Information Theory, Pattern Recognition and Neural Networks

Handout 3 March 8, 2007

1 Course summary: central chapters

Data compression and noisy channel coding (Chapters 1–6, 8–10, 14). (But omitting section 6.4 and 10.4–10.8)
Inference and data modelling. (Chapters 3, (20), 21, and 22; also the Taylor expansion of chapter 27 (p. 341)). (20 wasn't covered, but may be helpful reading.)

2 Exercises that have been recommended

1: Invent a code. 1.3 (p.8), 1.5-7 (p.13), **1.9**, & 1.11 (p.14).
2–3: Invent a compressor. **ex 5.29** (p. 103), 5.22, 5.27, 5.31, 6.3, 6.7, 6.17.
then if you need more practice, 5.26, 5.28, 6.15, 15.3 (p. 233).
Also recommended: 2.25, 2.26, 2.28.
4: Invent a channel. 9.17 (p. 155) 10.12 (172) 15.12 (235); then if you need more practice, 15.11, 15.13, 15.15.
5–6: See 'spy' question on handout 2.
Examples 22.1-4 (p. 300) and exercise 22.8.
Ex 3.10 (p57) (children); 8.10, black and white cards; 9.19 TWOS; 9.20, birthday problem; 15.5, 15.6, (233) magic trick; 8.3 (140), 8.7; 22.11 sailor.
Ex 22.5.

3 What's on the exam

Data compression. Evaluating entropy, conditional entropy, mutual information. Symbol codes. Huffman algorithm. 'How well would arithmetic coding do?'

Noisy channels. Evaluating conditional entropy, mutual information. Definition of capacity. Evaluating capacity. Finding optimal input distributions. Inference of input given output. Connection to reliable communication.

Inference problems. Inferring parameters. Comparing two hypotheses. Sketching posterior distributions. Finding error bars.

4 Past exam questions

The following exercises from the book were exam questions, and are relevant to the 2007 course. The **bold** questions are especially recommended (and were all recommended exercises already).

Source coding	Noisy channels	Inference
5.27 ++	10.12	**22.5**
5.28	15.11	**22.8** ++
5.29	15.12	27.1
6.9	15.13	
6.15	**15.15** ++	
6.17		
6.18		
15.3 ++		

The 2006 exam is available from `http://www.inference.phy.cam.ac.uk/itprnn/MINOR2006.pdf`.
I intend to put some more old exam questions and worked solutions on the course website shortly.