Introduction to Binary and Hexadecimal

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Module Goals

Introduce the need for binary

Review – Primary School Math

Counting in Binary

Converting Binary to Decimal

Converting Decimal to Binary

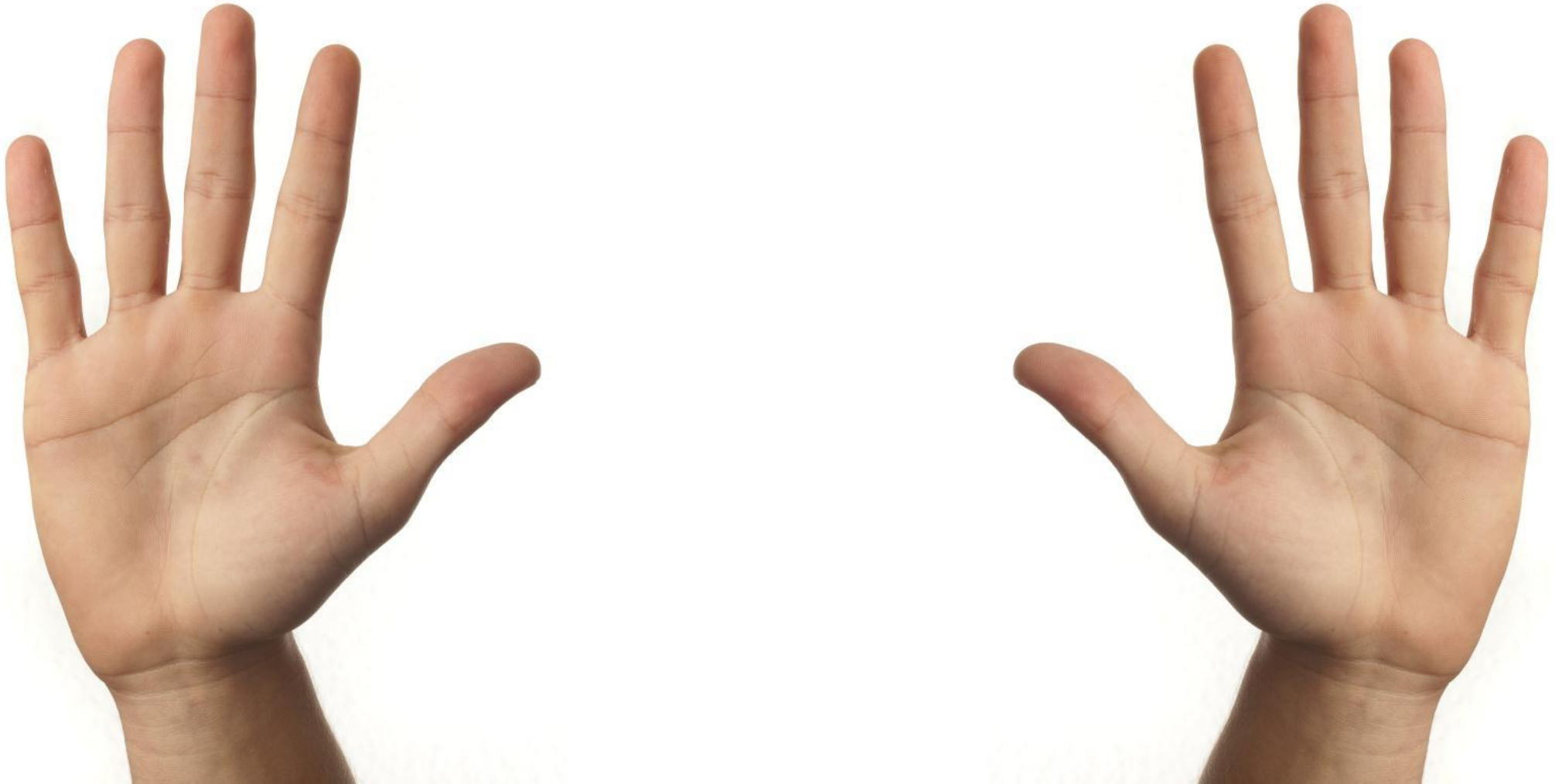
Hexadecimal

1.4

Binary 101

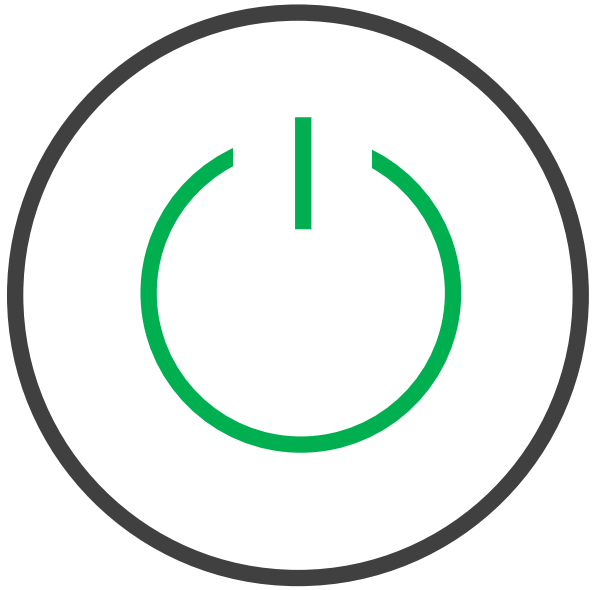
Base 10

1.4



Binary

1.4



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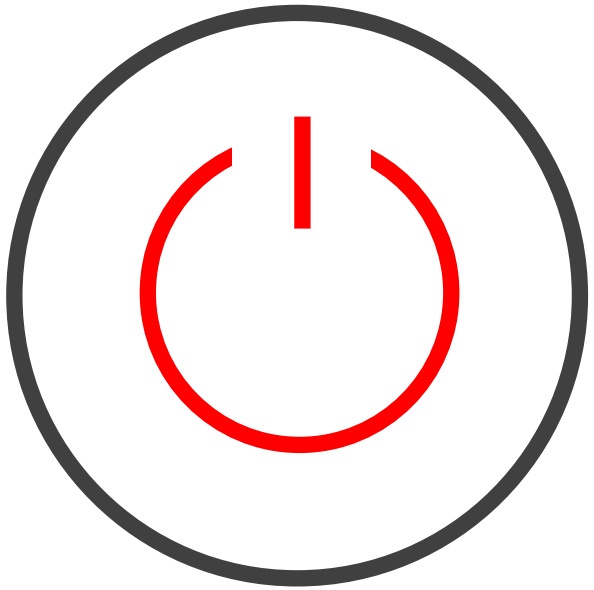

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1.4

EXAMPLE

Decimal or Powers or Ten

1.4

Ten Millions Place	Millions Place		Hundred Thousands Place	Ten Thousands Place	Thousands Place		Hundreds Place	Tens Place	Ones Place
0	0	,	0	0	0	,	0	0	0
									1
									2
									3
									...
									5
									6
									...
									8
									9

Decimal or Powers or Ten

1.4

Ten Millions Place	Millions Place		Hundred Thousands Place	Ten Thousands Place	Thousands Place		Hundreds Place	Tens Place	Ones Place
0	0	,	0	0	0	,	0	1	0
								1	1
								1	2
								1	3
								...	...
								6	5
								6	6
								...	...
								9	8
								9	9

Decimal or Powers or Ten

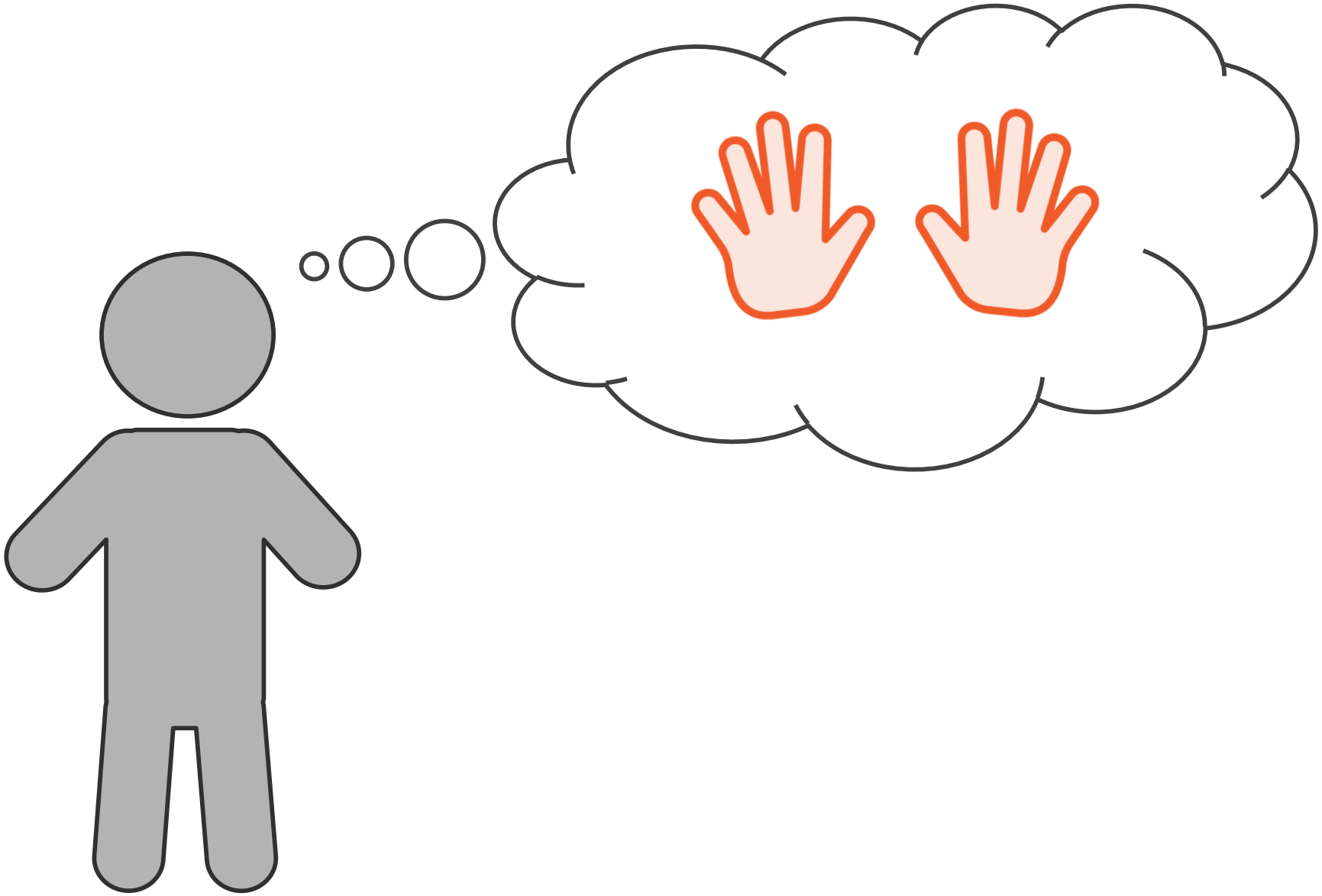
1.4

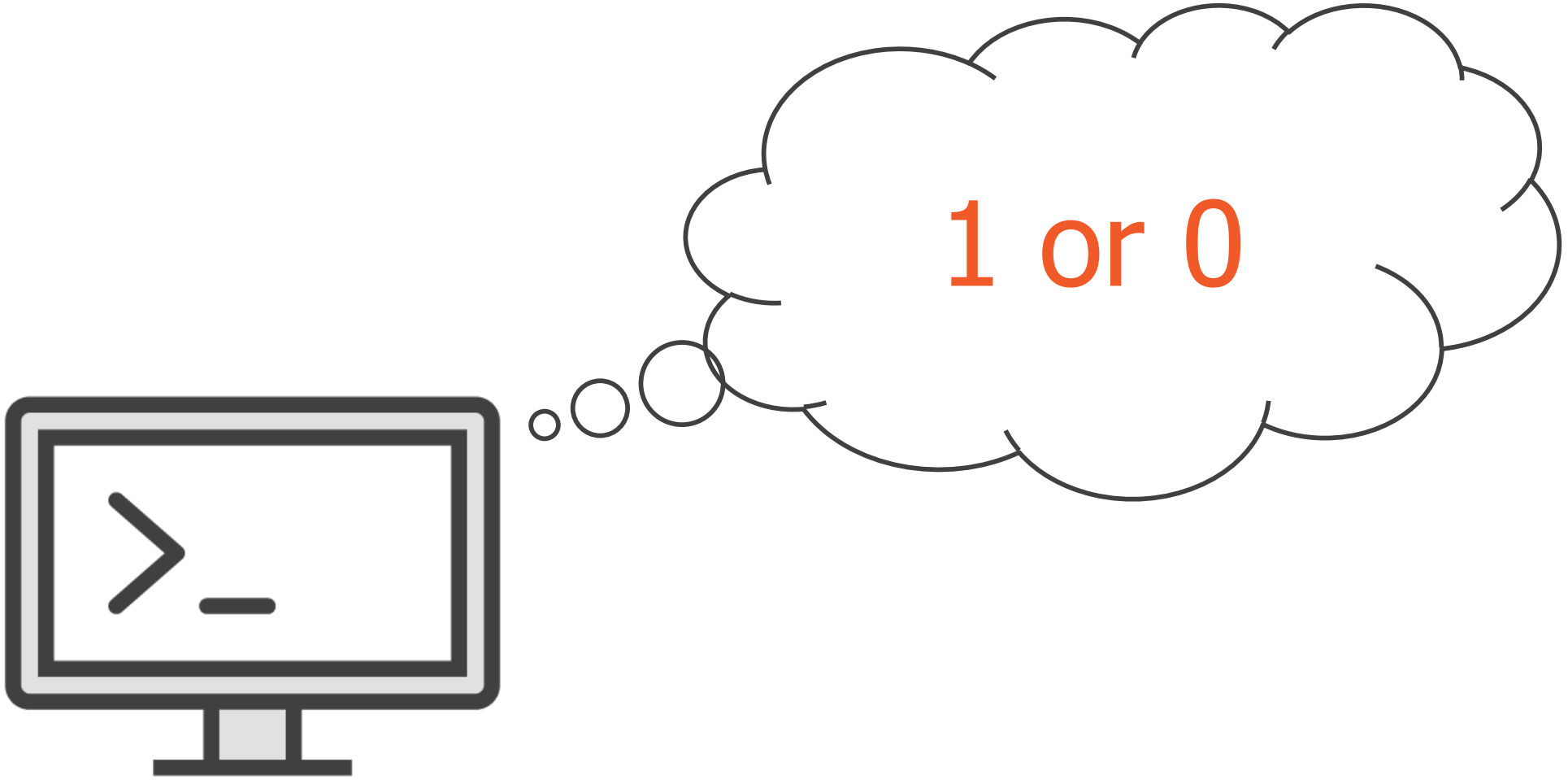
Ten Millions Place	Millions Place		Hundred Thousands Place	Ten Thousands Place	Thousands Place		Hundreds Place	Tens Place	Ones Place
0	0	,	0	0	0	,	1	0	0
0	0	,	0	0	1	,	0	0	0
0	0	,	0	1	0	,	0	0	0

Decimal or Powers or Ten

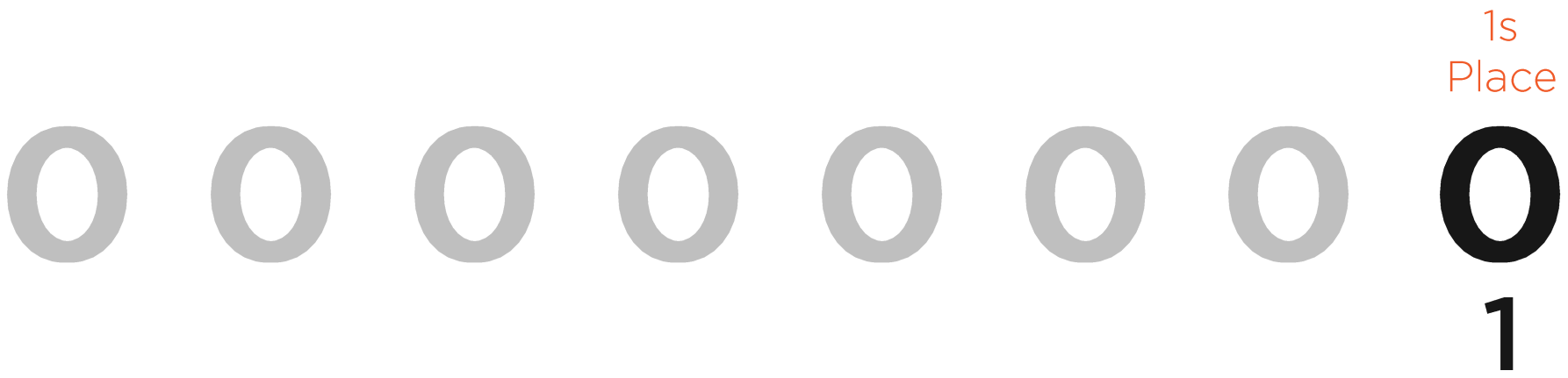
1.4

Ten Millions Place	Millions Place		Hundred Thousands Place	Ten Thousands Place	Thousands Place		Hundreds Place	Tens Place	Ones Place
0	0	,	1	0	0	,	0	0	0
0	1	,	0	0	0	,	0	0	0
1	0	,	0	0	0	,	0	0	0




1 or 0

Binary or Powers of Two



Binary or Powers of Two

1.4

							2s Place	1s Place
0	0	0	0	0	0	0	0	0
							0	1
							1	0
							1	1

Binary or Powers of Two

1.4

4s Place	2s Place	1s Place
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

0	0	0	0	8s Place	4s Place	2s Place	1s Place
				0	0	0	1
				0	0	1	0
				0	0	1	1
				0	1	0	0
				0	1	0	1
				0	1	1	0
				0	1	1	1

Binary or Powers of Two

1.4

				8s Place	4s Place	2s Place	1s Place
0	0	0	0	**1**	**0**	**0**	**0**
				1	0	0	1
				1	0	1	0
				1	0	1	1
				1	1	0	0
				1	1	0	1
				1	1	1	0
				1	1	1	1

Binary or Powers of Two

1.4

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
0	0	0	1	0	0	0	0

Binary or Powers of Two

1.4

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
0	0	1	0	0	0	0	0

Binary or Powers of Two

1.4

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
0	1	0	0	0	0	0	0

Binary or Powers of Two

1.4

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
1	0	0	0	0	0	0	0

1.4

Converting Binary to Decimal

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
1	1	0	0	0	0	0	0
1x128	1x64	0x32	0x16	0x8	0x4	0x2	0x1

128 + 64 + 0 + 0 + 0 + 0 + 0 + 0

=192

Binary or Powers of Two

1.4

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
0	0	0	1	0	1	1	0
0x128	0x64	0x32	1x16	0x8	1x4	1x2	0x1

0 + 0 + 0 + 16 + 0 + 4 + 2 + 0

=22

1.4

Let’s try a few more...

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
0	1	0	0	0	1	1	0
OFF	ON	OFF	OFF	OFF	ON	ON	OFF

0 + 64 + 0 + 0 + 0 + 4 + 2 + 0

=70

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
1	1	0	0	1	0	0	0
ON	ON	OFF	OFF	ON	OFF	OFF	OFF

128 + 64 + 0 + 0 + 8 + 0 + 0 + 0

=200

No help this time...

1.4

1 1 [redacted] 0 0 1

−225

1.4

Converting Decimal to Binary

1.4

210

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
Can we subtract 128 from 210?	Can we subtract 64 from 82?	Can we subtract 32 from 18?	Can we subtract 16 from 18?	Can we subtract 8 from 2?	Can we subtract 4 from 2?	Can we subtract 2 from 2?	Can we subtract 1 from 0?
YES	YES	NO	YES	NO	NO	YES	NO
210 **-128** **= 82**	**82** **-64** **= 18**		**18** **-16** **= 2**			**2** **-2** **= 0**	

1.4

210

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
1	1	0	1	0	0	1	0
YES	YES	NO	YES	NO	NO	YES	NO

1.4

Would you like to see that again?

1.4

47

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
Can we subtract 128 from 47?	Can we subtract 64 from 47?	Can we subtract 32 from 47?	Can we subtract 16 from 15?	Can we subtract 8 from 15?	Can we subtract 4 from 7?	Can we subtract 2 from 3?	Can we subtract 1 from 1?
NO	NO	YES	NO	YES	YES	YES	YES
		47 **-32** **= 15**		**15** **-8** **= 7**	**7** **-4** **= 3**	**3** **-2** **= 1**	**1** **-1** **= 0**

1.4

47

128s Place	64s Place	32s Place	16s Place	8s Place	4s Place	2s Place	1s Place
0	0	1	0	1	1	1	1
NO	NO	YES	NO	YES	YES	YES	YES

1.4

Hexadecimal

Hexadecimal

Binary	Decimal	Hexadecimal
	0	
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	

Hexadecimal

Binary	Decimal	Hexadecimal
	0	
	1	
	2	
	3	
0000	4	0
	5	
	6	
	7	
	8	

Hexadecimal

Binary	Decimal	Hexadecimal
0000	0	0
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	

Hexadecimal

Binary	Decimal		Hexadecimal
	0000	0	0
		1	
		2	
		3	
0001		4	1
		5	
		6	
		7	
		8	

Hexadecimal

Binary	Decimal		Hexadecimal
	0000	0	0
		1	
		2	
		3	
0001		4	1
		5	
		6	
		7	
		8	

Hexadecimal

Binary	Decimal	Hexadecimal
0000	0	0
0001	1	1
	2	
	3	
	4	
	5	
	6	
	7	
	8	

Hexadecimal

Binary	Decimal		Hexadecimal
	0000	0	0
	0001	1	1
		2	
		3	
0010		4	2
		5	
		6	
		7	
		8	

Hexadecimal

Binary	Decimal	Hexadecimal
0000	0	0
0001	1	1
0010	2	2
	3	
	4	
	5	
	6	
	7	
	8	

Hexadecimal

Binary	Decimal		Hexadecimal
	0000	0	0
	0001	1	1
	0010	2	2
		3	
0011		4	3
		5	
		6	
		7	
		8	

Hexadecimal

Binary	Decimal	Hexadecimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
	4	
	5	
	6	
	7	
	8	

Hexadecimal

Binary	Decimal		Hexadecimal
	0000	0	0
	0001	1	1
	0010	2	2
0100	0011	3	3
		4	
		5	
		6	
		7	
		8	

1.4

Hexadecimal

Binary	Decimal	Hexadecimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
	5	
	6	
	7	
	8	

Hexadecimal

Binary	Decimal		Hexadecimal
0101	0000	0	0
	0001	1	1
	0010	2	2
	0011	3	3
	0100	4	4
		5	
		6	
		7	
		8	

Hexadecimal

Binary	Decimal	Hexadecimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
	6	
	7	
	8	

Hexadecimal

Binary	Decimal		Hexadecimal
	0000	0	0
	0001	1	1
	0010	2	2
	0011	3	3
0110	0100	4	4
	0101	5	5
		6	
		7	
		8	

Hexadecimal

Binary	Decimal	Hexadecimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
	7	
	8	

Hexadecimal

Binary	Decimal		Hexadecimal
	0000	0	0
	0001	1	1
	0010	2	2
0111	0011	3	3
	0100	4	4
	0101	5	5
	0110	6	6
		7	
		8	

7

Hexadecimal

Binary	Decimal	Hexadecimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
	8	

Hexadecimal

Binary	Decimal		Hexadecimal
	0000	0	0
	0001	1	1
	0010	2	2
	0011	3	3
1000	0100	4	4
	0101	5	5
	0110	6	6
	0111	7	7
		8	

8

Hexadecimal

Binary	Decimal	Hexadecimal
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

Hexadecimal

Binary	Decimal	Hexadecimal
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
	9	

Hexadecimal

Binary	Decimal	Hexadecimal
	9	
	10	
	11	
	12	
	13	
	14	
	15	
	16	

Hexadecimal

Binary	Decimal	Hexadecimal
	9	
	10	
	11	
	12	
1001	13	9
	14	
	15	
	16	

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
	10	
	11	
	12	
	13	
	14	
	15	
	16	

Hexadecimal

Binary	Decimal	Hexadecimal
	1001	9	9
		10	
		11	
		12	
1010		13	A
		14	
		15	
		16	

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
1010	10	A
	11	
	12	
	13	
	14	
	15	
	16	

Hexadecimal

Binary	Decimal	Hexadecimal
	9	9
	10	A
	11	
	12	
	13	
	14	
	15	
	16	
1011		B

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
1010	10	A
1011	11	B
	12	
	13	
	14	
	15	
	16	

Hexadecimal

Binary	Decimal	Hexadecimal
1100	9	9
	10	A
	11	B
	12	C
	13	
	14	
	15	
	16	

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
1010	10	A
1011	11	B
1100	12	C
	13	
	14	
	15	
	16	

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
1010	10	A
1011	11	B
1100	12	C
	13	
	14	
	15	
	16	

1101

D

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
	14	
	15	
	16	

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
	14	
	15	
	16	

1110

E

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
	15	
	16	

Hexadecimal

Binary	Decimal	Hexadecimal
1111	1001	9	9
	1010	10	A
	1011	11	B
	1100	12	C
	1101	13	D
	1110	14	E
		15	
		16	

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F
	16	

Hexadecimal

Binary	Decimal		Hexadecimal
	1001	9	9
	1010	10	A
	1011	11	B
	1100	12	C
	1101	13	D
	1110	14	E
	1111	15	F
		16	

10000

10

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F
	16	

10000

10

Hexadecimal

Binary	Decimal	Hexadecimal
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F
10000	16	10

Summary

Introduce the need for binary

Review – Primary School Math

Counting in Binary

Converting Binary to Decimal

Converting Decimal to Binary

Hexadecimal