Lesson 5

Tuple . Print variations. Collatz Conjecture . Caesar Cypher . Coin Flip Simulation

Administrative

- Practical Test changed to Lesson 7 (T2W1)

Lesson Objectives

- tuple
- print variations
- Discussion of problems:
  - Chinese zodiac
  - Collatz conjecture
  - Caesar Cipher
  - Coin Flip Simulation

Tuple → ( )

- Immutable version of list
- Methods for tuple:
  - index → returns the index of the first occurrence of parameter
  - count → returns the number of occurrence of parameter
- Cannot append, pop, insert … etc (trying to mutate the array)
- Good for keep a data that does not change:
  - Encryption key, grading system … etc

print variations

- `print(  , sep = ' ')`
- `print(  , end = '')`
- `print(  ,sep = '',end = '')`

Collatz Conjecture

Consider the following function:

$$f(n) = \begin{cases} n/2 & \text{if } even(n) \\ 3n+1 & \text{if } odd(n) \end{cases}$$

The Collatz conjecture states that for any integer n, the sequence n, $f(n)$, $f(f(n))$, $\cdots$ will eventually reach 1.
We define the Collatz distance for an integer n as the number of steps needed to reach 1.

Write a function `collatz_distance(n)`.

```
>>> collatz_distance(1)
0
>>> collatz_distance(4)
2
>>> collatz_distance(27)
111
```

Caesar Cipher

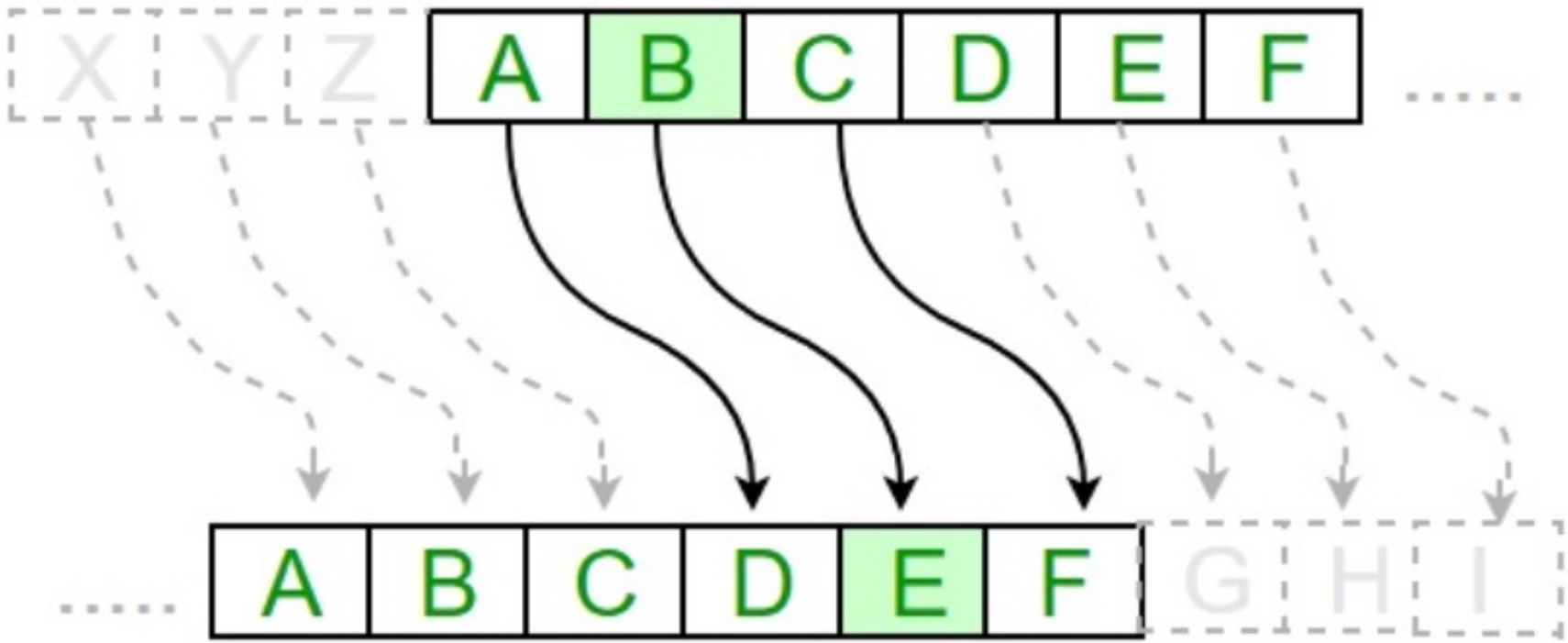
The Caesar Shift Cipher is a type of substitution cipher where each letter in the original plaintext message is replaced by a letter some fixed number of positions down the alphabet.

It is named after Julius Caesar, who used it in his private correspondence.

The table below shows an example where the letters have been shifted to the right by 3.

Note that the letters “wrap-around” at the end.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c


X Y Z
A B C D E F
A B C D E F G H I

shift in one character

```
def shift(char):
    '''
    Cycles alphabets, preserving case:
    a -> b -> c -> ... -> y -> z -> a
    Does nothing to other characters.
    '''
    if char.isalpha():
        return chr(ord(char)+1)
    else:
        return char
```

string.isalpha() returns True if is an alphabet, False otherwise

Something is missing !

Cipher – 2

- Write a function to implement the encryption using the Caesar cipher with a key
  - You are to use the shift function done in cipher – 1
- Write a function to decrypt the cipher text, using the brute force approach
  - Hint: you use the encryption to decrypt the code with different keys and output **all** possible original text

Head or Tail

```
from random import randint

def fairCoin():
    prob = randint(0,1)
    if prob <0.5:
        return 'Head'
    else:
        return 'Tail'
```

Coin Flip Simulation

What's the minimum number of times you have to flip a coin before you can have three consecutive flips that result in the same outcome (either all three are heads or all three are tails)?

What's the maximum number of flips that might be needed? How many flips are needed on average?

In this exercise we will explore these questions by creating a program that simulates several series of coin flips.

Coin Flip Simulation

Create a program that uses Python's random number generator to simulate flipping a coin several times. The simulated coin should be fair, meaning that the probability of heads is equal to the probability of tails. Your program should flip simulated coins until either 3 consecutive heads of 3 consecutive tails occur.

Display an H each time the outcome is heads, and a T each time the outcome is tails, with all of the outcomes shown on the same line. Then display the number of flips needed to reach 3 consecutive flips with the same outcome. **When your program is run it should perform the simulation 10 times and report the average number of flips needed.**

Coin Flip Simulation

```
H T T T (4 flips)
H H T T H T H T T H H T H T T H T T T (19 flips)
T T T (3 flips)
T H H H (4 flips)
H H H (3 flips)
T H T T H T H H T T H H T H T H H H (18 flips)
H T T H H H (6 flips)
T H T T T (5 flips)
T T H T T H T H T H H H (12 flips)
T H T T T (5 flips)
On average, 7.9 flips were needed.
```

Work to do . . .

- 5A – Control Structures
- Revision 2
- Programming Assignment 5
- Cipher – 2
- Coin Flip Simulation