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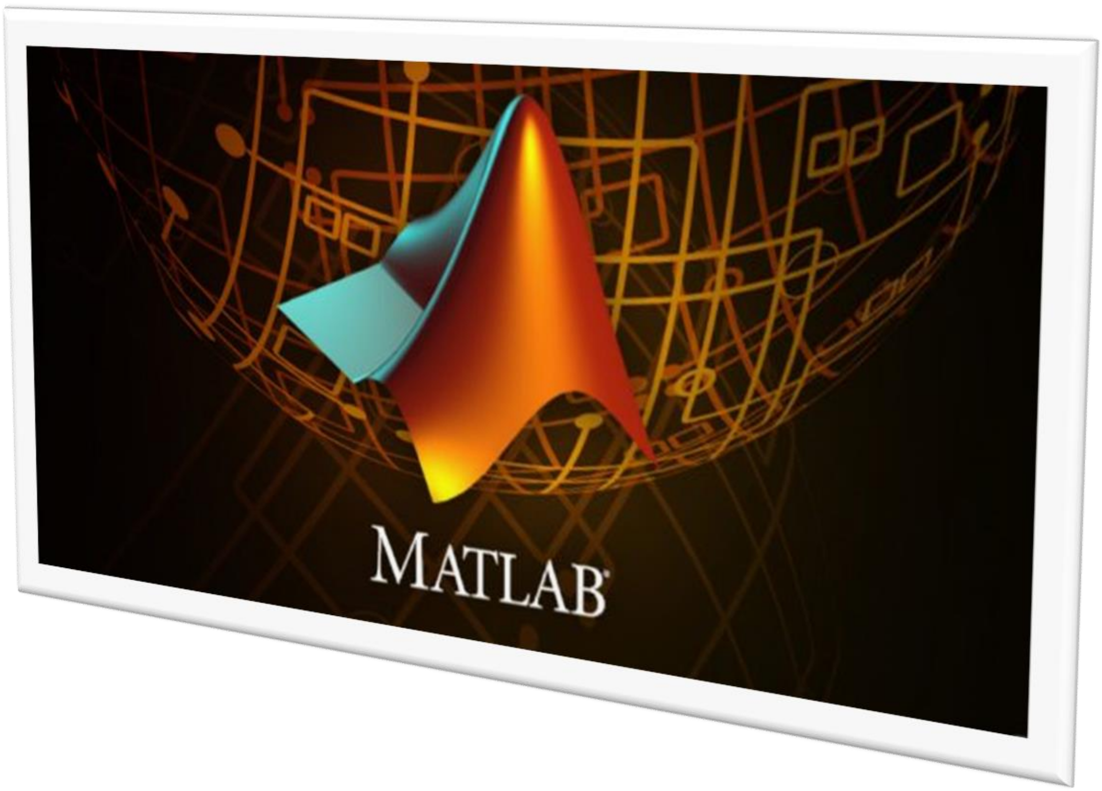
Course N°4
Polynomials in MATLAB



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1.Description of polynomials

In MATLAB, a polynomial is represented by a row vector containing the coefficient in decreasing order.

$P_n(x) = b_n x^n + b_{n-1} x^{n-1} + \dots + b_2 x^2 + b_1 x + b_0$	(1)

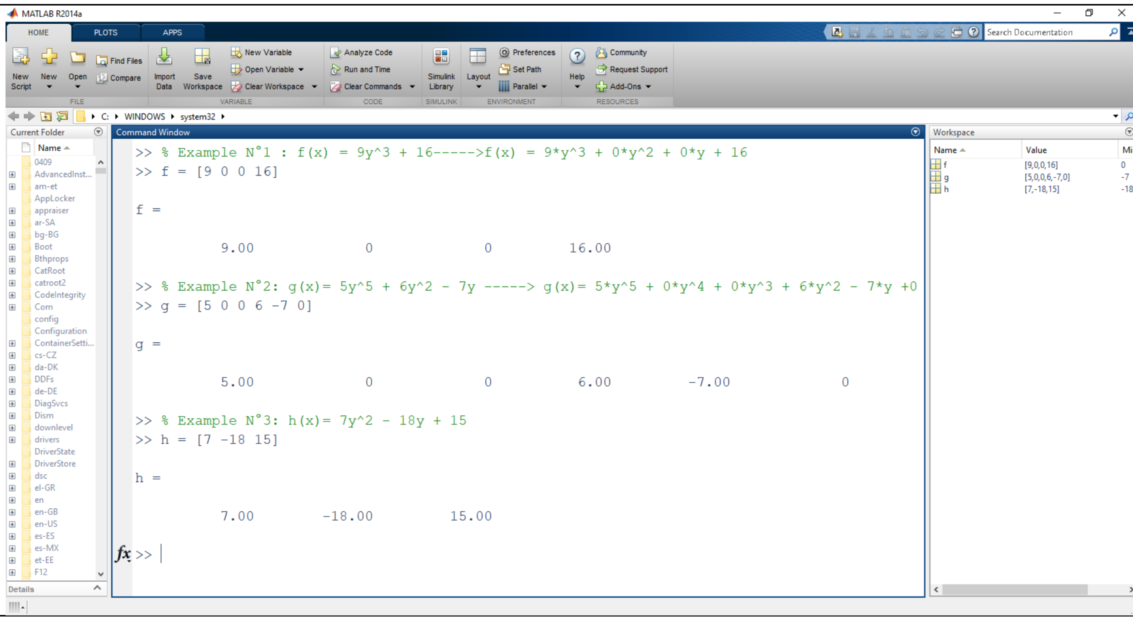

Fig 1. Create a polynomial in MATLAB

Note. A polynomial of degree n is represented by a vector of size $n+1$; Vector must include all polynomial coefficient, even those that are zero.

2.Calculate or find the roots of polynomials

The roots of a polynomial are the values of the independent variable that make the polynomial zeros.

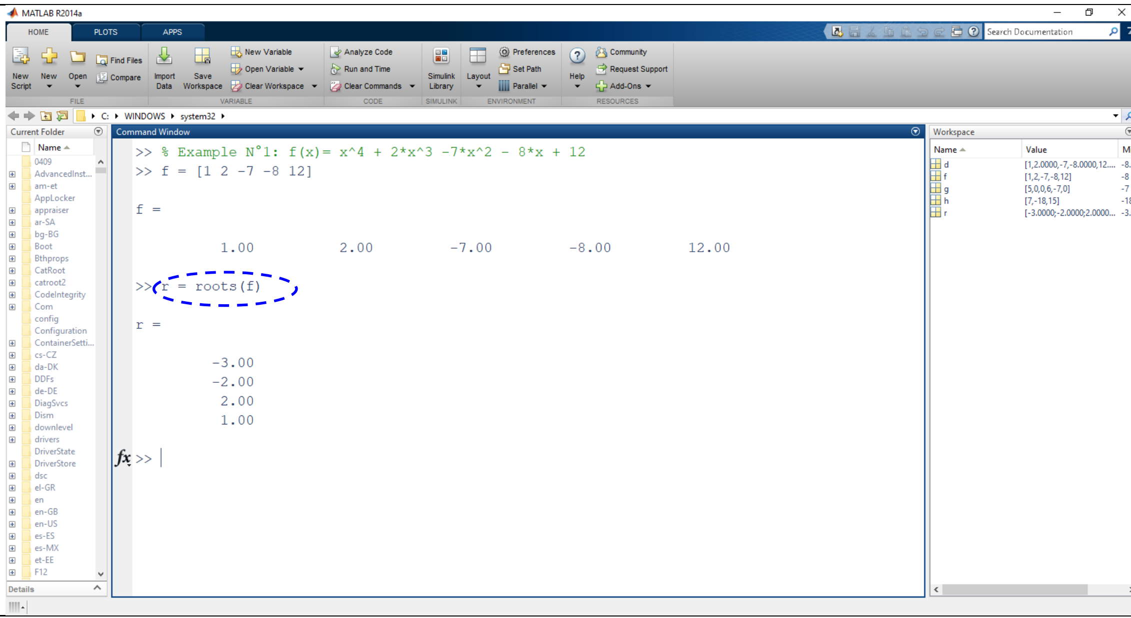

Fig 2. Compute the roots of the given polynomials in MATLAB

Note. A polynomial of degree n has exactly n roots, though some may be repeated or imaginary.

3.Obtain polynomials from roots

If you know the roots of such polynomials, you can get the polynomial's coefficient with

$$P_n(x) = b(x - r_1)(x - r_2)(x - r_3)....(x - r_n) \quad (2)$$

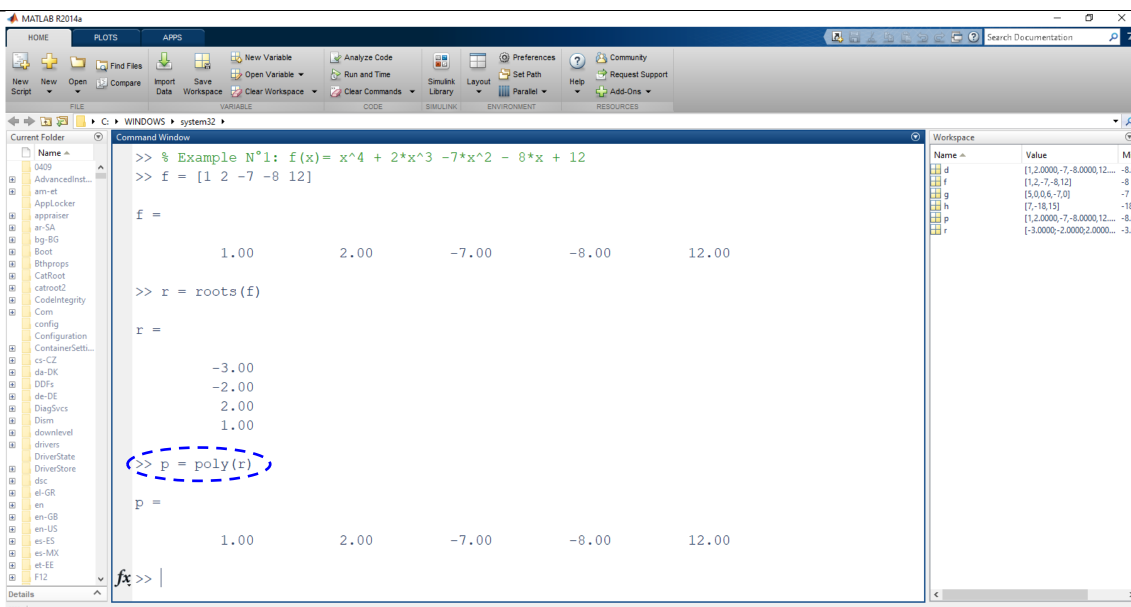

Fig 3. An example in MATLAB of the obtain polynomials from roots

4.Evaluation of polynomials

To evaluate the polynomial $f(x)$ at a given point, one must use the *polyval(,)* function/command.

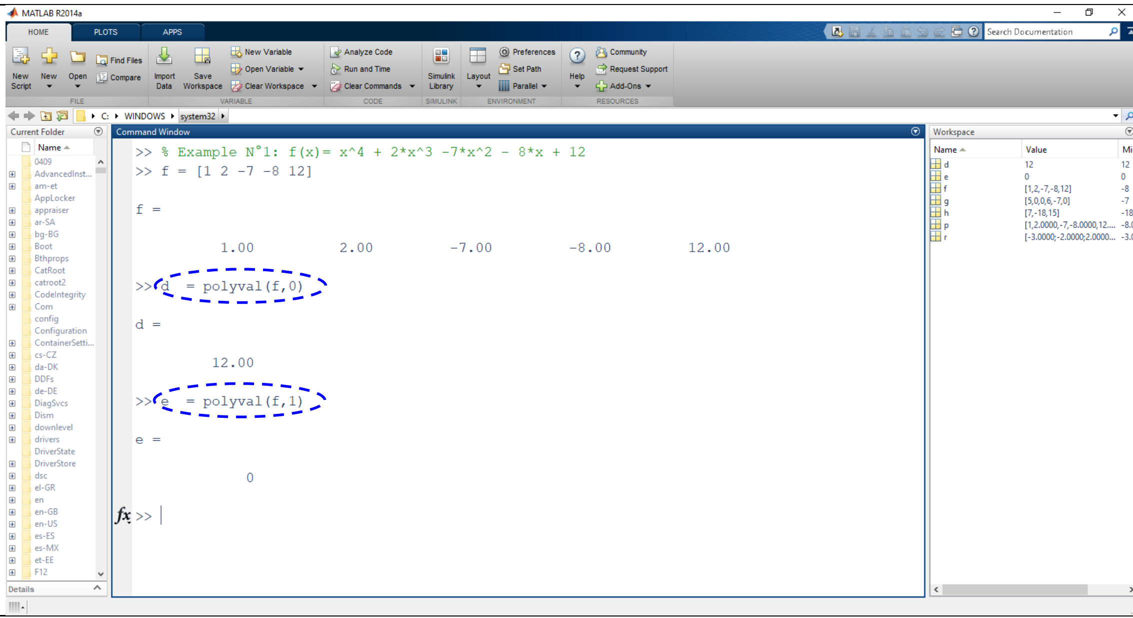

Fig 4. An example in MATLAB of the compute polynomial at a given point

5.Operation with polynomials (Polynomials operations in MATLAB)

5.1.Multiplication of polynomials

The classical multiplication of polynomials is performed by convolution of arrays of coefficients, either with the function *conv(,)*

$$h(x) = f(x) \times g(x) \quad (3)$$

Note. The polynomials can be different in the addition and difference polynomials operation.

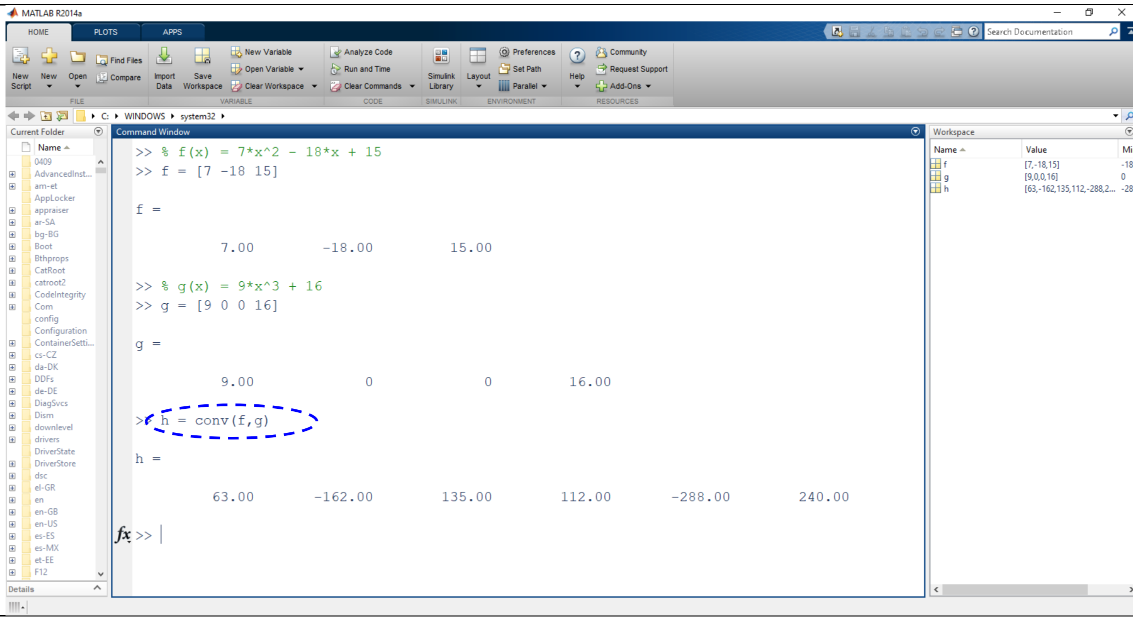

Fig 5. An example of the polynomial's multiplication in MATLAB

5.2.Division of polynomials

The function *deconv(,)* gives the convolution ratio of two polynomials (deconvolution of the coefficient of the polynomial).

The following example shows the use of this function/command :

$$\begin{cases} d(x) = h(x) \div f(x) \\ e(x) = h(x) \div g(x) \end{cases} \quad (4)$$

Note. Assuming the result of multiplication of two polynomials $f(x)$ and $g(x)$ is $h(x)$; so the division of $h(x)$ with $f(x)$ will give the polynomial $g(x)$; and similarly the division $h(x)$ with $g(x)$ will give the polynomial $f(x)$ of result of the multiplication.

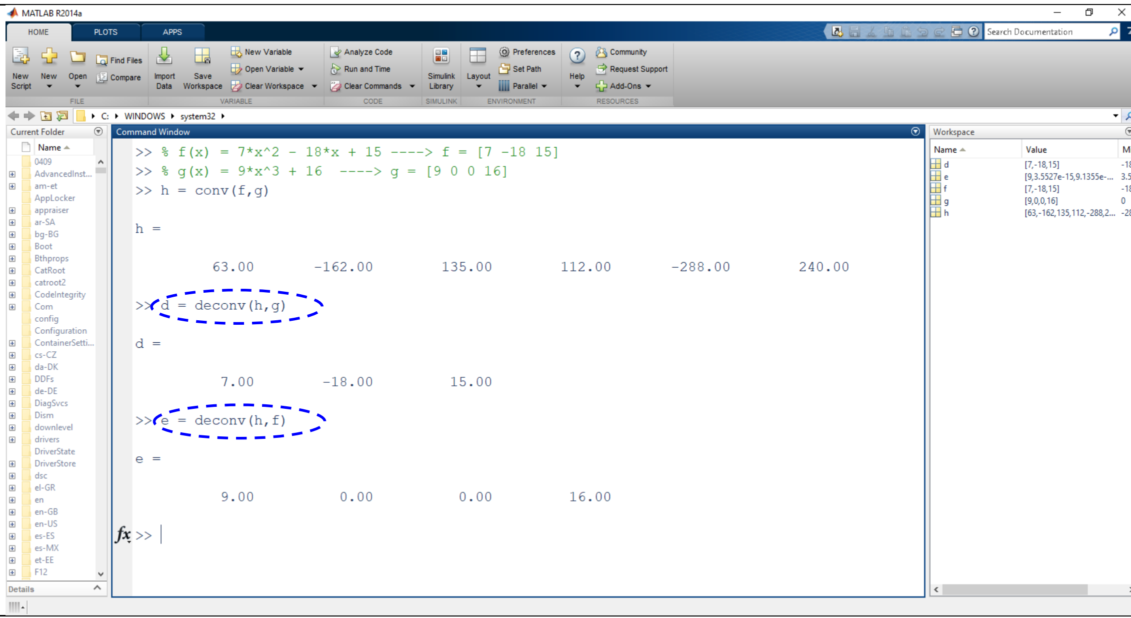

Fig 6. Compute the division of the polynomials in MATLAB

5.3. Addition of polynomials

To add two polynomials, simply add their coefficient. Vectors must have the same size or dimensions.

$$a(x) = f(x) + g(x) \quad (5)$$

Note. If one shorter than other, must add zero in front (at begin) to make them same size.

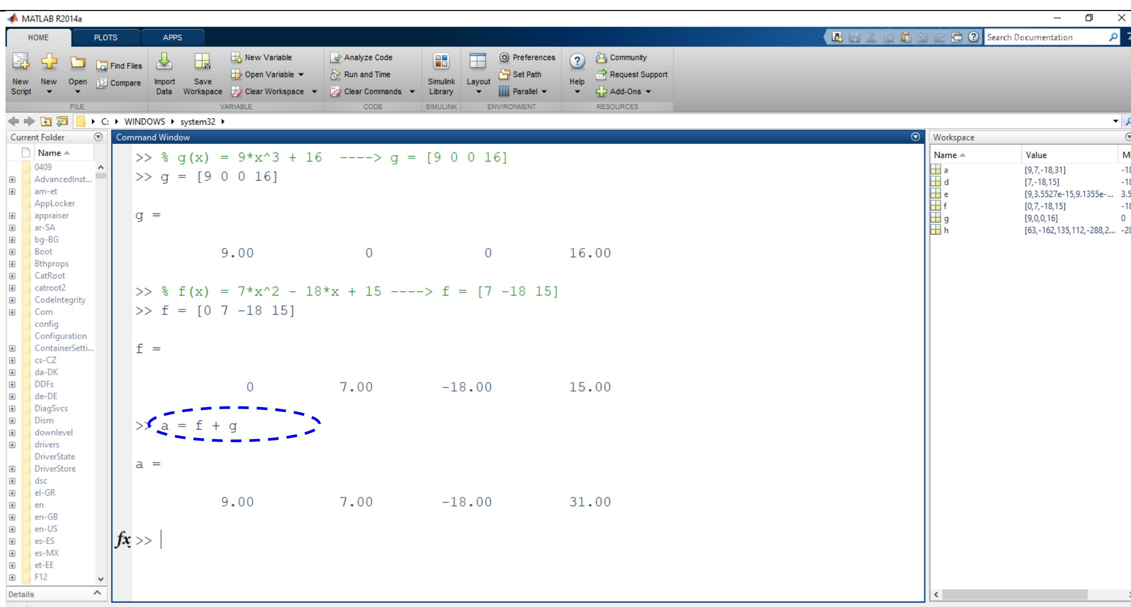

Fig 7. Calculate the addition of the given polynomials

5.4.Subtraction of polynomials

To subtract two polynomials, simply and their coefficient. Vectors must have the same size or dimension.

$s(x) = f(x) - g(x)$	(6)

Note. It one shorter than other, must add zero in front (at begin) to make them same size.

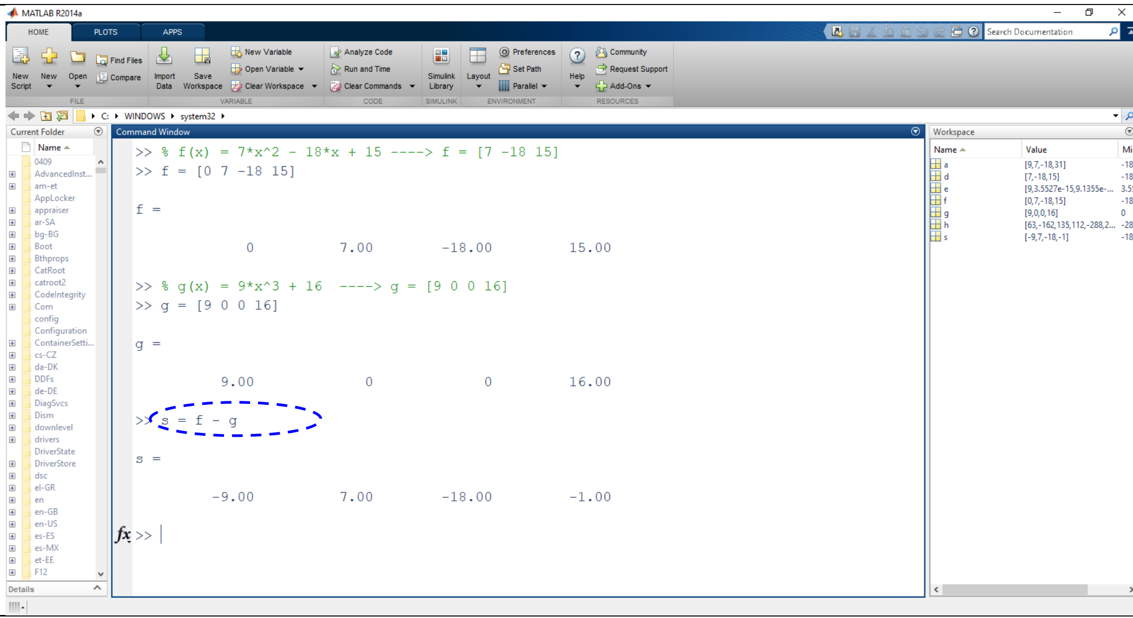

Fig 8. Calculate the difference of the polynomials

5.5.Derivative of polynomials

Using the *polyder(.)* function/command allows you to compute or find or evaluate the derivative. The following example shows the use of this function :

$d(x) = f(x)'$	(7)

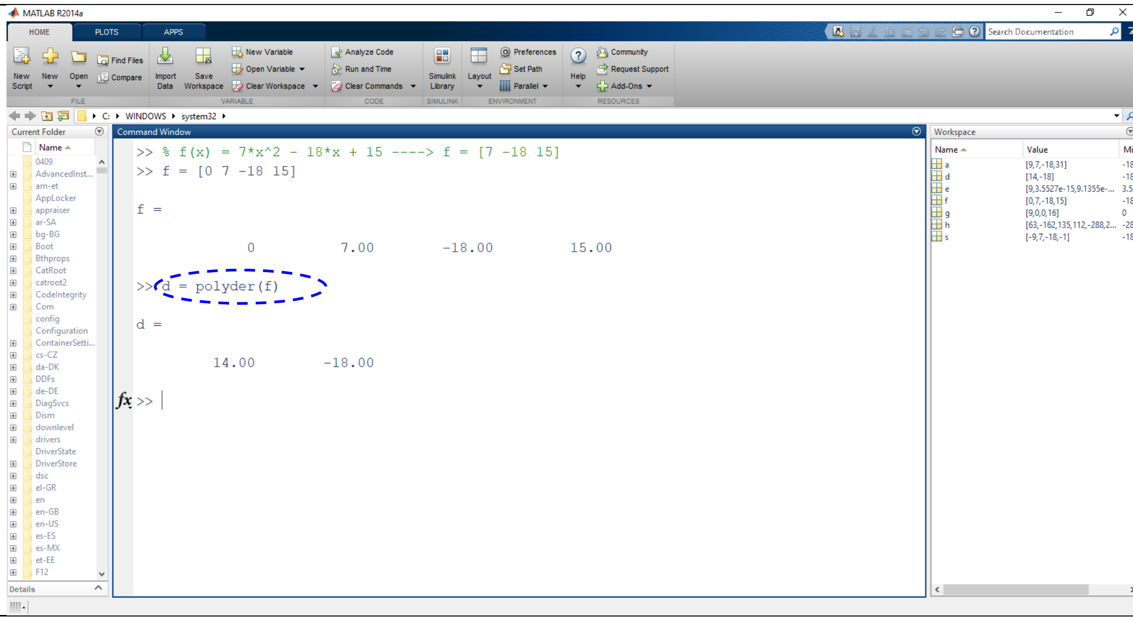

Fig 9. Compute the derivative of the given polynomials

5.6. Integration of polynomials

Using the *polyint(.)* function/command allows you to compute the integration; The following example shows the use of this function :

$$n(x) = \int f(x)dx \quad (8)$$

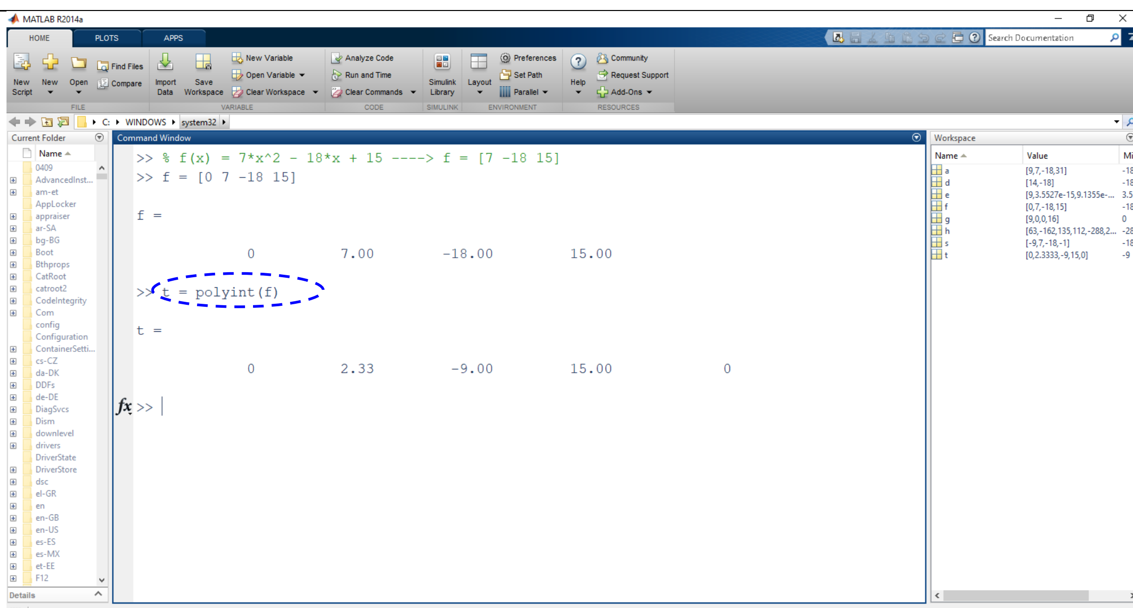

Fig 10. Compute the integration of the given polynomials

7.List of References

Kattan, Peter Issa. Matlab for Beginners: A gentle approach. Petra books, 2008.

Etter, Delores M., David C. Kuncicky, and Douglas W. Hull. Introduction to MATLAB. Vol.4. Hoboken, NJ, USA: Prentice Hall, 2002.

Attaway, Stormy. Matlab: a practical introduction to programming and problem solving. Butterworth-Heinemann, 2013.

Driscoll, Tobin A. Learning Matlab. Society for Industrial and Applied Mathematics, 2009.

Butt, Rizwan. Introduction to numerical analysis using MATLAB. Laxmi Publications, Ltd.,2008.

Sigmon, Kermit. Matlab: aide-mémoire. Springer Science & Business Media, 1999.

Chapman, Stephen J. Essentials of MATLAB programming. Cengage Learning, 2016.