PROF. DR. SEBASTIAN SAGER, BENJAMIN PETERS
INSTITUT FÜR OPTIMIERUNG
OTTO-VON-GUERICKE–UNIVERSITÄT MAGDEBURG

October 29, 2020

Webpage for the lecture: `https://mathopt.de/TEACHING/2020OMML/`

Optimization Methods for Machine Learning

WS 2020 – 1. exercise sheet

Exercise 1.1 (Installation of scikit-learn)
Goals: *Get scikit-learn running on your own notebook.*

1. Visit the page `http://scikit-learn.org/stable/install.html` and look for the requirements of scikit-learn
2. **Linux (tested on 64bit Ubuntu 16.04 and 18.04)**:
   - check your *python* version: `python3 -V` (`python -V`)
   - update/install *numpy, scipy*: `sudo apt-get install python3-numpy python3-scipy` (`python-...`)
   - check *pip*: `pip3 -V` (`pip -V`),
     if necessary install it: `sudo apt-get install pyton3-pip (python-pip)`
   - install *scikit-learn*: `sudo pip3 install sklearn` (`pip`)
3. **Mac**:
   - similar to Linux, but use *homebrew* (or *macports*) instead of *apt-get* to install *pip*
   - use pip to install *numpy, scipy* and *sklearn* (same as in Linux):
4. **Windows (tested on Windows 10)**:
   - use Third-party Distributions like *Anaconda* (or *Canopy*)
   - run install-executable as administrator and install for every user on your system (install in *Program files*)
   - (recommended: install the provided *VS Code* as editor)
5. **Anaconda is also available for Linux and Mac.**

Exercise 1.2
Let $\{(x_i, y_i)\}_{i\in[n]} \subseteq \mathbb{R}^d \times \{-1, 1\}$, $\lambda > 0$ and

$$Feas := \left\{(w, \tau, z) \in \mathbb{R}^d \times \mathbb{R} \times \mathbb{R}^n_+ : \frac{\mathbb{1}^T z}{n} + \frac{\lambda}{2} w^T w \leq 1,\ y_i(w^T x_i - \tau) + z_i \geq 1,\ i \in [n]\right\}$$

Prove the following: If there exist $i \in [n]$ with $y_i = 1$ and $j \in [n]$ with $y_j = -1$ then $Feas$ is a nonempty and compact set.

Exercise 1.3
Let $x \in \mathbb{R}^d$. Write

$$\min_{w\in\mathbb{R}^d, \tau\in\mathbb{R}} \max(0, 1 - (w^T x - \tau)).$$

as a linear optimization problem.

Probably discussed on: Thursday, 29.10.2020