Information and Coding Theory MA41024/ MA60020/ MA60262

Bibhas Adhikari

Spring 2022-23, IIT Kharagpur

Lecture 1 January 3, 2023

э

(B)

Some basics:

▷ Is it 3-1-0 or 3-0-0 ?

3

★ ∃ ► < ∃ ►</p>

Image: A matrix

Some basics:

- ▷ Is it 3-1-0 or 3-0-0 ?
- ▷ Who should register?

Some basics:

- ▷ Is it 3-1-0 or 3-0-0 ?
- ▷ Who should register?
- ▷ Prerequisites P&S, basics of LA

Some basics:

- ▷ Is it 3-1-0 or 3-0-0 ?
- ▷ Who should register?
- ▷ Prerequisites P&S, basics of LA
- ▷ Grading policy

Some basics:

- ▷ Is it 3-1-0 or 3-0-0 ?
- ▷ Who should register?
- ▷ Prerequisites P&S, basics of LA
- ▷ Grading policy
- Books and class materials
 - (a) Cover, Thomas M., and Joy A. Thomas. Elements of Information Theory.
 - (b) Yeung, Raymond W. A First Course in Information Theory.
 - (c) Robert McEliece. The Theory of Information and Coding.
 - (d) Daniel Costello, and Shu Lin. Error Control Coding: Fundamentals and Applications

Some basics:

- ▷ Is it 3-1-0 or 3-0-0 ?
- ▷ Who should register?
- ▷ Prerequisites P&S, basics of LA
- ▷ Grading policy
- Books and class materials
 - (a) Cover, Thomas M., and Joy A. Thomas. Elements of Information Theory.
 - (b) Yeung, Raymond W. A First Course in Information Theory.
 - (c) Robert McEliece. The Theory of Information and Coding.
 - (d) Daniel Costello, and Shu Lin. Error Control Coding: Fundamentals and Applications
- ▷ Caution it will be a math/TCS course!!

Bibhas Adhikari (Spring 2022-23, IIT Kharag Information and Coding Theory Lecture

(日) (四) (日) (日) (日)

What is information?

What is information?

 $\triangleright\,$ Informal way of thinking about information - listen to a song

What is information?

- > Informal way of thinking about information listen to a song
- ▷ Think of a fax machine the font size of the words



What is information?

- > Informal way of thinking about information listen to a song
- ▷ Think of a fax machine the font size of the words



▷ Physics of information - how to store and process?

What is information?

- > Informal way of thinking about information listen to a song
- ▷ Think of a fax machine the font size of the words



- ▷ Physics of information how to store and process?
 - $\triangledown\,$ Claude E Shannon (2016 2001) father of information theory

Shannon's theory/model

Information is uncertainty - information source is modeled as a random variable/process

Shannon's theory/model

- > Information is uncertainty information source is modeled as a random variable/process
- ▷ Information should be digital ASCII

Shannon's theory/model

- Information is uncertainty information source is modeled as a random variable/process
- ▷ Information should be digital ASCII

Shannon's theorems

Source coding theorem - *entropy* as a fundamental measure of information

Shannon's theory/model

- Information is uncertainty information source is modeled as a random variable/process
- Information should be digital ASCII

Shannon's theorems

- Source coding theorem *entropy* as a fundamental measure of information
- Channel coding theorem the *capacity* of a channel reliable information with unreliable channel

Shannon's theory/model

- Information is uncertainty information source is modeled as a random variable/process
- ▷ Information should be digital ASCII

Shannon's theorems

- Source coding theorem *entropy* as a fundamental measure of information
- Channel coding theorem the *capacity* of a channel reliable information with unreliable channel

Quantum entropy existed before classical entropy!!

Model of a digital communication system



Model of a digital communication system



Example Let $S = \{a_1, \ldots, a_k\}$ denote the source i.e. a random variable X with sample space S and pmf p.

Model of a digital communication system



Example Let $S = \{a_1, \ldots, a_k\}$ denote the source i.e. a random variable X with sample space S and pmf p.