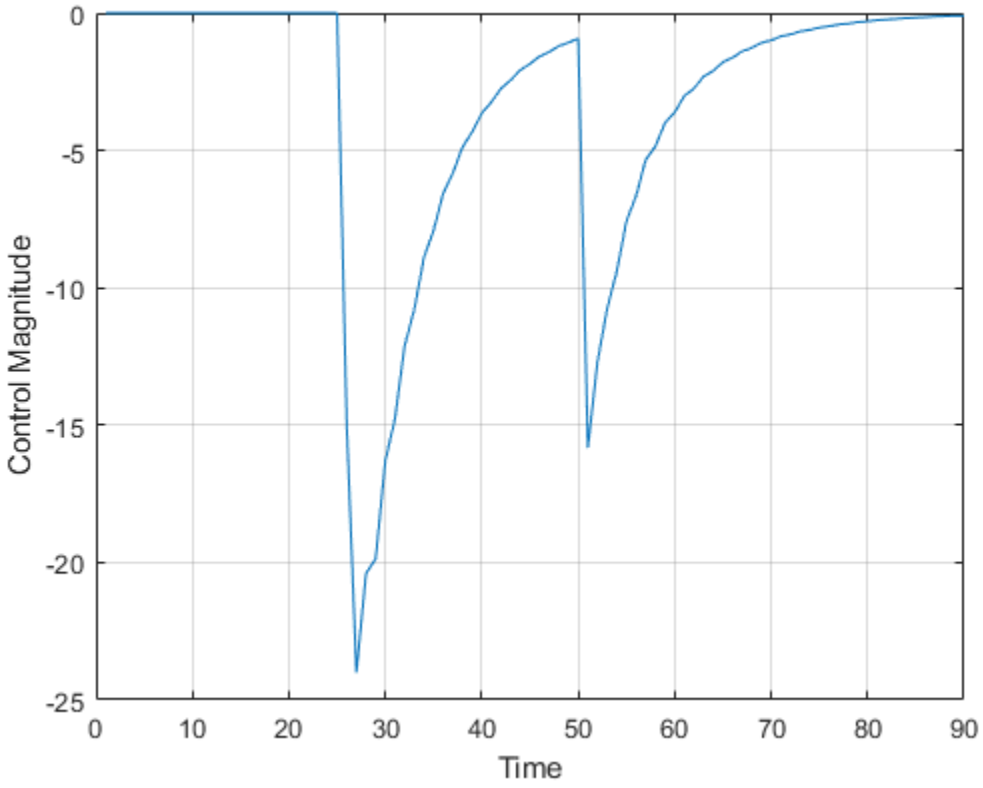


Plot the total activation of the network as a function of time

```
figure(3);
plot(sum(x_out));
xlabel('Time');
ylabel('Activation');
grid on;

figure(4);
plot(sum(control_out));
xlabel('Time');
ylabel('Control Magnitude');
grid on;
```


Activation
Time
0
5
10
15
20
25
0
10
20
30
40
50
60
70
80
90


Control Magnitude
Time
0
-5
-10
-15
-20
-25
0
10
20
30
40
50
60
70
80
90

prototype for function that returns a "control vector"

```
% parameter x_out is the column data for the current day, along with
 the
% column data for every previous day that has happened so far
 function control_vector = find_cvec(x_out);

    % make control vector 100x1 vector
    control_vector = zeros([length(x_out),1]);

    % check if number of columns is only 1
    cols = size(x_out, 2);
    if(cols == 1)
        % do nothing, leave control_vector as all zeros
    else
        for i = 1:100
            % check difference between each row of the
            % last column with the row in the previous column
            % i.e. each row of "cols" - each row of "cols-1"
            if(x_out(i,cols) - x_out(i,cols-1) > 0.001)
                control_vector(i) = -1*x_out(i, cols);
            end
        end
    end
 end
```

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