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October 12, 2018

Mathematics and Information, Exercise sheet 6

Problem 1: (*8 points*)
Based on a letter count of Oscar Wilde's *Importance of being Earnest,* the frequencies of letters in english plain text are as follows:

E	A	T	O	N	I	R	S	L	H	D	U	Y
.1182	.0833	.0803	.0771	.0740	.0708	.0609	.0578	.0508	.0452	.0340	.0332	.0327

C	M	G	W	F	B	P	K	V	J	X	Q	Z
.0314	.0285	.0221	.0203	.0180	.0169	.0150	.0120	.0102	.00395	.00185	.00131	.000123

Construct a binary Huffman code for this alphabet!

Problem 2: (*5 points*)
Let A be an alphabet consisting of n letters occuring with equal probability, Compute the average length of a binary Huffman code for

a) $n = 3$ *b)* $n = 24$ *c)* $n = 2^k - 1$ for $k \geq 2$

Problem 3: (*2 points*)
Transmitting a message usually involves three coding steps:
- *Source coding* in order to adapt the message to the medium and possibly also compressing ist
- *Channel coding* uses error correcting codes to safeguard against transmission errors
- *Cryptographic codes* safe against intelligent adversaries.

In which order should those three steps be applied for best results?

Problem 4: (*5 points*)
Let X, Y be random variables with values in a subset of $\mathbb{R}$. Both X and Y have expectation μ and variance σ^2; their correlation is ρ. Find unit vectors $\binom{a_1}{a_2}$ and $\binom{b_1}{b_2}$ such that the random variables $U = a_1 X + a_2 Y$ and $V = b_1 X + b_2 Y$ are uncorrelated, und determine expectation and variance of U and V!

Can be submittel till Thursday, October 18, 2018 at 11.55h