Digital Image Processing
Chapter 8:
Image Compression-2

Outline

1 Fundamentals

2 Some basic compression method

- Huffman coding
- Arithmetic coding
- LZW coding
- Block Transform coding
- Predictive coding
- …

Error-Free Compression: Huffman Coding

Huffman coding: give the smallest possible number of code symbols per source symbols.

Step 1: Source reduction

Original source		Source reduction			
Symbol	Probability	1	2	3	4
a_2	0.4	0.4	0.4	0.4	0.6
a_6	0.3	0.3	0.3	0.3	0.4
a_1	0.1	0.1	0.2	0.3	
a_4	0.1	0.1	0.1		
a_3	0.06	0.1			
a_5	0.04				

Error-Free Compression: Huffman Coding

Step 2: Code assignment procedure

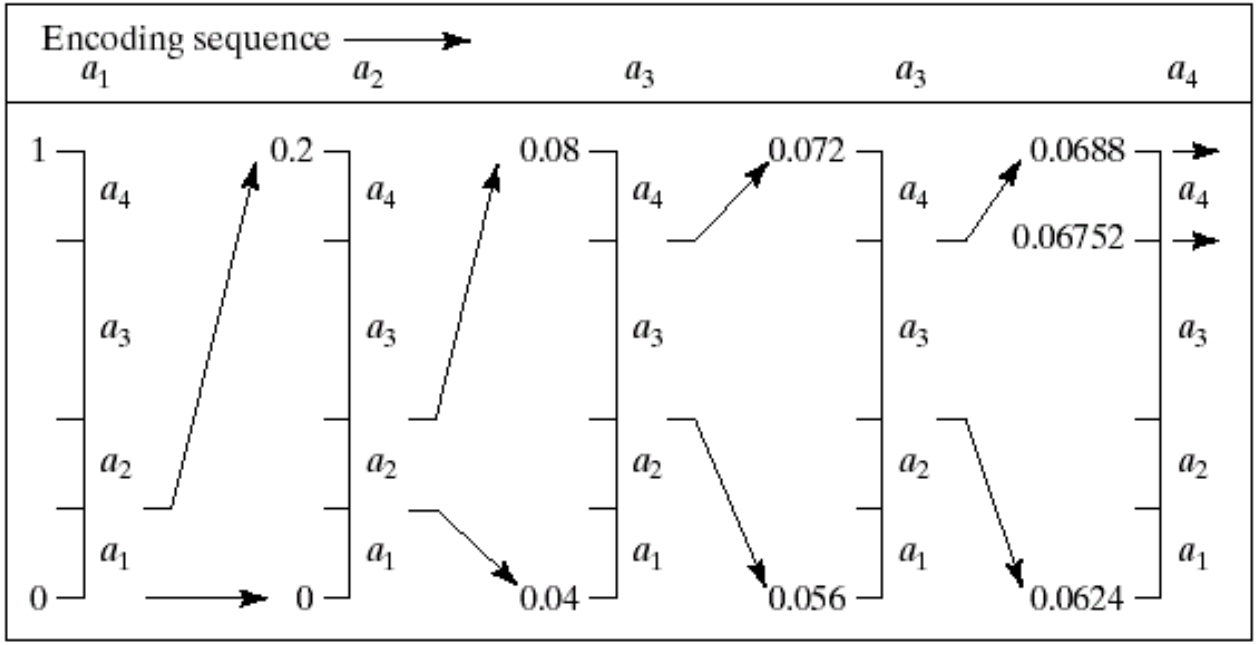
Original source			Source reduction							
Sym.	Prob.	Code	1		2		3		4	
a_2	0.4	1	0.4	1	0.4	1	0.4	1	0.6	0
a_6	0.3	00	0.3	00	0.3	00	0.3	00	0.4	1
a_1	0.1	011	0.1	011	0.2	010	0.3	01		
a_4	0.1	0100	0.1	0100	0.1	011				
a_3	0.06	01010	0.1	0101						
a_5	0.04	01011								

The code is instantaneous uniquely decodable without referencing succeeding symbols.

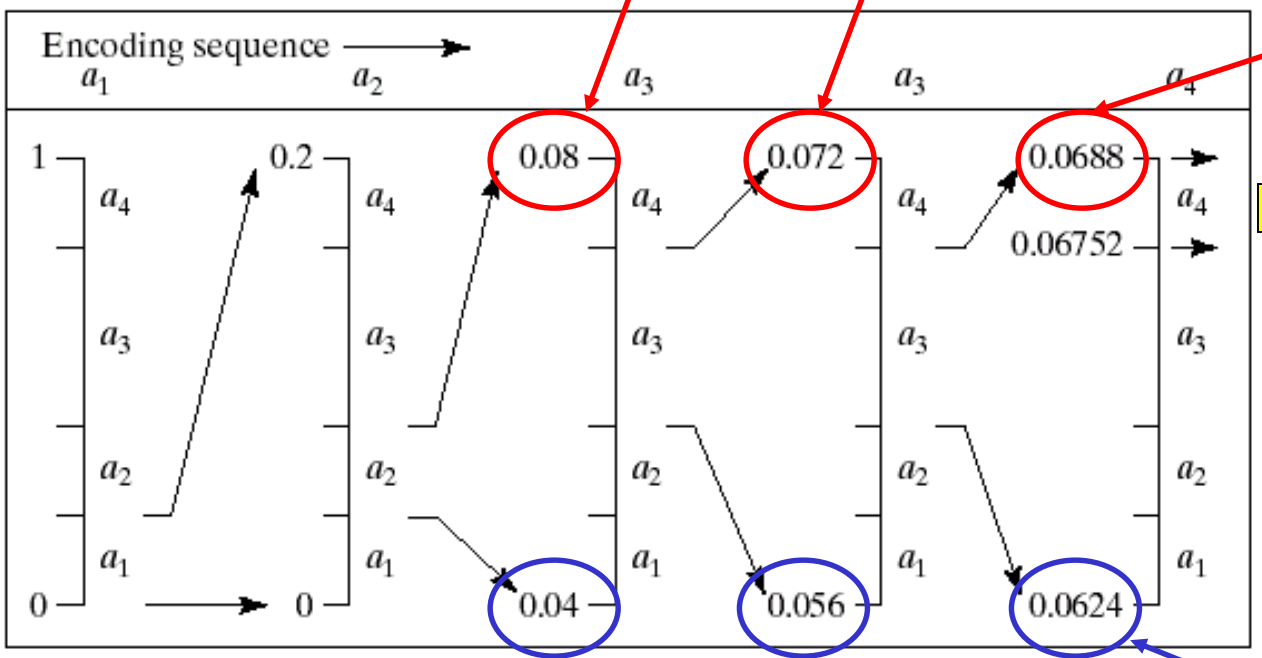
Arithmetic Coding

Nonblock code: one-to-one correspondence between source symbols And code words does not exist.

Concept: The entire sequences of source symbols is assigned a single arithmetic code word in the form of a number in an interval of real number between 0 and 1.



Arithmetic Coding Example



The number between 0.0688 and 0.06752 can be used to represent the sequence $a_1\ a_2\ a_3\ a_3\ a_4$

Source Symbol	Probability	Initial Subinterval
a_1	0.2	[0.0, 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)

LZW Coding

Lempel-Ziv-Welch coding : assign fixed length code words to variable length sequences of source symbols.

Dictionary Location	Entry
0	0
1	1
⋮	⋮
255	255
256	—
⋮	⋮
511	—

LZW Coding

Currently Recognized Sequence	Pixel Being Processed	Encoded Output	Dictionary Location (Code Word)	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		

24 Bits

9 Bits