CHAPTER 15

Data Compression

(Solutions to Practice Set)

Review Questions

1. The two categories of data compression methods are lossless and lossy.
2. Lossless compression preserves the integrity of the data; in lossy compression, some of the data is lost in the compression/decompression process.
3. Run length encoding is a lossless compression method in which repeated occurrences of a symbol are replaced by one occurrence of the symbol followed by the number of occurrences.
4. Lempel-Ziv (LZ) encoding is a type of dictionary-based, lossless compression method in which a dictionary is constructed during encoding. During decoding, the dictionary is reconstructed from the received data. During encoding or decoding, the already-encountered strings can be substituted by their index in the dictionary to reduce the amount of information transmitted.
5. Huffman coding uses the frequency of the characters in the file to construct a tree. The tree is then used to generate codes for each character with the more frequent characters having shorter codes than the less frequent characters.
6. The dictionary in LZ encoding consists of indexed entries that refer to substrings in the original file. These indices are used to refer to future occurrences of these substrings.
7. In Huffman coding, both the sender and receiver must have a copy of the same code in order for the decoded file to match the encoded file. In LZ encoding, the dictionary is generated from the data itself.
8. The three lossy compressions are JPEG, MPEG, and MP3.
9. JPEG is used to compress images while MPEG is used to compress video.
10. MPEG uses a method similar to JPEG to compress the individual frames of video. Whereas, JPEG uses only spatial compression, MPEG uses both spatial and temporal compression.
11. Blocking is the act of dividing the image into 8×8 blocks in order to reduce the number of calculations.

12. DCT changes the 64-pixel values in each block so that the relative relationships between pixels are kept but the redundancies are removed.
13. Quantization of the T table reduces the number of bits needed for encoding each value.
14. A motion picture is a rapid flow of a set of frames where each frame is a picture.
15. Spatial compression is the compression of each frame by using a modified version of JPEG; temporal compression is the removal of redundant frames in MPEG.
16. I-frames (intracoded frames) are complete, independent frames and are not related to any other frames. P-frames (predicted frames) contain only the changes from the preceding I-frame or P-frame. B-frames (bidirectional frames) are relative to the preceding and following I-frame or P-frame.

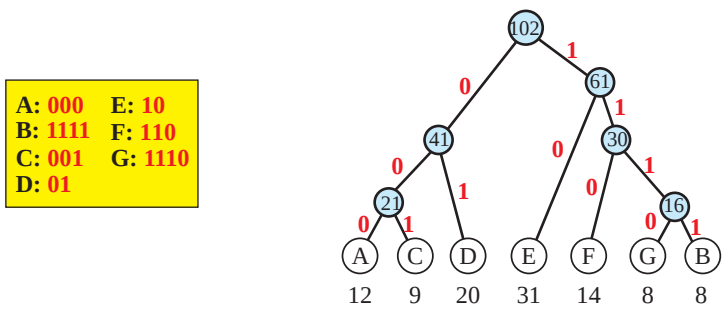
Multiple-Choice Questions

17. b	18. a	19. d	20. a	21. d	22. d
23. a	24. b	25. c	26. d	27. b	28. a
29. c	30. c				

Exercises

31. 10010 00000 11111 11001 01111 00000 00000
32. 00000 01000 11111 01110 00000 00000
33. Different codes result from different ways of organizing the tree. One possible tree with the resulting code is shown Figure S15.33.

Figure S15.33 *Exercise 33*



34. Different codes result from different ways of constructing the tree. One possible tree with the resulting code is shown in Figure S15.34.
35. This can be a Huffman code. The shorter codes is not the prefix of any of the two longer codes. The tree is shown in Figure S15.35.

Figure S15.34 *Exercise 34*

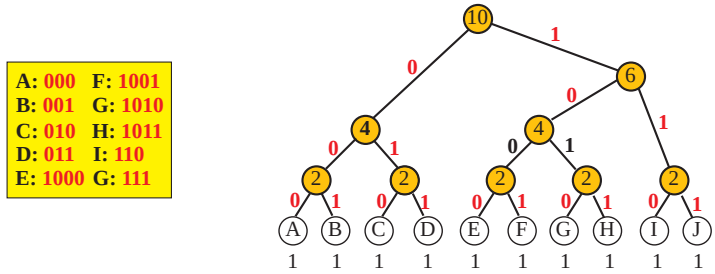
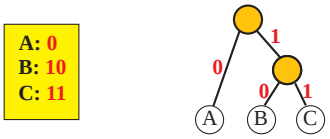


Figure S15.35



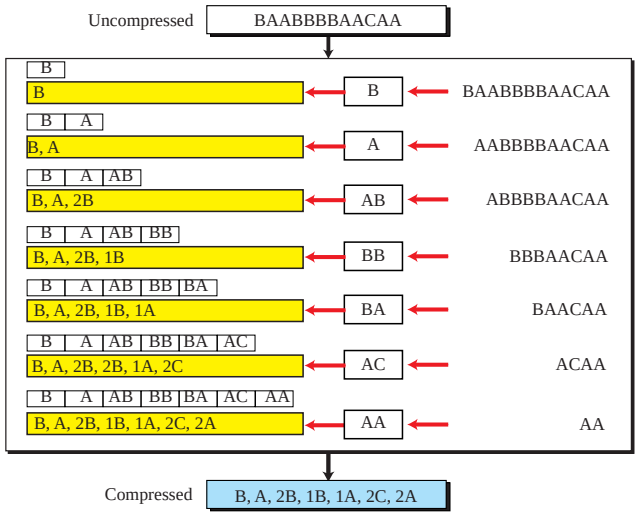
36. This cannot be a Huffman code. The longer codes all start with one of the shorter codes. For instance, if the receiver receives one 0, it cannot tell if this single zero is an A or the beginning of a C (00) or the beginning of a D (01).

37. 100 0101 0101 000 1100

38. ABBAAACCA

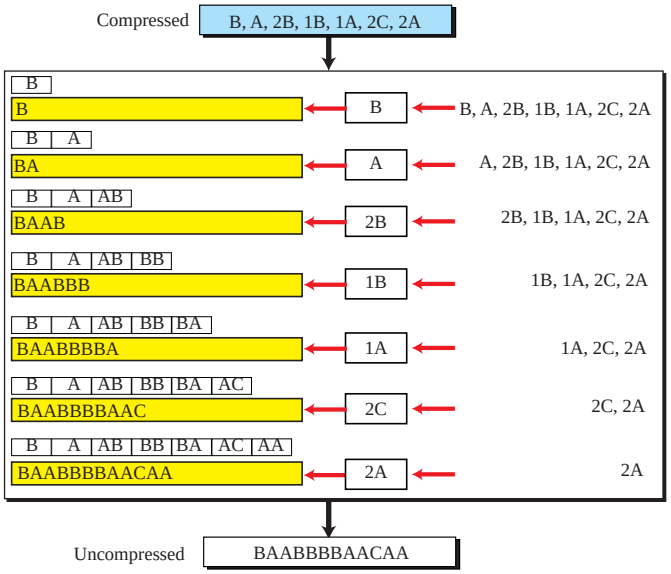
39. Encoding is shown in Figure 15.39a.

Figure S15.39a *Exercise 39 part a*



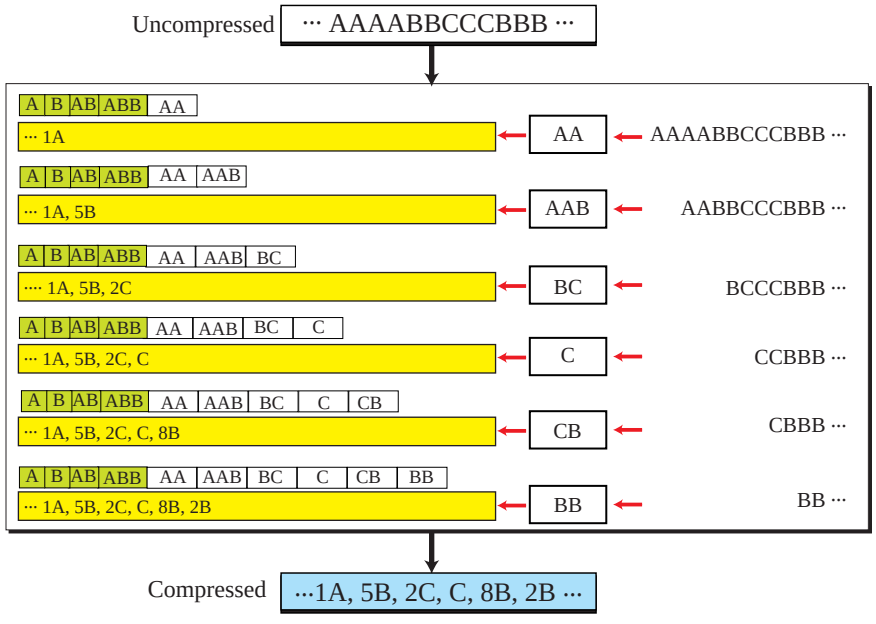
Decoding is shown in Figure 15.39b.

Figure S15.39b *Exercise 39 part b*



40. Figure S15.40 shows the dictionary.

Figure S15.40 *Exercise 40*



Note that if the dictionary contains ABB, it must also have A, B, AB.

41. Calculations are

T(0, 0)	=	1/16 [16 + 32 + 128 + 48]	=	17.00
T(0, 1)	=	1/16 [0.94 (64) + 0.90 (32) + 0.85 (128) + 0.80 (48)]	=	14.08
T(1, 0)	=	1/16 [0.90 (64) + 0.85 (32) + 0.80 (128) + 0.75 (48)]	=	13.59
T(1, 1)	=	1/16 [0.85 (64) + 0.80 (32) + 0.75 (128) + 0.70 (48)]	=	13.10