



Universität zu Köln
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Convex Optimization

Winter Term 2018/19

— Exercise Sheet 5 —

Exercise 5.1. Show: $\dim \mathbb{R}[x_1, \dots, x_n]_d = \binom{n+d}{d}$.

Exercise 5.2. Show: $\Sigma_{1,d} = \mathcal{P}_{1,d}$.

Hint: Recall the fundamental theorem of algebra.

Exercise 5.3. (Hand-in) Is the polynomial $f(x_1, x_2, x_3)$ a SOS, where

$$f(x_1, x_2, x_3) = x_1^6 + x_2^6 + 16x_3^6 + x_1^4x_2^2 + x_1^2x_3^4 - 2x_1^3x_2^3 + 2x_1^3x_2x_3^2 - 8x_1^3x_3^3 + 8x_2^3x_3^3 ?$$

Exercise 5.4. (Hand-in) Use an SDP solver to find the minimum of the polynomial

$$p(x) = 8x^8 - 40x^7 - 38x^6 + 296x^5 + 210x^4 - 901x^3 - 488x^2 + 1113x + 792$$

and prove that it is the global minimum.

Hand-in: Until Wednesday November 14, 12:00 (noon).

Exercises 5.3 and 5.4 to be submitted to the “Convex optimization” mailbox in room 3.01 (Studierendenarbeitsraum) of the Mathematical Institute.