76528 - LABORATORY OF COMPUTER PROGRAMMING

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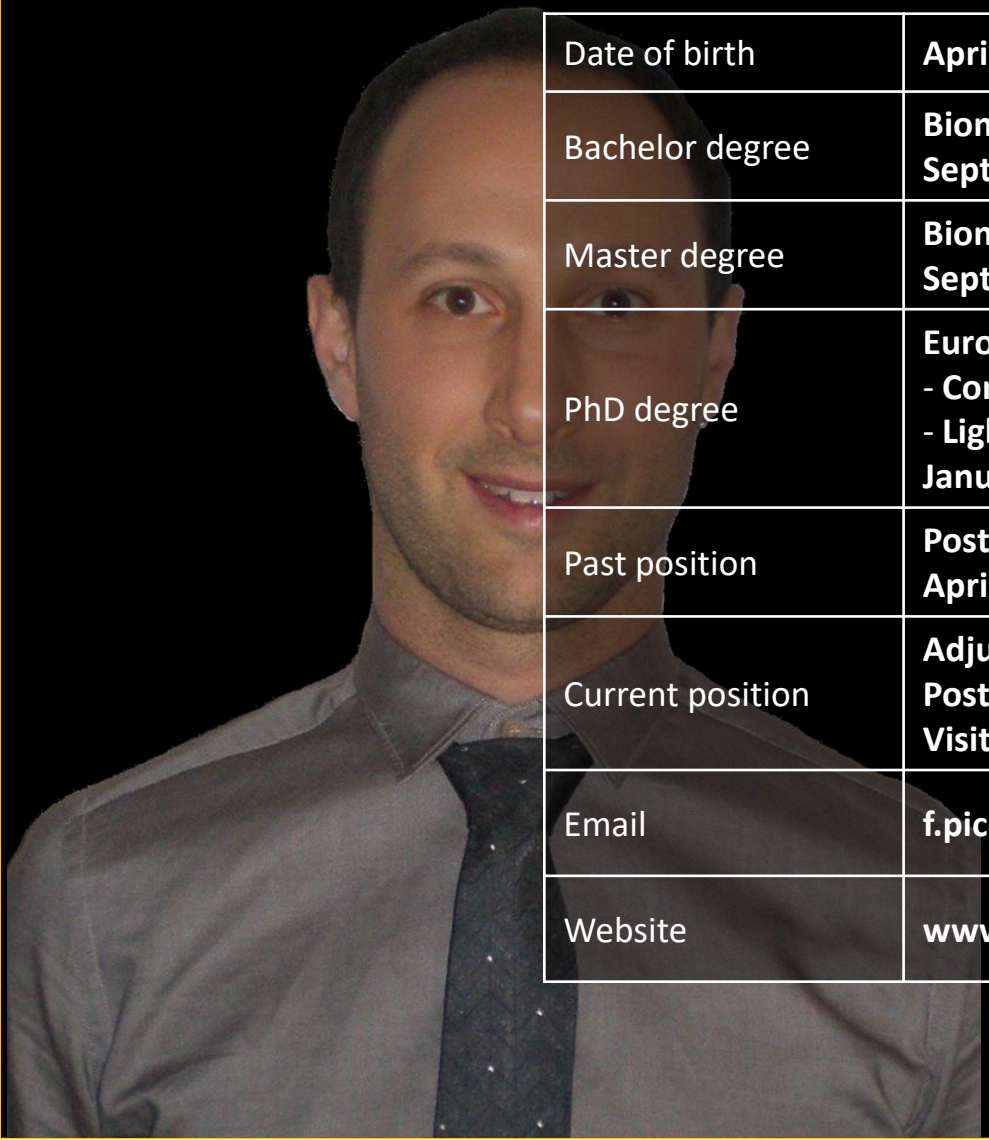
Laurea in Economics and Finance (CLEF)
Alma Mater Studiorum, University of Bologna
2018/2019

Filippo Piccinini



Date of birth	**April 20, 1985**
Bachelor degree	**Biomedical Engineer, University of Bologna, September 2004 - July 2007, score: 110/110 cum LAUDE**
Master degree	**Biomedical Engineer, University of Bologna September 2007 - October 2009, score: 110/110 cum LAUDE**
PhD degree	**European Doctorate in Information Technology - Computer Vision Group, University of Bologna - Light Microscopy and Screening Center, ETH Zurich January 2010 – April 2013 (3 years)**
Past position	**Postdoc Research Fellow, University of Bologna April 2013 – February 2017 (4 years)**
Current position	**Adjunct Professor, University of Bologna, Italy Postdoc Research Fellow, IRCCS-IRST, Meldola, Italy Visiting Scientist, BIOMAG, HAS-BRC, Szeged, Hungary**
Email	**f.piccinini@unibo.it**
Website	**www.filippopiccinini.it**

Software tools

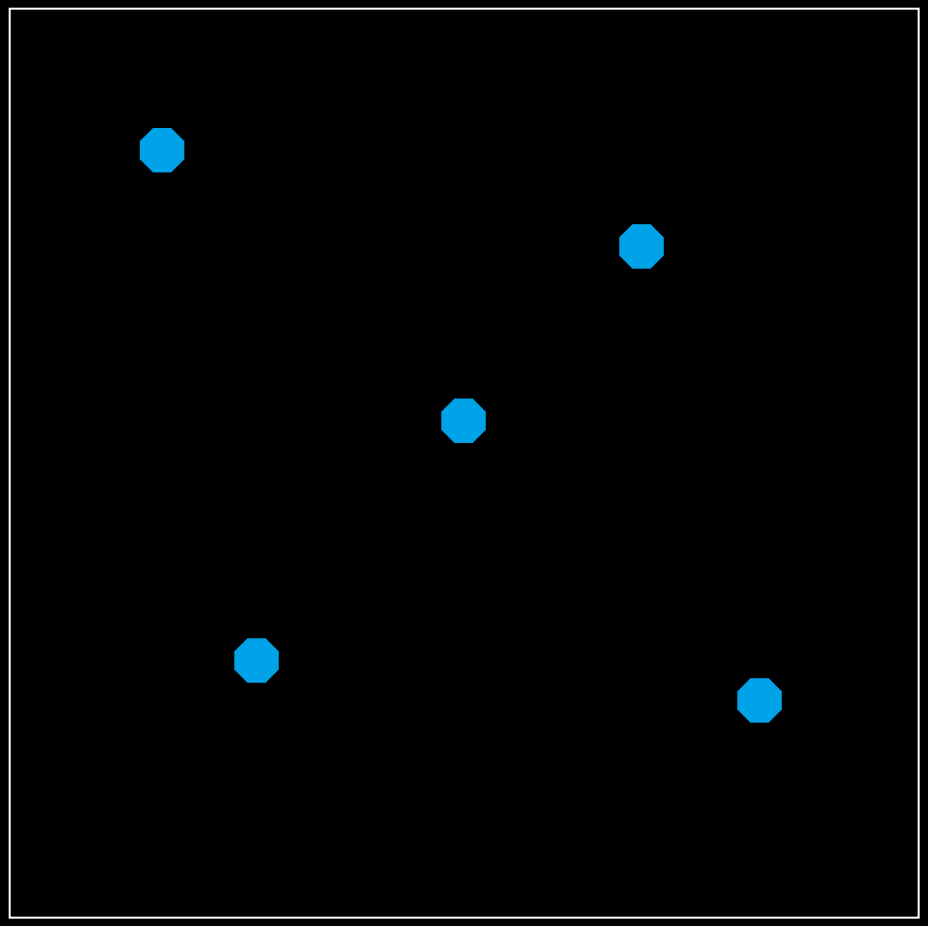
- **ReViSP**, for cancer spheroids Reconstruction and Visualization using a Single Projection
  http://sourceforge.net/projects/revisp
- **ReViMP**, for cancer spheroids Reconstruction and Visualization using Multiple Sections
  http://sourceforge.net/projects/revimp
- **AnaSP**, software suite to segment brightfield images of multicellular spheroids
  http://sourceforge.net/projects/anasp
- **F-Tracker3D,** for tracking in 3D fluorescent particles imaged with a light-sheet microscope.
  http://sourceforge.net/p/f-tracker3d
- **CellTracker,** for tracking cells cultured in vitro
  http://celltracker.website
- **Advanced Cell Classifier**, for classifying cells in high-content screening images
  http://www.cellclassifier.org
- **MicroMos**, for building a panorama, starting from a set of overlapping images
  http://www.filippopiccinini.it/Mosaicing/index.html
- **CIDRE**, for correcting the illumination field of microscopy images
  http://www.nature.com/nmeth/journal/v12/n5/full/nmeth.3323.html
- **……..**

Let’s play!

How many dots are there?

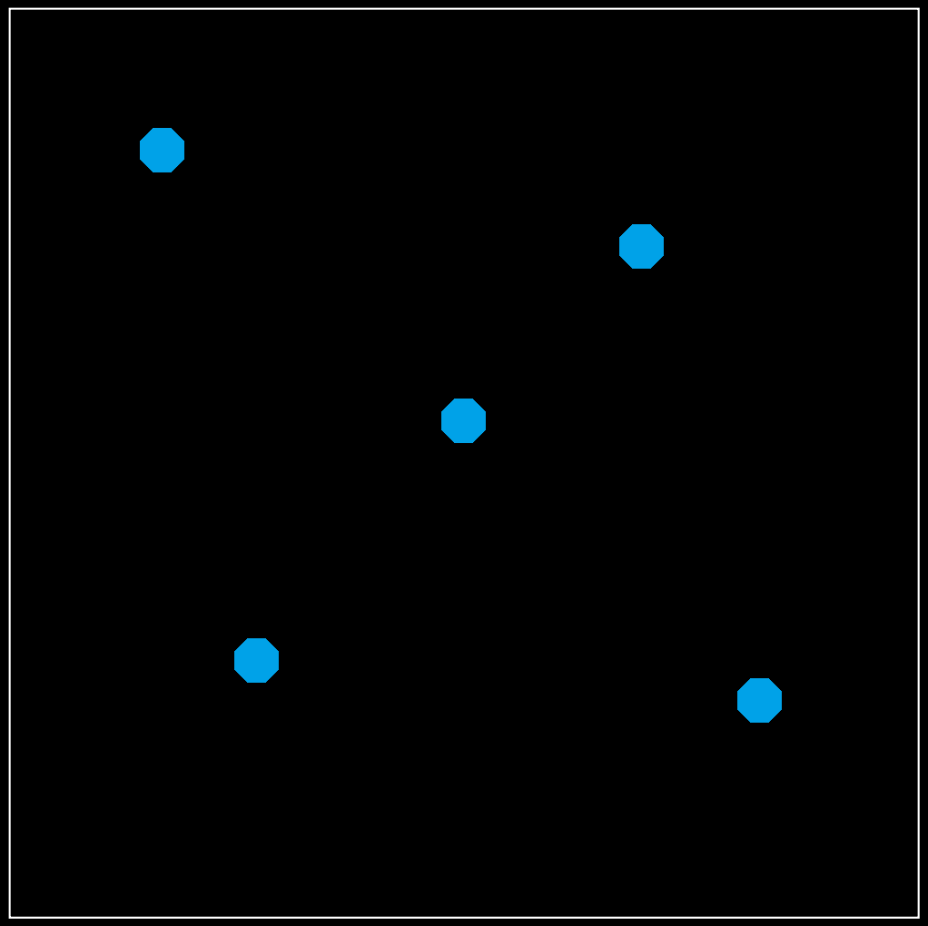
Let’s play!

How many dots are there?



Let’s play!

How many dots are there?



5 DOTS

PERFORMANCE:

Humans ~3 sec

Computers ~1 sec

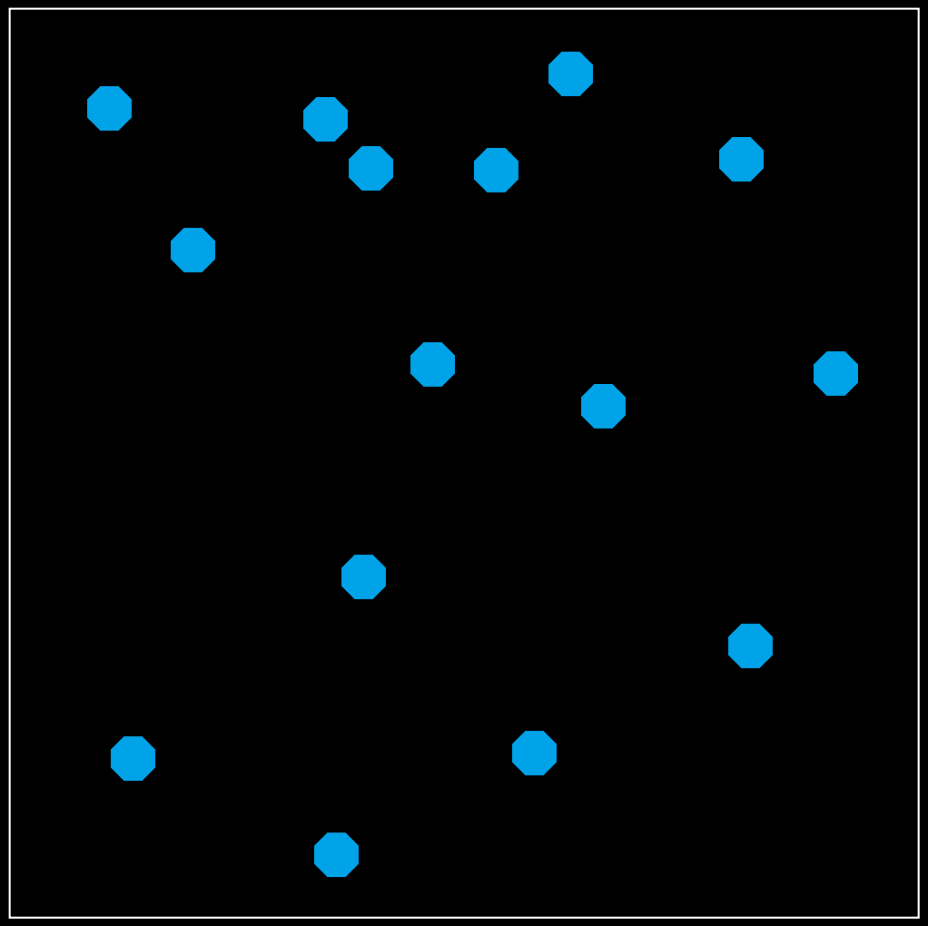
(using the standard Watershed segmentation algorithm)

Let’s play!

How many dots are there?

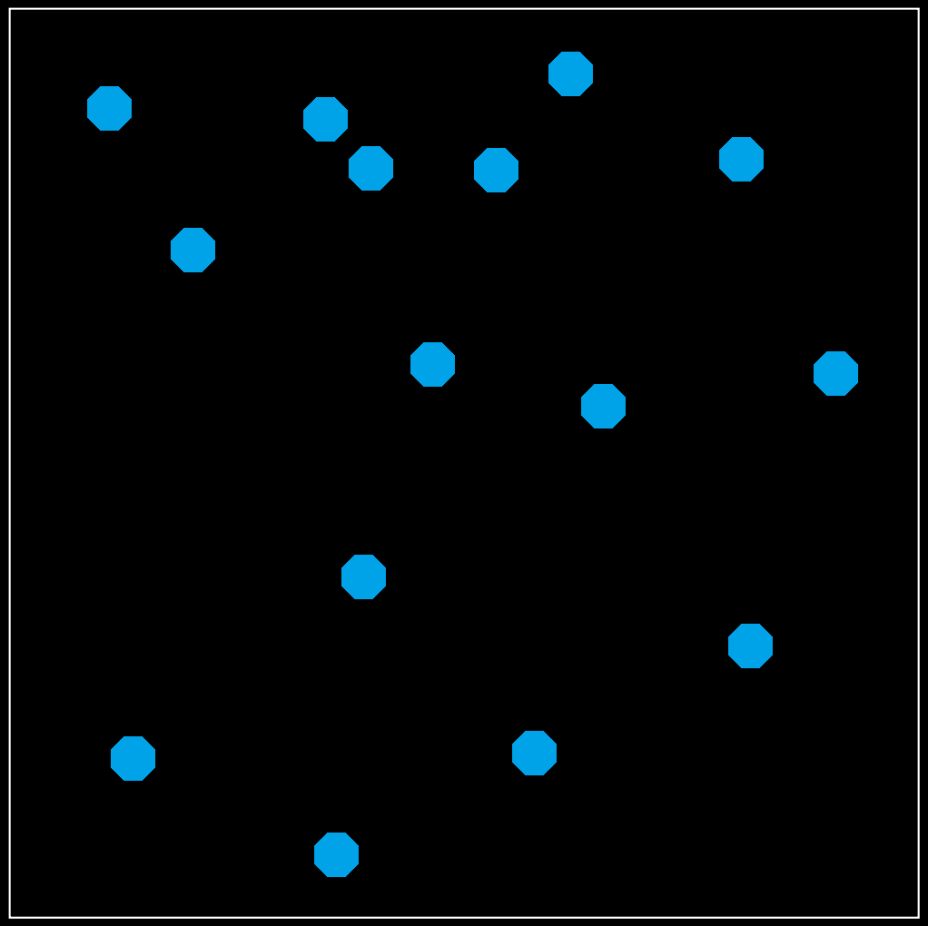
Let’s play!

How many dots are there?



Let’s play!

How many dots are there?



15 DOTS

PERFORMANCE:

Humans ~6 sec

Computers ~1 sec

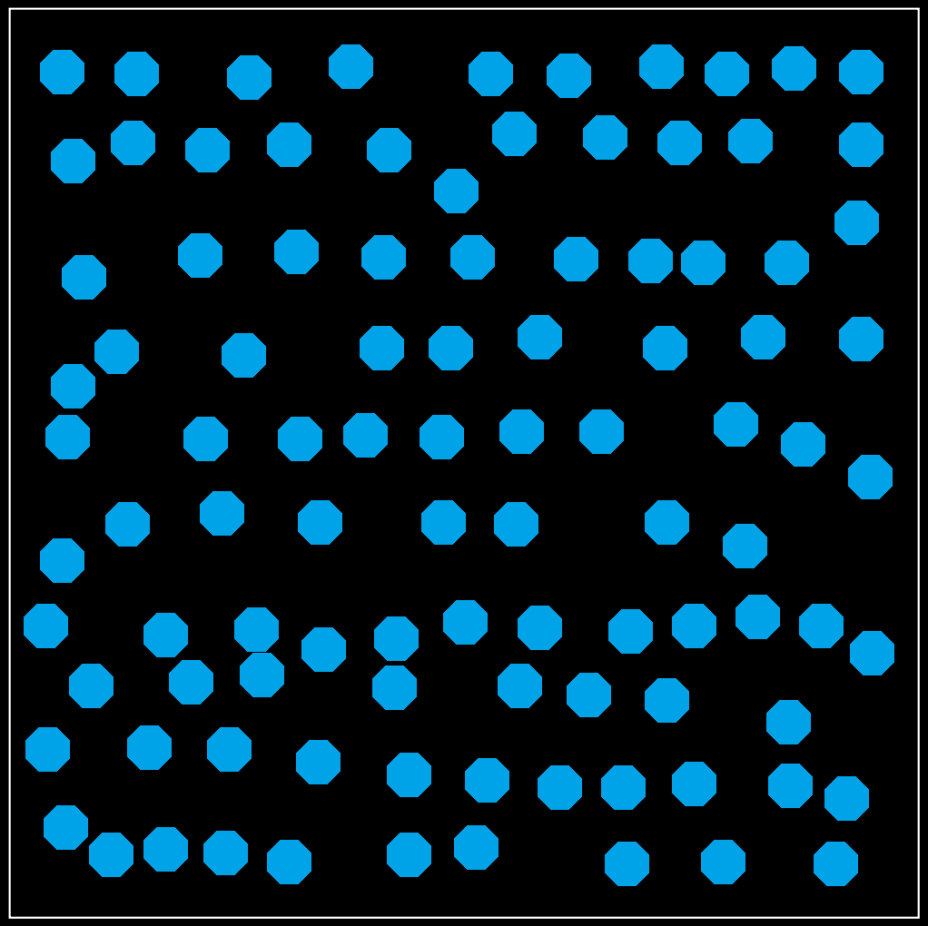
(using the standard Watershed segmentation algorithm)

Let’s play!

How many dots are there?

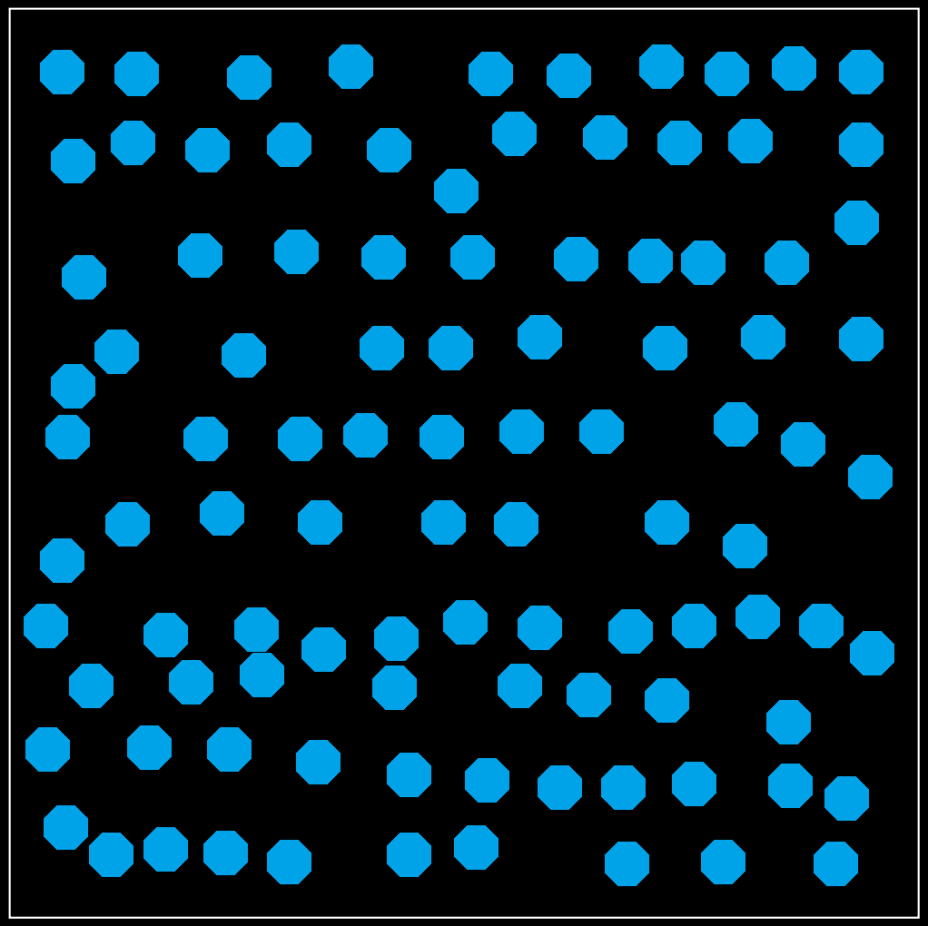
Let’s play!

How many dots are there?



Let’s play!

How many dots are there?



99 DOTS

PERFORMANCE:

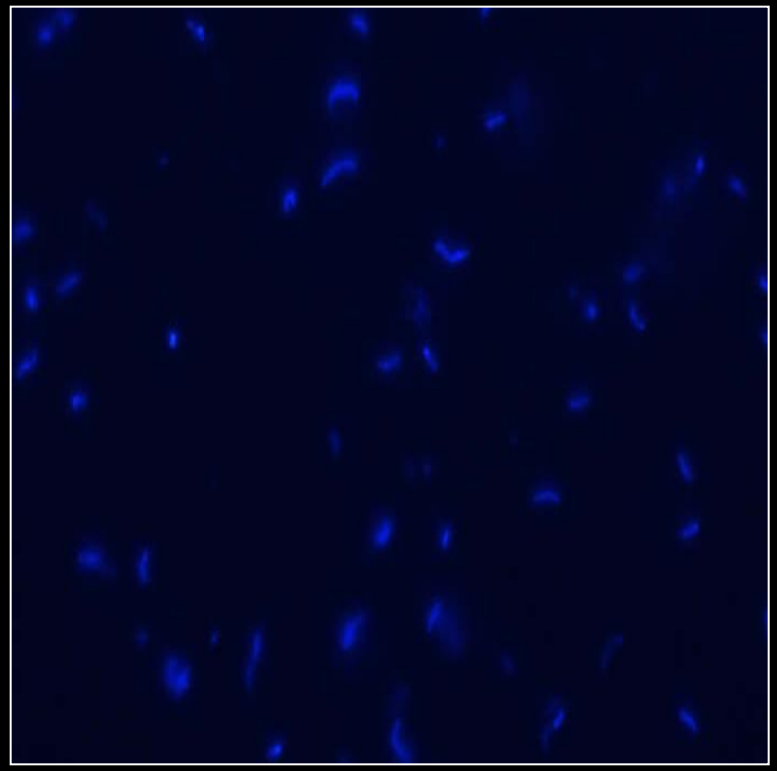
Humans :-(

Computers ~1 sec

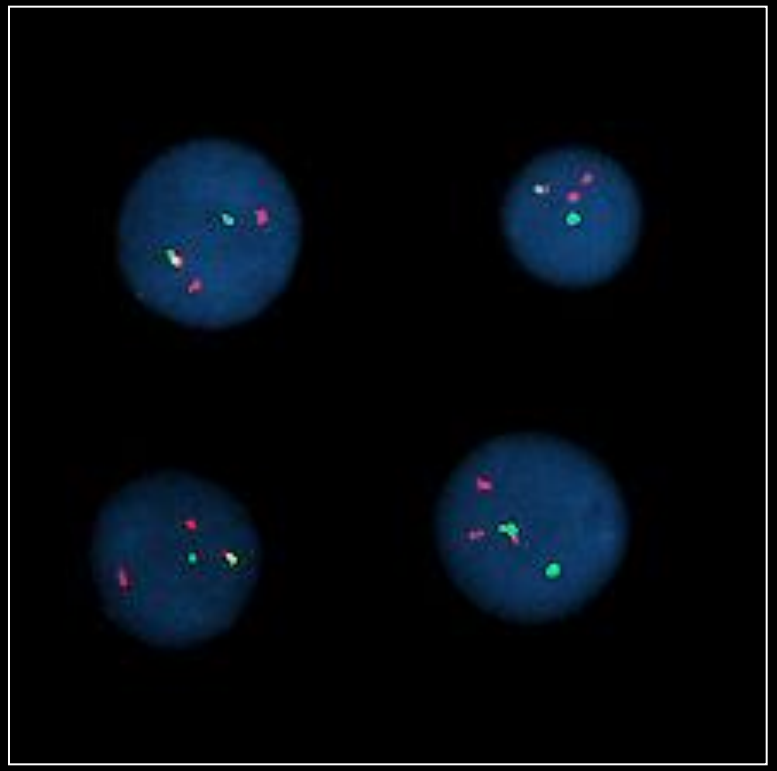
(using the standard Watershed segmentation algorithm)

To be competitive we need customized algorithms!

Cell counting applications



FISH analysis



Outline

- **Aim of the course**
- **References**
- **Lessons**
- **Final test**

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Aim of the course

IN THIS SHORT COURSE WILL WE LEARN THE BASICS OF PROGRAMMING

We will use:

R (https://cran.r-project.org/): *R* is a programming language and free software environment for statistical computing and graphics

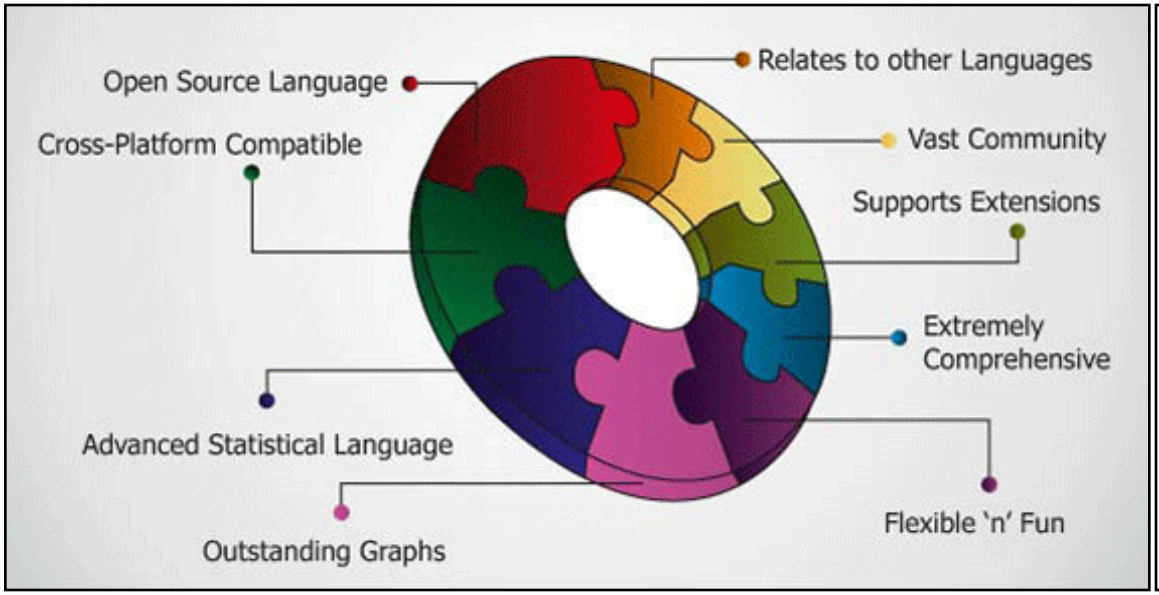
&

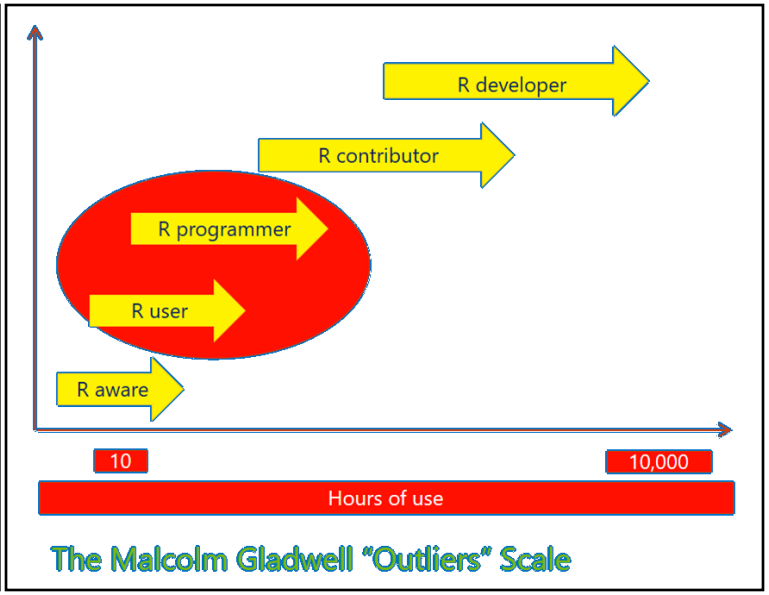
RStudio (https://www.rstudio.com/products/rstudio/download/): *RStudio* is a set of integrated tools designed to help you be more productive with *R*. It includes a console, syntax-highlighting editor that supports direct code execution, and a variety of robust tools for plotting, viewing history, debugging and managing your workspace

***R* and *Rstudio* are open-source!**
You need just a computer and nothing more!

Why learn *R*?

"R is the most popular language used in the field of statistics" [Roger Peng]





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References

- **Official course's website:**
  http://www.ems.unibo.it/en/programmes/course-unit-catalogue/course-unit/2018/422027

- **Piccinini's website**:
  www.filippopiccinini.it → Teaching section → Link to the Homepage of your course

- **Book1**:
  "R Programming", tutorialspoint.
  Website: https://www.tutorialspoint.com/r/index.htm
  Book PDF: https://www.tutorialspoint.com/r/r_pdf_version.htm

- **Book2**:
  "Get started in R: a complete beginners workbook", R Statistics.Net.
  Website: http://rstatistics.net/r-tutorial-exercise-for-beginners/

- **Book3**:
  "An introduction to R", W. N. Venables and D. M. Smith
  Website: https://cran.r-project.org/doc/manuals/R-intro.pdf

- **Information (also for quick info like lesson-changings, problems, etc.)**:
  www.filippopiccinini.it → Teaching section → Link to the Homepage of your course

References – other links

- ***R* website (see the Download section)**:
  https://cran.r-project.org/

- ***RStudio* (see the Download section)**:
  https://www.rstudio.com/products/rstudio/download/

- **How to install *R* and *Rstudio* (in a MAC):**
  https://www.youtube.com/watch?v=d-u_7vdag-0

- **Introduction to *RStudio***:
  https://www.youtube.com/watch?v=5YmcEYTSN7k

- **How to use functions saved in different files**:
  https://stackoverflow.com/questions/13548266/define-all-functions-in-one-r-file-call-them-from-another-r-file-how-if-pos

- **Rdocumentation: example of documentation of the std function**:
  https://www.rdocumentation.org/packages/pracma/versions/1.9.9/topics/std

References – exercises

- **Datacamp "Introduction to *R*" (amazing free online course)**:
  https://www.datacamp.com/onboarding/learn?from=home&technology=r

- **Datacamp "Intermediate *R*" (look at the first part only, which is freely available)**:
  https://www.datacamp.com/courses/intermediate-r

- **Exercises with *R***:
  https://www.r-exercises.com/2016/06/01/scripting-loops-in-r-solutions/
  https://www.r-exercises.com/2016/02/07/functions-exercises-solutions/
  https://www.r-exercises.com/2016/10/30/regular-expressions-part-1-solution/
  https://www.r-exercises.com/2016/01/07/reading-delimited-data-solutions/
  https://www.r-exercises.com/2016/03/11/start-plotting-data-solutions/

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Course timetable

Remember: during the lessons bring your laptop!

Four lessons of four hours each (in total 16 hours):

- 1st lesson - Saturday 22/09/2018, 09:00-13:00 (4 hours)
- 2nd lesson - Tuesday 25/09/2018, 09:00-13:00 (4 hours)
- 3rd lesson - Tuesday 02/10/2018, 09:00-13:00 (4 hours)
- 4th lesson - Tuesday 09/10/2018, 09:00-13:00 (4 hours)

OFFICIAL LINK:
http://www.ems.unibo.it/it/corsi/insegnamenti/insegnamento/2018/422027/orariolezioni

Tentative lesson plan

1ST LESSON:

H01:

Course organization
Presentation of the course's book
Presentation of the online material
Introduction to other online courses

H02:

How to install *R* and *RStudio*
How *RStudio* works

H03:

R – data types
R – variables
R – operators
Exercises

H04:

R – vectors
Exercises
R – lists

2ND LESSON:

H01:

R – matrices
Exercises

H02:

R – factors
Exercises

H03:

R – data frames

H04:

R – decision making
Exercises

Tentative lesson plan

3RD LESSON:

H01:

R – loops
Exercises

H02:

R – mean, median & mode

H03:

R – function
Exercises

H04:

R – packages

4TH LESSON:

H01:

Reading data from files
R – CSV files

H02:

Exercises

H03:

R – histograms
R – line graphs

H04:

Exercises

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Exam

Assessment method

The exam consists of a written part and an optional oral part based on the outcome of the written part. For this course there is no final numeric score, but simply a final evaluation in the form "pass/fail". The positive result obtained by the students resulting eligible, is recorded in the days following the communication of the exam's result (if it is not request to attend to the oral part). Students who in case of a positive result do not want to verbalize their eligibility, must send the request by email to the professor immediately after the exam.

Written part

The written part of the exam is composed by three exercises, to be solved using the *R* language. The students cannot use computers, devices and any other type of material, just pens and paper! The written part of the exam is considered “positively past” if at least two out of the three exercises are perfectly solved.

(Optional) oral part

The Professor (not the student), depending on the result of the written part of the exam, can require the student to attend an oral examination, this to better evaluate the level of preparation of the student.

Exam - written part

- 1st exam date - Saturday 03/11/2018, 08:00-10:00
  place: Aula Magna - Piazza Scaravilli, 2 – first floor

- 2nd exam date - Saturday 19/01/2019, 08:00-10:00
  place: Aula Magna - Piazza Scaravilli, 2 – first floor

- 3rd exam date - Saturday 07/09/2019, 09:00-11:00
  place: Aula Magna - Piazza Scaravilli, 2 – first floor

The date will be reported directly in the website www.filippopiccinini.it

Exam - (optional) oral part

The Professor (not the student), depending on the result of the written part of the exam, can require the student to attend an oral examination, this to better evaluate the level of preparation of the student.
These days are also used as "Reception Days" for who want to privately see the result of the written part.

The dates will be reported in the website www.filippopiccinini.it

THANK YOU

Eng. Filippo Piccinini, PhD
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