# Computational Inverse Problems

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**Timetable:** 16 hrs. (2 two-hours lectures per week): Classes on Tuesday and Thursday, 10:30 - 12:30. First lecture on Tuesday February 25th, 2014. Room DEI/G, 3-rd floor, Dept. of Information Engineering, via Gradenigo Building.

**Course requirements**:

1. basic notions of linear algebra and, possibly, numerical linear algebra.
2. the examples and homework will be in Python (the transition from Matlab to Python is effortless).

**Examination and grading:** Homework assignments and final test.

**Aim:** We study numerical methods that are of fundamental importance in computational inverse problems. Real application examples will be given for distributed parameter systems. Computer implementation performance issues will be considered also.

**Course contents**:

1. definition of inverse problems, basic examples and numerical difficulties.
2. numerical methods for QR and SVD and their application to the square-root implementation in PCA, least-squares, model reduction and Kalman filtering; recursive least-squares;
3. regularization methods;
4. numerical algorithms for nonlinear parameter estimation: Gauss-Newton, Levenberg-Marquardt, back-propagation (neural networks), adjoint model (VDA);
5. examples with distributed parameter systems;
6. HPC implementations and parallel implementations on GPUs;

**References:**

[1] F.Marcuzzi ”Analisi dei dati mediante modelli matematici”, http://www.math.unipd.it/ marcuzzi/MNAD.html
[2] CUDA programming guide, http://docs.nvidia.com/cuda/index.html