

# MATLAB: Polynomials

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**Polynomial:** A polynomial is an expression consisting of variables (usually denoted by  $x$ ) raised to non-negative integer powers (like  $x^2$ ,  $x^3$ , etc.), combined with coefficients (numerical values) using addition, subtraction, and multiplication.

## 4.6 Polynomial Multiplication

**Example:** Multiply  $2x^2 \times 3x$

```
x = [2 0 0];  
y = [3 0];  
  
z = conv(x,y);  
disp(z);
```

**Output:**

```
6      0      0      0
```

The polynomial is  $6x^3$

**See also:**

- [Multiplying Polynomials - byjus.com](#)
- [Multiplying Polynomials - libretexts.org](#)

## 4.7 Polynomial DIVISION

**See also:**

- [Polynomial division - byjus.com](#)

## 4.8 Formulation of polynomial equation

## 4.9 Characteristic polynomial of a matrix

The characteristic polynomial, in linear algebra, is a polynomial associated with a square matrix. It has several key properties:

**Eigenvalue Relationship:** The eigenvalues of the matrix are the values that make the characteristic polynomial equal to zero. In other words, the roots of the polynomial correspond to the eigenvalues. **Degree and Size:** The characteristic polynomial is a polynomial of degree  $n$ , where  $n$  is the dimension of the square matrix. This implies that an  $n \times n$  matrix can have at most  $n$  distinct eigenvalues.

## 4.11 Polynomial Integration

**Polynomial:** A polynomial is an expression consisting of variables (usually denoted by  $x$ ) raised to non-negative integer powers (like  $x^2$ ,  $x^3$ , etc.), combined with coefficients (numerical values) using addition, subtraction, and multiplication.

**Derivative:** In calculus, the derivative of a function represents the instantaneous rate of change of that function at a specific point. For polynomials, it tells you how fast the polynomial's value changes as its input ( $x$ ) changes.

## Key Terms

True/False (Mark T for True and F for False)

**Answer Key (True/False):**

Multiple Choice (Select the best answer)

In MATLAB, how are polynomial coefficients stored?

- (a) As a column vector with powers in ascending order.
- (b) As a row vector with powers in descending order.
- (c) As a matrix with coefficients on the diagonal.
- (d) None of the above.

How can you evaluate a polynomial for a specific input value in MATLAB?

- (a) By directly substituting the value into the polynomial - expression.
- (b) Using the `polyval(p, x)` function, where  $p$  is the polynomial object and  $x$  is the input value. **\*\* <-- Correct Answer\*\***
- (c) The `roots(p)` function cannot be used for evaluation.
- (d) None of the above.

Which function is used for polynomial multiplication in MATLAB?

- (a) `mult(p1, p2)`
- (b) `polyprod(p1, p2)`
- (c) `conv(p1, p2)` **\*\* <-- Correct Answer (Convolution is used for polynomial multiplication)\*\***
- (d) None of the above.

How are polynomial coefficients stored in a MATLAB variable?

- a) As a column vector with powers in ascending order.
- b) As a row vector with powers in descending order. **CORRECT**
- c) As a matrix with rows representing coefficients and columns - representing powers.
- d) None of the above.

Which MATLAB function evaluates a polynomial for a specific input value?

- a) poly(p)
- b) polyder(p)
- c) polyint(p)
- d) polyval(p, x) CORRECT (where x is the input value)

The following code snippet `p = [2 1 -3]; polyval(p, 2)` will evaluate to:

- a) The value of x where the polynomial equals 2.
- b) The derivative of the polynomial evaluated at  $x = 2$ .
- c) The integral of the polynomial from 0 to 2.
- d) The value of the polynomial when  $x = 2$ . CORRECT (`p = [2 1 -3]` represents a polynomial, `polyval` evaluates it at  $x = 2$ )

Which MATLAB function finds the derivative of a polynomial p?

- a) polydiv(p)
- b) polyint(p)
- c) polyder(p) CORRECT
- d) polyval(p, 1)

When defining a polynomial with missing terms (e.g.,  $x^3 + 2x + 1$ ), you should:

- a) Leave gaps in the coefficient vector.
- b) Insert zeros at the corresponding positions in the vector. - CORRECT
- c) Define separate polynomials for each term.
- d) It is not possible to define such polynomials in MATLAB.

Which function is used to find the roots of a polynomial in MATLAB?

- A) polyfit
- B) roots
- C) polyval
- D) conv

Which function evaluates a polynomial for a given set of x values?

- A) polyfit
- B) polyval
- C) polyder
- D) conv

What does the polyder function do?

- A) Finds the derivative of a polynomial
- B) Integrates a polynomial
- C) Multiplies two polynomials
- D) Fits a polynomial to data

Given `p = [2 -4 3]`, what is the result of `polyval(p, 2)`?

- A) 1
- B) 3
- C) 0
- D) 2

To perform polynomial division, which function is used in MATLAB?

- A) deconv
- B) conv
- C) polyval
- D) roots

Which MATLAB command converts a vector of roots back to polynomial coefficients?

- A) roots
- B) poly
- C) polyval
- D) conv

What is the result of the MATLAB command `polyval([1 -4 4], 3)`?

- A) 5
- B) 7
- C) 4
- D) 1

Given  $p = [1 \ -6 \ 11 \ -6]$ , what command finds its roots?

- A) `poly(p)`
- B) `polyfit(p)`
- C) `roots(p)`
- D) `polyval(p)`

Given a polynomial  $p = [2 \ 0 \ -5 \ 1]$ , how can you find its value at  $x = -1$ ?

- A) `polyval(p, -1)`
- B) `polyfit(p, -1)`
- C) `conv(p, -1)`
- D) `roots(p, -1)`

How do you add two polynomials in MATLAB?

- A) Add their coefficient vectors
- B) Use `conv()` function
- C) Use `polyval()` function
- D) Add them directly

What is the degree of the polynomial represented by the coefficient vector  $[4, 0, 2, 1]$ ?

- A) 3
- B) 2

- C) 4
- D) 1

The degree of polynomials in one variable is the highest power of the variable in the algebraic expression. For example, in the following equation:  $x^2+2x+4$ . The degree of the equation is 2 . i.e. the highest power of variable in the equation. [Learn more ...](#)

## Fill in the Blanks

**Answer Key (Fill in the Blanks):**

## Exercises

## Review Questions

## References and Bibliography