Communications

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Error Detection Routines

- Parity Check: Add one bit to make the number of bits even/odd in a word.

- Assuming that a bit has a probability of $P_B$ of being wrong, what is the probability of: (a) receiving a byte with an error (8 bits), (b) receiving an error byte and not detecting an error.

\[
P_a = (1 - P_B)^{N_B}
\]

\[
P_b = \sum_{j=2}^{N_B} \binom{N_B}{j} P_B^j (1 - P_B)^{N_B-j}
\]

- Errors are often not independent. Bursts of errors, especially at high transmission rates

- Vertical and longitudinal error checks

- Parity computed as exclusive or

- Can this method detect all errors?
Cyclic Redundancy Checks

- Message $M$ ($n$ bits), and $k$ frame bits
- Choose $N$ ($k$ bits) such that $M | N$ is exactly divisible by a predetermined number $P$ ($n + 1$ bits).
- How do we choose $N$?
  
  $$T = 2^n \times M + N$$
  $$T / P = \frac{2^n \times M + N}{P} = \frac{2^n \times M}{P} + \frac{N}{P}$$
  $$N = -R$$
  
  - In Modulo arithmetic $R = -R$
  - Sender: Compute $(2^nM) / P$ and add remainder as checksum
  - Receiver: $T / P$, check if remainder is 0
  - $P$ is one bit longer than the checksum. Most and least significant bit should be one.
- CRC12: 12,11,3,2,1,0
• CRC16, 16,15,2,0
• Implement as shift/xor logic