1 2

s 1 9 s 4 1 4 f

- 1) L a g r a n g e

$$\phi_1(x)=\frac{(x-x_2)(x-x_3)}{(x_1-x_2)(x_1-x_3)},\quad \phi_2(x)=\frac{(x-x_1)(x-x_3)}{(x_2-x_1)(x_2-x_3)},\quad \phi_3(x)=\frac{(x-x_1)(x-x_2)}{(x_3-x_1)(x_3-x_2)}$$

- 2)

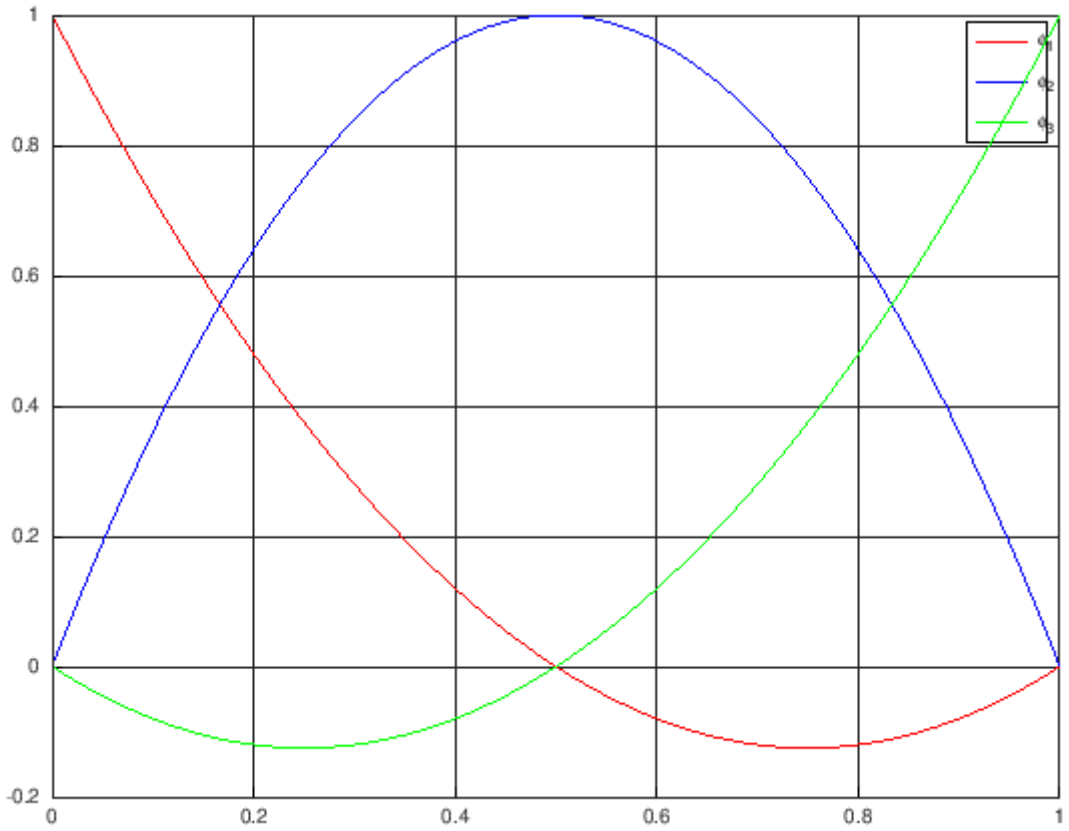
$(0,1),(0.5,-1),(1,5)$

- 3)

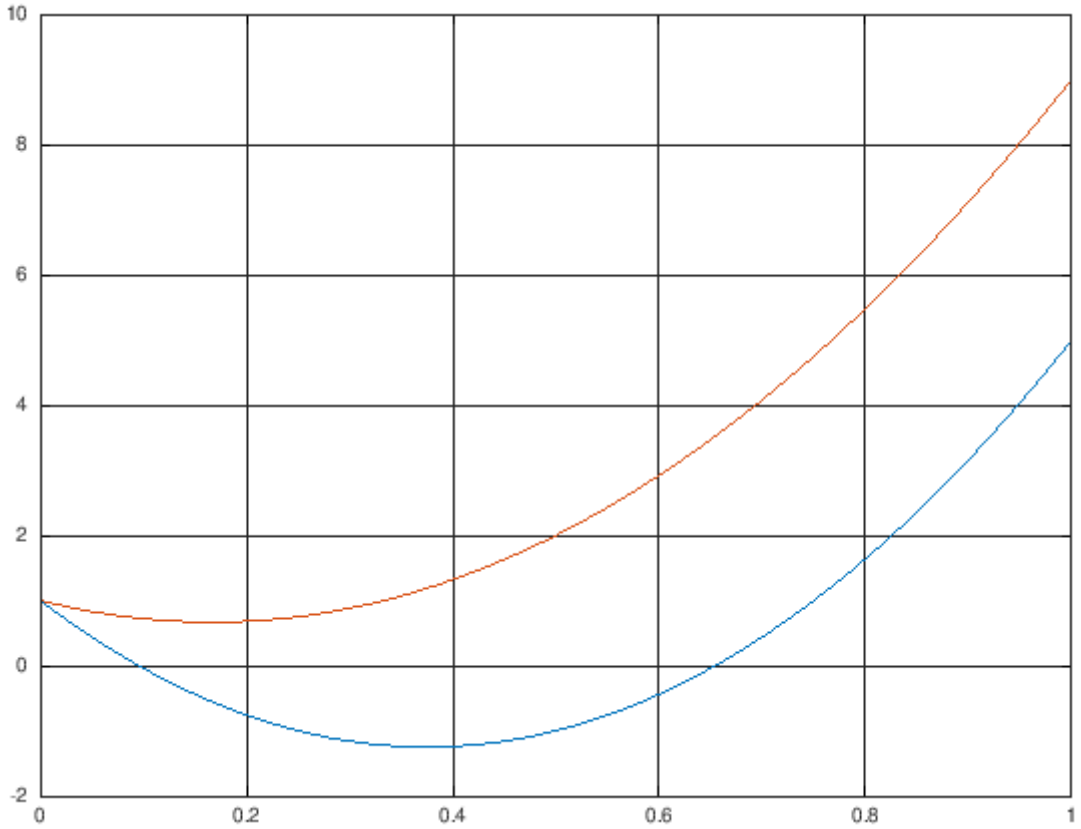
$(0,1),(0.5,2),(1,2.9)$

```
#
x = 0:0.01:1;
#3
x1=0;
x2=0.5;
x3=1;
node_list = [x1,x2,x3];
#       phi_1
function value = phi_1(node_list,x)
    x1 = node_list(1);
    x2 = node_list(2);
    x3 = node_list(3);
    value =(x-x2).*(x-x3)./(x1-x2)/(x1-x3);
end
#       phi_2
function value = phi_2(node_list,x)
    x1 = node_list(1);
    x2 = node_list(2);
    x3 = node_list(3);
    value =(x-x1).*(x-x3)/(x2-x1)/(x2-x3);
end
#       phi_3
function value = phi_3(node_list,x)
    x1 = node_list(1);
    x2 = node_list(2);
    x3 = node_list(3);
    value =(x-x1).*(x-x2)/(x3-x1)/(x3-x2);
end

#
hold on
plot( x, phi_1(node_list,x),'r-')
plot( x, phi_2(node_list,x),'b-')
plot( x, phi_3(node_list,x),'g-')
legend({'\phi_1','\phi_2','\phi_3'})
```

```
grid on
```




```
#               3
p1 = 1*phi_1(node_list, x) + (-1)*phi_2(node_list,x) + 5*phi_3(node_list,x);
p2 = 1*phi_1(node_list, x) + 2*phi_2(node_list,x) + 9*phi_3(node_list,x);
plot(x, p1, '-')
hold on
plot(x, p2, '-')
grid on
```



$$\phi_i(x) = \frac{(x-x_1)(x-x_2)\cdots(x-x_{i-1})(x-x_{i+1})\cdots(x-x_n)}{(x_i-x_1)(x_i-x_2)\cdots(x_i-x_{i-1})(x_i-x_{i+1})\cdots(x_i-x_n)} = \frac{\prod_{k=1,k\neq i}^{n}(x-x_k)}{\prod_{k=1,k\neq i}^{n}(x_i-x_k)} \qquad (i=1,2,\cdots,n)$$

ϕ_i Octave $Lagrange(xlist, i, x)$

Lagrange(node_list, i, x)

- node_xlist :
- i : (i=1, 2, n.o.d.e_, l ins)t (n
- x : x x(

- x i $\phi_i(x)$ x( )

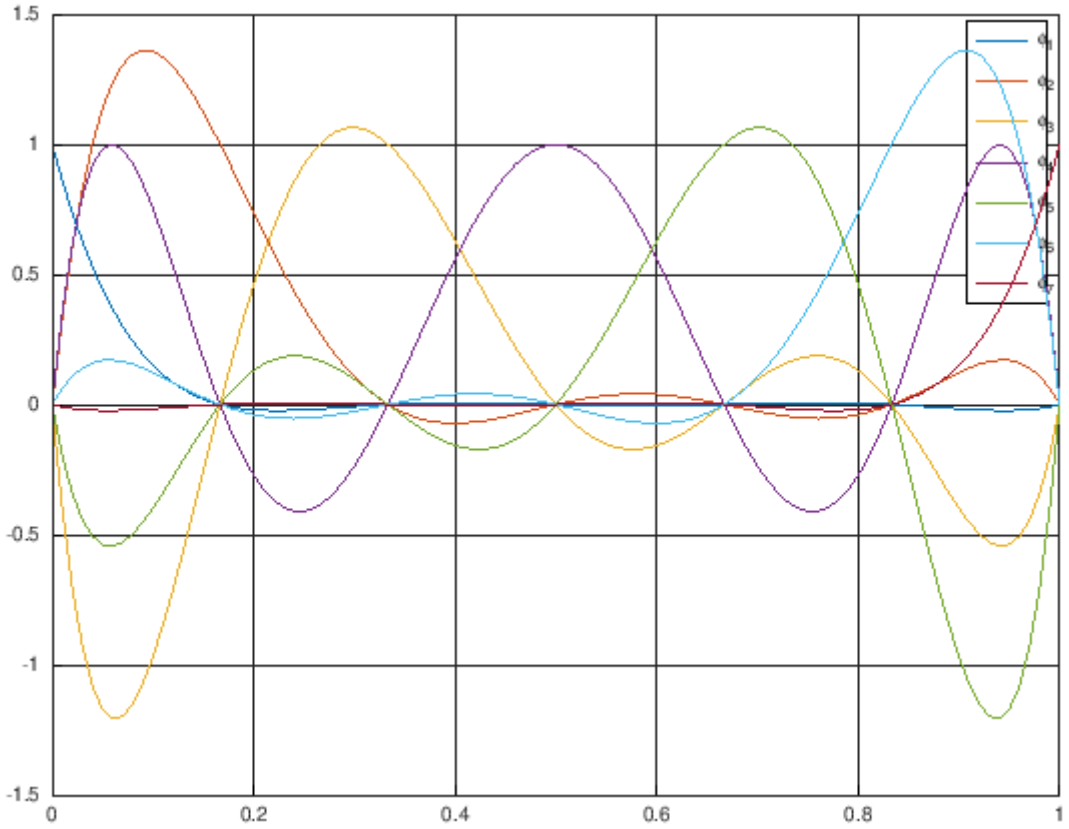
```
function value = Lagrange(node_list,i,x)
    n = length(node_list);
    denominator = 1;
    numerator = 1;
    for k=1:i-1
        numerator=numerator.*(x-node_list(k));
        denominator=denominator.*(node_list(i)-node_list(k));
    end
    for k=i+1:n
        numerator=numerator.*(x-node_list(k));
        denominator=denominator.*(node_list(i)-node_list(k));
    end
    value=numerator./denominator;
```

```
end
```

$[0,1]$ 6 6 Lagrange

$$x_1 = 0, x_2 = 1/6, \cdots, x_7 = 1$$

```
n=6;
node_list=0:(1/n):1;
x=0:0.01:1;

for k=1:n+1
    i=k;
    p=Lagrange(node_list,i,x);
    hold on
    plot(x,p,'-')
    grid on
end
legend({'\phi_1','\phi_2','\phi_3','\phi_4','\phi_5','\phi_6','\phi_7'})
```



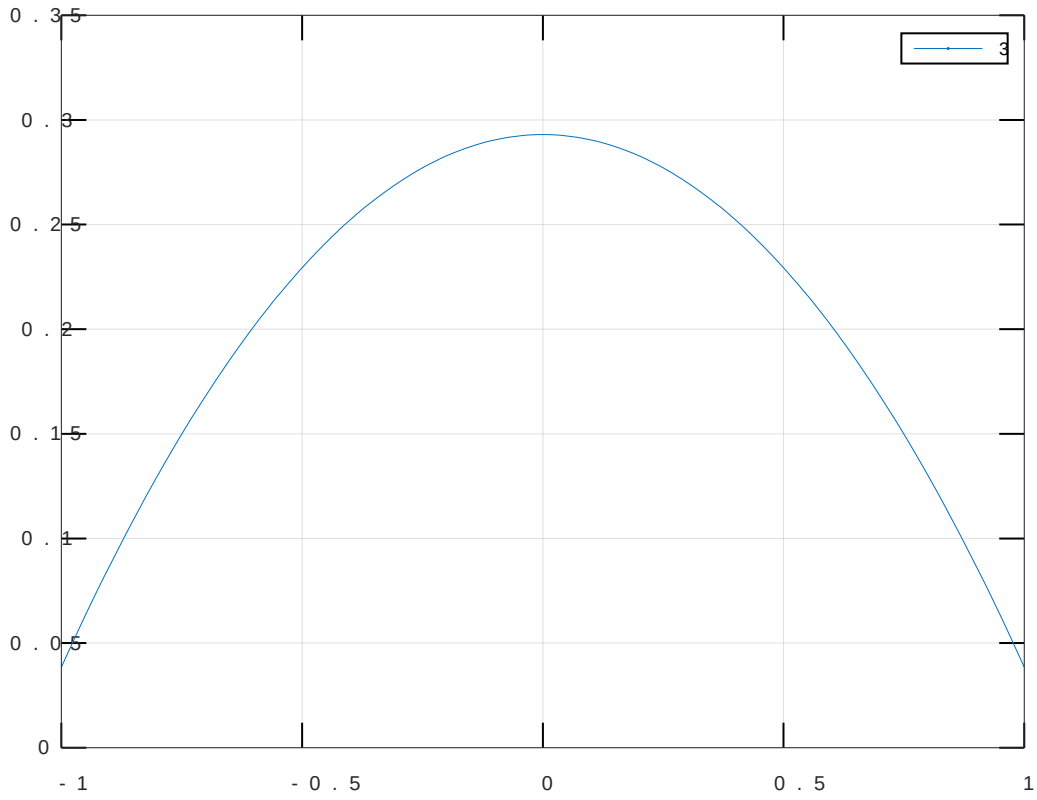
$[-1,1]$ $[-1,1]$ f $[-1,1]$ f n Lagrange $n = 3, 4, \cdots 10$

$$f = \frac{1}{1+25x^2}, \quad (x \in [-1,1])$$

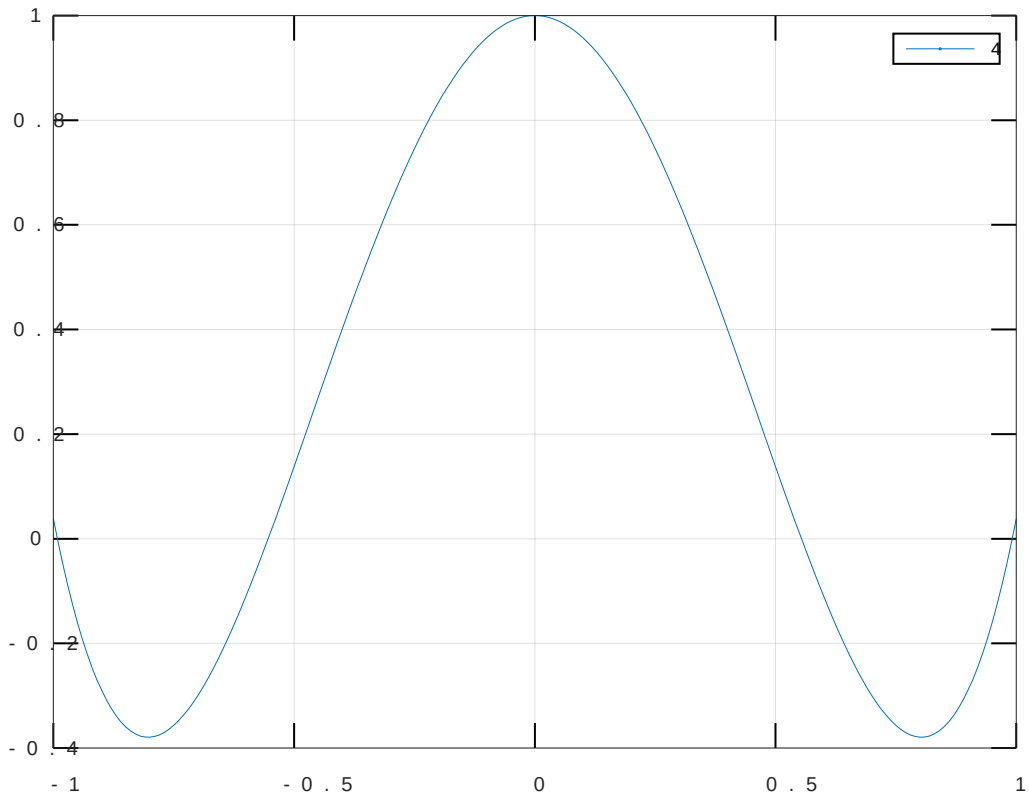
```
x=-1:0.01:1;
```

```
title_list=['3','4','5','6','7','8','9','10'];

for n=3:10
    x=-1:0.01:1;
    node_list=-1:(2/n):1;

    f_node=[];
    for k=1:n+1
        f_node(k)=1/(1+25*node_list(k)*node_list(k));
    end

    f=0;
    for i=1:n+1
        f+=f_node(i)*Lagrange(node_list,i,x);
    end
    figure
    plot(x,f,'-')
    title(title_list(n-2))
    grid on
end
```

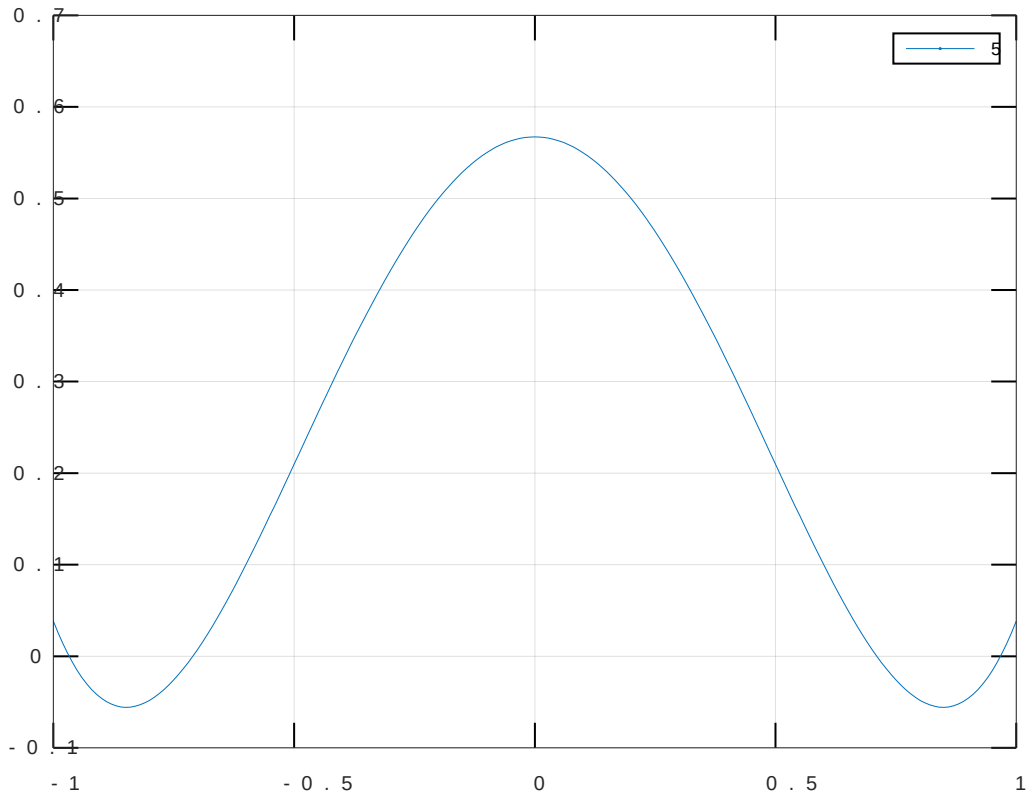
$n=3$



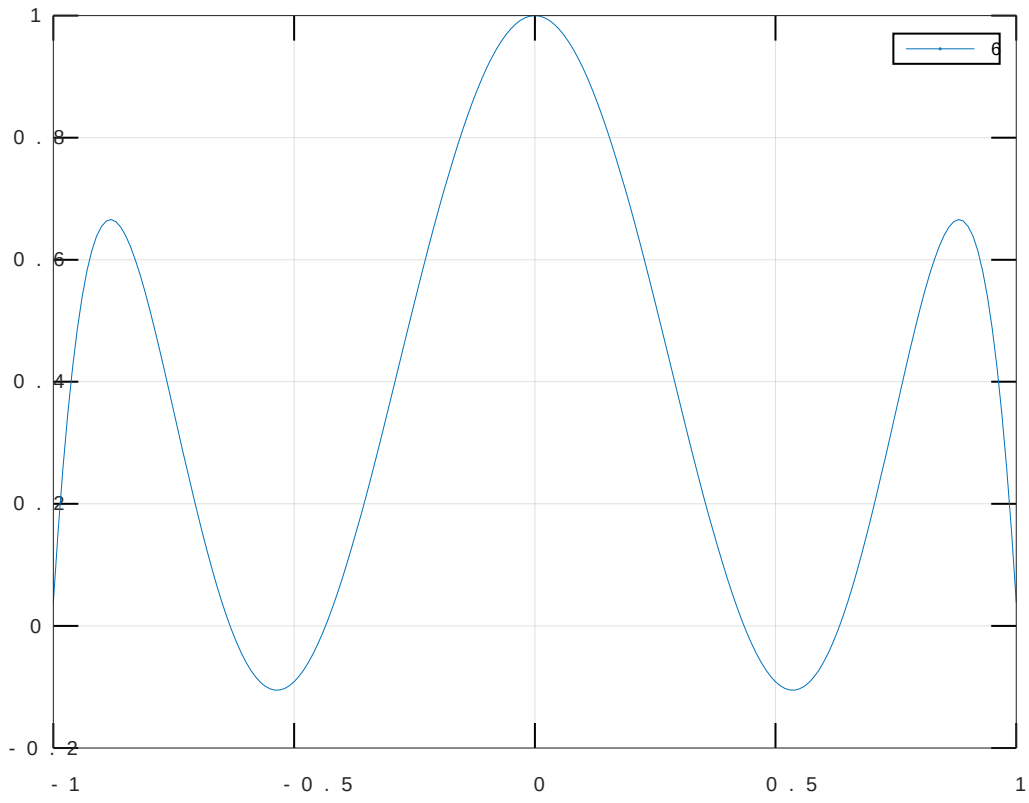
$n=4$



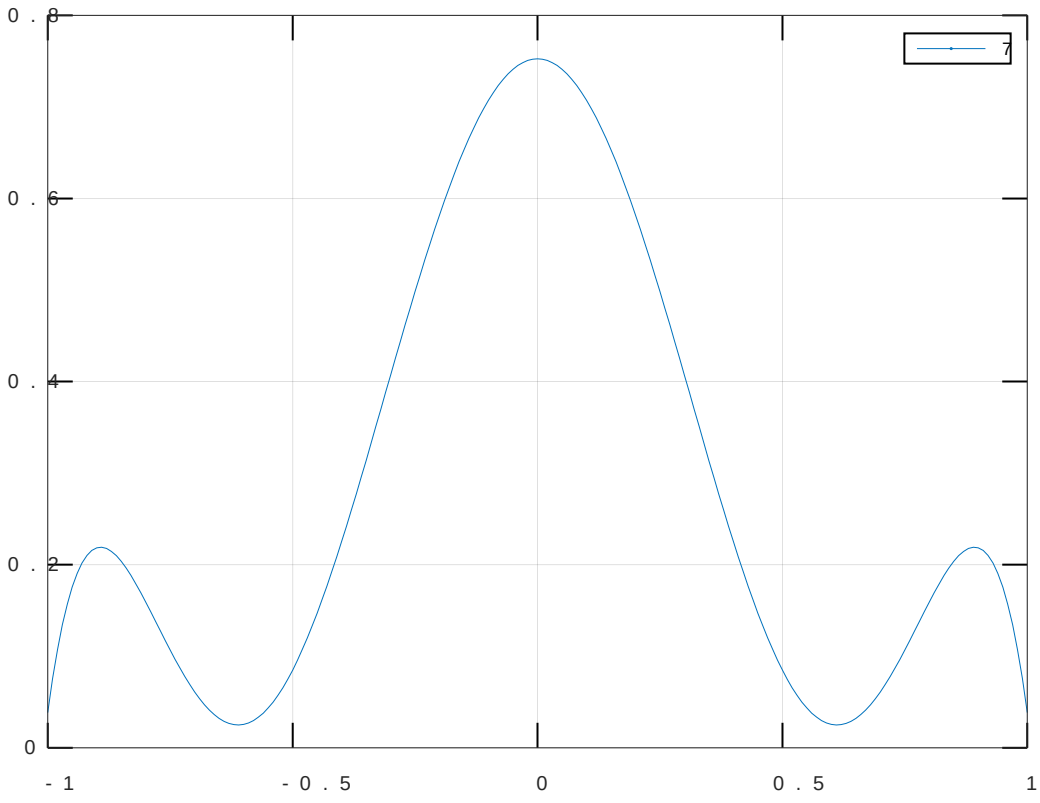
$n = 5$



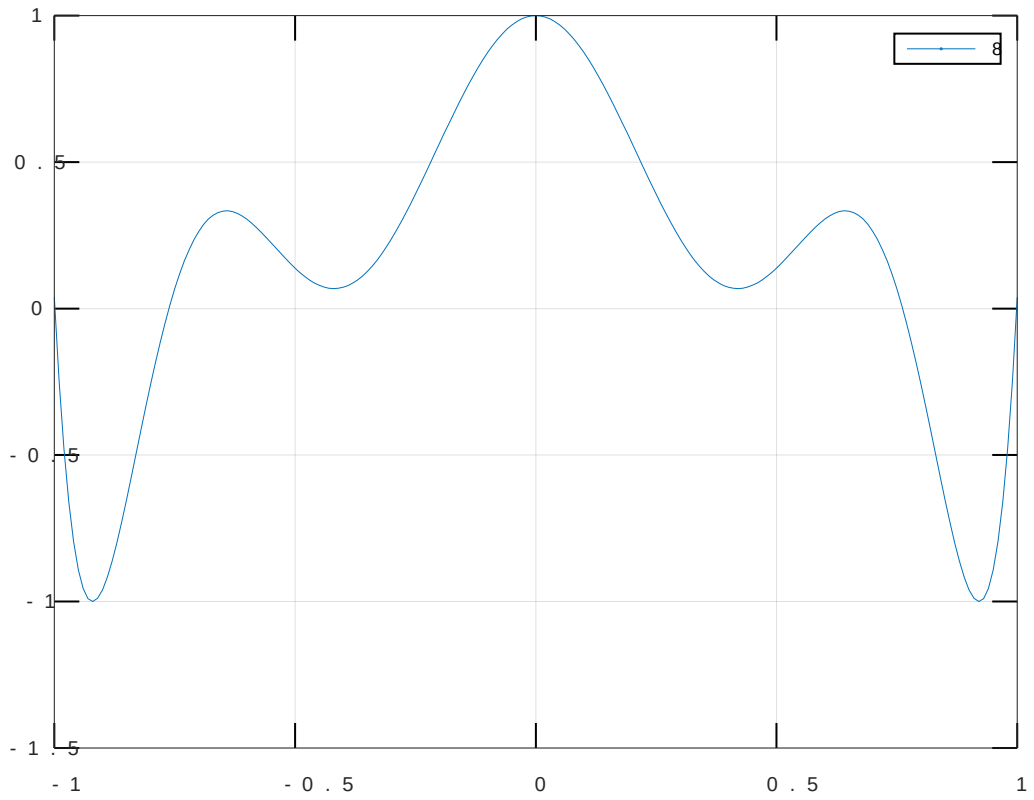
$n = 6$



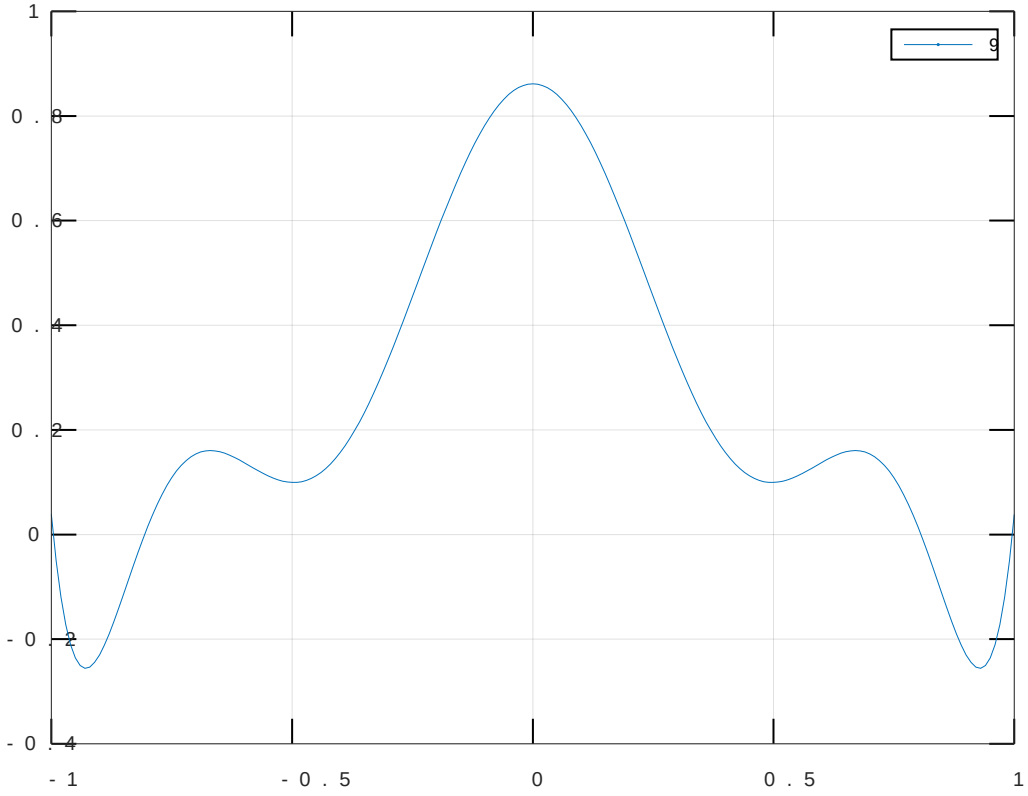
$n = 7$



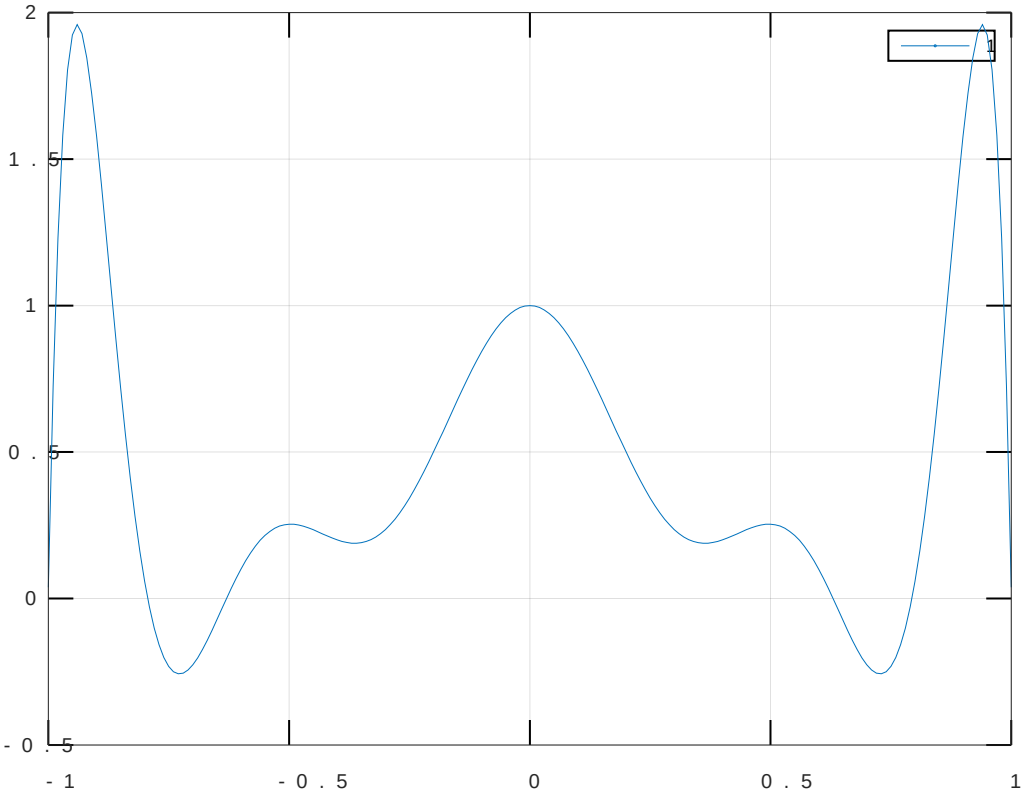
$n = 8$



$n = 9$



$n = 10$


2
1.5
1
0.5
0
-0.5
-1
-0.5
0
0.5
1
1