

Worksheet Data Representation

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Week 3

Do not use a calculator on any of the one below. You must be able to do this using mental arithmetic, or a piece of paper if you require it. On the last sheet you will find a table with ASCII encodings.

1. Assume that we have the datatype char and int.
 - (a) Which set belongs 0 to? Give two other example values of that datatype.
 - (b) Which set belongs '0' to? Give two other example values of that datatype.
 - (c) Which set belongs '\0' to? Give two other example values of that datatype.
2. Assume an 8-bit machine. Write down the binary representations for
 - (a) The int 0
 - (b) The int 1
 - (c) The int 10
 - (d) The int 100
 - (e) The int -1
 - (f) The int -10
 - (g) The int -100
 - (h) The unsigned 10
 - (i) The unsigned 100
 - (j) The unsigned 156
 - (k) The unsigned 246
 - (l) The unsigned 255
 - (m) The character 'd'
 - (n) The character '+'
3. Assume an 8-bit machine. What is the interpretation of each of the following as an int, unsigned, and char?
 - (a) '01100110'
 - (b) '01000110'

4. Assume an 8-bit machine programmed in C. How much is

- (a) `int 100 + 100 + 100 + 100`
- (b) `unsigned 100 + 100 + 100 + 100`
- (c) `int 100 + 100 + 100 - 400`
- (d) `unsigned 100 + 100 + 100 - 400`
- (e) `char '1' + 2`
- (f) `char '2' + 1`
- (g) `char '1' + '2'`
- (h) `char 'p' + ('A' - 'a')`

5. Assume a 32-bit floating point number, containing a sign bit s , an 8-bit unsigned biased exponent e , and a 23 bit mantissa m , such that the value of a number $s|e|m$ is $(-1)^s 2^{e-127} (1 + \frac{m}{2^{23}})$. Write down the representations for

- (a) 1
- (b) 0.5
- (c) 0.125
- (d) -257
- (e) 0.1

And interpretations for

- (f) 0 10000000 100000000000000000000000
- (g) 0 01111111 010101010000000000000000

How much is (nb, 2^{-23} is 0.0000001192...)

- (f) $1 + 0.1$
- (g) $1 + 0.0000001$
- (h) $1 + 0.00000005$
- (i) $((1 + 0.00000005) + 0.00000005) + 0.00000005$
- (j) $(1 + (0.00000005 + (0.00000005 + 0.00000005)))$

6. (a) In a computer language we make identifiers out of characters. In C, an identifier consists of a letter or underscore, followed by any number of letters, digits or underscores. How many different identifiers are there with up to 7 characters? (do NOT use a calculator, but write it down in terms of multiplications and additions, then make a guess as to how many zeroes the answer has). Note: case is important.
- (b) Write down the formula for identifiers of exactly N characters long.

0	null	32		64	@	96	'
1	CTRL-A	33	!	65	A	97	a
2	CTRL-B	34	”	66	B	98	b
3	CTRL-C	35	#	67	C	99	c
4	CTRL-D	36	\$	68	D	100	d
5	CTRL-E	37	%	69	E	101	e
6	CTRL-F	38	&	70	F	102	f
7	bell	39	'	71	G	103	g
8	backspace	40	(	72	H	104	h
9	tab	41	)	73	I	105	i
10	newline	42	*	74	J	106	j
11	CTRL-K	43	+	75	K	107	k
12	newpage	44	,	76	L	108	l
13	carr return	45	-	77	M	109	m
14	CTRL-N	46	.	78	N	110	n
15	CTRL-O	47	/	79	O	111	o
16	CTRL-P	48	0	80	P	112	p
17	start	49	1	81	Q	113	q
18	CTRL-R	50	2	82	R	114	r
19	stop	51	3	83	S	115	s
20	CTRL-T	52	4	84	T	116	t
21	CTRL-U	53	5	85	U	117	u
22	CTRL-V	54	6	86	V	118	v
23	CTRL-W	55	7	87	W	119	w
24	CTRL-X	56	8	88	X	120	x
25	CTRL-Y	57	9	89	Y	121	y
26	CTRL-Z	58	:	90	Z	122	z
27	CTRL-[	59	;	91	[	123	{
28	CTRL-	60	<	92	\	124	—
29	CTRL-]	61	=	93	]	125	}
30	CTRL-^	62	>	94	^	126	~
31	CTRL-_	63	?	95	_	127	del