

## Sample Usage of `polyinterp`

```
|> read polyinterp:
```

```
|> res1 := polyinterp(  
| [[0,1],[1,6],[2,4],[3,0]], 'x');
```

$$res1 := \frac{5}{6}x^3 - 6x^2 + \frac{61}{6}x + 1$$

```
|> [seq(subs(x=i, res1), i=0..3)];
```

```
| [1, 6, 4, 0]
```

```
|> res2 := polyinterp(  
| [[0,1],[1,6],[2,4],[3,0]], 'f(x)');
```

```
| Error, (in polyinterp) second argument must be a name
```

## Use polyinterp to generate an interpolation formula for evenly spaced data

```
> res3 := polyinterp(  
> [[-h, f[-1]], [0, f[0]], [h, f[1]]], 'x');
```

$$res3 := \frac{1}{2} \frac{f_{-1} x^2}{h^2} - \frac{1}{2} \frac{f_{-1} x}{h} - \frac{f_0 x^2}{h^2} + f_0 + \frac{1}{2} \frac{f_1 x^2}{h^2} + \frac{1}{2} \frac{f_1 x}{h}$$

In this case it is useful to collect terms proportional to the  $f[i]$

```
> res3c := collect(res3, {f[-1], f[0], f[1]});
```

$$res3c := \left( \frac{1}{2} \frac{x^2}{h^2} - \frac{1}{2} \frac{x}{h} \right) f_{-1} + \left( -\frac{x^2}{h^2} + 1 \right) f_0 + \left( \frac{1}{2} \frac{x^2}{h^2} + \frac{1}{2} \frac{x}{h} \right) f_1$$

## Use polyinterp to fit to $\sin(x)$ on $x = 0 .. 1.2\pi$

```
> seq(i, i=0..6);  
0, 1, 2, 3, 4, 5, 6  
  
> seq(0.2*i*Pi, i=0..6);  
0, .2 pi, .4 pi, .6 pi, .8 pi, 1.0 pi, 1.2 pi  
  
> [%];  
[0, .2 pi, .4 pi, .6 pi, .8 pi, 1.0 pi, 1.2 pi]  
  
> map(x->[x, sin(x)], %);  
[[0, 0], [.2 pi, sin(.2 pi)], [.4 pi, sin(.4 pi)], [.6 pi, sin(.6 pi)],  
 [.8 pi, sin(.8 pi)], [1.0 pi, 0], [1.2 pi, sin(1.2 pi)]]  
  
> sin_list := evalf(%);  
sin_list := [[0, 0], [.6283185308, .5877852524],  
 [1.256637062, .9510565165], [1.884955592, .9510565163],  
 [2.513274123, .5877852522], [3.141592654, 0],  
 [3.769911185, -.5877852529]]  
  
> p := polyinterp(sin_list, 'x');  
p := .99938790 x - .16630848 x3 + .00139080 x2 - .00305064 x4  
 + .011275606 x5 - .0011963788 x6
```

**Plot fitting polynomial and  $\sin(x)$  on  $x=0 \dots 2\pi$ . Note how fit deteriorates outside of original fitting range (i.e. for  $x > 1.2\pi$ )**

```
> plot([p, sin(x)], x=0..2*Pi, style=point);
```

