CPE-358 Review

Appendices D & E
in your textbook

Number Bases

$$253 = 3*10^0 + 5*10^1 + 2*10^2$$

Decimal to Binary

$(253)_{10} = (?)_2$

	Integer	Remainder	
	253		
$253 / 2^1$	126	1	Bit 1
$253 / 2^2$	63	0	
$253 / 2^3$	31	1	
$253 / 2^4$	15	1	
$253 / 2^5$	7	1	
$253 / 2^6$	3	1	
$253 / 2^7$	1	1	
$253 / 2^8$	0	1	Bit 8

Answer:
$(1111\ 1101)_2$

HC12:
%11111101

Decimal to Hexadecimal

$(253)_{10} = (?)_{16}$

	Integer	Remainder	Hex
	253		
$253 / 16^1$	15	13	D
$253 / 16^2$	0	15	F

Answer:
$(FD)_{16}$

HC12:
$FD

Binary to Hexadecimal

- Easy!
- Each group of 4 binary digits becomes 1 hex digit
- Example:

$$(1111\ 1101)_2$$

1111 = F   1101 = D

$$(1111\ 1101)_2 = (FD)_{16}$$

Math

Complement Notation
of Signed Numbers

Radix Complement (1)

The *r*'s complement of an *n*-digit number *N* in base *r* is defined as:

$$= \begin{cases} r^n - N & for\ N \neq 0 \\ 0 & for\ N = 0 \end{cases}$$

The *r*'s complement is obtained by adding 1 to the (*r*-1)'s complement since $r^n-N=[(r^n-1)-N]+1$.

Examples:

The 10's complement of 2389 is 7610+1=7611.

The 2's complement of $(101100)_2$ is $010011+1=(010100)_2$

Radix Complement (2)

The 10's complement of a number can be obtained by leaving all least significant 0's unchanged, subtracting the first nonzero least significant digit from 10, and subtracting all higher significant digits from 9.

Examples:

The 10's complement of 012398 is 987602

The 10's complement of 246700 is 753300

The 2's complement of a number can be obtained by leaving the all least significant 0's and the first 1 unchanged, and replace 1's with 0's and 0's with 1's in all other higher significant digits.

Examples:

The 2's complement of 1101100 is 0010100

The 2's complement of 0110111 is 1001001.

Example 1

Using 10's complement, calculate 26547 - 7280	
	26547
10's complement of 07280 =	+92720

Sum =	119267
Discard end carry 10^5	-100000

Answer =	19267

Example 2

Using 10's complement, calculate 7280 - 26547	
	07280
10's complement of 26547 =	+73453

Sum =	80733
There is no end carry.	
The answer is –(10's complement of 80733)	= -19267

Example 3

Using 2's complement, calculate $(111100)_2 - (100111)_2$	
	111100
2's complement of 100111 =	+011001

Sum =	1010101
Discard end carry 2^6	-1000000

Answer =	010101

Example 4

Using 2's complement, calculate $(100111)_2 - (111100)_2$	
	100111
2's complement of 111100 =	+000100

Sum =	101011
There is no end carry.	
The answer is –(2's complement of 101011)	= -010101

Binary Logic

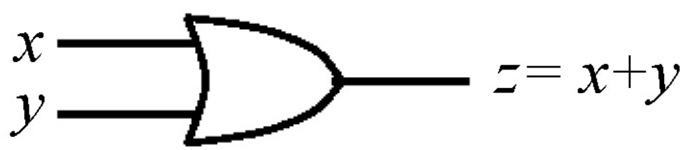
Logic Gates

Logic gates are electronic circuits that operate on one or more input signals to produce an output signal.

AND Gate

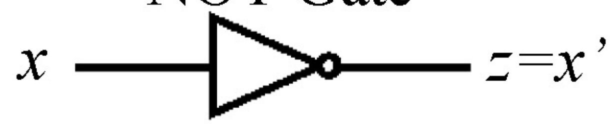
x	y	x.y
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate



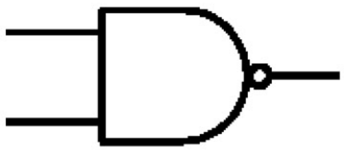
x	y	x+y
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate



x	x'
0	1
1	0

Other Digital Logic Gates



$F=(xy)'$

NAND

x	y	F
0	0	1
0	1	1
1	0	1
1	1	0

$F=(x+y)'$

NOR

x	y	F
0	0	1
0	1	0
1	0	0
1	1	0

XOR

$F = xy' + x'y$
$= x \oplus y$

x	y	F
0	0	0
0	1	1
1	0	1
1	1	0

XNOR

$F = xy + x'y'$
$= (x \oplus y)'$

x	y	F
0	0	1
0	1	0
1	0	0
1	1	1

Boolean Functions	Operator Symbol	Name	Comments
$F_0=0$		Null	Binary Constant 0
$F_1=xy$	$x \bullet y$	AND	*x* and *y*
$F_2=xy'$	x/y	Inhibition	*x, but not y*
$F_3=x$		Transfer	*x*
$F_4=x'y$	y/x	Inhibition	*y, but not x*
$F_5=y$		Transfer	*y*
$F_6=xy'+x'y$	$x \oplus y$	Exclusive-OR	*x or y, but not both*
$F_7=x+y$	$x + y$	OR	*x or y*
$F_8=(x+y)'$	$x \downarrow y$	NOR	*Not-OR*
$F_9=xy + x'y'$	$(x \oplus y)'$	Equivalence	*x equals y*
$F_{10}= y'$	y'	Complement	*Not y*
$F_{11}= x + y'$	$x \subset y$	Implication	*If y, then x*
$F_{12}= x'$	x'	Complement	*Not x*
$F_{13}= x' + y$	$x \supset y$	Implication	*If x, then y*
$F_{14}= (xy)'$	$x \uparrow y$	NAND	*Not-AND*
$F_{15}=1$		Identity	

Axioms & basic Theorems of Switching Algebra

1. Identity elements	(a) $x + 0 = x$	(b) $x \bullet 1 = x$
2. Commutative Law	(a) $x + y = y + x$	(b) $xy = yx$
3. Distributive Law	(a) $x(y+z) = xy + xz$	(b) $x+yz = (x+y)(x+z)$
4. Inverse	(a) $x + x' = 1$	(b) $x \bullet x' = 0$
Theorem 1	(a) $x + x = x$	(b) $x \bullet x = x$
Theorem 2	(a) $x + 1 = 1$	(b) $x \bullet 0 = 0$