Number system

Name	Base
• Binary	2
• Decimal	10
• Octal	8
• Hexadecimal	16

Binary to decimal

convert (1000100)2 to decimal

1 0 0 0 1 0 0

2^6 2^5 2^4 2^3 2^2 2^1 2^0

1*64+ 0*32 + 0*16 + 0*8 + 1*4 + 0*2 + 0*1

= 64 + 0 + 0 + 0 + 4 + 0 + 0

= (68)10

convert (0.101)2 to decimal

0 .1 0 1

$1*2^{-1} + 0*2^{-2} + 1*2^{-3}$

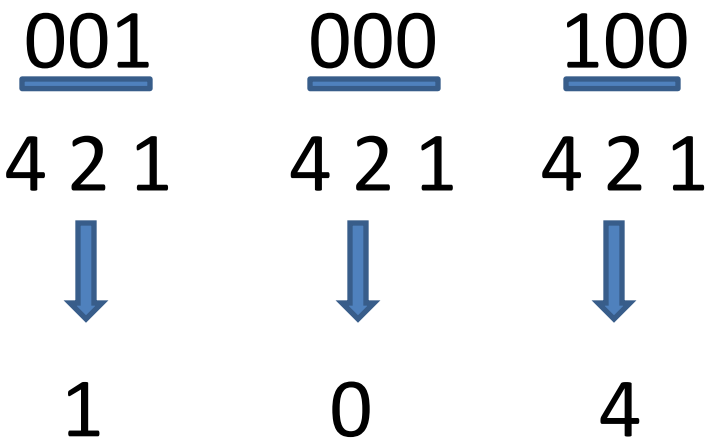
1*1/2 + 0*1/4 + 1*1/8

=1/2+1/8

=0.375

Binary to octal

convert (1000100)2 to octal (base 8=2^3)



Result: 104

Binary to hexadecimal

convert (1000100)2 to hexadecimal (base 16 =2^4)

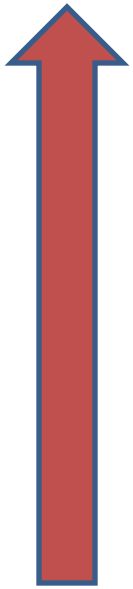
0100	0100
2^3 2^2 2^1 2^0	2^3 2^2 2^1 2^0
8 4 2 1	8 4 2 1
⇓	⇓
4	4

Result: 44

Decimal to binary

convert (68)10 to binary

68/ 2 = 34 remainder is 0
34/ 2 = 17 remainder is 0
17 / 2 = 8 remainder is 1
8 / 2 4 remainder is 0
4 / 2 = = 2 remainder is 0
2 / 2 = 1 remainder is 0
1 / 2 = 0 remainder is 1



Answer = 1 0 0 0 1 0 0

Decimal to binary

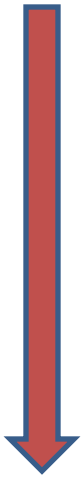
convert (0.8125)10 to binary fraction.

0.8125 * 2 = 1.625 integer part is 1

0.625 * 2 = 1.25integer part is 1

0.25 * 2 = 0.5 integer part is 0

0.5 * 2 = 1.0 integer part is 1



**until or unless fraction part will be 0

Answer =1101

Octal to decimal

convert (632)8 to decimal

= (6 x 8^2) + (3 x 8^1) + (2 x 8^0)

= (6 x 64) + (3 x 8) + (2 x 1)

= 384 + 24 + 2

= (410)10

Octal to decimal

convert (177)10 to octal

177 / 8 = *22 remainder is* *1*

22 / 8 = 2 remainder is 6

2 / 8 = 0 remainder is 2

Answer = 2 6 1

Hexadecimal Number System

- Base or radix 16 number system.
- 1 hex digit is equivalent to 4 bits.
- Numbers are 0,1,2…..8,9, A, B, C, D, E, F.
- B is 11, E is 14
- Numbers are expressed as powers of 16.
- $16^0 = 1$, $16^1 = 16$, $16^2 = 256$, $16^3 = 4096$, $16^4 = 65536$

Hexadecimal to decimal

convert (F4C)16 to decimal

= (F x 162) + (4 x 161) + (C x 160)

= (15 x 256) + (4 x 16) + (12 x 1)

Decimal to hex (base 10 to base 16)

convert (4768)10 to hex

4768 / 16 = 298 remainder 0

=> 298 / 16 = 18 remainder 10 (A)

=>18 / 16 = 1 remainder 2

=> 1 / 16 = 0 remainder 1

Answer: 1 2 A 0

Exercise

(11 100 111)2 = (347)8

- (11 100 010 101 010 010 001)2 = (3025221)8
- (1110 0111)2 = (E7)16
- (1 1000 1010 1000 0111)2 = (18A87)16

Binary addition

```
   1  1
   101
+  1  111
-------------
   1 1 00
```

Result: 1110

1+1=2

2/2 =1 rem 0

2= 1 0

1+1+1=3

3/2=1 rem 1

3= 1 1

Octal addition

octal numbers 0 1 2 3 4 5 6 7

	1	1	
	5	3	5
	1	5	3
	7	1	0

5+3 = 8 =8+0 = 1 0 carry 1

5+3+1=9 =8+1= 1 1 carry 1

5+1+1= 7

Result: (710) 8

Hexadecimal addition

1 1		1	
F	A	8	9
B	9	5	7
1 9	3	E	0

9+7= 16 = 16+0= 1 0 carry 1

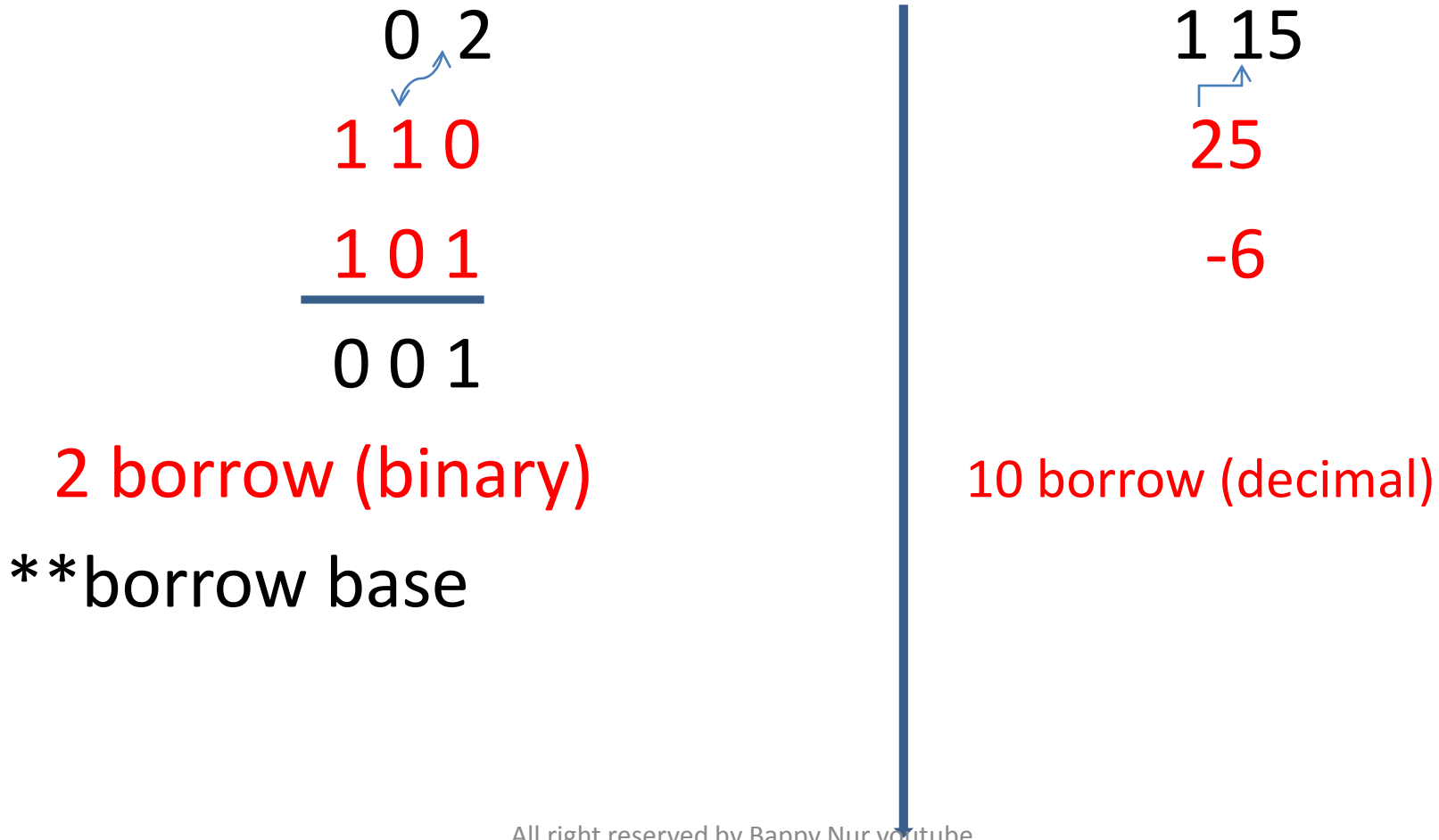
1+8+5= 14 (E)

A+9=19 =16+3 =1 3 carry 1

F+B+1= 15+11+1= 27 = 16+9= 1 9 carry 1

Result: 193E0

Binary subtraction



Octal subtraction

		8	
	4	1	8
	5	2	1
-	3	7	6
	1	2	3

borrow 8

Hexadecimal subtraction

	20	
12	4	26
$D_{(13)}$	5	A (10)
$A_{(10)}$	F	F (15)
2	5	11(B)

Result: 25B

Borrow 16