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Methods and problems in discrete mathematics

Wintersemester 2019/20

— Exercise Sheet 1 —

Exercise 1.1 Write the inverse power law $f(r) = 1/r^s$, for $s > 0$, as a nonnegative combination of functions $r \mapsto (4 - r)^k$, with $k = 0, 1, 2, \dots$

Exercise 1.2 Apply the spherical design strength test to

- (a) the vertices of the regular N -gon in the plane,
- (b) the vertices of the regular simplex in n dimensions,
- (c) the vertices of the regular cross polytope in n dimensions,
- (d) the E_8 roots.

Exercise 1.3 Compute the linear programming bound numerically for the following parameters and potential functions f :

- (a) $n = 3, N = 20, f(r) = 1/r^{1/2}$,
- (b) $n = 10, N = 40, f(r) = (4 - r)^k, k = 0, 1, 2, \dots, 10$.

Software suggestion: <https://www.sagemath.org/>

Exercise 1.4 Discuss how the linear programming bound can be generalized to the case of unequally charged particles.

“**Hand-in**”: Until Thursday October 17, 10 am, using the form on the course homepage.