

Exam topics (2016)

Statistics and Information Theory

1. Entropy, relative entropy, mutual information, log-sum inequality (Ch1 + addendum).
2. Continuous case, differential entropy, continuous version of the log-sum inequality, optimality of the Gaussian distribution (Ch7, p.495-497).
3. Coding and entropy: prefix codes, Kraft inequality, noiseless coding theorem (Ch1 + addendum).
4. Types, cardinality of type-classes, Lemma 2.1, 2.2, 2.3 (Ch2, p.429-431, 431-437 + addendum).
5. Sanov's theorem, Stein's lemma (Ch2, p.431-437).
6. I-projections, linear and exponential family (Ch3, p.440-444).
7. f-divergence, Theorems 4.1, 4.2 (Ch 4, p.447-453).
8. Contingency tables, log-linear and graphical models (Ch 4, p.454-458 + addendum).
9. ML estimation in exponential family and the EM algorithm (Ch 5.3, p.471-473 + addendum).
10. EM algorithm for decomposition of (Gaussian, multinomial, graph) mixtures (addendum).
11. Universal coding, redundancy, Theorem 6.1 (Ch 6, p.474-478).
12. Maximal redundancy, Theorem 6.2, and arithmetic codes for i.i.d. processes (Ch 6, p.479-482).
13. Average redundancy and channel capacity, Theorem 7.1, 7.2, 7.3 (Ch7, p.490-495).
14. Near optimal coding and redundancy bounds, Theorem 7.5 (Ch7, p.497-501), also read the Appendix for process concepts and the Example on page 499 (the Dirichlet prior gives the arithmetic code with $\alpha_i = \frac{1}{2}$, $i = 1, \dots, k$).
15. Ergodic processes, divergence rate (Ch 8, p.504-507), Lemma 8.1.
The MDL principle (Ch8.2, p.510-512), Theorem 8.3.