

Bit Permutations - 4 bit



0	0 0 0 0	8	1 0 0 0
1	0 0 0 1	9	1 0 0 1
2	0 0 1 0	10	1 0 1 0
3	0 0 1 1	11	1 0 1 1
4	0 1 0 0	12	1 1 0 0
5	0 1 0 1	13	1 1 0 1
6	0 1 1 0	14	1 1 1 0
7	0 1 1 1	15	1 1 1 1

Number Systems

CMSC 104 Section 301

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1 and 0

0	1	10	11	100	101
+1	+1	+1	+1	+1	+1
<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
1	10	11	100	101	110

110	111	1000	1001	1010
+1	+1	+1	+1	+1
<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
111	1000	1001	1010	1011

Bit Permutations - 4 bit (animation)



Done!!!

D → B

Decimal to Binary

- Decimal number 143 needs to be converted to binary
- Decimal number 256 needs to be converted to binary

Remainder

$143 \div 2 = 71$ remainder is 1
 $71 \div 2 = 35$ remainder is 1
 $35 \div 2 = 17$ remainder is 1
 $17 \div 2 = 8$ remainder is 1
 $8 \div 2 = 4$ remainder is 0
 $4 \div 2 = 2$ remainder is 0
 $2 \div 2 = 1$ remainder is 0
 $1 \div 2 = 0$ remainder is 1

10001111

$256 \div 2 = 128$ 0
 $128 \div 2 = 64$ 0
 $64 \div 2 = 32$ 0
 $32 \div 2 = 16$ 0
 $16 \div 2 = 8$ 0
 $8 \div 2 = 4$ 0
 $4 \div 2 = 2$ 0
 $2 \div 2 = 1$ 0
 $1 \div 2 = 0$ 1

10000000

B → D

Binary to Decimal

- 10101011 needs to be converted to decimal

1 0 1 0 1 0 1 1

2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

$2^0 \times 1 = 1$
 $2^1 \times 1 = 2$
 $2^2 \times 0 = 0$
 $2^3 \times 1 = 8$
 $2^4 \times 0 = 0$
 $2^5 \times 1 = 32$
 $2^6 \times 0 = 0$
 $2^7 \times 1 = 128$

$2^0 = 1$
 $2^1 = 2$
 $2^2 = 4$
 $2^3 = 8$
 $2^4 = 16$
 $2^5 = 32$
 $2^6 = 64$
 $2^7 = 128$

$1 + 2 + 8 + 32 + 128 = 171$

B+B

Adding Binary Numbers

Elements of Binary Additions

$$\begin{array}{r} 0 \\ + 0 \\ \hline 0 \end{array} \quad \begin{array}{r} 1 \\ + 0 \\ \hline 1 \end{array} \quad \begin{array}{r} 1 \\ + 1 \\ \hline 10 \end{array} \quad \begin{array}{r} 001 \\ + 001 \\ \hline 010 \end{array}$$

Elements of Decimal Additions

$$\begin{array}{r} 5 \\ + 5 \\ \hline 10 \end{array} \quad \begin{array}{r} 99 \\ + 1 \\ \hline 100 \end{array}$$

B+B

Adding Binary Numbers

□ 110110110 + 111110011

$$\begin{array}{r} 1111111 \\ 110110110 \\ + 111110011 \\ \hline 1110101001 \end{array}$$

0+1=1
1+1=10
1+0=1
0+0=0
0+1=1
1+1=10
1+1=10
10+1=11
10+1=11
1+1=10
10+1=11

D → H

Decimal to Hexadecimal

- Need to convert 1128 into Hexadecimal

$$1128 \div 16 = 70 \text{ R } 8$$

$$70 \div 16 = 4 \text{ R } 6$$

$$4 \div 16 = 0 \text{ R } 4$$

4 6 8

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, f,
10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1a, 1b, 1c, 1d, 1e, 1f, 20

D → H

Decimal to Hexadecimal

- Need to convert 256 into Hexadecimal

$$256 \div 16 = 16 \text{ R } 0$$

$$16 \div 16 = 1 \text{ R } 0$$

$$1 \div 16 = 0 \text{ R } 1$$

1 0 0

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, f,
10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1a, 1b, 1c, 1d, 1e, 1f, 20

D → H

Decimal to Hexadecimal

- Need to convert **43981** into Hexadecimal

$$43981 \div 16 = 2748 \quad \text{R } 13 \quad \mathbf{D}$$

$$2748 \div 16 = 171 \quad \text{R } 12 \quad \mathbf{C}$$

$$171 \div 16 = 10 \quad \text{R } 11 \quad \mathbf{B}$$

$$10 \div 16 = 0 \quad \text{R } 10 \quad \mathbf{A}$$

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, f,
10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1a, 1b, 1c, 1d, 1e, 1f, 20

A B C D

H → D

Hexadecimal to Decimal

- Need to convert **1FA8** into Decimal

1 F A 8

16^3 16^2 16^1 16^0

$$16^0 = 1$$

$$16^1 = 16$$

$$16^2 = 16 \times 16 = 256$$

$$16^3 = 16 \times 16 \times 16 = 4096$$

$$16^4 = 16 \times 16 \times 16 \times 16 = 65536$$

$$16^0 \times 8 = 8$$

$$16^1 \times \mathbf{A}\{10\} = 160$$

$$16^2 \times \mathbf{F}\{15\} = 256 \times 15 = 3840$$

$$16^3 \times 1 = 4096$$

$$8 + 160 + 3840 + 4096 = 8104$$

H+H

Adding Hexadecimal Numbers

□ Add hexadecimals AB35 + 7CF1

$$\begin{array}{r} 1 1 \\ A B 3 5 \\ + 7 C F 1 \\ \hline 1 2 8 2 6 \end{array}$$

$$\begin{aligned} 5 + 1 &= 6 \\ 3 + F \{15\} &= 12 \{18\} \\ B + C &= 17+1 = 18 \\ A + 7 &= 11+1 = 12 \end{aligned}$$

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, f,
10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1a, 1b, 1c, 1d, 1e, 1f, 20

Adding Hexadecimal Numbers

□ Add hexadecimals COFFEE+ DECADE

$$\begin{array}{r} 1 1 1 1 \\ C 0 F F E E \\ + D E C A D E \\ \hline 1 9 F C A C C \end{array}$$

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, f,
10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1a, 1b, 1c, 1d, 1e, 1f, 20



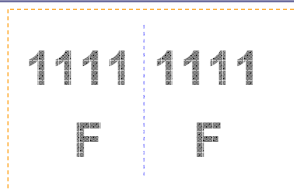
The Hexadecimal Number System

Binary	Decimal	Hexadecimal	Binary	Decimal	Hexadecimal
0	0	0	1010	10	A
1	1	1	1011	11	B
10	2	2	1100	12	C
11	3	3	1101	13	D
100	4	4	1110	14	E
101	5	5	1111	15	F
110	6	6			
111	7	7			
1000	8	8			
1001	9	9			



Binary to Hexadecimal

B → H



Binary	Hex	Decimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	A	10
1011	B	11
1100	C	12
1101	D	13
1110	E	14
1111	F	15

00101110101110101111
 2 E B A F