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Information for rookies of the ***Network and Machine Intelligence (NaMI) Lab***

1. Programming languages: Python, Matlab, C++

2. Writing a research paper: learn to use **LaTex** which is available at **http://www.ctex.org/CTeXDownload** or just use an online latex *Overleaf*

3. Math basis: convex optimization

- Learn at least the first five chapter of the following CVX book: (The basic task of the first semester)

  [1] S. Boyd and L. Vandenberghe, ***Convex Optimization***. Cambridge, U.K.: Cambridge Univ. Press, 2004. http://stanford.edu/~boyd/books.html

  - chapter 1: intro
  - chapter 2: sec. 2.1-2.3
  - chapter 3: sec. 3.1-3.2
  - chapter 4: sec. 4.1-4.4
  - chapter 5: sec. 5.1, 5.2, 5.5
  - chapter 9: sec. 9.1-9.5
  - *chapter 10: sec. 10.1-10.2 (optional)*

The corresponding lecture slides is available at http://stanford.edu/class/ee364a/lectures.html.

For communication guys, you **MUST** learn to use ***cvx***, a toolbox for convex optimization, available at http://stanford.edu/~boyd/software.html

- (Optional) Learn nonlinear programming, available at http://web.mit.edu/6.252/www/LectureNotes/
- some basic optimization methods （*learn at least first five methods*）

  - **Bisection method**

Algorithm 4.1 on page 145-146 of cvx book above

  - **Gradient method & Newton method**

[1] Chapter 9.1-9.5 of cvx book above

[2] L. Bottou, *Large-scale machine learning with stochastic gradient descent*, available at https://leon.bottou.org/publications/pdf/compstat-2010.pdf

  - **Block coordinate descent (BCD) method**

[1] S. J. Wright, "Coordinate descent algorithms," *Math. Program., Ser. B*, vol. 151, pp. 3-34, 2015.

[2] D. Bertsekas, *Nonlinear Programming*, 2nd ed. Belmont, MA: Athena Scientific, 1999, chapter 2.7.

  - **BSUM method and MM method**

[1] Y. Sun, P. Babu, and D. Palomar, "Majorization-minimization algorithms in signal processing, communications, and machine learning,"*IEEE Signal Process.*., vol. 33, no. 1, pp. 57–77, 2016.

[2] M. Razaviyayn, M. Hong, and Z.-Q. Luo, "A unified convergence analysis of block successive minimization methods for nonsmooth optimization," *SIAM Journal on Optimization*, vol. 23, no. 2, pp. 1126–1153, 2013

[3] M. Hong, M. Razaviyan, Z.-Q. Luo, and J. S. Pang, "A unified algorithmic framework for block-structured optimization involving big data,"*IEEE Signal Process. Mag.*, vol. 33, no. 1, pp. 57–77, 2016.

- **Alternating direction method of multipliers (ADMM)**

[1]S. Boyd, N. Parikh, E. Chu, et. al. Distributed optimization and statistical learning via the alternating direction method of multiplier, available online

at: http://web.stanford.edu/~boyd/papers/pdf/admm_distr_stats.pdf

[2] W. C. Liao, M. Hong, H. Farmanbar, X. Li, Z. Q. Luo, and H. Zhang, Min flow rate maximization for software defined radio access networks,"

IEEE Journal on Selected Areas in Communications, vol. 32, no. 6, pp. 1282–1294, June 2014.

[3] C. Shen, T. H. Chang, K. Y. Wang, Z. Qiu, and C. Y. Chi, "Distributed robust multicell coordinated beamforming with imperfect csi: An admm

approach," *IEEE Transactions on Signal Processing*, vol. 60, no. 6, pp. 2988–3003, June 2012.

- **concave-convex procedure**

[1] A. L. Yuille and A. Rangarajan, "The concave-convex procedure,"*Neural Comput.*, vol. 15, no. 4, pp. 915–936, Apr. 2003.

[2] G. R. Lanckriet and B. K. Sriperumbudur, "On the convergence of the concave-convex procedure," in *Advances in Neural Information Processing Systems*. Curran Associates, Inc., 2009, pp. 1759–1767.

- **primal-dual decomposition method**

[1] http://stanford.edu/class/ee364b/lectures/decomposition_slides.pdf

[2] https://see.stanford.edu/materials/lsocoee364b/08-decomposition_notes.pdf

[3] D. Parlomar and M. Chiang, "A tutorial o decomposition methods for network utility maximization," *IEEE journal on selected areas in communications, vol. 24, no. 8, Aug. 2006.*

- **semidefinite relaxation (SDR) method**

[1]Z.-Q. Luo, W.-K. Ma, A. M.-C. So, Y. Ye, and S. Zhang, "Semidefinite relaxation of quadratic optimization problems," *IEEE Signal Processing Mag.*, vol. 27, pp. 20–34, May 2010.

[2]Y. Huang and D. P. Palomar, "Rank-constrained separable semidefinite programming with applications to optimal beamforming," *IEEE Trans. Signal Process.*, vol. 58, no. 2, pp. 664–678, Feb. 2010.

4. Math basis: Matrix analysis

- Learn the following matrix book

  [1] C. D. Meyer, Matrix Analysis and Applied Linear Algebra. Cambridge, U.K.: SIAM, 2000.

  - chapter 3
  - chapter 4
  - chapter 5
  - chapter 6
  - chapter 7: sec. 7.1-7.3, 7.6
  - chapter 8: sec. 8.1-8.3 (must), 8.4 (*optional*)

  [2] **Matrix Cookbook (葵花宝典)**, available

at http://www2.imm.dtu.dk/pubdb/views/edoc_download.php/3274/pdf/imm3274.pdf