

# TEST: Model answers for Markers

(For V4.1/4.2/4.3/4.4)

## COMPSCI.210.F.T Computer Systems

2nd May 2003, 13:35 - 14:25pm

(TIME ALLOWED: 50 MINUTES)

**DO NOT START, DO NOT OPEN SCRIPT!**

UNTIL INSTRUCTED TO DO SO.

Please write your family name, given name and student ID at the top of every page. Answer all questions on the test paper in the spaces provided. The test is out of 100 (as a guide: allow approx 1 minute for every 2 marks). The test is worth 15% of your final grade.

No calculators are allowed!

There are three parts to the test. Part A (worth 40%) is on Data Representation Part B (worth 40%) is on UNIX and Part C (worth 20%) is on the remainder of the material.

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**PART A: Data Representation (worth 40% = 40 Marks)**

**A. 1**

Convert the following decimal numbers first to binary and then to hexadecimal: [4 marks]

$27_{10}$

$121_{10}$

$11011_2 = 1B_{16}$

$1111001_2 = 79_{16}$

**A. 2**

Perform the following operations in 8-bit two's complement arithmetic showing explicitly the overflow and carry outcomes: [6 marks]

0110 1110  
+ 0011 0101

1101 0011  
+ 1011 0110

(0)1010 0011 ovfl occurs

(1)10001001 no ovfl

**A. 3**

Convert the following unsigned hexadecimal numbers to octal: [4 marks]

$2255_{16}$

$11EC3_{16}$

easiest to convert to binary first

$10001001010101_2$

$21125_8$

$10001111011000011_2$

$217303_8$

**A. 4**

Convert the recurring decimal  $-41.33\dot{3}$  into binary floating point assuming the following 16 (should have read "17" bits) bit format: the sign bit is in the MSB position. The next six (6) bits are allocated to storing the exponent which assumes an XS32 representation, i.e., offset binary with  $k = 32$ , and the remaining ten (10) LSB's record the fraction, stored according to the VAX normalisation convention, i.e.,  $.1M$ . [6 marks]

$41.33\dot{3} = 101001.010\dot{1}_2 = .101001010\dot{1} \times 2^{-6}$

the sign bit will be 1

the exponent is thus  $32 + 6 = 38_{10} = 100110_2$

The 17 bit result assuming rounding is 11001100100101011

(If only 9 bit fraction assumed the result is 1100110010010101)

Print name clearly: \_\_\_\_\_

**A. 5**

What is the maximum error that may occur in using the above described floating point format (described in the previous question)? You may express this either as a ratio, or as a percentage.

[3 marks]

Assuming the 10 bit mantissa space plus the assumed bit, i.e. 11 bits, the largest absolute error is  $\pm 1$  in the truncated 12th place i.e.  $2^{-12}$ . The fractional error is largest if the truncation error is maximal and the value of the mantissa is minimal. The smallest mantissa value is  $0.5_{10}$ . Thus as a percentage the error is  $2^{-12}/2^{-1} \times 100/1 \approx 100/2000\% = 0.05\%$

**A. 6**

Take the 2's complement of the following 8-bit binary numbers:

[4 marks]

0010 1101

1000 0111

Perform the 1's complement first  
                   11010010<sub>2</sub>                   01111000<sub>2</sub>  
 Then add 1 to get the two's complement  
                   11010011<sub>2</sub>                   01111001<sub>2</sub>

**A. 7**

What values have the following 8-bit binary numbers if one assumes a 1's complement representation:

[4 marks]

0010 1101

1000 0111

The first is positive: read as unsigned binary, the second is negative so take 1's complement as above, then read as unsigned binary.  
                    $32 + 8 + 4 + 1 = 45_{10}$                     $-(64 + 32 + 16 + 8) = -120_{10}$

**A. 8**

Convert the 4 characters "PDP8" into the corresponding ASCII encoded, null delimited, hexadecimal string (see Appendix):

[2 marks]

From the Appendix: 'P' = 50<sub>16</sub>, 'D' = 44<sub>16</sub>, 'P' = 50<sub>16</sub>, '8' = 38<sub>16</sub>, 'NULL' = 00<sub>16</sub> so the string is:  
                   504453800<sub>16</sub>

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**A. 9**

Briefly describe what is meant by the term “Radix 64”

[2 marks]

*Radix 64 means, base 64. That is assuming a numerical representation with 64 symbols {0, 1, 2, ..., etc}. The symbols may be represented as binary strings, so 6 bit representations are required to cover the range. {000000, 000001, 00010, ..., 111111}*

**A. 10**

What does “BCD” stand for? Where might you expect to see this being used?

[3 marks]

*‘BCD’ stands for binary coded decimal. Here each of the decimal digits {0, 1, 2, ..., 9} are represented in 4-bit binary {0000, 0001, 0010, ..., 1001}. Clearly not all of the 4-bit representations are used. BCD is often used in imbedded processor applications where seven segment display of numerical data is a requirement, eg, gas pumps, calculators, etc.*

**A. 11**

Indicate whether you think the following claim is true or false: “Sign magnetude is today the representation of choice for performing arithmetic in modern computers”

[2 marks]

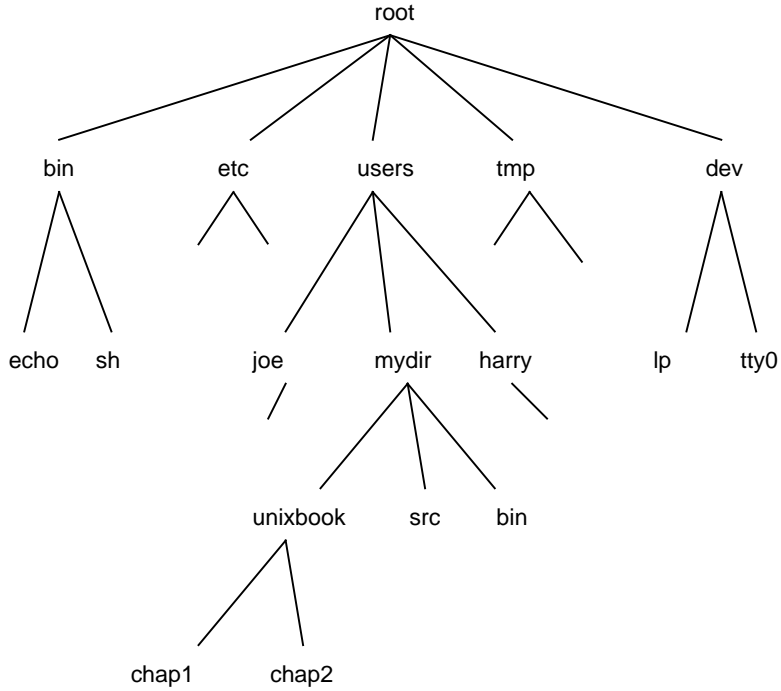
*integer arithmetic almost always assumes Two’s complement, so this would not be true. On the other hand floating point operations are a form of sign magnetude so one could argue the affirmative. On balance I would have to say it is ‘false’.*

Print name clearly: \_\_\_\_\_

### PART B: UNIX (worth 40% = 40 Marks)

#### B. 1

Following is a diagram that shows a file structure commencing at the root directory.



Assume that for each question below, the working directory is `mydir`.  
Give the output following each command line

[16 marks]

a. `echo > echo; ls`

```
bin echo src unixbook
```

b. `cd ../../..; ls`

```
bin dec etc users tmp
```

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c. `cd ../../; ls`

```
bin dec etc users tmp
```

d. `echo *`

```
bin src unixbook
```

e. `echo .*`

```
. .. (and any other hidden files)
```

f. `echo *.`

```
*.
```

g. `echo ../*`

```
../harry ../joe ../mydir
```

h. `echo ../../`

```
../../
```

Print name clearly: \_\_\_\_\_

**B. 2**

Assume that a file called `furniture.txt` contains a list:

```
apples
table
lounge-suite
sofa
chair
tallboy
bed
plantstand
shelf.
```

Give a single line shell command (not a procedure) that converts the contents of the file to a sorted list, excluding duplicates, and saves this in a new file called `furniture.lst`.

[4 marks]

```
sort -u furniture.txt > furniture.lst
```

**B. 3**

Give a `grep` command that will output, from the file `furniture.txt` (see previous question)

[9 marks]

a. all lines in the list containing the letter `l`

```
grep l furniture.txt
```

b. all lines containing at least two `t`'s

```
grep tt furniture.txt
```

c. all lines containing no occurrences of the letter `a`

```
grep -v a furniture.txt
```

Print name clearly: \_\_\_\_\_

**B. 4**

Assume that a Bourne shell variable called `VARIABLE` has been set by typing the line `VARIABLE="my string"`. Give a command that will then display the variable to the terminal screen.

[3 marks]

```
echo $VARIABLE
```

**B. 5**

Write down UNIX shell commands to achieve each of the following tasks:

[8 marks]

a. To combine two text files `Chapt1.txt` and `Chapt2.txt` into a new single text file called `twochaps.txt`:

```
cat Chapt1.txt Chapt2.txt > twochaps.txt
```

b. To initiate a remote secure terminal session from a local UNIX host to a remote UNIX host called `tcode.auckland.ac.nz`, as user `guest`:

```
ssh guest@ tcode.auckland.ac.nz
```

c. To display the current working directory name, and then change the current working directory to its parent directory:

```
pwd; cd .. or pwd; cd ../..
```

d. To display a file `filename` so that the content is displayed a screen-full only at a time.

```
cat filename | more or more filename
```



Print name clearly: \_\_\_\_\_

Part C: Other material (worth 20% = 20 Marks)

**C. 1**

*Describe briefly in your own words what you understand of the following terms:*

*[8 marks]*

*a. BUS*

*Is the parrallel signal paths which convey data, address and control information connecting the processor to memory and other interface Input/output devices such as disk controllers, terminal controller etc*

*b. BACKPLANE*

*Is the physical implementation of the BUS. Often a series of parallel wired connectors into which the modular electronic subsystems are plugged.*

*c. CPU*

*Stands for the central processing unit, contains registers, accumulators,m arithmetic logic unit, and control and status registers etc*

*d. RISC*

*Stands for Reduced Instruction Set Computer, in contrast to CISC (Complex instruction Set Comnputer). RISC machines achieve speed advantages of CISC machines with reduced complexity architecture and overheads, and smaller range of addressing modes etc. and using parallel processing.*

Print name clearly: \_\_\_\_\_

**C. 2**

*What is a program? How is this different from a process?:*

*[6 marks]*

*A program is a list of instructions usually stored as a file on a disk. It is a static representation, whereas a process refers to the running program. A process is dynamic, includes the notion of data and register states.*

**C. 3**

*Is the “shell” strictly part of the UNIX operating system?:*

*[3 marks]*

*The shell is not strictly part of the operating system, but a process which accepts commands from the terminal keyboard, and interprets these commands, displaying results on the terminal screen.*

**C. 4**

*What is meant by the term “standard I/O”?:*

*[3 marks]*

*Unix effectively assumes all data transfers as streams of characters. A process accepts an input stream and outputs a s stream. The standard input device from which characters are taken is the keyboard, and the standard output device is the terminal screen.*

# 1 Appendix

## American Standard Code for Information Interchange (ASCII)

b7 b6 BITS b5 b4 b3 b2 b1	0 0		0 1		1 0		1 1									
	0 1		0 1		0 1		0 1									
	CONTROL				SYMBOLS NUMBERS				UPPER CASE				LOWER CASE			
0 0 0 0	0 NUL	16 DLE	32 SP	48 0	64 @	80 P	96 ' ' p	112 p	128	144	160	176	192	208	224	240
0 0 0 1	1 SOH	17 DC1	33 !	49 1	65 A	81 Q	97 a	113 q	129	145	161	177	193	209	225	241
0 0 1 0	2 STX	18 DC2	34 " "	50 2	66 B	82 R	98 b	114 r	130	146	162	178	194	210	226	242
0 0 1 1	3 ETX	19 DC3	35 #	51 3	67 C	83 S	99 c	115 s	131	147	163	179	195	211	227	243
0 1 0 0	4 EOT	20 DC4	36 \$	52 4	68 D	84 T	100 d	116 t	132	148	164	180	196	212	228	244
0 1 0 1	5 ENQ	21 NAK	37 %	53 5	69 E	85 U	101 e	117 u	133	149	165	181	197	213	229	245
0 1 1 0	6 ACK	22 SYN	38 &	54 6	70 F	86 V	102 f	118 v	134	150	166	182	198	214	230	246
0 1 1 1	7 BEL	23 ETB	39 ' ' 7	55 7	71 G	87 W	103 g	119 w	135	151	167	183	199	215	231	247
1 0 0 0	8 BS	24 CAN	40 ( ( 8	56 8	72 H	88 X	104 h	120 x	136	152	168	184	200	216	232	248
1 0 0 1	9 HT	25 EM	41 ) ) 9	57 9	73 I	89 Y	105 i	121 y	137	153	169	185	201	217	233	249
1 0 1 0	10 LF	26 SUB	42 * *	58 10	74 J	90 Z	106 j	122 z	138	154	170	186	202	218	234	250
1 0 1 1	11 VT	27 ESC	43 + +	59 11	75 K	91 [	107 k	123 {	139	155	171	187	203	219	235	251
1 1 0 0	12 FF	28 FS	44 , ,	60 12	76 L	92 \	108 l	124	140	156	172	188	204	220	236	252
1 1 0 1	13 CR	29 GS	45 - -	61 13	77 M	93 ]	109 m	125 }	141	157	173	189	205	221	237	253
1 1 1 0	14 SO	30 RS	46 . .	62 14	78 N	94 ^	110 n	126 ~	142	158	174	190	206	222	238	254
1 1 1 1	15 SI	31 US	47 / /	63 15	79 O	95 _	111 o	127 DEL	143	159	175	191	207	223	239	255

LEGEND:

dec	CHAR
hex	oct