

# Computational Methods in Physics (PHY 365)

FA23

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# Lab 7

## MATLAB's `interp1` function

- `vq = interp1(x , v , xq)` returns interpolated values of a 1-D function at specific query points using **linear** interpolation.
  - ◇ **Vector** `x` contains the sample points.
  - ◇ **Vector** `v` contains the corresponding values,  $v(x)$ .
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- `vq = interp1(x , v , xq , method)` specifies an **alternative** interpolation method.

## MATLAB's `interp1` function

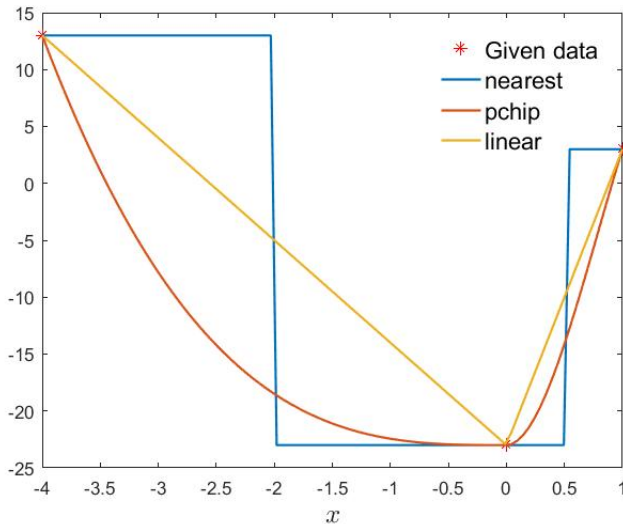
- `vq = interp1(x , v , xq)` returns interpolated values of a 1-D function at specific query points using **linear** interpolation.
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  - ◇ **Vector** `xq` contains the coordinates of the query points.
- `vq = interp1(x , v , xq , method)` specifies an **alternative** interpolation method.
- `vq = interp1(x , v , xq , method , extrapolation)` specifies a strategy for extrapolation of data.
  - ◇ Set extrapolation to 'extrap' when you want to use the method algorithm for extrapolation.
  - ◇ Alternatively, a scalar value can be specified, in which case, `interp1` returns that value for all points outside the domain of `x`.

MATLAB's `interp1` function

Method	Description
linear	Linear interpolation. The interpolated value at a query point is based on linear interpolation of the values at neighboring grid points in each respective dimension. This is the default interpolation method.
nearest	Nearest neighbor interpolation. The interpolated value at a query point is the value at the nearest sample grid point.
next	Next neighbor interpolation. The interpolated value at a query point is the value at the next sample grid point.
previous	Previous neighbor interpolation. The interpolated value at a query point is the value at the previous sample grid point.

## MATLAB's `interp1` function

Method	Description
<code>pchip</code>	Shape-preserving piecewise cubic interpolation. The interpolated value at a query point is based on a shape-preserving piecewise cubic interpolation of the values at neighboring grid points.
<code>cubic</code>	Same as 'pchip'. The behavior of <code>interp1(...,'cubic')</code> will change in a future release. In a future release, this method will perform cubic convolution.
<code>spline</code>	Spline interpolation using not-a-knot end conditions. The interpolated value at a query point is based on a cubic interpolation of the values at neighboring grid points in each respective dimension.

MATLAB's `interp1` function



## MATLAB's interp2 function

- $V_q = \text{interp2}(X, Y, V, X_q, Y_q)$  returns interpolated values of a function of two variables at specific query points using **linear** interpolation.
  - ◇ The results always pass through the original sampling of the function.
  - ◇  $X$  and  $Y$  contain the coordinates of the sample points.
  - ◇  $V$  contains the corresponding function values at each sample point.
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  - ◇  $X_q$  and  $Y_q$  contain the coordinates of the query points.
- $V_q = \text{interp2}(\_, \_, \_, \_, \_, \text{method})$  specifies an alternative interpolation method.
  - ◇ 'nearest'.
  - ◇ 'cubic'.
  - ◇ 'spline'.

## MATLAB's interp2 function

Write a MATLAB program to interpolate the surface  $\sin(\sqrt{x^2 + y^2}) / \sqrt{x^2 + y^2}$  ( $-2 \leq x, y \leq 2$ ).

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■ Given data

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[X , Y] = meshgrid(-2 : 2);
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R = sqrt(X .^2 + Y .^2);
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- The query points

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[Xq , Yq] = meshgrid(-2 : 0.2 : 2);
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- The query points

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- The interp2 function

```
interp2_poly_1 = interp2(X , Y , V, Xq , Yq);
```

## MATLAB's interp2 function

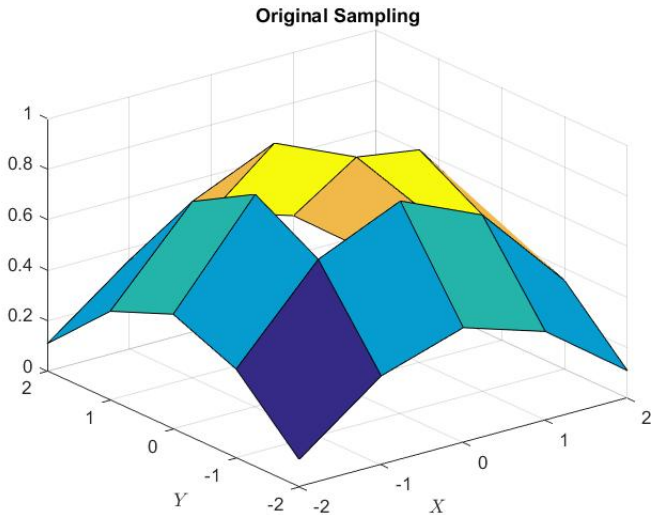
- Plotting

```
surf(X , Y , V)
```

```
figure
```

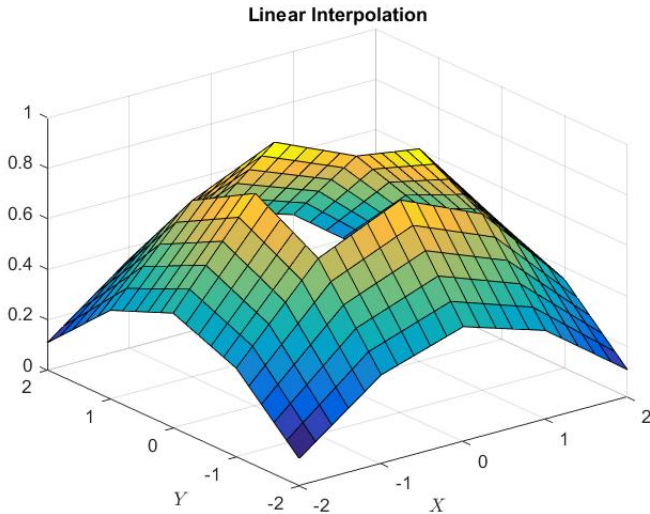
```
surf(Xq , Yq , interp2_poly_1)
```

## MATLAB's interp2 function





## MATLAB's interp2 function



## MATLAB's `interp3` function

- `Vq = interp3(X , Y , Z , V , Xq , Yq , Zq)` returns interpolated values of a function of three variables at specific query points using linear interpolation.
  - ◇ The results always pass through the original sampling of the function.
  - ◇ `X`, `Y`, and `Z` contain the coordinates of the sample points.
  - ◇ `V` contains the corresponding function values at each sample point.
  - ◇ `Xq`, `Yq`, and `Zq` contain the coordinates of the query points.

## MATLAB's `interp3` function

- `Vq = interp3(X , Y , Z , V , Xq , Yq , Zq)` returns interpolated values of a function of three variables at specific query points using linear interpolation.
  - ◇ The results always pass through the original sampling of the function.
  - ◇ `X`, `Y`, and `Z` contain the coordinates of the sample points.
  - ◇ `V` contains the corresponding function values at each sample point.
  - ◇ `Xq`, `Yq`, and `Zq` contain the coordinates of the query points.
- `Vq = interp3(__ , method)` specifies an alternative interpolation method.
  - ◇ 'nearest'.
  - ◇ 'cubic'.
  - ◇ 'spline'.

## MATLAB's spline function

- `s = spline(x , y , xq)` returns a vector of interpolated values `s` corresponding to the query points in `xq`.
  - ◇ The values of `s` are determined by cubic spline interpolation of `x` and `y`.

## MATLAB's spline function

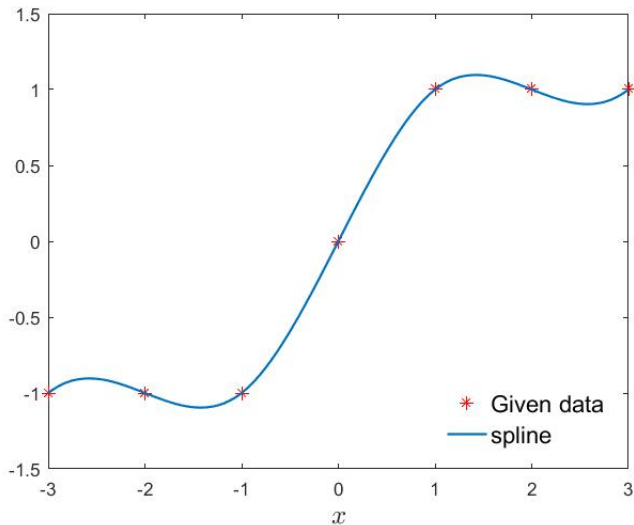
- `s = spline(x , y , xq)` returns a vector of interpolated values `s` corresponding to the query points in `xq`.
  - ◇ The values of `s` are determined by cubic spline interpolation of `x` and `y`.
- `pp = spline(x , y)` returns a piecewise polynomial structure for use by `ppval` and the spline utility `unmkpp`.

# MATLAB's spline function

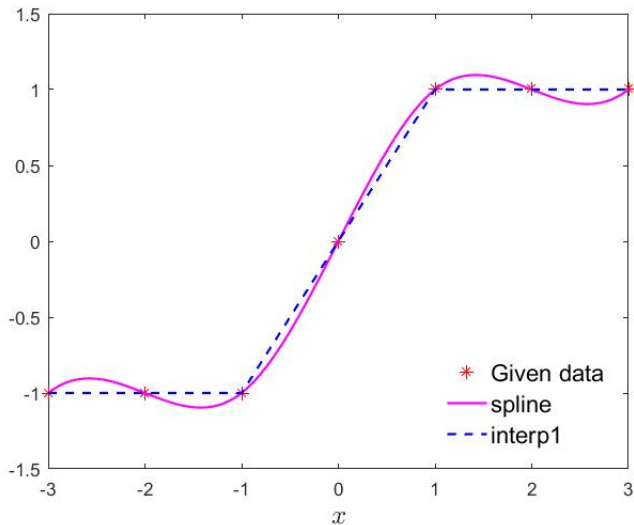
Use the spline function to interpolate the following data

x	-3	-2	-1	0	1	2	3
y	-1	-1	-1	0	1	1	1

## MATLAB's spline function



## MATLAB's spline function





## References

- <https://www.mathworks.com/help/matlab/ref/interp1.html>
- <https://www.mathworks.com/help/matlab/ref/interp2.html>
- <https://www.mathworks.com/help/matlab/ref/interp3.html>
- [https://en.wikipedia.org/wiki/Spline\\_interpolation](https://en.wikipedia.org/wiki/Spline_interpolation)
- <https://towardsdatascience.com/numerical-interpolation-natural-cubic-spline-52c1157b98ac>
- <https://www.mathworks.com/help/matlab/ref/spline.html>