

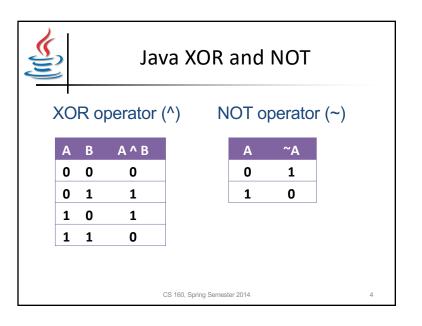


# Java Bitwise Operators

• Java has six bitwise operators:

Symbol	Operator	
&	Bitwise AND	
	Bitwise OR	
۸	Bitwise XOR	
~	Bitwise NOT	
<<	LEFT SHIFT	
>>	RIGHT SHIFT	
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Java AND and OR AND operator (&) OR operator (|) A & B A | B 0 0 0 0 0 0 1 0 1 1 1 0 1 1 1 1 1 1 CS 160, Spring Semester 2014





## Binary to Decimal

Decimal	Binary	Decimal	Binary
0	0000b	8	1000b
1	0001b	9	1001b
2	0010b	10	1010b
3	0011b	11	1011b
4	0100b	12	1100b
5	0101b	13	1101b
6	0110b	14	1110b
7	0111b	15	1111b



### Binary to Decimal

- 0-9 are used for decimal numbers (base-10):
  - $-149 = 1*10^2 + 4*10^1 + 9*10^0$
- 0-1 are used for binary numbers (base-2):
  - $-1010b = 1*2^3 + 0*2^2 + 1*2^1 + *2^0 = 8 + 2 = 10$
- Example:
  - 10111b in decimal?
  - $-1*2^4 + 0*2^3 + 1*2^2 + 1*2^1 + 1*2^1 = 16 + 4 + 2 + 1 = 23$
  - What is 14 in binary?
  - $-8+4+2=1*2^3$  C+161, \*227; tem1st\*20:4+  $0*2^0=1110b$



## Bitwise Operator Examples

- 4-bit numbers:
  - -6 & 5 = 0110b & 0101b = 0100b = 4
  - $-6 \mid 5 = 0110b \mid 0101b = 0111b = 7$
  - $-6^{5} = 0110b^{0101b} = 0011b = 3$
  - $^6 = ^0110b = 1001b = 9$
- 8-bit numbers:
  - -6 << 3 = 00000110b << 3 = 00110000b = 48 (6 \* 8)
  - 48 >> 4 = 00110000b >> 4 = 00000011b = 3 (48 / 16)

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## **Masking Operations**

- Clearing bits:
  - -x = 00101001b = 41
  - want to clear top 4-bits
  - -x = x & 00001111b = x & 15 = 00001001b = 9
- Setting bits:
  - -x = 00101001b = 41
  - want to set bottom 4-bits
  - $-x = x \mid 00001111b = x \mid 15 = 00101111b = 47$

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