========== **Problem 2_unifrom**

Author : Lishan Huang, Nick Hoffman, Harman Sahni, Nastaran Gh Created : January 24th, 2019 Last Updated : January 31st, 2019

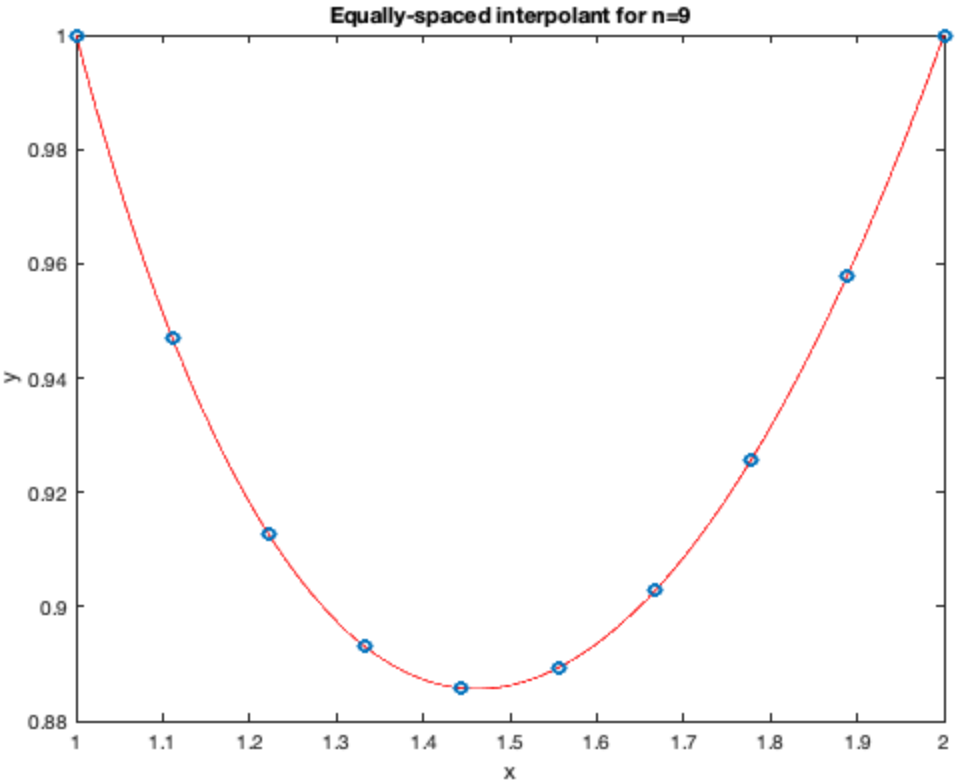
Interpolating the gamma function using Equally-spaced nodes

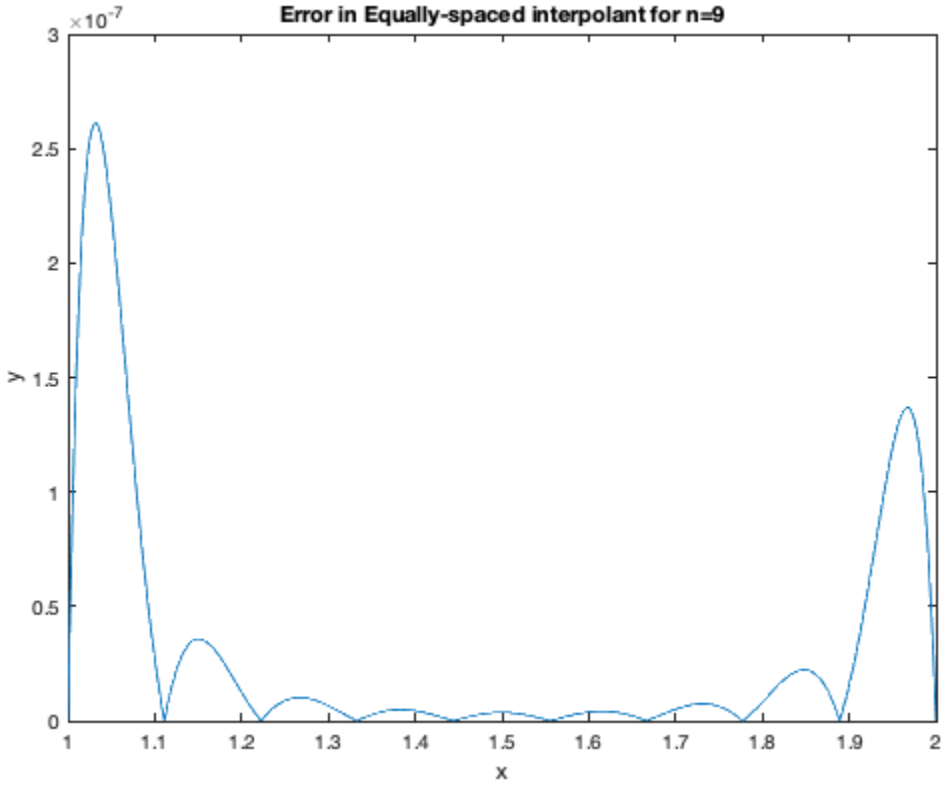
========== clear figures, close plot windows, clear variables

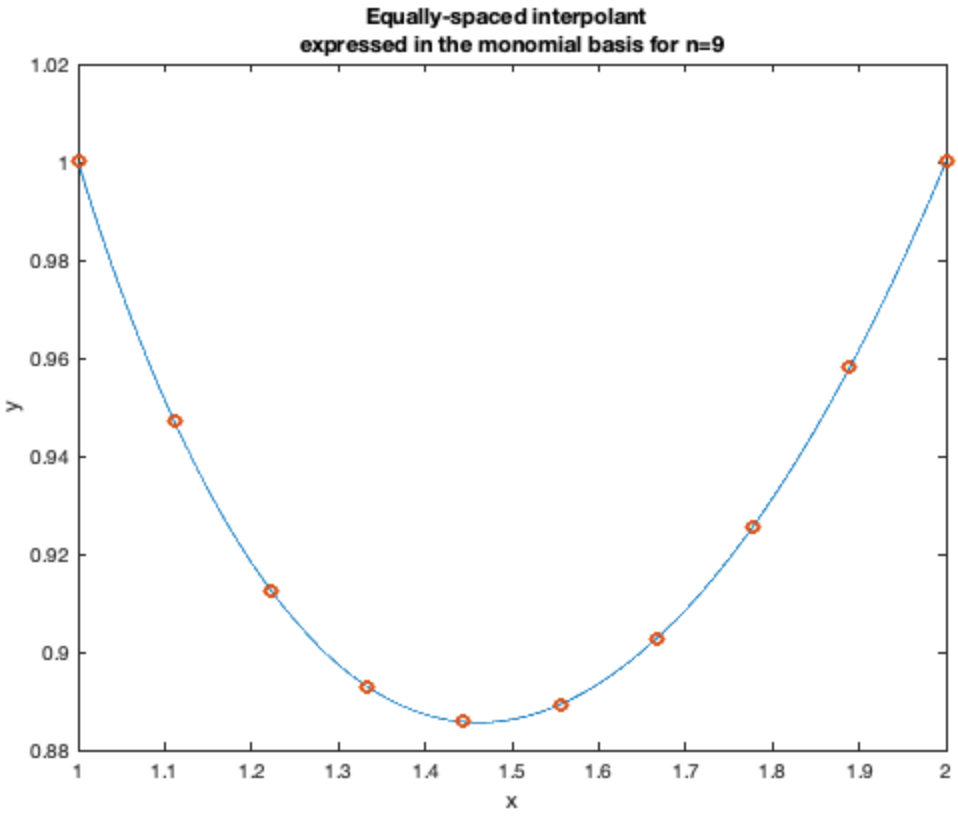
```
%text
clf
close all
clear all
  % create a vector with 1000 equal points bewteen 1 and 1000
    che=linspace(0,999,1000);
   % use the given fucntion to create 1000 Equally-spaced nodes in
 [1,2]
    chenode=1+che/999;
   % calculate the exact result for those Equally-spaced nodes in
 gamma
   % function
    chegamma=gamma(chenode);
   % create a vector that stores the numbers of nodes to be
 interpolated
   % where n=9 17 and 19 and then number of nodes are 10 18 20
    number=[9 17 19];
   % use for loop repeat steps from 1 to 5
 for i=1:length(number)
%question 1
        % create tau and rho with number of n=number(i)
        node=linspace(0,number(i),number(i)+1);
        tau=1+node/(number(i))
        name='Equally-spaced';
        figure((i-1)*4+1)
        rho=gamma(tau);

      %The values of the interpolating polynomial for tau and rho at
 each point in x
        p=secondbaryeval(tau,rho,chenode);
       %plot the values of interpolating polynomial
        plot(chenode,p,'r')
        %axis label
        xlabel('x')
        ylabel('y')
        %title
        title([name ' interpolant for n=',num2str(number(i))])
        hold on
        %plot interpolation points in same graph
        plot(tau,rho,'o')
        figure((i-1)*4+2)

%question 2
        %plot the the error in  interpolant
        plot(chenode,abs(chegamma-p))
```

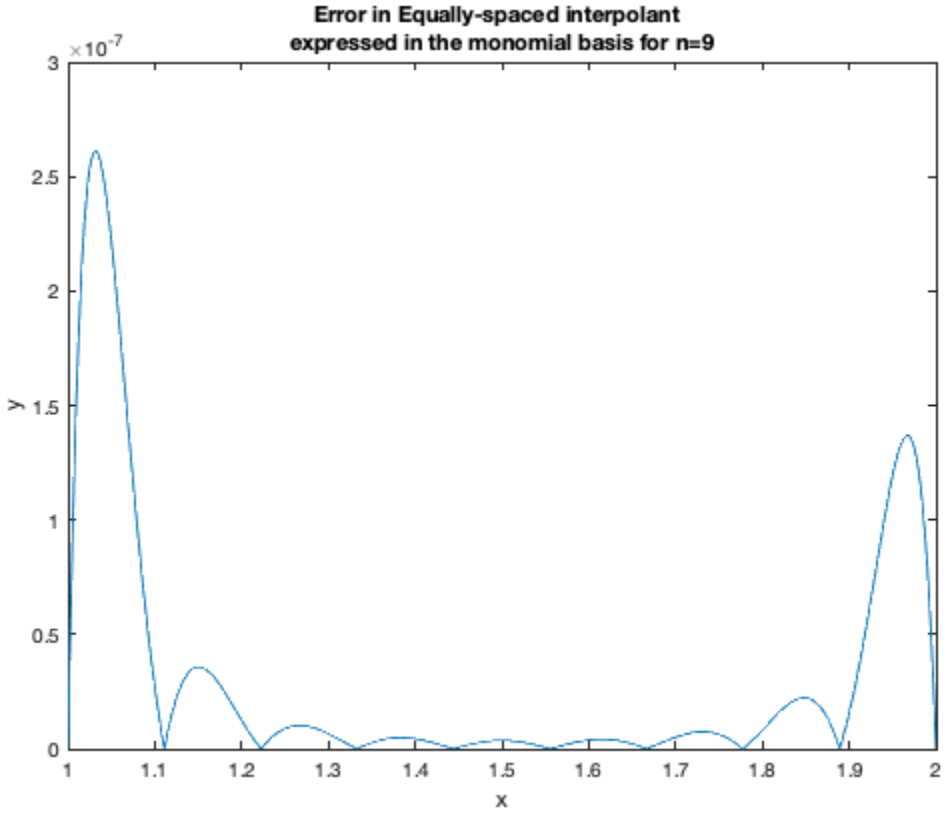
```
        xlabel('x');
        ylabel('y');
        title(['Error in ' name ' interpolant for n='
 num2str(number(i))])

%question 3
        % create the Vandermonde matrix  for tau
        V=vander(tau);
        % transform rho from row vector to column vector
        rhoR=rho.';
        %solve Va = ? to get the coefficient vector
        a = V\rhoR;
        %evaluate interpolating polynomial expressed in the monomial
 basis
        y=polyval(a,chenode);
        figure((i-1)*4+3)
        %plot interpolating polynomial expressed in the monomial basis
        plot(chenode,y)
        xlabel('x');
        ylabel('y');
        title({[name ' interpolant  '];['expressed in the monomial
 basis for n=' num2str(number(i))]})
        hold on
        %plot interpolation points in same graph
        plot(tau,rho,'o')

%question 4
         %plot the the error in  interpolant expressed in the monomial
 basis
        figure((i-1)*4+4)
        plot(chenode,abs(chegamma-y))
        xlabel('x');
        ylabel('y');
        title({['Error in ' name ' interpolant  '];['expressed in the
 monomial basis for n=' num2str(number(i))]})

 end


tau =

  Columns 1 through 7

    1.0000    1.1111    1.2222    1.3333    1.4444    1.5556    1.6667

  Columns 8 through 10

    1.7778    1.8889    2.0000


tau =

  Columns 1 through 7
```

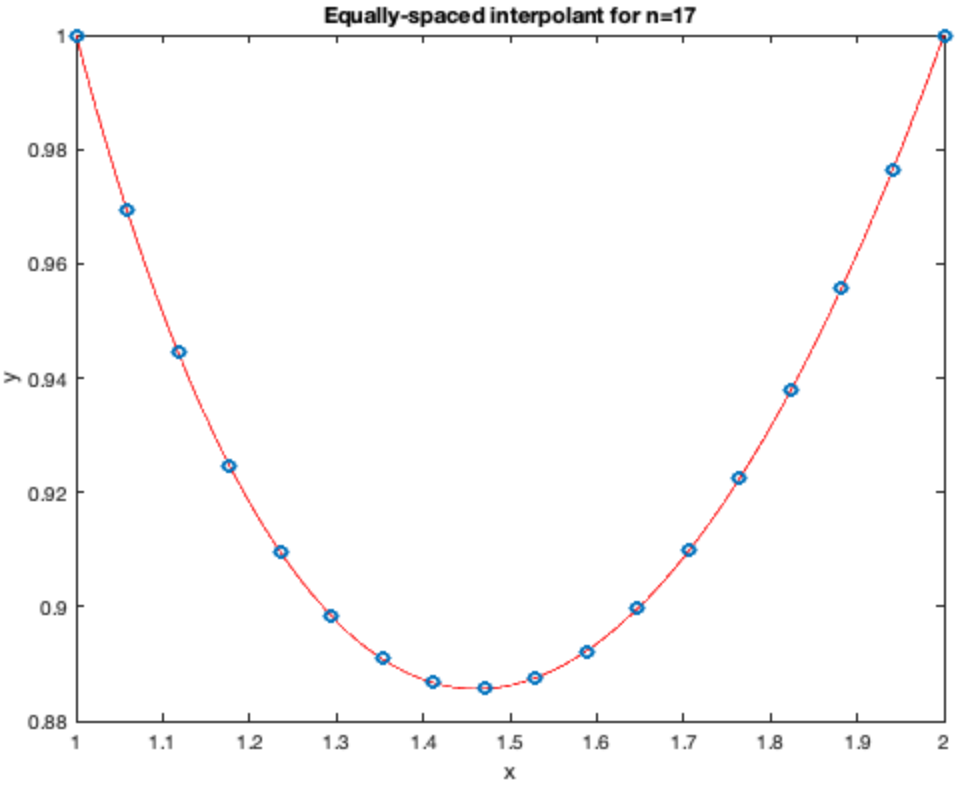
```
    1.0000    1.0588    1.1176    1.1765    1.2353    1.2941    1.3529

  Columns 8 through 14

    1.4118    1.4706    1.5294    1.5882    1.6471    1.7059    1.7647

  Columns 15 through 18

    1.8235    1.8824    1.9412    2.0000

Warning: Matrix is close to singular or badly scaled. Results may be
 inaccurate.
RCOND =  2.017191e-22.

tau =

  Columns 1 through 7

    1.0000    1.0526    1.1053    1.1579    1.2105    1.2632    1.3158

  Columns 8 through 14

    1.3684    1.4211    1.4737    1.5263    1.5789    1.6316    1.6842

  Columns 15 through 20

    1.7368    1.7895    1.8421    1.8947    1.9474    2.0000

Warning: Matrix is close to singular or badly scaled. Results may be
 inaccurate.
RCOND =  3.373780e-22.
```

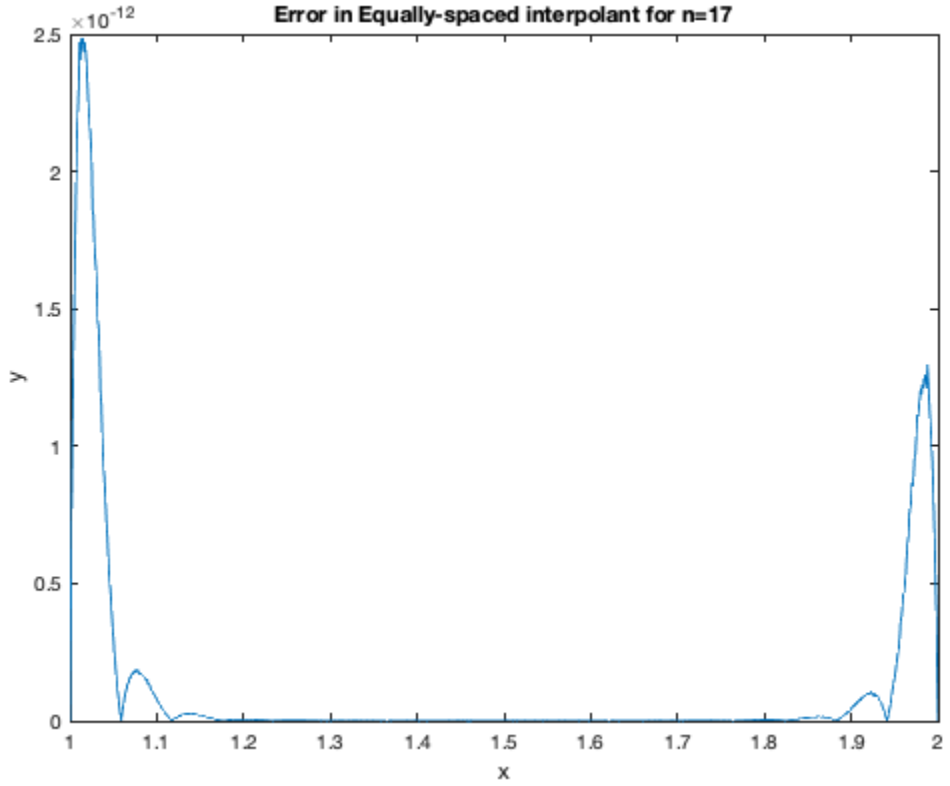

Equally-spaced interpolant for n=9
1
0.98
0.96
0.94
0.92
0.9
0.88
y
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
x

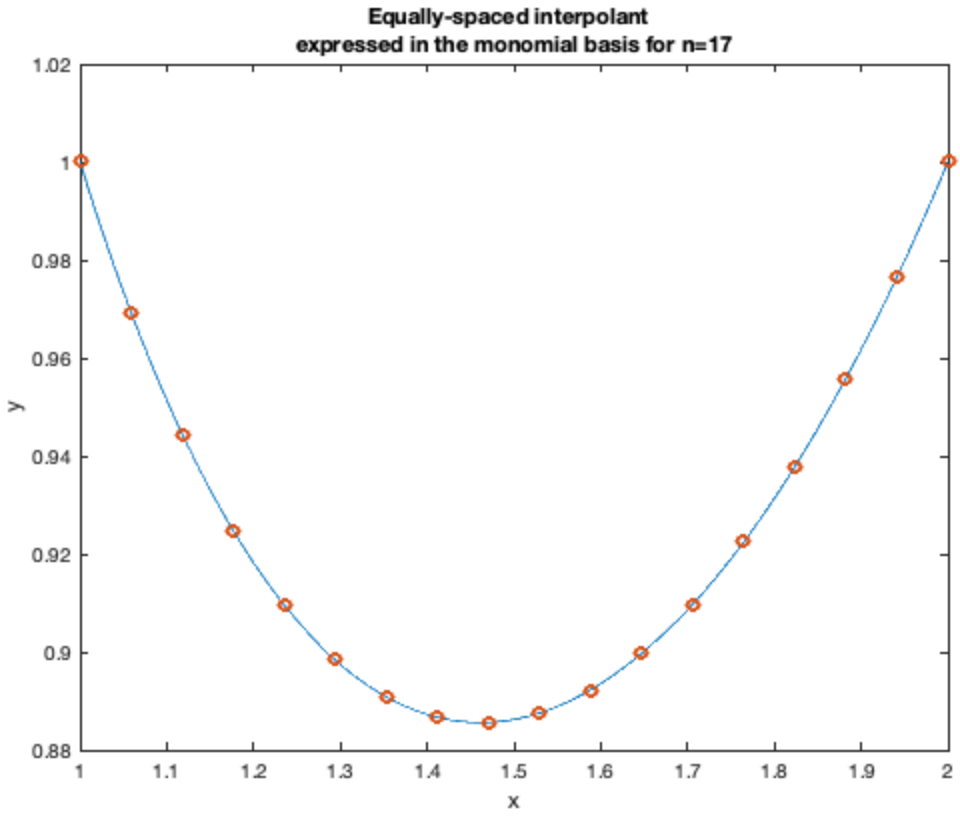

Error in Equally-spaced interpolant for n=9
×10^-7
3
2.5
2
1.5
1
0.5
0
y
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
x

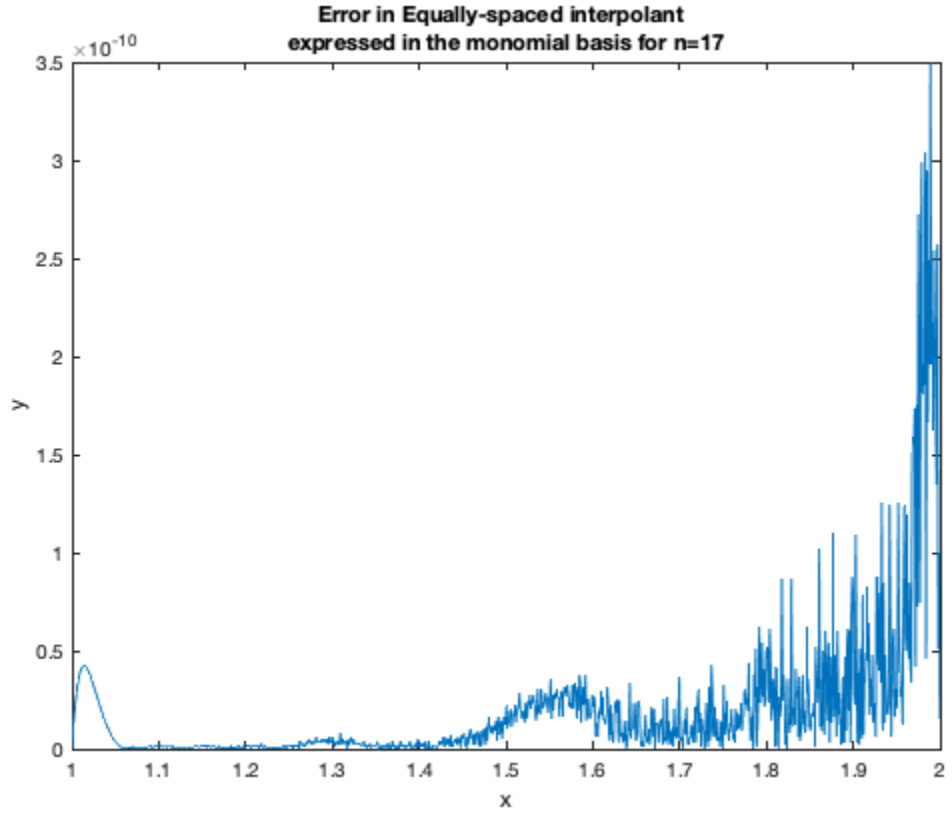

Equally-spaced interpolant
expressed in the monomial basis for n=9
1.02
1
0.98
0.96
0.94
0.92
0.9
0.88
y
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
x

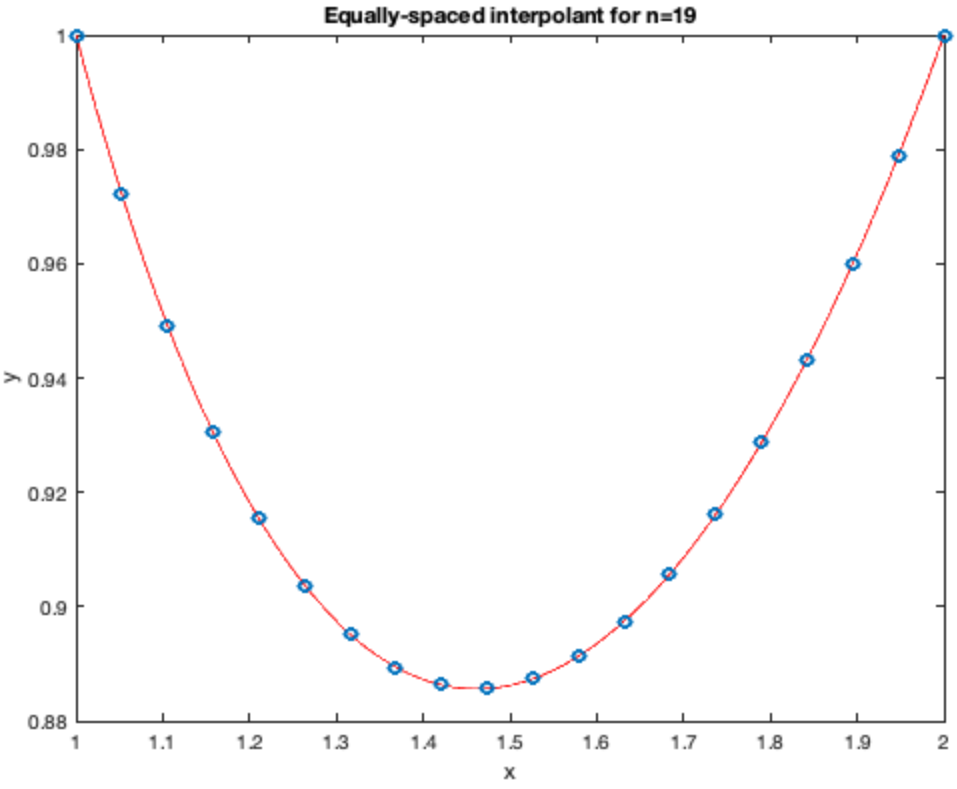

Error in Equally-spaced interpolant
expressed in the monomial basis for n=9
×10^-7
3
2.5
2
1.5
1
0.5
0
y
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
x

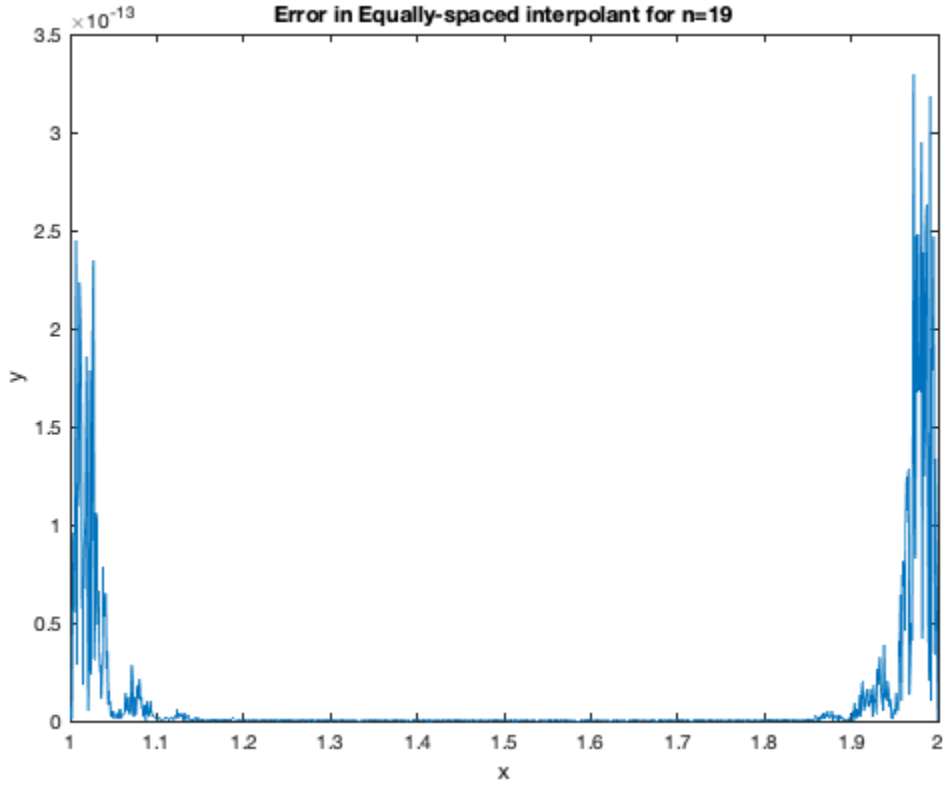

Equally-spaced interpolant for n=17
y
x
1
0.98
0.96
0.94
0.92
0.9
0.88
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2

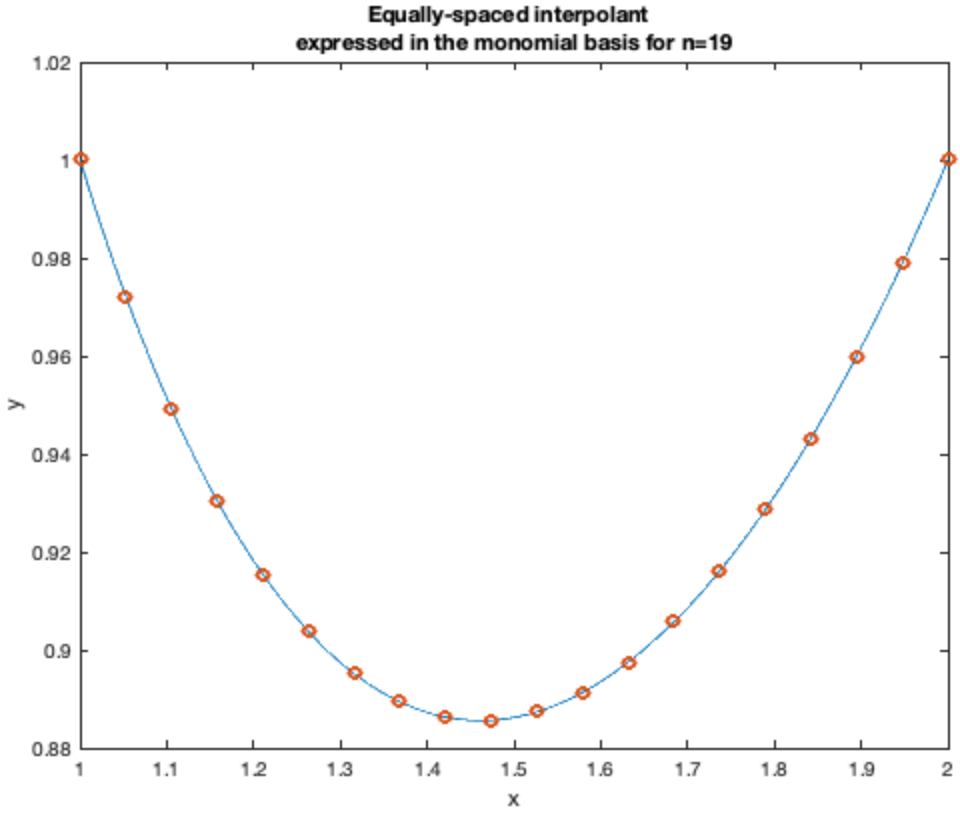

Error in Equally-spaced interpolant for n=17
×10^-12
y
x
2.5
2
1.5
1
0.5
0
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2

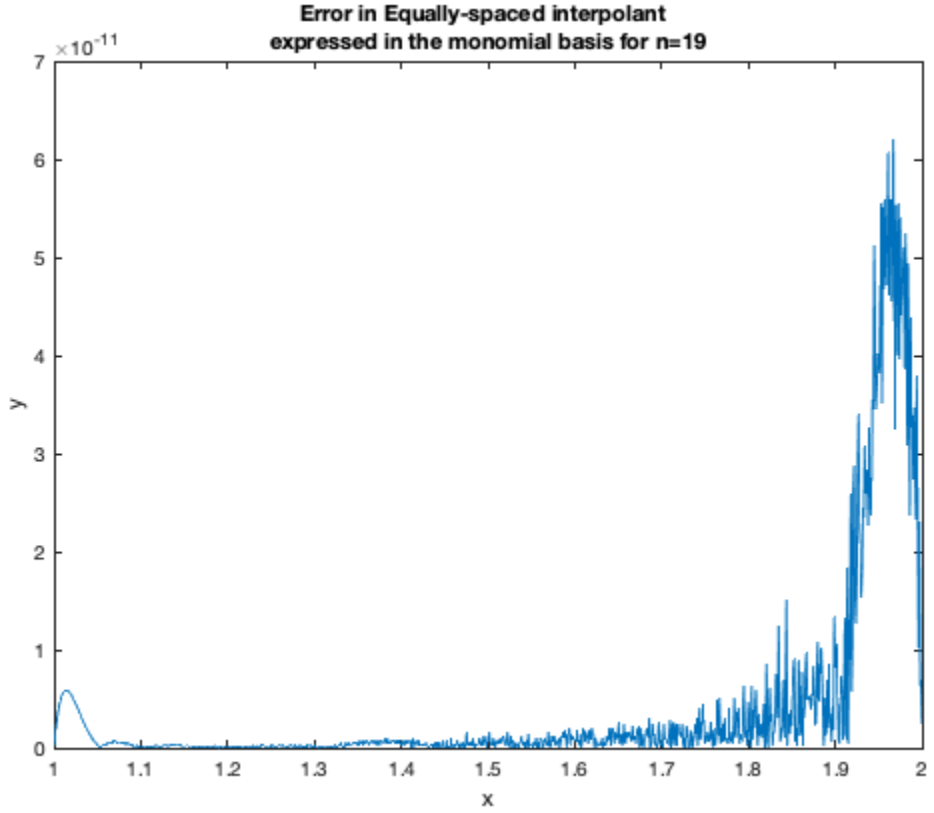

Equally-spaced interpolant
expressed in the monomial basis for n=17
1.02
1
0.98
0.96
0.94
0.92
0.9
0.88
y
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
x


Error in Equally-spaced interpolant
expressed in the monomial basis for n=17
×10^-10
3.5
3
2.5
2
1.5
1
0.5
0
y
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
x


Equally-spaced interpolant for n=19
1
0.98
0.96
0.94
0.92
0.9
0.88
y
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
x


Error in Equally-spaced interpolant for n=19
×10^-13
3.5
3
2.5
2
1.5
1
0.5
0
y
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
x


Equally-spaced interpolant
expressed in the monomial basis for n=19
1.02
1
0.98
0.96
0.94
0.92
0.9
0.88
y
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
x


Error in Equally-spaced interpolant
expressed in the monomial basis for n=19
×10^-11
7
6
5
4
3
2
1
0
y
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
x

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