```matlab
clear; close all;
beta = 1;
alphaV = [0.1, 0.5, 0.9, 0.99];
varX1 = 1;
x0 = 0;
varZ = 1;
h=1;

% As alpha increases the MSE decreses. This is confirmed by the graphs
% shown below. Also, as alpha increases Xn becomes smoother because it it
% is less succeptable to noise. When alpha is low, Xn+1 is almost entirely
% based on the noise. When alpha is high, Xn+1 is more dependant on its
% previous state than on the noise.

X = zeros(1,1000);

for i = 1:length(alphaV)
    alpha = alphaV(i);
    varW = beta*(1-alpha^2);
    for n=1:1000
        %calculate Xn
        if(n==1)
            X(n) = x0 + varX1*randn(1); %realization of Xn
        else
            X(n) = alpha*X(n-1) + sqrt(varW)*randn(1);
        end

        %calculate Xhat
        Yn = h*X(n)+sqrt(varZ)*randn(1);
        if(n==1)
            xhat(n) = x0 + (h*varX1*(Yn-h*x0))/((h*varX1+varZ));
            varSi(n) = varX1*varZ / (h*varX1 + varZ);
        else
            varZeta(n) = alpha^2*varSi(n-1) + varW;
            varSi(n) = varZeta(n)*varZ / (h*varZeta(n)+varZ);
            xhat(n) = alpha*xhat(n-1) + (h*varZeta(n)*(Yn-h*alpha*xhat(n-1)))/(h*varZeta(n)
 + varZ);
        end


    end

    figure; hold;
    subplot(2,1,1);hold;plot(X);plot(xhat,'--r');
    title(['alpha = ' num2str(alpha) '   MSE= ' num2str(norm((X-xhat))^2) ]);
    legend('X', 'Estimate of X');
    subplot(2,1,2);plot(varSi);
    title('Plot of variance of the estimation error');
    convergeSi(i) = varSi(n);
end

for i = 1:length(alphaV)
    alpha = alphaV(i);
    lam = convergeSi(i); %lamba is the limit as t-> infinity of the variance of estimation
error
```
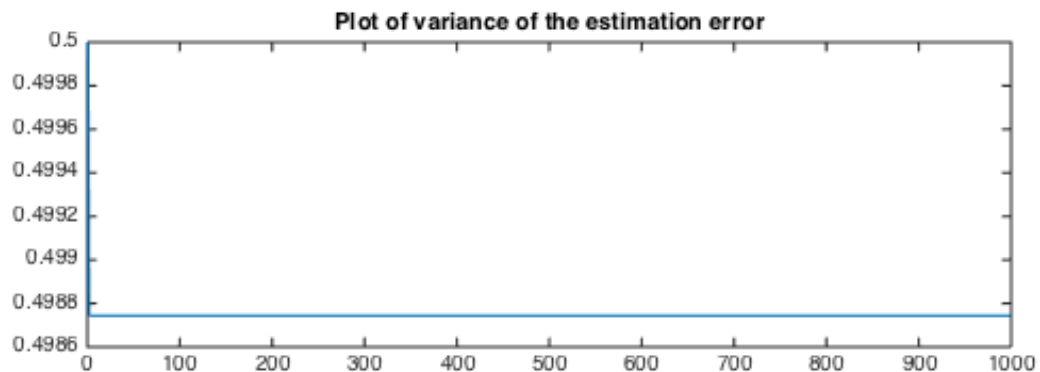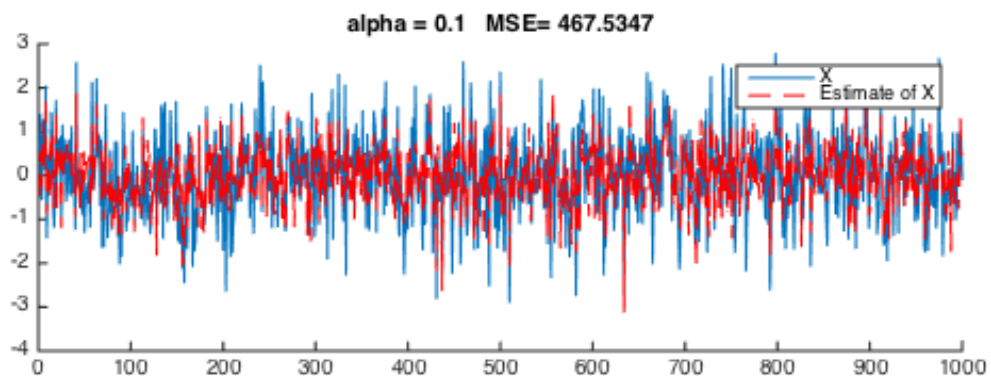
```
    for n = 1:30
        impulseWX(n)  = alpha^(n-1);
        a = h*lam/(h*lam+varZ);
        impulseXY(n) = a*alpha*(1-h*a)^n;
    end

    figure; hold;
    subplot(2,1,1); stem(impulseWX);
    title(['Plot of impulse response from W to X with alpha = ' num2str(alpha)]);
    subplot(2,1,2); stem(impulseXY);
    title(['Plot of impulse response from Y to Xhat with alpha = ' num2str(alpha)]);

end
```
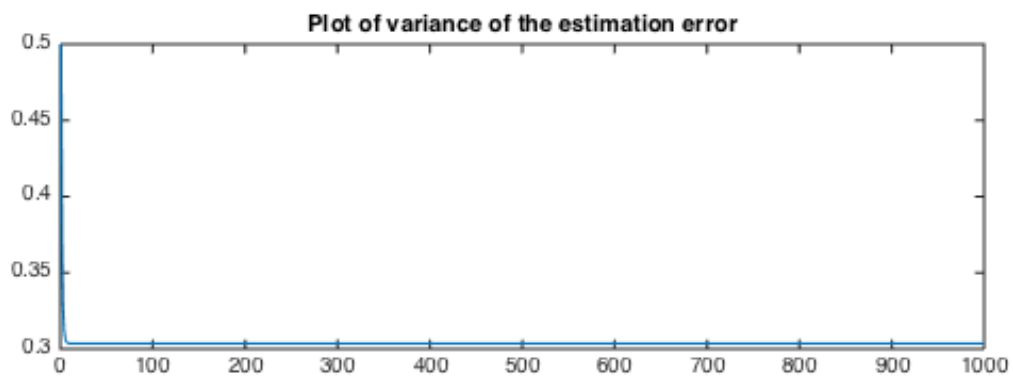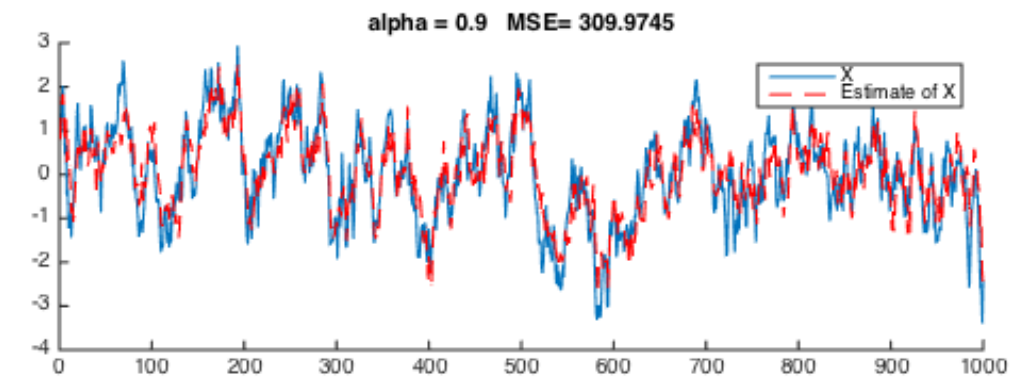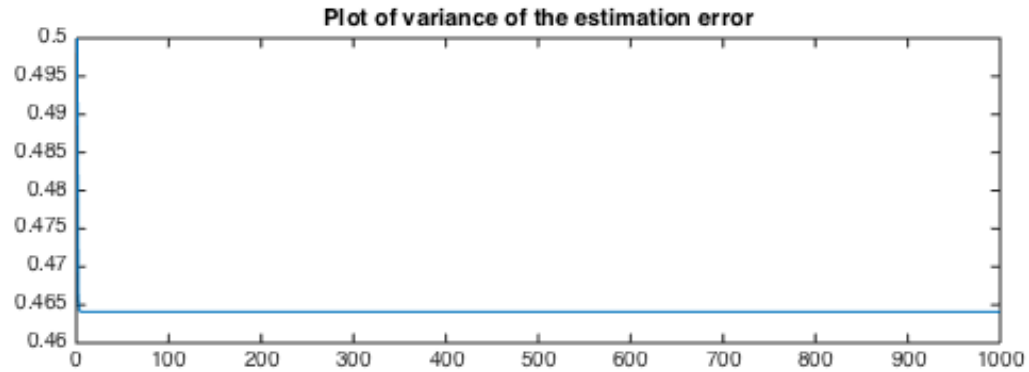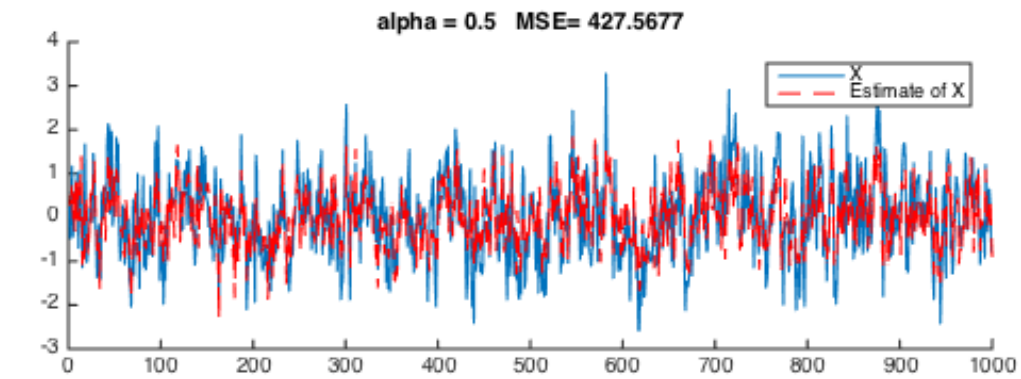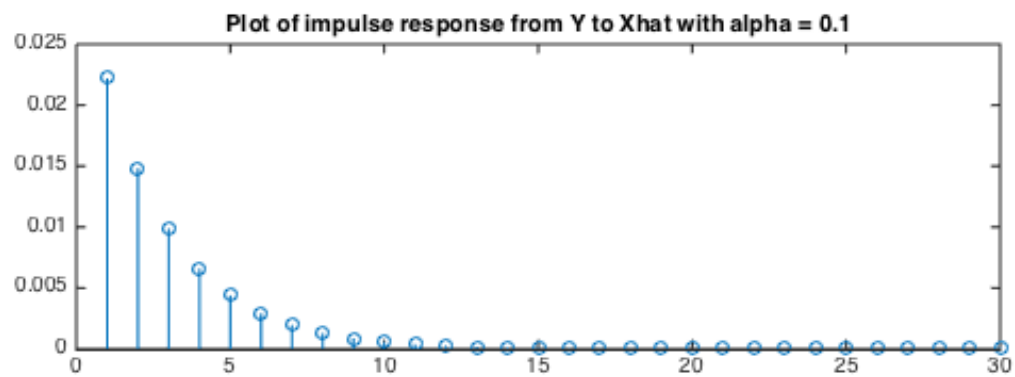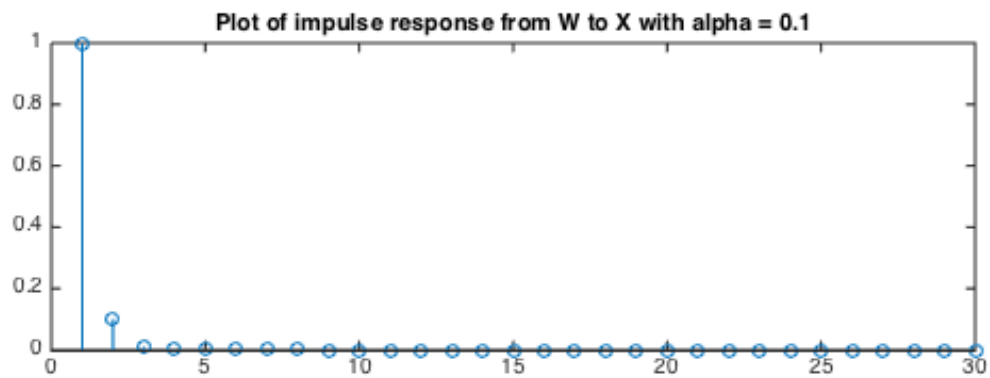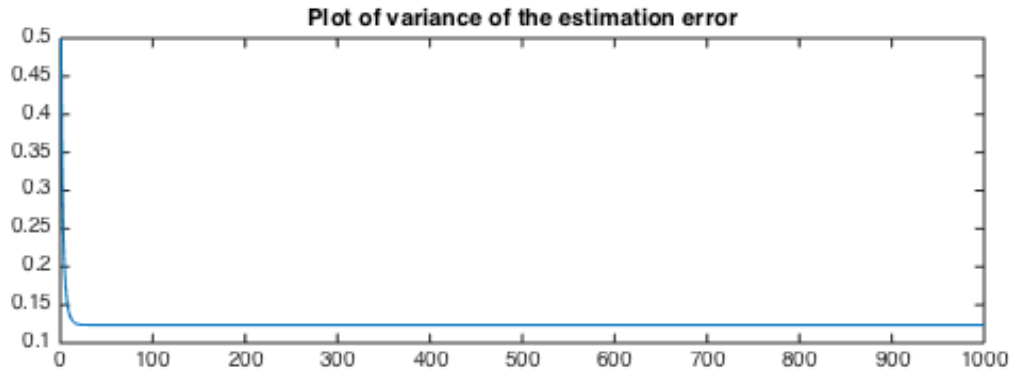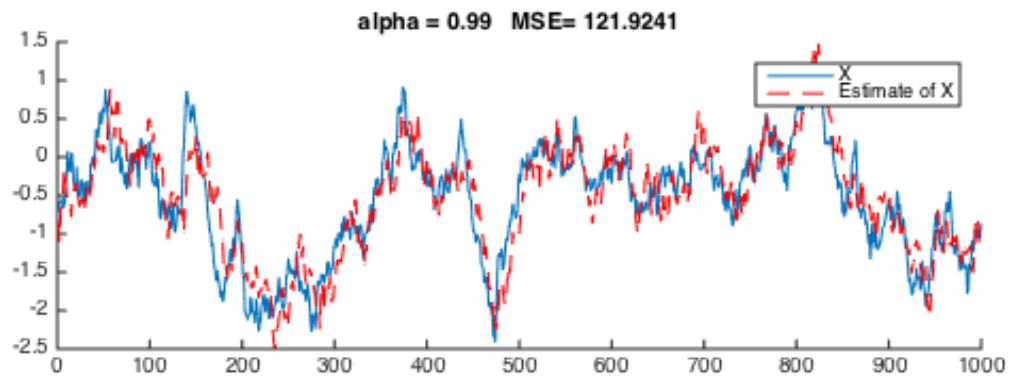
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alpha = 0.5   MSE= 427.5677
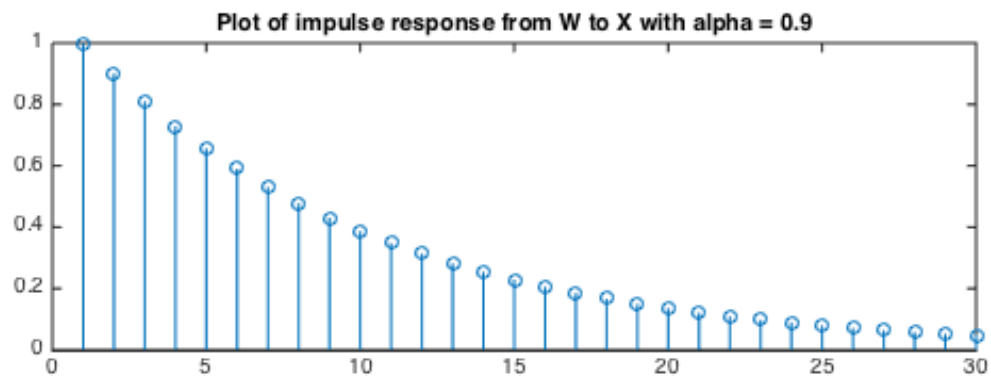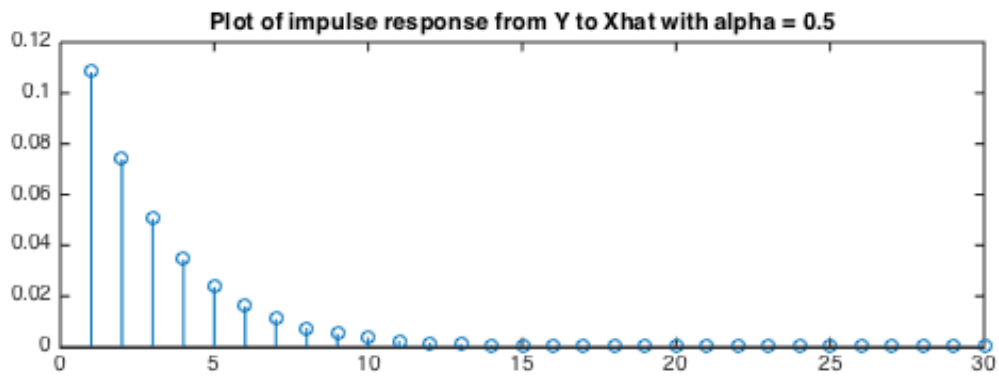
Plot of variance of the estimation error

alpha = 0.9   MSE= 309.9745

Plot of variance of the estimation error

alpha = 0.99   MSE= 121.9241

Plot of variance of the estimation error

Plot of impulse response from W to X with alpha = 0.1

Plot of impulse response from Y to Xhat with alpha = 0.1

Plot of impulse response from W to X with alpha = 0.5

Plot of impulse response from Y to Xhat with alpha = 0.5

Plot of impulse response from W to X with alpha = 0.9

Plot of impulse response from Y to Xhat with alpha = 0.9

Plot of impulse response from W to X with alpha = 0.99

Plot of impulse response from Y to Xhat with alpha = 0.99

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