[Lecture on 1.1]

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N.B. Module content has changed since last year, previous exams may not be relevant

0.1 Course Content

Necessary background:

- Signals and Systems
  - Fourier, FFT, autocorrelation, PSD, etc.
- Probabiliy Theory
  - Baye's Rule
- Random Signals
  - AWGN, etc.
- Linear algebra
  - Vector spaces, inner products, etc.

Preliminary section: DMCs and the MAP rule.

Three mains sections:

- Signal Space Analysis
- Modulation Techniques
- Wireless Communications

Recommended textbook: "Communication Systems" by Simon Haykin (4th ed)

0.2 Assessment

Component	**Weight**
MATLAB Assignment 1	10%
MATLAB Assignment 2	10%
Final Exam	80%

1 Discrete Memoryless Channel

Idealised channel with no memory.

Symbols x_j are transmitted, symbols y_j are received for $0 < j < M$.

- Probability map of TX symbols to RX symbols
- 'a priori' probability of each symbol x_j being transmitted
- Use Bayes' and cleverness to get 'a posteriori' probability of x_j for a given y_j

Question: Suppose y_k is observed at the output. What is the *optimum decision rule*?

Answer: We define the optimum decision rule as follows: The receiver sets its decision $\hat{x}$ to be the *most likely transmitted* symbol. This is called the 'maximum a posteriori' (MAP) decision rule. Mathematically:

$$\hat{x} = \text{argmax}_{x_j} P(x_j|y_k)$$

Using Bayes' rule,

$$P(x_j|y_k) = \frac{P(y_k|x_j)\dot{P}(x_j)}{P(y_k)}$$