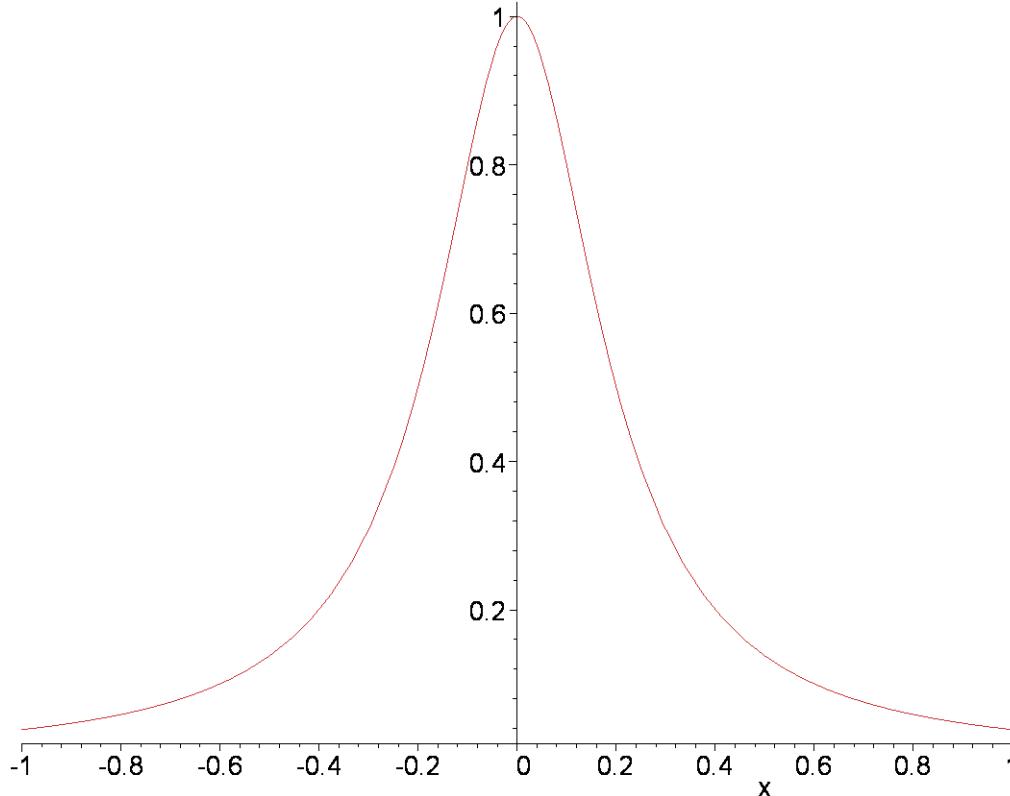


```
[ > restart:
[ > with(plots):
[ > with(linalg):
Warning, new definition for norm
Warning, new definition for trace
[ > f:=x->(1/(1+25*x^2));
```

$$f := x \rightarrow \frac{1}{1 + 25x^2}$$

```
[ > z:=plot([f(x)], x=-1.0..1.0, color=[blue], style=[line]):
[ > plot([f(x)], x=-1.0..1.0, color=[orange], style=[line]);
```



INTERPOLAÇÃO DA FUNÇÃO: POLINOMIO DE GRAU DOIS

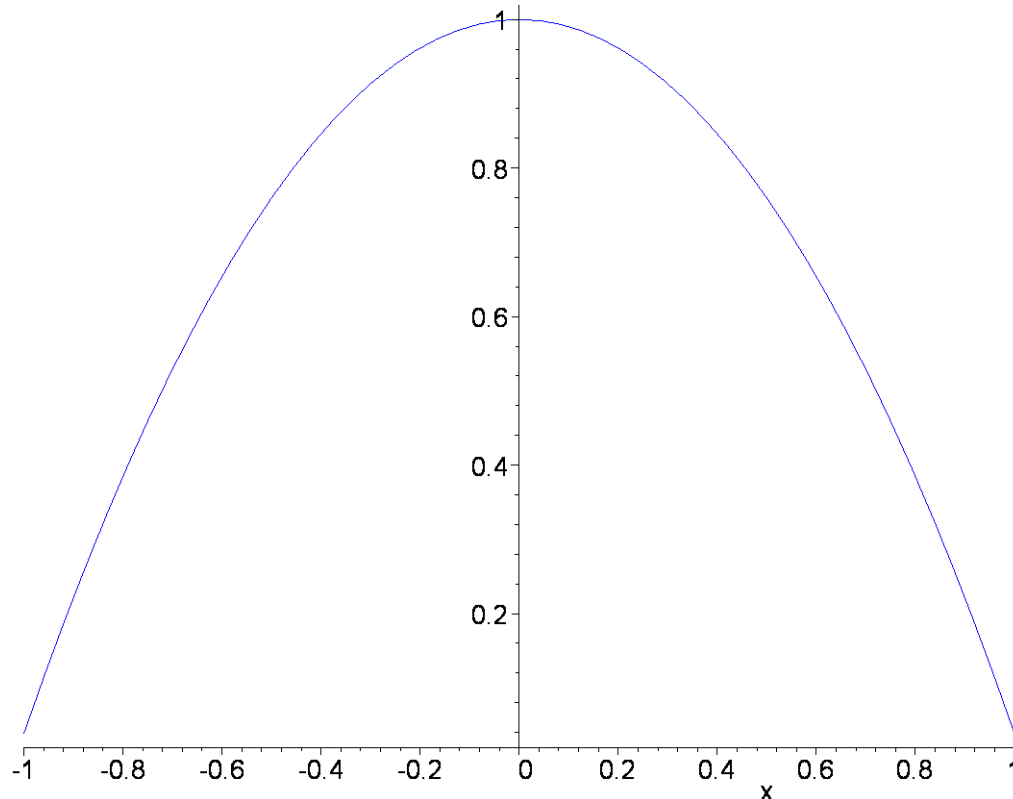
```
[ > x0:=-1:
[ > x1:=0.0:
[ > x2:=1.0:
[ > y0:=f(x0):;
[ > y1:=f(x1):;
[ > y2:=f(x2):;
[ > h:=1.0:
[ OPERADOR DIFERENÇAS DIVIDIDAS DE ORDEM 1
[ > f[x0,x1]:=(y1-y0)/h;
```

$$f_{-1,0} := .9615384615$$

```

[ > f[x1,x2]:=(y2-y1)/h;
                                     f0,1.0 := -0.9615384615
[ OPERADOR DIFERENÇAS DIVIDIDAS DE ORDEM 2
[ > f[x0,x1,x2]:=(f[x1,x2]-f[x0,x1])/(2*h);
                                     f-1,0,1.0 := -0.9615384615
[ > P2:=y0+f[x0,x1]*(x-x0)+f[x0,x1,x2]*(x-x0)*(x-x1);
                                     P2 := 1.000000000 + 0.9615384615 x - 0.9615384615 (x + 1) x
[ POLINOMIO INTERPOLADOR DE GRAU 2
[ > Runge2:=plot([P2(x)], x=-1.0..1.0, color=[blue], style=[line]):
[ > plot([P2(x)], x=-1.0..1.0, color=[blue], style=[line]);

```



```

[ >
[ > with(linalg):
[ >
[ > with(plots):
[ INTERPOLAÇÃO DA FUNÇÃO: POLINOMIO DE GRAU QUATRO
[ > f:=x->(1/(1+25*x^2)):
[ PONTOS CONHECIDOS
[ > x0:=-1:
[ > x1:=-0.5:
[ > x2:=0.0:
[ > x3:=0.5:
[ > x4:=1.0:
[ >

```

```

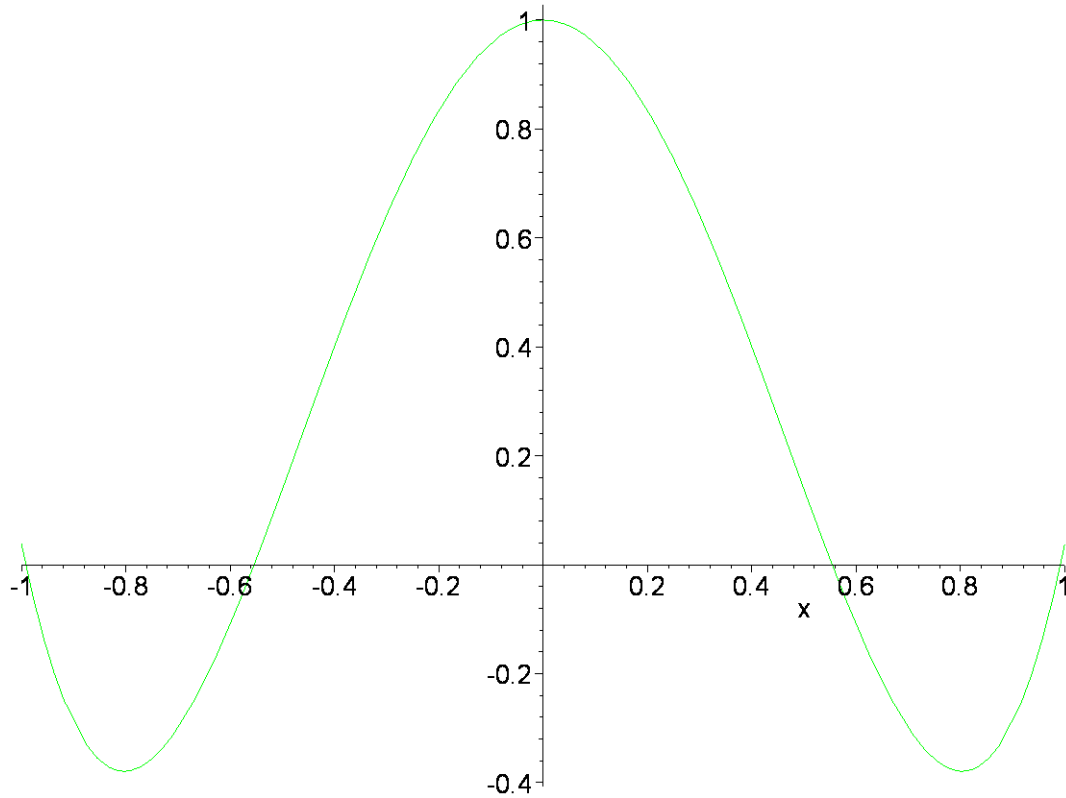
[ VALOR DA FUNÇÃO
[ > y0:=f(x0):;
[ > y1:=f(x1):
[ > y2:=f(x2):;
[ > y3:=f(x3):
[ > y4:=f(x4):
[ > h:=0.5:
[ OPERADOR DIFERENÇAS DIVIDIDAS DE ORDEM 1
[ > f[x0,x1]:=(y1-y0)/h;
[                                     f-1,-.5 := .1989389921
[ > f[x1,x2]:=(y2-y1)/h;
[                                     f-.5,0 := 1.724137931
[ > f[x2,x3]:=(y3-y2)/h;
[                                     f0,.5 := -1.724137931
[ > f[x3,x4]:=(y4-y3)/h;
[                                     f.5,1.0 := -.1989389921
[ OPERADOR DIFERENÇAS DIVIDIDAS DE ORDEM 2
[ > f[x0,x1,x2]:=(f[x1,x2]-f[x0,x1])/(2*h);
[                                     f-1,-.5,0 := 1.525198939
[ > f[x1,x2,x3]:=(f[x2,x3]-f[x1,x2])/(2*h);
[                                     f-.5,0,.5 := -3.448275862
[ > f[x2,x3,x4]:=(f[x3,x4]-f[x2,x3])/(2*h);
[                                     f0,.5,1.0 := 1.525198939
[ OPERADOR DIFERENÇAS DIVIDIDAS DE ORDEM 3
[ > f[x0,x1,x2,x3]:=(f[x1,x2,x3]-f[x0,x1,x2])/(3*h);
[ > f[x1,x2,x3,x4]:=(f[x2,x3,x4]-f[x1,x2,x3])/(3*h);
[                                     f-1,-.5,0,.5 := -3.315649867
[                                     f-.5,0,.5,1.0 := 3.315649867
[
[ OPERADOR DIFERENÇAS DIVIDIDAS DE ORDEM 4
[ > f[x0,x1,x2,x3,x4]:=(f[x1,x2,x3,x4]-f[x0,x1,x2,x3])/(4*h);
[                                     f-1,-.5,0,.5,1.0 := 3.315649868
[ POLINOMIO INTERPOLADOR DE GRAU 4
[ > P4:=y0+f[x0,x1]*(x-x0)+f[x0,x1,x2]*(x-x0)*(x-x1)+f[x0,x1,x2,x3]*(x
[   -x0)*(x-x1)*(x-x2)+f[x0,x1,x2,x3,x4]*(x-x0)*(x-x1)*(x-x2)*(x-x3);
[ >
[ >
[ P4 := .2374005306 + .1989389921 x + 1.525198939 (x + 1) (x + .5)
[   - 3.315649867 (x + 1) (x + .5) x + 3.315649868 (x + 1) (x + .5) x (x - .5)

```

```

>
> Runge4:=plot([P4(x)], x=-1.0..1.0, color=[blue], style=[line]):
> plot([P4(x)], x=-1.0..1.0, color=[green], style=[line]);

```



POINTERPOLAÇÃO DA FUNÇÃO: POLINOMIO DE GRAU DEZ
PONTOS CONHECIDOS

```

[ > with(linalg):
[ >
[ > with(plots):
[ > f:=x->(1/(1+25*x^2)):
[ >
[ > x0:=-1:
[ > x1:=-0.8:
[ > x2:=-0.6:
[ > x3:=-0.4:
[ > x4:=-0.2:
[ > x5:=0.0:
[ > x6:=0.2:
[ > x7:=0.4:
[ > x8:=0.6:
[ > x9:=0.8:
[ > x10:=1.0:

```

```

[ VALOR DA FUNÇÃO
[ > y0:=f(x0):
[ > y1:=f(x1):
[ > y2:=f(x2):
[ > y3:=f(x3):
[ > y4:=f(x4):
[ > y5:=f(x5):
[ > y6:=f(x6):
[ > y7:=f(x7):
[ > y8:=f(x8):
[ > y9:=f(x9):
[ > y10:=f(x10):
[ > h:=0.2:
[ >
[ > X[0]:= array(1..11,[x0,x1,x2,x3,x4,x5,x6,x7,x8,x9,x10]);
[                               X0 := [-1, -8, -6, -4, -2, 0, .2, .4, .6, .8, 1.0]
[ TABELA DAS DIFERENÇAS DIVIDIDAS: ODEM 1
[ >
[ > f[x0,x1]:=(y1-y0)/h;
[                               f-1,-8 := .1018099548
[ > f[x1,x2]:=(y2-y1)/h;
[                               f-.8,-6 := .2058823530
[ > f[x2,x3]:=(y3-y2)/h;
[                               f-.6,-4 := .5000000000
[ > f[x3,x4]:=(y4-y3)/h;
[                               f-.4,-2 := 1.5000000000
[ > f[x4,x5]:=(y5-y4)/h;
[                               f-.2,0 := 2.5000000000
[ > f[x5,x6]:=(y6-y5)/h;
[                               f0,2 := -2.5000000000
[ > f[x6,x7]:=(y7-y6)/h;
[                               f2,4 := -1.5000000000
[ > f[x7,x8]:=(y8-y7)/h;
[                               f4,6 := -.5000000000
[ > f[x8,x9]:=(y9-y8)/h;
[                               f6,8 := -.2058823530
[ > f[x9,x10]:=(y10-y9)/h;
[                               f8,1.0 := -.1018099548
[ >

```

[TABELA DAS DIFERENÇAS DIVIDIDAS: ODEM 2

> $f[x_0, x_1, x_2] := (f[x_1, x_2] - f[x_0, x_1]) / (2 * h);$
 $f_{-1, -8, -6} := .2601809955$

> $f[x_1, x_2, x_3] := (f[x_2, x_3] - f[x_1, x_2]) / (2 * h);$
 $f_{-8, -6, -4} := .7352941175$

> $f[x_2, x_3, x_4] := (f[x_3, x_4] - f[x_2, x_3]) / (2 * h);$
 $f_{-6, -4, -2} := 2.500000000$

> $f[x_3, x_4, x_5] := (f[x_4, x_5] - f[x_3, x_4]) / (2 * h);$
 $f_{-4, -2, 0} := 2.500000000$

> $f[x_4, x_5, x_6] := (f[x_5, x_6] - f[x_4, x_5]) / (2 * h);$
 $f_{-2, 0, 2} := -12.50000000$

> $f[x_5, x_6, x_7] := (f[x_6, x_7] - f[x_5, x_6]) / (2 * h);$
 $f_{0, 2, 4} := 2.500000000$

> $f[x_6, x_7, x_8] := (f[x_7, x_8] - f[x_6, x_7]) / (2 * h);$
 $f_{2, 4, 6} := 2.500000000$

> $f[x_7, x_8, x_9] := (f[x_8, x_9] - f[x_7, x_8]) / (2 * h);$
 $f_{4, 6, 8} := .7352941175$

> $f[x_8, x_9, x_{10}] := (f[x_9, x_{10}] - f[x_8, x_9]) / (2 * h);$
 $f_{6, 8, 10} := .2601809955$

[TABELA DAS DIFERENÇAS DIVIDIDAS: ODEM 3

> $f[x_0, x_1, x_2, x_3] := (f[x_1, x_2, x_3] - f[x_0, x_1, x_2]) / (3 * h);$
 $f_{-1, -8, -6, -4} := .7918552033$

> $f[x_1, x_2, x_3, x_4] := (f[x_2, x_3, x_4] - f[x_1, x_2, x_3]) / (3 * h);$
 $f_{-8, -6, -4, -2} := 2.941176472$

> $f[x_2, x_3, x_4, x_5] := (f[x_3, x_4, x_5] - f[x_2, x_3, x_4]) / (3 * h);$
 $f_{-6, -4, -2, 0} := 0$

> $f[x_3, x_4, x_5, x_6] := (f[x_4, x_5, x_6] - f[x_3, x_4, x_5]) / (3 * h);$
 $f_{-4, -2, 0, 2} := -25.00000000$

> $f[x_4, x_5, x_6, x_7] := (f[x_5, x_6, x_7] - f[x_4, x_5, x_6]) / (3 * h);$
 $f_{-2, 0, 2, 4} := 25.00000000$

> $f[x_5, x_6, x_7, x_8] := (f[x_6, x_7, x_8] - f[x_5, x_6, x_7]) / (3 * h);$
 $f_{0, 2, 4, 6} := 0$

> $f[x_6, x_7, x_8, x_9] := (f[x_7, x_8, x_9] - f[x_6, x_7, x_8]) / (3 * h);$
 $f_{2, 4, 6, 8} := -2.941176472$

> $f[x_7, x_8, x_9, x_{10}] := (f[x_8, x_9, x_{10}] - f[x_7, x_8, x_9]) / (3 * h);$
 $f_{4, 6, 8, 10} := -.7918552033$

[TABELA DAS DIFERENÇAS DIVIDIDAS: ODEM 4

```

> f[x0,x1,x2,x3,x4] := (f[x1,x2,x3,x4]-f[x0,x1,x2,x3]) / (4*h);
      f-1,-8,-6,-4,-2 := 2.686651588
> f[x1,x2,x3,x4,x5] := (f[x2,x3,x4,x5]-f[x1,x2,x3,x4]) / (4*h);
      f-8,-6,-4,-2,0 := -3.676470590
> f[x2,x3,x4,x5,x6] := (f[x3,x4,x5,x6]-f[x2,x3,x4,x5]) / (4*h);
      f-6,-4,-2,0,2 := -31.25000000
> f[x3,x4,x5,x6,x7] := (f[x4,x5,x6,x7]-f[x3,x4,x5,x6]) / (4*h);
      f-4,-2,0,2,4 := 62.50000000
> f[x4,x5,x6,x7,x8] := (f[x5,x6,x7,x8]-f[x4,x5,x6,x7]) / (4*h);
      f-2,0,2,4,6 := -31.25000000
> f[x5,x6,x7,x8,x9] := (f[x6,x7,x8,x9]-f[x5,x6,x7,x8]) / (4*h);
      f0,2,4,6,8 := -3.676470590
> f[x6,x7,x8,x9,x10] := (f[x7,x8,x9,x10]-f[x6,x7,x8,x9]) / (4*h);
      f2,4,6,8,10 := 2.686651588

```

[TABELA DAS DIFERENÇAS DIVIDIDAS: ODEM 5

```

> f[x0,x1,x2,x3,x4,x5] := (f[x1,x2,x3,x4,x5]-f[x0,x1,x2,x3,x4]) / (5*h);
      f-1,-8,-6,-4,-2,0 := -6.363122178
> f[x1,x2,x3,x4,x5,x6] := (f[x2,x3,x4,x5,x6]-f[x1,x2,x3,x4,x5]) / (5*h);
      f-8,-6,-4,-2,0,2 := -27.57352942
> f[x2,x3,x4,x5,x6,x7] := (f[x3,x4,x5,x6,x7]-f[x2,x3,x4,x5,x6]) / (5*h);
      f-6,-4,-2,0,2,4 := 93.75000000
> f[x3,x4,x5,x6,x7,x8] := (f[x4,x5,x6,x7,x8]-f[x3,x4,x5,x6,x7]) / (5*h);
      f-4,-2,0,2,4,6 := -93.75000000
> f[x4,x5,x6,x7,x8,x9] := (f[x5,x6,x7,x8,x9]-f[x4,x5,x6,x7,x8]) / (5*h);
      f-2,0,2,4,6,8 := 27.57352942
> f[x5,x6,x7,x8,x9,x10] := (f[x6,x7,x8,x9,x10]-f[x5,x6,x7,x8,x9]) / (5*h);
      f0,2,4,6,8,10 := 6.363122178

```

[TABELA DAS DIFERENÇAS DIVIDIDAS: ODEM 6

```

> f[x0,x1,x2,x3,x4,x5,x6] := (f[x1,x2,x3,x4,x5,x6]-f[x0,x1,x2,x3,x4,x5]) / (6*h);
      f-1,-8,-6,-4,-2,0,2 := -17.67533937
> f[x1,x2,x3,x4,x5,x6,x7] := (f[x2,x3,x4,x5,x6,x7]-f[x1,x2,x3,x4,x5,x6]) / (6*h);
      f-8,-6,-4,-2,0,2,4 := 101.1029412
> f[x2,x3,x4,x5,x6,x7,x8] := (f[x3,x4,x5,x6,x7,x8]-f[x2,x3,x4,x5,x6,x7]) / (6*h);

```

$$f_{-.6, -.4, -.2, 0, .2, .4, .6} := -156.2500000$$

> $f[x3, x4, x5, x6, x7, x8, x9] := (f[x4, x5, x6, x7, x8, x9] - f[x3, x4, x5, x6, x7, x8]) / (6 * h);$

$$f_{-.4, -.2, 0, .2, .4, .6, .8} := 101.1029412$$

> $f[x4, x5, x6, x7, x8, x9, x10] := (f[x5, x6, x7, x8, x9, x10] - f[x4, x5, x6, x7, x8, x9]) / (6 * h);$

$$f_{-.2, 0, .2, .4, .6, .8, 1.0} := -17.67533937$$

TABELA DAS DIFERENÇAS DIVIDIDAS: ODEM 7

> $f[x0, x1, x2, x3, x4, x5, x6, x7] := (f[x1, x2, x3, x4, x5, x6, x7] - f[x0, x1, x2, x3, x4, x5, x6]) / (7 * h);$

$$f_{-1, -.8, -.6, -.4, -.2, 0, .2, .4} := 84.84162900$$

> $f[x1, x2, x3, x4, x5, x6, x7, x8] := (f[x2, x3, x4, x5, x6, x7, x8] - f[x1, x2, x3, x4, x5, x6, x7]) / (7 * h);$

$$f_{-.8, -.6, -.4, -.2, 0, .2, .4, .6} := -183.8235294$$

> $f[x2, x3, x4, x5, x6, x7, x8, x9] := (f[x3, x4, x5, x6, x7, x8, x9] - f[x2, x3, x4, x5, x6, x7, x8]) / (7 * h);$

$$f_{-.6, -.4, -.2, 0, .2, .4, .6, .8} := 183.8235294$$

> $f[x3, x4, x5, x6, x7, x8, x9, x10] := (f[x4, x5, x6, x7, x8, x9, x10] - f[x3, x4, x5, x6, x7, x8, x9]) / (7 * h);$

$$f_{-.4, -.2, 0, .2, .4, .6, .8, 1.0} := -84.84162900$$

TABELA DAS DIFERENÇAS DIVIDIDAS: ODEM 8

> $f[x0, x1, x2, x3, x4, x5, x6, x7, x8] := (f[x1, x2, x3, x4, x5, x6, x7, x8] - f[x0, x1, x2, x3, x4, x5, x6, x7]) / (8 * h);$

$$f_{-1, -.8, -.6, -.4, -.2, 0, .2, .4, .6} := -167.9157240$$

> $f[x1, x2, x3, x4, x5, x6, x7, x8, x9] := (f[x2, x3, x4, x5, x6, x7, x8, x9] - f[x1, x2, x3, x4, x5, x6, x7, x8]) / (8 * h);$

$$f_{-.8, -.6, -.4, -.2, 0, .2, .4, .6, .8} := 229.7794118$$

> $f[x2, x3, x4, x5, x6, x7, x8, x9, x10] := (f[x3, x4, x5, x6, x7, x8, x9, x10] - f[x2, x3, x4, x5, x6, x7, x8, x9]) / (8 * h);$

$$f_{-.6, -.4, -.2, 0, .2, .4, .6, .8, 1.0} := -167.9157240$$

TABELA DAS DIFERENÇAS DIVIDIDAS: ODEM 9

> $f[x0, x1, x2, x3, x4, x5, x6, x7, x8, x9] := (f[x1, x2, x3, x4, x5, x6, x7, x8, x9] - f[x0, x1, x2, x3, x4, x5, x6, x7, x8]) / (9 * h);$

$$f_{-1, -.8, -.6, -.4, -.2, 0, .2, .4, .6, .8} := 220.9417421$$

> $f[x1, x2, x3, x4, x5, x6, x7, x8, x9, x10] := (f[x2, x3, x4, x5, x6, x7, x8, x9, x10] - f[x1, x2, x3, x4, x5, x6, x7, x8, x9]) / (9 * h);$

$$f_{-.8, -.6, -.4, -.2, 0, .2, .4, .6, .8, 1.0} := -220.9417421$$

TABELA DAS DIFERENÇAS DIVIDIDAS: ODEM 10

> $f[x0, x1, x2, x3, x4, x5, x6, x7, x8, x9, x10] := (f[x1, x2, x3, x4, x5, x6, x7, x8, x9, x10] - f[x0, x1, x2, x3, x4, x5, x6, x7, x8, x9]) / (10 * h);$


```
9, x10]-f[x0, x1, x2, x3, x4, x5, x6, x7, x8, x9])/(10*h);
```

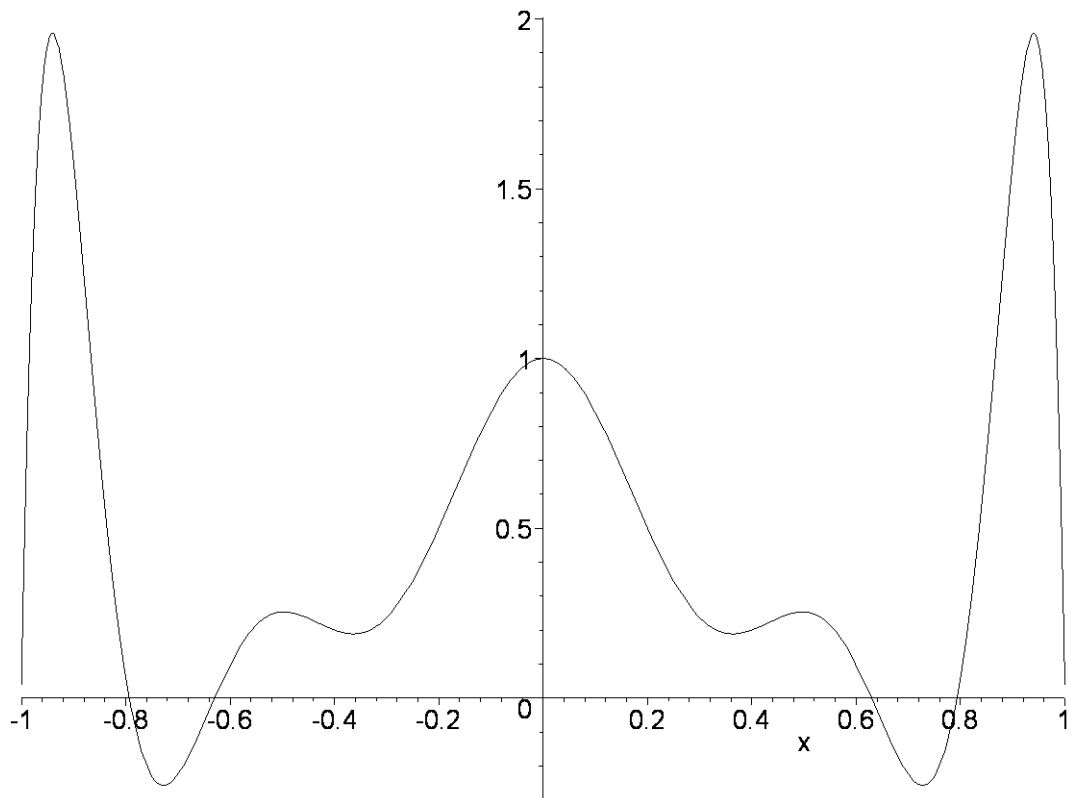
```
f_{-1, -.8, -.6, -.4, -.2, 0, .2, .4, .6, .8, 1.0} := -220.9417421
```

```
[ POLINOMIO INTERPOLADOR DE GRAU 10
```

```
> P10:=y0+f[x0, x1]*(x-x0)+f[x0, x1, x2]*(x-x0)*(x-x1)+f[x0, x1, x2, x3]*(x-x0)*(x-x1)*(x-x2)+f[x0, x1, x2, x3, x4]*(x-x0)*(x-x1)*(x-x2)*(x-x3)+f[x0, x1, x2, x3, x4, x5]*(x-x0)*(x-x1)*(x-x2)*(x-x3)*(x-x4)+f[x0, x1, x2, x3, x4, x5, x6]*(x-x0)*(x-x1)*(x-x2)*(x-x3)*(x-x4)*(x-x5)+f[x0, x1, x2, x3, x4, x5, x6, x7]*(x-x0)*(x-x1)*(x-x2)*(x-x3)*(x-x4)*(x-x5)*(x-x6)+f[x0, x1, x2, x3, x4, x5, x6, x7, x8]*(x-x0)*(x-x1)*(x-x2)*(x-x3)*(x-x4)*(x-x5)*(x-x6)*(x-x7)+f[x0, x1, x2, x3, x4, x5, x6, x7, x8, x9]*(x-x0)*(x-x1)*(x-x2)*(x-x3)*(x-x4)*(x-x5)*(x-x6)*(x-x7)*(x-x8)+f[x0, x1, x2, x3, x4, x5, x6, x7, x8, x9, x10]*(x-x0)*(x-x1)*(x-x2)*(x-x3)*(x-x4)*(x-x5)*(x-x6)*(x-x7)*(x-x8)*(x-x9);
```

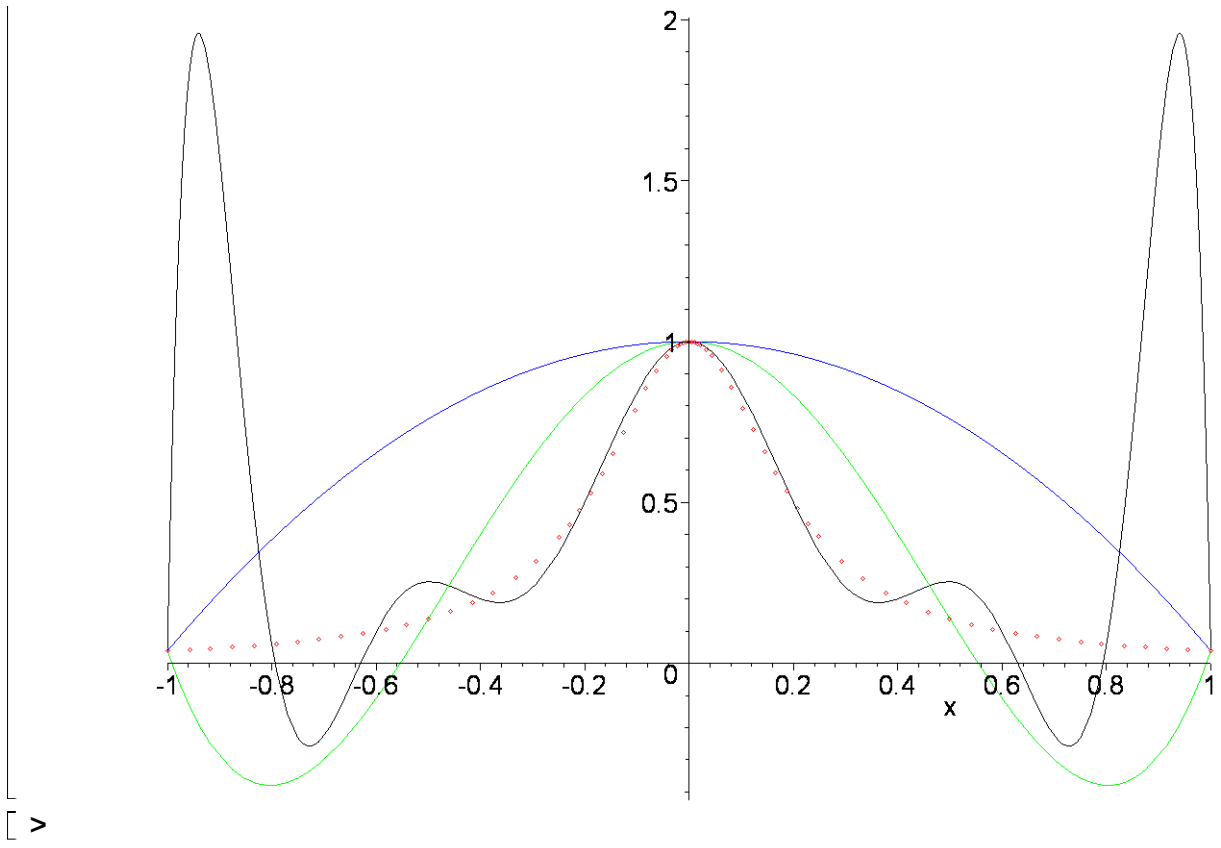
```
P10 := .1402714933 + .1018099548 x + .2601809955 (x + 1) (x + .8)  
+ .7918552033 (x + 1) (x + .8) (x + .6) + 2.686651588 (x + 1) (x + .8) (x + .6) (x + .4)  
- 6.363122178 (x + 1) (x + .8) (x + .6) (x + .4) (x + .2)  
- 17.67533937 (x + 1) (x + .8) (x + .6) (x + .4) (x + .2) x  
+ 84.84162900 (x + 1) (x + .8) (x + .6) (x + .4) (x + .2) x (x - .2)  
- 167.9157240 (x + 1) (x + .8) (x + .6) (x + .4) (x + .2) x (x - .2) (x - .4)  
+ 220.9417421 (x + 1) (x + .8) (x + .6) (x + .4) (x + .2) x (x - .2) (x - .4) (x - .6)  
- 220.9417421 (x + 1) (x + .8) (x + .6) (x + .4) (x + .2) x (x - .2) (x - .4) (x - .6) (x - .8)
```

```
> Runge10:=plot([P10(x)], x=-1.0..1.0, color=[blue], style=[line]):  
> plot([P10(x)], x=-1.0..1.0, color=[black], style=[line]);
```



COMPARAÇÃO EENTRE OS GRAFICOS DA FUNÇÃO E OS POLINOMIOS DE GRAU 2, 4 E 10

```
> plot([f(x), P2(x), P4(x), P10(x)], x=-1.0..1.0,
color=[red,blue,green,black], style=[point,line,line,line]);
```



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