MANCHESTER METROPOLITAN UNIVERSITY

FACULTY OF SCIENCE AND ENGINEERING

SCHOOL OF COMPUTING, MATHEMATICS & DIGITAL TECHNOLOGY

ACADEMIC YEAR 2014-2015:

MIDSEMESTER EXAMINATION SESSION

Examination for the
MSC COMPUTER AND NETWORK SECURITY

UNIT 6G7Z1009 : INTRODUCTION TO COMPUTER FORENSICS AND SECURITY

Duration: 3 hours

Instructions to Candidates

Please answer **FOUR** questions (**TWO** questions each from both **SECTION A** and **SECTION B**).

Each question carries 25 marks.

Students are permitted to use their own calculators subject to the standard Faculty conditions.

SECTION A

1. (a) What is meant by the following terms: **admissible evidence**, **search warrant**, and **hearsay evidence**? [6]

(b) The following states ACPO Principles 1 & 3

"No action taken by law enforcement agencies or their agents should change data held on a computer or storage media which may subsequently be relied upon in court"

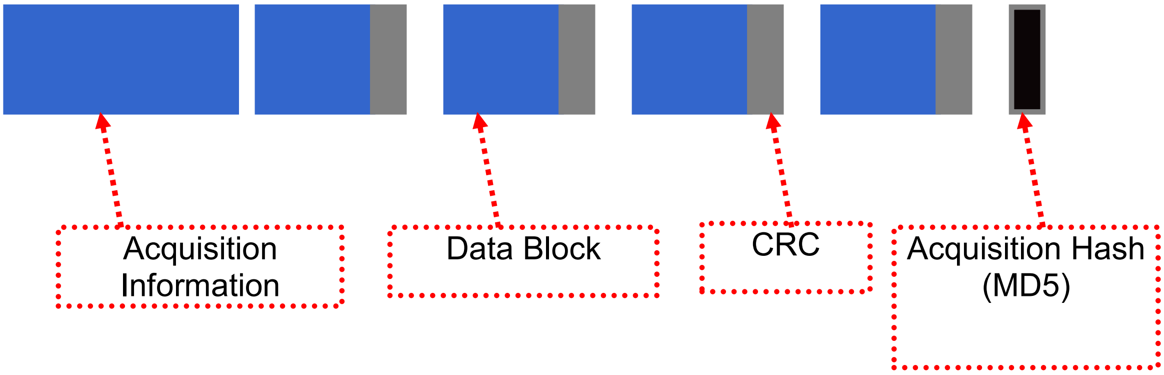
"An audit trail or other record of all processes applied to computer-based electronic evidence should be created and preserved. An independent third party should be able to examine those processes and achieve the same result."

Critically anlayse how you can comply with the above two principles during a forensic investigation. Use the forensic computing process to structure your points. [11]

(c) Given the following EnCase evidence file structure (Diagram Q1):

(i) What information can be found in the acquisition Information section? [4]
(ii) What is meant by **CRC**; and what its role? [2]
(iii) What is meant by **MD5**; and what its role? [2]

DIAGRAM Q1



2. The following two figures are a hexadecimal and an ASCII representation of the DOS Boot Record (Figure Q2.1) and the first 512 bytes of a root directory (Figure Q2) as seen in the View Pane in EnCase. From this information, identify the following:

   (a) What is the file system type; and how did you identify it? [2]

   (b) What is the size of FAT1 in sectors; and how did you identify it? [3]

   (c) What is the maximum number of files/directories in the root directory and how did you identify it? [5]

   (d) State the names of files (excluding deleted files), if any, and their extensions and how you identified them. [6]

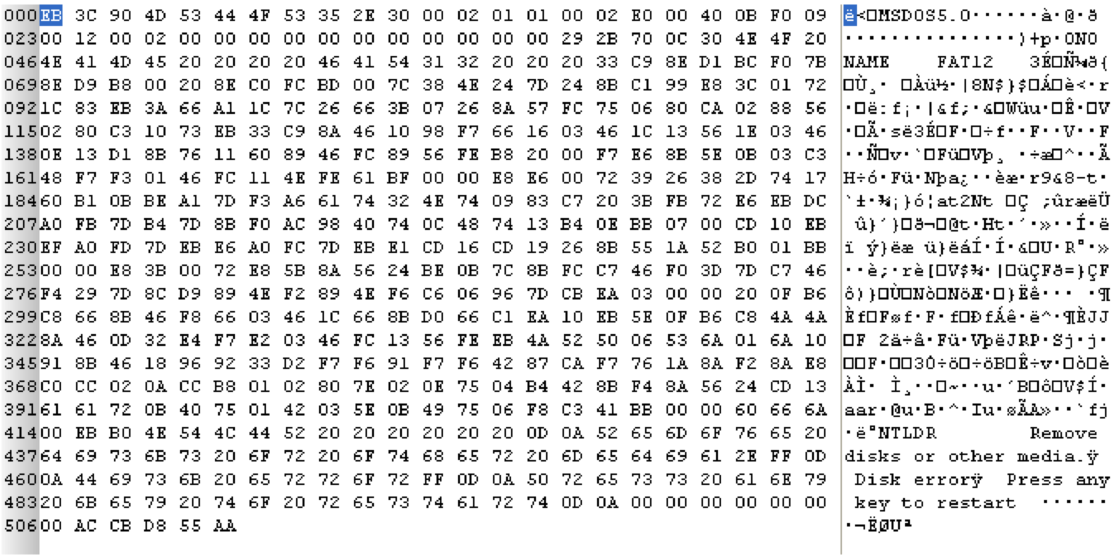
   (e) State the names of directories, if any, and how you identified them. [3]

   (f) State the names of deleted files, if any, including their extensions and how you identified them. [3]

   (g) For the file passwords.txt located in the root directory; what is the logical file size and how did you identify it? [3]

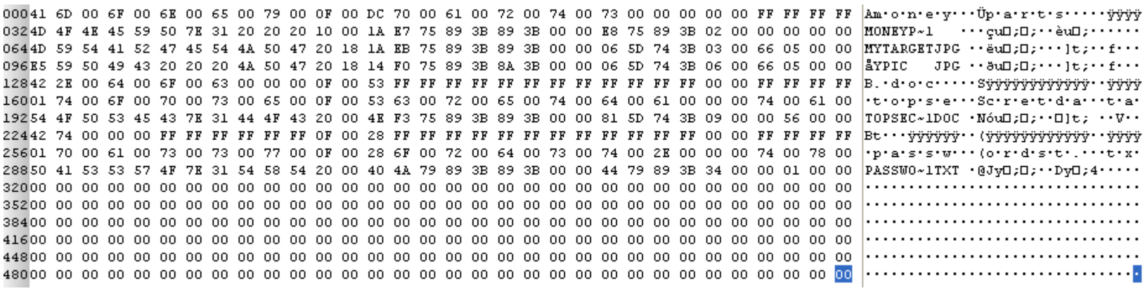
Hint: help tables are provided in the appendix

FIGURE Q2.1: 512 Bytes extracted from DOS Boot Record.



```
000EB 3C 90 4D 53 44 4F 53 35 2E 30 00 02 01 01 00 02 E0 00 40 0B F0 09  ë<□MSDOS5.0······à·@·ð
02300 12 00 02 00 00 00 00 00 00 00 00 00 00 00 29 2B 70 0C 30 4E 4F 20  ···············)+p·0NO 
0464E 41 4D 45 20 20 20 20 46 41 54 31 32 20 20 20 33 C9 8E D1 BC F0 7B  NAME    FAT12   3É□Ñ¼ð{
0698E D9 B8 00 20 8E C0 FC BD 00 7C 38 4E 24 7D 24 8B C1 99 E8 3C 01 72  □Ù¸· □Àü½·|8N$}$□Á□è<·r
0921C 83 EB 3A 66 A1 1C 7C 26 66 3B 07 26 8A 57 FC 75 06 80 CA 02 88 56  ·□ë:f¡·|&f;·&□Wüu·□Ê·□V
11502 80 C3 10 73 EB 33 C9 8A 46 10 98 F7 66 16 03 46 1C 13 56 1E 03 46  ·□Ã·së3É□F·□÷f··F··V··F
1380E 13 D1 8B 76 11 60 89 46 FC 89 56 FE B8 20 00 F7 E6 8B 5E 0B 03 C3  ··Ñ□v·`□Fü□Vþ¸ ·÷æ□^··Ã
16148 F7 F3 01 46 FC 11 4E FE 61 BF 00 00 E8 E6 00 72 39 26 38 2D 74 17  H÷ó·Fü·Nþa¿··èæ·r9&8-t·
18460 B1 0B BE A1 7D F3 A6 61 74 32 4E 74 09 83 C7 20 3B FB 72 E6 EB DC  `±·¾¡}ó¦at2Nt □Ç ;ûræëÜ
207A0 FB 7D B4 7D 8B F0 AC 98 40 74 0C 48 74 13 B4 0E BB 07 00 CD 10 EB   û}´}□ð¬□@t·Ht·´·»··Í·ë
230EF A0 FD 7D EB E6 A0 FC 7D EB E1 CD 16 CD 19 26 8B 55 1A 52 B0 01 BB  ï ý}ëæ ü}ëáÍ·Í·&□U·R°·»
25300 00 E8 3B 00 72 E8 5B 8A 56 24 BE 0B 7C 8B FC C7 46 F0 3D 7D C7 46  ··è;·rè[□V$¾·|□üÇFð=}ÇF
276F4 29 7D 8C D9 89 4E F2 89 4E F6 C6 06 96 7D CB EA 03 00 00 20 0F B6  ô)}□Ù□Nò□NöÆ·□}Ëê···  ·¶
299C8 66 8B 46 F8 66 03 46 1C 66 8B D0 66 C1 EA 10 EB 5E 0F B6 C8 4A 4A  Èf□Føf·F·f□ÐfÁê·ë^·¶ÈJJ
3228A 46 0D 32 E4 F7 E2 03 46 FC 13 56 FE EB 4A 52 50 06 53 6A 01 6A 10  □F 2ä÷â·Fü·VþëJRP·Sj·j·
34591 8B 46 18 96 92 33 D2 F7 F6 91 F7 F6 42 87 CA F7 76 1A 8A F2 8A E8  □□F·□□3Ò÷ö□÷öB□Ê÷v·□ò□è
368C0 CC 02 0A CC B8 01 02 80 7E 02 0E 75 04 B4 42 8B F4 8A 56 24 CD 13  ÀÌ· Ì¸··□~··u·´B□ô□V$Í·
39161 61 72 0B 40 75 01 42 03 5E 0B 49 75 06 F8 C3 41 BB 00 00 60 66 6A  aar·@u·B·^·Iu·øÃA»··`fj
41400 EB B0 4E 54 4C 44 52 20 20 20 20 20 20 0D 0A 52 65 6D 6F 76 65 20  ·ë°NTLDR      Remove 
43764 69 73 6B 73 20 6F 72 20 6F 74 68 65 72 20 6D 65 64 69 61 2E FF 0D  disks or other media.ÿ
4600A 44 69 73 6B 20 65 72 72 6F 72 FF 0D 0A 50 72 65 73 73 20 61 6E 79   Disk errorÿ  Press any
48320 6B 65 79 20 74 6F 20 72 65 73 74 61 72 74 0D 0A 00 00 00 00 00 00   key to restart  ······
50600 AC CB D8 55 AA                                                      ·¬ËØUª
```

FIGURE Q2.2: 512 Bytes extracted from the Root Directory.



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00041 6D 00 6F 00 6E 00 65 00 79 00 0F 00 DC 70 00 61 00 72 00 74 00 73 00 00 00 00 00 FF FF FF FF  Am·o·n·e·y···Üp·a·r·t·s·····ÿÿÿÿ
0324D 4F 4E 45 59 50 7E 31 20 20 20 10 00 1A E7 75 89 3B 89 3B 00 00 E8 75 89 3B 02 00 00 00 00 00  MONEYP~1   ···çu□;□;··èu□;······
0644D 59 54 41 52 47 45 54 4A 50 47 20 18 1A EB 75 89 3B 89 3B 00 00 06 5D 74 3B 03 00 66 05 00 00  MYTARGETJPG ··ëu□;□;···]t;··f···
096E5 59 50 49 43 20 20 20 4A 50 47 20 18 14 F0 75 89 3B 8A 3B 00 00 06 5D 74 3B 06 00 66 05 00 00  åYPIC   JPG ··ðu□;□;···]t;··f···
12842 2E 00 64 00 6F 00 63 00 00 00 0F 00 53 FF FF FF FF FF FF FF FF FF FF FF FF 00 00 FF FF FF FF  B.·d·o·c·····Sÿÿÿÿÿÿÿÿÿÿÿÿ··ÿÿÿÿ
16001 74 00 6F 00 70 00 73 00 65 00 0F 00 53 63 00 72 00 65 00 74 00 64 00 61 00 00 00 74 00 61 00  ·t·o·p·s·e···Sc·r·e·t·d·a···t·a·
19254 4F 50 53 45 43 7E 31 44 4F 43 20 00 4E F3 75 89 3B 89 3B 00 00 81 5D 74 3B 09 00 00 56 00 00  TOPSEC~1DOC ·Nóu□;□;··□]t; ··V··
22442 74 00 00 00 FF FF FF FF FF FF 0F 00 28 FF FF FF FF FF FF FF FF FF FF FF FF 00 00 FF FF FF FF  Bt···ÿÿÿÿÿÿ··(ÿÿÿÿÿÿÿÿÿÿÿÿ··ÿÿÿÿ
25601 70 00 61 00 73 00 73 00 77 00 0F 00 28 6F 00 72 00 64 00 73 00 74 00 2E 00 00 00 74 00 78 00  ·p·a·s·s·w···(o·r·d·s·t·.···t·x·
28850 41 53 53 57 4F 7E 31 54 58 54 20 00 40 4A 79 89 3B 89 3B 00 00 44 79 89 3B 34 00 00 01 00 00  PASSWO~1TXT ·@Jy□;□;··Dy□;4·····
32000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ································
35200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ································
38400 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ································
41600 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ································
44800 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ································
48000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ································
```

continued

3. Figure 3.1 shows a basic directory entry structure and the hexadecimal data associated from a windows OS based machine uses Intel processor, find out the following:

FIGURE 3.1: Basic directory entry structure and Hex. data associate.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
E5	**4F**	**50**	**20**	**20**	**20**	**20**	**20**	**54**	**58**	**54**	**20**	**18**	**84**	**82**	**70**	**9F**	**2D**	**9F**	**2D**	**00**	**00**	**F1**	**71**	**9F**	**2D**	**16**	**02**	**80**	**00**	**00**	**00**
Status	File Name							Extension			Attributes	Reserved		Created				Date Accessed		Unused		Written				Cluster Starting		File Size			
														Time		Date						Time		Date							

(a) What is the file system type this directory entry structure is part of? [2]

(b) Briefly explain what the starting cluster section contains and how it is used? [4]

(c) What is the status of the file; and how did you identify it? [2]

(d) What is the logical file size and how did you identify it? [5]

(e) When was the file created; including date and time; show your calculations? [12]

SECTION B

4. (a) Define the following security related concepts: Information Security, Security attacks/threats, Security services, security mechanism. [18]

(b) Describe one-time pad and explain why it is secure. [7]

5. (a) Define Symmetric cipher and a-Symmetric cipher. [4]

(b) Use symmetric ciphers to encrypt message "hello" and decrypt message "DEFINE". [8]

The representation of characters in modulo 26 is described as follows:

Plaintext →	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
Ciphertext →	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Value →	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

The mathematical equations for encryption and decryption can be described as follows:

Encryption $E_{(k)}$: i ! i + k mod 26

Decryption $D_{(k)}$: i ! i - k mod 26

i represents the messages (plaintext or cipher), k represents a symmetric key. In this case k=18

(c) Define Fiestel cipher and explain how it works. [11]

(d) The message is placed row-wise in a 2D array (in this case 3x5 matrix) starting at top left. The encrypted message is read out column-wise starting at the bottom right. Write down plaintext and encrypted messages.

D	E	F	A	C
	T		O	S
T	A	N		D

[2]

6. (a) Describe a method that can provide integrity. [2]

(b) Define KDC (key distribution center) and describe the types how the keys are distributed. [8]

(c) (i) Explain how Needham Schroeder Protocol operates and use the diagram to assist your analysis. [10]

(ii) Explain the vulnerability in Needham-Shroeder protocol and how to overcome it? [5]

END OF QUESTIONS

Appendix: FAT directory entries tables have been taken from the following book:
B. Carrier, File System Forensic Analysis, Addison Wesley Professional, 2005.

The following table shows the data structure for the DOS Boot Record:

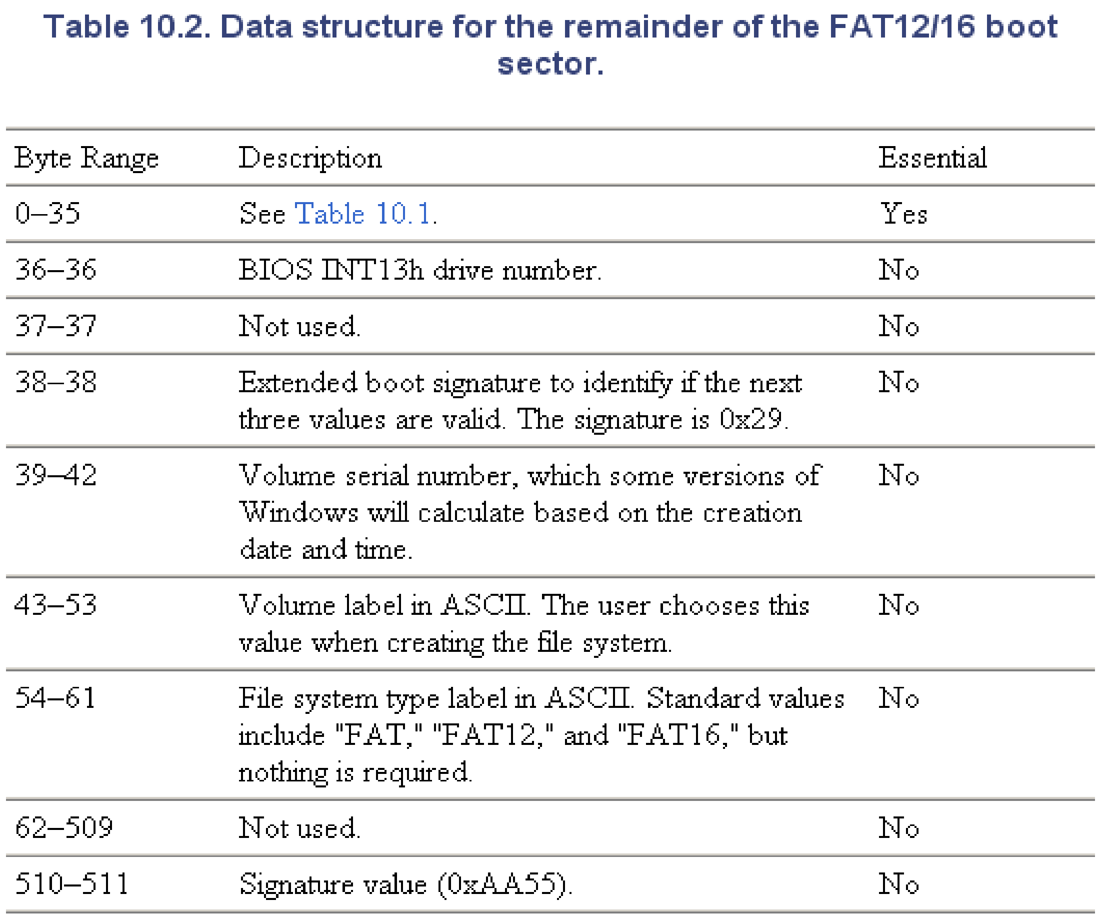


Table 10.2. Data structure for the remainder of the FAT12/16 boot sector.

Byte Range	Description	Essential
0–35	See Table 10.1.	Yes
36–36	BIOS INT13h drive number.	No
37–37	Not used.	No
38–38	Extended boot signature to identify if the next three values are valid. The signature is 0x29.	No
39–42	Volume serial number, which some versions of Windows will calculate based on the creation date and time.	No
43–53	Volume label in ASCII. The user chooses this value when creating the file system.	No
54–61	File system type label in ASCII. Standard values include "FAT," "FAT12," and "FAT16," but nothing is required.	No
62–509	Not used.	No
510–511	Signature value (0xAA55).	No

continued

The following table shows the data structure for the first 36 bytes of the DOS Boot Record:

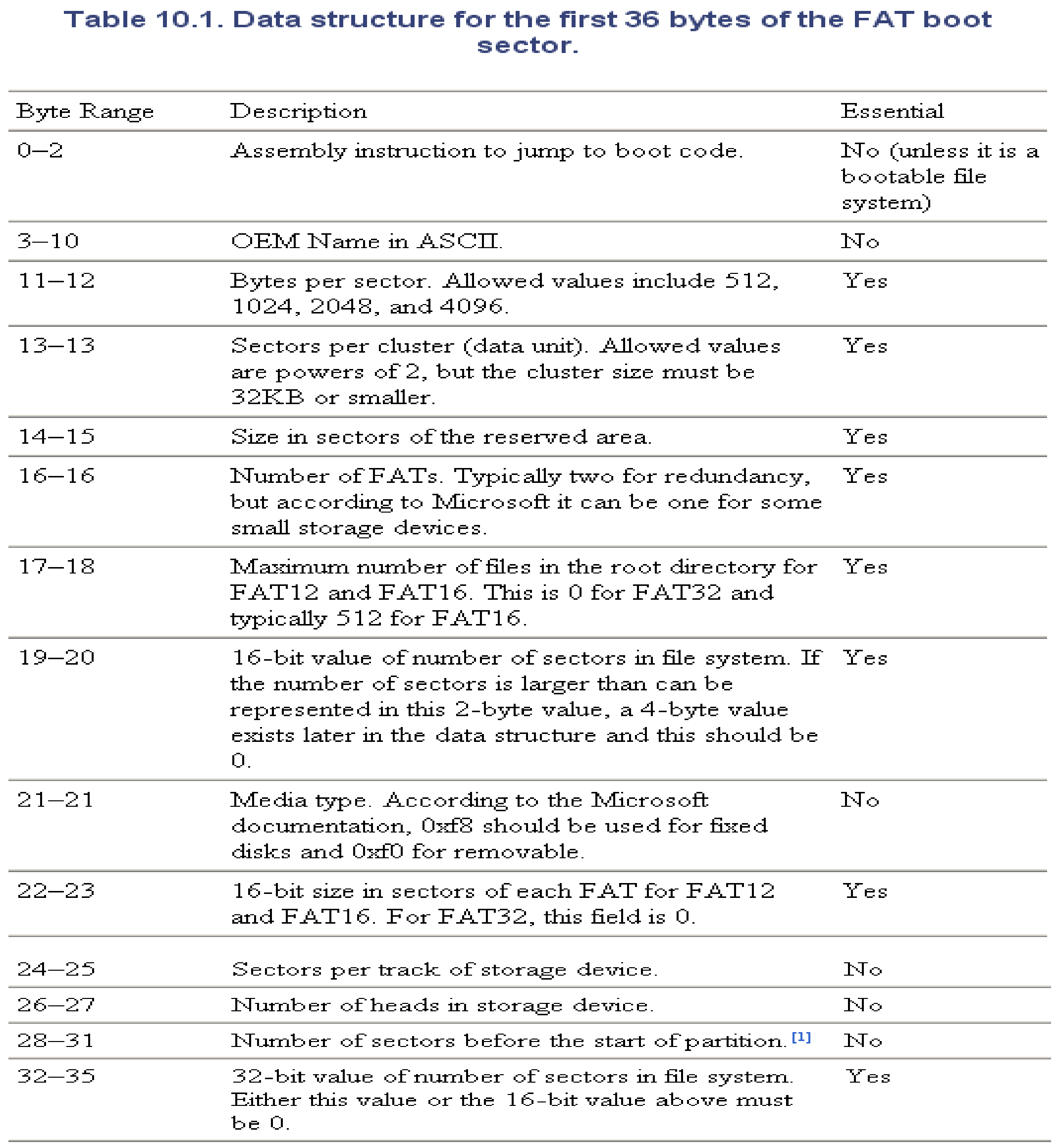


Table 10.1. Data structure for the first 36 bytes of the FAT boot sector.

Byte Range	Description	Essential
0–2	Assembly instruction to jump to boot code.	No (unless it is a bootable file system)
3–10	OEM Name in ASCII.	No
11–12	Bytes per sector. Allowed values include 512, 1024, 2048, and 4096.	Yes
13–13	Sectors per cluster (data unit). Allowed values are powers of 2, but the cluster size must be 32KB or smaller.	Yes
14–15	Size in sectors of the reserved area.	Yes
16–16	Number of FATs. Typically two for redundancy, but according to Microsoft it can be one for some small storage devices.	Yes
17–18	Maximum number of files in the root directory for FAT12 and FAT16. This is 0 for FAT32 and typically 512 for FAT16.	Yes
19–20	16-bit value of number of sectors in file system. If the number of sectors is larger than can be represented in this 2-byte value, a 4-byte value exists later in the data structure and this should be 0.	Yes
21–21	Media type. According to the Microsoft documentation, 0xf8 should be used for fixed disks and 0xf0 for removable.	No
22–23	16-bit size in sectors of each FAT for FAT12 and FAT16. For FAT32, this field is 0.	Yes
24–25	Sectors per track of storage device.	No
26–27	Number of heads in storage device.	No
28–31	Number of sectors before the start of partition.[1]	No
32–35	32-bit value of number of sectors in file system. Either this value or the 16-bit value above must be 0.	Yes

continued

The following table shows the data structure for the directory entry:

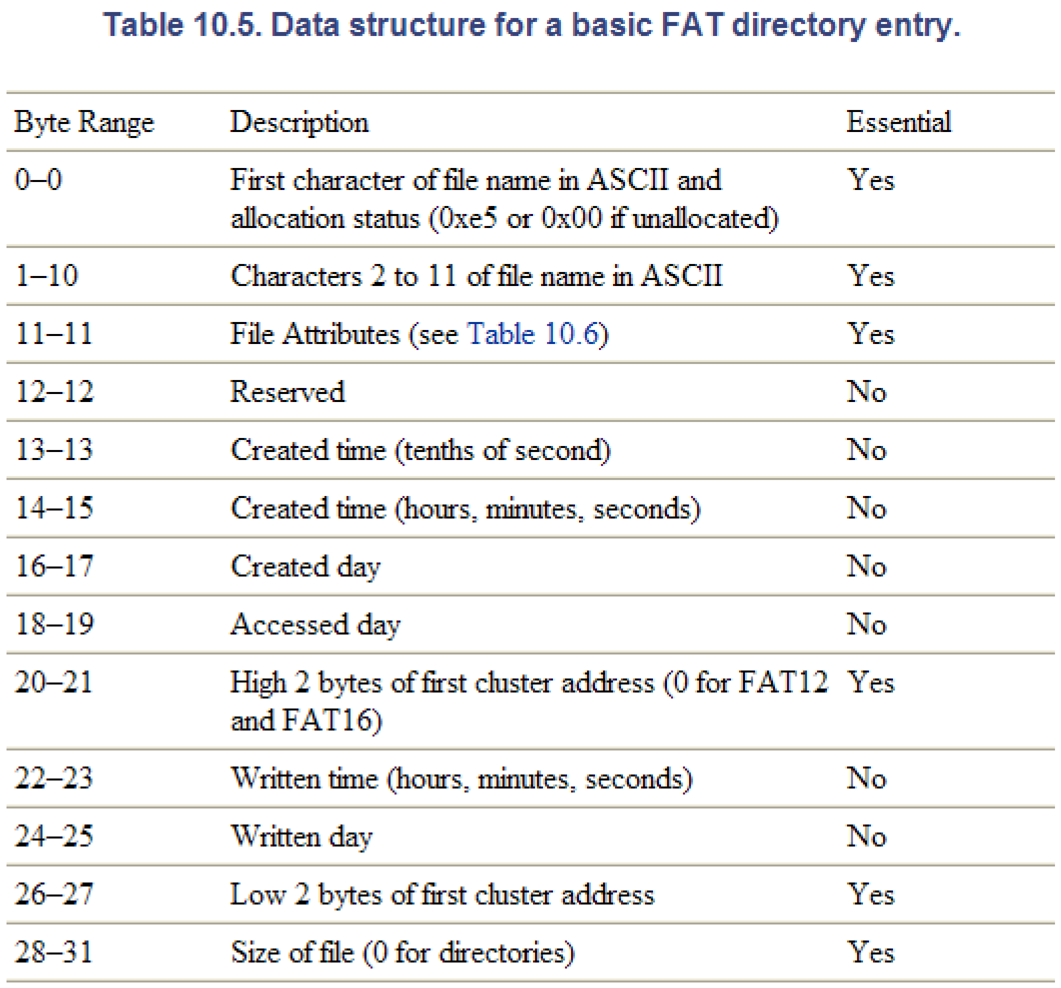


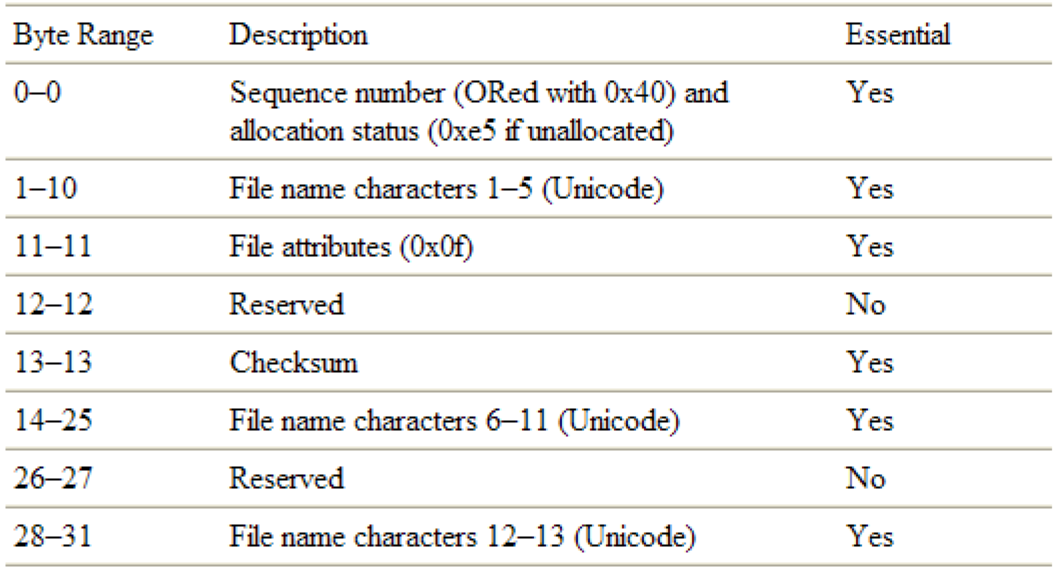
Table 10.5. Data structure for a basic FAT directory entry.

Byte Range	Description	Essential
0–0	First character of file name in ASCII and allocation status (0xe5 or 0x00 if unallocated)	Yes
1–10	Characters 2 to 11 of file name in ASCII	Yes
11–11	File Attributes (see Table 10.6)	Yes
12–12	Reserved	No
13–13	Created time (tenths of second)	No
14–15	Created time (hours, minutes, seconds)	No
16–17	Created day	No
18–19	Accessed day	No
20–21	High 2 bytes of first cluster address (0 for FAT12 and FAT16)	Yes
22–23	Written time (hours, minutes, seconds)	No
24–25	Written day	No
26–27	Low 2 bytes of first cluster address	Yes
28–31	Size of file (0 for directories)	Yes

continued

The following table shows the data structure for the long file name directory entry:

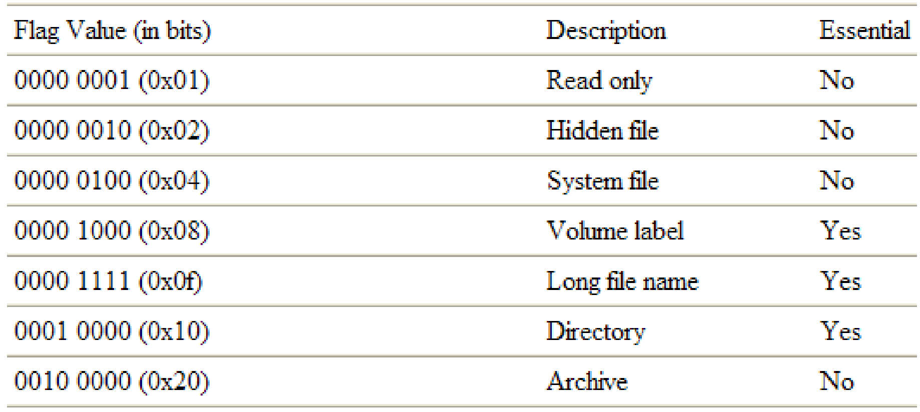
Table 10.7. Data structure for an LFN FAT directory entry.



Byte Range	Description	Essential
0–0	Sequence number (ORed with 0x40) and allocation status (0xe5 if unallocated)	Yes
1–10	File name characters 1–5 (Unicode)	Yes
11–11	File attributes (0x0f)	Yes
12–12	Reserved	No
13–13	Checksum	Yes
14–25	File name characters 6–11 (Unicode)	Yes
26–27	Reserved	No
28–31	File name characters 12–13 (Unicode)	Yes

The following table shows the flag values for the directory entry attributes field and the corresponding description of each value:

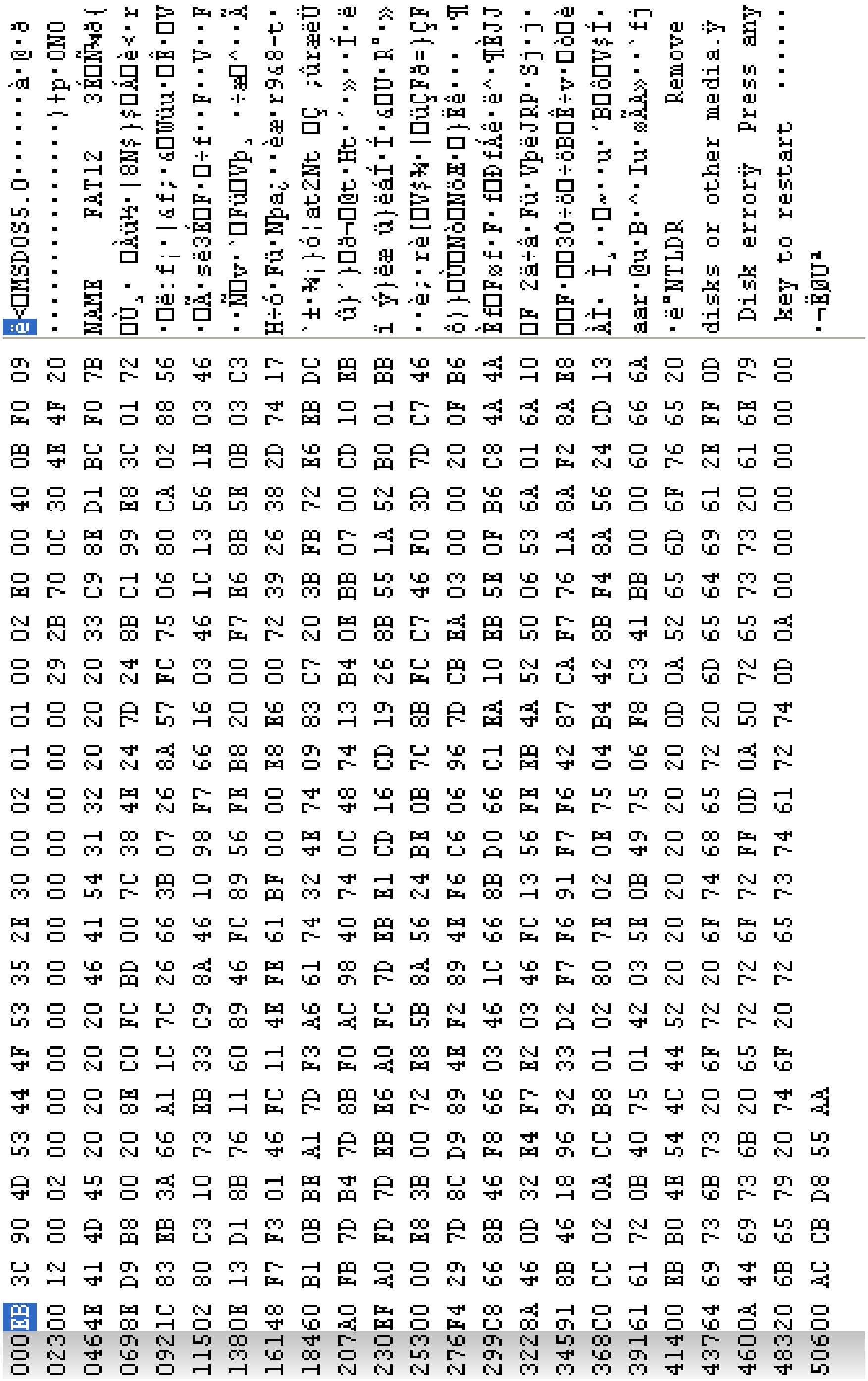
Table 10.6. Flag values for the directory entry attributes field.



Flag Value (in bits)	Description	Essential
0000 0001 (0x01)	Read only	No
0000 0010 (0x02)	Hidden file	No
0000 0100 (0x04)	System file	No
0000 1000 (0x08)	Volume label	Yes
0000 1111 (0x0f)	Long file name	Yes
0001 0000 (0x10)	Directory	Yes
0010 0000 (0x20)	Archive	No

continued

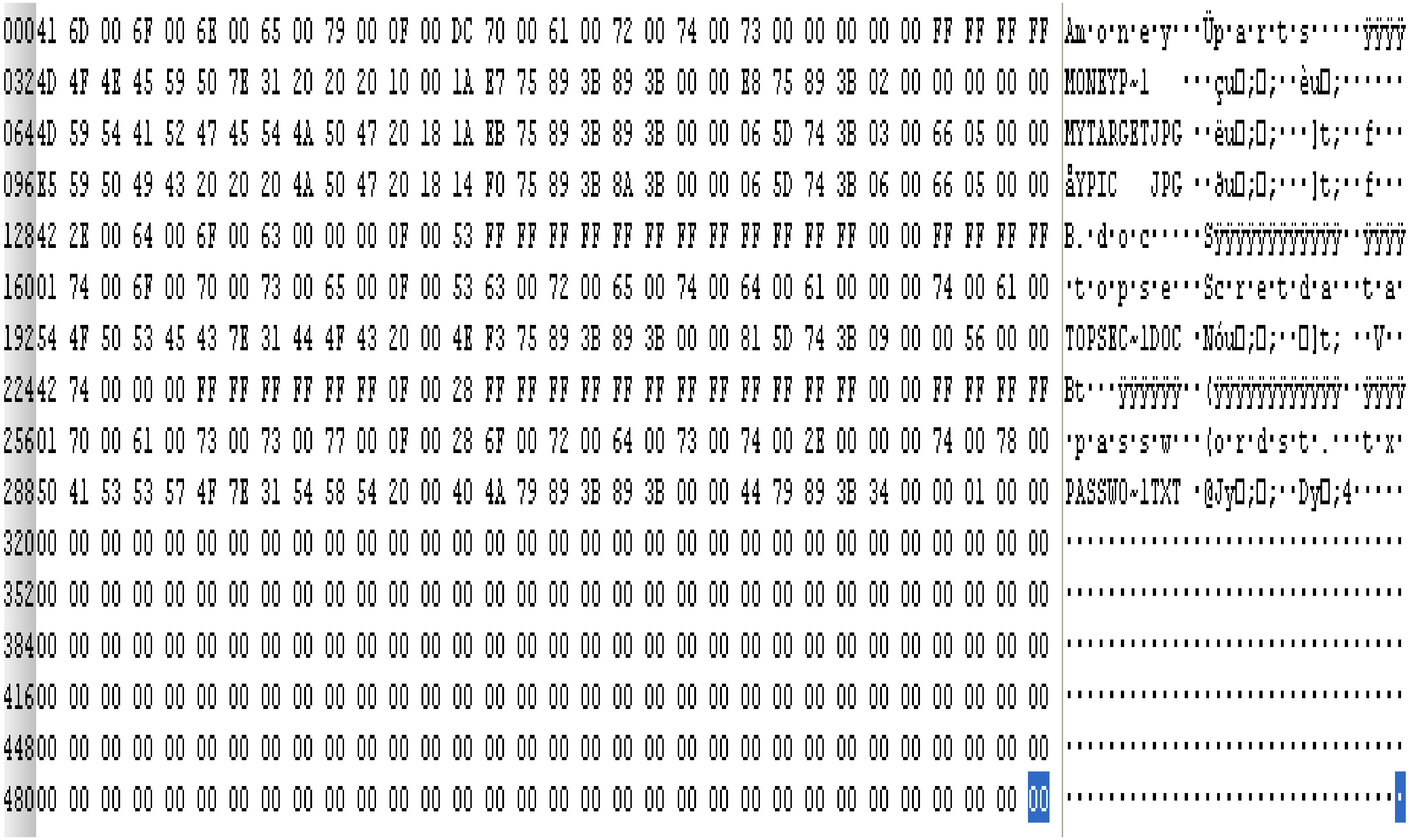
The following figure is a copy of question 2 figure 1 which shows the DOS Boot Record; it may help you by being easier to read.



```
000EB 3C 90 4D 53 44 4F 53 35 2E 30 00 02 01 01 00 02 E0 00 40 0B F0 09  ë<□MSDOS5.0······à·@·ð
02300 12 00 02 00 00 00 00 00 00 00 00 00 00 00 29 2B 70 0C 30 4E 4F 20  ···············)+p·0NO 
0464E 41 4D 45 20 20 20 20 46 41 54 31 32 20 20 20 33 C9 8E D1 BC F0 7B  NAME    FAT12   3É□Ñ¼ð{
0698E D9 B8 00 20 8E C0 FC BD 00 7C 38 4E 24 7D 24 8B C1 99 E8 3C 01 72  □Ù¸· □Àü½·|8N$}$□Á□è<·r
0921C 83 EB 3A 66 A1 1C 7C 26 66 3B 07 26 8A 57 FC 75 06 80 CA 02 88 56  ·□ë:f¡·|&f;·&□Wüu·□Ê·□V
11502 80 C3 10 73 EB 33 C9 8A 46 10 98 F7 66 16 03 46 1C 13 56 1E 03 46  ·□Ã·së3É□F·□÷f··F··V··F
1380E 13 D1 8B 76 11 60 89 46 FC 89 56 FE B8 20 00 F7 E6 8B 5E 0B 03 C3  ··Ñ□v·`□Fü□Vþ¸ ·÷æ□^··Ã
16148 F7 F3 01 46 FC 11 4E FE 61 BF 00 00 E8 E6 00 72 39 26 38 2D 74 17  H÷ó·Fü·Nþa¿··èæ·r9&8-t·
18460 B1 0B BE A1 7D F3 A6 61 74 32 4E 74 09 83 C7 20 3B FB 72 E6 EB DC  `±·¾¡}ó¦at2Nt □Ç ;ûræëÜ
207A0 FB 7D B4 7D 8B F0 AC 98 40 74 0C 48 74 13 B4 0E BB 07 00 CD 10 EB   û}´}□ð¬□@t·Ht·´·»··Í·ë
230EF A0 FD 7D EB E6 A0 FC 7D EB E1 CD 16 CD 19 26 8B 55 1A 52 B0 01 BB  ï ý}ëæ ü}ëáÍ·Í·&□U·R°·»
25300 00 E8 3B 00 72 E8 5B 8A 56 24 BE 0B 7C 8B FC C7 46 F0 3D 7D C7 46  ··è;·rè[□V$¾·|□üÇFð=}ÇF
276F4 29 7D 8C D9 89 4E F2 89 4E F6 C6 06 96 7D CB EA 03 00 00 20 0F B6  ô)}□Ù□Nò□NöÆ·□}Ëê···  ·¶
299C8 66 8B 46 F8 66 03 46 1C 66 8B D0 66 C1 EA 10 EB 5E 0F B6 C8 4A 4A  Èf□Føf·F·f□ÐfÁê·ë^·¶ÈJJ
3228A 46 0D 32 E4 F7 E2 03 46 FC 13 56 FE EB 4A 52 50 06 53 6A 01 6A 10  □F 2ä÷â·Fü·VþëJRP·Sj·j·
34591 8B 46 18 96 92 33 D2 F7 F6 91 F7 F6 42 87 CA F7 76 1A 8A F2 8A E8  □□F·□□3Ò÷ö□÷öB□Ê÷v·□ò□è
368C0 CC 02 0A CC B8 01 02 80 7E 02 0E 75 04 B4 42 8B F4 8A 56 24 CD 13  ÀÌ· Ì¸··□~··u·´B□ô□V$Í·
39161 61 72 0B 40 75 01 42 03 5E 0B 49 75 06 F8 C3 41 BB 00 00 60 66 6A  aar·@u·B·^·Iu·øÃA»··`fj
41400 EB B0 4E 54 4C 44 52 20 20 20 20 20 20 0D 0A 52 65 6D 6F 76 65 20  ·ë°NTLDR      ··Remove 
43764 69 73 6B 73 20 6F 72 20 6F 74 68 65 72 20 6D 65 64 69 61 2E FF 0D  disks or other media.ÿ·
4600A 44 69 73 6B 20 65 72 72 6F 72 FF 0D 0A 50 72 65 73 73 20 61 6E 79  ·Disk errorÿ··Press any
48320 6B 65 79 20 74 6F 20 72 65 73 74 61 72 74 0D 0A 00 00 00 00 00 00   key to restart········
50600 AC CB D8 55 AA                                                      ·¬ËØUª
```

continued

The following figure is a copy of question 2 figure 2 which shows the first 512 Bytes extracted from the Root Directory, It may help you by being easier to read.



```
00041 6D 00 6F 00 6E 00 65 00 79 00 0F 00 DC 70 00 61 00 72 00 74 00 73 00 00 00 00 00 FF FF FF FF  Am·o·n·e·y···Üp·a·r·t·s·····ÿÿÿÿ
0324D 4F 4E 45 59 50 7E 31 20 20 20 10 00 1A E7 75 89 3B 89 3B 00 00 E8 75 89 3B 02 00 00 00 00 00  MONEYP~1   ···çu□;□;··èu□;······
0644D 59 54 41 52 47 45 54 4A 50 47 20 18 1A EB 75 89 3B 89 3B 00 00 06 5D 74 3B 03 00 66 05 00 00  MYTARGETJPG ··ëu□;□;···]t;··f···
096E5 59 50 49 43 20 20 20 4A 50 47 20 18 14 F0 75 89 3B 8A 3B 00 00 06 5D 74 3B 06 00 66 05 00 00  åYPIC   JPG ··ðu□;□;···]t;··f···
12842 2E 00 64 00 6F 00 63 00 00 00 0F 00 53 FF FF FF FF FF FF FF FF FF FF FF FF 00 00 FF FF FF FF  B.·d·o·c·····Sÿÿÿÿÿÿÿÿÿÿÿÿ··ÿÿÿÿ
16001 74 00 6F 00 70 00 73 00 65 00 0F 00 53 63 00 72 00 65 00 74 00 64 00 61 00 00 00 74 00 61 00  ·t·o·p·s·e···Sc·r·e·t·d·a···t·a·
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