

Scientific Programming

Lecture AE2 – Exercises

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Typoglycemia

The word Typoglycemia describes Teh mdin's atbily to dpeihecr a msi-selpeld wrod if the fsirt and lsat lteetr of the wrod are cerorct

Wirte a fuincton taht tkaes an arbitarry txet as iunpt and rtreuns a tpglyomyeic veriosn of the txet

Use `random.shuffle(s)` to randomize a string `s`.

Exercise – Maximal sum

Problem

- **Input:** a list A containing n numbers
- **Output:** a slice (sublist) $A[i : j]$ of maximal sum, i.e. the slice whose element sum $\sum_{k=i}^{j-1} A[k]$ is larger or equal than the sum of any other slice

Example:

[1, 3, 4, -8, 2, 3, -1, 3, 4, -3, 10, -3, 2]

max = 18

Problems – Palindromes

- A palindromic number reads the same both ways. The largest palindrome made from the product of two 2-digit numbers is $9009 = 91 \times 99$. Find the largest palindrome made from the product of two 3-digit numbers. Generalize to n digits.
- Write a function that finds the longest palindromic substring of a given string.

Problems – Strings

- Compression makes use of the fact that repeated structures are redundant, and it's more efficient to represent the pattern and the count or a reference to it. Similarly, we can condense a sentence by using the redundancy of overlapping letters from the end of one word and the start of the next. In this manner we can reduce the size of the sentence, even if we start to lose meaning. For instance, the phrase "live verses" can be condensed to "liverses". In this challenge you'll be asked to write a tool to condense sentences.
Example:
 - Digital alarm clocks scare area children \Rightarrow Digitalarm clockscarea children.

Problems – Saddle points

Write a program to search for the "saddle points" in a $n \times n$ matrix of integers. A saddle point is a cell whose value is greater than or equal to any in its row, and less than or equal to any in its column. There may be more than one saddle point in the matrix. Print out the coordinates of any saddle points your program finds. Print out "No saddle points" if there are none.

Problems – Roman numbers

- Write a function that takes a string containing a roman number as input, and returns the equivalent integer value
- Write a function that takes an integer value as input, and returns the equivalent roman number as output

$I = 1, X = 10, C = 100, M = 1000, V = 5, L = 50, D = 500$

Problems – Mathematics

- Write a function that given a number N , returns **True** if and only if N is a factorial number for some n : $N = n!$
- Similarly the movie Back to the Future - Part II, you have found a Python list of prices for a particular stock for the next n days. Given the list L , return a pair of indexes $i < j$ such that $L[j] - L[i]$ is maximal, i.e. you obtain the maximal gain by buying on day i and sell on day j .

Problems – Lists

- Given two ordered lists $L1$ and $L2$, merge the two lists into a new list L , such that L is sorted and L contains all the elements of $L1$ and $L2$.
- Do not use Python `sort` or similar functions to complete the task.

Problems – Lists

- Write a function to find the list in a list of lists whose sum of elements is the highest

$$[[1, 2, 3], [4, 5, 6], [10, 11, 12], [7, 8, 9]] \Rightarrow [10, 11, 12]$$

- Write a function that takes a list of list of integers as input, and returns a new list where duplicate lists are removed.
 - Version 1: two lists are duplicates if they are equal

$$[[10, 12], [10, 12], [8, 14]] \Rightarrow [[10, 12], [8, 14]]$$

- Version 2: two lists are duplicates if their sum is equal:

$$[[10, 12], [10, 12], [8, 14]] \Rightarrow [[10, 12]]$$

- Write a program that takes a recursive list RL , i.e. a list that contain integers, lists or other recursive lists, and returns the depth of RL , i.e. the maximum number of lists nested in each other.

$$[[2, [2, 3]], [2, 3, [4]]] \Rightarrow 4$$

Problems – Statistics

Let's consider this file,

`http://disi.unitn.it/~montreso/sp/presidents.csv`

containing the birth and death dates of the american presidents. In which year or years were the largest number of presidents alive?

```
PRESIDENT,BIRTH DATE,BIRTH PLACE,DEATH DATE,LOCATION OF DEATH
```

```
George Washington,Feb 22 1732,Westmoreland Co. Va.,Dec 14 1799,Mount Vernon
```

```
John Adams,Oct 30 1735,Quincy Mass.,July 4 1826,Quincy Mass.
```

```
Thomas Jefferson,Apr 13 1743,Albemarle Co. Va.,July 4 1826,Albemarle Co. Va
```

```
[...]
```

```
Jimmy Carter,Oct 1 1924,Plains Georgia,,
```

```
Ronald Reagan,Feb 6 1911,Tampico Illinois,June 5 2004,Los Angeles Cal.
```

```
George Bush,June 12 1924,Milton Mass.,,
```

```
Bill Clinton,Aug 19 1946,Hope Arkansas,,
```

```
George W. Bush,July 6 1946,New Haven Conn.,,
```

```
Barack Obama,Aug 4 1961,Honolulu Hawaii,,
```

```
from datetime import datetime
```

```
date = datetime.strptime("Jan 1 1700", "%b %d %Y")
```