

Paths ahead in computational vision

Pietro Perona
California Institute of Technology

Paths Ahead in the Science of Information and Decision Systems
LIDS - 14 November, 2009







navigation

- [Main page](#)
- [Contents](#)
- [Featured content](#)
- [Current events](#)
- [Random article](#)

search

interaction

- [About Wikipedia](#)
- [Community portal](#)
- [Recent changes](#)
- [Contact Wikipedia](#)
- [Donate to Wikipedia](#)
- [Help](#)

toolbox

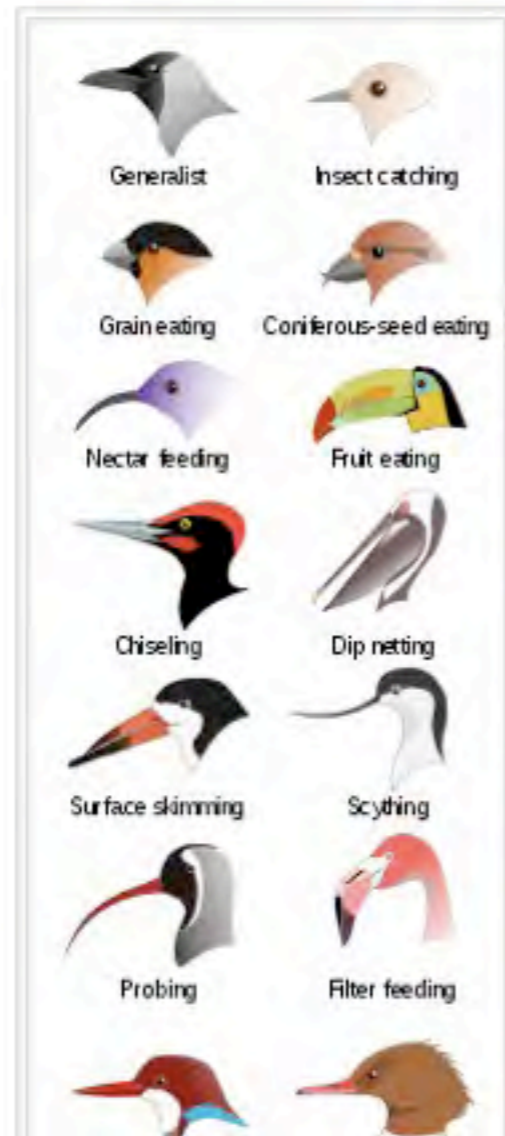
- [What links here](#)
- [Related changes](#)
- [Upload file](#)
- [Special pages](#)
- [Printable version](#)
- [Permanent link](#)
- [Cite this page](#)

Beak

From Wikipedia, the free encyclopedia

For other uses, see [Beak \(disambiguation\)](#).

The **beak**, **bill** or **rostrum** is an external anatomical structure of [birds](#) which, in addition to eating, is used for [grooming](#), manipulating objects, killing prey, probing for food, [courtship](#) and feeding their young. The term also refers to a similar mouthpart in some [cephalopods](#), [cetaceans](#), [pufferfishes](#), [turtles](#), [Anuran tadpoles](#) and [sirens](#).



Contents [\[hide\]](#)

- [1 Anatomy](#)
- [2 Billing](#)
- [3 Terminology](#)
- [4 See also](#)
- [5 References](#)
- [6 External links](#)

Anatomy [\[edit\]](#)

Beaks can vary significantly in size and shape from species to species. The beak is composed of an upper jaw called the [maxilla](#), and a lower jaw called the [mandible](#). The jaw is made



The bill of a scavenger—the [vulture](#).



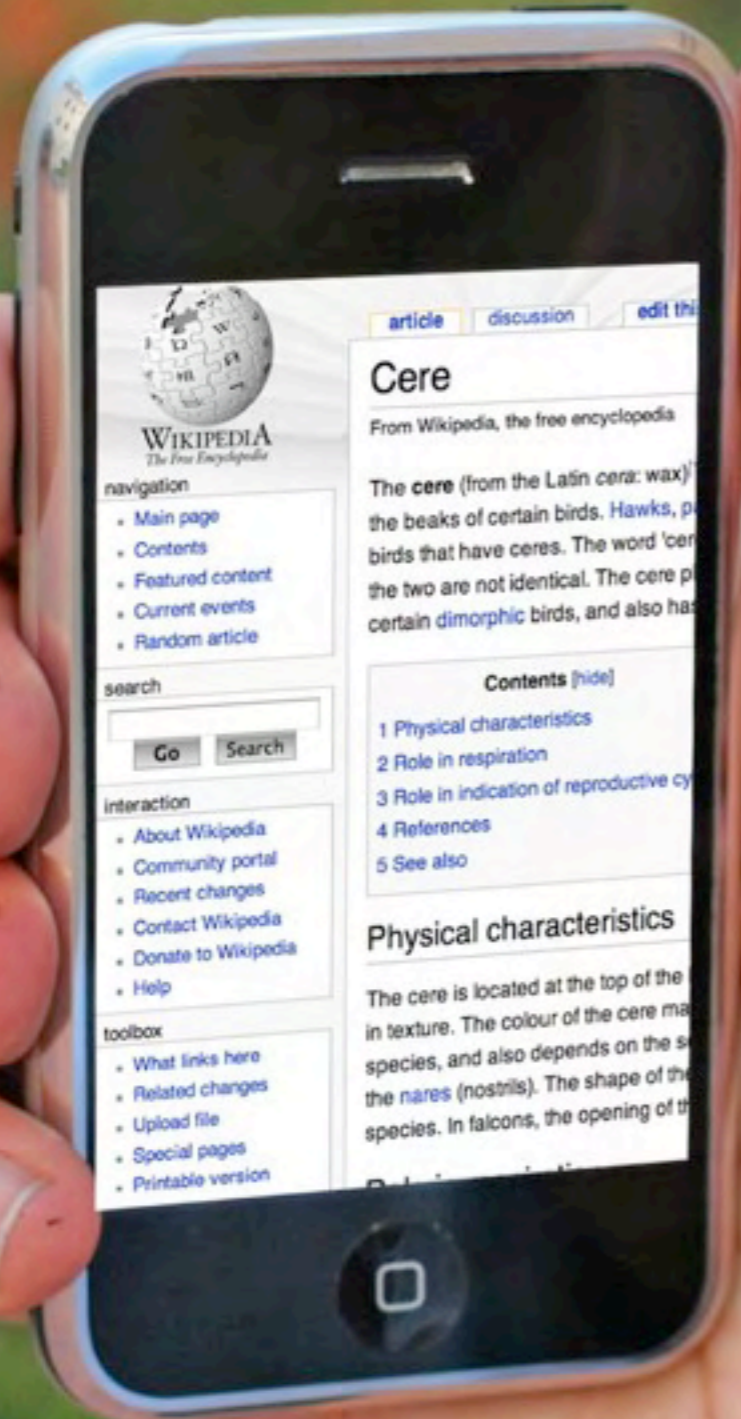
The bill and knob of a [domesticated Chinese goose](#), highly exaggerated by farm selection.







Saturday, November 14, 2009



from **John Stevenson** <solarjack@gmail.com>
to Pietro Perona <perona@vision.caltech.edu>
date Thu, Aug 6, 2009 at 7:50 AM
subject Mushrooms galore at Caumsett

Can I eat this one? - Love John

Sent from my iPhone





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[article](#)

[discussion](#)

[view source](#)

[history](#)

Mushroom

From Wikipedia, the free encyclopedia

For other uses, see [Mushroom \(disambiguation\)](#).

A **mushroom** is the fleshy, [spore-bearing fruiting body](#) of a [fungus](#), typically produced above ground on soil or on its food source. The standard for the name "mushroom" is the cultivated white button mushroom, *Agaricus bisporus*, hence the word mushroom is most often applied to those fungi ([Basidiomycota](#), [Agaricomycetes](#)) that have a stem (*stipe*), a cap (*pileus*), and gills (lamellae, sing. [lamella](#)) on the underside of the cap, just as do store-bought white mushrooms.

The word "mushroom" can also be used for a wide variety of gilled fungi, with or without stems, and the term is used even more generally, to describe both the fleshy fruiting bodies of some [Ascomycota](#) and the woody or leathery fruiting bodies of some [Basidiomycota](#)



The mushroom *Amanita muscaria*, commonly

navigation

- [Main page](#)
- [Contents](#)
- [Featured content](#)
- [Current events](#)
- [Random article](#)

search

[Go](#)

[Search](#)

interaction

- [About Wikipedia](#)
- [Community portal](#)
- [Recent changes](#)
- [Contact Wikipedia](#)
- [Donate to Wikipedia](#)
- [Help](#)

toolbox

- [What links here](#)

Amanita pantherina var. *pantherina*

From Wikipedia, the free encyclopedia

(Redirected from [Amanita pantherina](#))

Amanita pantherina var. ***pantherina***, also known as the "*European Panther*" and "*False Blusher*" due to its similarity to the true Blusher (*Amanita rubescens*), is a species of [Europe](#) and western Asia. Material described as *A. pantherina* in the [Americas](#) seems to belong to a number of distinct taxa only some of which have been described.

Contents [\[hide\]](#)

- [1 Description](#)
- [2 Habitat and distribution](#)
- [3 Biochemistry](#)
- [4 See also](#)
- [5 References](#)
- [6 External links](#)

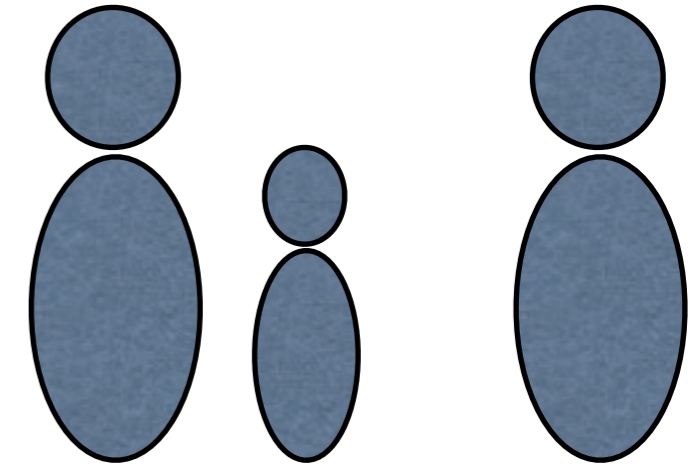
European Panther



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[article](#) [discussion](#) [edit this page](#) [history](#)

Cere

From Wikipedia, the free encyclopedia

The **cere** (from the Latin *cera*: wax)^[1] or **operculum**^[2] is a soft, fleshy swelling found on the beaks of certain birds. [Hawks](#), [parrots](#), [doves](#), [skuas](#) and [budgerigars](#) are among the birds that have ceres. The word 'cere' is often used synonymously with 'beak', although the two are not identical. The cere plays a role in indicating the reproductive stage of certain [dimorphic](#) birds, and also has a key function in respiration.

Contents [\[hide\]](#)

- [1 Physical characteristics](#)
- [2 Role in respiration](#)
- [3 Role in indication of reproductive cycle](#)
- [4 References](#)
- [5 See also](#)



The [Rock Pigeon](#), *Columba livia*. The cere is located at the top of the beak, and is a distinctive white-grey colour.

Physical characteristics

[\[edit\]](#)

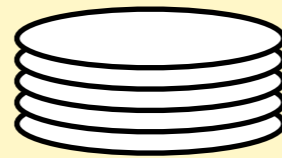
The cere is located at the top of the beak,^{[2][3]} and is often waxy in texture. The colour of the cere may vary from species to species, and also depends on the season.^[4] The cere contains the [nares](#) (nostrils). The shape of the cere varies from species to species. In falcons, the opening of the nares is roughly circular in shape.^[2]



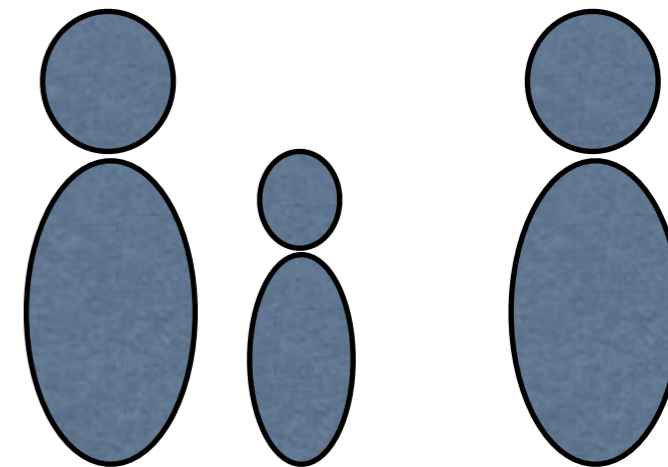
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Contents [hide]

- 1 Physical characteristics
- 2 Role in respiration
- 3 Role in indication of reproductive cycle
- 4 References
- 5 See also



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Physical characteristics

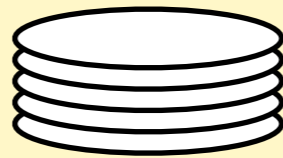
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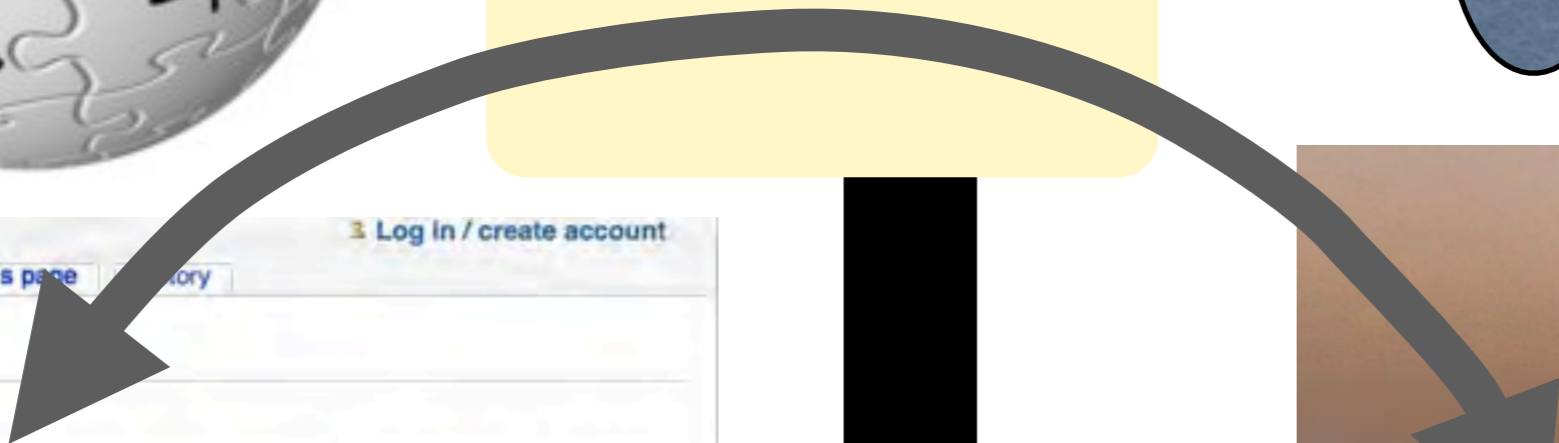
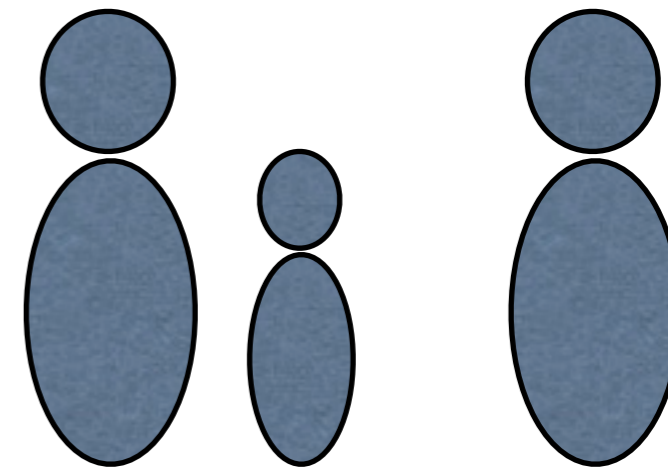
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article discussion edit this page history


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Contents [hide]

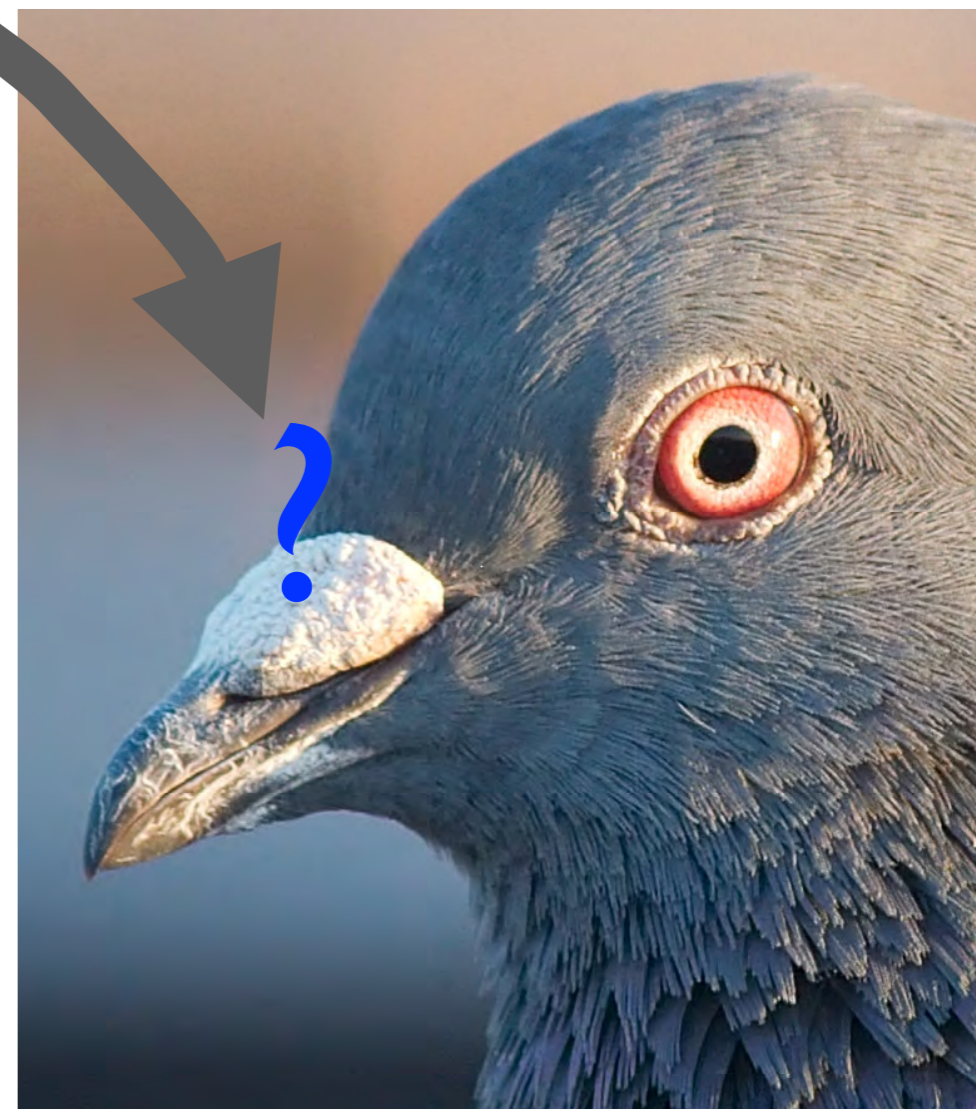
- 1 Physical characteristics
- 2 Role in respiration
- 3 Role in indication of reproductive cycle
- 4 References
- 5 See also



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Femur

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For the [invertebrate femur](#), see [Arthropod leg](#).

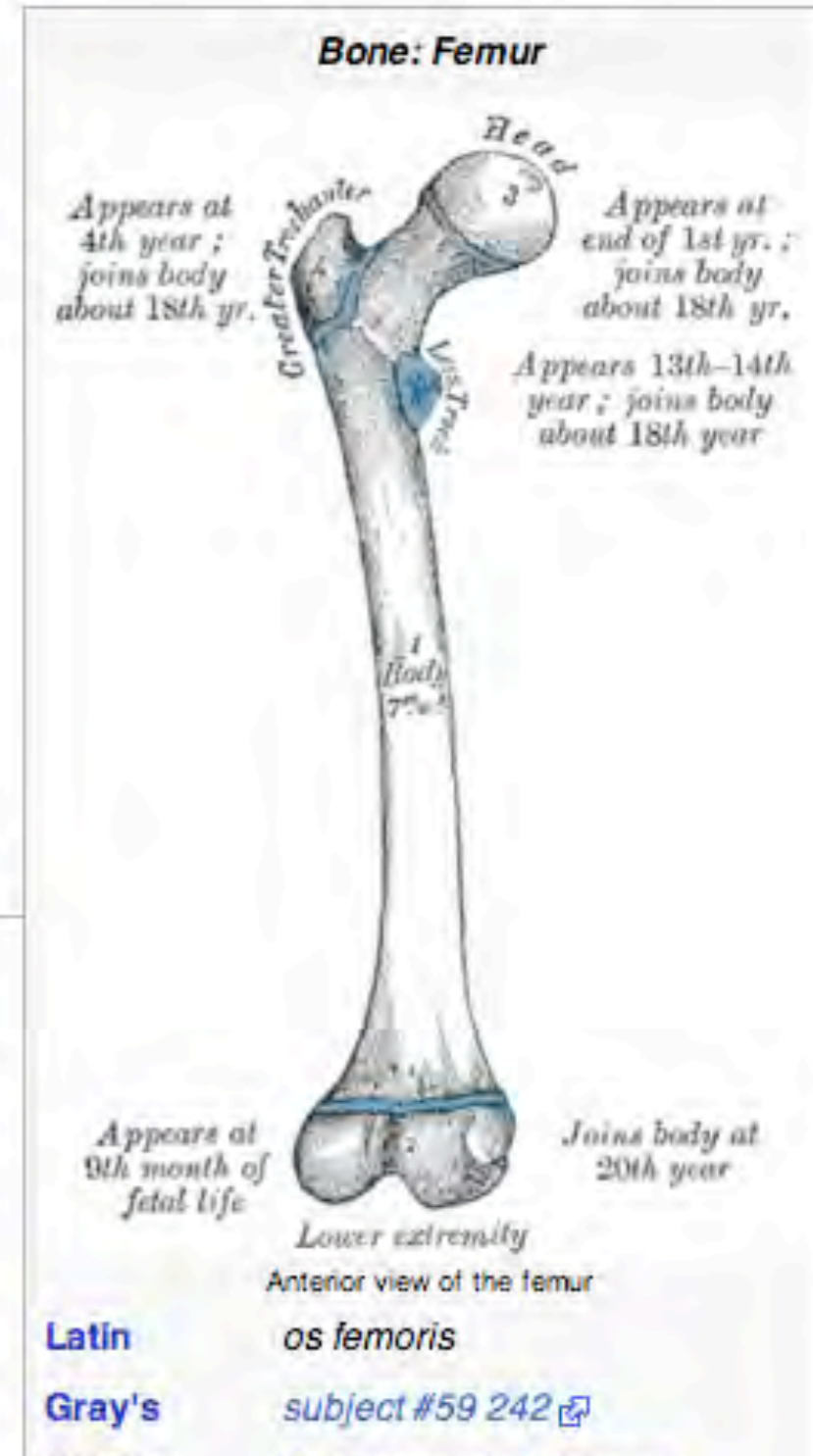
The **femur**, or **thigh bone**, is the most **proximal** (closest to the body) **bone** of the **leg** in **vertebrates** capable of **walking** or **jumping**, such as most **land mammals**, **birds**, many **reptiles** such as **lizards**, and **amphibians** such as **frogs**. In vertebrates with four legs such as **dogs** and **horses**, the femur is found only in the rear legs.

Contents [\[hide\]](#)

- 1 Human anatomy
- 2 Evolutionary variation
- 3 Etymology
- 4 Additional images
- 5 References
- 6 External links

Human anatomy [\[edit\]](#)

In **human anatomy**, the femur is the **longest** and largest bone. Along with the **temporal bone** of the **skull**, it is one of the two strongest bones in the body. The average adult male femur is 48 centimeters (18.9 in) in length and 2.34 cm (0.92 in) in diameter and can support up to 30 times the weight of an adult.^[1] It forms part of the **hip** (at the **acetabulum**) and part of the **knee**, which is located above. There are four eminences, or protuberances, in the human femur: the **head**, the **greater trochanter**, the **lesser trochanter**, and the **lower extremity**. They appear at various times from just before birth to about age 14. Initially, they are joined to the main body of the femur with **cartilage**, which gradually



Latin os femoris
Gray's subject #59 242 [↗](#)

navigation

- [Main page](#)
- [Contents](#)
- [Featured content](#)
- [Current events](#)
- [Random article](#)

search

interaction

- [About Wikipedia](#)
- [Community portal](#)
- [Recent changes](#)
- [Contact Wikipedia](#)
- [Donate to Wikipedia](#)
- [Help](#)

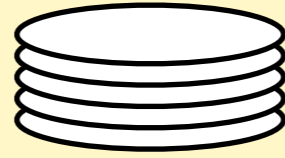
toolbox

- [What links here](#)
- [Related changes](#)
- [Upload file](#)
- [Special pages](#)
- [Printable version](#)
- [Permanent link](#)
- [Cite this page](#)

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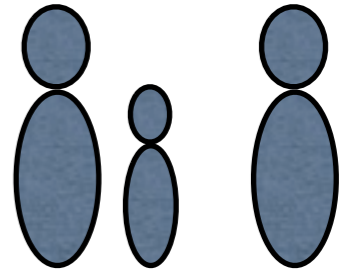
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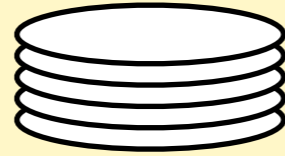
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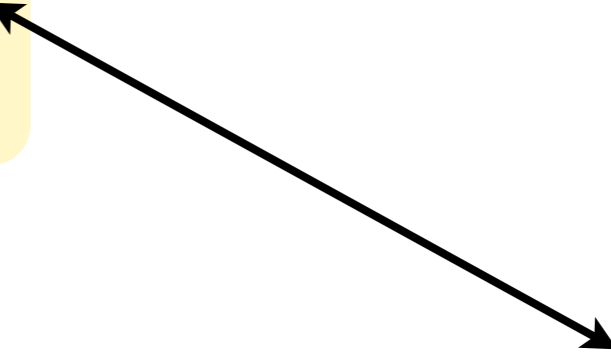
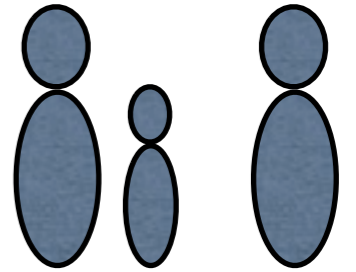
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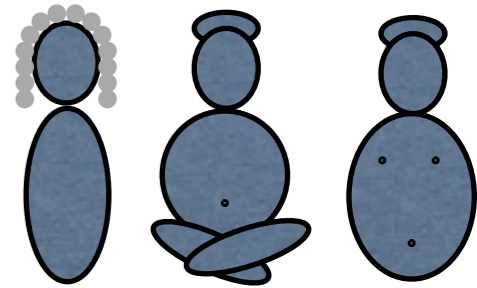
Images, segments
annotations, links,
GUIs, diagnostics



Users



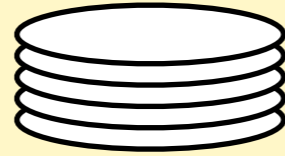
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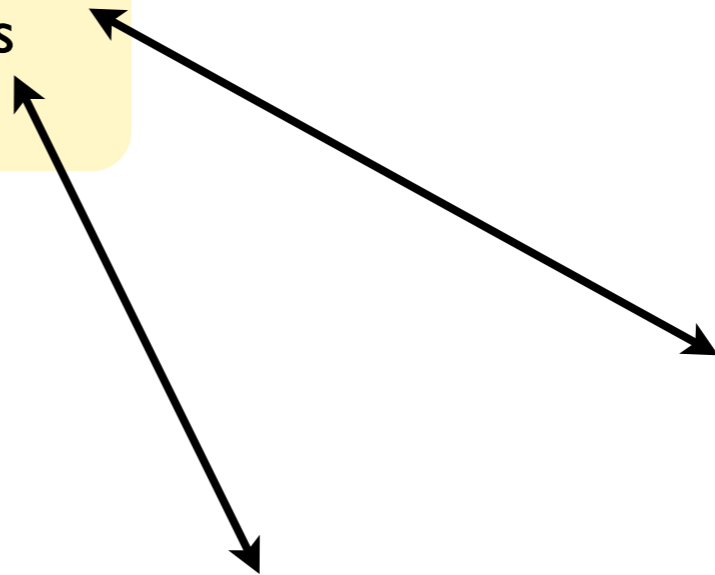
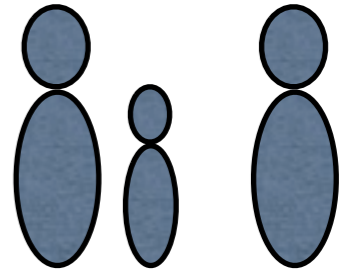
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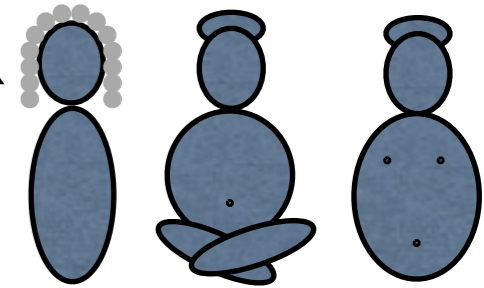
Images, segments
annotations, links,
GUIs, diagnostics



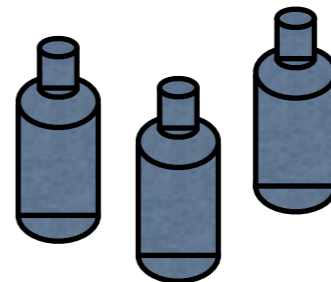
Users



Experts



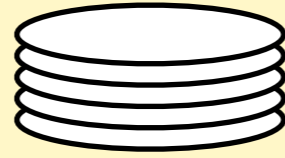
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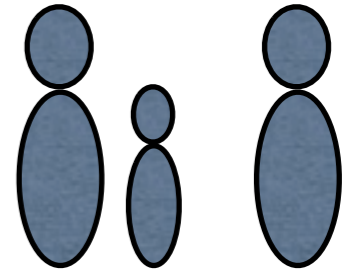


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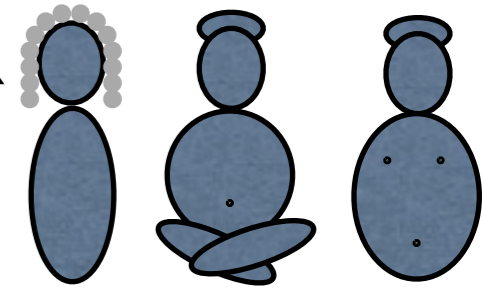


Images, segments
annotations, links,
GUIs, diagnostics

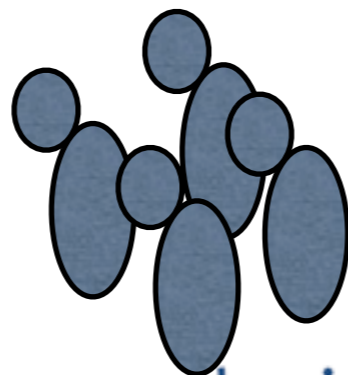
Users



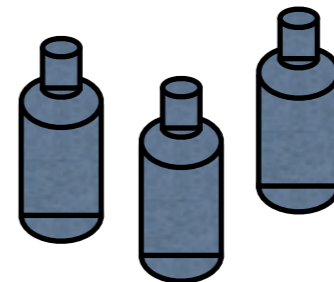
Experts



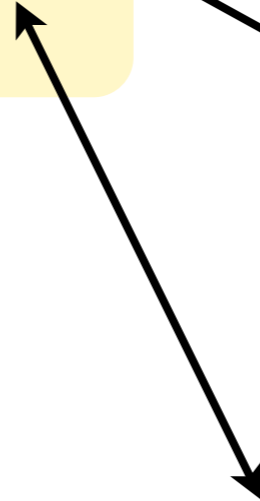
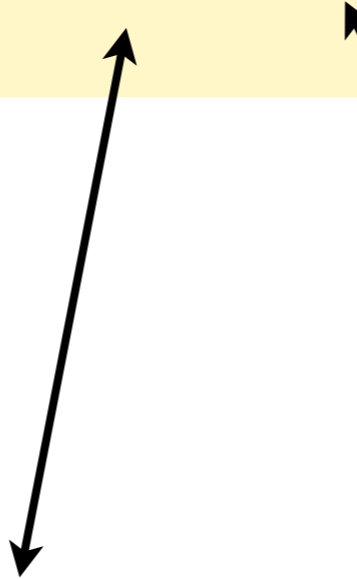
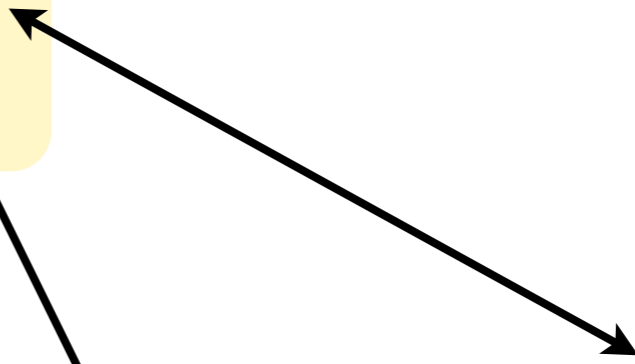
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Automata



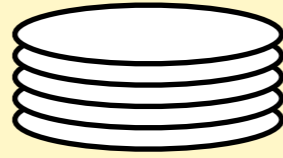
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beta Artificial Intelligence



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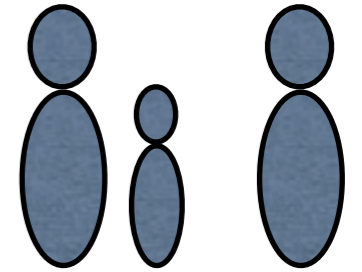


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annotations, links,
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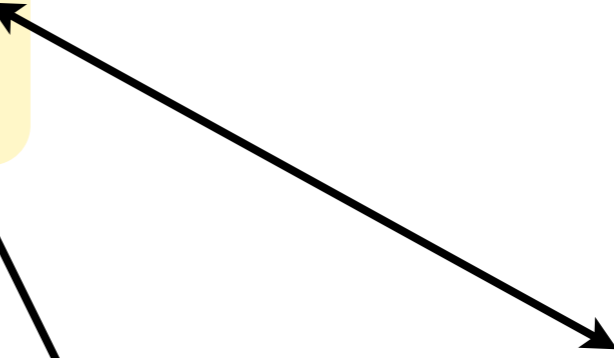
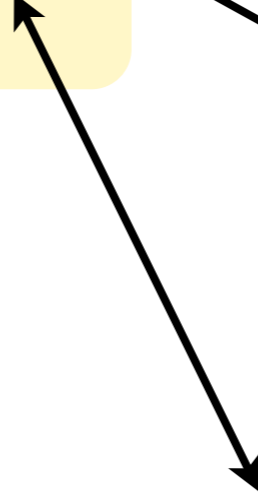
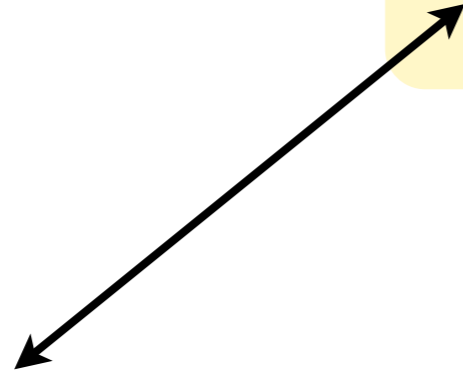
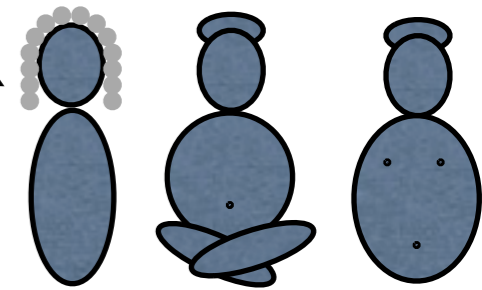
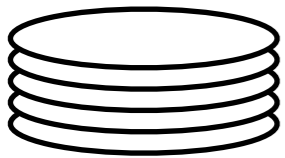
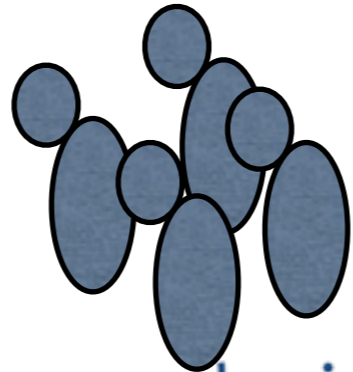


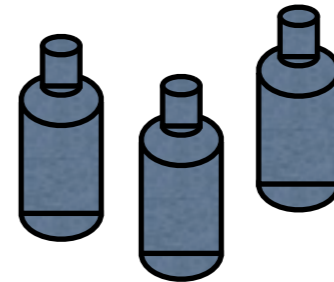
Image databases



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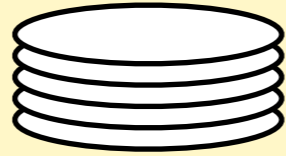
Automata



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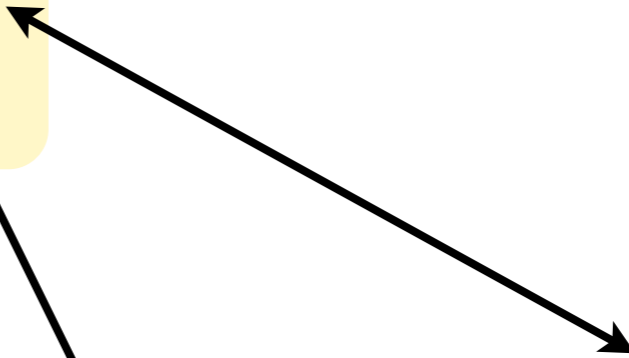
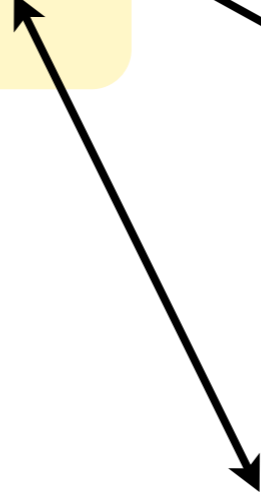
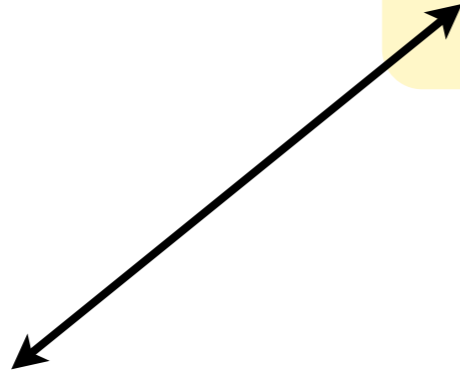
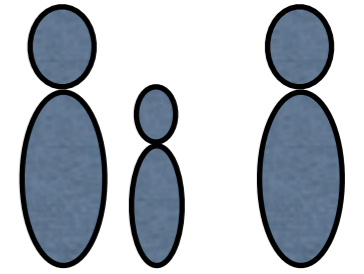


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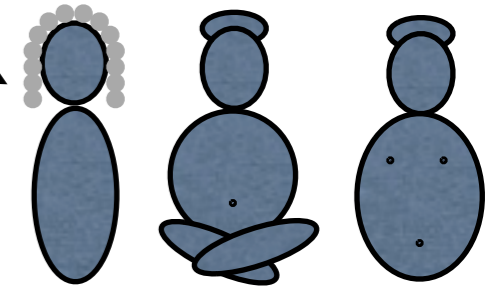
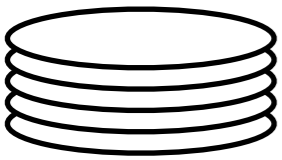
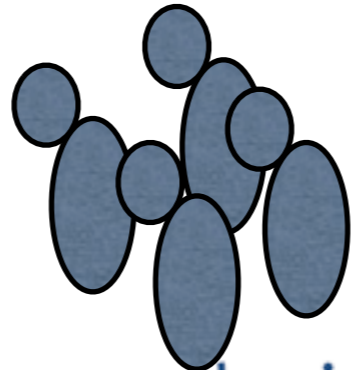


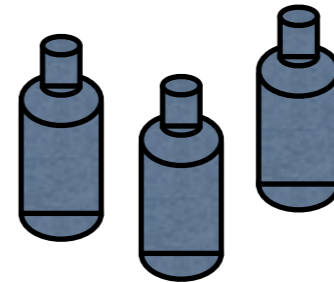
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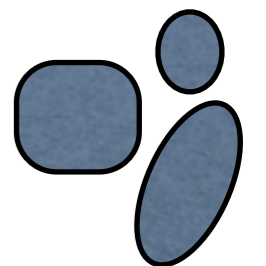
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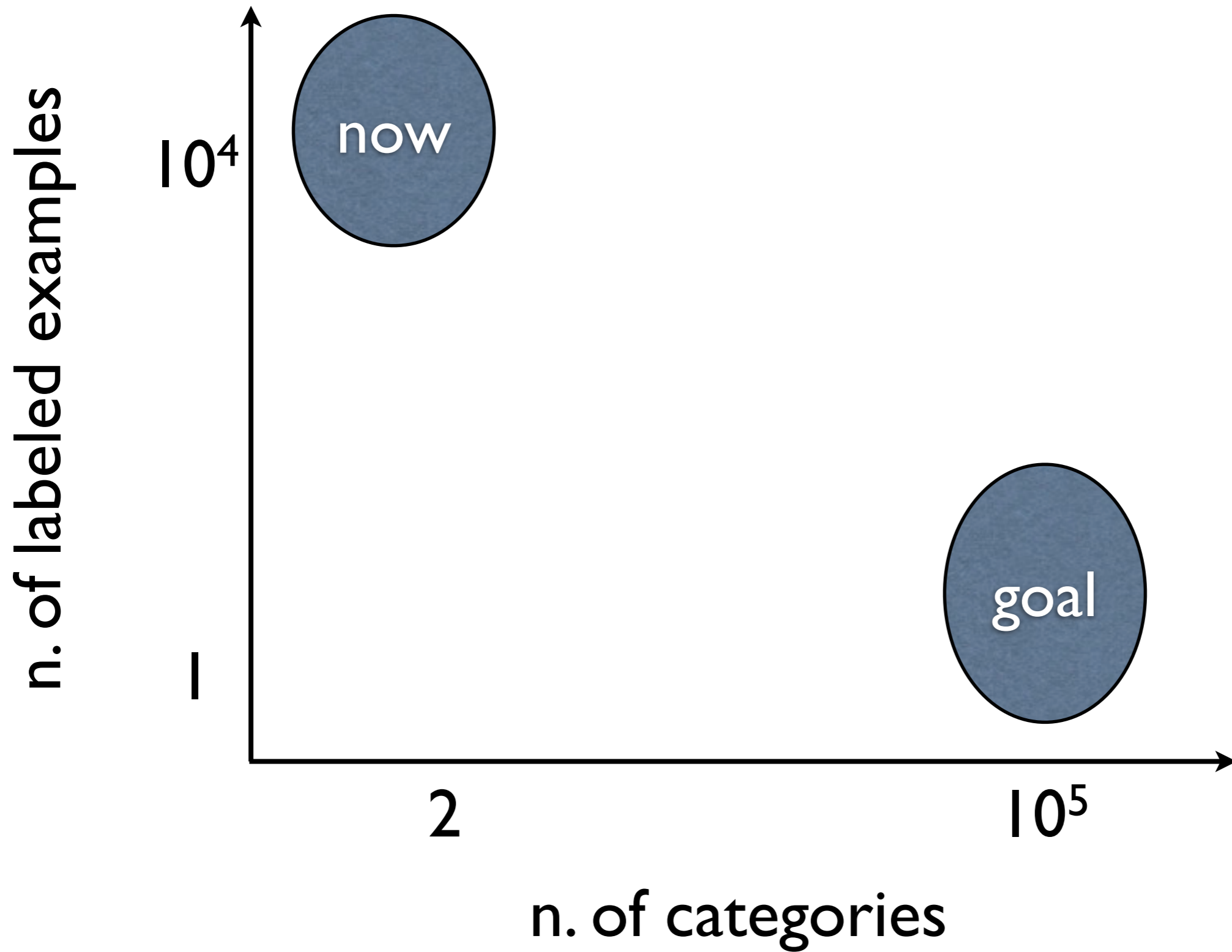


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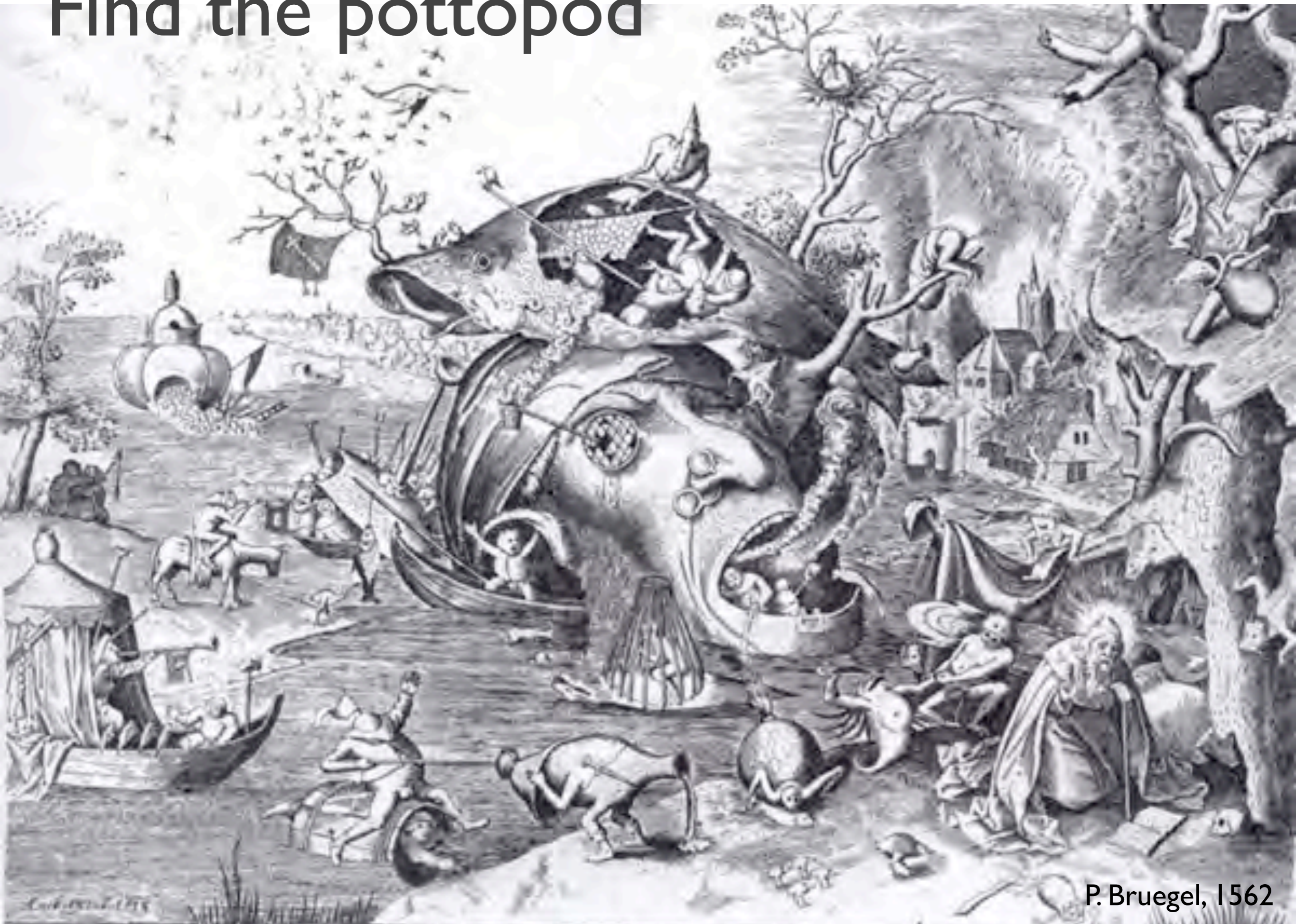


This is a
pottopod



S. Savarese, 2003

Find the pottopod



P. Bruegel, 1562

Training example



Smart
box



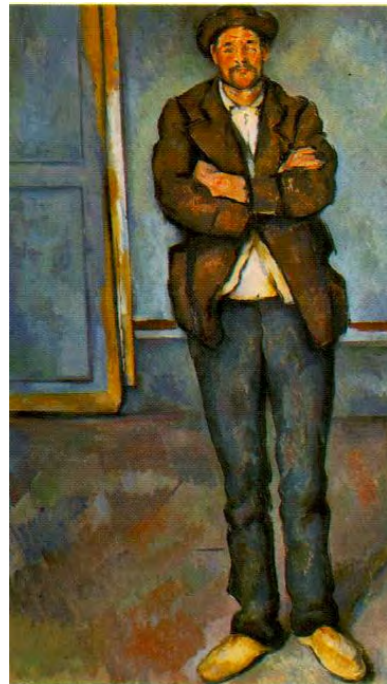
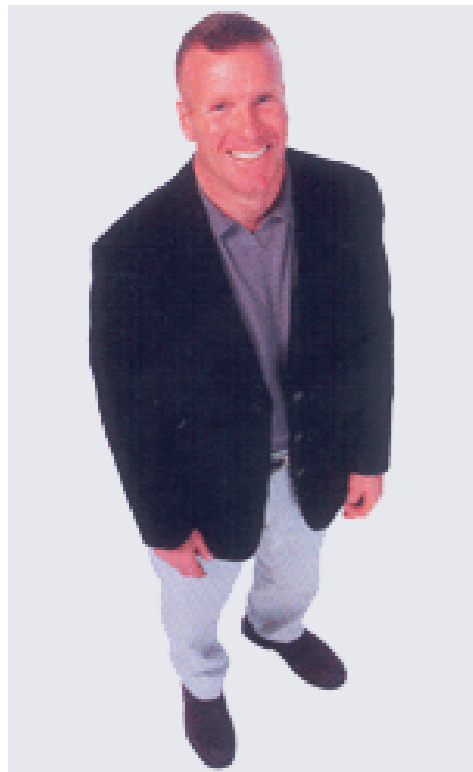
New category

Training example

Previously learnt categories



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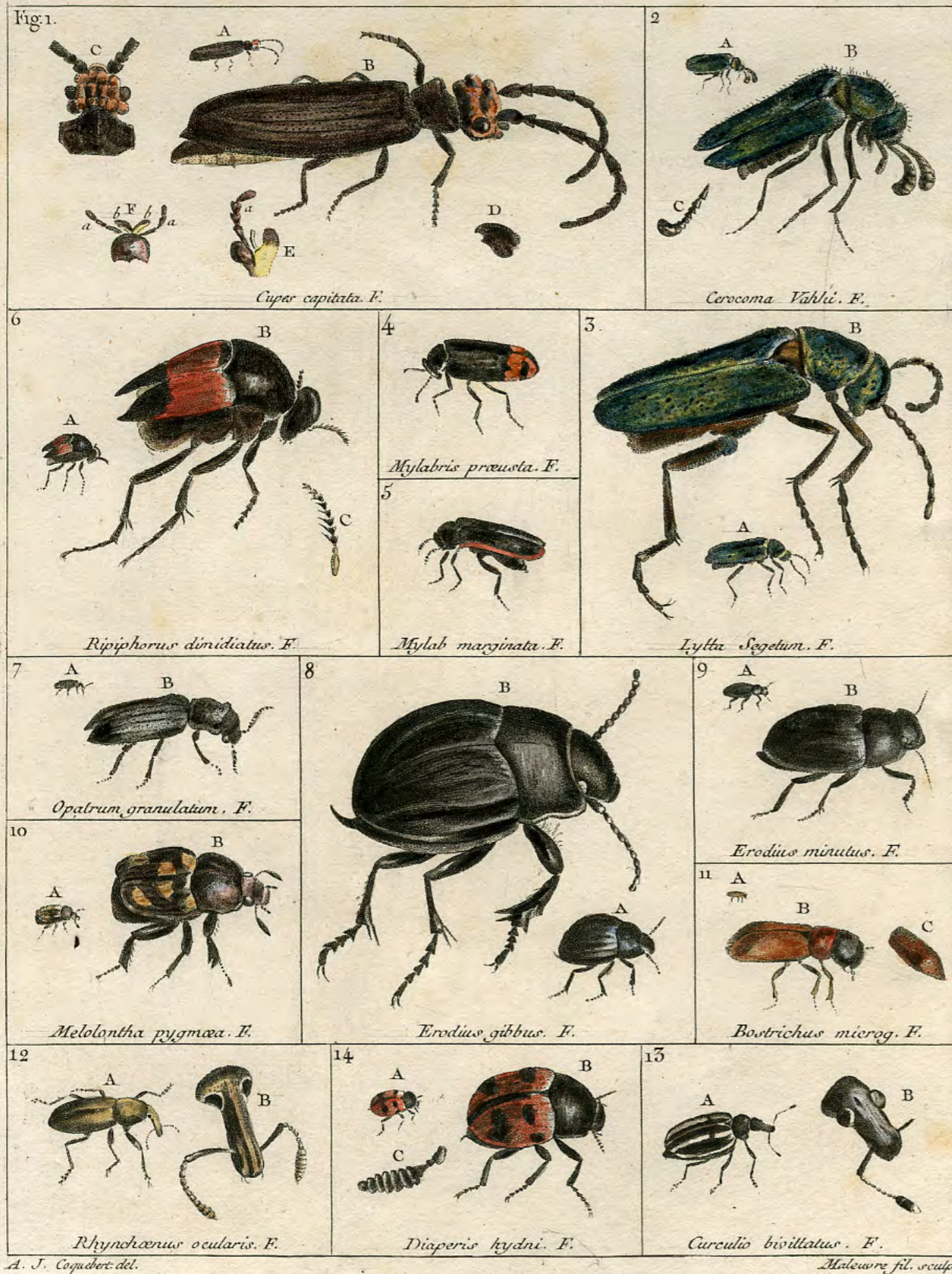
.....



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New category

Organizing visual info

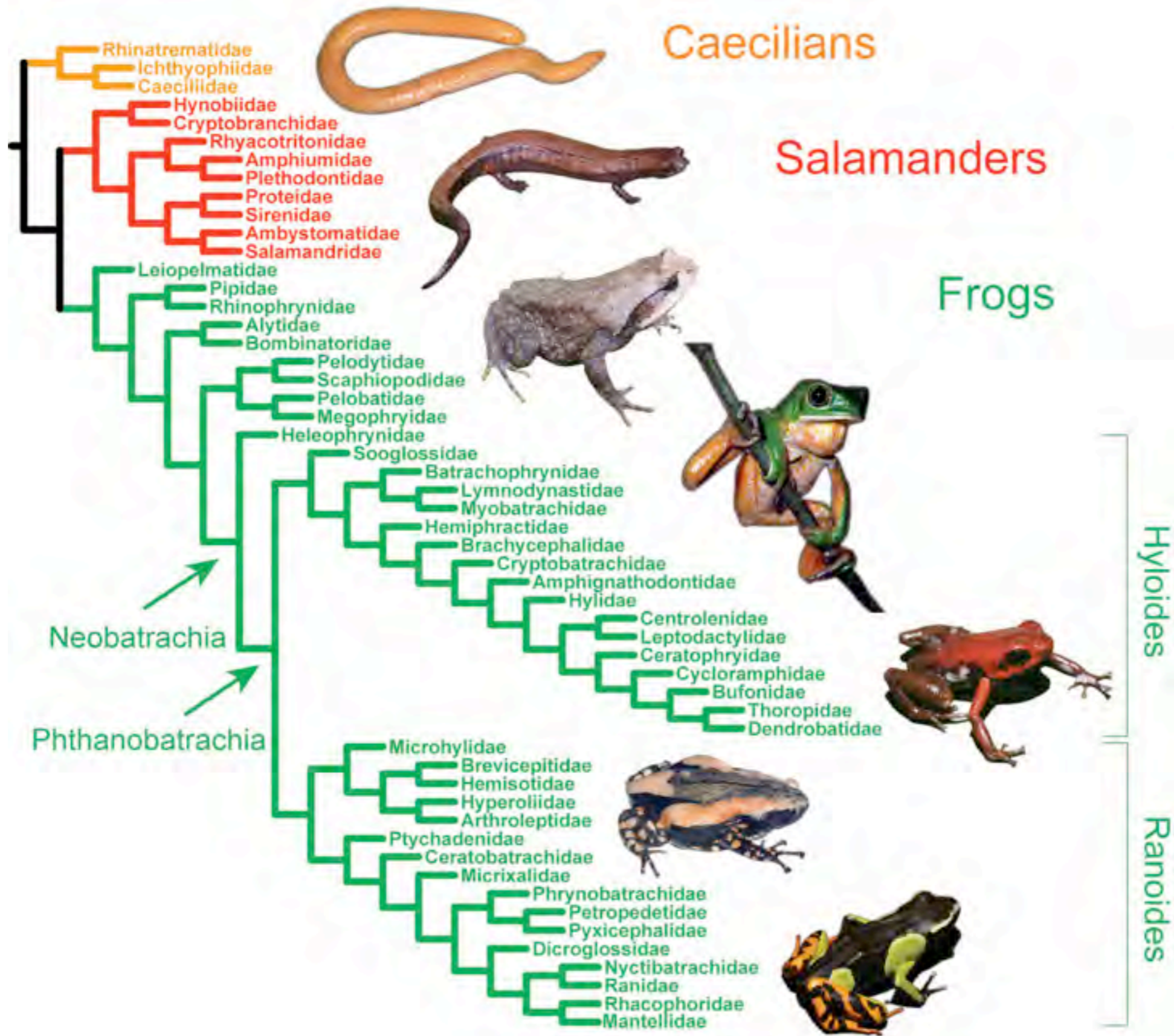


Antoine Jean Coquebert de Montbret

Illustratio iconographica insectorum quae in musaeis parisinis observavit et in lucem edidit Joh. Christ. Fabricius, praemissis ejusdem descriptionibus; accedunt species plurimae, vel minus aut nondum cognitae, vol. 3
 Paris: P. Didot, 1799
 3 v. XXX col. pl. 35 cm

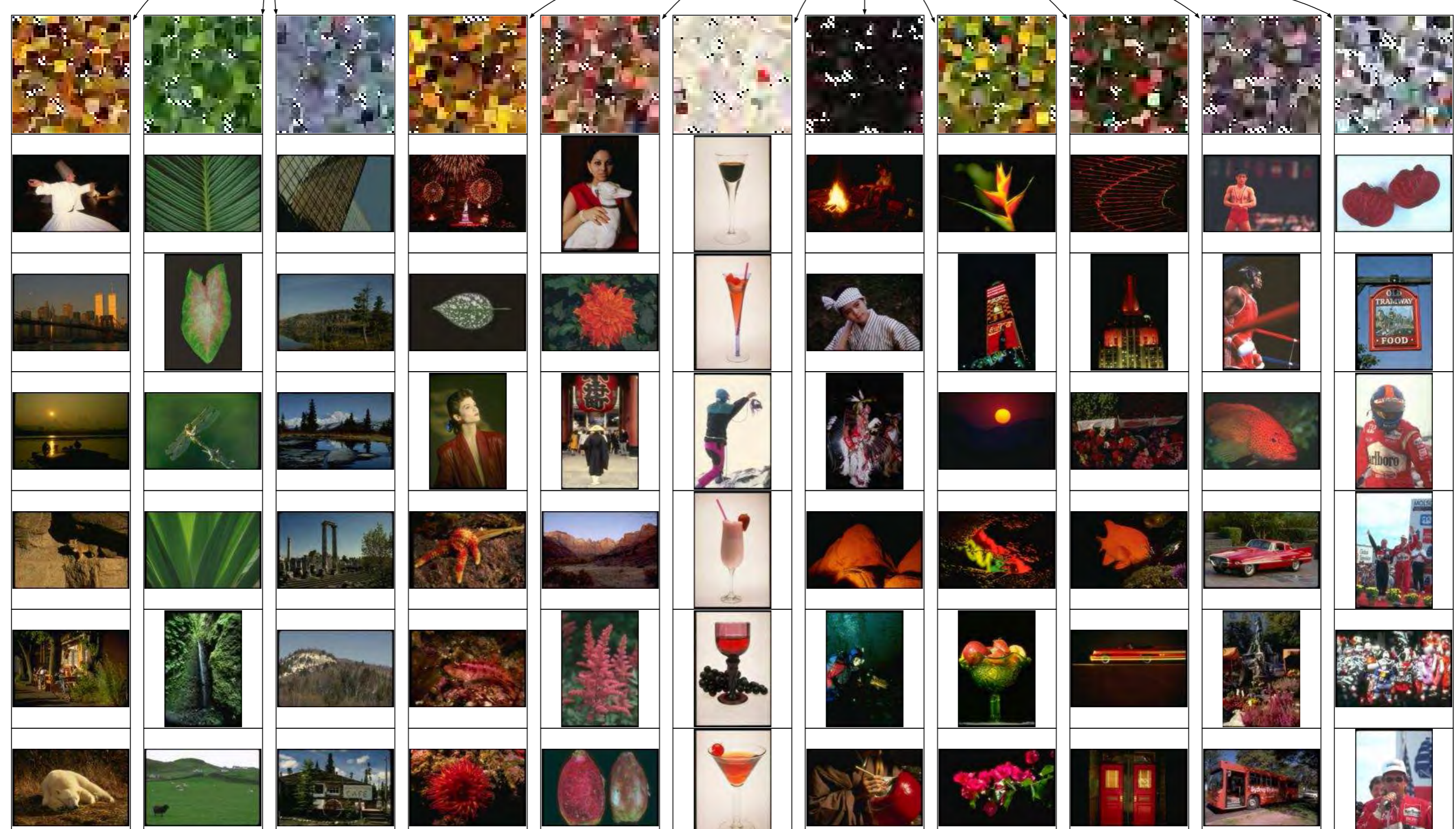
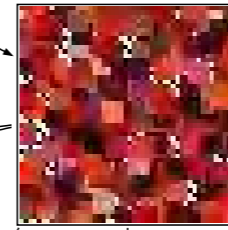
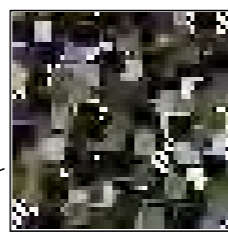
<http://www.library.umass.edu/spcoll/exhibits/herbal/15.jpg>

Taxonomies



Taxonomies

[Bart et al. '08]





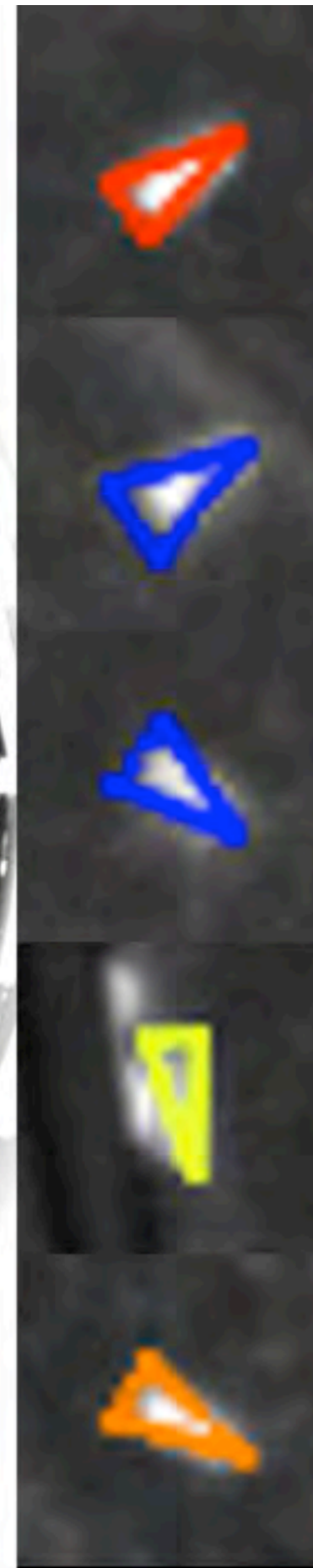
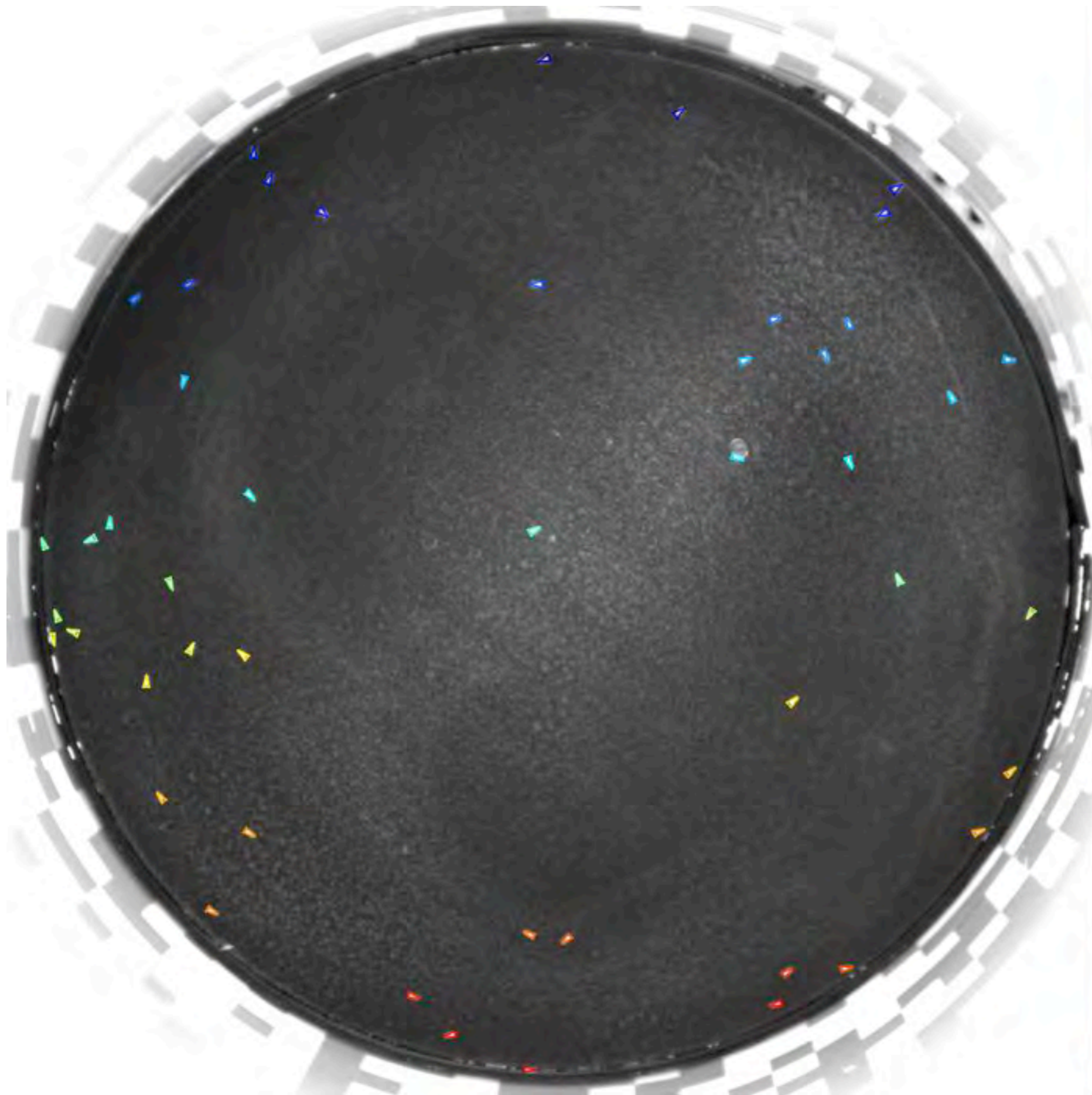
Zidane in a dish

[Dankert et al., Nature Methods, April 2009]

Zidane in a dish



[Dankert et al., Nature Methods, April 2009]



Incremental learning



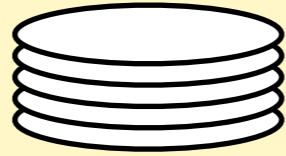
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WIKIPEDIA

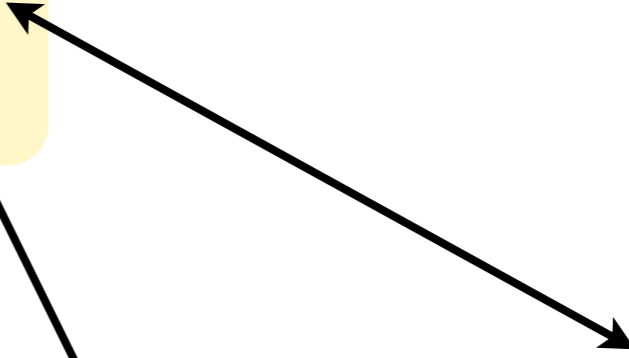
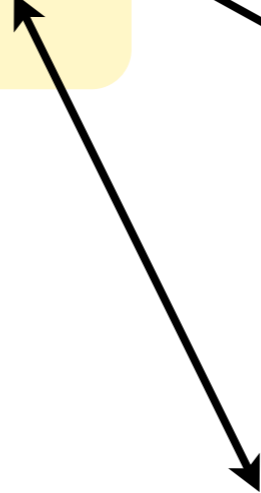
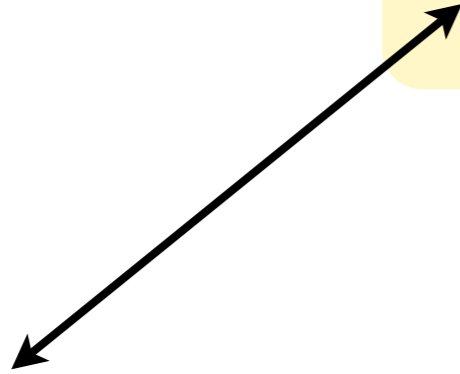
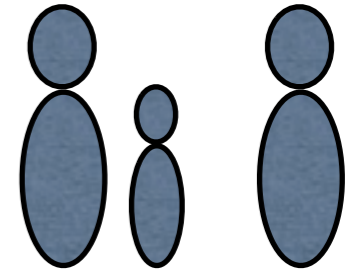


VISIPEDIA



Images, segments
annotations, links,
GUIs, diagnostics

Users



Experts

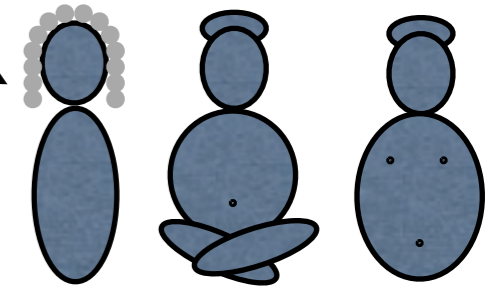
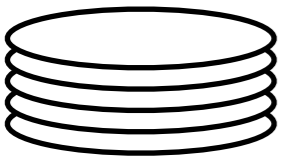
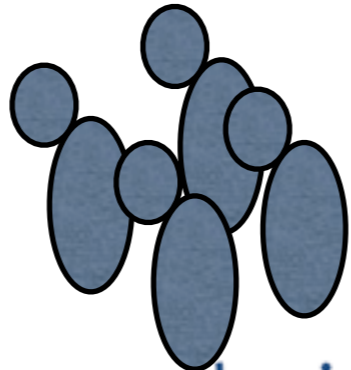


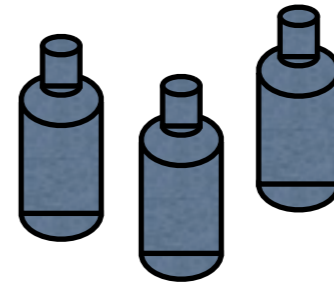
Image databases



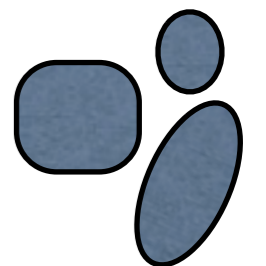
Annotators



Automata



Vision scientists



Sensory knowledge

- sensory data deluge, most of it unlabeled
- categories, taxonomies
- actions and activities
- learning: unsupervised, incremental, one-shot
- Interfacing with humans