Introduction to Programming using PYTHON

Session 1

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Part I

About the course

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  - http://www.pasteur.fr/formation/infobio/python/

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- The course is **very** introductory
- You will be asked to do much of the work outside the course
- We will be following a manual prepared at Institut Pasteur
  - http://www.pasteur.fr/formation/infobio/python/
- Before every session you will be asked to:
  - read a number of chapters from the manual
  - complete a number of exercises

Part II

Basic Programming Rules

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- Programs should be **elegant** and **readable**
  - Elegant programs

    Programs that address the problem at hand with simplicity, being concerned with the general case and addressing the exceptions separately. Elegant programs do not try to do everything in a single step and tend to be modular.
  - Readable programs

    Programs that can be easily followed and readily understood by someone who knows the language. The code is simple. Programs with commentaries tend to be readable.

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   - Messages like `"An error has occurred..."` are as good as nothing
5. Document your programs and functions

Part III

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- There should only be 3 ways of combining program instructions: **sequencing**, **selection** and **iteration**

Sequencing	Selection	Iteration

instruction$_1$
instruction$_2$
...
instruction$_n$
	if $condition$ **then**
	instruction$_{t_1}$
	instruction$_{t_2}$
	...
	instruction$_{t_n}$
	else
	instruction$_{f_1}$
	instruction$_{f_2}$
	...
	instruction$_{f_n}$
	end if
		while $condition$ **do**
		instruction$_1$
		instruction$_2$
		...
		instruction$_n$
		end while

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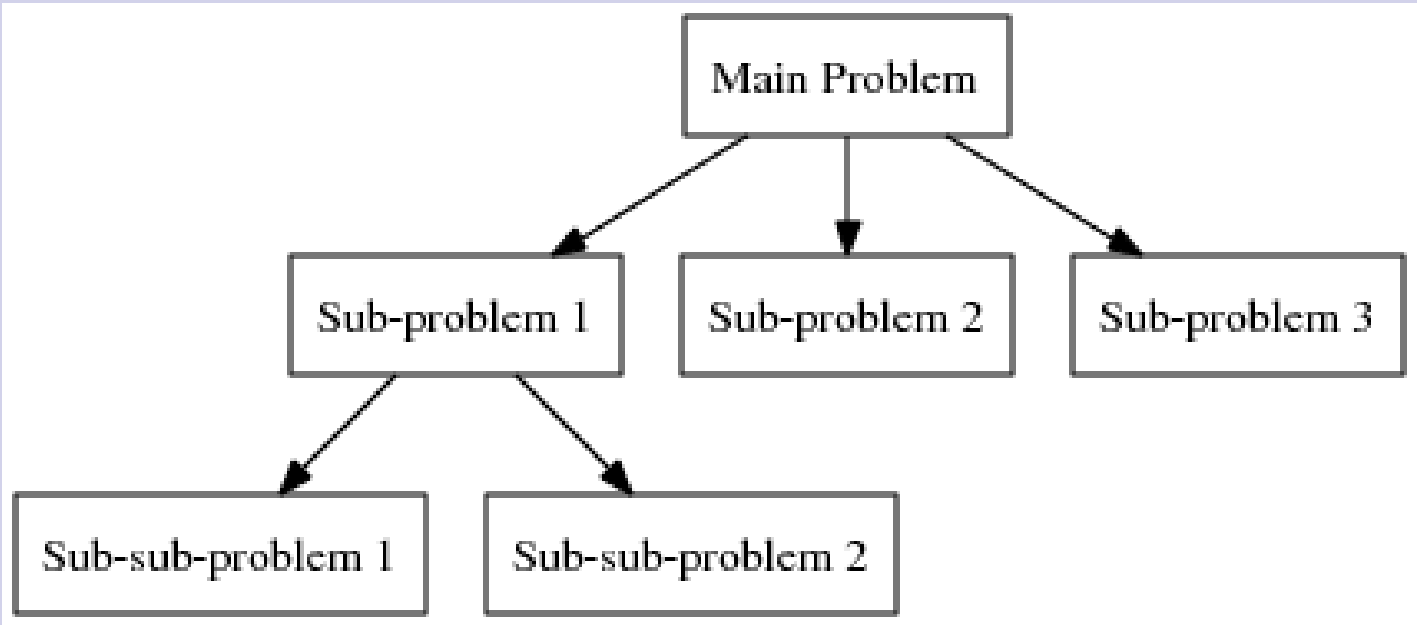
The notion of Structured Programming is not universal. In Dijkstra's sense it can be summarized into these principles:

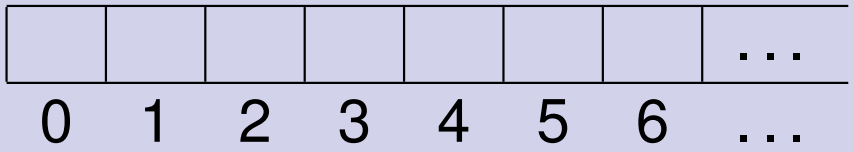
- There should only be 3 ways of combining program instructions: **sequencing**, **selection** and **iteration**
- We should adopt a top-down approach whereby we divide a problem into smaller subproblems which can eventually be directly addressed
  - Programs should be broken down into modules, functions and blocks which are easy to understand



Part IV

A taste of abstract thinking

URM



- Abstract machine (Unlimited Register Machine)
- Each register R_i contains an integer
- The machine keeps an additional counter p for the index of the next instruction
- A URM program consists of an ordered list of commands:

Command	Effect on registers	Effect on program counter
$Z(i)$	$R_i \leftarrow 0$	$p \leftarrow p + 1$
$S(i)$	$R_i \leftarrow R_i + 1$	$p \leftarrow p + 1$
$T(j, i)$	$R_j \leftarrow R_i$	$p \leftarrow p + 1$
$J(i, j, n)$	no effect	$p \leftarrow n$ if $R_i = R_j$
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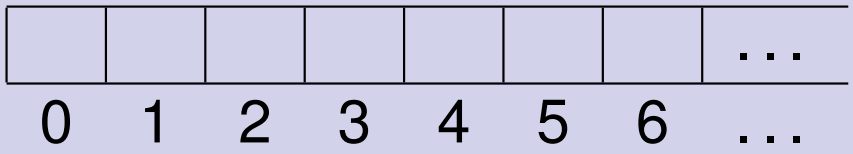

Conventions

- Initially $R_i \leftarrow 0, \forall_i$
- The output of a program is given by R_0
- The the n arguments of a program are given at $R_1, \ldots, R_n$
- The working space of a program are all registers $R_i, i > n$

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- Why do we need the first command?
  Consider the case where $i = j$

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How would you implement **addition** such that in the end of the program $R_0 \leftarrow R_1 + R_2$

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How would you implement **addition** such that in the end of the program $R_0 \leftarrow R_1 + R_2$

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2: $J(2,3,6)$
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Let us computer $2 + 2$

0	2	2	0	0	0	0	...
0	1	2	3	4	5	6	...

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Part V

For the next session

- From the manual
  - Chapters 1, 2, 3
- Exercises
  - Implement
    - Multiplication ($R_0 \leftarrow R_1 \times R_2$)
    - $\leq$-test ($R_0 \leftarrow 1$ if $R_1 \leq R_2$ otherwise $R_0 \leftarrow 0$)
    - Subtraction $R_0 \leftarrow R_1 - R_2$
  - Send implementations in **plain text** to *ndm@algos.inesc-id.pt*