

Foundations of Information Systems

Mock Exam

January 24, 2024

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0 NUL	1 SOH	2 STX	3 ETX	4 EOT	5 ENQ	6 ACK	7 BEL	8 BS	9 HT	10 LF	11 VT	12 FF	13 CR	14 SO	15 SI
1	16 DLE	17 DC1	18 DC2	19 DC3	20 DC4	21 NAK	22 SYN	23 ETB	24 CAN	25 EM	26 SUB	27 ESC	28 FS	29 GS	30 RS	31 US
2	32 SPACE	33 EXCLAM. MARK	34 QUOT. MARK	35 HASH	36 DOLLAR SIGN	37 PERCENT SIGN	38 &	39 AMPERSAND	40 LEFT PAREN.	41 RIGHT PAREN.	42 ASTERISK	43 PLUS SIGN	44 COMMA	45 HYPHEN-MINUS	46 FULL STOP	47 SOLIDUS
3	48 DIGIT ZERO	49 DIGIT ONE	50 DIGIT TWO	51 DIGIT THREE	52 DIGIT FOUR	53 DIGIT FIVE	54 DIGIT SIX	55 DIGIT SEVEN	56 DIGIT EIGHT	57 DIGIT NINE	58 COLON	59 SEMI-COLON	60 LESS-THAN SIGN	61 EQUALS SIGN	62 GREATER-THAN SIGN	63 QUESTION MARK
4	64 COMM. AT	65 A	66 B	67 C	68 D	69 E	70 F	71 G	72 H	73 I	74 J	75 K	76 L	77 M	78 N	79 O
5	80 P	81 Q	82 R	83 S	84 T	85 U	86 V	87 W	88 X	89 Y	90 Z	91 LEFT SQ. BRACKET	92 REVERSE SOLIDUS	93 RIGHT SQ. BRACKET	94 CIRCUMFLEX ACCENT	95 LOW LINE
6	96 GRAVE ACCENT	97 a	98 b	99 c	100 d	101 e	102 f	103 g	104 h	105 i	106 j	107 k	108 l	109 m	110 n	111 o
7	112 p	113 q	114 r	115 s	116 t	117 u	118 v	119 w	120 x	121 y	122 z	123 LEFT CURLY BRACKET	124 VERTICAL LINE	125 RIGHT CURLY BRACKET	126 TILDE	127 DELETE

ASCII code table including entity references, control codes and Unicode names (1.1)

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1. A Boolean function is described by the following truth table:

a	b	c	z
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

- (a) Write out a Boolean algebra expression for this function.
(b) Simplify the expression as much as possible.

Hint: In the final expression, each of the input variables should appear exactly once.

- (c) Draw a realization of this Boolean function via logic gates.

Note: If you get stuck in part (b), you can draw the version from part (a).

(5+5+5)

2. Interpret the 8-bit string 01001001 in each of the following ways:

- (a) Unsigned integer
(b) Signed two's complement integer
(c) ASCII
(d) An 8-bit floating point representation where the leading bit is the sign, the next three bits encode the exponent with a bias of 3, and the last four bits encode the normalized mantissa, with the leading 1 before the binary point implied, but not stored
(e) Hamming-(8,4)-encoded bit string (correct or detect errors, if necessary)

(5+5+5+5+5)

3. For each of the following cases, is it possible to construct a finite state transducer that reads the infinitely repeating input sequence 01010101... and outputs the stated infinite output sequence? If possible, draw the finite state transducer, otherwise argue why it cannot be done.

- (a) ABABABAB...
(b) AAAAABABABA...
(c) ABBAABBBBBAAAAABBBBBB...

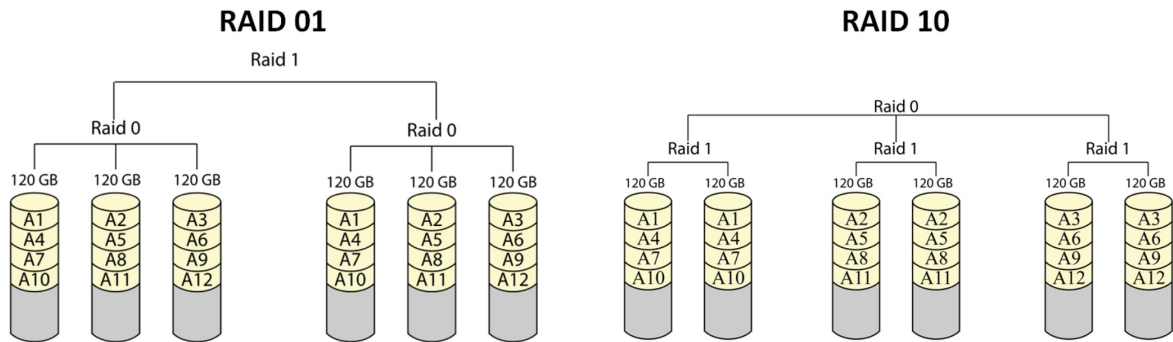
(5+5+5)

4. Consider what is known as the “cigarette-smoker’s problem”: Three smokers are sitting around a table. The first has a supply of paper, the second has tobacco, and the third has matches. There is also an agent who has all three, but does not smoke. The agent randomly places two different of the three ingredients on the table. The smoker who has the third missing ingredient could then roll a cigarette, light it, and smoke. When done, the smoker signals the agent to continue providing the next set of two items.

- (a) State the four necessary conditions for deadlock.
- (b) Explain why, without further provisions, each of the four necessary conditions for deadlock is present here, then describe how deadlock is possible.

(4+6)

5. A RAID-01 configuration is a RAID-1 (“mirroring”) arrangement of several RAID-0 (“striping”) disk arrays. A RAID-10 configuration is similar, but in reversed order. Consider the 6-disk case as shown:



(Image from: <https://serverfault.com/a/848689>)

- (a) What is the total storage capacity of the RAID-01 or RAID-10 array as shown?
- (b) What is the read speed of RAID-01 or RAID-10 compared to the read speed of a single disk?
- (c) What is the write speed of RAID-01 or RAID-10 compared to the write speed of a single disk?
- (d) Which one is safer? Answer this question assuming, as is often the case in practical implementations, that an entire RAID-0 array is failing as soon a single disk in that array is failing.

(5+5+5+5)