

# Information Theory and Networks

## Lecture 1: Intro

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Lecture\\_notes/InformationTheory/](http://www.maths.adelaide.edu.au/matthew.roughan/Lecture_notes/InformationTheory/)

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## Admin

- All the usual stuff: cover sheets, consulting, ...
- Assessment: weights to be determined
  - ▶ Exam
  - ▶ Assignments
    - ★ I will expect solutions to be LaTeX'd
    - ★ Some parts will involve some coding, mostly in Matlab
  - ▶ Participation in class
    - ★ I plan roughly 1/3 of classes to be more like a tutorial, with discussion of problems.
- I am away from 5-9, so there won't be any lectures that week. We will make them up as needed.
- Course materials on [http:](http://)

## Part I

### Signals and Noise

The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; ...

*Claude Shannon, 1948 [Sha48]*

# Discrete Signals

Most data today is stored and transmitted digitally:

- It means that it is discrete both in time and nature
  - ▶ basically it is made up of a string of numbers
  - ▶ most are stored in Binary bits (1s and 0s)
    - ★ The term *bit* was chosen by Shannon
- Examples:
  - ▶ images: JPEG
  - ▶ sound: PCM or MP3
- The alternatives: analogue data
  - ▶ e.g., vinyl LPs, audio cassettes, photographic film, ... are rare today.
- Conversions:
  - ▶ most signals in real life are analogue so we need A2D (Analogue to Digital converters)
  - ▶ we listen in analogue, so stereos (etc) have D2A (Digital to Analogue) converters
  - ▶ we may also need to convert digital signals into analogue for transmission (e.g. electrical impulses)

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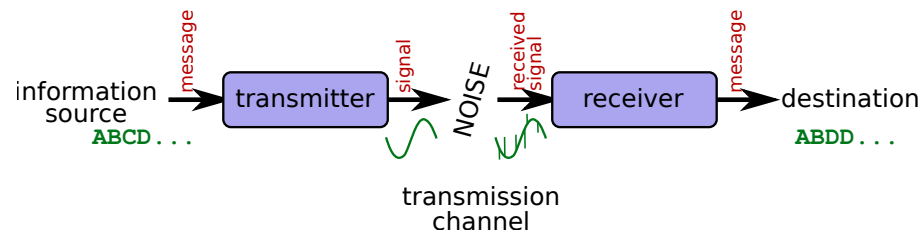
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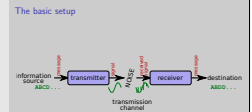
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# The basic setup



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- Information/messages could be
  - ▶ text
  - ▶ audio (digitally coded, e.g., PCM)
  - ▶ images (digitally coded, e.g. PNM)
  - ▶abstract it to be a series of symbols.
- Transmission channel could be
  - ▶ a wire (copper or fibre)
  - ▶ wireless
  - ▶ storage media (transmission over time)abstract it with some noise model.

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  - How much noise can we tolerate?
  - How fast can we transmit? OR How much data can we store?
- and how do these three issues interrelate?

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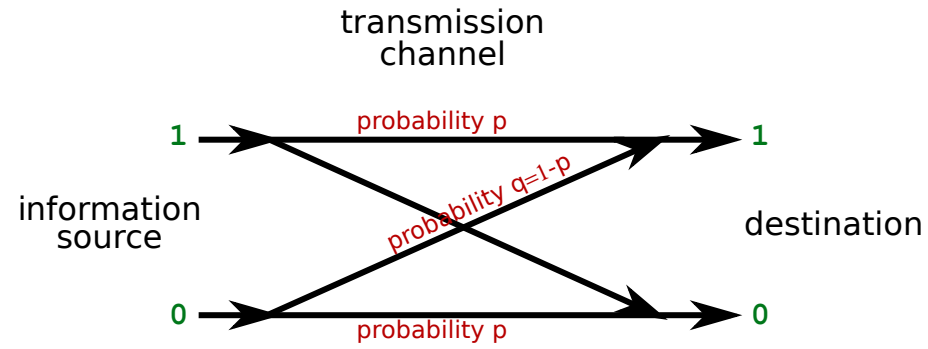
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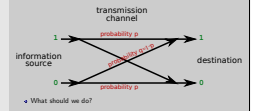
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## Some ideas

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## Further reading I



C.E. Shannon, *A mathematical theory of communication*, The Bell System Technical Journal **27** (1948), 379–423, 623–656,  
<http://cm.bell-labs.com/cm/ms/what/shannonday/paper.html>.