Outline

1. midterm exam on Friday 26 February 2016
   - policies
2. some review questions
   - with answers

MCS 260 Lecture 19
Introduction to Computer Science
Jan Verschelde, 24 February 2016

review of the first 18 lectures

1. midterm exam on Friday 26 February 2016
   - policies

2. some review questions
   - with answers

policies

The exam will be closed book, no notes, and no computer.

The material on Python scripting consists of:

1. variables and assignments, elementary and composite types, intrinsic operations, tuples, lists, dictionaries, dbm, queues and stacks;
2. if else elif, while and for, queues and stacks, top down design, functions, lambda, list comprehensions.

This review contains some preliminary examples of questions which may help you prepare for the second part of the midterm exam.

review of the first 18 lectures

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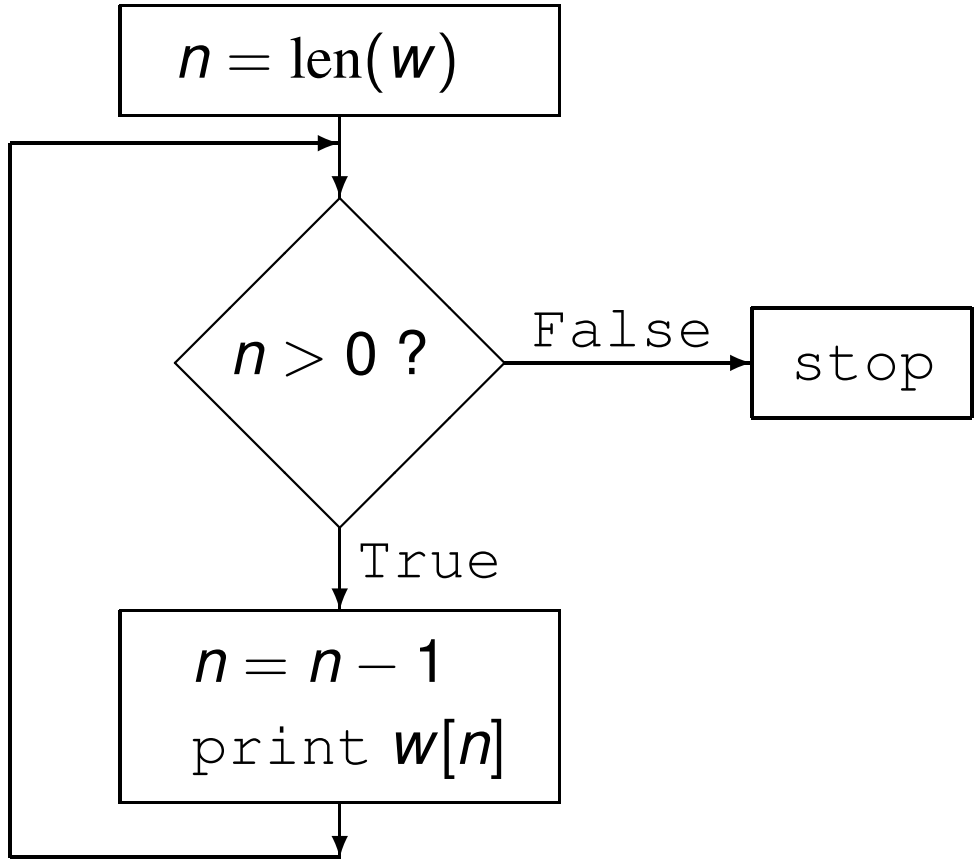
question 1

Consider the flowchart, that takes on input the word w:



1. Write Python code based using the same control logic as shown in the flowchart.
2. Write Python code that uses a for loop.

answer to question 1

```
WORD = input('give a word : ')
N = len(WORD)
while N>0:
    N = N - 1
    print(WORD[N])

N = len(WORD)
for k in range(N):
    print(WORD[N-k-1])
```

or the last for loop:

```
for k in range(N-1, -1, -1):
    print(WORD[k])
```

question 2

Consider the following pseudocode:

```
input: x, a floating point number;
       c, a list of coefficients.
output: c[0] + c[1]*x + c[2]*x**2 + .. + c[n]*x**n,
        where n = len(c) - 1.
result = c[0]; i = 0; n = len(c); p = x
as long as i < n-1 do
    result = result + c[i+1]*p
    p = p * x; i = i + 1
output result
```

Write a Python script that implements this pseudocode.

answer to question 2

```
from ast import literal_eval
C = literal_eval(input('give a list of coefficients :
X = float(input('give a floating point number : '))
RESULT = C[0]
i = 0
N = len(C)
P = X
while i < N-1:
    RESULT = RESULT + C[i+1]*P
    P = P * X
    i = i + 1
print(RESULT)
```

question 3

What data structure of Python would you use to store the derivatives of trigonometric expressions such as cos, sin, and tan?
Illustrate with actual Python code.

answer to question 3

```
D = {'cos':'-sin', 'sin':'cos', 'tan':'tan**2 + 1'}
for k in D.keys():
    print('the derivative of', k, 'is', D[k])
```

question 4

Give the Python code to generate a list of all tuples containing all possible input values for a Boolean expression, i.e.: [(False,False),(False,True),(True,False),(True,True)].

Extend the code so it will work for triplets.

answer to question 4

```
L = [(bool(i), bool(j)) for i in range(2) \
for j in range(2)]
```

or with explicit loops:

```
L = []
for i in (False, True):
    for j in (False, True):
        L.append((i, j))
print(L)
L = []
for i in (False, True):
    for j in (False, True):
        for k in (False, True):
            L.append((i, j, k))
print(L)
```

question 5

Write a program to sum the values of coins.
The coins are represented by a sequence of characters, for example:
`pnqdpqnnppdqddpp`,
where `p`, `n`, `d`, `q` represent respectively a penny ($0.01), nickel ($0.05), dime ($0.10), and quarter ($0.25). Use a dictionary.

answer to question 5

```
DICT = {'p':0.01, 'n':0.05, 'd':0.10, 'q':0.25}
DATA = input('give a sequence : ')
S = 0
for C in DATA:
    S = S + DICT[C]
print('value = ', S)
```

or, instead of the `for` loop, with a list comprehension:

```
V = [DICT[C] for C in DATA]
print('value = ', sum(V))
```

question 6

Give Python code to convert strings
such as `"34 dollar"` and `"1.23 dollar"`
into `"$34"` and `"$1.23"`.

The number in front of the `dollar` can be of any size.

answer to question 6

```
INPUT = input('give a string : ')
SPLITTED = INPUT.split(' ')
AMOUNT = float(SPLITTED[0])
if float(int(AMOUNT)) == AMOUNT:
    FORMATTED = '%d' % int(AMOUNT)
else:
    FORMATTED = '%.2f' % AMOUNT
OUTPUT = '$' + FORMATTED
print(OUTPUT)
```

question 7

Consider the following game.

The computer generates a random natural number between 1 and 9.
This number is the secret.
The user is allowed to make three guesses for the secret.

Write Python code to implement this game.

answer to question 7

```
from random import randint
SECRET = randint(1, 9)
for k in range(3):
    GUESS = input('make a guess : ')
    if SECRET == int(GUESS):
        print('Congratulations!')
        break
    else:
        print('Please try again.')
print('Game over.')
```

question 8

To test whether `random.uniform(0,1)` generates numbers uniformly distributed in $[0, 1]$,

we generate 1000 samples and build a histogram, counting how many numbers are in the four equal subintervals of $[0, 1]$.

Write Python code to perform this test.

answer to question 8

```
from random import uniform as u
L = [u(0, 1) for k in range(1000)]
H = [0 for k in range(4)]
for r in L:
    if r < 0.25:
        H[0] = H[0] + 1
    elif r < 0.50:
        H[1] = H[1] + 1
    elif r < 0.75:
        H[2] = H[2] + 1
    else:
        H[3] = H[3] + 1
print('histogram :', H)
```

question 9

Explain how to simulate an unfair coin that when flipped returns head with probability 0.6.

Give a Python function for such unfair coin.

answer to question 9

```
def unfair_coin():
    "returns head with probability 0.6"
    from random import uniform
    toss = uniform(0, 1)
    if toss < 0.6:
        return('head')
    else:
        return('tail')

print('simulation of an unfair coin')
while True:
    print(unfair_coin())
    ANS = input('continue ? (y/n) ')
    if ANS != 'y':
        break
```

question 10

Define a Python function that returns as a tuple the roots of a polynomial $p(x) = ax^2 + bx + c$,
using $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Write the function so that 1 is the default value for a.

answer to question 10

```
def roots ( cx0, bx1, ax2=1 ):
    """
    Returns roots via quadratic formula.
    """
    from cmath import sqrt
    disc = sqrt(bx1**2 - 4*ax2*cx0)
    return ((-bx1+disc)/(2*ax2), (-bx1-disc)/(2*ax2))

A = float(input('give a : '))
B = float(input('give b : '))
C = float(input('give c : '))
print('roots = ', roots(C, B, A))
```

question 11

A trigonometric function as $A\sin(k2\pi t)$ has amplitude A and frequency k (number of cycles per time unit).

Write a Python function `f` to evaluate $A\sin(k2\pi t)$ at t (the first argument of `f`) where default values for A and k are both one.

If the last optional argument of f takes the value `nopi`, then the function will return the value $A\sin(kt)$ instead.

answer to question 11

```
def fun(time, amp=1, freq=1, arg='pi'):
    """
    Return amp*sin(freq*2*pi*time).
    """
    from math import pi, sin
    if arg == 'nopi':
        return amp*sin(freq*2*time)
    else:
        return amp*sin(freq*2*pi*time)

AMP = float(input('give the amplitude : '))
FRQ = float(input('give the frequency : '))
TIM = float(input('give the time : '))
VAL = fun(TIM, AMP, FRQ)
print 'the value :', VAL
VAL = fun(TIM, AMP, FRQ, 'nopi')
print 'with nopi :', VAL
```

question 12

Give Python code to create a list of the first 20 natural numbers, raised to the power 3.

Do it once with `for` and once without using any `for` or `while` loops, but do it with list comprehensions.

answer to question 12

```
L = []
for k in range(20):
    L.append(k**3)
print(L)
L = [k**3 for k in range(20)]
print(L)
```

question 13

Use list comprehensions to make
`L = [[('a', 97), ('b', 98), ..., ('z', 122)]`.

The list of tuples `L` links the lower case letters `a` to `z`
to their respective ASCII codes.

answer to question 13

```
A = [k for k in range(ord('a'), ord('z')+1)]
B = [chr(k) for k in A]
L = list(zip(B, A))
print(L)
```

question 14

Write a Python program that doubles the spaces in a file:

every space in the input file is replaced by two consecutive spaces in the output file.

answer to question 14

```
NAME = input('Give the name of the input file : ')
INFILE = open(NAME, 'r')
NAME = input('Give the name of the output file : ')
OUTFILE = open(NAME, 'w')
while True:
    C = INFILE.read(1)
    if C == '':
        break
    elif C == ' ':
        OUTFILE.write(C)
        OUTFILE.write(C)
    else:
        OUTFILE.write(C)
```