Pattern Recognition And Image Processing

Notes For Final Exam

Prepared By

Noor Mohammed Anik

Final Exam

Pattern Recognition And Image Processing

Segment - 4

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Noor Mohammed Anik
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[1] What is Image compression?

Ans: Image compression is the process of encoding or converting an image file in such a way that it consumes less space than the orginal file.

It is a type of compression technique that reduces the size of an image file without affecting its quality to a greater extent.

[2] Write the necessity of image compression in brief.

Ans: Digital image are very large in size and hence occupy larger storage space. Due to their larger size, they take larger bandwidth and more time for upload or download through the internet. This makes it inconvenient for storage as well as file sharing. To combat with this problem, the images are compressed in size with special techniques. This compression not only helps in saving storage space but also enables easy sharing of files.

3 What is data redundancy?

Ans: Data redundancy is a condition created within a database or data storage technology in which the same piece of data is held in two separate places.

$$R_d = 1 - \frac{1}{C_R}$$

where R_d = relative data redundancy
C_R = compression ratio

4 Write down the types of data redundancy.

Ans: There are three types data redundancy:

(i) Coding redundancy:

Coding redundancy refers to the binary code used to represent gray values.

Example:

variable length coding

(ii) Interpixel redundancy:

Interpixel redundancy refers to the correlation between adjacent pixels in an image.

Example: spatial redundancy

(iii) Psychovisual redundancy:

Psychovisual redundancy refers to the unequal sensitivity of the human eye to different visual information.

Example: TV

5 Describe various types of interpixel redundancy.

Ans: (i) spatial redundancy:

Local: Pixel at neighboring location have similar intensity. And can be reduced.

Global: Reoccuring patterns in same image.

(ii) Spectral redundancy:

Reoccuring patterns between color planes.

(iii) Temporal redundancy:

Reoccuring patterns between consecutive planes.

6 Define Fidelity criteria.

Ans. Fidelity Criteria mean a measure is needed in order to measure the amount of data lost due to a compression scheme.

There are two main fidelity criteria –

(i) objective and (ii) subjective.

7 Explain the steps of JPEG algorithm.

Ans: JPEG compression and decomposition consist of 4 distinct and independent phases.

Compression

Phase one: Divide the image

First, the image is divided into 8x8 pixel blocks.

Phase two: conversion to the frequency domain

A discrete cosine transformation is applied to each block to convert the information from the spatial domain to the frequency domain.

Phase three: Quantization

The frequency information is quantized to remove unnecessary information

Phase Four: Entropy Coding

Finally, standard compression techniques compress the final bit stream.

Decomposition of a JPEG image is basically the same as performing the compression step in reverse and in the opposite order.

[8] Describe image compression model.

Ans:

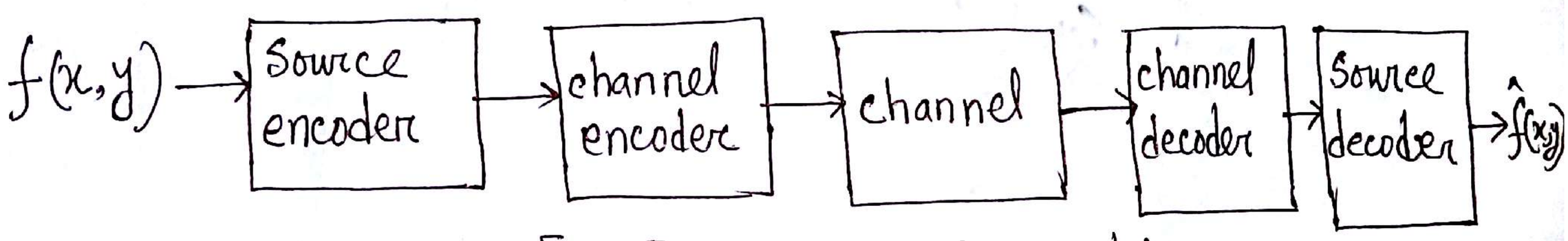


Fig: Image compression model.

channenl encoder and decoder

The channel encoder and decoder are designe to reduce the impact of channel noise by a controlled form of redundancy into the encoded data.

Source encoder and decoder

The source encoder is responsible for reducing or eliminating any coding, interpixel or psychovisual redundancies in the input image.

9 Define Bit plane coding ?

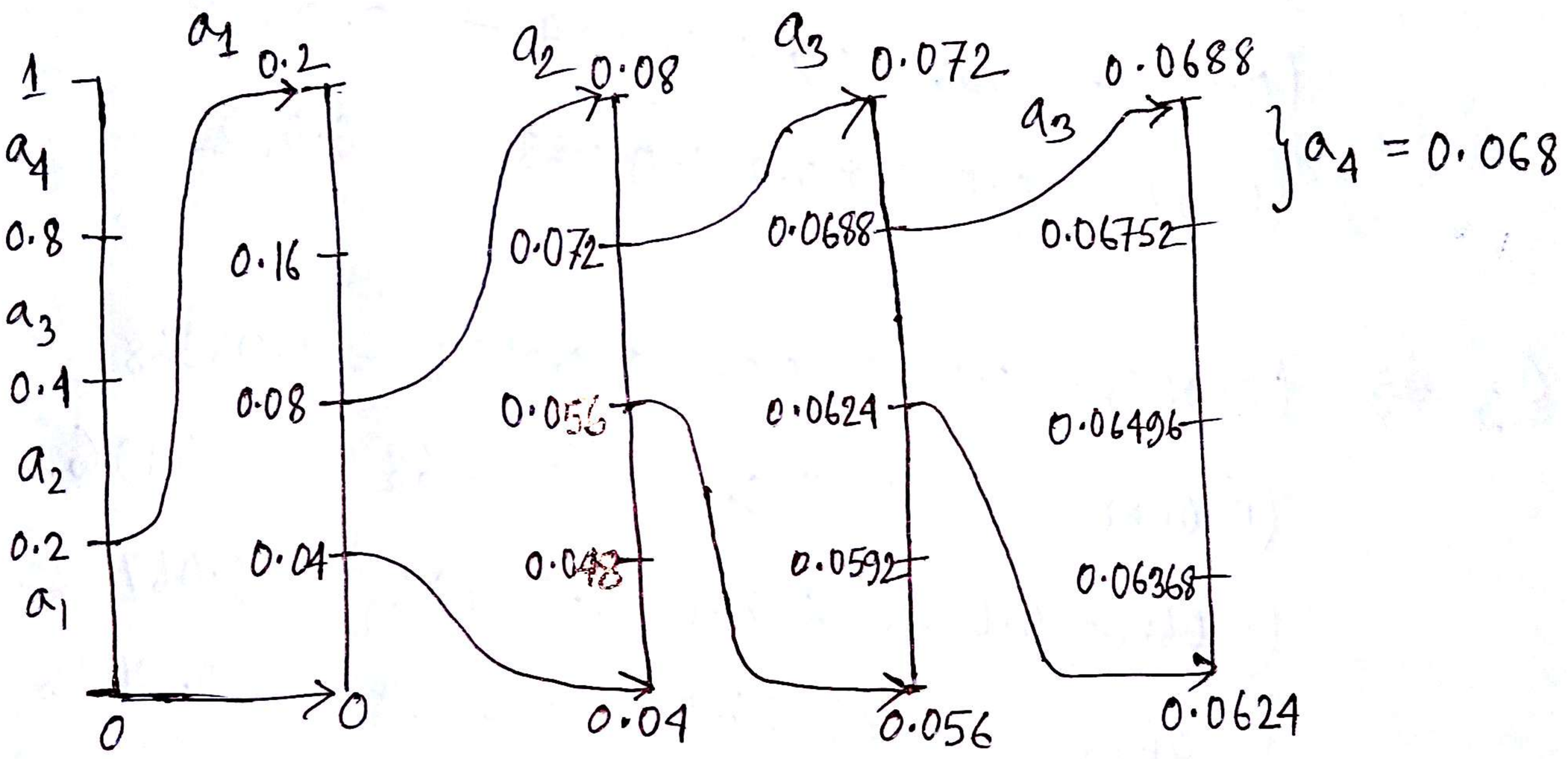
Ans: Bit plane coding is a technique for reducing an images interpixel redundancies is to process the images bit plane individually.

10 Encode the following sequence using arithmetic coding : $a_1\ a_2\ a_3\ a_3\ a_4$

Symbol	Probability
a_1	0.2
a_2	0.2
a_3	0.4
a_4	0.2

Ans:

Symbol	Probability	Interval
a_1	0.2	[0 - 0.2]
a_2	0.2	[0.2 - 0.4]
a_3	0.4	[0.4 - 0.8]
a_4	0.2	[0.8 - 1.0]



$a_1 \Rightarrow (0.2-0) * 0.2 + 0 = 0.04$

$(0.2-0) * 0.2 + 0.04 = 0.08$

$(0.2-0) * 0.4 + 0.08 = 0.16$

$(0.2-0) * 0.2 + 0.16 = 0.2$

$a_2 \Rightarrow (0.08-0.04)*0.2+0.04 = 0.048$

$(0.08-0.04)*0.2+0.048 = 0.056$

$(0.08-0.04)*0.2+0.056 = 0.072$

$(0.08-0.04)*0.2+0.072 = 0.08$

$a_3 \Rightarrow (0.072-0.056)*0.2+0.056 = 0.0592$

$(0.072-0.056)*0.2+0.0592 = 0.0624$

$(0.072-0.056)*0.2+0.0624 = 0.0688$

$(0.072-0.056)*0.2+0.0688 = 0.072$

$a_3 \Rightarrow (0.0688-0.0624)*0.2+0.0624 = 0.06368$

$(0.0688-0.0624)*0.2+0.06368 = 0.06496$

$(0.0688-0.0624)*0.4+0.06496 = 0.06752$

$(0.0688-0.0624)*0.2+0.06752 = 0.0688$

$a_1 a_2 a_3 a_3 a_4$ encoded into 0.068 (Ans)

11 Encode the following images using LZW coding algorithm

39	39	126	126
39	39	126	126
39	39	126	126
39	39	126	126

Ans:

Currently Recognized sequence	Pixel being Processed	Encoded output	Dictionary Location	Dictionary Entry
	39			
39	39	39	256	39-39
39	126	39	257	39-126
126	126	126	258	126-126
126	39	126	259	126-39
39	39			
39-39	126	256	260	39-39-126
126	126			
126-126	39	258	261	126-126-39
39	39			
39-39	126			
39-39-126	126	260	262	39-39-126-126
126	39			
126-39	39	259	263	126-39-39
39	126			
39-126	126	257	264	39-126-126
126		126		

Encoded output

39 39 126 126

256 258 260 259

257 126

Am

12 Decode the following images using LZW algorithm

39 39 126 126

256 258 260 259

257 126

Ans:

Currently Recognized sequence	Pixel being processed	Decoded output	Dictionary Location	Dictionary Entry
	39			
39	39	39	256	39-39
39	126	39	257	39-126
126	126	126	258	126-126
126	256	126	259	126-39
256	258	39-39	260	39-39-126
258	260	126-126	261	126-126-39
260	259	39-39-126	262	39-39-126-126
259	257	126-39	263	126-39-39
257	126	39-126	264	39-126-126
126		126		

Decoded output:

39 39 126 126

39 39 126 126

39 39 126 126

39 39 126 126

Am

13 Given Six symbol source $\{a_2, a_6, a_1, a_4, a_3, a_5\}$ with source probability $\{0.4, 0.3, 0.1, 0.1, 0.06, 0.04\}$. Give suitable code for each pixel to eliminate data redundancy.

Ans:

Symbol	Probability	code	1	2	3	4
a_2	0.4	1	0.4	0.4	0.4	0.6 0
a_6	0.3	00	0.3	0.3	0.3 00	0.4 1
a_1	0.1	011	0.1	0.2 010	0.3 01	
a_4	0.1	0100	0.1 0100	0.1 011		
a_3	0.06	01010	0.1 0101			
a_5	0.04	01011				

$$L_{avg} = 0.4 \times 1 + 0.3 \times 2 + 0.1 \times 3 + 0.1 \times 4 + 0.06 \times 5 + 0.04 \times 5$$

$$= 2.2$$

Here,
n_1 = number bits need to represent symbol
$n_2 = L_{avg}$

$$C_R = \frac{n_1}{n_2} = \frac{3}{2.2} = 1.36$$

$$\therefore R_d = 1 - \frac{1}{C_R} = 1 - \frac{1}{1.36} = 0.27 = 27\%$$ (Ans)

END