

**Complexity Theory: SV 2/3.**  
MORE ON NP-COMPLETENESS, CO-NP

## 1 Instructions

- **Please submit your work at most 48 hours before your supervision to my cam email.**
- I'd appreciate it if you could typeset your work, but I'll accept legible scans of handwriting.
- Please make it clear which question you're writing a solution to, by referring to the numbering scheme of this sheet.
- I don't expect you to spend more than 3–4 hours of focussed work on each supervision's worth of work.
- The questions are not ordered by difficulty. If you're stuck on a question, feel free to ask me for a hint or wait till the supervision to discuss.
- Please never paste in answers that you don't understand – that defeats the purpose. It's not an issue if you leave an answer empty when you couldn't solve a problem.

## 2 Short questions

1. Is the relation  $\leq_P$  reflexive, transitive, and symmetric? Is it antisymmetric?
2. Explain why P is closed under taking complements.
3. Explain why your reasoning from above does not extend to NP.
4. Explain why it follows that  $P \subseteq NP \cap \text{co-NP}$ .
5. If NP would turn out to be closed under taking complements, what set relation would hold between NP and  $NP \cap \text{co-NP}$ ?
6. Is list sorting in co-NP?

*(Links to exercises and tripos problems are clickable btw!)*