Hw1 part2 Xiaotian Zhu

1.First, I defined a function to compute the maximum likelihood given x, mu and Likelihood function.

```
function [X,FVAL] = maxllh(X,mu0,Lfunction)
ml = @(mu) (-sum(log(Lfunction(X,mu))));
[X,FVAL,EXITFLAG,OUTPUT,GRAD,HESSIAN] = fminunc(ml,[mu0]);
```

2.According to the Notes from the assignment, I set the parameters a and b to 1 and 0.6, the initial value to 0. I also simulate data to test my program. I choose the first 999 columns of X0 and the last 999 columns of it to create a new matrix of 2*999 as the input.

```
n = 1000;
error = random('norm',0,1,[1,n-1]);
X0 = zeros(1,n);
X0(1) = 2;
a = 1; b = 0.6;

for i = 2:n
    X0(i) = a + b*X0(i-1) +error(i-1);
end
Xs = [X0(1:n-1);X0(2:n)];
```

3.Then I use the mle function defined above to get the theta. And I set alpha to 0.05 to get the confidence interval

```
Lfunction = @(X,theta) ((1/sqrt(2*pi))* exp(-((X(1,:)-(theta(2)+theta(1)*X(2,:))).^2)/2));

[X,FVAL] = MLE(Xs,[1,1],Lfunction)

J = [1 mean(X0(1:n-1)); mean(X0(1:n-1)) mean(X0(1:n-1).^2)];
Lambda = inv(J)

Z_alpha = 1.96;
Interval = [X' - sqrt(diag(Lambda))/sqrt(n)*Z_alpha, X' + sqrt(diag(Lambda))/sqrt(n)*Z_alpha]
```

4. I choose to use Chi-Squared test

```
theta_0 = [0.6 1];
Eta = n*(X-theta_0)*inv(Lambda)*(X-theta_0)';
p = 1-chi2cdf(Eta,2)
```

5.All the output is below:

```
X =

    0.6447    0.9182


FVAL =

   1.4151e+03


Lambda =

    4.9281   -1.5187
   -1.5187    0.5872


Interval =

    0.5072    0.7823
    0.8707    0.9657


p =

   3.0606e-09
```