# Slides

# Introduction

# Organization

Professors:

- Lectures: Nicolae Cleju (nikcleju@etti.tuiasi.ro)
- Laboratories: Daniel Matasaru (..@etti.tuiasi.ro)

## Grades

$$\text{Final grade} = 0.75\ \text{Exam} + 0.25\ \text{Lab}$$

# Time schedule

- 14 weeks of lectures (3h each)
- 14 weeks of laboratories (2h each)
  - 5 laboratories
  - 7 seminars
  - 1 recuperari
  - 1 test

# Course structure

1. Introduction to probabilities

2. Pam

# Bibliography


1. Pam Pam
2. HamHam
3. Yoyo

# Introduction to probabilities

## Basic notions of probability

Random variable = the outcome of an experiment

Distribution (probability mass function)

Discrete distribution

Alphabet

## Basic properties

Two independent events:

$$P(A \cap B) = P(A) \cdot P(B)$$

# Chapter I: Discrete information sources

# Discrete memoryless source

Is a random variable that takes, succesively, different independent values according to a certain distribution:

$$S : \begin{pmatrix} s_1 & s_2 & s_3 \\ \frac{1}{2} & \frac{1}{4} & \frac{1}{4} \end{pmatrix}$$

Properties:

- Discrete: it can take a value from a discrete set (alphabet)
- Complete: $\sum p(s_i) = 1$
- Memoryless: succesive values are independent of previous values (e.g. successive throws of a coin)

# Examples

A coin is a discrete memoryless source (DMS) with two possibilities (head, tail):

$$S : \begin{pmatrix} s_1 & s_2 \\ \frac{1}{2} & \frac{1}{2} \end{pmatrix}$$

A dice is a discrete memoryless source (DMS) with six possibilities:

$$S : \begin{pmatrix} s_1 & s_2 & s_3 & s_4 & s_5 & s_6 \\ \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \end{pmatrix}$$

Winning the lottery can be modeled as DMS:

$$S : \begin{pmatrix} s_1 & s_2 \\ 0.9999 & 0.0001 \end{pmatrix}$$

# Terminology

The different choices are called *messages*.

When an event takes place (e.g. throwing a coin/dice), it is said that the *DMS provides a message*.

# Information

When a DMS provides a new message, it gives out some new information, i.e. the information that a particular message took place.

The information attached to a particular event (message) is rigorously defined as:

$$i(s_i) = -log(p(s_i))$$

...

# Example - Game

Game: I think of a number between 1 and 8. You have to guess it by asking yes/no questions.

- How much indetermination does the problem have?
- How is the best way to ask questions? Why?
- What if the questions are not asked in the best way?
- On average, what is the number of questions required to find the number?

# Example - Game v2

Suppose I choose a number according to the following distribution:

...

- On average, what is the number of questions required to find the number?
- What distribution makes guessing the number the most difficult?
- What distribution makes guessing the number the easiest?