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## 14. Interlude: Polynomials and Geometric

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Homework0 due Feb 8, 2023 08:59 -03 Completed

## Quadratic Polynomials

1/1 point (graded)

Recall a **degree  $n$**  polynomial in  $x_1, x_2, \dots, x_k$  is a linear combination of monomials in the highest of degrees of the monomials with non-zero coefficients is  $n$ .

(Recall **monomials** in  $x_1, x_2, \dots, x_k$  are **unordered words** using  $x_1, x_2, \dots, x_k$  as the letters. The degree of a monomial is its length (or power), e.g. the monomial  $x_1 x_2 x_3^2 := x_1 x_2 x_3 x_3$  has degree 4.)

### Examples:

1. A degree 2, also known as quadratic, polynomial in the 1 variable  $x$  is of the form

$$ax^2 + bx + c$$



for some numbers  $a, b, c$ . The polynomial is determined by the 3 coefficients  $a, b, c$ . Different choices of  $(a, b, c)$  result in different polynomials.

In linear algebraic terms, the space of degree 2 polynomials in 1 variable is of dimension 3. It consists of all linear combinations of 3 linearly independent vectors  $x^2, x$ , and 1.



2. A degree 2 polynomial in 2 variables  $x_1, x_2$  is of the form

$$ax_1^2 + bx_2^2 + cx_1x_2 + dx_1 + ex_2 + f$$

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for some numbers  $a, b, c, d, e, f$ . Different choices of  $(a, b, c, d, e, f)$  result in different polynomials.

In linear algebraic terms, the space of degree 2 polynomials in 2 variables is of dimension 6. It consists of all linear combinations of 6 linearly independent vectors  $x_1^2, x_2^2, x_1x_2, x_1, x_2$ , and 1.

## Legal

Consider degree 2 polynomials in 3 variables  $x_1, x_2, x_3$ . How many coefficients are needed to determine such a polynomial? Equivalently, what is the dimension of the space of polynomials of degree 2 in 3 variables?

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Number of coefficients needed/ Dimension:

10



What is dimension of the polynomials of degree  $N$  in  $K$  variables? (This part of the question has no answer box for it.)

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You have used 2 of 2 attempts



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