Writing on the Facade of RWTH ICT Cubes

Georg Böcherer
Institute for Communications Engineering, TU Munich
georg.boecherer@tum.de

M. Malsbender
kaddawittfeldarchitektur

F. Altenbach, R. Mathar
Institute for Theoretical Informationtechnology
RWTH Aachen University

April 4, 2012
Chair of Architectural Informatics, TU Munich

RWTH Information and Communication Technology Cubes

Slats

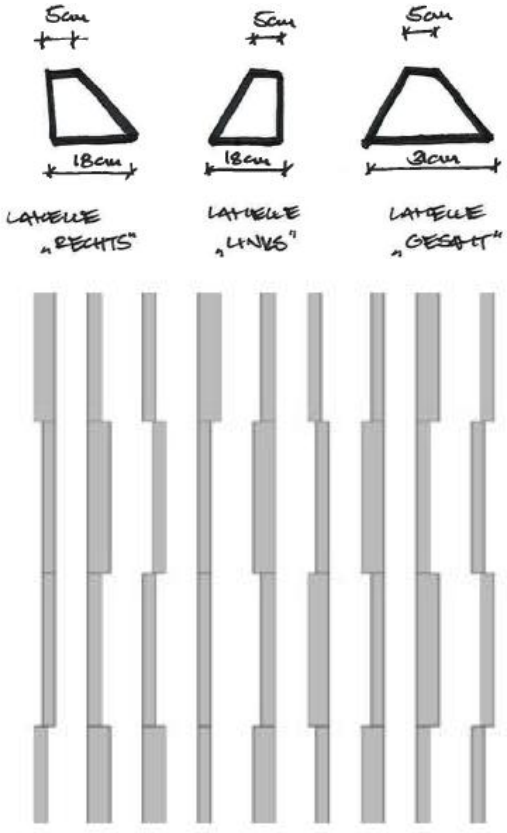
Three types of slats: left, right, middle

Purpose:

- Make stacked floors appear as a cube
- Keep building from heating up in the sun

Side effect:

- Slats shadow the rooms



Design constraints

- Sequence of slats should look random
- Balance between cooling and shadowing:
  40% left, 40% right, 20% middle

Idea: Write a text to the facade

Challenge:

- Find a code that maps a text to a sequence of slats
- The generated slat sequence should respect the design constraints

Tool 1: Data compression

- Compressing (zip,rar,...) data generates a binary sequence that resembles the output of flipping a coin

Tool 2: Distribution matching

- Distribution matching maps the output of flipping a coin to a sequence that resembles the output of a desired source.[1]

[1] G. Böcherer, "Capacity-achieving probabilistic shaping for noisy and noiseless channels," Ph.D. dissertation, RWTH Aachen University, 2012.

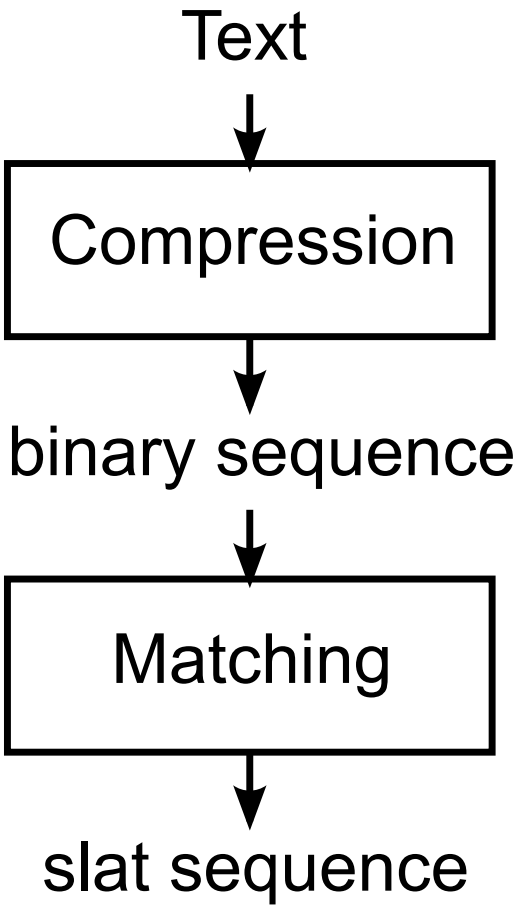
Tool 3: Law of large numbers

Think of a source that generates slats with the probabilities

$$\Pr(\text{left}) = \Pr(\text{right}) = 0.4, \qquad \Pr(\text{middle}) = 0.2$$

For a long sequence of slats generated by this source, the empirical distribution is close to 40% left, 40% right, 20% middle.

Approach



Text: Quotes from researchers

shannon the fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point **plato** let no one ignorant of mathematics enter here **schottky** space permits only an approximate statement of the theory **nyquist** when the output of an amplifier is connected to the input through a transducer the resulting combination may be either stable or unstable **hamming** it is better to do the right problem the wrong way than the wrong problem the right way **turing** machines take me by surprise with great frequency **fourier** the profound study of nature is the most fertile source of mathematical discoveries **wiener** there are no answers only cross references **gallager** good communication is central to a civilized society **knuth** beware of bugs in the above code i have only proved it correct not tried it **mackay** combine a simple pseudo random code with a message passing decoder **bell** you cannot force ideas successful ideas are the result of slow growth **kolmogorov** the human brain is incapable of creating anything which is really complex **gauss** when i have clarified and exhausted a subject then i turn away from it in order to go into darkness again **zuse** it is not true that virtually all news in a totalitarian state is false **marconi** every day sees humanity more victorious in the struggle with space and time **bernoulli** it would be better for the true physics if there were no mathema

Compression code[2]

_ : 000	a : 0111	b : 101110
c : 11110	d : 00110	e : 110
f : 10000	g : 010100	h : 11111
i : 0110	j : 00111000100	k : 00111001
l : 10110	m : 01011	n : 1001
o : 1010	p : 001111	q : 00111000101
r : 0010	s : 0100	t : 1110
u : 10001	v : 0011101	w : 101111
x : 001110000	y : 010101	z : 0011100011

[2]F. Altenbach, G. Böcherer, R. Mathar, "Short Huffman codes producing 1s half of the time," presented at ICSPCS 2011.

Matching code[3]

0010 : lll	1101 : llr	00000 : llm
1100 : lrl	1111 : lrr	00011 : lrm
00010 : lml	01101 : lmr	0000111 : lmm
1110 : rll	1001 : rlr	01100 : rlm
1000 : rrl	1011 : rrr	01111 : rrm
01110 : rml	01001 : rmr	000010 : rmm
01000 : mll	01011 : mlr	001101 : mlm
01010 : mrl	1010 : mrr	001100 : mrm
001111 : mml	001110 : mmr	0000110 : mmm

[3] G. Böcherer, F. Altenbach, M. Malsbender, R. Mathar, "Writing on the facade of RWTH ICT Cubes: cost constrained geometric Huffman coding," presented at ISWCS 2011, received best paper award.

Checking design constraints: Cooling and shadowing

	left	right	middle
Generated sequence	38.7%	40.9%	20.4%
Design constraint	40%	40%	20%

Checking design constraints: Appearance