

# MATH 3341: Introduction to Scientific Computing Lab

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# Lab 08: MATLAB Interpolation Routines & Their Derivatives





## Polynomial Interpolation Routines



## polyfit: Fit polynomial to data

- $P = \text{polyfit}(X, Y, N)$ : finds the coefficients of a polynomial  $P(X)$  of degree  $N$  that fits the data  $Y$  best in a least-squares sense.  $P$  is a row vector of length  $N+1$  containing the polynomial coefficients in descending powers,  $P(1)*X^N + P(2)*X^{(N-1)} + \dots + P(N)*X + P(N+1)$ .



## polyval: Evaluate polynomial

- $Y = \text{polyval}(P,X)$ : returns the value of a polynomial  $P$  evaluated at  $X$ .  $P$  is a vector of length  $N+1$  whose elements are the coefficients of the polynomial in descending powers.  $Y = P(1)*X^N + P(2)*X^{(N-1)} + \dots + P(N)*X + P(N+1)$ .



## spline: Cubic spline data interpolation

- `PP = spline(X,Y)`: provides the piecewise polynomial form of the cubic spline interpolant to the data values `Y` at the data sites `X`, for use with the evaluator `PPVAL` and the spline utility `unmkpp`. `X` must be a vector.
- `YY = spline(X,Y,XX)`: is the same as `YY = ppval(spline(X,Y),XX)`, thus providing, in `YY`, the values of the interpolant at `XX`.



## ppval: Evaluate piecewise polynomial.

- $V = \text{ppval}(PP, XX)$ : returns the value, at the entries of  $XX$ , of the piecewise polynomial  $f$  contained in  $PP$ , as constructed by `pchip`, `spline`, `interp1`, or the spline utility `mkpp`.



# pchip: Piecewise Cubic Hermite Interpolating Polynomial

- $PP = \text{pchip}(X,Y)$ : provides the piecewise polynomial form of a certain shape-preserving piecewise cubic Hermite interpolant, to the values  $Y$  at the sites  $X$ , for later use with `ppval` and the spline utility `unmkpp`.  $X$  must be a vector.
- $YY = \text{pchip}(X,Y,XX)$  is the same as  $YY = \text{ppval}(\text{pchip}(X,Y),XX)$ , thus providing, in  $YY$ , the values of the interpolant at  $XX$ .







## Derivatives of Interpolation Polynomials



## polyder: Differentiate polynomial

- `polyder(P)`: returns the derivative of the polynomial whose coefficients are the elements of vector `P`.

