Linear & Nonlinear Programming

Homework Set 2

DUE: 6:00 pm, Oct 10, 2018

1. Prove $3SAT \leq_m^P VC$.

   Hint: You should describe what $3SAT$ and VC are, construct a VC problem from a 3-CNF formula F, and show the equivalence and the polynomial time reducibility.

2. P384, Exercise 7.5, Problem 1 (b)(c).

3. P35, Exercise 1.9, 1.11, 1.13, 1.16.

Reading Assignment:

- **Section 7.5:** Understand the definition and proof of the NP-completeness for a search problem. Read materials from P370 to P373.
- **Chapter 1:** Understand LP problems' formulation, reduction to the standard form, and graphical presentation/solution. Read materials in Section 1.1-1.6.
- **Chapter 2:** Read materials in Section 2.1-2.6, 2.9. You are not required to complete before the next lecture, while please read as much as you can.

Project(Optional):

1. Read [3, Theorem 3] (available in our Wechat group). Follow the proof for (1) and figure out why a direct corollary for (2) may not hold.

2. [2] points out that [1] did NOT excluded the possibility of the existence of polynomial time algorithms with small approximation error.

   Read [2, Theorem 2] and follow the proof in the supplementary material (available in our Wechat group). Propose an theorem for the Strong NP-hardness to find an ε-optimal solution of problems discussed in [1] (as a special case) and prove it.

References

[1] Xiaojun Chen, Dongdong Ge, Zizhuo Wang, and Yinyu Ye. Complexity of unconstrained $l\_2 - l\_p$ minimization. *Mathematical Programming*, 143(1-2):371–383, 2014.

[2] Yichen Chen, Dongdong Ge, Mengdi Wang, Zizhuo Wang, Yinyu Ye, and Hao Yin. Strong np-hardness for sparse optimization with concave penalty functions. *arXiv preprint arXiv:1501.00622*, 2015.

[3] Dongdong Ge, Xiaoye Jiang, and Yinyu Ye. A note on the complexity of lp minimization. *Mathematical programming*, 129(2):285–299, 2011.