



academic year 2026-2027  
welcome session & master presentation

[mcv.uab.cat](https://mcv.uab.cat)

Maria Vanrell

# Welcome session

1. aim of the master
2. about computer vision
3. about the master
4. about the partners
  - UAB-CVC
  - UOC
  - UPC
  - UPF
  - UB
5. about the students

# aim of the master

## What?

To give to the students updated knowledge on Computer Vision

from basic techniques to state-of-art methods

## Why?

Computer Vision is an AI technology whose development and applicability is exponentially growing

new jobs, start-up opportunities, PHD studentships

## How?

Joining the expertise in the field of 5 universities which are living in Barcelona

a big concentration of companies and research institutions

# Welcome session

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about computer vision

close to 75 years of research in the field



## CV raise in parallel with AI, 1950s ...

From Wikipedia:

“[...] The Dartmouth Summer Research Project on Artificial Intelligence was a 1956 summer workshop widely considered [\[1\]\[2\]\[3\]](#) to be the founding event of [artificial intelligence](#) as a field.

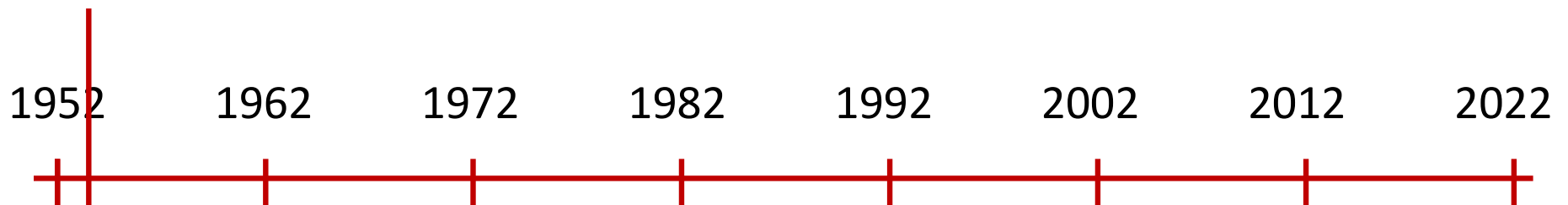
The project lasted approximately six to eight weeks and was essentially an extended [brainstorming](#) session. Eleven mathematicians and scientists originally planned to attend; not all of them attended, but more than ten others came for short times. [...]”

### Published list of attendees

- *Ray Solomonoff*
- *Marvin Minsky*
- *John McCarthy*
- *Claude Shannon*
- *Trenchard More*
- *Nat Rochester*
- *Oliver Selfridge*
- *Julian Bigelow*
- *W. Ross Ashby*
- *W.S. McCulloch*
- *Abraham Robinson*
- *Tom Etter*
- *John Nash*
- *David Sayre*
- *Arthur Samuel*
- *Kenneth R. Shoulders*
- *Shoulders' friend*
- *Alex Bernstein*
- *Herbert Simon*
- *Allen Newell*

AI birth (*Dartmouth Workshop*)

1956



Worth to mention, that some years before

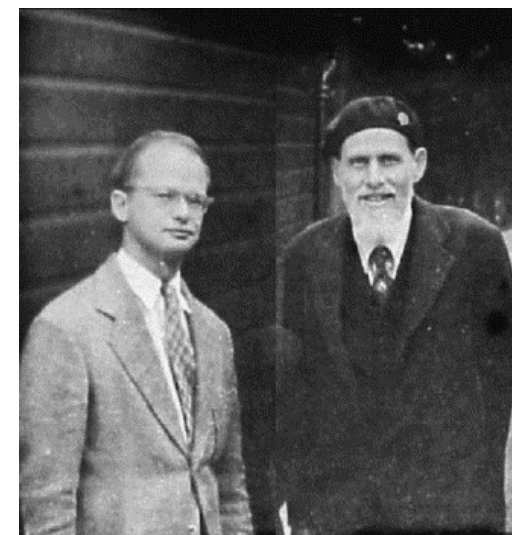
Warren McCulloch & Walter Pitts

A Neuroscientist and an expert in Logics

*"A logical calculus of the ideas immanent in nervous activity"*

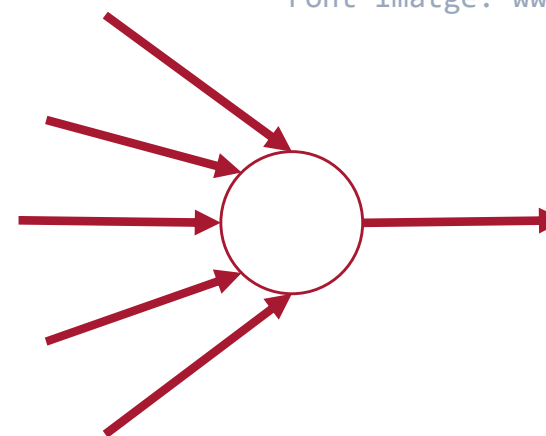
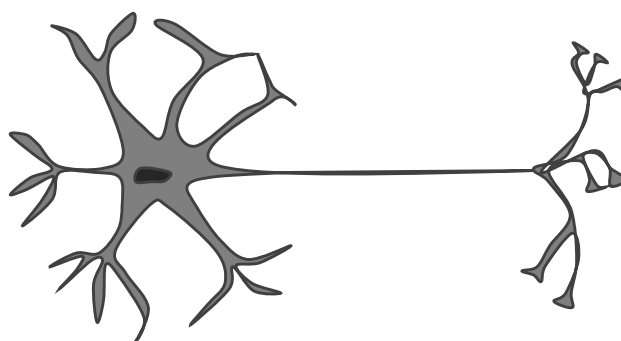
*Department of Psychiatry*

*University of Chicago*



Font image: [www.semanticscholar.org](http://www.semanticscholar.org)

1943 Artificial  
Neuron



AI birth (*Darmouth Workshop*)  
1956

1952

1962

1972

1982

1992

2002

2012

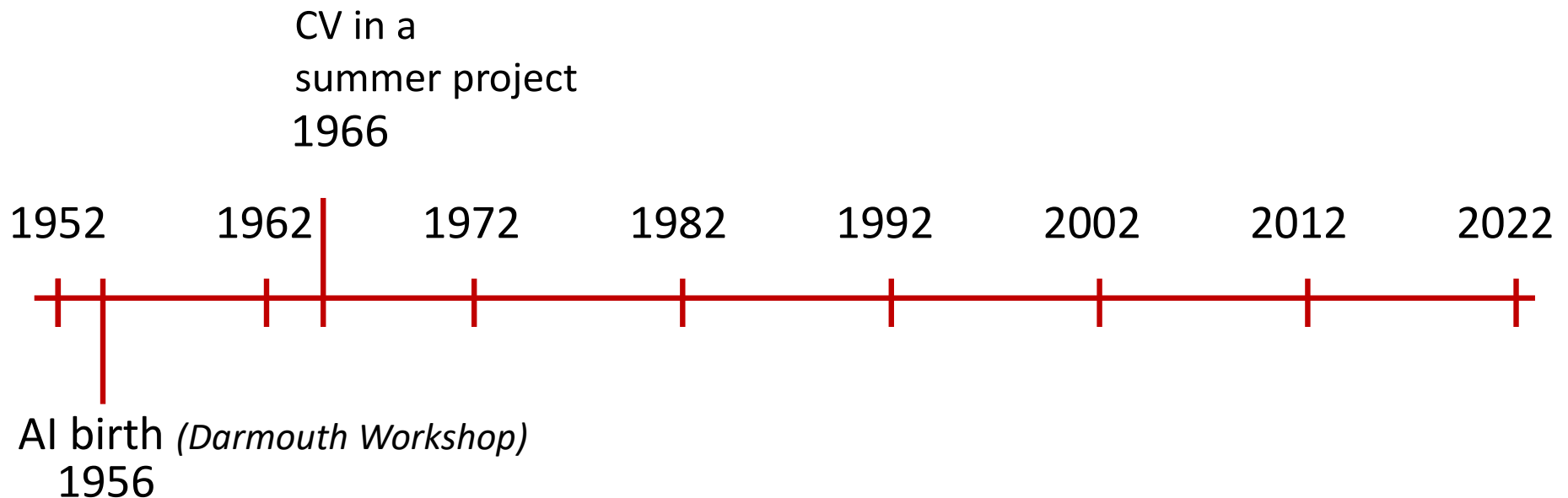
2022

## Vision as a Summer Project, 1966

from MIT AI Memos (1959-2004) we can find

[Papert, Seymour](#) (1966-07-01). "[The Summer Vision Project](#)"

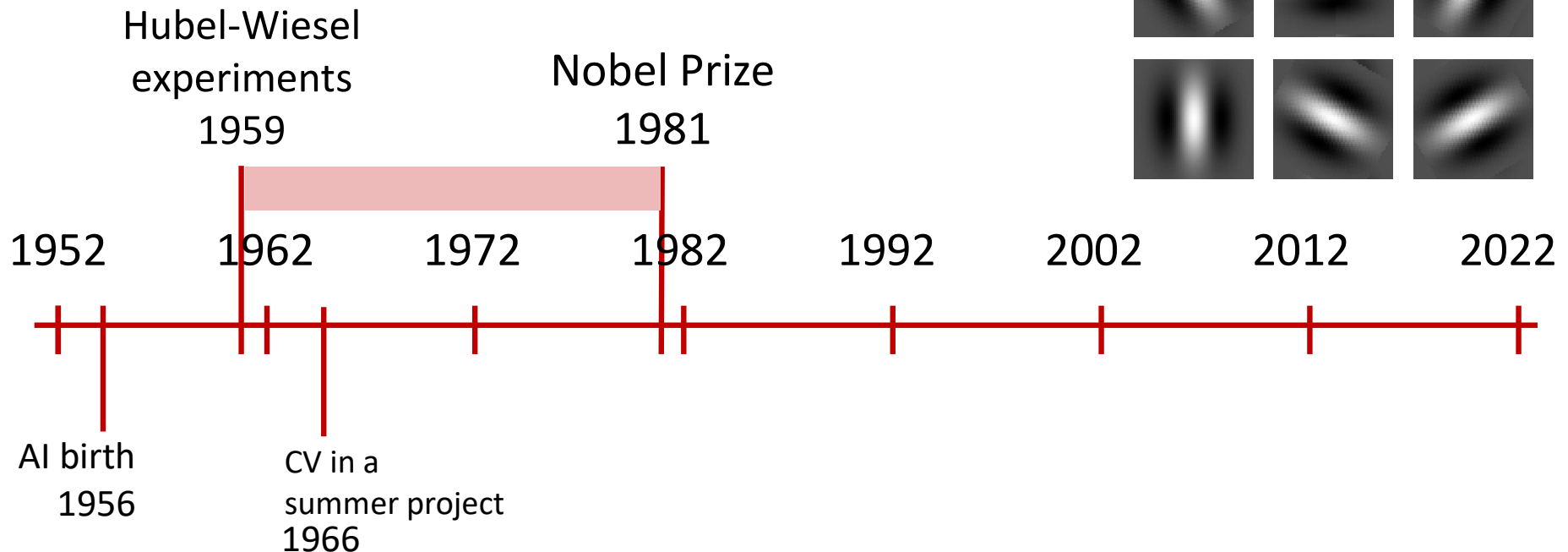
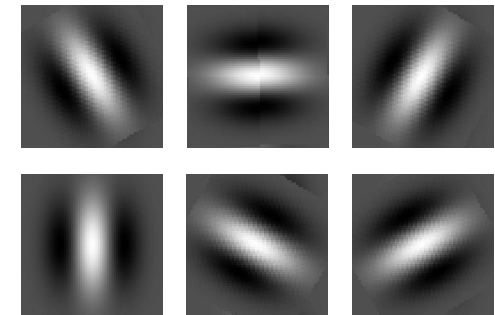
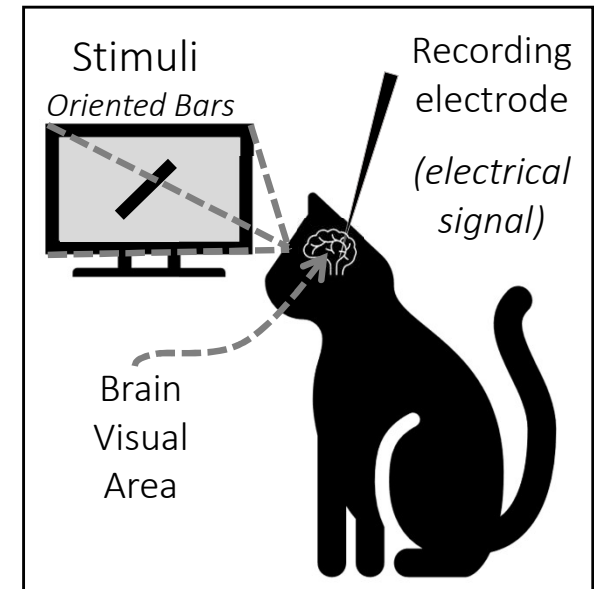
[...] The primary goal of the project is to construct a system of programs which will divide a vidisector picture into regions such as likely objects, likely background areas and chaos. We shall call this part of its operation **FIGURE-GROUND analysis**. It will be impossible to do this without considerable analysis of shape and surface properties, so FIGURE-GROUND analysis is really inseparable in practice from the second goal which is **REGION DESCRIPTION**. The final goal is **OBJECT IDENTIFICATION** which will actually name objects by matching them with a vocabulary of known objects.



# Important findings in neurophysiology, 1959

From Wikipedia:

“[...] The Hubel and Wiesel experiments greatly expanded the scientific knowledge of sensory processing. In one experiment, done in 1959, they inserted a [microelectrode](#) into the [primary visual cortex](#) of an anesthetized cat. They then projected patterns of light and dark on a screen in front of the cat. They found that some [neurons](#) fired rapidly when presented with lines at one angle, while others responded best to another angle. They called these neurons "[simple cells](#)." Still other neurons, which they termed "[complex cells](#)," responded best to lines of a certain angle moving in one direction. These studies showed how the visual system builds an image from simple stimuli into more complex representations [...]



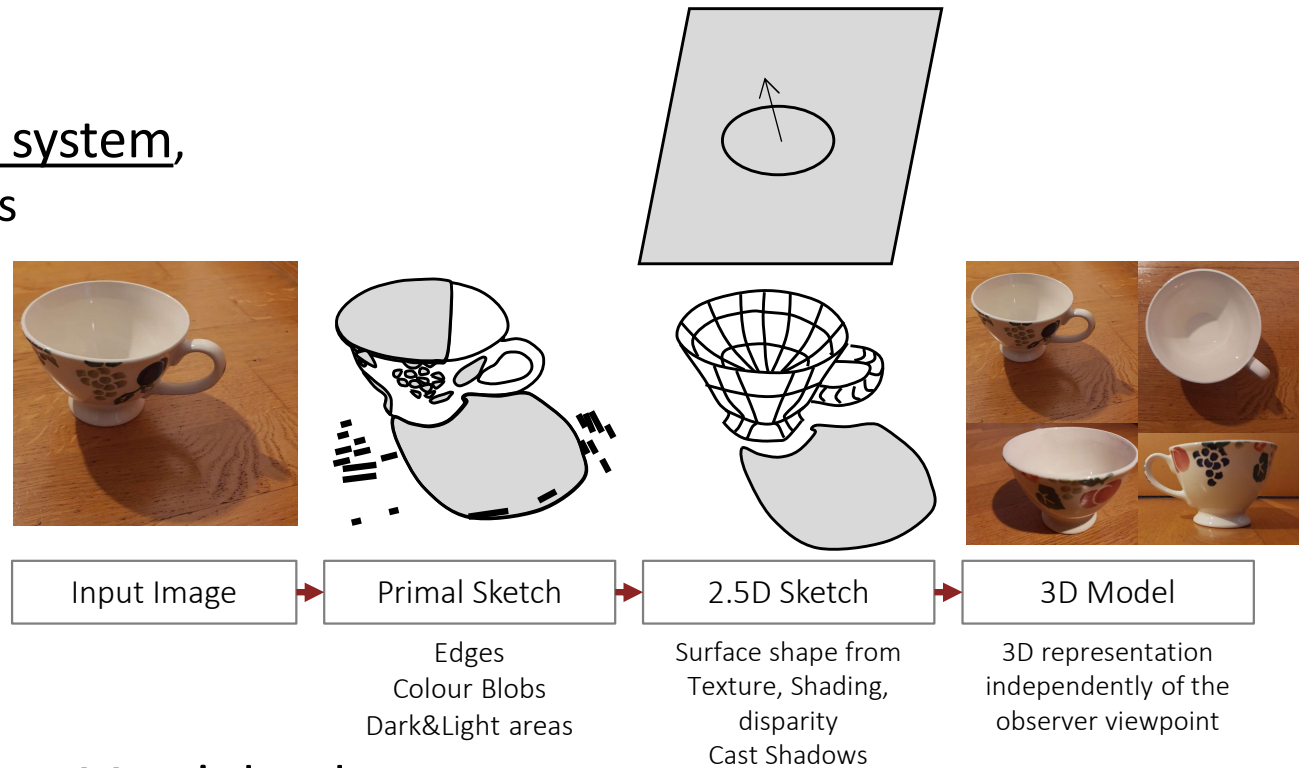
# Marr's Theory, 1982

Vision must be considered as  
an information processing system,  
that is built at different stages

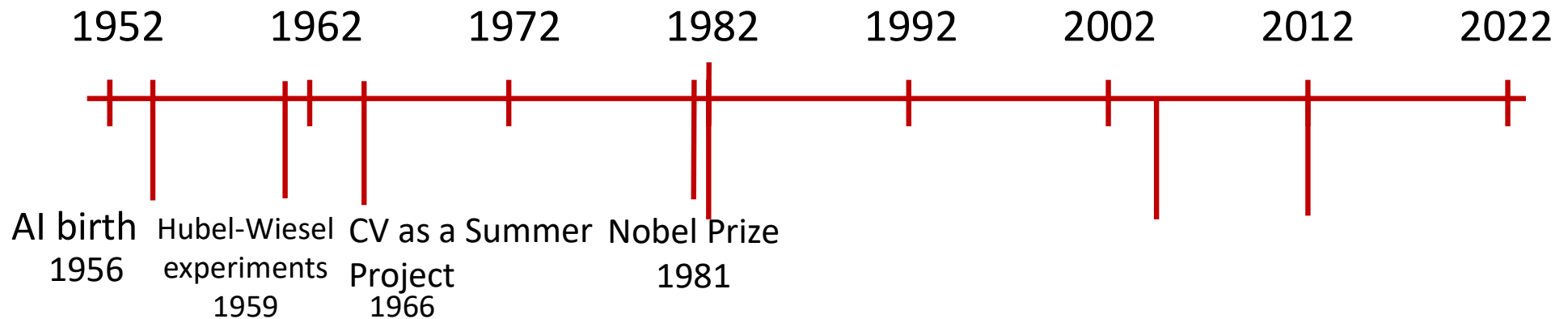
VISION



DAVID MARR



Marr's book  
1982



# CV field explodes with multiple computational approaches

Different optimization method to extract important features that requires regularization methods to solve the ill-posed nature

Pros:

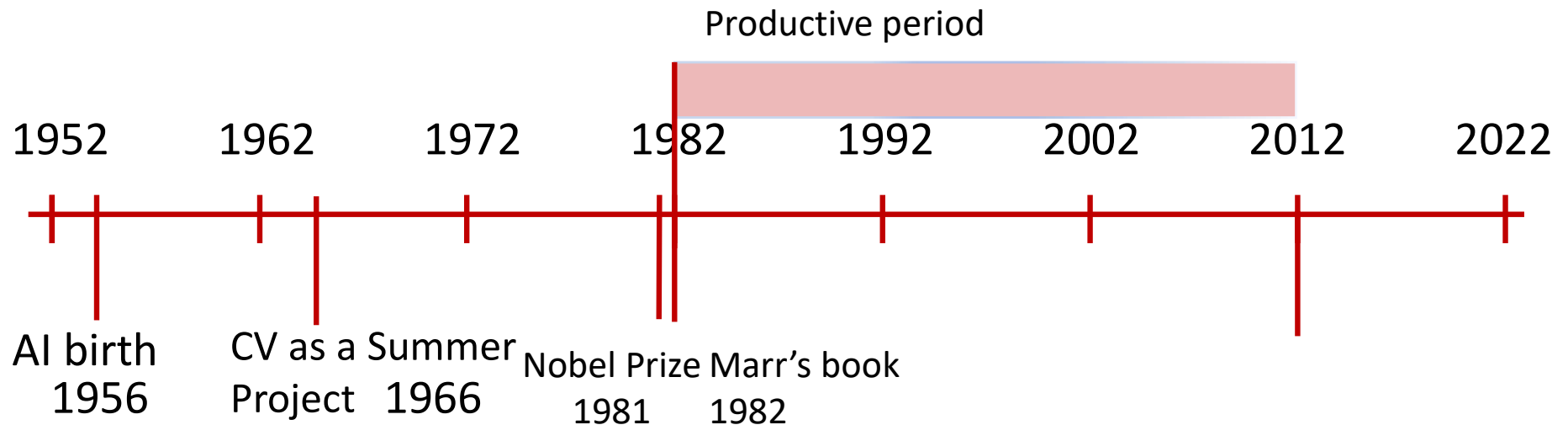
Application of a rich diversity of mathematical models ...  
(*Markov models, Wavelets, graphical models, neural networks...*)



Cons:

A lot of hand-crafted design and parameter setting ....

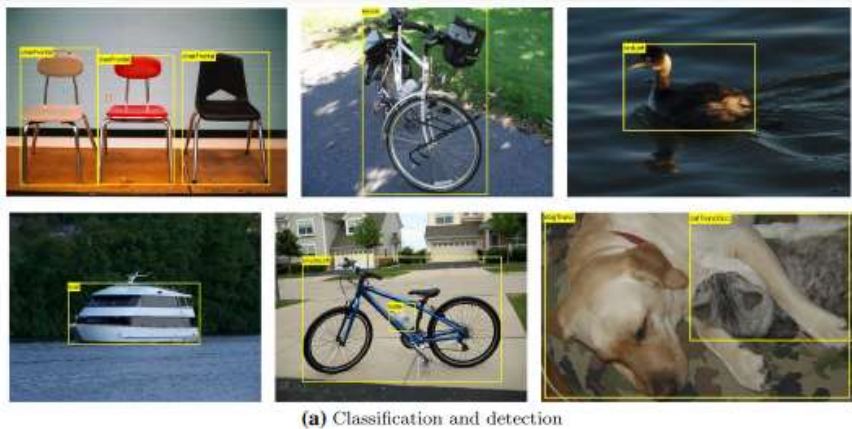
Not a unified methodology to deal with visual information



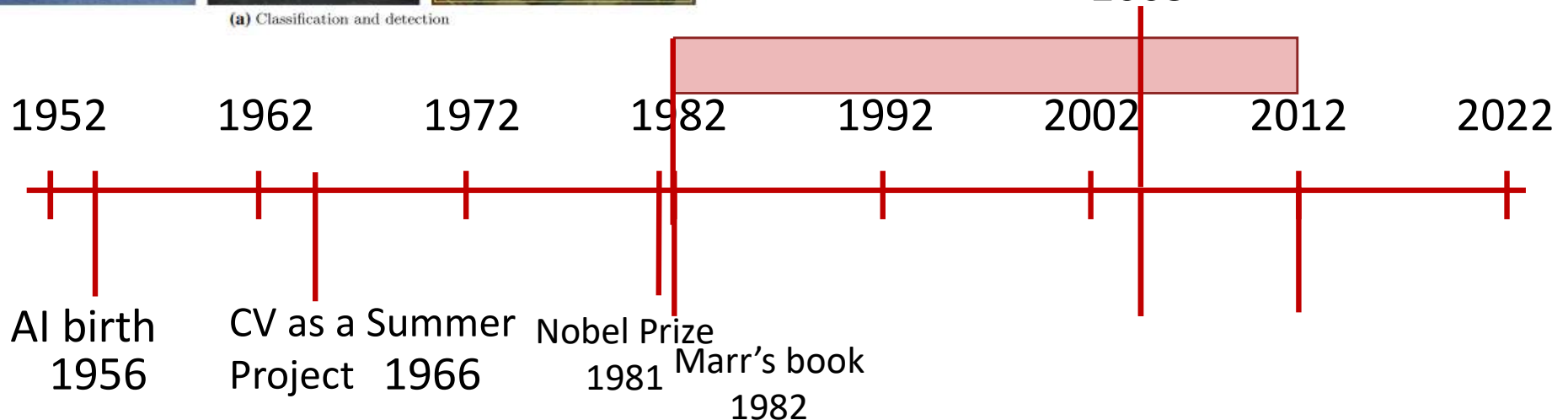
# CV seriously start to work on Image annotation (2005)

The Pascal VOC Project (EU funded) provided a serious datasets for object class recognition [<http://host.robots.ox.ac.uk/pascal/VOC/>]

- *Standardized image datasets*
- *A common set of tools to access data*
- *Standardize evaluation and comparison of methods*
- *Ran challenges to evaluate methods (from 2005-2012)*



Pascal VOC  
2005

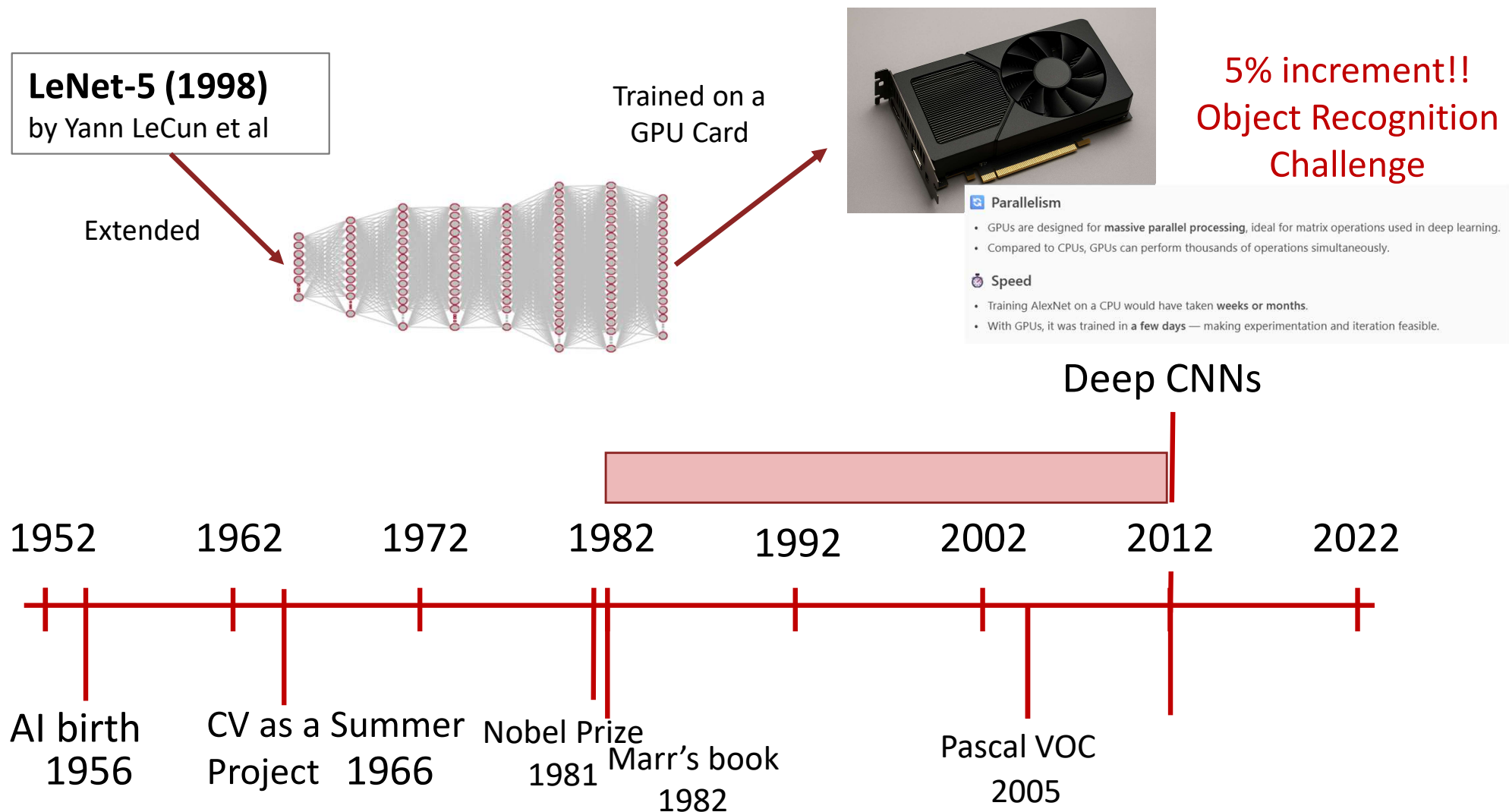


# Deep Convolutional Networks (2012)

There is an important increase in performance accuracy in the Pascal Challenge

*ImageNet Classification with Deep Convolutional Neural Networks*

A. Krizhevsky, I. Sutskever and G.E. Hinton. NEURIPS 2012



# Deep Convolutional Networks (2012)

There is an important increase in performance accuracy in the Pascal Challenge

*ImageNet Classification with Deep Convolutional Neural Networks*

A. Krizhevsky, I. Sutskever and G.E. Hinton. NEURIPS 2012

**They had provoked a break in Computer Vision Methodology!!!**

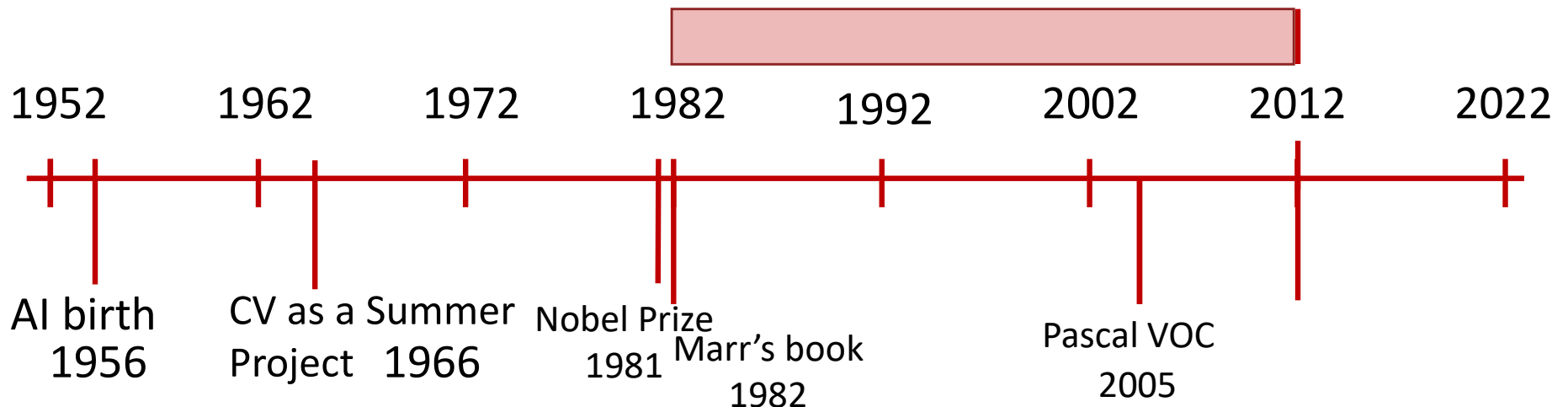
**From flat descriptors to hierarchical descriptors**

*Increase the power of representation of visual information*

**From hand-crafted to learned descriptors**

*CNN is trained with large datasets using graphical Cards and all parameter are all set in the training processs*

Deep CNNs

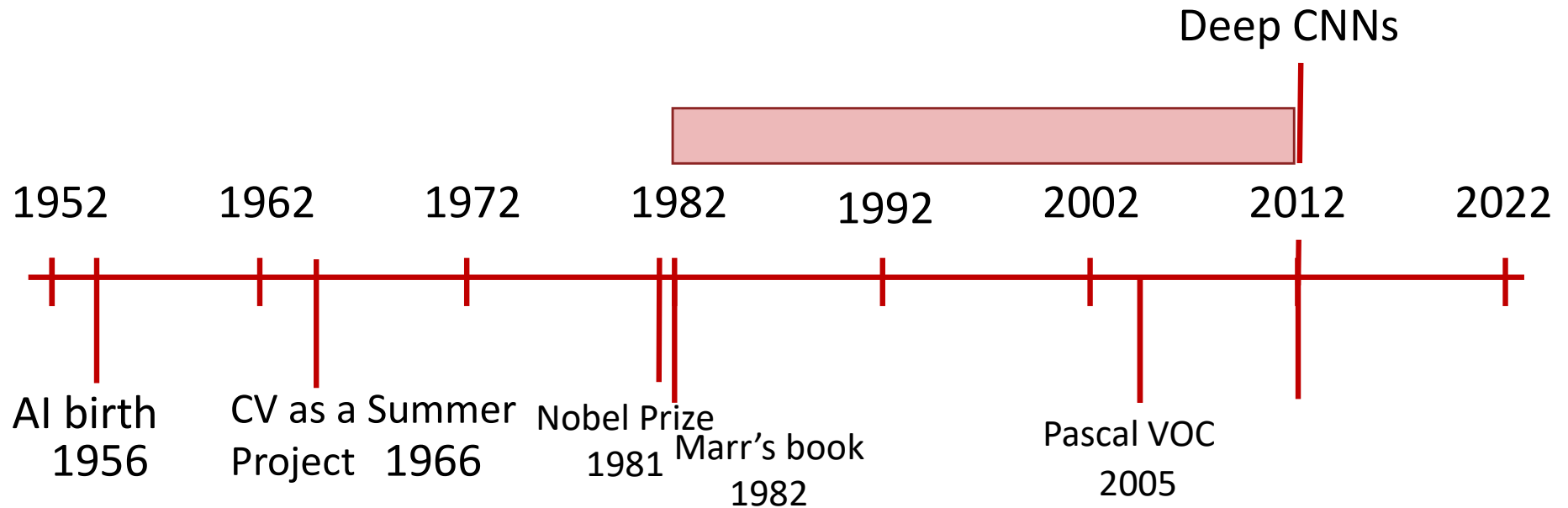
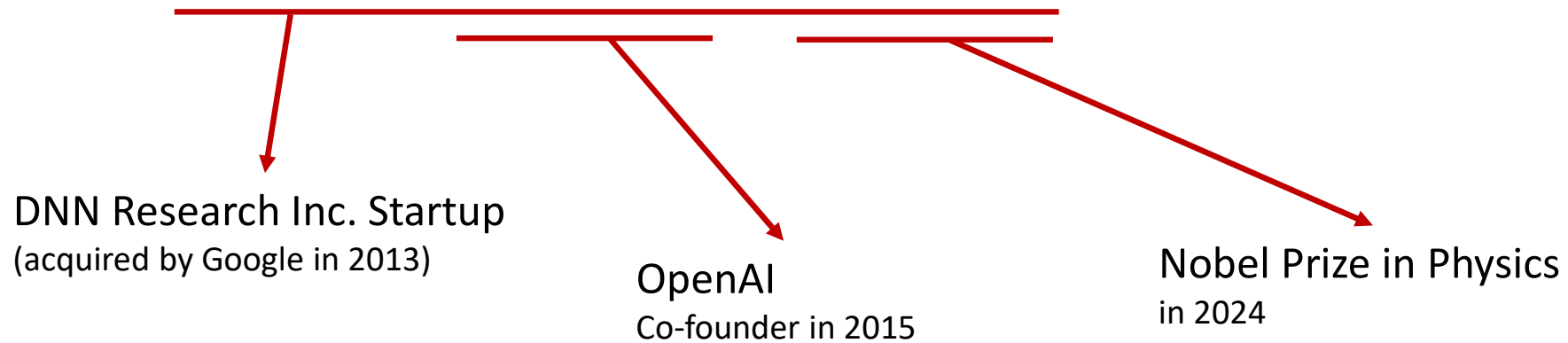


## Deep Convolutional Networks (2012)

There is an important increase in performance accuracy in the Pascal Challenge

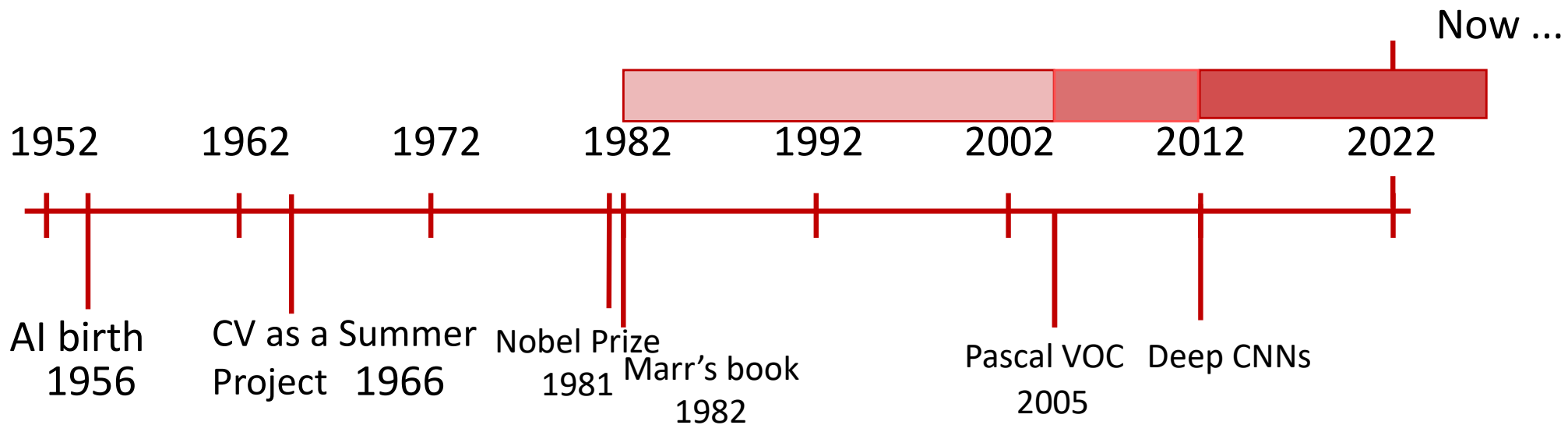
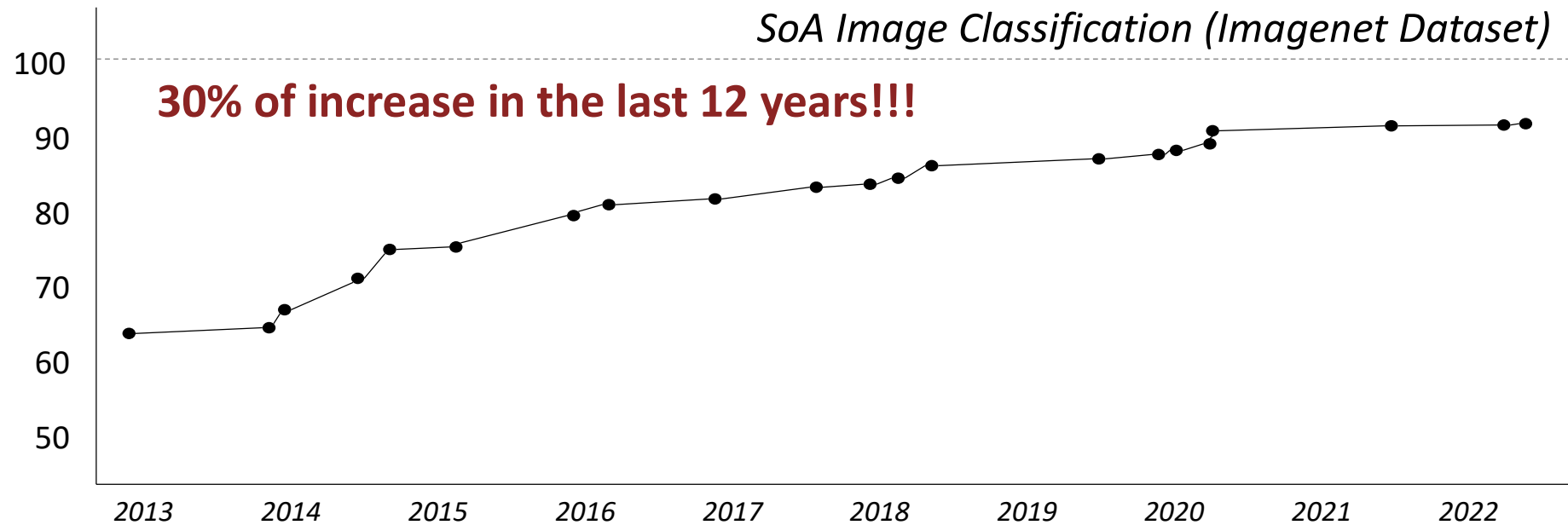
*ImageNet Classification with Deep Convolutional Neural Networks*

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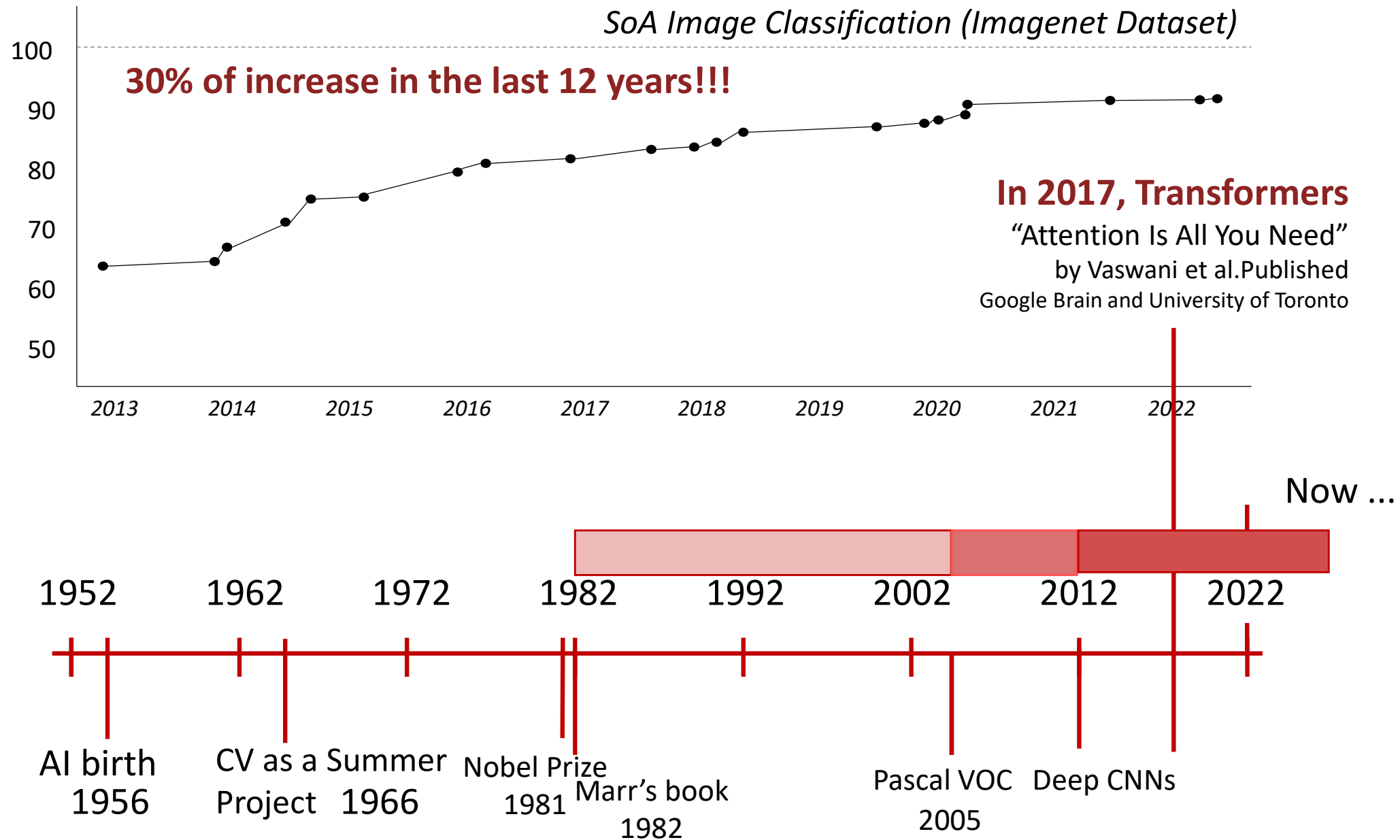
**Since 2012 ...** CV field is installed in a permanent growing ....

**Image Classification performance is still improving results**



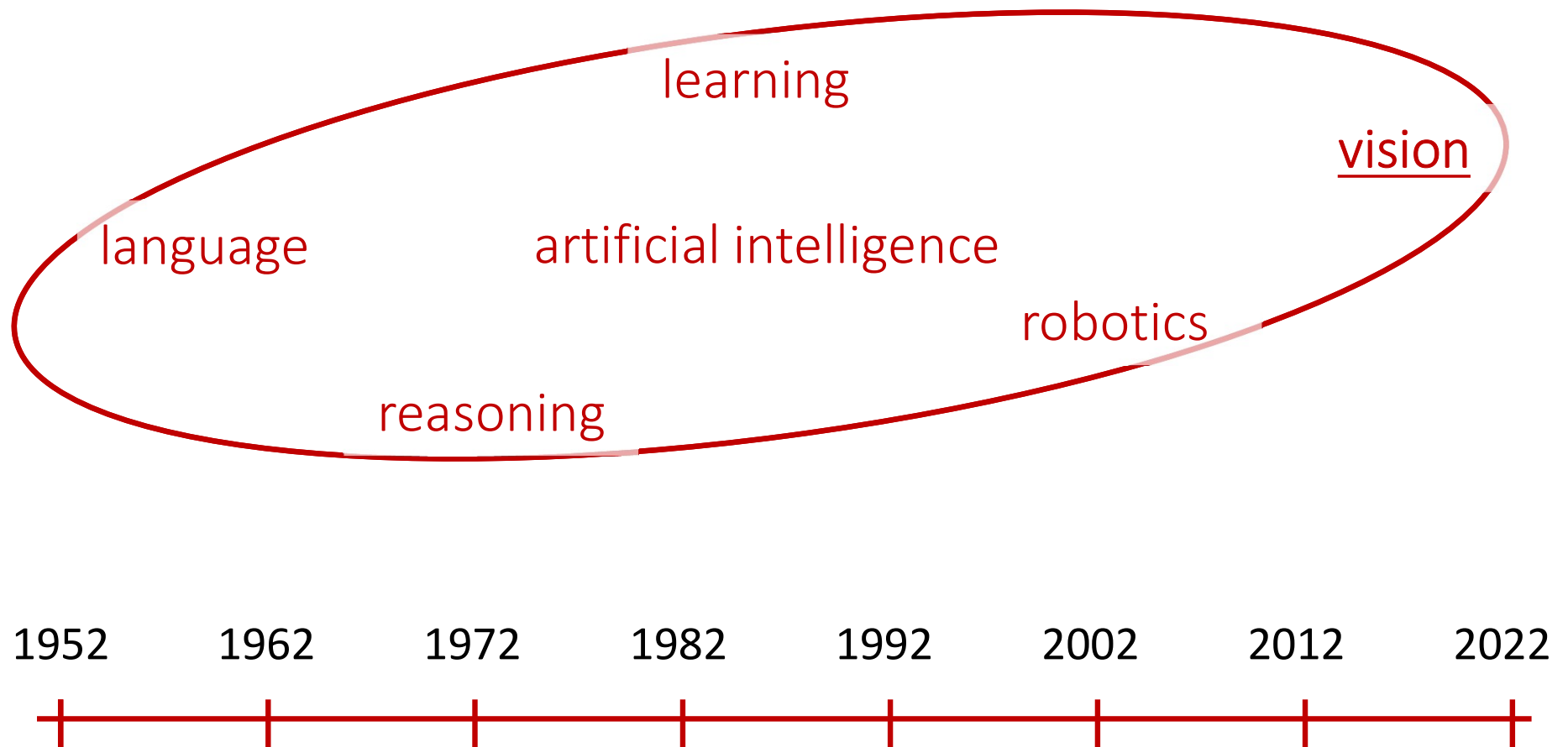
**Since 2012 ...** CV field is installed in a permanent growing ....

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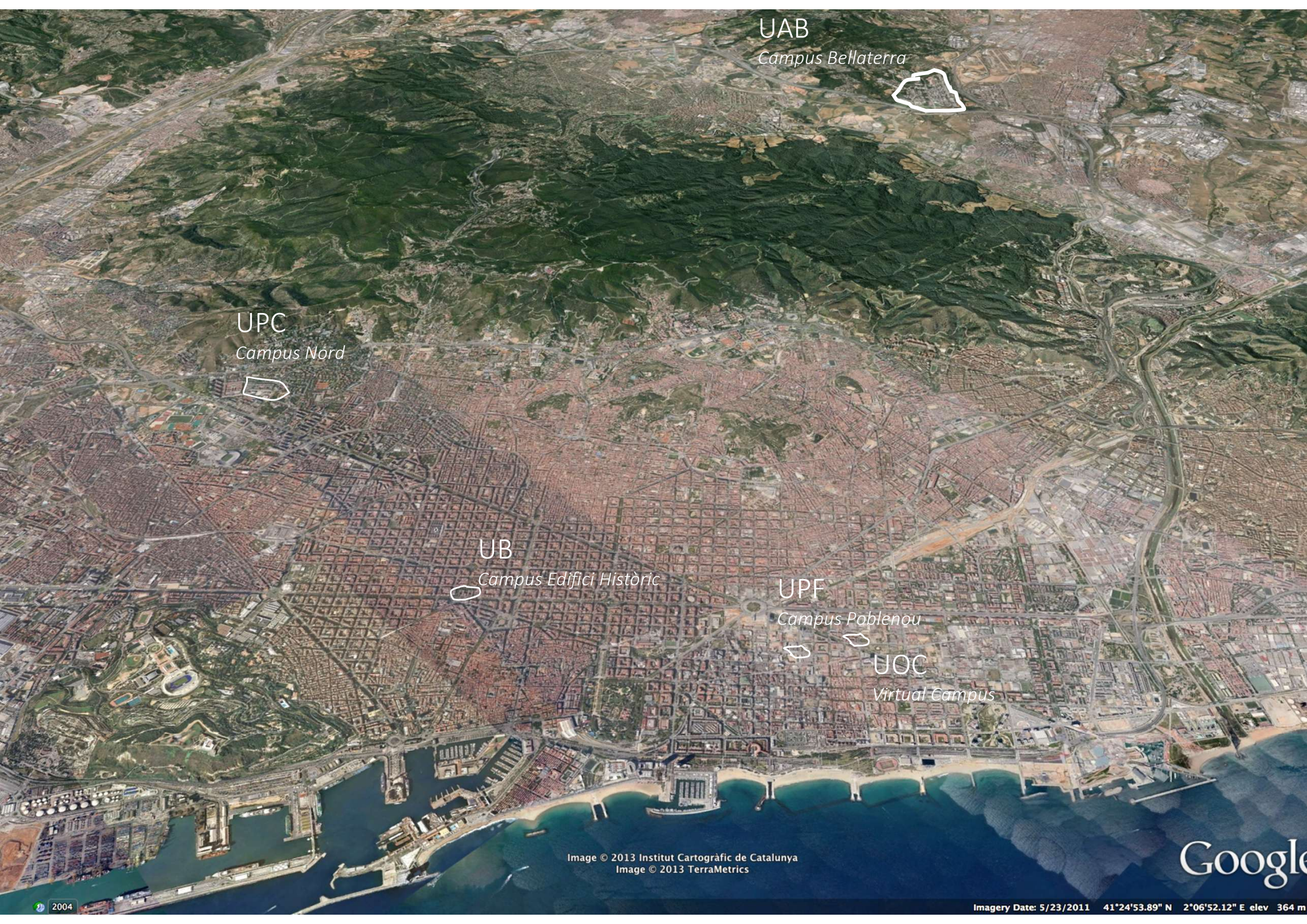
# about computer vision

after 75 years we are installed in the AI era



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UAB  
Campus Bellaterra

UPC  
Campus Nord

UB  
Campus Edifici Històric

UPF  
Campus Poblenou

UOC  
Virtual Campus

Image © 2013 Institut Cartogràfic de Catalunya  
Image © 2013 TerraMetrics

Google

# UAB Campus Bellaterra



Administration  
*Escola d'Enginyeria*

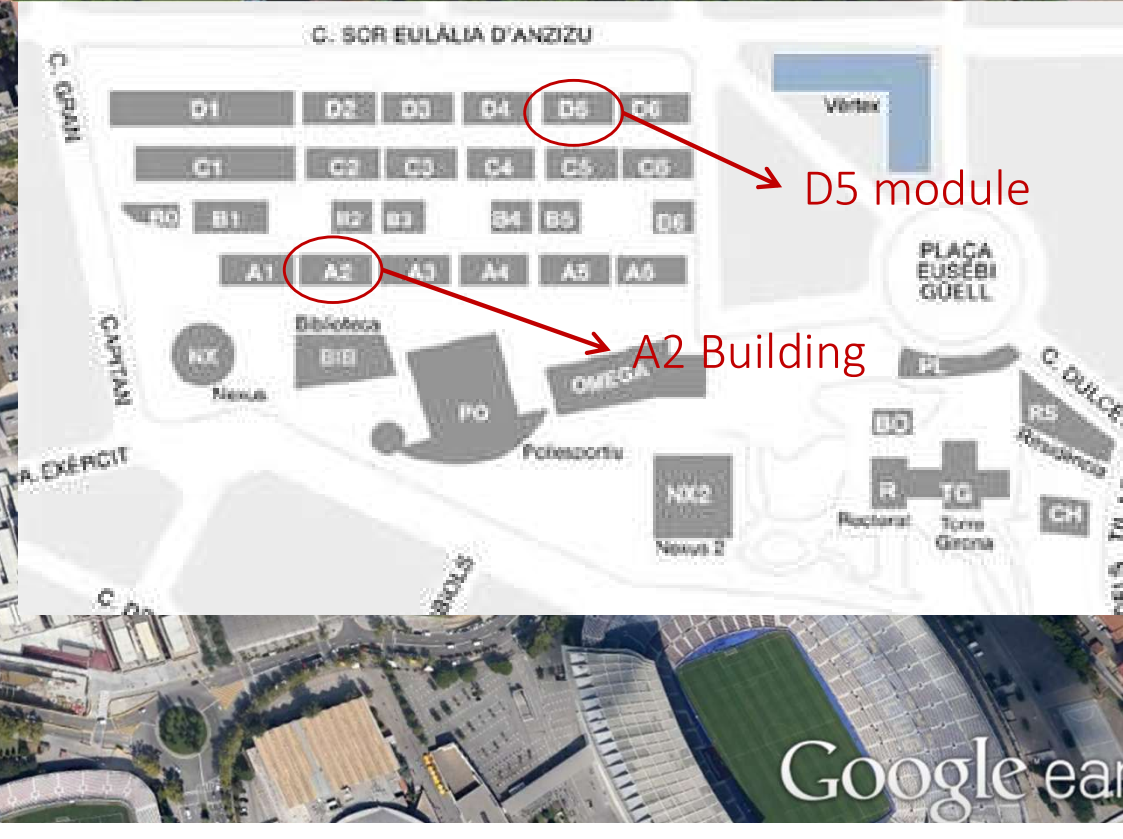
Image © 2013 Institut Cartogràfic de Catalunya



Computer Vision Center

Google earth

## An aerial photograph of a city area, likely a university campus or a planned urban development. A white outline highlights a specific building complex in the upper-middle section. A white arrow points from this outlined area towards a building in the lower-right section. The image shows various types of buildings, including residential-style structures with red roofs, larger institutional buildings, and sports facilities like a large green field and tennis courts. Roads and parking lots are also visible throughout the scene.



Google Earth



UPF  
*Campus Poblenou*





UOC  
*22@ Building*



Google

UB

*Campus Edifici Històric*

URL Facultat  
de Filosofia

Universitat  
de Barcelona



talunya

# 1 year program (60 ECTS: *European Credit Transfer System*)

| Courses |                                              | ECTS | Univ.  |        |
|---------|----------------------------------------------|------|--------|--------|
| C1      | Introduction to human and CV                 | 6    | UPC    | 6 ECTS |
| C2      | Optimization and Inference techniques for CV | 6    | UPF    |        |
| C3      | Machine Learning techniques for CV           | 6    | UAB    |        |
| C4      | 3D Vision                                    | 6    | UPF    |        |
| C5      | Visual Recognition                           | 9    | UAB-UB | 9 ECTS |
| C6      | Video Analysis                               | 9    | UPC-UB |        |
| C7      | Research Dissemination and Transfer          | 9    | UOC    |        |
| C8      | Master Dissertation                          | 9    | ALL    |        |

Total: 60

1 ECTS = 25 Hours of student work

# 1 year program (2 Semesters)

| Courses |                                              | ECTS | Univ.  |                             |
|---------|----------------------------------------------|------|--------|-----------------------------|
| C1      | Introduction to human and CV                 | 6    | UPC    | 1 <sup>st</sup><br>Semester |
| C2      | Optimization and Inference techniques for CV | 6    | UPF    |                             |
| C3      | Machine Learning techniques for CV           | 6    | UAB    |                             |
| C4      | 3D Vision                                    | 6    | UPF    |                             |
| C5      | Visual Recognition                           | 9    | UAB-UB | 2 <sup>nd</sup><br>Semester |
| C6      | Video Analysis                               | 9    | UPC-UB |                             |
| C7      | Research Dissemination and Transfer          | 9    | UOC    | Annual                      |
| C8      | Master Dissertation                          | 9    | ALL    |                             |

Total: 60

# 1 year program (Contents)

| Courses |                                              | ECTS | Univ.  |                    |
|---------|----------------------------------------------|------|--------|--------------------|
| C1      | Introduction to human and CV                 | 6    | UPC    | CV<br>Techniques   |
| C2      | Optimization and Inference techniques for CV | 6    | UPF    |                    |
| C3      | Machine Learning techniques for CV           | 6    | UAB    |                    |
| C4      | 3D Vision                                    | 6    | UPF    | Vision<br>Problems |
| C5      | Visual Recognition                           | 9    | UAB-UB |                    |
| C6      | Video Analysis                               | 9    | UPC-UB |                    |
| C7      | Research Dissemination and Transfer          | 9    | UOC    | Transversal Skills |
| C8      | Master Dissertation                          | 9    | ALL    | Individual Project |

Total: 60

# 1 year program (Coordinators)

|    | Courses                                      | ECTS | Univ.  |                                      |
|----|----------------------------------------------|------|--------|--------------------------------------|
| C1 | Introduction to human and CV                 | 6    | UPC    | <i>Ramon Morros</i>                  |
| C2 | Optimization and Inference techniques for CV | 6    | UPF    | <i>Coloma Ballester</i>              |
| C3 | Machine Learning techniques for CV           | 6    | UAB    | <i>Ramon Baldrich</i>                |
| C4 | 3D Vision                                    | 6    | UPF    | <i>Gloria Haro</i>                   |
| C5 | Visual Recognition                           | 9    | UAB-UB | <i>Javier Vázquez-Julio Silveira</i> |
| C6 | Video Analysis                               | 9    | UPC-UB | <i>Javier Ruiz-Albert Clapès</i>     |
| C7 | Research Dissemination and Transfer          | 9    | UOC    | <i>Carles Ventura</i>                |
| C8 | Master Dissertation                          | 9    | ALL    |                                      |

Total: 60

  
*M. Vanrell & R. Baldrich (UAB)*  
*J.R. Casas (UPC)*  
*C. Ballester (UPF)*  
*I. Benito (UOC)*  
*X. Baró (UB)*

# 1 year program (Methodology)

| Courses |                                              | ECTS | Univ.  |                           |
|---------|----------------------------------------------|------|--------|---------------------------|
| C1      | Introduction to human and CV                 | 6    | UPC    | Project-based methodology |
| C2      | Optimization and Inference techniques for CV | 6    | UPF    |                           |
| C3      | Machine Learning techniques for CV           | 6    | UAB    |                           |
| C4      | 3D Vision                                    | 6    | UPF    |                           |
| C5      | Visual Recognition                           | 9    | UAB-UB |                           |
| C6      | Video Analysis                               | 9    | UPC-UB |                           |
| C7      | Research Dissemination and Transfer          | 9    | UOC    | Online Activities         |
| C8      | Master Dissertation                          | 9    | ALL    | Individual work           |

Total: 60

# 1 year program (Project Coordinators)

| Courses |                                              | ECTS | Univ.  |                                      |
|---------|----------------------------------------------|------|--------|--------------------------------------|
| C1      | Introduction to human and CV                 | 6    | UPC    | <i>Ramon Morros</i>                  |
| C2      | Optimization and Inference techniques for CV | 6    | UPF    | <i>Adriano Pastore</i>               |
| C3      | Machine Learning techniques for CV           | 6    | UAB    | <i>Ramon Baldrich</i>                |
| C4      | 3D Vision                                    | 6    | UPF    | <i>Gloria Haro</i>                   |
| C5      | Visual Recognition                           | 9    | UAB-UB | <i>Ernest Valveny-Julio Silveira</i> |
| C6      | Video Analysis                               | 9    | UPC-UB | <i>Javier Ruiz -Albert Clapés</i>    |
| C7      | Research Dissemination and Transfer          | 9    | UOC    |                                      |
| C8      | Master Dissertation                          | 9    | ALL    |                                      |

Total: 60

# Schedule:

|          |                                                                                                              |                     |                       |                      |        |
|----------|--------------------------------------------------------------------------------------------------------------|---------------------|-----------------------|----------------------|--------|
|          | <i>hybrid</i>                                                                                                |                     |                       |                      |        |
| Courses: | Monday<br>C1-C3-C5                                                                                           | Tuesday<br>C2-C4-C6 | Wednesday<br>C1-C3-C5 | Thursday<br>C2-C4-C6 | Friday |
| 4pm-5pm  | Lecture                                                                                                      | Lecture             | Lecture               | Lecture              |        |
| 5pm-6pm  | Lecture                                                                                                      | Lecture             | Lecture               | Lecture              |        |
| 6pm-7pm  | [Lecture]                                                                                                    | [Lecture]           | [Lecture]             | [Lecture]            |        |
| 7pm-8pm  | Project Follow-up                                                                                            |                     |                       | Project Follow-up    |        |
|          | 3 or 4 hours                                                                                                 | 2 or 3 hours        | 2 or 3 hours          | 3 or 4 hours         |        |
|          | <i>Number of hours per day depends on the Lecture Topic</i><br><i>Total amount Hours/Course = 6 per week</i> |                     |                       |                      |        |

6 hours/week (1 follow-up, 5 theoretical) within the schedule  
*but can change a bit depending on the course and the contents*



MASTER IN  
COMPUTER VISION  
Barcelona



**UAB**  
Universitat Autònoma  
de Barcelona

**UNIVERSITAT DE BARCELONA**

**UOC** Universitat Oberta  
de Catalunya

**UPC** UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH

**upf.** Universitat  
Pompeu Fabra  
Barcelona

News Goals Program Schedule Admission MCV Internships Jobs, Interns & Phd Grants Contact Log In

## News

**ACMCV 2025** will take place on **September 16th** at the

**Academic Year 2025-2026.** The **Welcome Session** will place at different Barcelona Campuses depending on c

C1 and C6 (UPC) at [Campus Nord](#). The last part of C6 will be at UB [Campus Edifici històric](#)

C2 and C4 (UPF) at [Campus Poblenou](#)

C3 and C5 (UAB) at [Campus Bellaterra](#). The last part of C5 will be at UB [Campus Edifici històric](#).

Practical Information  
about the courses:

Schedule, rooms ...  
(Quick access)

## Modules

- C1. Introduction to human and CV
- C2. Optimization&Inference for CV
- C3. Machine Learning for CV
- C4. 3D Vision
- C5. Visual Recognition
- C6. Video Analysis
- C7. Research Dissemination and Transfer
- C8. Master Dissertation



# MASTER IN COMPUTER VISION Barcelona



**UAB**  
Universitat Autònoma  
de Barcelona

**UNIVERSITAT DE  
BARCELONA**

**UOC** Universitat Oberta  
de Catalunya

**UPC** UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH

**upf.** Universitat  
Pompeu Fabra  
Barcelona

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## News

**ACMCV 2025** will take place on **September 16th** at the Computer Vision Center [\[+\]](#).

**Academic Year 2025-2026.** The **Welcome Session** will take place on **September, the 26th** at Computer Vision Center (UAB Campus) at 4pm. **Courses will start on September, the 29th**, they will take place at different Barcelona Campuses depending on course coordination.

C1 and C6 (UPC) at [Campus Nord](#). The last part of C6 will be at UB [Campus Edifici històric](#)

C2 and C4 (UPF) at [Campus Poblenou](#)

C3 and C5 (UAB) at [Campus Bellaterra](#). The last part of C5 will be at UB [Campus Edifici històric](#).

## Modules

- C1. Introduction to human and CV
- C2. Optimization&Inference for CV
- C3. Machine Learning for CV
- C4. 3D Vision
- C5. Visual Recognition
- C6. Video Analysis
- C7. Research Dissemination and Transfer
- C8. Master Dissertation

# C1. Introduction to human and computer vision

M1 Schedule – Academic Year 2026-2027 – Student Guide [<here>](#)

| DATE            | TIME         | Lecture                                                                | Lecturer              | University | Building/Room             |
|-----------------|--------------|------------------------------------------------------------------------|-----------------------|------------|---------------------------|
| Mon. Sept. 28th | 16:00-17:00  | Image processing assessment and pixel-based processing                 | Ramon Morros          | UPC        | Aulari A3 A3-102          |
| Mon. Sept. 28th | 17:00-18:00  |                                                                        | R. Morros & J. Ruiz   |            |                           |
| Mon. Sept. 28th | 18:00-19:00  | Project Introduction                                                   |                       |            |                           |
| Wed. Sept. 30th | 16:00-17:00  | Morphological and nonlinear filtering                                  | Ramon Morros          | UPC        | Aulari A3 A3-105 & Hybrid |
| Wed. Sept. 30th | 17:00-18:00  |                                                                        |                       |            |                           |
| Mon. Oct. 5th   | 16:00-17:00  | Human Visual system and perception                                     | Javier Vázquez-Corral | UAB        | Aulari A3 A3-102          |
| Mon. Oct. 5th   | 17:00-18:00  |                                                                        |                       |            |                           |
| Mon. Oct. 5th   | 18:00-19:00  | Project Introduction                                                   | R. Morros & J. Ruiz   | UPC        |                           |
| Wed. Oct. 7th   | 16:00-17:00  | Human Visual system and perception                                     | Javier Vázquez-Corral | UAB        | Aulari A3 A3-105 & Hybrid |
| Wed. Oct. 7th   | 17:00-18:00  |                                                                        |                       |            |                           |
| Mon. Oct. 12th  |              | HOLIDAY                                                                |                       |            |                           |
| Wed. Oct. 14th  | 16:00-17:00  | Space-frequency representation, Fourier transform and linear filtering | Javier Ruiz           | UPC        | Aulari A3 A3-105 & Hybrid |
| Wed. Oct. 14th  | 17:00-18:00  |                                                                        |                       |            |                           |
| Mon. Oct. 19th  | 16:00-17:00  | Space-frequency representation, Fourier transform and linear filtering | Javier Ruiz           | UPC        | Aulari A3 A3-102          |
| Mon. Oct. 19th  | 17:00-18:00  |                                                                        |                       |            |                           |
| Mon. Oct. 19th  | 18:00-19:00  | Project Introduction                                                   | R. Morros & J. Ruiz   |            |                           |
| Wed. Oct. 21st  | 16:00-17:00  | Space-frequency representation, Fourier transform and linear filtering | Javier Ruiz           | UPC        | Aulari A3 A3-105 & Hybrid |
| Wed. Oct. 21st  | 17:00-18:00  |                                                                        |                       |            |                           |
| Mon. Oct. 26th  | 16:00-17:00  | Feature extraction                                                     | Ramon Morros          | UPC        | Aulari A3 A3-102          |
| Mon. Oct. 26th  | 17:00-18:00  |                                                                        |                       |            |                           |
| Mon. Oct. 26th  | 18:00-19:00  | Project Introduction                                                   | R. Morros & J. Ruiz   |            |                           |
| Wed. Oct. 28th  | 16:00-17:00  | Grouping, segmentation and classification                              | Ramon Morros          | UPC        | Aulari A3 A3-105 & Hybrid |
| Wed. Oct. 28th  | 17:00-18:00  |                                                                        |                       |            |                           |
| Mon. Nov. 2nd   | 16:00-17:00  | Grouping, segmentation and classification                              | Ramon Morros          | UPC        | Aulari A3 A3-102          |
| Mon. Nov. 2nd   | 17:00-18:00  |                                                                        |                       |            |                           |
| Wed. Nov. 4th   |              | HOMEWORK                                                               |                       |            |                           |
| Mon. Nov. 9th   | 16:00-17:00  | Project Presentations                                                  | R. Morros & J. Ruiz   | UPC        | Aulari A3 A3-102          |
| Mon. Nov. 9th   | 17:00-18:00  |                                                                        |                       |            |                           |
| Mon. Nov. 9th   | 18:00-19:00  |                                                                        |                       |            |                           |
| Wed. Nov. 11th  |              | HOMEWORK                                                               |                       |            |                           |
| Mon. Nov. 16th  |              | HOMEWORK                                                               |                       |            |                           |
| Wed. Nov. 18th  |              | HOMEWORK                                                               |                       |            |                           |
| Mon. Nov. 23rd  | 16:00 -19:00 | EXAM                                                                   | Ramon Morros          | UPC        | Aulari A4 A4-202          |

We usually have:

4 Theory hours/week  
1 Follow-up session/week

But, with some variations:

1 free day in the middle  
4 follow-up sessions  
1 Project Presentation Session  
1 Exam



# MASTER IN COMPUTER VISION Barcelona



**UAB**  
Universitat Autònoma  
de Barcelona

**UNIVERSITAT DE  
BARCELONA**

**UOC** Universitat Oberta  
de Catalunya

**UPC** UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH

**upf.** Universitat  
Pompeu Fabra  
Barcelona

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## News

**ACMCV 2025** will take place on **September 16th** at the Computer Vision Center [\[+\]](#).

**Academic Year 2025-2026.** The **Welcome Session** will take place on **September, the 26th** at Computer Vision Center (UAB Campus) at 4pm. **Courses will start on September, the 29th**, they will take place at different Barcelona Campuses depending on course coordination.

C1 and C6 (UPC) at [Campus Nord](#). The last part of C6 will be at UB [Campus Edifici històric](#)

C2 and C4 (UPF) at [Campus Poblenou](#)

C3 and C5 (UAB) at [Campus Bellaterra](#). The last part of C5 will be at UB [Campus Edifici històric](#).

## Modules

C1. Introduction to human and CV

C2. Optimization&Inference for CV

C3. Machine Learning for CV

C4. 3D Vision

C5. Visual Recognition

C6. Video Analysis

C7. Research Dissemination and Transfer

C8. Master Dissertation

## C2. Optimization for Introduction to Human and Computer Vision

M2 Schedule – Academic Year 2026-2027 – Student Guide [<here>](#)

| DATE           | TIME        | Lecture                                                                                                                                                                                   | Lecturer         | University | Room/Building                             |
|----------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------|-------------------------------------------|
| Tue. Sep. 29th | 16:00-17:00 | Introduction to optimization problems and energy minimization methods. Examples.                                                                                                          | Coloma Ballester | UPF        | Room 52.321 (Hybrid)<br>Roc Boronat Bldg. |
| Tue. Sep. 29th | 17:00-18:00 | Numerical techniques for optimization problems (I): Euler-Lagrange equation and Gradient methods. Gateaux derivative.                                                                     |                  |            |                                           |
| Thu. Oct. 1st  | 16:00-17:00 | Numerical techniques for optimization problems (II): Euler-Lagrange equation and Gradient methods. Gateaux derivative.                                                                    | Coloma Ballester | UPF        | Room 52.321<br>Roc Boronat Bldg.          |
| Thu. Oct. 1st  | 17:00-18:00 | Numerical techniques for optimization problems (III): Gradient methods. Applications: denoising, image inpainting, Poisson editing, etc.                                                  |                  |            |                                           |
| Thu. Oct. 1st  | 18:00-19:00 | Project Introduction                                                                                                                                                                      | Adriano Pastore  |            |                                           |
| Tue. Oct. 6th  | 16:00-17:00 | Review and complements of numerical linear algebra (I and II): least squares methods, singular value decomposition. Applications.                                                         | Pablo Arias      | UPF        | Room 52.410 (Hybrid)<br>Tangar Bldg.      |
| Tue. Oct. 6th  | 17:00-18:00 |                                                                                                                                                                                           |                  | UPF        |                                           |
| Thu. Oct. 8th  | 16:00-17:00 | Stochastic Optimization for Machine Learning (I and II). The backpropagation strategy for gradient formulation. Gradient descent optimization methods useful for deep learning approaches | Pablo Arias      | UPF        | Room 52.321<br>Roc Boronat Bldg.          |
| Thu. Oct. 8th  | 17:00-18:00 |                                                                                                                                                                                           |                  | UPF        |                                           |
| Thu. Oct. 8th  | 18:00-19:00 | Convex optimization (I). Convex sets and convex functions                                                                                                                                 | Pablo Arias      | UPF        |                                           |
| Thu. Oct. 8th  | 19:00-20:00 | Project Follow-up                                                                                                                                                                         | Adriano Pastore  | UPF        |                                           |
| Tue. Oct. 13th | 16:00-17:00 | Convex optimization (II). Constrained and unconstrained optimization. Karush-Kuhn-Tucker optimality conditions.                                                                           | Pablo Arias      | UPF        | Room 52.321 (Hybrid)<br>Roc Boronat Bldg. |
| Tue. Oct. 13th | 17:00-18:00 | Convex optimization (III). Constrained and unconstrained optimization. Karush-Kuhn-Tucker optimality conditions. Applications.                                                            | Pablo Arias      | UPF        |                                           |
| Thu. Oct. 15th | 16:00-17:00 | Convex Optimization (IV). Duality principles and methods. Subgradient methods.                                                                                                            | Coloma Ballester | UPF        | Room 52.321<br>Roc Boronat Bldg.          |
| Thu. Oct. 15th | 17:00-18:00 | Convex Optimization (V). Duality-based methods. Applications. Non-convex problems.                                                                                                        | Coloma Ballester | UPF        |                                           |
| Thu. Oct. 15th | 18:00-19:00 | Segmentation with variational models. The Mumford and Shah functional and the level sets framework.                                                                                       | Adriano Pastore  | UPF        |                                           |
| Thu. Oct. 15th | 19:00-20:00 | Project Follow-up                                                                                                                                                                         | Adriano Pastore  | UPF        |                                           |
| Tue. Oct. 20th |             | HOMEWORK                                                                                                                                                                                  |                  |            |                                           |
| Thu. Oct. 22nd |             | HOMEWORK                                                                                                                                                                                  |                  |            |                                           |
| Tue. Oct. 27th | 16:00-17:00 | Bayesian networks and MRFs (I): Inference problems. Main inference algorithms. Examples.                                                                                                  | Toni Lozano      | UAB        | Room 52.321 (Hybrid)<br>Roc Boronat Bldg. |
| Tue. Oct. 27th | 17:00-18:00 | Bayesian networks and MRFs (II): Factor graphs. From Bayesian networks to factor graphs.                                                                                                  |                  |            |                                           |
| Tue. Oct. 27th | 18:00-19:00 | Inference (I): Types of inference queries. Exact inference.                                                                                                                               |                  |            |                                           |
| Thu. Oct. 29th | 16:00-17:00 | Inference (II): Belief propagation. Inference as variational optimization.                                                                                                                | Toni Lozano      | UAB        | Room 52.321<br>Roc Boronat Bldg.          |
| Thu. Oct. 29th | 17:00-18:00 | Sampling methods (I): Forward sampling. Sampling under evidence.                                                                                                                          | Toni Lozano      |            |                                           |
| Thu. Oct. 29th | 18:00-19:00 | Sampling methods (II): Markov Chain Monte Carlo, Gibbs sampling.                                                                                                                          | Toni Lozano      |            |                                           |
| Thu. Oct. 29th | 19:00-20:00 | Project Follow-up                                                                                                                                                                         | Adriano Pastore  | UPF        |                                           |
| Tue. Nov. 3rd  |             | HOMEWORK                                                                                                                                                                                  |                  |            |                                           |
| Thu. Nov. 5th  |             | HOMEWORK                                                                                                                                                                                  |                  |            |                                           |
| Thu. Nov. 12th | 16:00-19:00 | Project Presentations                                                                                                                                                                     | Adriano Pastore  | UPF        | Room 52.321<br>Roc Boronat Bldg.          |
| Tue. Nov. 17th |             | HOMEWORK                                                                                                                                                                                  |                  |            |                                           |
| Thu. Nov. 19th |             | HOMEWORK                                                                                                                                                                                  |                  |            |                                           |
| Thu. Nov. 26th | 16:00-19:00 | EXAM                                                                                                                                                                                      | Coloma Ballester | UPF        | Room 52.019<br>Roc Boronat Bldg.          |

We have a similar schedule, but with differences

5 Theory hours/week  
1 Follow-up session/week

2 free weeks

Theory hours:

1 week with 4 hours

1 week with 6 hours of theory

# Teaching Methodology:

## Supervised Sessions

- **Lecture Sessions**, where the lecturers will explain general contents about the topics. Some of them will be used to solve the problems.
- **Project follow-up Sessions**, where the problems and goals of the projects will be presented and discussed, students will interact with the project coordinator about problems and ideas on solving the project (approx. 1 hour/week)
- **Presentation Session**, where the students give an oral presentation about how they have solved the project and a demo of the results.
- **Exam Session**, where the students are evaluated individually. Knowledge achievements and problem-solving skills

**Homework**, student will work in **groups** to solve the problems of the projects with deliverables:

- Code
- Reports
- Oral presentations

## C7. Research Dissemination and Transfer

| Courses |                                              | ECTS | Univ.  |
|---------|----------------------------------------------|------|--------|
| C1      | Introduction to human and CV                 | 6    | UPC    |
| C2      | Optimization and Inference techniques for CV | 6    | UPF    |
| C3      | Machine Learning techniques for CV           | 6    | UAB    |
| C4      | 3D Vision                                    | 6    | UPF    |
| C5      | Visual Recognition                           | 9    | UAB-UB |
| C6      | Video Analysis                               | 9    | UPC-UB |
| C7      | Research Dissemination and Transfer          | 9    | UOC    |
| C8      | Master Dissertation                          | 9    | ALL    |
| Total:  |                                              | 60   |        |

**Important note:** Starts on October 14th?

## Contents

### Project Planification and Development

- Project Planning
- Data Analysis
- Ethics in Research: Debate

### Writing Scientific texts in Latex

- Introduction to Latex: edition of basic text
- Advanced Latex: Standard text edition
- Writing scientific texts: simplifying a scientific document
- Writing Scientific Texts: introduction to computer vision (C1)
- Writing of Scientific Texts: machine learning techniques for computer vision (C3 or C4)
- Literature review and composition of the state-of-the-art

### Oral presentation

- Oral Presentation: "Introduce yourself"
- Oral Presentation: "Machine learning for computer vision"

### Research management and dissemination

- Publishing Research Results: quiz test
- Entrepreneurship
- Public Funding of Research Projects
- Intellectual property, patents, copyright and trademarks

|                                                  |          |               |         |          |                    |       |     |      |                   |
|--------------------------------------------------|----------|---------------|---------|----------|--------------------|-------|-----|------|-------------------|
| October                                          | November | December      | January | February | March              | April | May | June | July or September |
| C2. Optimization and Inference techniques for CV |          | C4. 3D Vision |         |          | C6. Video Analysis |       |     |      |                   |
| C8. Master Dissertation                          |          |               |         |          |                    |       |     |      |                   |

## C8. Master Dissertation

| Courses |                                              | ECTS | Univ.  |
|---------|----------------------------------------------|------|--------|
| C1      | Introduction to human and CV                 | 6    | UPC    |
| C2      | Optimization and Inference techniques for CV | 6    | UPF    |
| C3      | Machine Learning techniques for CV           | 6    | UAB    |
| C4      | 3D Vision                                    | 6    | UPF    |
| C5      | Visual Recognition                           | 9    | UAB-UB |
| C6      | Video Analysis                               | 9    | UPC-UB |
| C7      | Research Dissemination and Transfer          | 9    | UOC    |
| C8      | Master Dissertation                          | 9    | ALL    |

Total: 60

## C8. Master Dissertation

January-March, Project proposals are made available, they can be seen at:

- Academic: [https://mcv.uab.cat/show\\_academic\\_proposals/](https://mcv.uab.cat/show_academic_proposals/)
- Company: [https://mcv.uab.cat/show\\_company\\_proposals/](https://mcv.uab.cat/show_company_proposals/)

April, Selection period is open

Students should discuss with academic supervisors and companies and select a project.

End of April, Project assignment

Students take a decision

May-September (or July) - Master project development

Project carries 225 hours of work and should be completed between May and September.

Defence of the thesis (July or September)

Call 1: July 1st / Call2: September 1st

Step 1. Informing M9 coordinators about your intention of defending your MSc thesis

Step 2. Submitting your dissertation (pdf report)

Step 3. Oral presentation

## Evaluation

| Courses |                                              | ECTS | Univ.  |
|---------|----------------------------------------------|------|--------|
| C1      | Introduction to human and CV                 | 6    | UPC    |
| C2      | Optimization and Inference techniques for CV | 6    | UPF    |
| C3      | Machine Learning techniques for CV           | 6    | UAB    |
| C4      | 3D Vision                                    | 6    | UPF    |
| C5      | Visual Recognition                           | 9    | UAB-UB |
| C6      | Video Analysis                               | 9    | UPC-UB |
| C7      | Research Dissemination and Transfer          | 9    | UOC    |
| C8      | Master Dissertation                          | 9    | ALL    |

Total: 60

## Evaluation C1-C6

The final marks for modules M1-M6 are computed with a formula, such as:

$$\text{Final Mark} = 0,4 \times \text{Exam} + 0,55 \times \text{Project} + 0,05 \times \text{Attendance}$$

**Exam:** is the mark obtained in the Module Exam (must be equal or greater than 3)

**Attendance:** is the mark derived from the control of attendance at lectures  
(must be at least 70%)

**Project:** is the mark provided by the project coordinator based on the weekly control of the project through the project sessions and deliverables accordingly with specific criteria of the projects, such as:

- Participation in discussion sessions and in team work (intra-group evaluations)
- Mandatory and optional exercises
- Code development (style, comments, etc.)
- Report (justification of the decisions in your project development)
- Presentation (Talk and demonstrations on your project).

**Special Exercises** can allow you to get extra points or increase the Exam Mark, but only if Exam Mark is greater than 3.

# Evaluation

| Courses |                                              | ECTS | Univ.  |
|---------|----------------------------------------------|------|--------|
| C1      | Introduction to human and CV                 | 6    | UPC    |
| C2      | Optimization and Inference techniques for CV | 6    | UPF    |
| C3      | Machine Learning techniques for CV           | 6    | UAB    |
| C4      | 3D Vision                                    | 6    | UPF    |
| C5      | Visual Recognition                           | 9    | UAB-UB |
| C6      | Video Analysis                               | 9    | UPC-UB |
| C7      | Research Dissemination and Transfer          | 9    | UOC    |
| C8      | Master Dissertation                          | 9    | ALL    |
| Total:  |                                              | 60   |        |

## Evaluation C7

The final Mark in this course will be computed by the following weighted formula on the whole evaluation activities:

### Project Planification and Development (10%)

- Project Planning (3%)
- Data Analysis (3%)
- Ethics in Research: Debate (4%)

### Writing Scientific texts in Latex (30%)

- Introduction to Latex: edition of basic text
- Advanced Latex: Standard text edition
- Writing scientific texts: simplifying a scientific document
- Writing Scientific Texts: introduction to computer vision (C1)
- Writing of Scientific Texts: machine learning techniques for computer vision (C3 or C4)
- Literature review and composition of the state-of-the-art

### Oral presentation (30%)

- Oral Presentation: "Introduce yourself" (10%)
- Oral Presentation: "Machine learning for computer vision" (20%)

### Research management and dissemination (30%)

- Publishing Research Results: quiz test (2%)
- Entrepreneurship (20%)
- Public Funding of Research Projects (6%)
- Intellectual property, patents, copyright and trademarks (2%)

# Evaluation

| Courses |                                              | ECTS | Univ.  |
|---------|----------------------------------------------|------|--------|
| C1      | Introduction to human and CV                 | 6    | UPC    |
| C2      | Optimization and Inference techniques for CV | 6    | UPF    |
| C3      | Machine Learning techniques for CV           | 6    | UAB    |
| C4      | 3D Vision                                    | 6    | UPF    |
| C5      | Visual Recognition                           | 9    | UAB-UB |
| C6      | Video Analysis                               | 9    | UPC-UB |
| C7      | Research Dissemination and Transfer          | 9    | UOC    |
| C8      | Master Dissertation                          | 9    | ALL    |

Total: 60

## Evaluation C8

The final Mark of the dissertation is computed by the following weighted formula:

$$\text{Final Mark} = 0,25 \times \text{Supervisor Evaluation} + 0,75 \times \text{Committee Evaluation}$$

### Supervisor Evaluation Criteria:

- Technical Competences
- Attitude
- Innovation and Research capabilities

### Committee Evaluation Criteria:

- Written report
- Work carried out
- Oral presentation

## Plagiarism and irregularities:

Notwithstanding other disciplinary measures deemed appropriate, and in accordance with the academic regulations in force, **assessment activities will receive a zero whenever a student commits academic irregularities** that may alter such assessment.

Assessment activities graded in this way and by this procedure **will not be re-assessable**. If passing the assessment activity or activities in question is required to pass the subject, the awarding of a zero for disciplinary measures will also entail a direct fail for the subject, with no opportunity to re-assess this in the same academic year.

Irregularities contemplated in this procedure include, among others:

- the total or partial copying of a practical exercise, report, or any other evaluation activity,
- allowing others to copy,
- unauthorized and/or non-cited use of AI tools (*such as, Copilot, ChatGPT or equivalent*) to solve exercises or projects or any assessed activity,
- presenting teamwork that has not been entirely done by the members of the team,
- presenting any materials prepared by a third party as one's own work, even if these materials are translations or adaptations, including work that is not original or exclusively that of the student,
- having communication devices (*such as mobile phones, smart watches, etc.*) accessible during theoretical-practical assessment tests (individual exams).

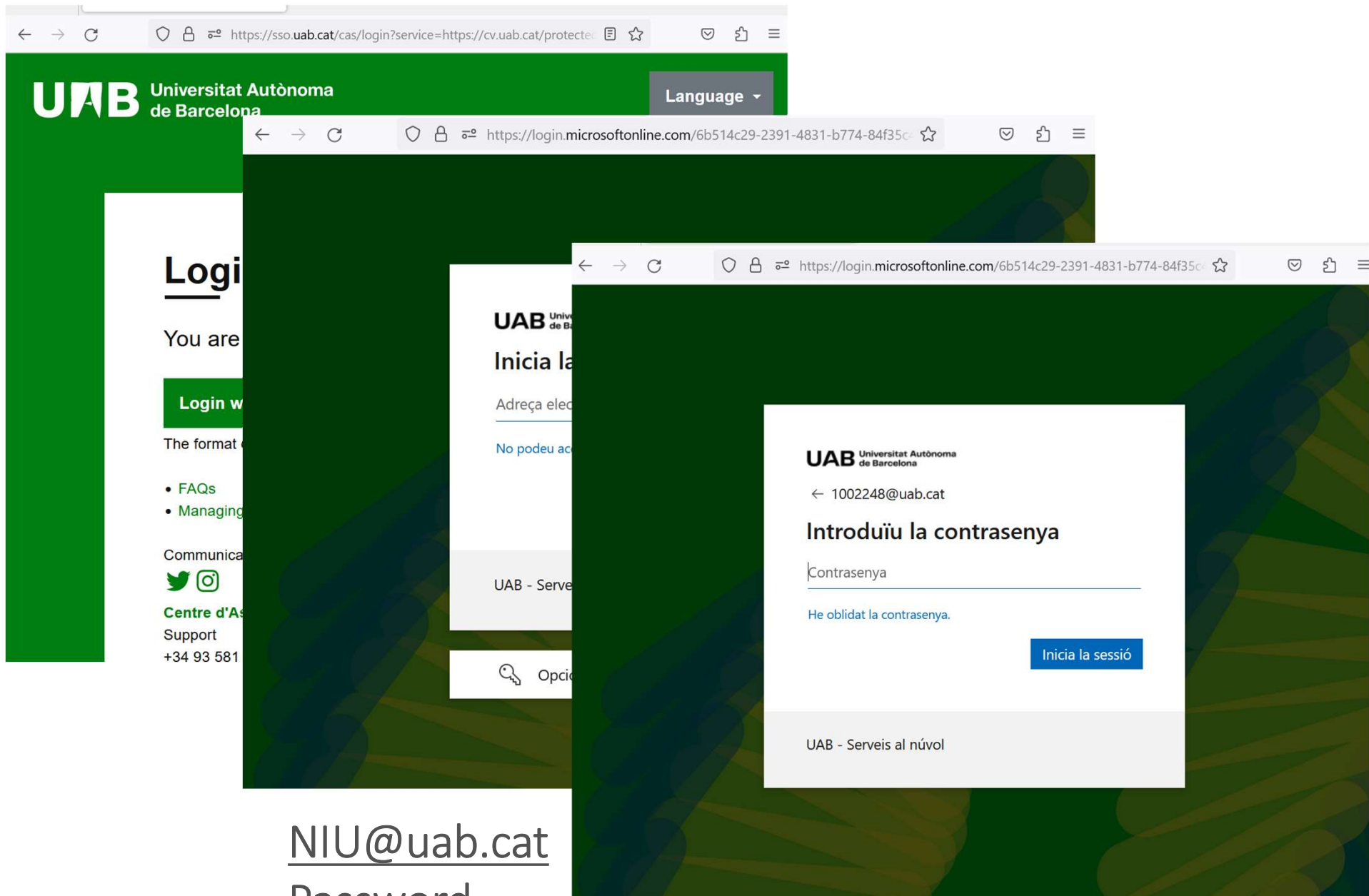
# Communication

## Courses

|    |                                              |
|----|----------------------------------------------|
| C1 | Introduction to human and CV                 |
| C2 | Optimization and Inference techniques for CV |
| C3 | Machine Learning techniques for CV           |
| C4 | 3D Vision                                    |
| C5 | Visual Recognition                           |
| C6 | Video Analysis                               |
| C7 | Research Dissemination and Transfer          |
| C8 | Master Dissertation                          |

Moodle rooms at  
UAB Virtual Campus at  
[cv.uab.cat](http://cv.uab.cat)

cv.uab.cat



NIU@uab.cat

Password

Verification code



Benvinguda al Campus Virtual



## Les teves assignatures

Preferències ⚙️



Missatgeria (Moodle)



No hi ha missatges nous

C1. Introduction to Human and Computer Vision [MO90232] (26-27)



C2. Optimisation techniques for Computer Vision [MO90233] (26-27)



## Actualitat

### Al Campus



Nova edició de la Fira virtual de màsters, postgraus i doctorats UAB

L'Institut de Neurociències

## Utilitats



Gestió d'aules Moodle



Ajuda tecnològica



El Campus Virtual en xifres



Aules amb autoinscripció

## Cursos



✕

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▾ **Contacts**

Coordinators and Lecturers

▾ **Lectures**

Calendar 2023

Virtual Room for Lectures Se...

Materials

▾ **Project**

Project Materials

QS Test 1 - W5 🔒

▾ **Evaluation**

Evaluation Criteria

## C1. Introduction to Human and Computer Vision [MO64870]

[Course](#)[Settings](#)[Participants](#)[Grades](#)[Reports](#)[More ▾](#)

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[Coordinators and Lecturers](#)

▾ **Lectures**



FILE

[Calendar 2023](#)

IMPORTANT

## About UAB e-mail address

You can access your account at: `correu.uab.cat`  
with the UAB NIU and password

Once logged in, you should

- At the top of the page, select Settings > View all Outlook settings.
- Select Mail > Forwarding.
- Select Enable forwarding, enter the forwarding email address

If you have technical problems with your account or

Campus Virtual you can contact to `cas@uab.cat`

# Communication

## Courses

|    |                                              |
|----|----------------------------------------------|
| C1 | Introduction to human and CV                 |
| C2 | Optimization and Inference techniques for CV |
| C3 | Machine Learning techniques for CV           |
| C4 | 3D Vision                                    |
| C5 | Visual Recognition                           |
| C6 | Video Analysis                               |
| C7 | Research Dissemination and Transfer          |
| C8 | Master Dissertation                          |

UOC Virtual Campus for C7  
[aula.uoc.edu](http://aula.uoc.edu)

# UOC Virtual Campus for C7

www.uoc.edu

You Will receive your login information from UOC at your contact e-mail given to UAB

The image shows a screenshot of the UOC Virtual Campus website. The top navigation bar includes links for UOC, UOC Corporate, UOC Alumni, and Join our team. The main header features the UOC logo, the text 'Universitat Oberta de Catalunya', and the slogan 'Learning. Transforming.'. Below this, a horizontal menu lists various sections: About us: a pioneering online university, Research and innovation, Open knowledge, Global impact #2030Agenda, Course offering, and Campus. The 'Campus' link is circled in red. A red arrow points from the 'Campus' link to the login page shown below. The login page has a header with the UOC logo and a language selector set to 'CA'. The main content area is titled 'Identifica't' and includes a link for 'Necessites ajuda?'. There are input fields for 'Usuari' (Username) and 'Contrasenya' (Password), followed by a link for 'Has oblidat la contrasenya?'. At the bottom of the login form are buttons for 'Entra' (Login) and 'Ves a uoc.edu'. A large banner on the left side of the login page reads 'Have a good year! Welcome to 2023/2024' and 'Don't miss these videos for techniques for studying!'. A large image of a woman's face is visible on the right side of the login page. At the bottom of the page, there is a footer with 'e 61', 'anglès (EUA)', and 'Accés'.

UOC Virtual Campus for C7

www.uoc.edu

You Will receive your login information from UOC at your contact e-mail given to UAB

They are different from the UAB NIU/password!!!

Important: C7 course starts on October 14th?

# Welcome session

1. aim of the master
2. about computer vision
3. about the master
4. about the partners
  - UAB-CVC
  - UOC
  - UPC
  - UPF
  - UB
5. about the students

**UAB / CVC**

Created in 1968

University campus with 263ha with all necessary services for living



## International Rankings



**170 (2)**



**201-300 (2)**



**178 (1)**



**44 (1)**



**(1)**

| Rank    | Scientific fields and subjects                                                                                                                                                                                                                                                                                                                                                                                      |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1-50    | Geography (34), Veterinary Sciences (5)                                                                                                                                                                                                                                                                                                                                                                             |
| 51-75   | Agricultural Sciences                                                                                                                                                                                                                                                                                                                                                                                               |
| 76-100  | Biotechnology, Ecology, Economics                                                                                                                                                                                                                                                                                                                                                                                   |
| 101-150 | Atmospherical Sciences, Instrumental Sciences and Technology, Mathematics, Materials Science, Nanoscience and Nanotechnology, Oceanography, Physics, Biological Sciences, Chemistry, Energy Science and Engineering, Environment Science and Engineering, Hospitality and Tourism Management, Human Biological Sciences, Medical Technology, Nursing, Pharmacy, Political Science, Public Administration, Sociology |
| 151-200 |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 201-300 | Biomedical Engineering, Clinical Medicine, Earth Sciences, Education, Food Science and Technology, Psychology, Telecommunications Engineering                                                                                                                                                                                                                                                                       |

# Degrees

## 112 Bachelor's degrees

## 140 Official Master's degrees

## 129 Master's Degrees

## 293 Lifelong learning programmes

## 56 MOOC offered at Coursera

221,562 MOOC students

**89%** Bachelor's degree performance rate

**93%** Employment rate

# Students

**27,203** Undergraduate students (25,537 full-time)

**2,987** Official Master's students

**2,046** UAB master's degree students

**3,789** Lifelong learning programmes students

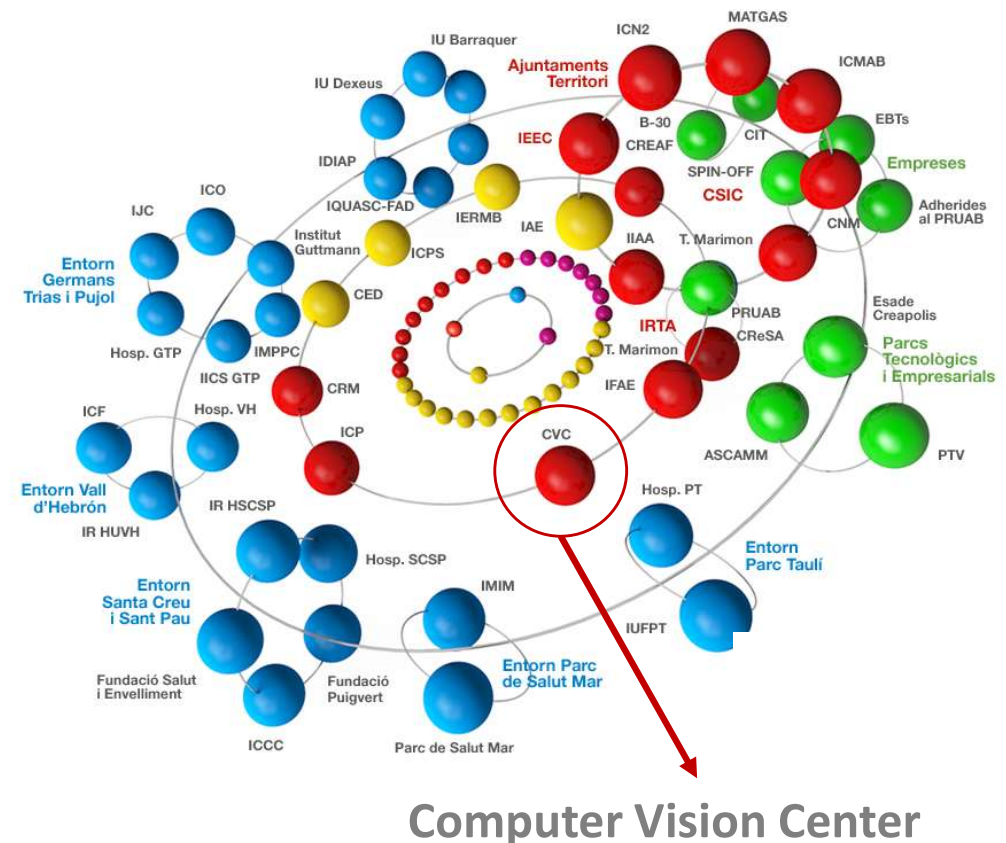
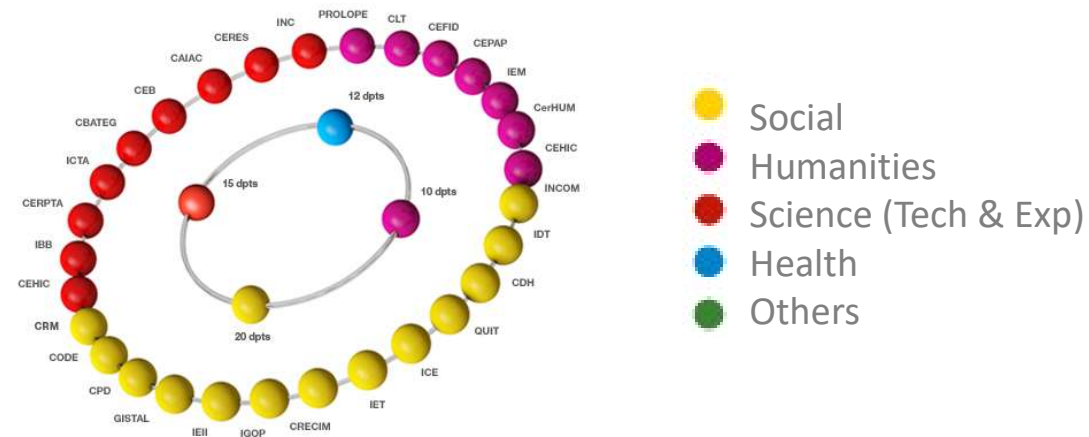
## Staff

## 57 Departments

**15 Centers**  **Engineering School**

**4,020** Teaching and Research Staff

## Research



# Computer Vision Center, since 1995



**27**  
YEARS



**+130**  
STAFF



**2,8 M**  
€/YEAR INCOME



**+50**  
PUBLICATIONS/YEAR



**+50**  
ONGOING PHD THESIS



**Generalitat  
de Catalunya**



**Universitat Autònoma  
de Barcelona**



**TECH  
TRANSFER**

**40** active projects with a total budget of 2.342.200 €

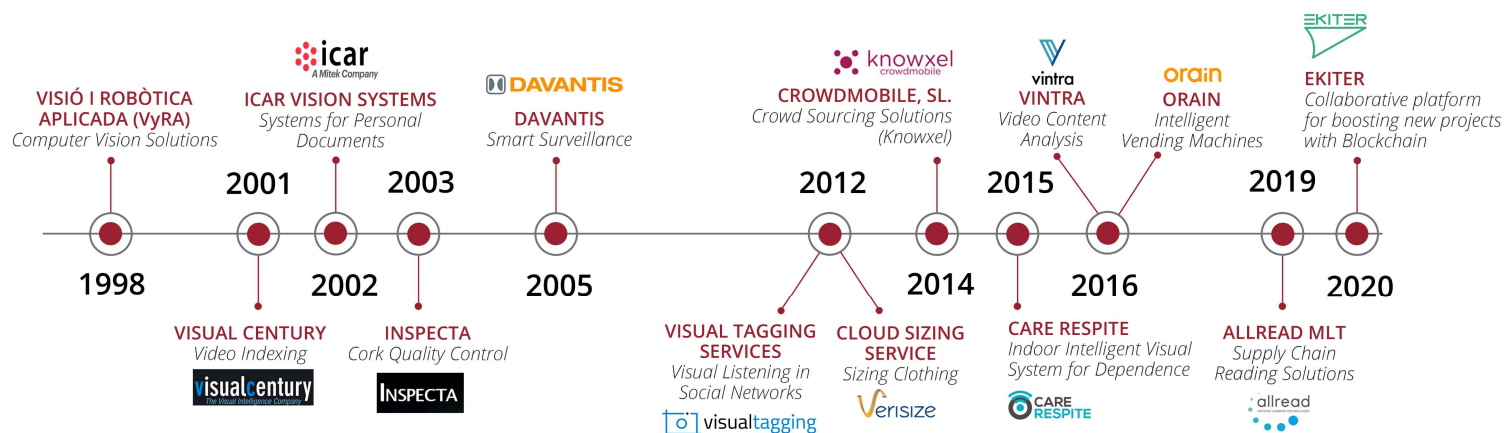
**18** new projects with a total budget of 1.188.372 €

**2** Transferred Licenses

**+150** companies among our customers and contacts



## CVC SPIN-OFFS



# Research Lines



## Health and well-being

Computer assisted diagnosis, intervention and planning;  
Augmented modelling;  
Well-being and ambient assisted living.



## Mobility and transport

Advanced driving systems and autonomous driving;  
Virtual worlds for ADAS;  
Unmanned Aerial Vehicles.



## Culture & Experience-based technologies

Cultural heritage (AR/VR)  
Reading Systems – Document analysis  
Surveillance



## Industry 4.0

Quality control  
AR/VR technologies for industry 4.0  
Robotic Vision

**UOC**

# The world's first online university

## The UOC was founded in 1995!

The idea behind founding the UOC back in 1995 was not to create a distance university, but to take advantage of the incipient World Wide Web to create the first-ever *distanceless* university

The UOC has students in 141 countries



> 51,400  
in Catalonia



> 28,500  
in Spain  
(excluding Catalonia)



> 6,600  
in the rest of the  
world

Student data for 2020/2021. These figures do not include UOC Corporate students.

They come from **many** places and social backgrounds.

They are between **25** and **40 years old**, and more than **57%** are women.

They study, **work** and have **family obligations**.

They have previous training and **professional experience**: almost **67%** **work** in the private sector and **61%** are studying to **increase their knowledge**.

They have **little time** and **balance their studies with their work**.



**1,944**

students have a certified  
disability of 33% or more

**95,000**  
graduates

**6,500**  
course instructors  
and tutors

**15,500**  
virtual  
classrooms

**87,500**  
students

**800**  
programmes taught

**Times Higher Education  
World University Rankings**

Global  
**Top 175**  
among young universities

Ibero-America  
**1st**  
online university

Spain  
**4th**  
university created less than 50 years ago



Social  
sciences



Arts and  
humanities



Information and  
knowledge  
society



Health  
sciences



Information and  
communication  
technologies



E-learning



**2025: 30 years later we  
launched the first  
European cluster of  
remote universities:**

**OpenEU**

The Open  
European  
University

# At UOC we do also research!

## Welcome to **UOC Labs** @ Poble Nou



# AIWELL Group – Artificial Intelligence for Human Well-being

<https://aiwell.uoc.edu>

## Our mission

*Advancing AI research and creating  
trustworthy AI technologies to promote  
and improve the human well-being*

**Computer  
Vision**

**Natural  
Language  
Processing**

**Explainable  
Artificial  
Intelligence**

**Fairness in  
Artificial  
Intelligence**

## Full professors, professors & lecturers:



Agata  
Lapedriza



Carles  
Ventura



David  
Masip



David  
Merino



Ismael  
Benito



Agnès  
Pérez



Joan M.  
Nunez



Carlos  
González

**PhD Candidates:** Marcelo Teran, Mujeeb Ur, Rubén González, Josep López, Elena Ortega, Josep Cabacas, Lisa Hornung, Jordi Morales, Sandra Benito, Alex Esteban, Odreman Ferrer, Miguel Fernández,

**Assistants and Students:** Edgar Sanchez, Sofia Gassó, Jose Luis Peña, Saida Li Sillo, Pol Ferrer, Pablo Mallada, Omar Romera.

**UPC**

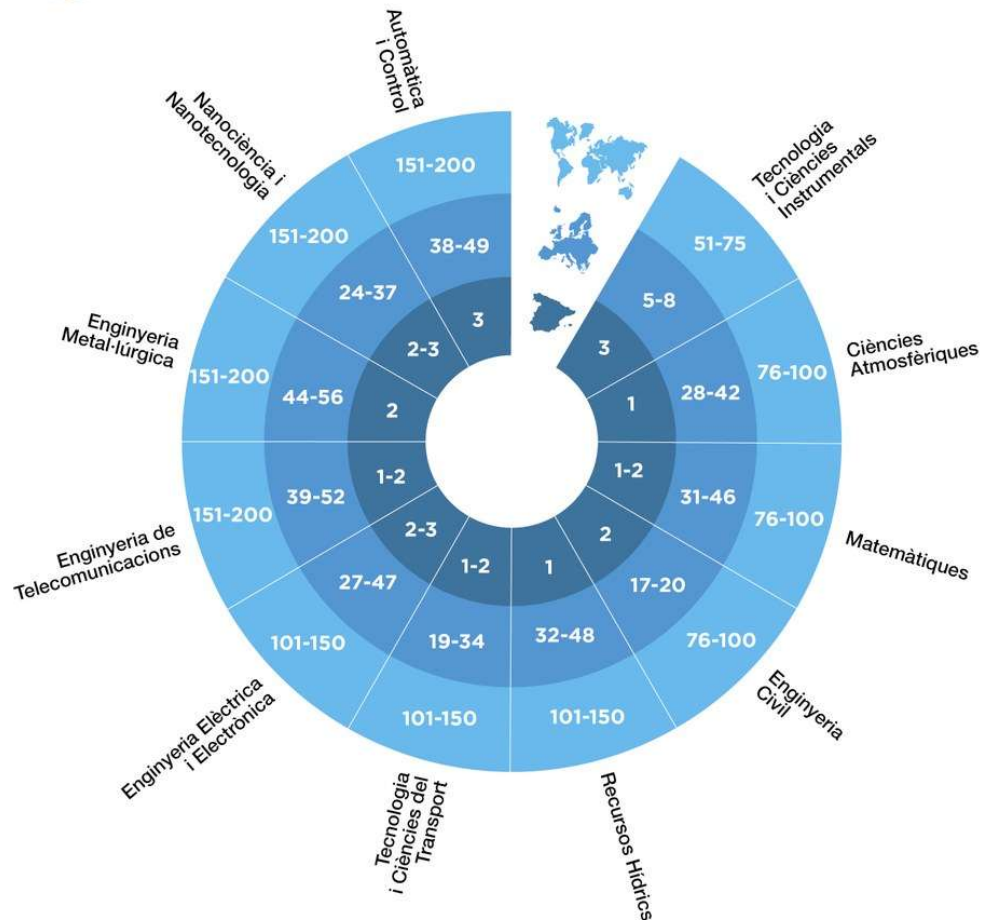


# Universitat Politècnica de Catalunya BarcelonaTech

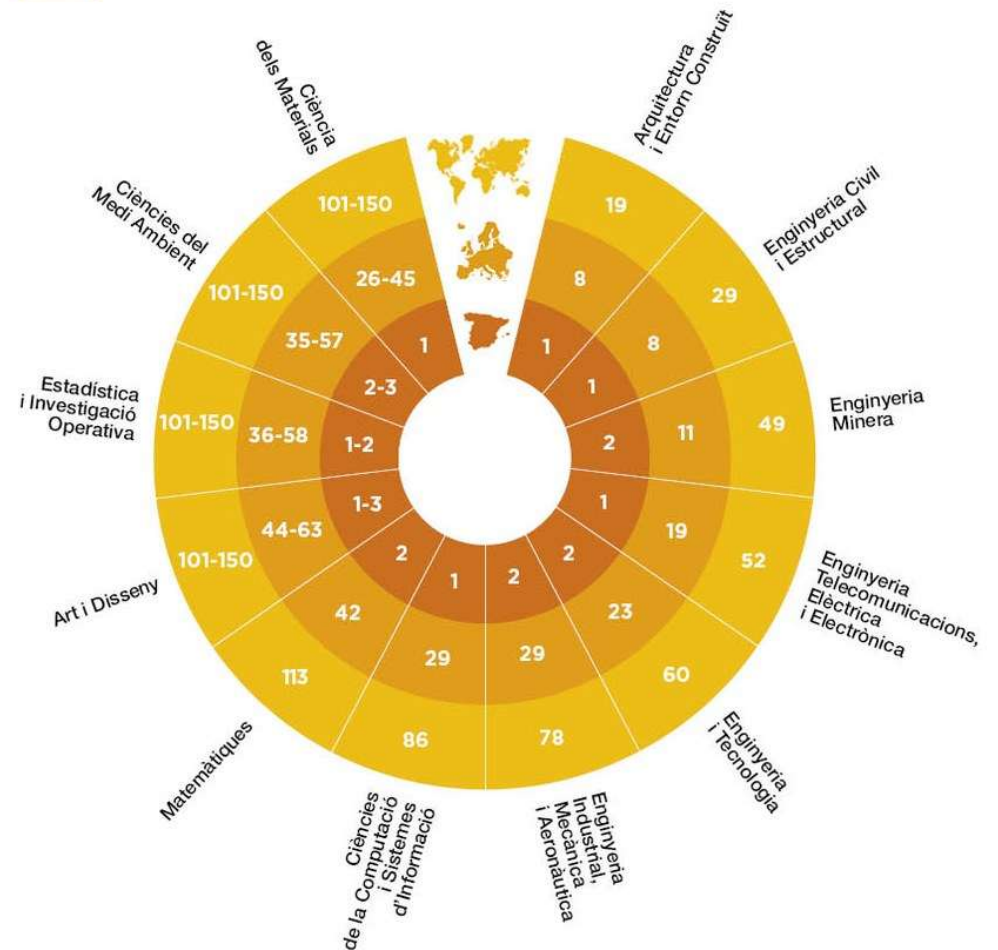
La **UPC** és una institució **pública** de **recerca** i d'**educació superior** en els àmbits de l'**enginyeria**, l'**arquitectura**, les **ciències** i la **tecnologia**, i és una de les universitats politècniques líders d'Europa.



Shanghai Global Ranking  
of Academic Subjects, 2022

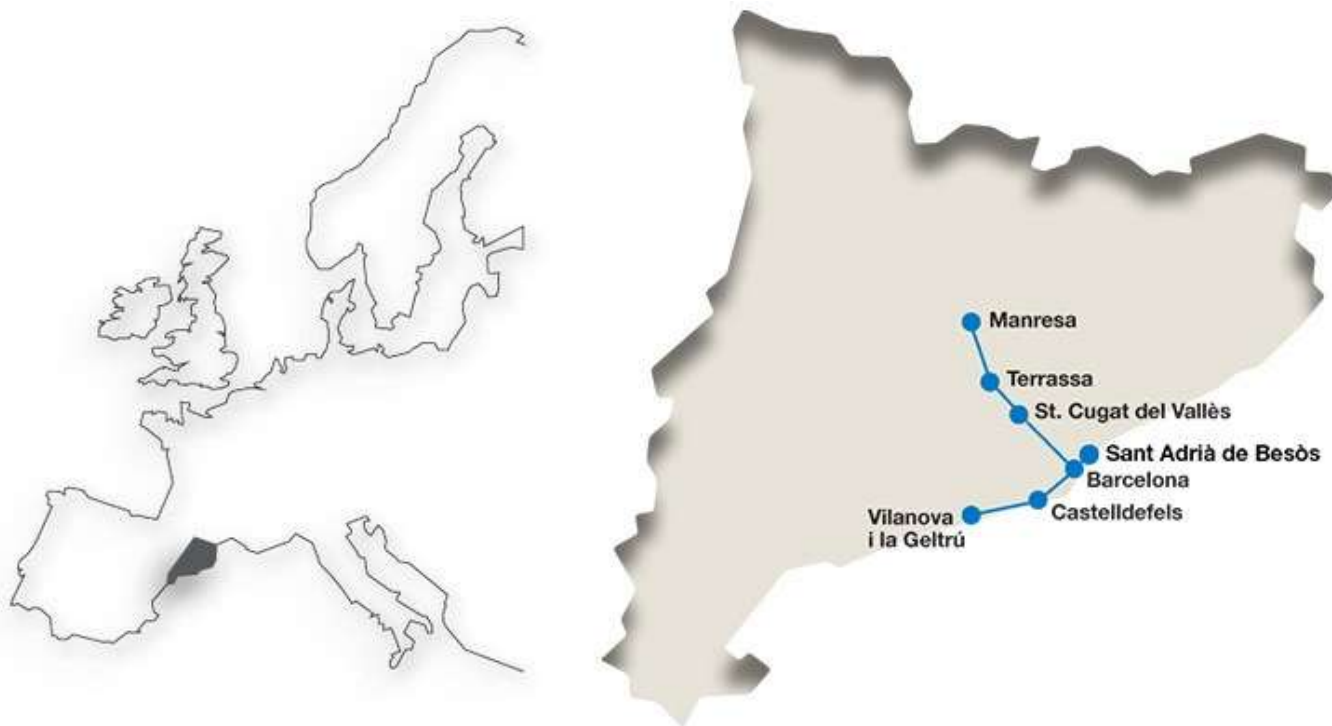


QS World University Rankings  
by Subject, 2022





# Universitat Politècnica de Catalunya BarcelonaTech



La UPC és una universitat amb una extensa implantació en el territori, amb **9 campus** distribuïts en **7 ciutats de Catalunya**: Barcelona, Castelldefels, Manresa, Sant Adrià de Besòs, Sant Cugat del Vallès, Terrassa i Vilanova i la Geltrú.

29.812

estudiants

3.523

PDI

2.074

PAS

65

graus

84

màsters

45

programes de doctorat

18

centres docents

275

programes de formació permanent

19

patents el darrer any

317 M

pressupost 2022

72,7 M

ingressos per R+D+I (2021)

70.151

Alumni

# GPI – Image Processing Group

## Signal Theory and Communications Department



### GPI – Image Processing Group

Signal theory and communications Department

- 10 faculty members
- 25 PhD and master students
- <https://imatge.upc.edu>
- Consolidated Research Group since 1999
- GPI is part of IDEAI



### IDEAI - Intelligent Data Science and Artificial Intelligence

- UPC Research Center
- 60 researchers / 150 Phd and Master students
- <https://ideai.upc.edu>

### GPI Experience:

- >30 years in image processing and computer vision
- Pioneered adoption of Deep Learning (DL) since 2015
  - Introduced DL in master and bachelor programs
- Long experience in European and national projects

### GPI Current research lines:

- Medical imaging applications (neuroimaging, histopathology, dermoscopic,...)
- CV solutions for micro mobility vehicles
- CV for agri-food industry
- Image processing for plasma facing components protection
- Remote sensing applications (super-resolution, semantic segmentation,...)
- Human computer interfaces
- Audio-visual production, archives, search and retrieval

**UPF**

# UPF An urban **public** university in the heart of Barcelona



## **Ciutadella campus:**

Social Sciences and Humanities

(+Inf. Tech.:  
*Centre for Brain  
& Cognition - CBC*)



## **Mar campus:**

Health and Life Sciences



## **Poblenou campus:**

Communication, Translation and  
**Engineering**

## UPF in the rankings



**1st. Spanish, 69th. European**  
**156th. Worldwide** (2022)  
**15th. Worldwide Young University** (<50Y)



**1st. Spanish** in **Engineering** studies  
**82nd. European** in **Engineering** studies  
**240th. Worldwide** in **Engineering** studies



**5th. Worldwide** in sector of gender & equality



**4th. European**



**1st. Of two Spanish ICT Department** granted  
with research excellence seal **Maria de Maeztu**  
by the Spanish Ministry



**3rd. Spanish university** in terms of absolute  
H2020 funding [source: Horizon dashboard]  
**21** cumulative ERC grants @DTIC up to date



# School of Engineering

## Department of Engineering

*(previously, of Information and Communication Technologies DTIC)*



**1.020**  
Under-  
graduate  
students

**138**  
Master  
students

**180**  
PhD  
students

**46**  
Faculty  
members

**86**  
Tenure Track /  
PostDocs

**95 + 68**  
Research  
Support +  
part-time  
teaching

**Total**  
**1.630**  
Community  
members

**46** Faculty members: **16** Full Professors  
+ **20** Associate Professors  
+ **10** ICREA Research Professors  
(Catalan Institution for Research and Advanced Studies)

# 23 Research Groups: 5 Research Areas

- Image Processing
- Computer Vision
- Sound & Music computing
- 3D Graphics, AR
- HCI, Educational Technologies

- Foundations of Computer Science
- Artificial intelligence (planning, natural language processing, CV, ML, robotics...)
- Ubiquitous computing
- Web science & social computing

- Computational Neuroscience
- Speech acquisition & perception; Language cognition
- Theoretical & Cognitive neuroscience
- Multisensory;
- Infant Reasoning, Cognition

Multimedia Technologies  
(4 groups)

Computation & Intelligent Systems  
(5 groups)

Brain & Cognition  
(5 groups)

Networks & Communications  
(4 groups)

Computational Biology & Biomedical Systems  
(5 groups)

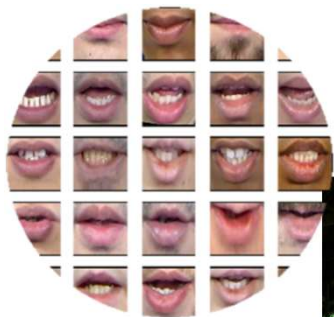
- Wireless Networks
- Information Theory and Coding
- Cybersecurity
- Network Technologies policy aspects and Strategies
- Internet of Things

- Medical Imaging & modelling of biomedical systems
- Analysis of biomedical data
- Instrumentation & biomedical electronics
- Computational simulation & biomechanics
- Nonlinear signal analysis in biological systems

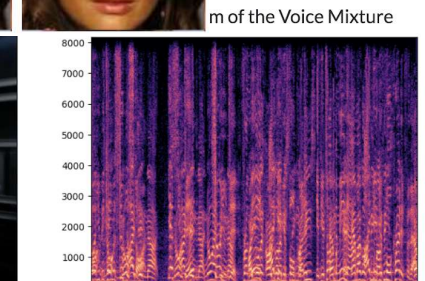
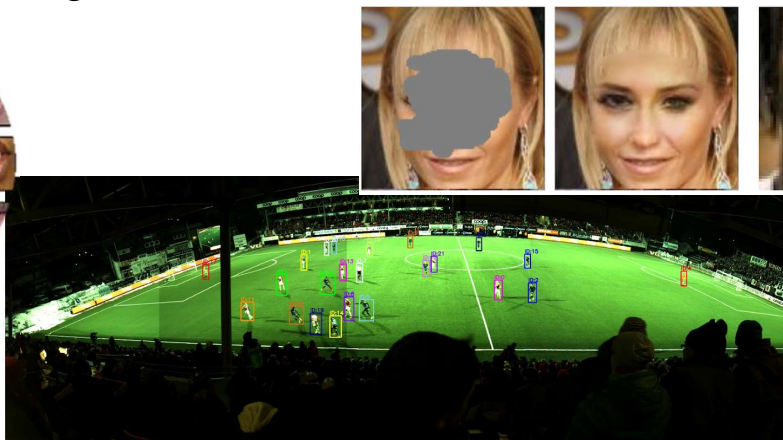
# Research at Intelligent Multimodal Vision Analysis (IMVA) group

PIs: Coloma Ballester, Gloria Haro, Federico Sukno

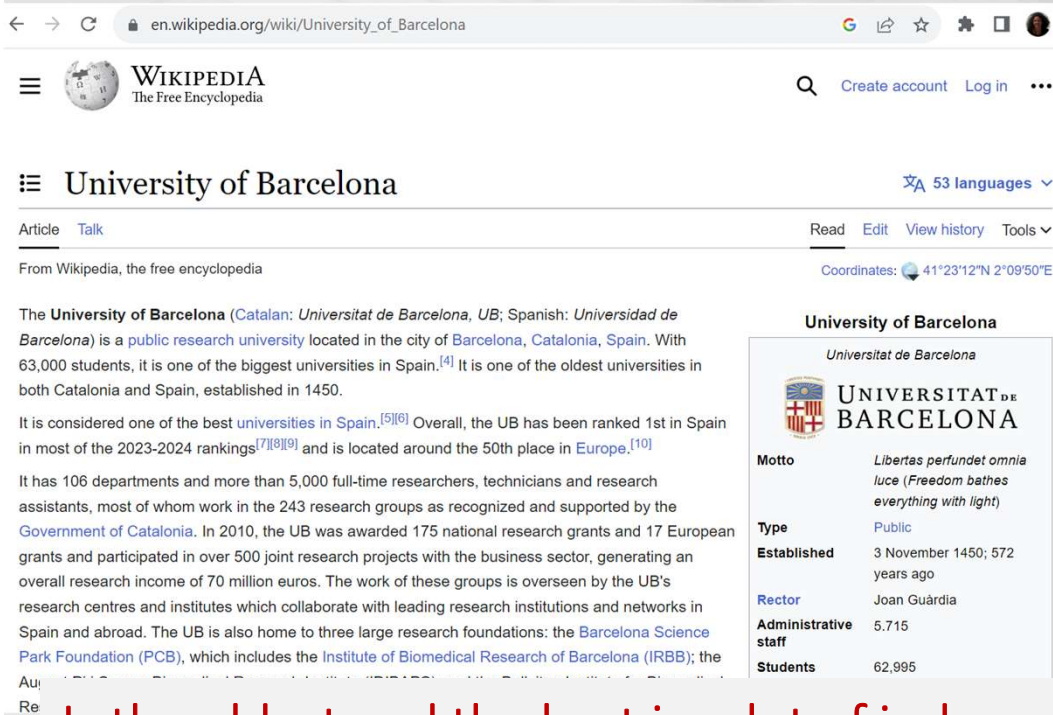
Our overall goal is to investigate the automatic analysis and understanding of visual content and to address real-world problems and applications, often involving also modalities beyond vision, such as audio, natural language, ultrasound or magnetic resonance. We develop model-based and data-driven (deep learning) approaches, algorithms and innovative digital technologies, together with their theoretical analysis. The applications include: accessibility of people with visual, hearing or reading impairment to multimedia content and may contribute to the development of more accessible devices; the analysis of the human face both in terms of its morphology and its dynamics (e.g. expressions and emotions) with enormous potential for disciplines such as psychology, linguistics, neuroscience, health or developmental biology; the separation of the different audio sources that make up the audio mixture of a particular video; the understanding and the exploitation of the correlations and complementations among different modalities; etc



Automatic  
Lip-Reading



**UB**



en.wikipedia.org/wiki/University\_of\_Barcelona

WIKIPEDIA  
The Free Encyclopedia

University of Barcelona

Article Talk

From Wikipedia, the free encyclopedia

The **University of Barcelona** (Catalan: *Universitat de Barcelona*, *UB*; Spanish: *Universidad de Barcelona*) is a **public research university** located in the city of **Barcelona**, **Catalonia**, **Spain**. With 63,000 students, it is one of the biggest universities in Spain.<sup>[4]</sup> It is one of the oldest universities in both Catalonia and Spain, established in 1450.

It is considered one of the best **universities in Spain**.<sup>[5][6]</sup> Overall, the UB has been ranked 1st in Spain in most of the 2023-2024 rankings<sup>[7][8][9]</sup> and is located around the 50th place in **Europe**.<sup>[10]</sup>

It has 106 departments and more than 5,000 full-time researchers, technicians and research assistants, most of whom work in the 243 research groups as recognized and supported by the **Government of Catalonia**. In 2010, the UB was awarded 175 national research grants and 17 European grants and participated in over 500 joint research projects with the business sector, generating an overall research income of 70 million euros. The work of these groups is overseen by the UB's research centres and institutes which collaborate with leading research institutions and networks in Spain and abroad. The UB is also home to three large research foundations: the **Barcelona Science Park Foundation (PCB)**, which includes the **Institute of Biomedical Research of Barcelona (IRBB)**; the **Au**;

Re

|                                                                                   |                                                                                     |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <b>University of Barcelona</b><br><i>Universitat de Barcelona</i>                 |                                                                                     |
|  | <b>UNIVERSITAT DE<br/>BARCELONA</b>                                                 |
| <b>Motto</b>                                                                      | <i>Libertas perfundet omnia<br/>lucē (Freedom bathes<br/>everything with light)</i> |
| <b>Type</b>                                                                       | <b>Public</b>                                                                       |
| <b>Established</b>                                                                | 3 November 1450; 572<br>years ago                                                   |
| <b>Rector</b>                                                                     | Joan Guàrdia                                                                        |
| <b>Administrative<br/>staff</b>                                                   | 5,715                                                                               |
| <b>Students</b>                                                                   | 62,995                                                                              |



Is the oldest and the best in a lot of indexes

1401 - General Study of Medicine and Arts

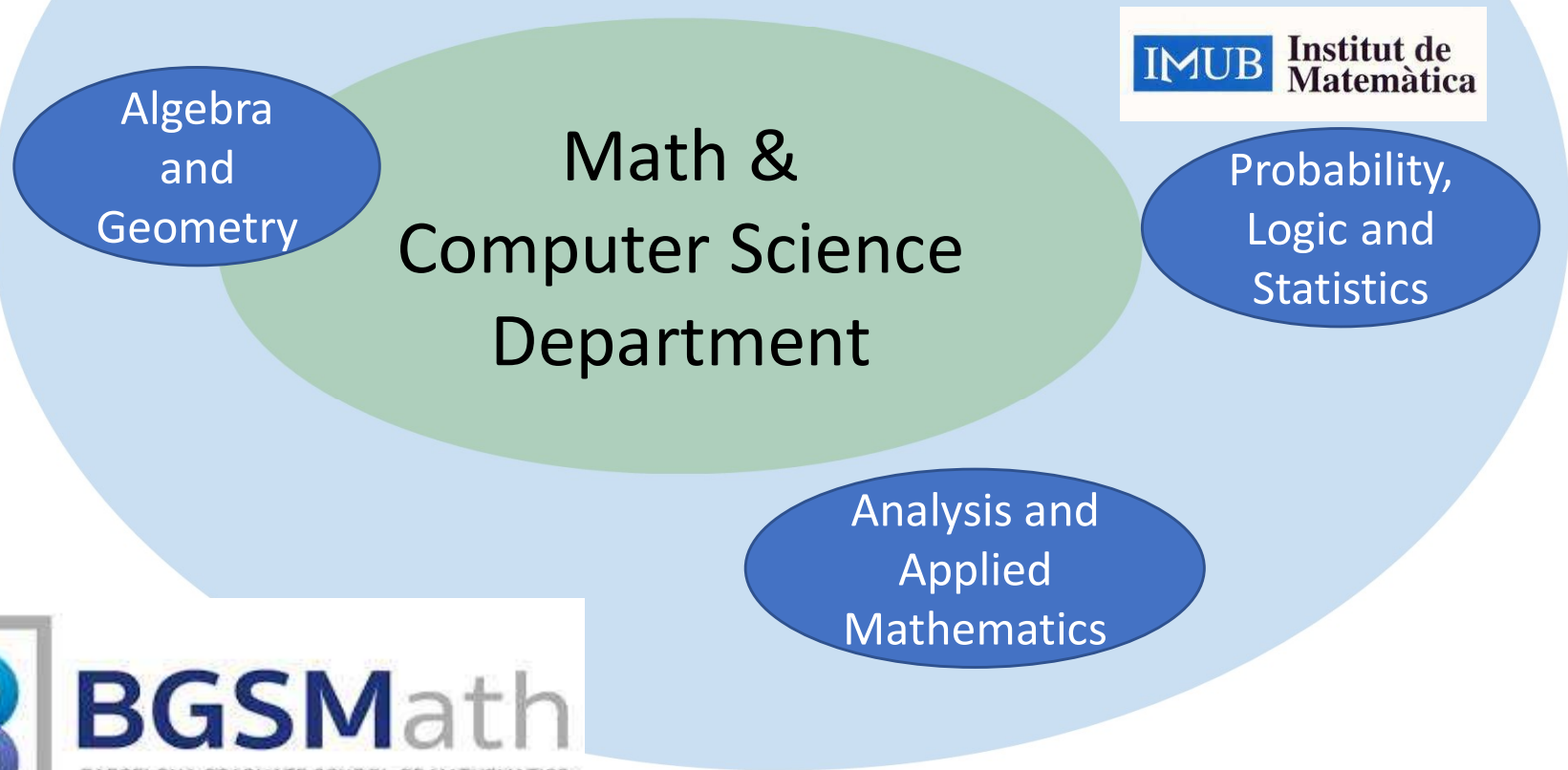
1450 - General Study of Barcelona

Suppressed in 1717, with the the lost of Catalan independence.

1842 – Created again as University of Barcelona

1863 – Building of the current venue, courses started in 1871.

[https://en.wikipedia.org/wiki/University\\_of\\_Barcelona](https://en.wikipedia.org/wiki/University_of_Barcelona)



**BGSMath**  
BARCELONA GRADUATE SCHOOL OF MATHEMATICS

**PhD  
Students**

**Tenure  
Lecturers**

Algebra, Geometry,  
Logic and Topology

**3 ICREA**

**71 Permanent  
Members**

**Post-Doctoral  
Fellows**

Analysis and Probability

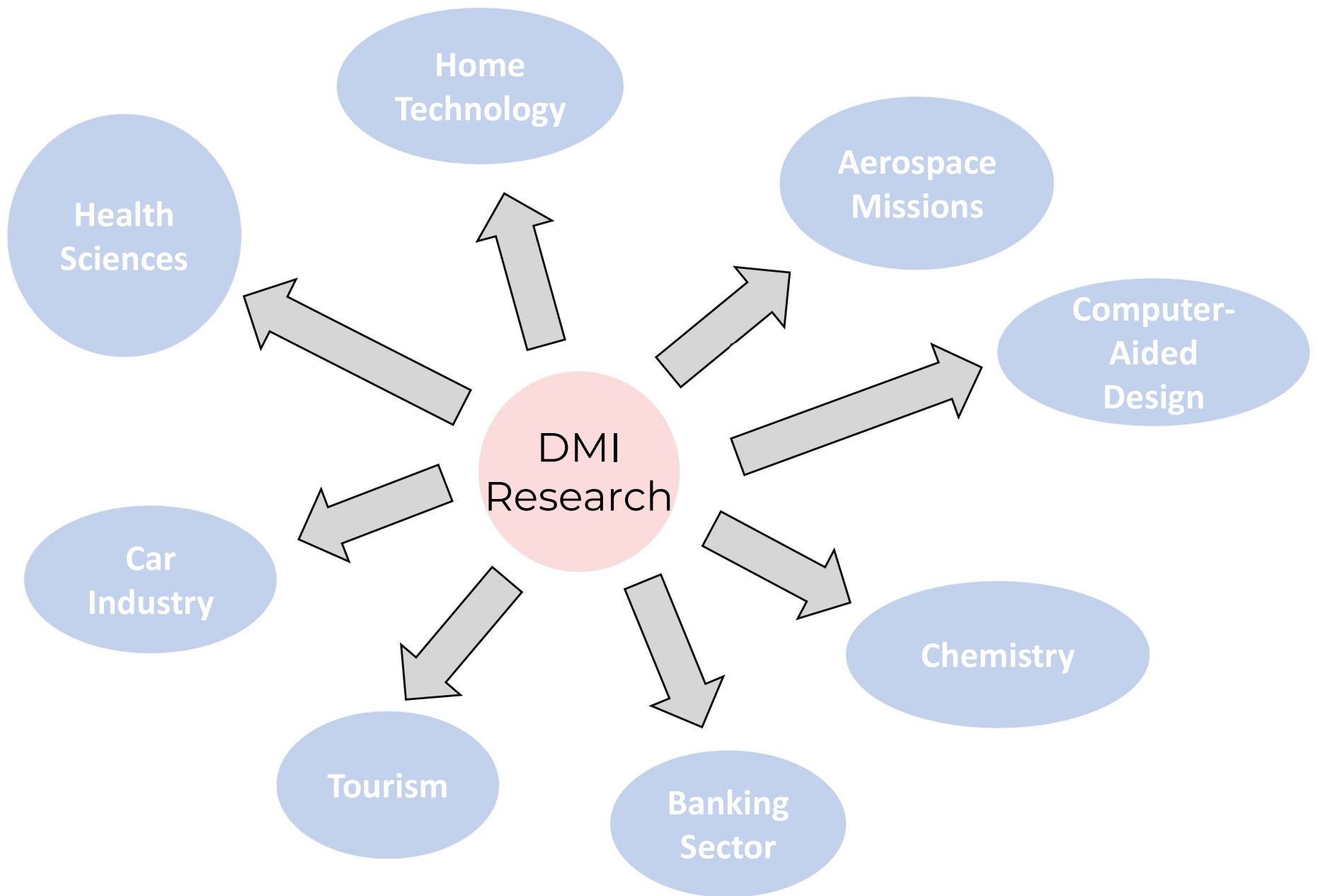
**Assistant  
Lecturers**

**Temporary  
Visitors**

Applied Mathematics  
(and Statistics)

**3 Office staff  
(1 Research staff)**

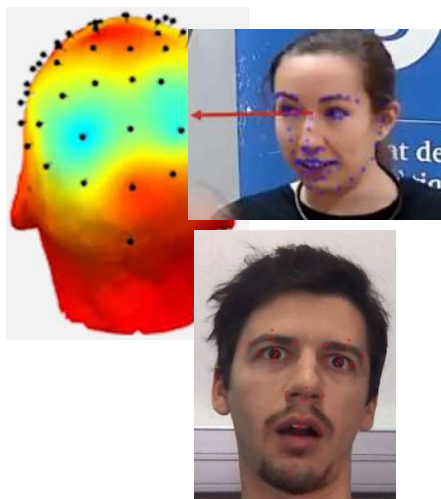
Computer Science



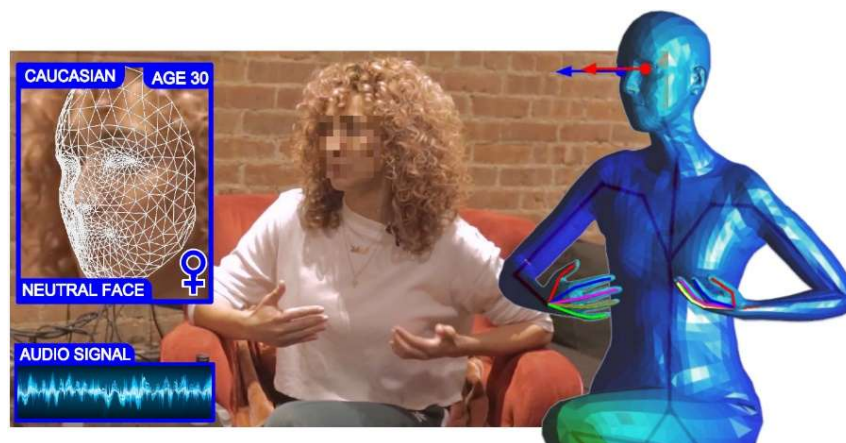
# Research lines

## Human Behavior Understanding

### FACE ANALYSIS



### VISUAL (AND MULTIMODAL) MODELING OF HUMANS



### 3D (& 4D) POSE, SHAPE, TEXTURE (IN 3D AND FROM 2D)

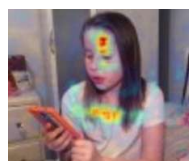


### BEHAVIOR ANALYSIS

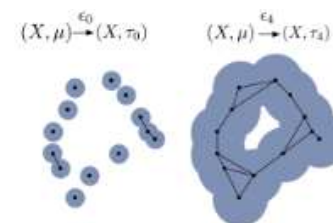


### UNDERSTANDING AND EXPLAINING HUMAN BEHAVIOR (Affective & Personality Computing)

- INTERPRETABILITY & EXPLAINABILITY
- FAIRNESS



### BIAS ANALYSIS VISUALIZATION



### INTERPRETING AND EXPLAINING LEARNING

## **Research lines:**

- Spatio-temporal and multi-modal deep Learning
- Domain Adaptation
- Bias and fairness
- Explainability and interpretability

## **Research fields**

- Computer Vision
- Machine Learning
- Social Signal Processing
- Affective Computing
- Personality Computing

## **Application domains:**

- eHealth and welfare
- Security
- Connected city / home
- Leisure

# Welcome session

1. aim of the master
2. about computer vision
3. about the master
4. about the partners
  - UAB-CVC
  - UOC
  - UPC
  - UPF
  - UB
5. about the students

# About the students

| Genre  | #  | %    |
|--------|----|------|
| Female | 10 | 30.3 |
| Male   | 23 | 69.7 |
| Others | 0  | 0    |

|      |    | Enrolment | #  |
|------|----|-----------|----|
| News | 33 | Full-time | 31 |
|      |    | Part-time | 2  |
| Old  | 7  | PT2       | 6  |
|      |    | Others    | 1  |

| Univerity of Graduation                                                  | %   |             |
|--------------------------------------------------------------------------|-----|-------------|
| International                                                            | 21% |             |
| UNIVERSITY OF SCIENCE AND TECHNOLOGY                                     | 7   | Egypt       |
| NATIONAL FORENSIC SCIENCES UNIVERSITY                                    |     | India       |
| BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE                                |     | India       |
| THE FEDERAL UNIVERSITY OF TECHNOLOGY AKURE                               |     | Nigeria     |
| NHTV INTERNATIONALE HOGESCHOOL BRED                                      |     | Netherlands |
| SABANCI UNIVERSITY                                                       |     | Turkey      |
| BEIHANG UNIVERSITY OR BEIJING UNIVERSITY OF AERONAUTICS AND ASTRONAUTICS |     | China       |
| Spain                                                                    | 3%  |             |
| Universidad del País Vasco                                               | 1   |             |
| SUC (Sistema Univ. Català)                                               | 76% |             |
| UAB                                                                      | 9   | 27%         |
| UB                                                                       | 1   | 3%          |
| UPC                                                                      | 13  | 39%         |
| UPF                                                                      | 2   | 6%          |

# About the students

We have a novelty with 55% of students from AI degrees

| Degree                         | #  | Universities  |       |                    |
|--------------------------------|----|---------------|-------|--------------------|
| AI Degree                      | 18 | 11 UPC        | 6 UAB | 1 Univ.Pbasc       |
| CS Engineering                 | 6  | 3 UAB         | 1 UB  | 1 India / 1 Turkey |
| Data Science Engineering       | 3  | 2 UPC         | 1 UPF |                    |
| Software Engineering           | 1  | 1 China       |       |                    |
| Data Science and AI            | 1  | 1 Netherlands |       |                    |
| Civil Engineering              | 1  | 1 Nigeria     |       |                    |
| Biomedical Engineering         | 1  | 1 UPF         |       |                    |
| Commun.and Inform. Engineering | 1  | 1 Egypt       |       |                    |
| Electrical Engineering         | 1  | 1 India       |       |                    |

Now, time for the students  
to introduce themselves

# Welcome session

1. aim of the master
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  - UOC
  - UPC
  - UPF
  - UB
5. about the students

Time to go to the garden (photo + drinks) ...