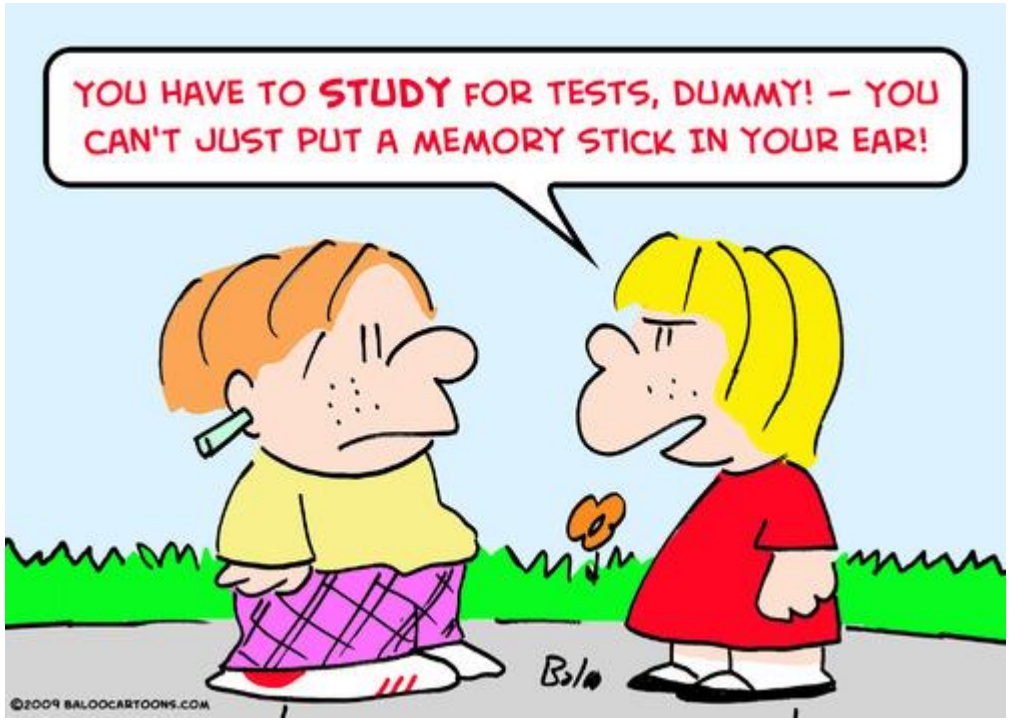
CSc 110, Spring 2017

Lecture 14: Boolean Logic and Midterm Review

Adapted from slides by Marty Stepp and Stuart Reges



Logic Question

- Consider the statement:
  - It is not true that he took Art History and Physics 101
- Is this an equivalent statement?
  - He did not take Art History or he did not take Physics 101

De Morgan's Laws

- **De Morgan's Laws**: Rules used to negate boolean tests involving and and or.
  - Useful when you want the opposite of an existing test.

Original Expression	Negated Expression	Alternative
`a and b`	`not a or not b`	`not(a and b)`
`a or b`	`not a and not b`	`not(a or b)`

  - Example:

Original Code	Negated Code
`if (x == 7 and y > 3):` `  ...`	`If not(x == 7 and y > 3):` `if (x =! 7 or y <= 3):`

Boolean practice questions

- Write a function `is_vowel(c)` that returns `True` if the 1 character string `c` is a vowel (a, e, i, o, or u) or `False` otherwise. Ignore case.
  - `is_vowel("q")` returns `False`
  - `is_vowel("A")` returns `True`
  - `is_vowel("e")` returns `True`

- Change the above function into `is_non_vowel(c)` that returns `True` if `c` is any character except a vowel and `False` otherwise.
  - `is_non_vowel("q")` returns `True`
  - `is_non_vowel("A")` returns `False`
  - `is_non_vowel("e")` returns `False`

Boolean practice answers

```
# Enlightened version.  I have seen the true way (and false way)
def is_vowel(c):
    c = c.lower()        # allows testing for only lower case
    return c == 'a' or c == 'e' or c =='i' or c == 'o' or c == 'u'


# Enlightened "Boolean Zen" version
def is_non_vowel(c):
    c = c.lower()
    return not(c == 'a' or c == 'e' or c =='i' or c == 'o' or c == 'u')

    # or, return not is_vowel(c)
```

When to return?

- Consider a function with a loop and a return value:
  - When and where should the function return its result?

- Write a function `seven` that uses `randint` to draw up to ten lotto numbers from 1-30.
  - If any of the numbers is a lucky 7, the function should immediately return `True`. If none of the ten are 7 it should return `False`.
  - The function should print each number as it is drawn.

```
15 29 18 29 11 3 30 17 19 22 (first call)
29 5 29 4 7                  (second call)
```

Flawed solution

```
# Draws 10 lotto numbers; returns True if one is 7.
def seven():
    for i in range(1, 11):
        num = randint(1, 30)
        print(str(num) + " ", end='')

        if (num == 7):
            return True;
        else:
            return False;
```

- The function always returns immediately after the first draw.
- If the draw isn't a 7, we need to keep drawing (up to 10 times).

Returning at the right time

```
# Draws 10 lotto numbers; returns True if one is 7.
def seven():
    for i in range(1, 11):
        num = randint(1, 30)
        print(str(num) + " ", end='')

        if (num == 7):    # found lucky 7; can exit now
            return True

    return False   # if we get here, there was no 7
```

- Returns `True` immediately if 7 is found.
- If 7 isn't found, the loop continues drawing lotto numbers.
- If all ten aren't 7, the loop ends and we return `False`.

Sidebar…

- Write a function `digit_sum(n)` that accepts an integer parameter and returns the sum of its digits.
  - Assume that the number is non-negative.
  - Example: `digit_sum(29107)` returns `19`

    (19 is the sum of 2+9+1+0+7)

  - Hint: Use the `%` operator to extract a digit from a number.
  - Hint: Use the // operator to remove the last digit

Summing digits answer

```
def digit_sum(n):

    sum = 0
    while (n > 0):
        sum = sum + (n % 10)   # add last digit to sum
        n = n // 10            # remove last digit from n

    return sum
```

Boolean return questions

- `has_an_odd_digit` : returns `True` if <u>any</u> digit of an integer is odd.
  - `has_an_odd_digit(4822116)` returns `True`
  - `has_an_odd_digit(2448)` returns `False`

- `all_digits_odd` : returns `True` if <u>every</u> digit of an integer is odd.
  - `all_digits_odd(135319)` returns `True`
  - `all_digits_odd(9174529)` returns `False`

- `is_all_vowels` : returns `True` if <u>every</u> char in a string is a vowel.
  - `is_all_vowels("eIeIo")` returns `True`
  - `is_all_vowels("oink")` returns `False`

Boolean return answers

```
def has_an_odd_digit(n):
    while (n != 0):
        if (n % 2 != 0):    # check whether last digit is odd
            return True
        n = n // 10
    return False

def all_digits_odd(n):
    while (n != 0) :
        if (n % 2 == 0):    # check whether last digit is even
            return False
        n = n // 10
    return True


def is_all_vowels(s):
    for i in range(0, len(s)):
        letter = s[i: i + 1]
        if (not is_vowel(letter)):
            return False
    return True
```

Midterm

- Rules
  - Not allowed: phones, watches, hats, books, notes, drinks
  - Have your student ID
- Strategies
  - Practice (drill) on the problem types 1, 2 and 3 on the samples.
  - You will get partial credit. Write something on down paper.
  - Example:

  Define a function mod5 that takes two integer parameters and returns 1 if both integers are divisible by 5.

```
def mod5(a,b):
      if (a % 5 == 0
```

Drill

```
14 + 2 * 6 < 25 or 3 + 33 //5 + 2 > 6 % 8
```

```
8 // 7 * 3 //1.5 + 16 % 2 + 8
```

Drill

```
def mystery(a,b):
    c = 5
    if (b > a):
        c = a + b
        b = b + 10
    if (b < a ):
        b = b % 2
    else:
        a = a * c
    print(str(a) + " " + str(b))


mystery(3,8)
mystery(6,6)
mystery(14,9)
```