COMPUTER SYSTEMS FUNDAMENTALS
(4COSC004W)

Lecture: Week 2

Previous weeks:

- Introduction to the module
  - *Structure*
  - *Administration*
- Positional Number Systems
  - *Denary*
  - *Binary*

Tutorials

- See YOUR personalised timetable to find out time & tutor
- Online exercises on Blackboard - Live now
  - *Apps to help*
- Tutor available to assist
- Will cover all topics from lectures
- Feedback after each attempt
- Re-attempt each exercise until you achieve full marks
- Always wear a face mask unless you are exempt

HEXADECIMAL BASE 16

Positive Integers

By the end of this lecture, you will:

- Be able to convert Hexadecimal Positive Integers to their Binary values
- Be able to convert Binary Positive Integers to their Hexadecimal values
- Be able to convert Hexadecimal Positive Integers to their Denary values

Hexadecimal

- Base-16
- Each digit can be a value 0-F
  - *One of 16 different values*

Denary	Hexadecimal
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	A
11	B
12	C
13	D
14	E
15	F

Why Hexadecimal?

- Denary works well for us humans
- Binary works for digital computers
  - *00101011*
  - *0100101000101011*
- Hexadecimal is convenient way to represent Binary values:
  - *Base-16*
  - *One Hexadecimal digit maps to a 4-Bit Binary Nibble*
  - *Each 4-Bit Binary Nibble maps to a Hexadecimal digit*

Hexadecimal Table

Denary	Binary	Hexadecimal
0	0 0 0 0	0
1	0 0 0 1	1
2	0 0 1 0	2
3	0 0 1 1	3
4	0 1 0 0	4
5	0 1 0 1	5
6	0 1 1 0	6
7	0 1 1 1	7
8	1 0 0 0	8
9	1 0 0 1	9
10	1 0 1 0	A
11	1 0 1 1	B
12	1 1 0 0	C
13	1 1 0 1	D
14	1 1 1 0	E
15	1 1 1 1	F

Binary:
Bit weightings

2^3	2^2	2^1	2^0
8	4	2	1

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

Binary:
Bit weightings

2^3	2^2	2^1	2^0
8	4	2	1

Denary	Binary	Hexadecimal
0	0 0 0 0	0
1	0 0 0 1	1
2	0 0 1 0	2
3	0 0 1 1	3
4	0 1 0 0	4
5	0 1 0 1	5
6	0 1 1 0	6
7	0 1 1 1	7
8	1 0 0 0	8
9	1 0 0 1	9
10	1 0 1 0	A
11	1 0 1 1	B
12	1 1 0 0	C
13	1 1 0 1	D
14	1 1 1 0	E
15	1 1 1 1	F

Binary				Hexadecimal
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	A
1	0	1	1	B
1	1	0	0	C
1	1	0	1	D
1	1	1	0	E
1	1	1	1	F

Try it for yourself

- Generate the Hexadecimal Nibble (4-bit) Table with its corresponding columns for Binary and Hexadecimal values

Binary				Hexadecimal
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	A
1	0	1	1	B
1	1	0	0	C
1	1	0	1	D
1	1	1	0	E
1	1	1	1	F

Converting from Hexadecimal to Binary

2				A				B				3			
0	0	1	0	1	0	1	0	1	0	1	1	0	0	1	1

Binary				Hexadecimal
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	A
1	0	1	1	B
1	1	0	0	C
1	1	0	1	D
1	1	1	0	E
1	1	1	1	F

Converting from Binary to Hexadecimal

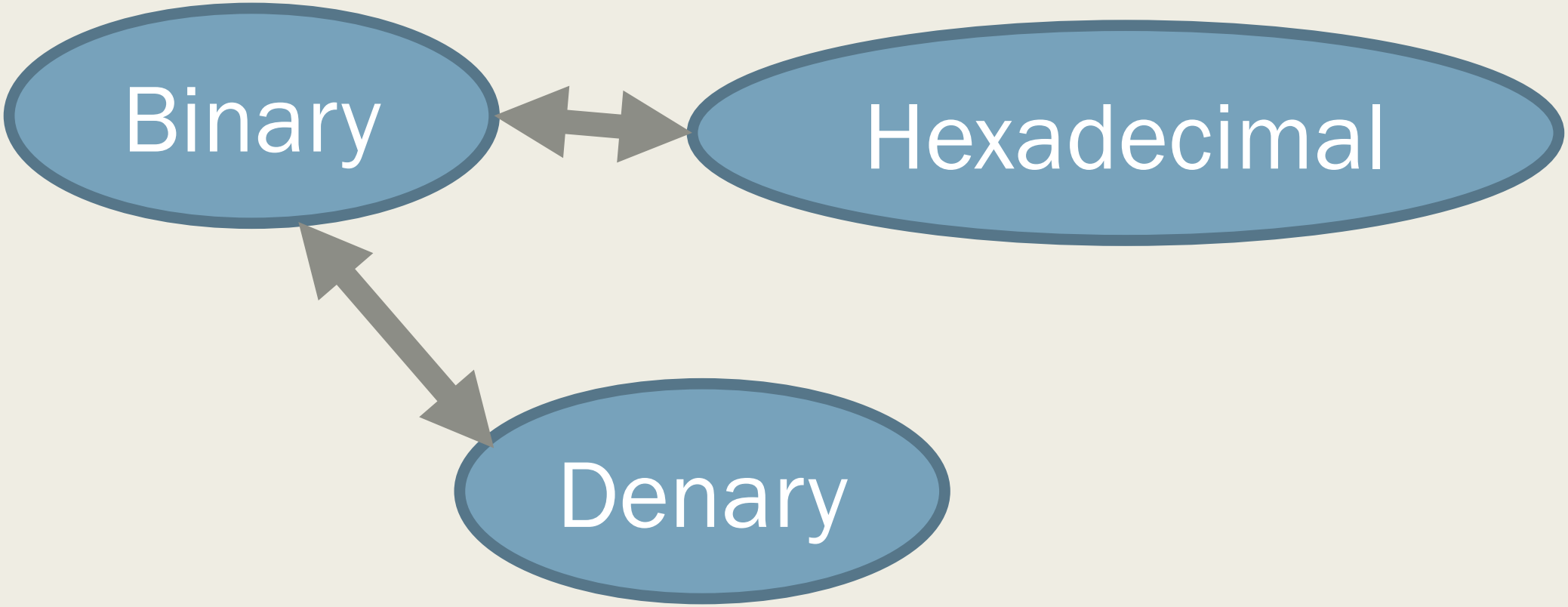
0	0	1	0	1	0	1	0	1	0	1	1	0	0	1	1
2				A				B				3			

Binary				Hexadecimal
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	A
1	0	1	1	B
1	1	0	0	C
1	1	0	1	D
1	1	1	0	E
1	1	1	1	F

Try it for yourself

- Convert a long (no less than sixteen bits long) binary number to Hexadecimal
- Convert the Hexadecimal value you found back to Binary

Number System Triangle



Converting from Hexadecimal to Denary

- Base 16
- Weighting of each position are successive powers of 16

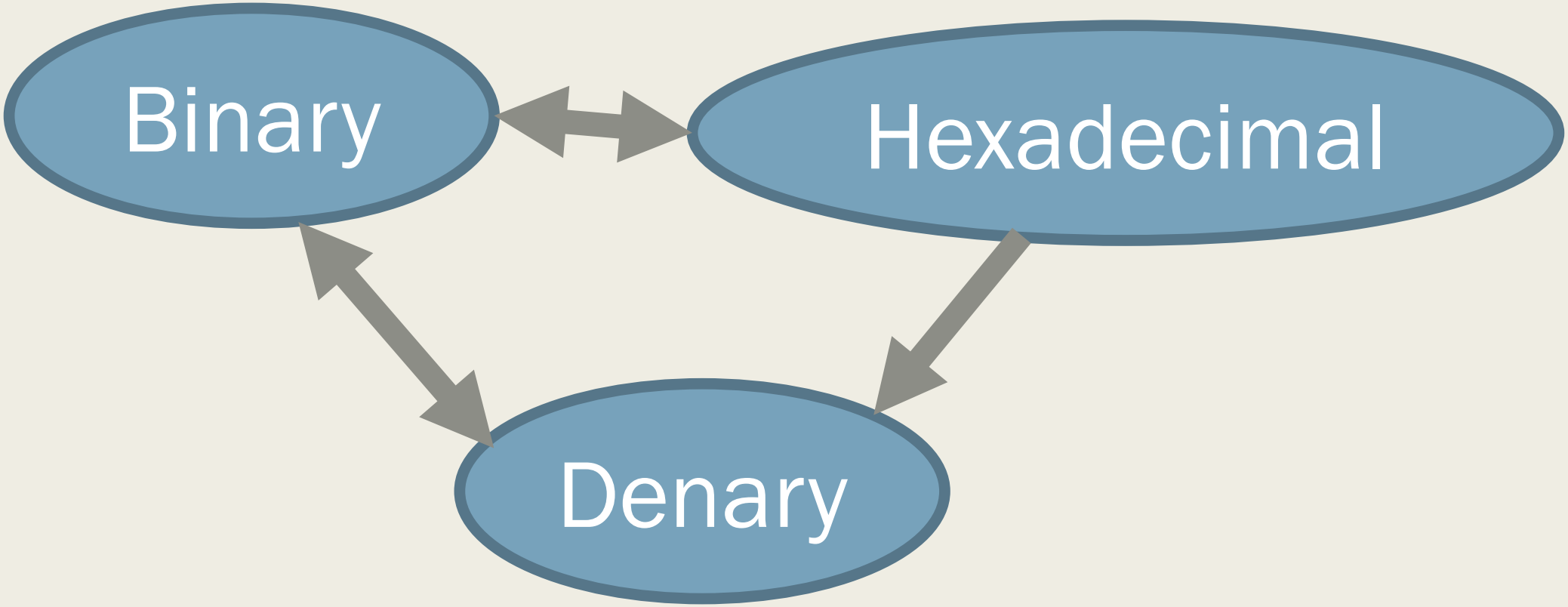
16^3	16^2	16^1	16^0
4096	256	16	1

4096 table	
1	4096
2	8192
3	12288
4	16384
5	20480
6	24576
7	28672
8	32768
9	36864
10	40960
11	45056
12	49152
13	53248
14	57344
15	61440

256 table	
1	256
2	512
3	768
4	1024
5	1280
6	1536
7	1792
8	2048
9	2304
10	2560
11	2816
12	3072
13	3328
14	3584
15	3840

16 table	
1	16
2	32
3	48
4	64
5	80
6	96
7	112
8	128
9	144
10	160
11	176
12	192
13	208
14	224
15	240

Number System Triangle



In this lecture we have covered:

- Hexadecimal:
  - *Converting values from Hexadecimal to Binary*
  - *Converting values from Binary to Hexadecimal*
  - *Converting values from Hexadecimal to Decimal*

Further reading:

- Foundation Maths
  - *Chapter 14*
- Computer Science Illuminated
  - *Chapter 2*

Thank you