Deferred Restructuring of Experience in Autonomous Machines

H2020 FET Proactive
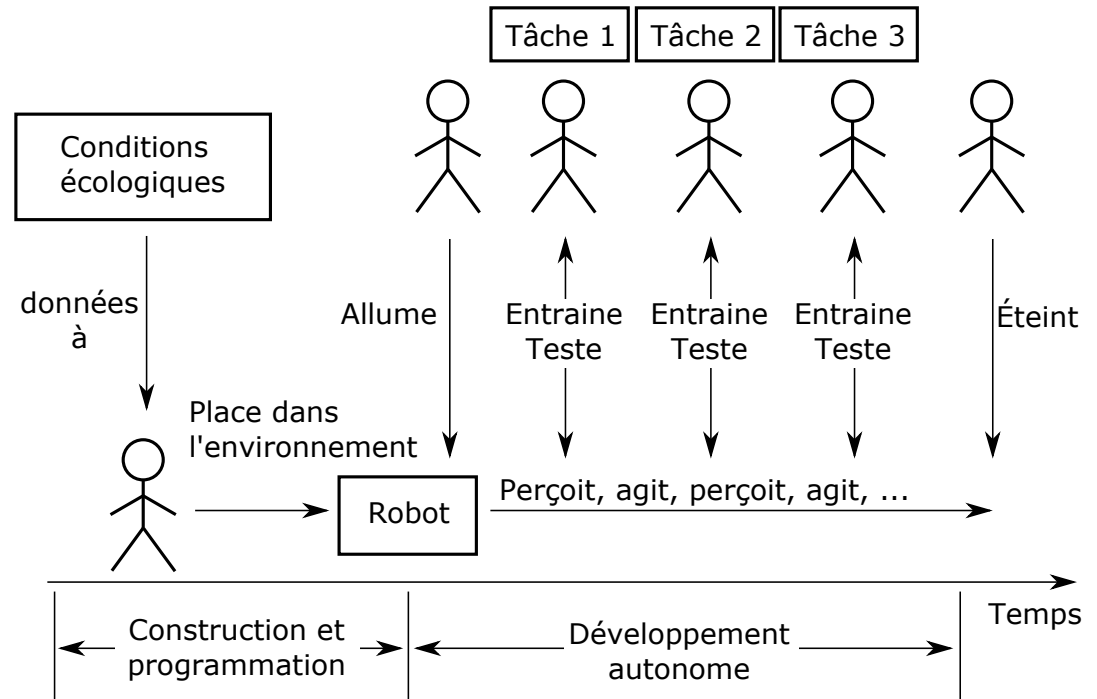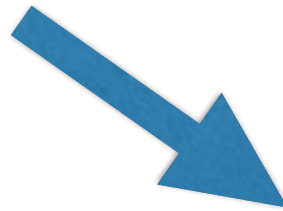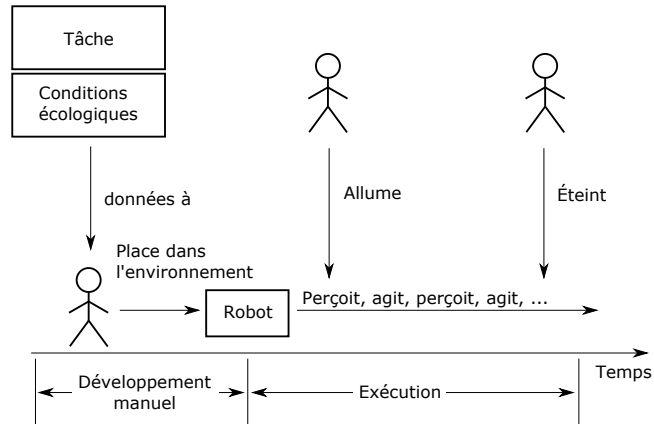
« **Knowing, doing, being** »

01/2015-12/2018

Coordinator: S. Doncieux, UPMC

Vers des robots adaptatifs

Weng, J. (2004). **Developmental robotics : Theory and experiments**.
International Journal of Humanoid Robotics, 1(2), 199–236.

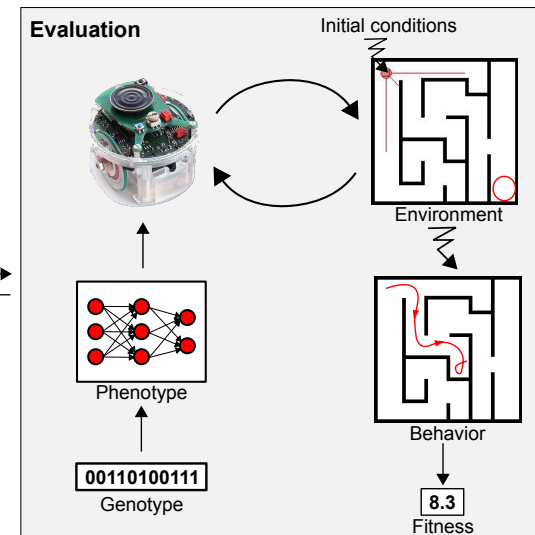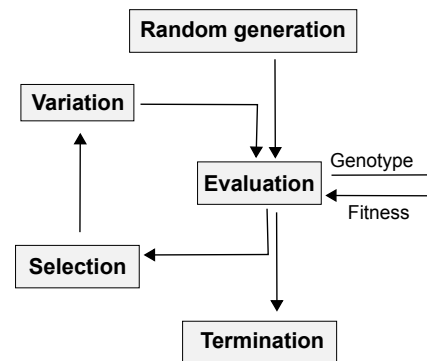# The robot needs to be *creative* !

Creativity of a behavior [Doncieux 2016]:

– Efficiency of the behavior

– **Originality w.r.t. knowledge available to the robot programmer**

Human creativity as the outcome of variation and selection system [Dietrich and Haider 2014]

DREAM approach: development relying on *Evolutionary Algorithms*

???

Evaluation

Initial conditions

Random generation

Variation

Evaluation — Genotype →

Fitness

Selection

Termination

Genotype

Environment

Phenotype

Behavior

00110100111
Genotype

8.3
Fitness

DREAM overview

Goal: enable robots to gain an **open-ended understanding** of the world **over long periods of time**
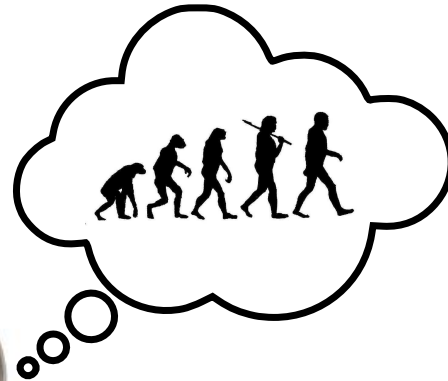
Main ideas:

- evolutionary approach to bootstrap cognition

- redescription of acquired knowledge

- alternation between

  – « daytime »: active interaction

  – « nighttime »:

    - analysis of past events

    - knowledge consolidation

    - simulation of new behaviors

- Inter-disciplinary approach: robotics and neuroscience

Some results

1. « Day 1» Discovering objects
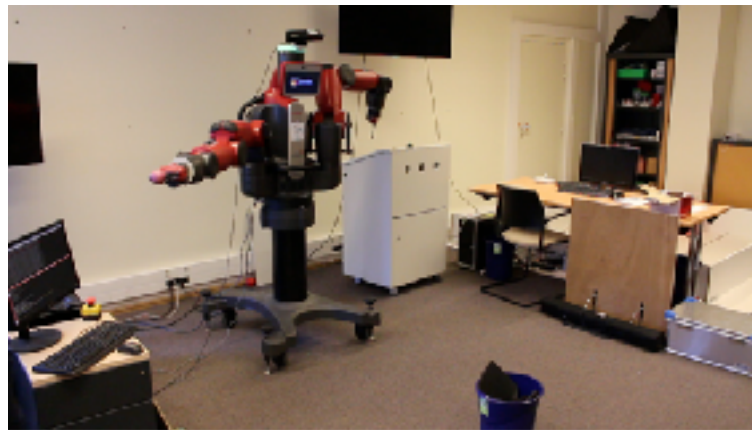

A gray scale map represents the segmentation.
The white areas represent the most probable part of the environment to be moveable

Probability to be part of a moveable object.
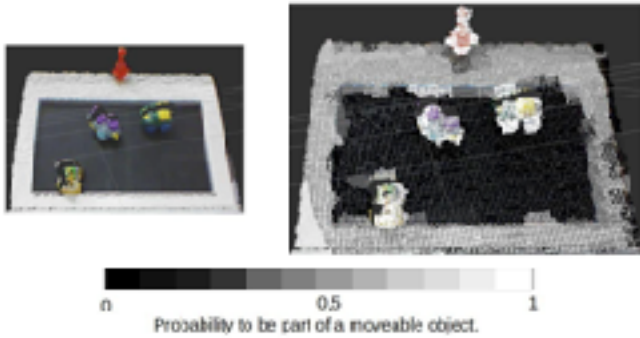
2. « Night 1 » Learning to deal with them

Babbling
(the first generation)

**3.** « Day 2 » Back to the real world

HORIZON 2020

Partners

- **Armines/ENSTA:** motor skills, vision, deep learning and sensorimotor representations

- **QMUL-> Edinburgh:** machine learning, deep learning, computational neuroscience

- **UDC:** cognitive architectures based on evolutionary algorithms

- **UPMC/CNRS:** evolutionary algorithms, embodied evolution, computational neuroscience, deep learning

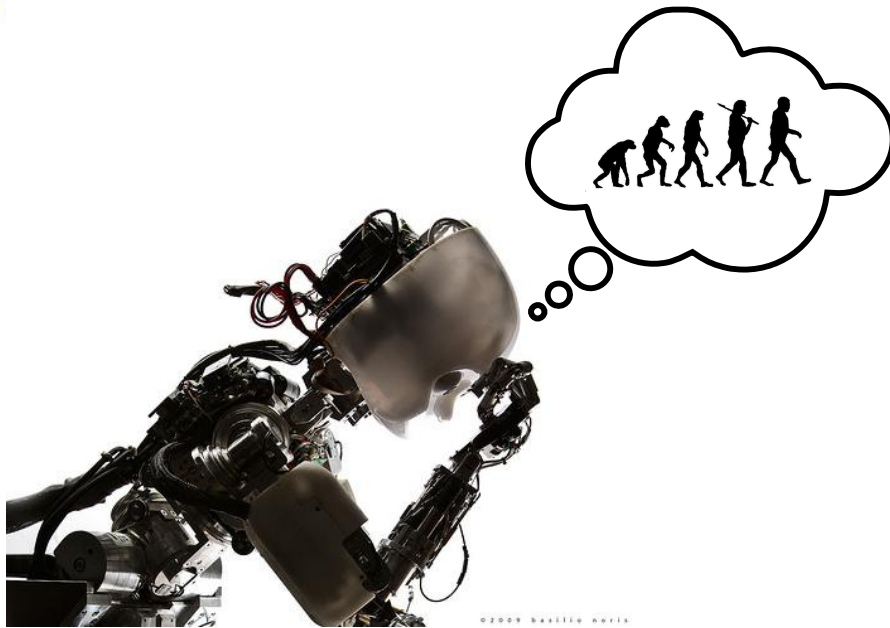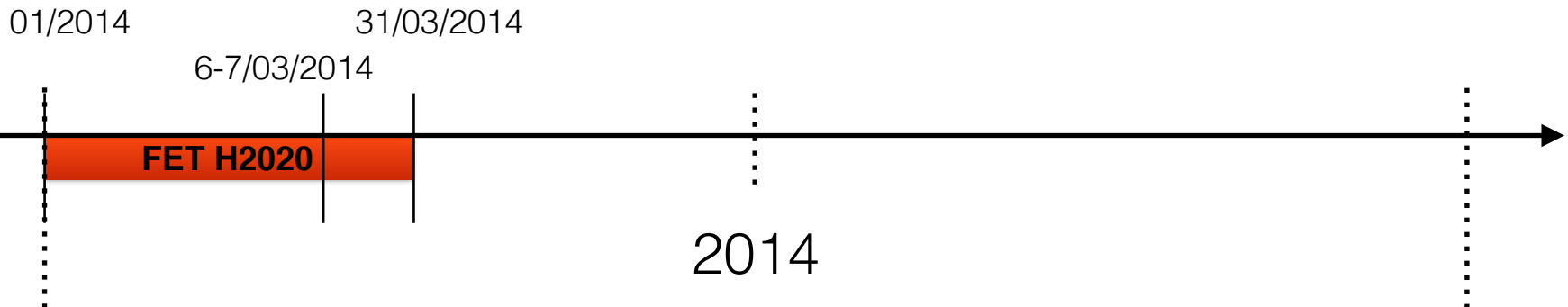- **VU Amsterdam:** social learning, embodied evolution

Before DREAM

- **11-12/2012**: Very first idea

- **03/2013**: Submission of a paper on the topic

- **09/2013**: Beginning of ANR project preparation (short description)

- **10/2013**: Submission of the ANR project

11/2012   03/2013   09/2013   10/2013

First ideas   **ANR**
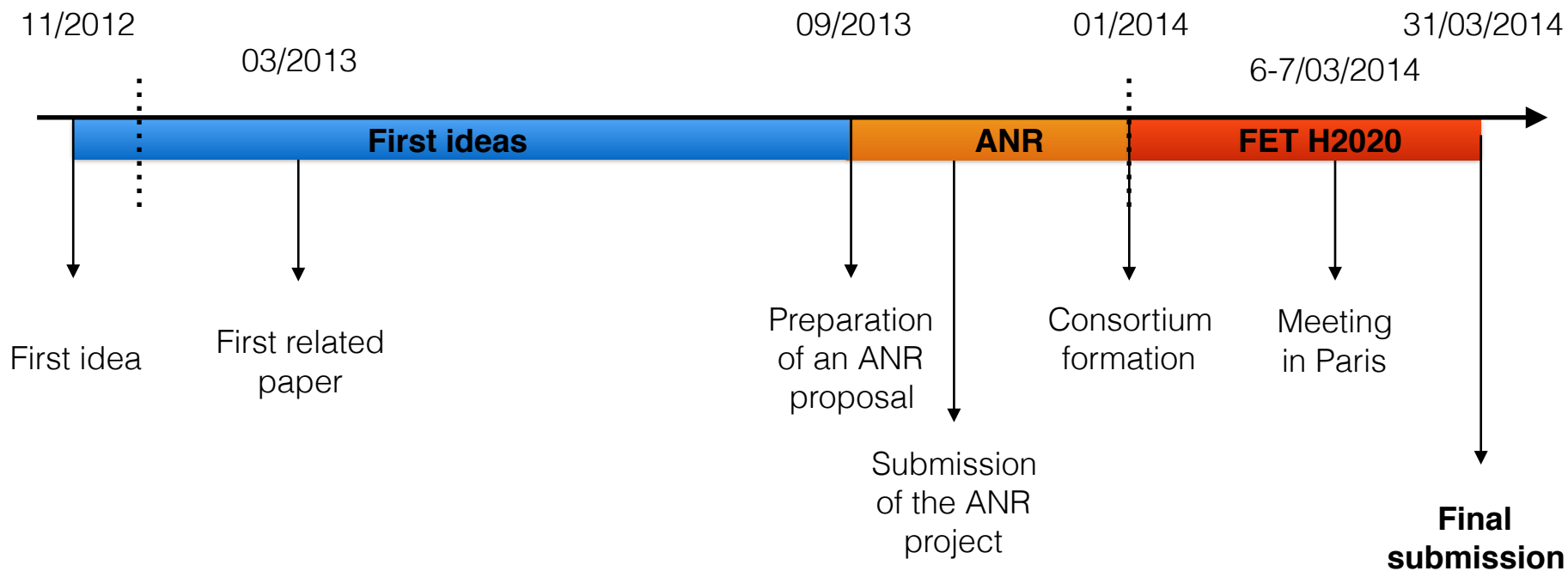
2013

HORIZON 2020
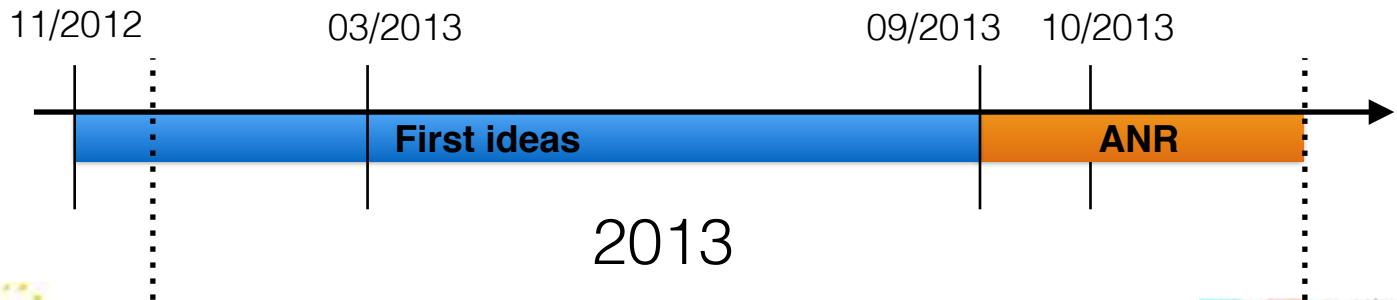
DREAM preparation

- **01/2014**: Consortium formation

- **6-7/03/2014**: Meeting in Paris

- **31/03/2014**: Submission

- Support from the UPMC European affairs office

01/2014   31/03/2014
        6-7/03/2014

FET H2020

2014

HORIZON 2020

DREAM preparation

11/2012

03/2013

09/2013

01/2014

31/03/2014

6-7/03/2014

First ideas | **ANR** | **FET H2020**

First idea

First related paper

Preparation of an ANR proposal

Submission of the ANR project

Consortium formation

Meeting in Paris

Final submission

Quelques recommandations

- **En amont:**
    - Se définir un cadre de réflexion et de travail inter-disciplinaire
    - Réfléchir à la vision à long terme et vérifier son alignement avec l'appel visé

- **Formation du consortium:**
    - Equilibrer entre partenaires de confiance et nouveaux partenaires
    - Viser la cohérence du consortium et sa solidité scientifique

- **Pendant le montage:**
    - Etre moteur
    - Se faire aider par des spécialistes europe
    - Prévoir du temps (et de l'énergie…)
    - Faire (au moins) une réunion dans un même lieu, en plus des visioconférences

- **Si cela passe, cela en vaut vraiment la peine…**

Merci pour votre attention !

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🌐 http://www.robotsthatdream.eu/

🐦 https://twitter.com/robotsthatdream