CDS 130-001 Computing for Scientists

Final Exam - Sample Final Exam

Dec. 08, 2011

This is a closed-book closed-computer exam. Calculators are allowed. You should show your work and the answer on the space provided immediately following or beside each question on the exam sheets. If additional space is needed, please use the back of the paper and indicate such usage.

1. Convert 100111_2 to its base ten equivalent using the template method

2. Convert 109_{10} to its binary equivalent using either the template method or long-division method.

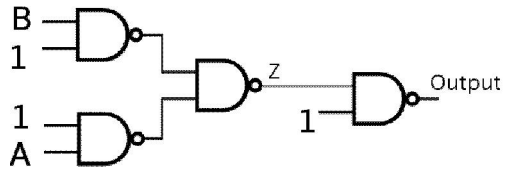
3. Carry out the binary addition of **11101_2 + 01101_2?** Keep your operation and answer in binary format.

4. Carry out the binary multiplication of **110_2 x 101_2?** Keep your operation and answer in binary format

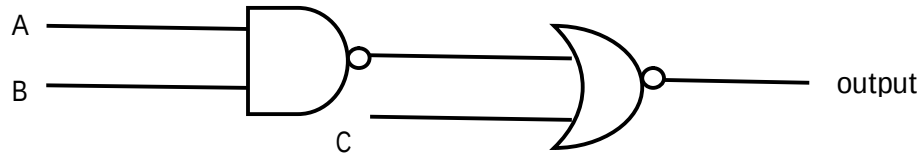
5. What is the decimal value of 135_{16}?

6. Use ASCII code to encode the string "JOBS" into a binary sequence. Express each character in a 8-bit binary number.

7. In the image below, four NANDS are connected and three of the inputs are set to 1. What are the values of Z and output if B = 0 and A = 0?



8. Fill out the logic table corresponding to the Logic Circuit shown below, which consists of a NAND gate and an NOR gate. Show all input bit pattern combinations A, B and C in the table. For each input bit pattern combination, calculate the corresponding output.



A	B	C	Output

9. Considering the following iteration code, what is A(5)?

```
A(1)=5;
for i=[2:5]
  A(i)=A(i-1)+3;
end
```

10. (a) Translate the following statement into a mathematical model.

(b) Then Translate your mathematical model into MATLAB programming code. Your code should be able to calculate the balance from year 1 to year 10. There is no need of doing the calculation in the exam. Only MATLAB code is needed.

My bank offers 2.5% interest on my account compounded yearly. Every year I deposit an additional $1000. Assuming that on the first year your account had a balance of $2000.

11. Write down the mathematic model of the following scientific model. Note that you need to use two iterative mathematic equations.

- The birth rate of rabbits is 50%. The death rate or rabbits is 0.02 times the number of rabbits multiplied by the number of foxes.
- The death rate of foxes is 10%. The birth rate of foxes is 0.001 times the number of foxes multiplied by the number foxes

12. For any give data array "array", what are the differences of the output on a plot window when the Matlab code "plot(array,'-*r')" and the code "plot(array,'--ob')" are executed?

13. Briefly answer the following questions?

(a) What is iteration?

(b) what is algorithm?

(c) What is initial condition?

(d) What are the pros and cons if a smaller sub-interval is used in the iterative calculation?

14 Convert the following differential equation into a mathematic model expressed in an iterative equation?

$$\frac{dP}{dt} = 2(P-1)$$

15.

$$f(x) = x^3$$
$$F = \int_0^{4.0} x^3 dx$$

Consider the integration of the function, $f(x)=x^3$, from the interval of x=0 to x=4.0. You are asked to make a numerical approximation of this integration using the rectangle method, that is to find the geometric area underneath the function with the sum of a series of rectangles. If you choose the sub-interval Δx=1.0, what is the approximated integration result?

16. One creates a 2-D array in Matlab using the following statement:

```
>a=[3, 3, 3, 3; 1, 2, 3, 4; 4, 4, 4, 4; 5, 6 ,7, 8]
```

How many rows in this 2-D array? What is value of a(3,2)? What is a(2,3)?

17. What is the array "a" after executing the following Double-nested For Loops?

```
for i=[1:3]
    for j=[1:3]
        a(i,j)=i*j+2;
    end
end
```

18. What is the array "A" after executing the following Double-nested For Loops?

```
A = [1, 2, 3; 4, 5, 6; 7, 8, 9];
for m = [1:3]
     for n = [1:3]
          A(m,n) = m*n + 1;
     end
end
```

19. What final value of c is printed out?

```
c = 1;
a = 1;
b = 2;
if(a + b < 3)
    c = c + 1;
 end
c
```

20. What final value of a, b, c is printed out?

```
a = 4;
b = 3;
c = 10;
if ( a < b && a < c)
   a = a + b + c;
end
a

if (a < b || a < c)
  a = a + b + c;
end
a
b
c
```

21: Does a usual scientific data set have color or not, such as temperature data? Why is color used in visualization?

22. Describe the colors represented by the following [R, G, B] values

(1) [0, 0, 0]

(2) [1, 1, 1]

(3) [0.3, 0.3, 0.3]

(4) [1, 1, 0]

(5) [0, 1, 1]

23. For the following image and colormap,

```
MyImage=[1  2  3;
         4  5  6;
         7  8  9]
MyColorMap=[ 1    1    1;
           0.5  0.5  0.5;
             0    0    0]
```

(1) What is the color of the pixel MyImage(1,1)?

(2) What is the color of the pixel MyImage(1,3)?

24. Briefly describe the functionality of "plot()" and "imagesc()" methods in MATLAB?

25. Write a MATLAB program to visualize the height plot of the following 2-D function (only the algorithm matters, syntax errors will not be graded). The X-interval is from -2.0 to +2.0 and sub-interval is 0.1, and the Y-interval is from -2.0 to +2.0 and the subinterval is 0.1

$$f(x, y) = (x + y)^2$$

26. List at least three statistical measures? What are their corresponding functional names in MATLAB?

27. What is plotted along the X-axis of a histogram? What is plotted along the Y-axis?

28. What does regression mean? What does it mean if the correlation coefficient R is equal to one?

Information Sheet

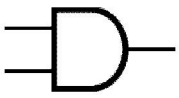
1. ASCII Table

Dec	Hx	Oct	Char	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr
0	0	000	NUL (null)	32	20	040		Space	64	40	100	@	@	96	60	140	`	`
1	1	001	SOH (start of heading)	33	21	041	!	!	65	41	101	A	A	97	61	141	a	a
2	2	002	STX (start of text)	34	22	042	"	"	66	42	102	B	B	98	62	142	b	b
3	3	003	ETX (end of text)	35	23	043	#	#	67	43	103	C	C	99	63	143	c	c
4	4	004	EOT (end of transmission)	36	24	044	$	$	68	44	104	D	D	100	64	144	d	d
5	5	005	ENQ (enquiry)	37	25	045	%	%	69	45	105	E	E	101	65	145	e	e
6	6	006	ACK (acknowledge)	38	26	046	&	&	70	46	106	F	F	102	66	146	f	f
7	7	007	BEL (bell)	39	27	047	'	'	71	47	107	G	G	103	67	147	g	g
8	8	010	BS (backspace)	40	28	050	(	(	72	48	110	H	H	104	68	150	h	h
9	9	011	TAB (horizontal tab)	41	29	051	)	)	73	49	111	I	I	105	69	151	i	i
10	A	012	LF (NL line feed, new line)	42	2A	052	*	*	74	4A	112	J	J	106	6A	152	j	j
11	B	013	VT (vertical tab)	43	2B	053	+	+	75	4B	113	K	K	107	6B	153	k	k
12	C	014	FF (NP form feed, new page)	44	2C	054	,	,	76	4C	114	L	L	108	6C	154	l	l
13	D	015	CR (carriage return)	45	2D	055	-	-	77	4D	115	M	M	109	6D	155	m	m
14	E	016	SO (shift out)	46	2E	056	.	.	78	4E	116	N	N	110	6E	156	n	n
15	F	017	SI (shift in)	47	2F	057	/	/	79	4F	117	O	O	111	6F	157	o	o
16	10	020	DLE (data link escape)	48	30	060	0	0	80	50	120	P	P	112	70	160	p	p
17	11	021	DC1 (device control 1)	49	31	061	1	1	81	51	121	Q	Q	113	71	161	q	q
18	12	022	DC2 (device control 2)	50	32	062	2	2	82	52	122	R	R	114	72	162	r	r
19	13	023	DC3 (device control 3)	51	33	063	3	3	83	53	123	S	S	115	73	163	s	s
20	14	024	DC4 (device control 4)	52	34	064	4	4	84	54	124	T	T	116	74	164	t	t
21	15	025	NAK (negative acknowledge)	53	35	065	5	5	85	55	125	U	U	117	75	165	u	u
22	16	026	SYN (synchronous idle)	54	36	066	6	6	86	56	126	V	V	118	76	166	v	v
23	17	027	ETB (end of trans. block)	55	37	067	7	7	87	57	127	W	W	119	77	167	w	w
24	18	030	CAN (cancel)	56	38	070	8	8	88	58	130	X	X	120	78	170	x	x
25	19	031	EM (end of medium)	57	39	071	9	9	89	59	131	Y	Y	121	79	171	y	y
26	1A	032	SUB (substitute)	58	3A	072	:	:	90	5A	132	Z	Z	122	7A	172	z	z
27	1B	033	ESC (escape)	59	3B	073	;	;	91	5B	133	[	[	123	7B	173	{	{
28	1C	034	FS (file separator)	60	3C	074	<	<	92	5C	134	\	\	124	7C	174			|
29	1D	035	GS (group separator)	61	3D	075	=	=	93	5D	135	]	]	125	7D	175	}	}
30	1E	036	RS (record separator)	62	3E	076	>	>	94	5E	136	^	^	126	7E	176	~	~
31	1F	037	US (unit separator)	63	3F	077	?	?	95	5F	137	_	_	127	7F	177	&#127;	DEL

Source: www.LookupTables.com

2. Logical Gates and Tables

AND

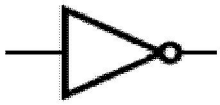


INPUT		OUTPUT
A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1

OR

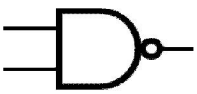
INPUT		OUTPUT
A	B	A OR B
0	0	0
0	1	1
1	0	1
1	1	1

NOT



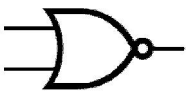
INPUT	OUTPUT
A	NOT A
0	1
1	0

NAND



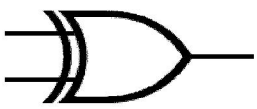
INPUT		OUTPUT
A	B	A NAND B
0	0	1
0	1	1
1	0	1
1	1	0

NOR



INPUT		OUTPUT
A	B	A NOR B
0	0	1
0	1	0
1	0	0
1	1	0

XOR



INPUT		OUTPUT
A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0