Fundamentals of Terabit communications
Practice sessions. Part 2. LDPC codes

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1 Random ensembles
2 Tanner graph
3 Measuring girth
4 Simulations. Decoding schedules
5 Simulations. Sum-Product vs Min-Sum
Problem 1. Write a program for generating codes from random \((J, K)\)-regular codes form Gallager’s ensemble. In order to generate \((n, k)\)-code, \(n = MK\), \(k \geq n - MJ\)

- Let

\[
H_1 = \begin{pmatrix}
11\ldots1 & 00\ldots0 & \ldots & 00\ldots0 \\
00\ldots0 & 11\ldots1 & \ldots & 00\ldots0 \\
\ldots & \ldots & \ldots & \ldots \\
00\ldots0 & 00\ldots0 & \ldots & 11\ldots1
\end{pmatrix}
\]

of size \(M \times KM\).

- Get \(H\) as

\[
H = \begin{pmatrix}
H_1 \\
H_2 \\
\ldots \\
H_J
\end{pmatrix}
\]

where \(H_j\) are random permutations of columns of \(H_1\).
Problem 2. Write a program for generating codes from random \((J, K)\)-regular codes form RU ensemble.

Steps:

1. Assign \(K\) edges to each of \(M\) check nodes, totally \(KM\) edges.

2. Connect at random \(J\) edges to each variable node,

3. Check for parallel edges and repeat the attempt if there are too many parallel edges.
Problem 3. Write a program for computing the girth of an arbitrary LDPC code.
Steps:

1. Construct the Tanner graph for the graph
2. Search for the shortest cycle by using Dijkstra algorithm