Data Science and Scientific Computing
Track Core Course 2016/17

Skill Checklist

You should have heard about (most of) these concepts before, even if you don't remember all details at this moment. By the beginning of the course (27/02/2016), you should be able to work with these and answer (most of) the mock exam without having to consult an external source (too much).

Linear Algebra

- vectors in arbitrary dimension
- matrix-matrix/matrix-vector multiplication:
- inner product of vectors, orthogonality
- hyperplanes in $\mathbb{R}^n$ (lines in $\mathbb{R}^2$), distance of a vector to a line/hyperplane
- norms of vectors, triangular inequality
- orthonormal bases, rotations between bases
- properties of matrices: invertible, symmetric, positive definite, orthogonal
- determinant of a matrix, trace of a matrix
- eigenvalues, eigenvectors
- matrix decompositions (e.g. Cholesky decomposition, singular value decomposition)
- matrix exponentiation

Calculus

- derivatives/gradients of functions
- the very basics of differential equations (e.g. finding a solution to dx/dt = ax)
- Fourier transform (not deep theorems, just familiarity with what is an "integral transform" is)
- using derivatives to find the minimum/maximum of a functions
- nice to have: Lagrangian multipliers

Probability

- basic concepts: probability distributions, random variable, sample from a distribution

- probability density function, cumulative density function

- joint distribution, marginal distribution, conditional distribution

- independence/dependence of random variables

- mean, median, mode, standard deviation, covariance, correlation, moments

- rules of probability theory: marginalization, Bayes rule

- some useful distributions: Bernoulli, uniform, (multivariate) Gaussian, Poisson, Exponential, Beta, Gamma

Programming

- being able to read C, Matlab and/or Python programs

- procedural programming in a language of your choice (that can do the things below)

- basic procedural constructs: loops, conditions/branching, subroutines, recursion

- reading and writing text files from disk

- calling numeric libraries if not built-in: matrix operations, FFT

- (pseudo-)random number generation

- making plots from data (Excel is not recommended, but would suffice if nothing else)

Numerics

- approximating a derivative by a finite difference

- approximating an integral by a sum