TECHNISCHE UNIVERSITÄT DRESDEN

DRESDEN concept

Faculty of Computer Science, Institute of Systems Architecture, Chair of Systems Engineering

RoboLab Autumn Course – Hamming Codes #2

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Construction approach – Cyclic (polynomial)

- Binary matrices can also be generated using polynomials
  - ➔ Results in a cyclic generator matrix (non-systematic)
  - ➔ Any binary Hamming Code of **`Ham(r,2)`** is equivalent to a cyclic code
    - ➔ Also, if **`Ham(q,r)`** with **`r,q-1`** relatively prime, it's equivalent, too
- Example: Hamming Code (7,4)
  - ➔ 4 data bits, 3 parity bits → Polynomial here is $1+x+x^3$
- Example: Hamming Code (8,4)
  - ➔ 4 data bits, 4 parity bits → Polynomial here is $1+x^2+x^4$

Construction approach – Cyclic (polynomial)

- Examples for both (7,4) and (8,4)

$G(x) = x^3+x+1$	$G(x) = x^4+x^2+1$
$G' := \begin{pmatrix} 1 & 0 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \end{pmatrix}$	$G' := \begin{pmatrix} 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 \end{pmatrix}$

Construction approach - Hsiao-Codes

- Definition of Hsiao is used for SEC-DED codes in GF(2)
  - Not really applicable for small codes we use here in the lab
  - ➔ Those codes are called „**Optimal Minimum Odd-weighted SEC-DED Code**“
- We have four rules to follow when creating the generator matrix
  1) Every column contains an odd number if 1‘s
  2) The total number of 1‘s reaches the minimum
  3) The difference of the numbers of 1‘s in any to rows is not greater than 1
  4) No two columns are the same
- Reference: https://arxiv.org/pdf/0803.1217.pdf

Assignment 2 – Hamming Code (Implementation)

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- Task 1
  - ➔ Add the given generator matrix and implement both the convert and derive methods
- Task 2
  - ➔ Implement the encoder
- Task 3
  - ➔ Implement the decoder, be careful on how to implement the different cases
- Task 4
  - ➔ Implement the unit-test for your class HammingCode