ENGR 101
Engineering Technology

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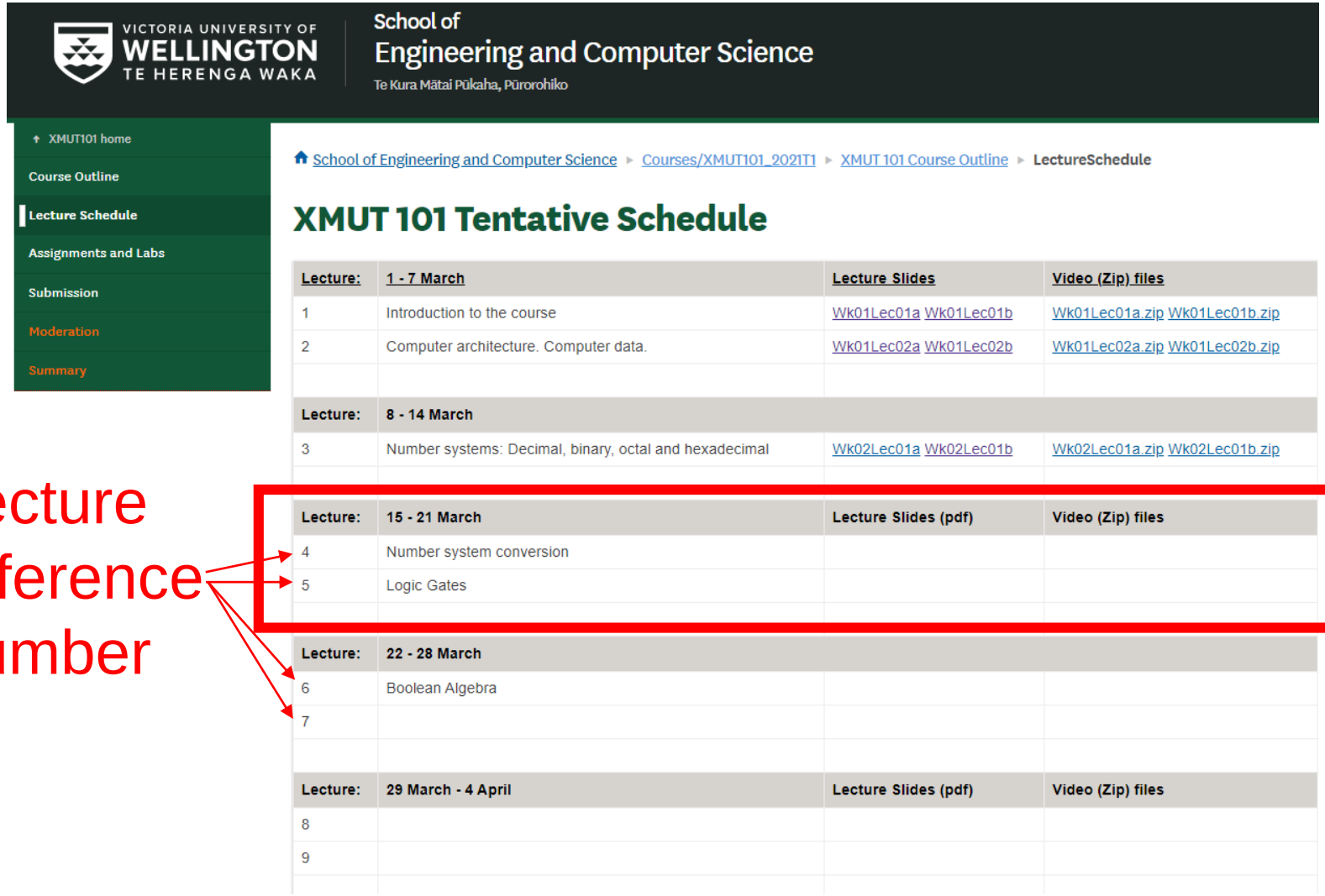
Victoria
UNIVERSITY OF WELLINGTON
Te Whare Wānanga
o te Ūpoko o te Ika a Māui
CAPITAL CITY UNIVERSITY

https://ecs.wgtn.ac.nz/Courses/XMUT101_2021T1/LectureSchedule



Lecture reference number

Week 3 Lecture 4a

- Main topics
  - Introduction to Engineering Technology
  - Number system
  - Logic Gates
  - Boolean Algebra

- Course web page:
  https://ecs.wgtn.ac.nz/Courses/XMUT101_2021T1/

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Convert a Integer *from* Decimal *to* Another Base

For each digit position:

1. **Divide decimal number by the base (8)**
2. **The *remainder* is the lowest-order digit**
3. **Repeat first two steps until no *divisor* remains.**

Exercise 3 – CORRECTION!!

Convert the following decimal numbers to octal:

a) $(172)_{10} = (\cancel{221})_8$ $= (254)_8$

b) $(32)_{10} = (40)_8$

c) $(99)_{10} = (\cancel{125})_8$ $= (143)_8$

d) $(114)_{10} = (162)_8$

Convert an Integer *from* Decimal *to* Hexadecimal

For each digit position:

1. **Divide decimal number by the base (e.g. 16)**
2. **The *remainder* is the lowest-order digit**
3. **Repeat first two steps until no *divisor* remains.**

Exercise 5

Convert the following decimal numbers to hexadecimal:

a) $(171)_{10} = (11)_{16}$ $= (AB)_{16}$

b) $(32)_{10} = (20)_{16}$

c) $(85)_{10} = (55)_{16}$

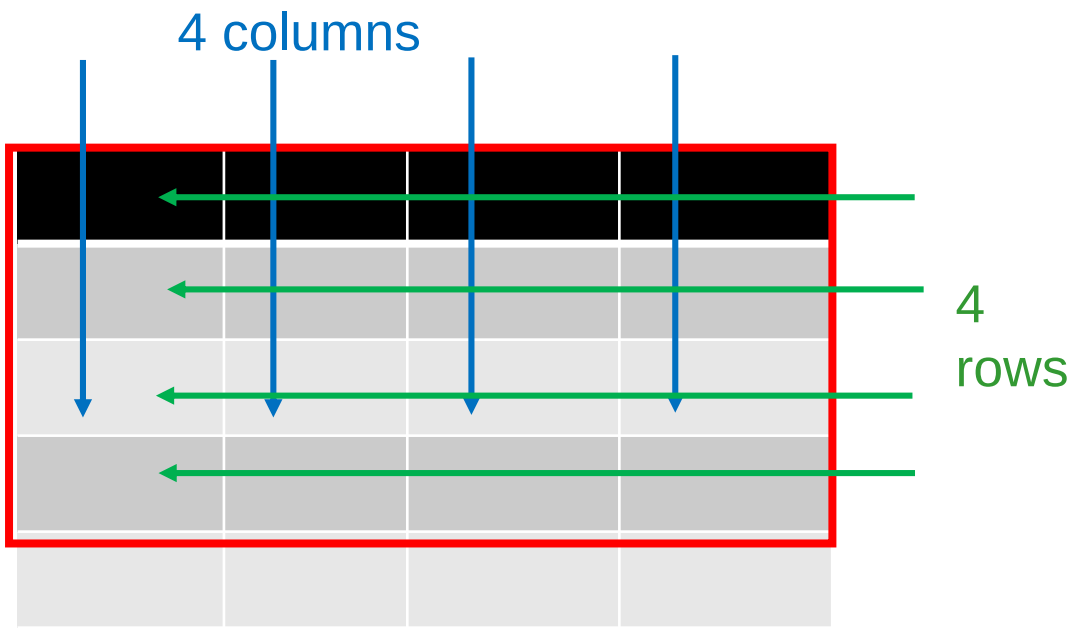
d) $(114)_{10} = (172)_{16}$ $= (72)_{16}$

Convert an Integer from Binary *to* Decimal

Convert the binary number $(1001)_2$ to decimal number.

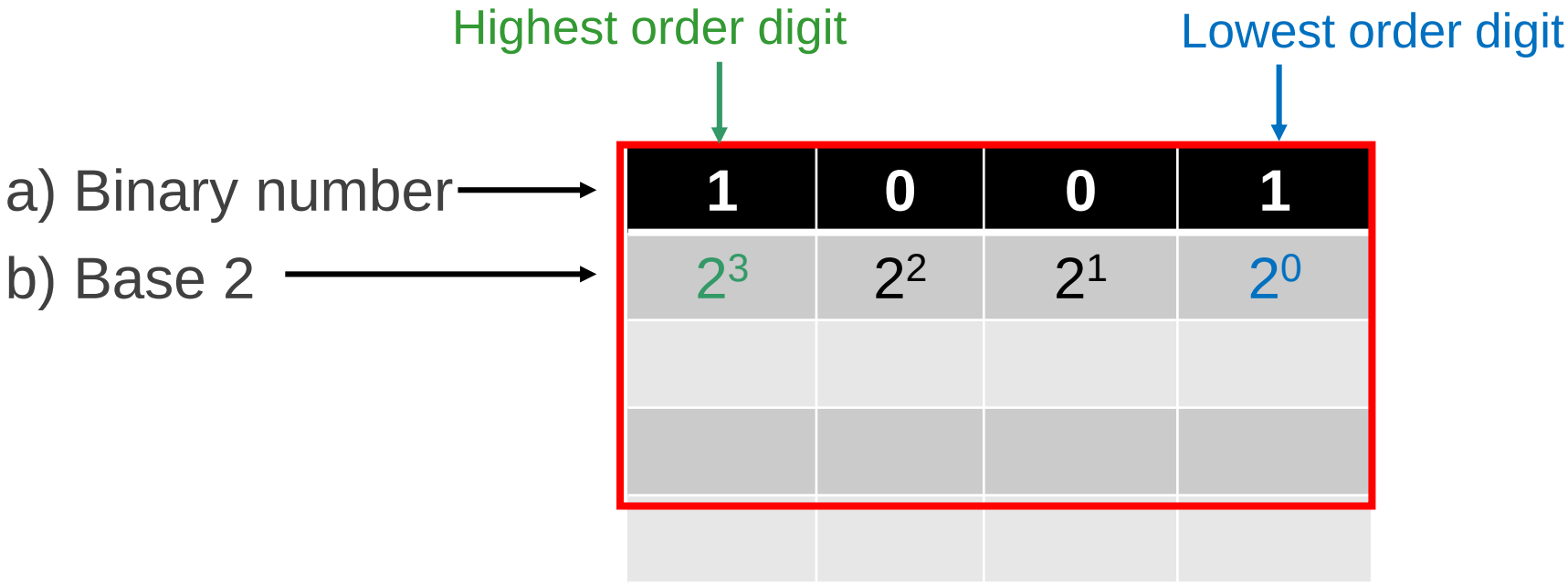
Convert an Integer from Binary *to* Decimal

Convert the binary number $(1001)_2$ to decimal number.



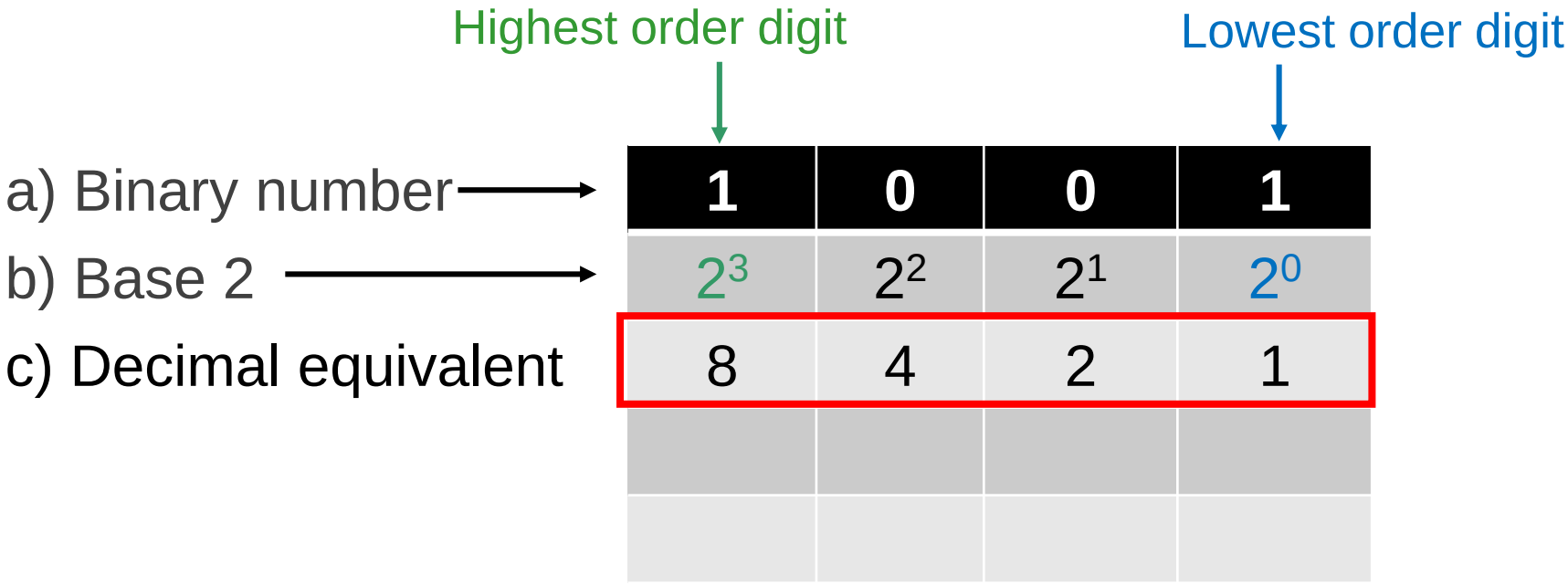
Convert an Integer from Binary *to* Decimal

Convert the binary number $(1001)_2$ to decimal number.



Convert an Integer from Binary *to* Decimal

Convert the binary number $(1001)_2$ to decimal number.



Convert an Integer from Binary *to* Decimal

Convert the binary number $(1001)_2$ to decimal number.

Highest order digit

Lowest order digit

a) Binary number →	1	0	0	1
b) Base 2 →	2^3	2^2	2^1	2^0
c) Decimal equivalent	8	4	2	1
a) x c)	1 x 8 = 8	0 x 4 = 0	0 x 2 = 0	1 x 1 = 1

Convert an Integer from Binary *to* Decimal

Convert the binary number $(1001)_2$ to decimal number.

a) Binary number	1	0	0	1
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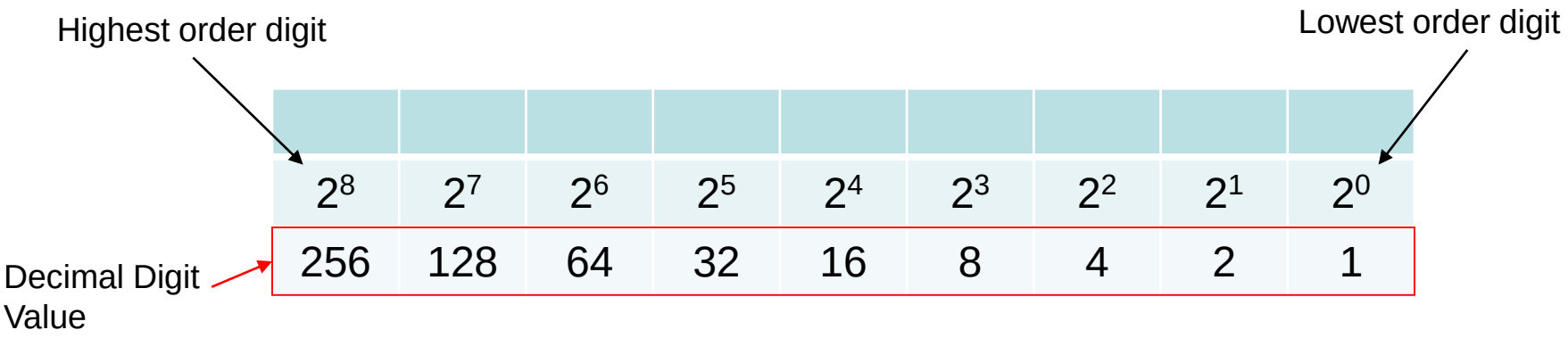
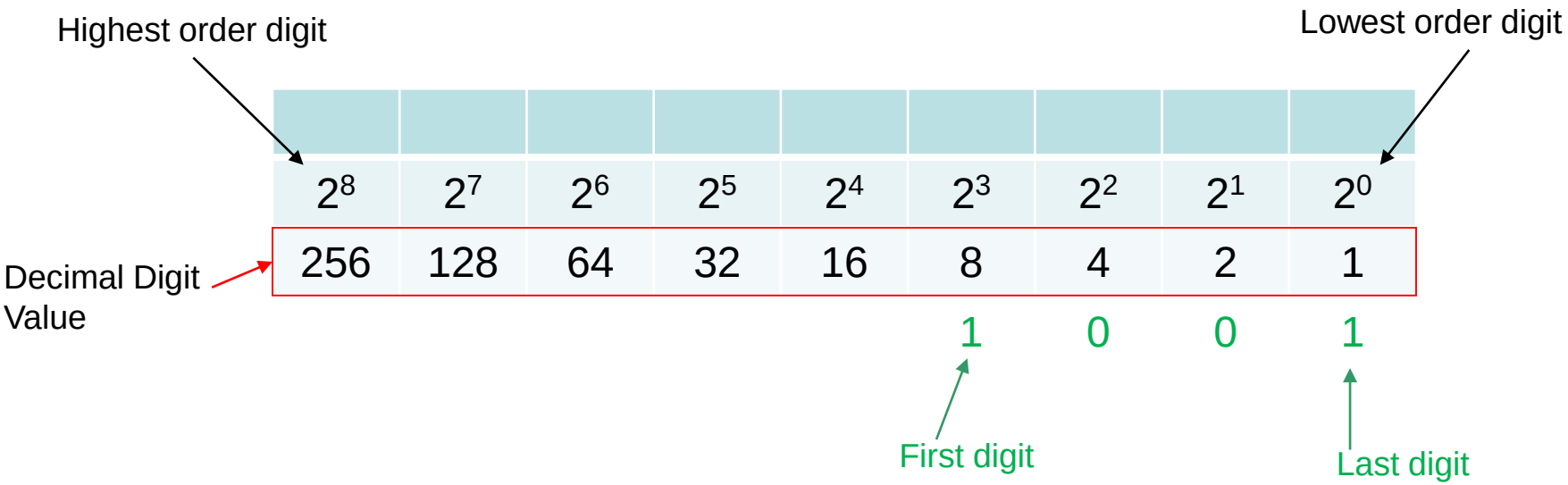
c) Decimal equivalent	8	4	2	1
a) x b)	1 x 8 = 8	0 x 4 = 0	0 x 2 = 0	1 x 1 = 1

$$(1001)_2 = (8 + 0 + 0 + 1)_{10} = (9)_{10}$$

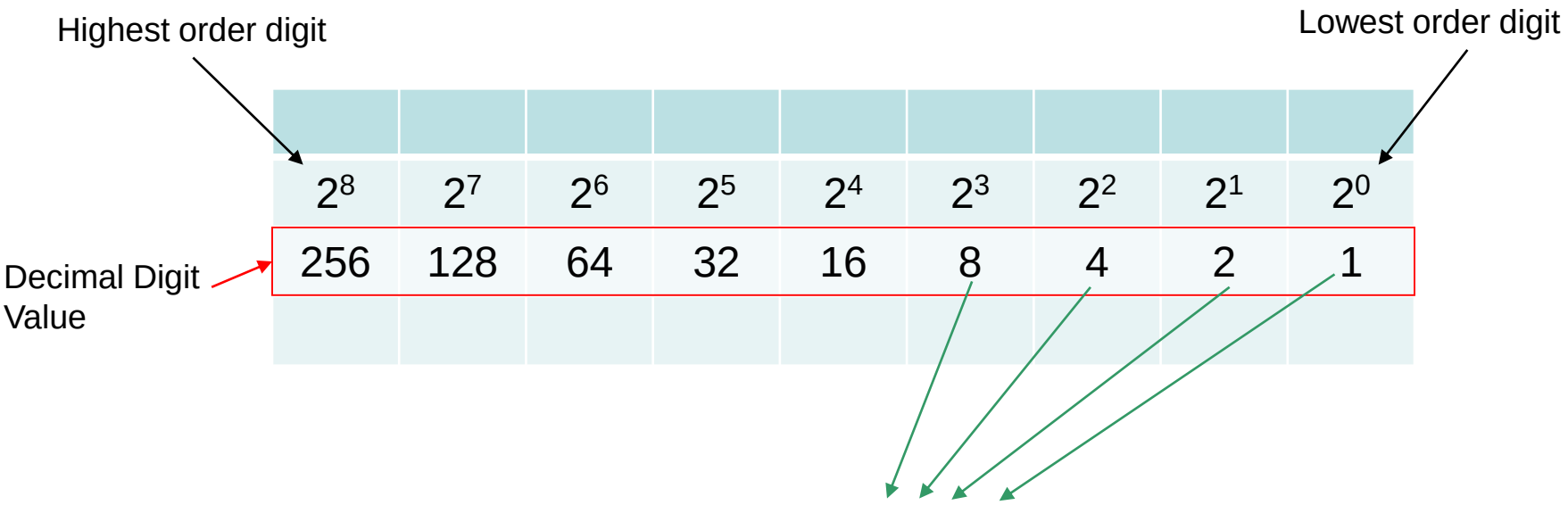
Convert an Integer *from* Binary *to* Decimal



Convert an Integer *from* Binary *to* Decimal

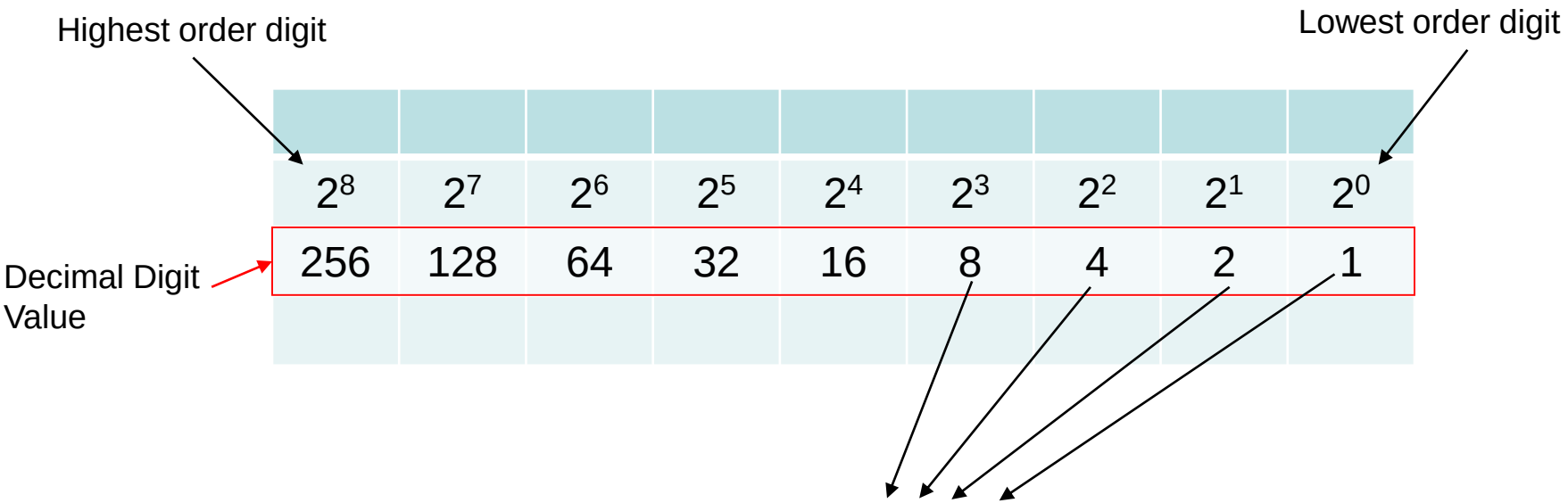


Convert an Integer *from* Binary *to* Decimal



Convert binary number 1001 to decimal

Convert an Integer *from* Binary *to* Decimal



Convert binary number 1001 to decimal

$(1\ 0\ 0\ 1)_2 = (1x8) + (0x4) + (0x2) + (1x1) = (9)_{10}$

Convert an Integer *from* Binary *to* Decimal

Exercise 4.1

Convert the following binary numbers to decimal:

a) $(1\ 0\ 1\ 1)_2$

b) $(1\ 0\ 1\ 0\ 1\ 0)_2$

c) $(1\ 1\ 1\ 1\ 0\ 1)_2$

d) $(1\ 1\ 0\ 0\ 0\ 1\ 0)_2$

5 minutes to convert these 4 binary numbers to decimal!!

Convert an Integer *from* Binary *to* Decimal

Exercise 4.1

Convert the following binary numbers to decimal:

a) $(1\ 0\ 1\ 1)_2$ $= (11)_{10}$

b) $(1\ 0\ 1\ 0\ 1\ 0)_2$ $= (42)_{10}$

c) $(1\ 1\ 1\ 1\ 0\ 1)_2$ $= (61)_{10}$

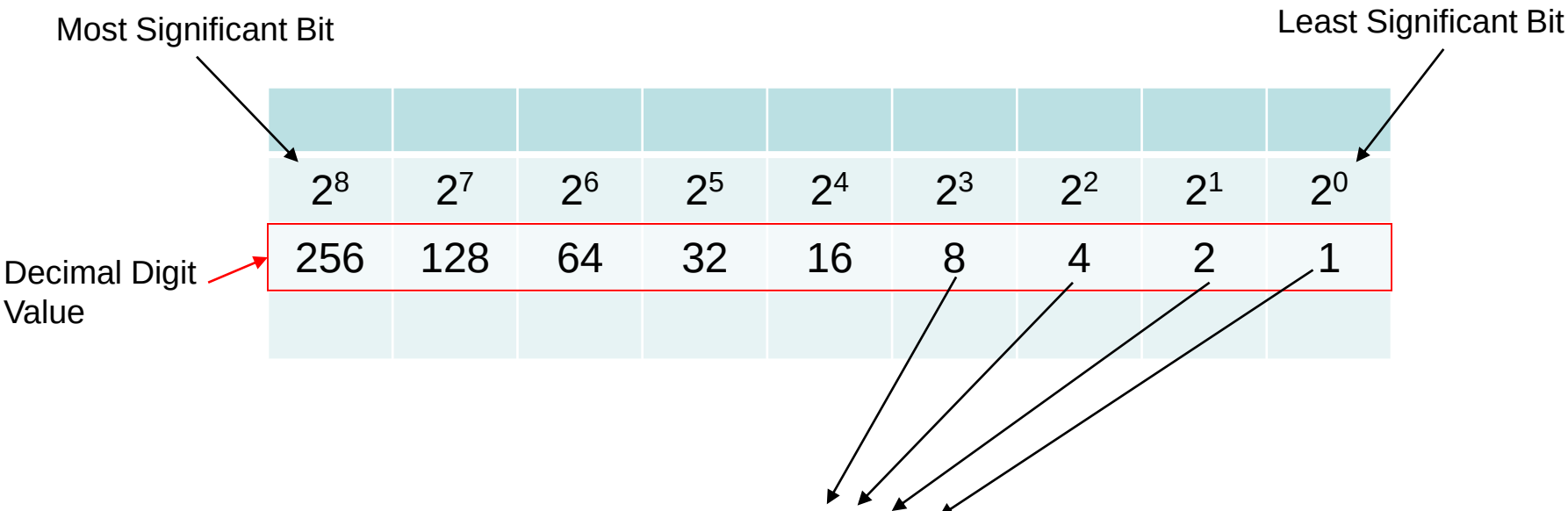
d) $(1\ 1\ 0\ 0\ 0\ 1\ 0)_2$ $= (98)_{10}$

Convert an Integer *from* Binary *to* Octal

1) First convert the binary number to decimal

2) Convert the decimal number to octal

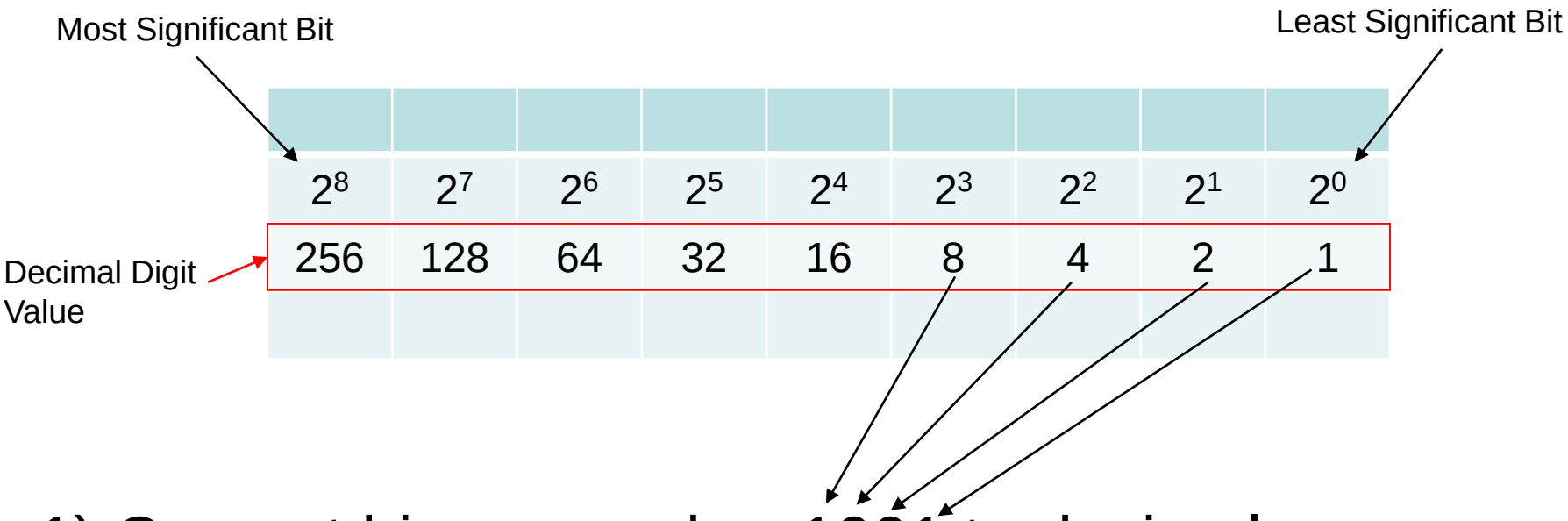
Convert an Integer *from* Binary *to* Octal



1) Convert binary number 1001 to decimal

$(1\ 0\ 0\ 1)_2 = (1x8) + (0x4) + (0x2) + (1x1) = (9)_{10}$

Convert an Integer *from* Binary *to* Octal



1) Convert binary number 1001 to decimal

$(1\ 0\ 0\ 1)_2 = (1x8) + (0x4) + (0x2) + (1x1) = (9)_{10}$

2) Convert $(9)_{10}$ to octal: $(9)_{10} \rightarrow 9/8 = 1$ remainder 1

$(9)_{10} \rightarrow (11)_8$

Convert an Integer *from* Binary *to* Octal

Exercise 4.2

Convert the following binary numbers to octal:

a) $(1\ 0\ 1\ 1)_2$

b) $(1\ 0\ 1\ 0\ 1\ 0)_2$

c) $(1\ 1\ 1\ 1\ 0\ 1)_2$

d) $(1\ 1\ 0\ 0\ 0\ 1\ 0)_2$

5 minutes to convert these 4 binary numbers to octal numbers!!

Convert an Integer *from* Binary *to* Octal

Exercise 4.2

Convert the following binary numbers to octal:

a) $(1\ 0\ 1\ 1)_2$ $= (13)_8$

b) $(1\ 0\ 1\ 0\ 1\ 0)_2$ $= (52)_8$

c) $(1\ 1\ 1\ 1\ 0\ 1)_2$ $= (75)_8$

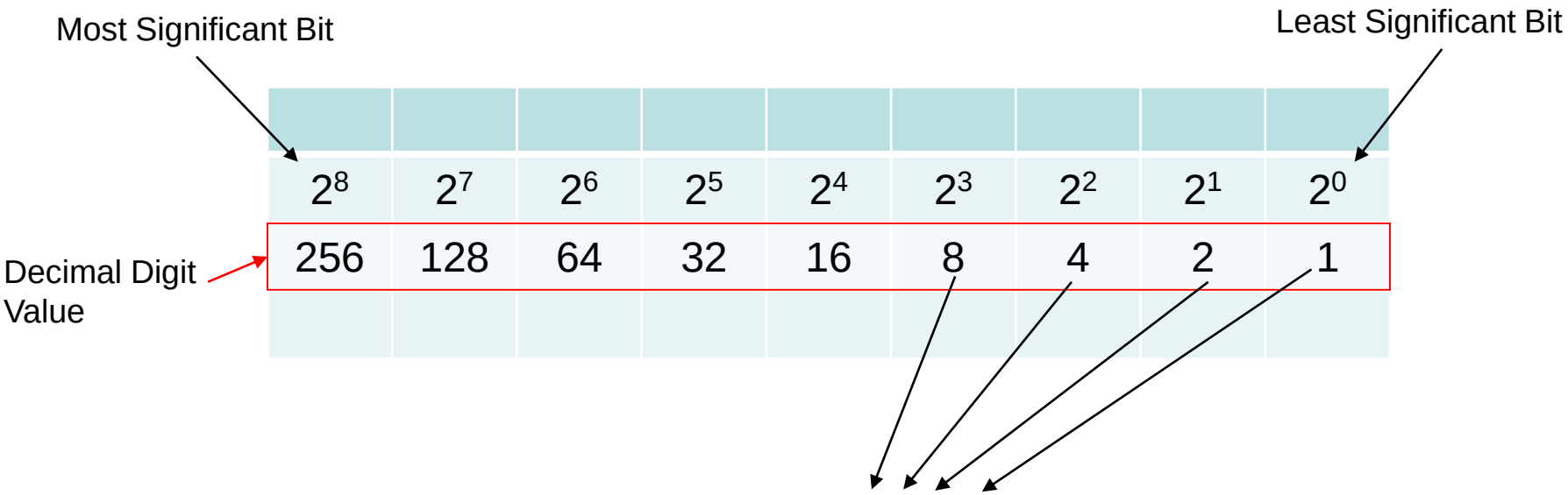
d) $(1\ 1\ 0\ 0\ 0\ 1\ 0)_2$ $= (142)_8$

Convert an Integer *from* Binary *to* Hexadecimal

1) First convert the binary number to decimal

2) Convert the decimal number to hexadecimal

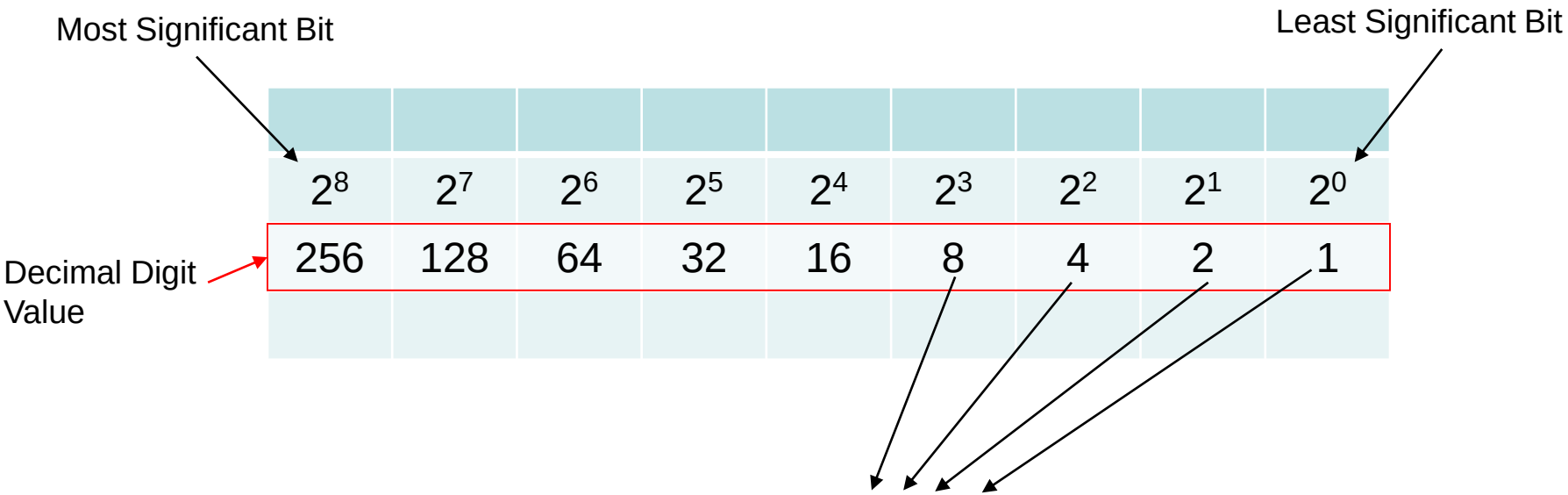
Convert an Integer *from* Binary *to* Hexadecimal



Convert binary number 1001 to decimal

$(1\ 0\ 0\ 1)_2 = (1x8) + (0x4) + (0x2) + (1x1) = (9)_{10}$

Convert an Integer *from* Binary *to* Hexadecimal



Convert binary number 1001 to decimal

$(1\ 0\ 0\ 1)_2 = (1x8) + (0x4) + (0x2) + (1x1) = (9)_{10}$

Convert $(9)_{10}$ to hexadecimal:

9/16 = 0 remainder 9

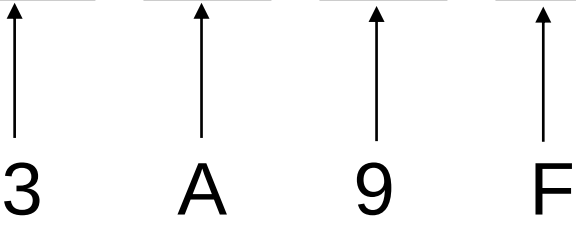
$(9)_{10} \rightarrow (9)_{16}$

Converting between Base 16 and Base 2

- Conversion is easy!
  - Determine 4-bit value for each hex digit
- Note that there are $2^4 = 16$ different values of four bits
- Easier to read and write in hexadecimal.
- Representations are equivalent!

Converting between Base 16 and Base 2

$3A9F_{16} = (0011\ 1010\ 1001\ 1111)_2$



Converting Between Base 16 and Base 8

1. Convert from Base 16 to Base 2
2. Regroup bits into groups of three starting from right
3. Ignore leading zeros
4. Each group of three bits forms an octal digit.

Converting Between Base 16 and Base 8

$3A9F_{16} = (0011\ \ 1010\ \ 1001\ \ 1111)_2$

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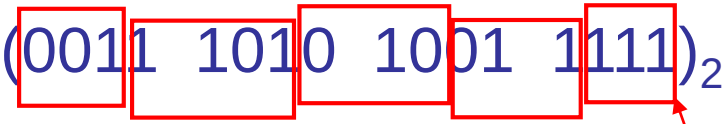

Start from right

1. Convert from Base 16 to Base 2
2. Regroup bits into groups of three starting from right
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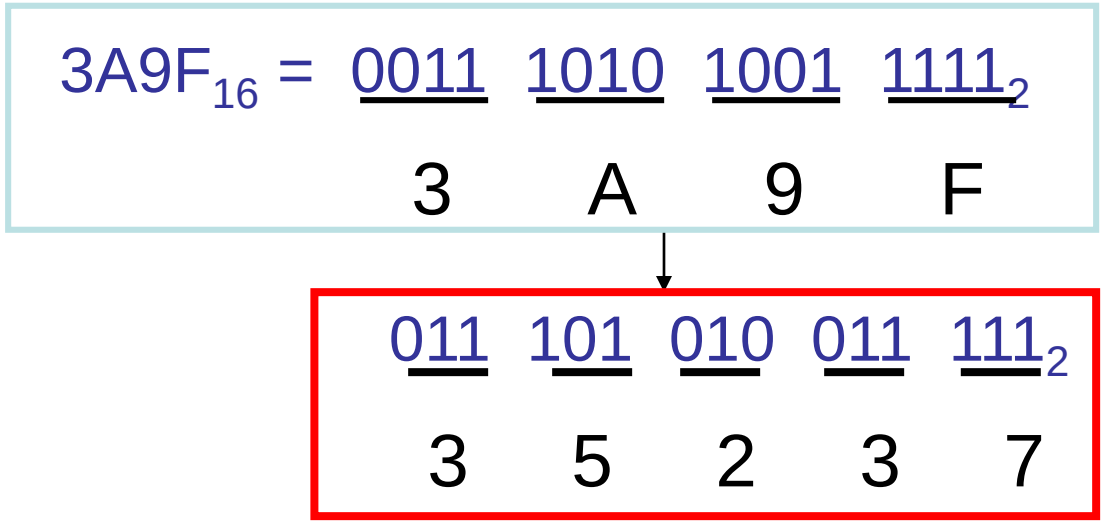
4. Each group of three bits forms an octal digit.

Converting Between Base 16 and Base 8



1. Convert from Base 16 to Base 2
2. Regroup bits into groups of three starting from right
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4. Each group of three bits forms an octal digit.

Converting Between Base 16 and Base 8

$3A9F_{16}$ = 0011 1010 1001 1111_2

3 A 9 F

35237_8 = 011 101 010 011 111_2

3 5 2 3 7

1. Convert from Base 16 to Base 2
2. Regroup bits into groups of three starting from right
3. Ignore leading zeros
4. Each group of three bits forms an octal digit.

Week 3 Lecture 4a

- Number system conversion
  - Decimal number system
  - Binary number system
  - Octal number system
  - Hexadecimal number system

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