

Art of Constructing Low-Complexity Encoders/Decoders for Constrained Block Codes

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Rate 4/5 code for RLL (0, 2) Constraint

Datawords	Codewords
excess	10101
0000	10010
0001	10110
0010	10011
0011	10111
0100	01001
0101	01101
0110	11001
0111	11101
1000	01010
1001	01110
1010	01011
1011	01111
1100	11010
1101	11110
1110	11011
1111	11111

Many Choices: $17! \sim 3.5568 \times 10^{14}$

Simple Set of Words

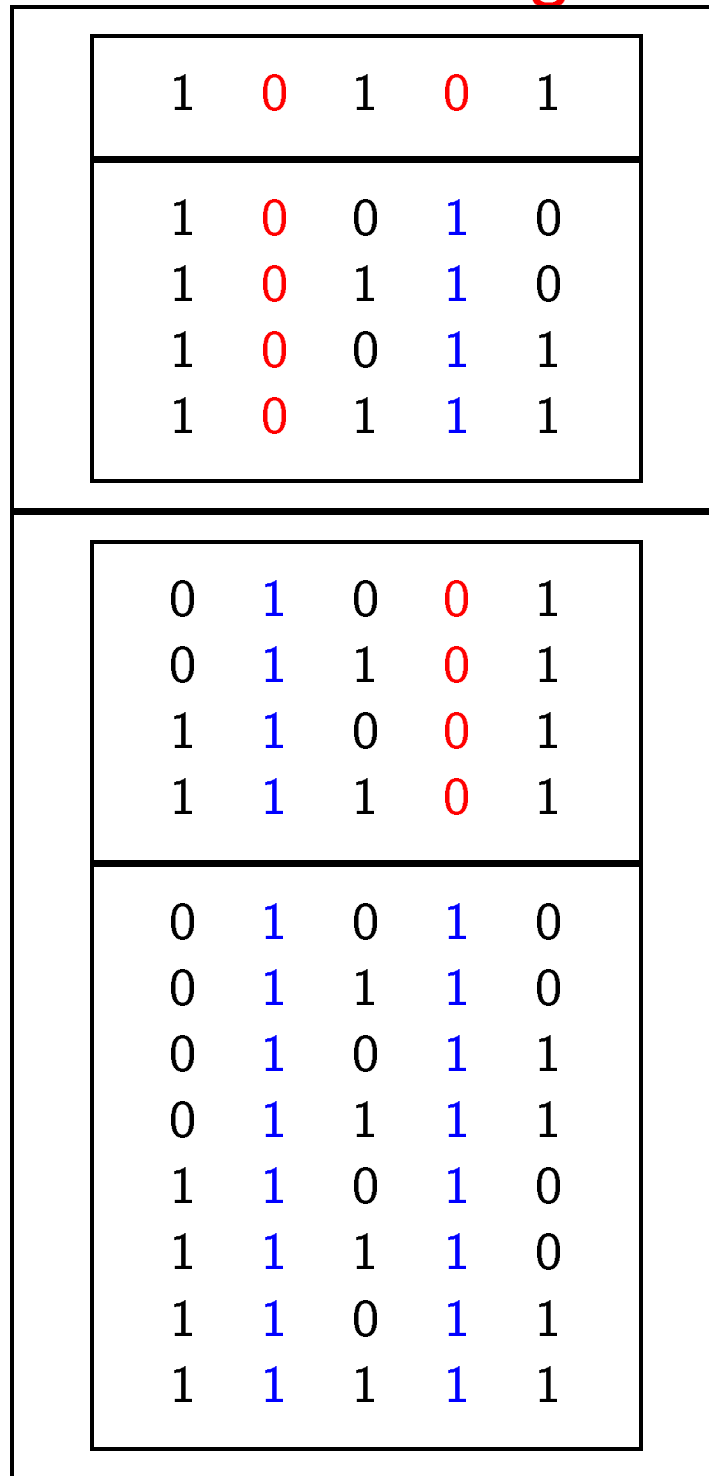
A set of q -bit codewords is simple if

- it has 2^s words (for some $s \geq 0$)
- s free coordinates (don't cares or independent)
- remaining coordinates are either fixed or dependent

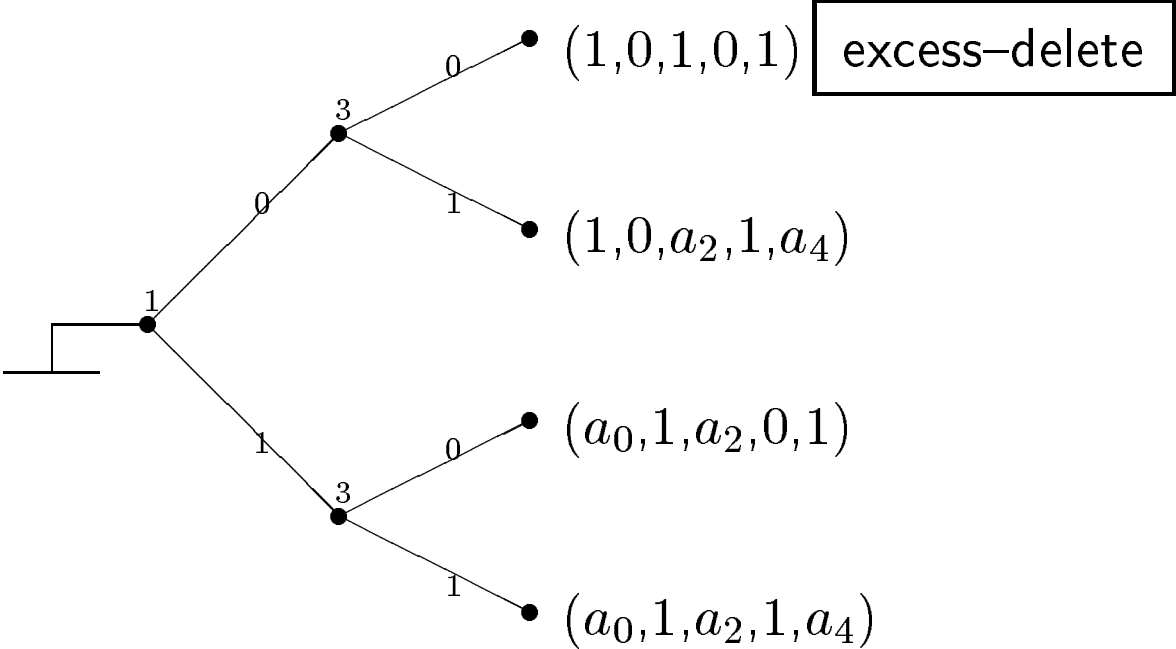
0	1	2	3	4
1	0	0	1	0
1	0	1	1	0
1	0	0	1	1
1	0	1	1	1
1	0	a_2	1	a_4

0	1	2	3	4	5	6
0	0	1	1	0	0	0
0	1	1	1	1	0	0
1	0	1	0	0	0	1
1	1	1	0	1	0	1
a_0	a_1	1	\bar{a}_0	a_1	0	a_0

Constraint Tree Algorithm



Constraint Tree



Codebook				
1	0	a_2	1	a_4
a_0	1	a_2	0	1
a_0	1	a_2	1	a_4

Constructing the Decoder

Given a codeword, the corresponding dataword has two-parts:

1. the index of the simple set that contains the given codeword (obtained using Huffman code)
2. the index of the particular codeword in the simple set = free coordinates in the simple set (but in what order?)

Codewords	→	Datawords
$(1 \quad 0 \quad a_2 \quad 1 \quad a_4)$	→	$(\mathbf{0} \quad \mathbf{0} \quad a_4 \quad a_2)$
$(a_0 \quad 1 \quad a_2 \quad 0 \quad 1)$	→	$(\mathbf{0} \quad \mathbf{1} \quad a_0 \quad a_2)$
$(a_0 \quad 1 \quad a_2 \quad 1 \quad a_4)$	→	$(\mathbf{1} \quad a_0 \quad a_4 \quad a_2)$

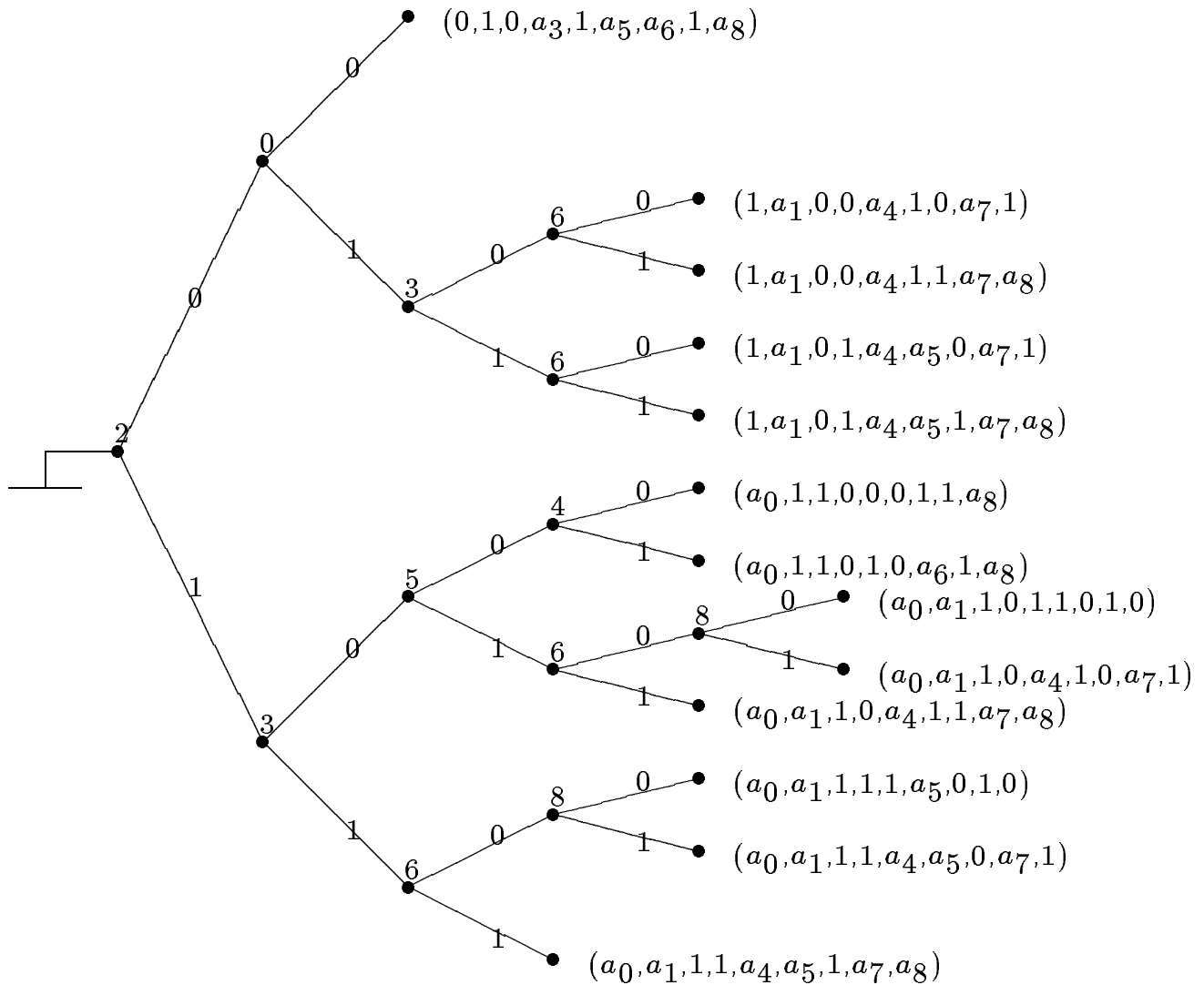
Results

		GCR	NEW	LEX
ENCODER	CELLS	39	31	91
	GATES	8	8	19
DECODER	CELLS	79	53	135
	GATES	18	13	29

Note: All CELL/GATE counts are with respect to the SA-12E cell library for CMOS 6SF technology.

Note: All counts are obtained by entering the dataword-to-codeword assignments in the BERKELEY SIS logic synthesis program.

Constraint Tree for PRML(0, 4/4) Constraint



More Results

Rate 8/9 code for PRML(0, 4/4) constraint

		EP	NEW	LEX
ENCODER	CELLS	201	246	1345
	GATES	39	47	263
DECODER	CELLS	161	271	1518
	GATES	33	58	310

Rate 8/9 code for PRML(0, 3/6) constraint

		EP	NEW	LEX
ENCODER	CELLS	292	293	1408
	GATES	64	59	281
DECODER	CELLS	258	376	1105
	GATES	52	76	219

Future Work

Extension to finite-state constraint codes:

low-complexity

low-error propagation

Download:

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