```
%% prob_3.m
%
% this script is for HW5 problem 3
%
% - written by: Dimitri Lezcano

     ;

%% Set-up
  = 100;

% system
   = [10; -5];
 .   =    (2);

 .  = 0.04;
 .   = 0.1;

 .  = [1,  .  ; 0.2* .  , 1 - 0.5* .  ];
 .  = [0; 1];
 .  = [0; 0.1];

% Value function params
 .  =     (1, );
 .  =     (1, );
 .  =     (1, );

 . { } =  .  ;
 . { } = [0;0];
 . { } = 0;

% control law
 .  =     (1, );
 .  =     (1, );

% trajectory and control arrays
  =      (2, );
 (:,1) =   ;

  =      (1, );


%% Back integrate to get P_i, b_i, c_i, K_i, k_i
for   =  -1:-1:1

    % get P_i+1, b_i+1, c_i+1
          =  . {  + 1};
          =  . {  + 1};
          =  . {  + 1};

    % determine K_i and k_i
             =    ( .  +  . ' *       *  . ); % helper inverse

        = -         *  . ' *       *  . ;
        = -         *  . ' * (      *  .  +      );

    % determine P_i, b_i, c_i
        = ( .  +  .  *    )'*     *( .  +  .  *    ) +    '* . *   ;
        = ( .  +  .  *    )'*(      * ( .   +  . *   ) +      ) +    '* . *   ;
        = 1/2 * ( .  +  .  *    )' *       * ( .  +  .  *    ) +      '*( .  +  .  *    ) + ...
              + 1/2 *    ' *  .  *    ;

    % assign the values
     . { } =    ;
     . { } =    ;

     . { } =    ;
     . { } =    ;
     . { } =    ;

end



%% Forward integrate using dynamics and new control law
```

```
for   = 1: -1
    % get x_i to integrate to x_i+1
        =  (:, );  % i-th column

    % get the control law
        =         ( ,    ,  );

    % get x_i+1
          =         ( ,    ,    ,  );

    % add x_i+1 and u_i to the array
     (:, +1) =      ;
     ( ) =    ;

end

%% Plotting
        =       (1);
    ( (1,:),  (2,:), 'DisplayName', 'trajectory');        ;
    (  (1),   (2), 'r*', 'DisplayName', 'start');         ;
     (       ('Trajectory: R = %.3f',  . ));
      ('p');       ('v');
      ();
       ;

       =       (2);
    ( );
     (       ('Control: R = %.3f',  . ));
      ('i');       ('u');
       ;

%% Saving
          = "prob_3_%s_" +        ("R-%.3f_x0_%d_%d",  . ,   (1),   (2));

      (      ,        (         , 'traj') + ".png");
    ("Saved figure: " +        (         , 'traj') + ".png");

      (      ,        (         , 'ctrl') + ".png");
    ("Saved figure: " +        (         , 'ctrl') + ".png");

%% Functions
% dynamics
function       =         ( ,    ,    ,  )
          =  .  *     +  .  *     +  . ;

end

% control law
function     =         ( ,  ,  )
        =  . { };
        =  . { };

        =     *   +    ;

end
```