



CS 49 Section

Week 6 Bonus Slides

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Bitwise Operators: & and |

- In addition to the logical operators **and** and **or**, Python also has bitwise and **&** and bitwise or **|**
- These operate on the binary representations of the operand values
- A binary representation is a representation in base 2
- An explanation of base 2 representation is in [this Khan Academy video](#)
- Given two binary numbers, the bitwise operators compare each bit of the left operand to the corresponding bit of the right operand
 - bitwise **&** yields 1 if both the bits are 1, and 0 if either bit is 0
 - bitwise **|** yields 0 if both the bits are 0, and 1 if either bit is 1
- This is analogous to when the logical **and** and **or** return **True** or **False**

Bitwise Operators: & and |

- $1 \& 1$ *# result: 1*
- $1 \& 0$ *# result: 0*
- $0 \& 1$ *# result: 0*
- $0 \& 0$ *# result: 0*

- $1 | 1$ *# result: 1*
- $1 | 0$ *# result: 1*
- $0 | 1$ *# result: 1*
- $0 | 0$ *# result: 0*

Bitwise Operators: & and |

- Example: decimal 5 is binary 101, decimal 2 is binary 10
- For convenience, we can add a leading zero to the latter so the two have the same number of digits: 010

- What is **5 & 2**?

$$\begin{array}{r} 101 \\ \& \ 010 \\ \hline \end{array}$$

000 # *Decimal 0*

- What is **5 | 2**?

$$\begin{array}{r} 101 \\ | \ 010 \\ \hline \end{array}$$

111 # *Decimal 7*

- Since no place has a 1 in both binary numbers, the **&** evaluates to 0
- Since every place has a 1 in one or the other, the **|** evaluates to 7

Bitwise Operators: & and |

+

```
def bitwise_operations():  
    a = 3          # decimal 3: binary 011  
    b = 6          # decimal 6: binary 110  
    c = a & b      # result: ?  
    d = a | b      # result: ?  
  
    print(f'Result of bitwise and, 3 & 6 : {c}')
```

```
    print(f'Result of bitwise or, 3 | 6 : {d}')
```

```
if __name__ == '__main__':  
    bitwise_operations()
```

Bitwise Operators: & and |

```
def bitwise_operations():  
    a = 3          # decimal 3: binary 011  
    b = 6          # decimal 6: binary 110  
    c = a & b      # result:          & 010 decimal 2  
    d = a | b      # result:          | 111 decimal 7  
  
    print(f'Result of bitwise and, 3 & 6 : {c}')  
    print(f'Result of bitwise or, 3 | 6 : {d}')  
  
if __name__ == '__main__':  
    bitwise_operations()
```

The background is a solid pink color. It is decorated with various hand-drawn geometric shapes and lines in white and black. In the top left, there is a dashed white line and a solid white triangle. In the top center, there is a dashed black line and a solid black zigzag line. In the top right, there is a solid black circle and two parallel black lines. In the middle right, there is a solid black triangle. In the bottom left, there is a solid black plus sign. In the bottom center, there is a solid black circle and a solid black triangle. In the bottom right, there is a solid black circle and a solid black semi-circle.

That's all, folks!