

Finding the Error Probability

Monte Carlo Simulation

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Decoding error

Definition (Decoding error)

A decoding error occurs when the decoder output \hat{m} is different from the transmitted message m .

- The Hamming Code is small and simple
 - able to determine the probability of decoding error analytically
- Practical coding systems can be exceedingly complex
 - defeats analysis
- How else can we determine the probability of decoding error?

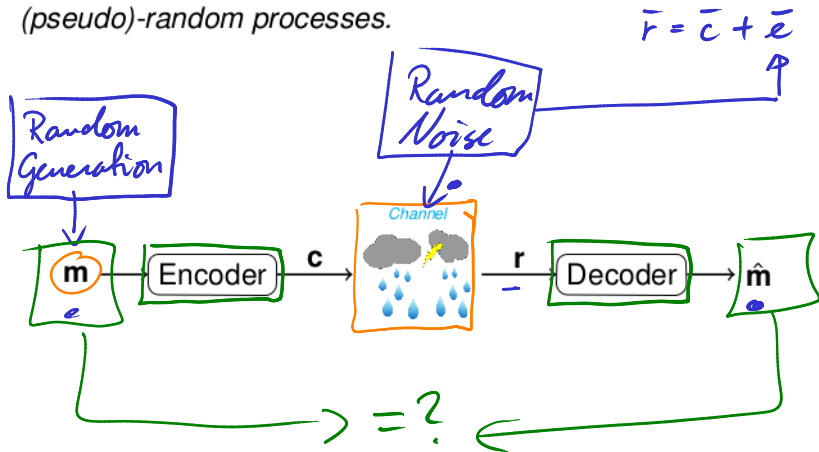
Monte Carlo Simulations and Statistical estimation.

Why simulation?

- Statistics provide inferences from **empirical data**.
- Where do we get the empirical data?
 - 1 field data — real data from real life
 - 2 simulation — synthetic data simulation real life
- Field data is often a scarce resource
- Simulation synthesises data at will

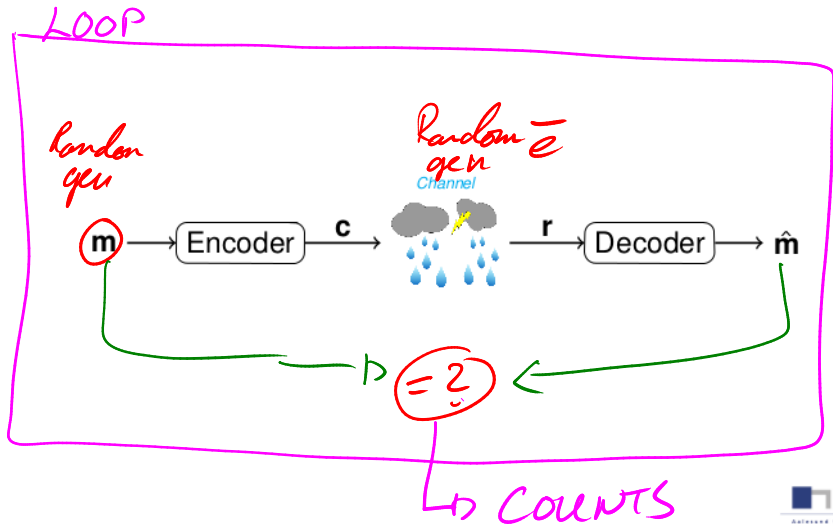
Monte Carlo Simulation

A Monte Carlo simulation is a simulation using (pseudo)-random processes.



Exercise

Monte Carlo Simulation



Simulator Output

- Run the simulator N times.
- Count the number of decoding errors X .
 - $0 \leq X \leq N$
- We get an error rate $R = X/N$.

NB The error rate *is not* the error probability.
We get back to that.

Closure

Exercise

Implement a Monte Carlo Simulator for the coding system

- 1 *Implement a function to generate random message*
- 2 *Implement a function to generate random noise (BSC)*
- 3 *Take the encoder/decoder functions from the web pages*
- 4 *Integrate the above function to a system to generate a random message, simulate transmission, and check for errors.*
- 5 *Implement a simulator iterating the above integrated system, counting the number of decoding errors.*

- There is a video to help you with the random generation.
- We will get back to the statistical analysis later.