

## CO450 Computer Architectures Week 2 Exercise Handout

Re-Cap on Base 10 Decimal Numbers .....	2
Positional Notation: Binary to Decimal Conversion.....	3
Doubling: Binary to Decimal Conversion .....	6
Short Division by Two with Remainder: Decimal to Binary Conversion .....	8
Comparison with Descending Powers of Two and Subtraction: Decimal to Binary Conversion .....	10
Binary Addition .....	12
The Answers .....	14

### Re-Cap on Base 10 Decimal Numbers

1. What is the correct way to write out the following base 10 number:

$45_{10}$

				$(4 \times 10^1)$	+	$(5 \times 10^0)$	=	$45_{10}$
--	--	--	--	-------------------	---	-------------------	---	-----------

2. What is the correct way to write out the following base 10 number:

$68_{10}$

				$(6 \times 10^1)$	+	$(8 \times 10^0)$	=	$68(10)$
--	--	--	--	-------------------	---	-------------------	---	----------

3. What is the correct way to write out the following base 10 number:

$183_{10}$

$$(1 \times 10^2) + (8 \times 10^1) + (3 \times 10^0) = 183(10)$$

--	--	--	--	--	--	--	--	--

4. What is the correct way to write out the following base 10 number:

$3549_{10}$

$$(3 \times 10^3) + (5 \times 10^2) + (4 \times 10^1) + (9 \times 10^0) = 3549(10)$$

--	--	--	--	--	--	--	--	--

5. What is the correct way to write out the following base 10 number:

$27318_{10}$

$$(2 \times 10^4) + (7 \times 10^3) + (3 \times 10^2) + (1 \times 10^1) + (8 \times 10^0) = 27318(10)$$

--	--	--	--	--	--	--	--	--	--

### Positional Notation: Binary to Decimal Conversion

1. Convert the following binary number to decimal using the Positional Notation method:

**00001110<sub>2</sub>**

We have worked this first question through for you.

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>
<b><math>8 + 4 + 2 = 14</math></b>							

The correct answer is:

**14<sub>10</sub>**

2. Convert the following binary number to decimal using the Positional Notation method:

**00101010<sub>2</sub>**

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

The correct answer is:

**00101010**

**$32+8+2 = 42$**

3. Convert the following binary number to decimal using the Positional Notation method:

**10001101<sub>2</sub>**

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

The correct answer is:

$$\begin{array}{l} 10001101 \\ \boxed{1} \\ 128+8+4+\boxed{1} = 141 \end{array}$$

4. Convert the following binary number to decimal using the Positional Notation method:

**11011111<sub>2</sub>**

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

The correct answer is:

$$\boxed{1}11011111$$

$$128+64+16+8+4+2+\boxed{1} = 223$$

5. Convert the following binary number to decimal using the Positional Notation method:

**01110001<sub>2</sub>**

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

The correct answer is:

--

**01110001**  
 $64+32+16+1 = 113$

6. Convert the following binary number to decimal using the Positional Notation method:

**11101010<sub>2</sub>**

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

The correct answer is:

--

**11101010**  
 $128+64+32+8+2 = 234$

**Doubling: Binary to Decimal Conversion**

1. Convert the following binary number to decimal using the Doubling method:

**10110100<sub>2</sub>**

We have worked this first question through for you.

0	x	2	+	1	=	1
1	x	2	+	0	=	2
2	x	2	+	1	=	5
5	x	2	+	1	=	11
11	x	2	+	0	=	22
22	x	2	+	1	=	45
45	x	2	+	0	=	90
90	x	2	+	0	=	<b>180</b>

The answer is:

**180<sub>10</sub>**

2. Convert the following binary number to decimal using the Doubling method:

**11100111<sub>2</sub>**

0	x	2	+	1	=	1
1	x	2	+	1	=	3
3	x	2	+	1	=	7
7	x	2	+	0	=	14
14	x	2	+	0	=	28
28	x	2	+	1	=	57
57	x	2	+	1	=	115
115	x	2	+	1	=	231

The answer is:

**231** |

3. Convert the following binary number to decimal using the Doubling method:

$00110101_2$

0	x	2	+	0	=	0
0	x	2	+	0	=	0
0	x	2	+	1	=	1
1	x	2	+	1	=	3
3	x	2	+	0	=	6
6	x	2	+	1	=	13
13	x	2	+	0	=	26
26	x	2	+	1	=	53

The answer is:

53

4. Convert the following binary number to decimal using the Doubling method:

$00111000_2$

0	x	2	+	0	=	0
0	x	2	+	0	=	0
0	x	2	+	1	=	1
1	x	2	+	1	=	3
3	x	2	+	1	=	7
7	x	2	+	0	=	14
14	x	2	+	0	=	28
28	x	2	+	0	=	56

The answer is:

56

## Short Division by Two with Remainder: Decimal to Binary Conversion

1. Convert the following decimal number to binary using the Short Division by Two with Remainder method:

 $86_{10}$ 

We have worked this first question through for you.

86	/	2	=	43	Remainder	0
43	/	2	=	21	Remainder	1
21	/	2	=	10	Remainder	1
10	/	2	=	5	Remainder	0
5	/	2	=	2	Remainder	1
2	/	2	=	1	Remainder	0
1	/	2	=	0	Remainder	1
	/	2	=		Remainder	

The answer is:

**1010110<sub>2</sub>**

2. Convert the following decimal number to binary using the Short Division by Two with Remainder method:

 $109_{10}$ 

109	/	2	=	54	Remainder	1
54	/	2	=	27	Remainder	0
27	/	2	=	13	Remainder	1
13	/	2	=	6	Remainder	1
6	/	2	=	3	Remainder	0
3	/	2	=	1	Remainder	1
1	/	2	=	0	Remainder	1
	/	2	=		Remainder	

The answer is:

**1101101**

3. Convert the following decimal number to binary using the Short Division by Two with Remainder method:

$72_{10}$

72	/	2	=	36	Remainder	0
36	/	2	=	18	Remainder	0
18	/	2	=	9	Remainder	0
9	/	2	=	4	Remainder	1
4	/	2	=	2	Remainder	0
2	/	2	=	1	Remainder	0
1	/	2	=	0	Remainder	1
	/	2	=		Remainder	

The answer is:

$100100_2$

4. Convert the following decimal number to binary using the Short Division by Two with Remainder method:

$124_{10}$

124	/	2	=	62	Remainder	0
62	/	2	=	31	Remainder	0
31	/	2	=	15	Remainder	1
15	/	2	=	7	Remainder	1
7	/	2	=	3	Remainder	1
3	/	2	=	1	Remainder	1
1	/	2	=	0	Remainder	1
	/	2	=		Remainder	

The answer is:

$111100$

**Comparison with Descending Powers of Two and Subtraction:  
Decimal to Binary Conversion**

1. Convert the following decimal number to binary using the Comparison with Descending Powers of Two and Subtraction method:

**57<sub>10</sub>**

We have worked this first question through for you.

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>
		<b>57 - 32 = 25</b>	<b>25 - 16 = 9</b>	<b>9 - 8 = 1</b>			<b>1-1 = 0</b>

The answer is:

0	0	1	1	1	0	0	1
---	---	---	---	---	---	---	---

2. Convert the following decimal number to binary using the Comparison with Descending Powers of Two and Subtraction method:

**113<sub>10</sub>**

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>•</b>	<b>1</b>
<b>49</b>	<b>18</b>		<b>1</b>				

The answer is:

<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
----------	----------	----------	----------	----------	----------	----------	----------

3. Convert the following decimal number to binary using the Comparison with Descending Powers of Two and Subtraction method:

$93_{10}$

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
0	1	0	1	1	1	0	1
29			13	5	1		

The answer is:

0	1	0	1	1	1	0	1
---	---	---	---	---	---	---	---

4. Convert the following decimal number to binary using the Comparison with Descending Powers of Two and Subtraction method:

$29_{10}$

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
0	0	0	1	1	1	0	1
			13	5	1		

The answer is:

0	0	0	1	1	1	0	1
---	---	---	---	---	---	---	---

## Binary Addition

1. Add the following binary numbers together, what is the correct answer:

$$00000110_2 + 00001010_2 =$$

We have worked this first question through for you.

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

The answer is:

0	0	0	1	0	0	0	0
---	---	---	---	---	---	---	---

2. Add the following binary numbers together, what is the correct answer:

$$00000110_2 + 00011100_2 =$$

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

The answer is:

0	0	1	0	0	0	1	0
---	---	---	---	---	---	---	---

3. Add the following binary numbers together, what is the correct answer:

$$00101100_2 + 00111001_2 =$$

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

The answer is:

0	1	1	0	0	1	0	1
---	---	---	---	---	---	---	---

4. Add the following binary numbers together, what is the correct answer:

$$00111100_2 + 00010101_2 =$$

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

The answer is:

0	1	0	1	0	0	0	1
---	---	---	---	---	---	---	---

## The Answers

### Re-Cap on Base 10 Decimal Numbers

1.  $(4 \times 10^1) + (5 \times 10^0) = 45_{10}$
2.  $(6 \times 10^1) + (8 \times 10^0) = 68_{10}$
3.  $(1 \times 10^2) + (8 \times 10^1) + (3 \times 10^0) = 183_{10}$
4.  $(3 \times 10^3) + (5 \times 10^2) + (4 \times 10^1) + (9 \times 10^0) = 3549_{10}$
5.  $(2 \times 10^4) + (7 \times 10^3) + (3 \times 10^2) + (1 \times 10^1) + (8 \times 10^0) = 27318_{10}$

### Positional Notation: Binary to Decimal Conversion

1.  $14_{10}$
2.  $42_{10}$
3.  $141_{10}$
4.  $223_{10}$
5.  $113_{10}$
6.  $234_{10}$

### Doubling: Binary to Decimal Conversion

1.  $180_{10}$
2.  $231_{10}$
3.  $53_{10}$
4.  $56_{10}$

### Short Division by Two with Remainder: Decimal to Binary Conversion

1.  $01010110_2$
2.  $01101101_2$
3.  $01001000_2$
4.  $01111100_2$

### Comparison with Descending Powers of Two and Subtraction

1.  $00111001_2$
2.  $01110001_2$
3.  $01011101_2$
4.  $00011101_2$

Binary Addition

1. 00010000<sub>2</sub>

2. 00100010<sub>2</sub>

3. 01100101<sub>2</sub>

4. 01010001<sub>2</sub>