Exercise set 3 Algorithms and Complexity 2019 **Due 28 Oct 2019**

You may collaborate and submit answers in groups of at most three. Good solutions are complete and concise. Please mail to j.nederlof@tue.nl or hand in a hardcopy on the day of the deadline.

5. Solve 100-CNF-Sat in $O^*((2-\epsilon)^n)$ time for some $\epsilon > 0$, where n is the number of variables.

6. Give an $O^*(k^{4k})$-time algorithm that takes as input n points in the plane $\mathbb{R}^2$ and integer k, and determines whether there exist k straight lines such that every point is on some line.[1]

7. A *triangle* of a graph $G = (V, E)$ is a triple $u, v, w \in V$ such that $\{u, v\}, \{v, w\}, \{u, w\} \in E$. A triangle partition is a partition of V into triangles, e.g., a set of triangles $T_1, \ldots, T_{n/3}$ such that $T_i \cap T_j = \emptyset$ for $i \neq j$ and $\cup_{i=1}^{n/3} T_i = V$. Give an algorithm that determines whether there is a triangle partition of a graph on n vertices in $O^*(2^n)$ time using polynomial space.
   Note: If your algorithm uses exponential space, you still get 90% of the points.

[1] Hint: *(i)* look at $k+1$ points that are on one line to find a reduction rule. *(ii)* conclude something if n is too large when compared with k^2 and your reduction rule does not apply. *(iii)* design an $O^*(n^{2k})$ time algorithm.