

CO450 Computer Architectures Week 3 Exercise Handout

Recap on Binary to Decimal Conversion.....	2
Recap on Decimal to Binary Conversion.....	3
Recap on Binary Addition	4
Binary Multiplication	5
Two's Complement.....	7
Binary Subtraction	9
Converting Hexadecimal to Decimal.....	13
Converting Hexadecimal to Binary	15
Converting Binary to Hexadecimal	16
Converting Octal to Decimal.....	17
Converting Octal to Binary.....	18
Converting Binary to Octal.....	19
The Answers	20

Recap on Binary to Decimal Conversion

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

11101010₂

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

The correct answer is:

234

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

00111101₂

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	+	1	=	15
15	x	2	+	0	=	30
30	x	2	+	1	=	61

The correct answer is:

61

Recap on Decimal to Binary Conversion

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

 167_{10}

167	/	2	=	83	Remainder	1
83	/	2	=	41	Remainder	1
	/	2	=	20	Remainder	0
	/	2	=	10	Remainder	0
	/	2	=	5	Remainder	0
	/	2	=	2	Remainder	1
	/	2	=	1	Remainder	0
	/	2	=	0	Remainder	1

The correct answer is:

10100111

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

 147_{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
1	0	0	1	0	0	1	1

The correct answer is:

10010011

Recap on Binary Addition

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

$$00110110_2 + 00101110_2 =$$

	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	0	1	1	0
+	0	0	1	0	1	1	1	0
	0	1	1	0	0	1	0	0
	1	1	1	1	1	1		

The correct answer is:

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

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

$$10100111_2 + 00010111_2 =$$

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

The correct answer is:

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

Binary Multiplication

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

$$00010110_2 \times 00000110_2 =$$

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
X	0	0	0	1	0	1	1	0			
	0	0	0	0	0	0	1	1	1	1	0
+	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	1	1	0	0	0	0
	0	0	1	0	0	0	0	0	1	0	0
	1	1	1	1							

The correct answer is:

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

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

$$00101100_2 \times 00000101_2 =$$

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

The answer is:

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

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

$$00000110_2 \times 00001101_2 =$$

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

The correct answer is:

01001110

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

$$00000101_2 \times 00001010_2 =$$

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

The correct answer is:

00110010

Two's Complement

1. Convert 35_{10} to binary then use Two's Complement to convert the binary representation of 35_{10} in to the Two's Complemented binary representation for -35_{10} , what is the correct answer:

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
Positional notation used to convert decimal to binary	0	0	1	0	0	0	1	1
Flipped bits	1	1	0	1	1	1	0	0
One to add to the flipped bits above	0	0	0	0	0	0	0	1
Result of addition of flipped bits and one	1	1	0	1	1	1	0	1
Carry Bits								

The correct answer is:

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

2. Convert 106_{10} to binary then use Two's Complement to convert the binary representation of 106_{10} in to the Two's Complemented binary representation for -106_{10} , what is the correct answer:

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Positional notation used to convert decimal to binary	0	1	1	0	1	0	1	0
Flipped bits	1	0	0	1	0	1	0	1
One to add to the flipped bits above								1
Result of addition of flipped bits and one	1	0	0	1	0	1	1	0
Carry Bits							1	

The correct answer is:

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

3. Convert 73_{10} to binary then use Two's Complement to convert the binary representation of 73_{10} in to the Two's Complemented binary representation for -73_{10} , what is the correct answer:

• = 0

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Positional notation used to convert decimal to binary	•		•	•		•	•	
Flipped bits		•			•			•
One to add to the flipped bits above								
Result of addition of flipped bits and one		•			•			
Carry Bits								

The correct answer is:

| • | | | • | | |

4. Convert 93_{10} to binary then use Two's Complement to convert the binary representation of 93_{10} in to the Two's Complemented binary representation for -93_{10} , what is the correct answer:

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Positional notation used to convert decimal to binary	•		•				•	
Flipped bits		•		•	•	•		•
One to add to the flipped bits above								
Result of addition of flipped bits and one		•		•	•	•		
Carry Bits								

The correct answer is:

| • | • • • | |

Binary Subtraction

1. Subtract 35_{10} from 100_{10} in binary, what is the correct answer:

$$100_{10} - 35_{10} =$$

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
Positional notation used to convert First Term decimal to binary		0	1	1	0	0	1	0	0
Positional notation used to convert Second Term decimal to binary		0	0	1	0	0	0	1	1
Flipped bits of Second Term		1	1	0	1	1	1	0	0
One to add to the flipped bits of Second Term		0	0	0	0	0	0	0	1
Two's Complement of Second Term		1	1	0	1	1	1	0	1
<i>Carry Bits</i>									
Addition of First Term and Two's Complement of Second Term	+	0	1	1	0	0	1	0	0
		1	1	0	1	1	1	0	1
Result		1	0	1	0	0	0	0	1
<i>Carry Bits</i>		1	1	1	1	1			

The correct answer is:

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

2. Subtract 28_{10} from 87_{10} in binary, what is the correct answer:

$$87_{10} - 28_{10} =$$

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Positional notation used to convert First Term decimal to binary	.		.		.			
Positional notation used to convert Second Term decimal to binary
Flipped bits of Second Term				.	.	.		
One to add to the flipped bits of Second Term								
Two's Complement of Second Term			
<i>Carry Bits</i>								
Addition of First Term and Two's Complement of Second Term	+	.		.		.		
Result		.	.				.	
<i>Carry Bits</i>								

The correct answer is:

.	.				.		
---	---	--	--	--	---	--	--

3. Subtract 49_{10} from 77_{10} in binary, what is the correct answer:

$$77_{10} - 49_{10} =$$

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Positional notation used to convert First Term decimal to binary								
Positional notation used to convert Second Term decimal to binary		.	.	1	1	.	.	1
Flipped bits of Second Term		1	1	.	.	1	1	.
One to add to the flipped bits of Second Term								1
Two's Complement of Second Term								
<i>Carry Bits</i>								
Addition of First Term and Two's Complement of Second Term	+	.	1	.	.	1	1	.
Result	1	.	.	.	1	1	1	.
<i>Carry Bits</i>	1	1			1	1	1	1

The correct answer is:

.	.	.	1	1	1	.	.
---	---	---	---	---	---	---	---

4. Subtract 63_{10} from 115_{10} in binary, what is the correct answer:

$$115_{10} - 63_{10} =$$

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Positional notation used to convert First Term decimal to binary								
Positional notation used to convert Second Term decimal to binary	.	.	1	1	1	1	1	1
Flipped bits of Second Term	1	1
One to add to the flipped bits of Second Term								1
Two's Complement of Second Term	1	1	1
<i>Carry Bits</i>								
Addition of First Term and Two's Complement of Second Term	+	.	1	1	1	.	1	1
Result	1	.	.	1	1	.	1	.
<i>Carry Bits</i>	1	1					1	1

The correct answer is:

.	.	1	1	.	1	.	.
---	---	---	---	---	---	---	---

Converting Hexadecimal to Decimal

1. Convert the following Hexadecimal (base 16) number to Decimal (base 10):

$A16_{16}$

We have worked this first question through for you.

+	$(10_{10} \times 256_{10})$		2	5	6	0
	$(1_{10} \times 16_{10})$				1	6
	$(6_{10} \times 1_{10})$					6
	=		2	5	8	2
					1	

The correct answer is:

2582₁₀

2. Convert the following Hexadecimal (base 16) number to Decimal (base 10):

$4DF_{16}$

+	4×256		1	0	2	4
	13×16			2	0	8
	15×1				1	5
	=		1	2	4	>

The correct answer is:

124>

3. Convert the following Hexadecimal (base 16) number to Decimal (base 10):

$E5C_{16}$

+	14×256		7	5	8	4
	5×16				0	0
	12×1				1	2
	=		3	6	>	5

The correct answer is:

36>5

4. Convert the following Hexadecimal (base 16) number to Decimal (base 10):

135_{16}

+	1×256			2	5	6
	3×16				4	0
	5×1					5
	=			2	0	9

The correct answer is:

209

Converting Hexadecimal to Binary

1. Convert the following Hexadecimal (base 16) number to Binary (base 2):

$0A16_{16}$

We have worked this first question through for you.

	8	4	2	1
	2^3	2^2	2^1	2^0
6₁₆	0	1	1	0
1₁₆	0	0	0	1
A₁₆	1	0	1	0
0₁₆	0	0	0	0

The correct answer is:

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

2. Convert the following Hexadecimal (base 16) number to Binary (base 2):

$FE37_{16}$

	8	4	2	1
	2^3	2^2	2^1	2^0
>	•			
3	•	•		
E				•
F		/		

The correct answer is:

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

Converting Binary to Hexadecimal

1. Convert the following Binary (base 2) number to Hexadecimal (base 16):

1101000100100110_2

We have worked this first question through for you.

	8	4	2	1
	2^3	2^2	2^1	2^0
6_{16}	0	1	1	0
2_{16}	0	0	1	0
1_{16}	0	0	0	1
D_{16}	1	1	0	1

The correct answer is:

D126₁₆

2. Convert the following Binary (base 2) number to Hexadecimal (base 16):

1011011011100111_2

	8	4	2	1
	2^3	2^2	2^1	2^0
>	.			
E				.
6	.			.
B		.		

The correct answer is:

B6E7

Converting Octal to Decimal

1. Convert the following Octal (base 8) number to Decimal (base 10):

217_8

We have worked this first question through for you.

+	$(2_{10} \times 64_{10})$			1	2	8
	$(1_{10} \times 8_{10})$					8
	$(7_{10} \times 1_{10})$					7
	=			1	4	3
					2	

The correct answer is:

143₁₀

2. Convert the following Octal (base 8) number to Decimal (base 10):

435_8

+	4×64			2	3	5
	3×8				2	4
	5×1					5
	=			2	3	5

The correct answer is:

235

Converting Octal to Binary

1. Convert the following Octal (base 8) number to Binary (base 2):

761₈

We have worked this first question through for you.

	4	2	1
	2^2	2^1	2^0
1₈	0	0	1
6₈	1	1	0
7₈	1	1	1

The answer is:

0 0 0 0 0 0 0 1 1 1 1 1 0 0 0 1

2. Convert the following Octal (base 8) number to Binary (base 2):

357₈

	4	2	1
	2^2	2^1	2^0
>	1	1	1
≤	1	.	1
≠	.	1	1

The answer is:

· | / | · | / | / |

Converting Binary to Octal

1. Convert the following Binary (base 2) number to Octal (base 8):

$0110\ 110\ 101\ 010\ 011_2$

We have worked this first question through for you.

	4	2	1
	2^2	2^1	2^0
3_8	0	1	1
2_8	0	1	0
5_8	1	0	1
6_8	1	1	0
6_8	1	1	0
0_8	-	-	0

The correct answer is:

66523₈

2. Convert the following Binary (base 2) number to Octal (base 8):

$0111\ 1011\ 0111\ 0100_2$

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

The correct answer is:

75564

The Answers

Recap on Binary to Decimal Conversion

1. 234_{10}

2. 61_{10}

Recap on Decimal to Binary Conversion

1. 10100111_2

2. 10010011_2

Recap on Binary Addition

1. 01100100_2

2. 10111110_2

Binary Multiplication

1. 10000100_2

2. 11011100_2

3. 01001110_2

4. 00110010_2

Two's Complement

1. 11011101_2

2. 10010110_2

3. 10110111_2

4. 10100011_2

Binary Subtraction

1. 01000001_2

2. 00111011_2

3. 00011100_2

4. 00110100_2

Converting Hexadecimal to Decimal

1. 2582_{10}

2. 1247_{10}

3. 3676_{10}

4. 309_{10}

Converting Hexadecimal to Binary

1. 0000101000010110_2

2. 111111000110111_2

Converting Binary to Hexadecimal

1. $D126_{16}$

2. $B6E7_{16}$

Converting Octal to Decimal

1. 143_{10}

2. 285_{10}

Converting Octal to Binary

1. 000000011110001_2

2. 0000000011101111_2

Converting Binary to Octal

1. 66523_8

2. 75564_8