

# *PRELUCRAREA SI ANALIZA IMAGINILOR*

*2007/2008*

*Prof. Dr. Ing. Constantin VERTAN*

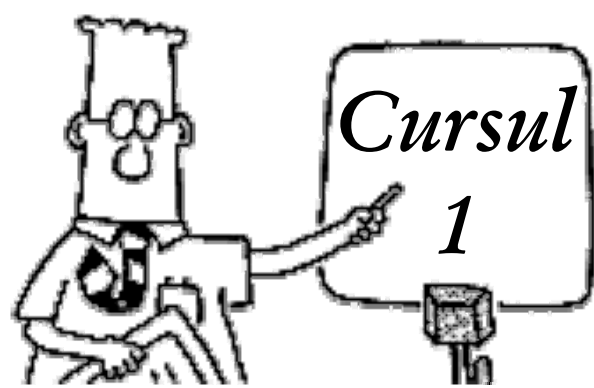


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# Chestiuni administrative

## Aplicatii ale PAI

## Notiuni fundamentale



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# Chestiuni administrative

*Cod curs: 04.S.07.A.142 - 4 puncte credit*

*Curs: 2 ore/ saptamana*

*Laborator: 2 ore/ 2 saptamani, cu subgrupa*

*Punctare: 30 puncte examen final*

*30 puncte partial cu degrevare*

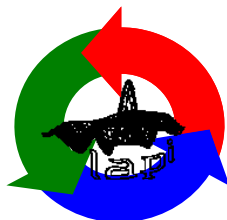
*40 puncte colocviu de laborator*

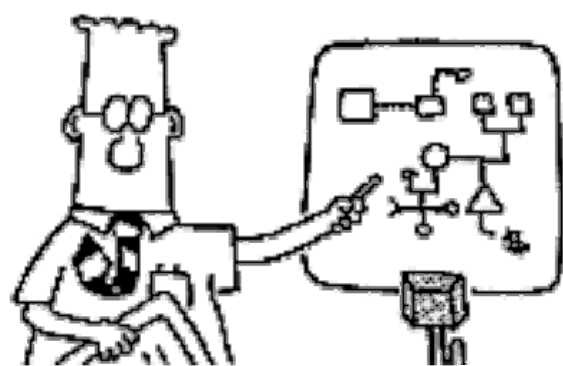
*(20 test teoretic laborator, eliminatoriu*

*20 test practic laborator)*

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# Chestiuni administrative

*Laborator (B135A):*

*As. Drd. Ing. Laura FLOREA*



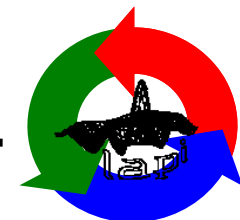
*Birou (B141)*

*<http://alpha.imag.pub.ro/cursuri>*



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# Chestiuni administrative: Bibliografie

*tiparit:*

C. Vertan, M. Ciuc:

“Tehnici fundamentale de  
Prelucrarea si Analiza Imaginilor”,  
Ed. MatrixROM, Bucuresti, 2007.

*on-line:*

<http://alpha.imag.pub.ro/cursuri>

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# Aplicatii ale PAI

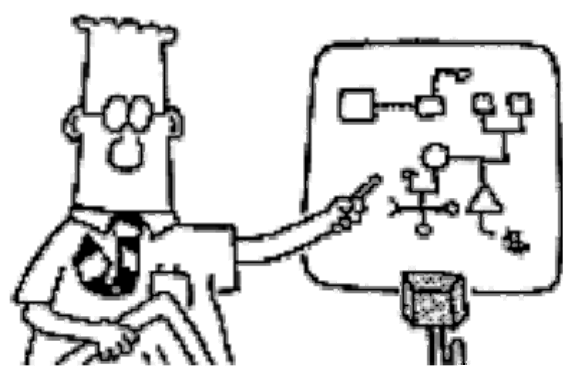
Imagini de “consum”  
Imagistica medicala  
Imagistica satelitara  
Supraveghere  
Aplicatii industriale  
Protectia proprietatii intelectuale  
  
si multe altele ...

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# Aplicatii ale PAI: imagini “de consum”

Corectia imaginilor in aparatul foto:  
ochi rosii  
iluminare  
puncte defecte si praf

Gestiunea colectiilor de imagini



# Corectia automata a efectului de ochi rosii



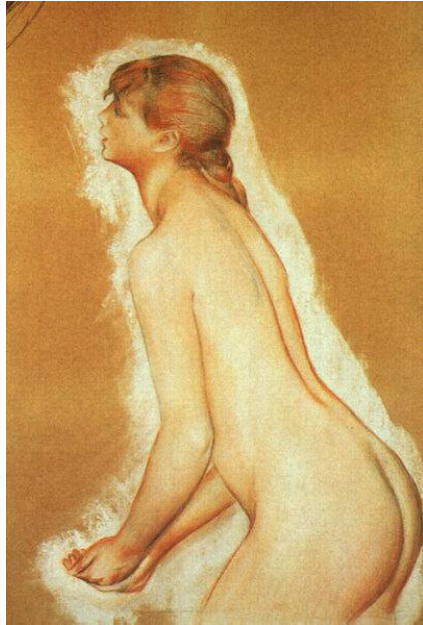


# Corectia iluminarii



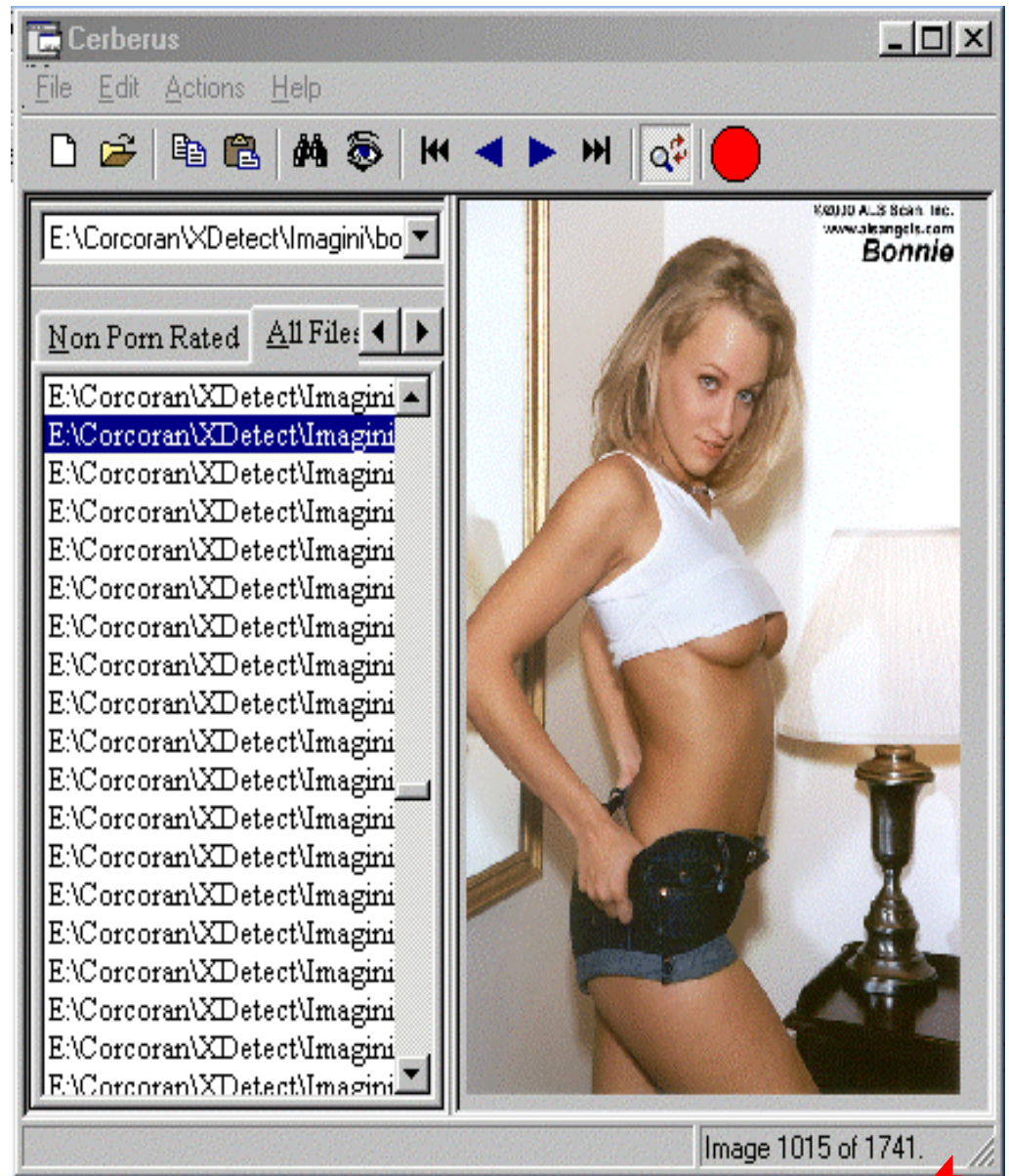


# Detectia automata a continutului “sensibil”: “family filter”



Renoir :

“Nud”



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21,5% à  
cables fe-  
que Fran-  
se par

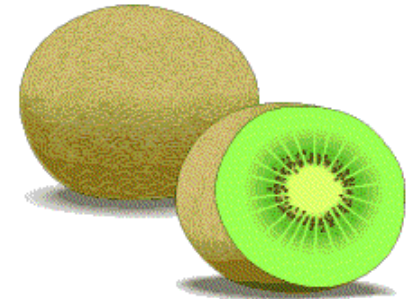
**soir 3**



# Cautare pe Internet: “kiwi”



kiwi - pasare



kiwi - fructul

Kiwi airlines



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bear



beer

**Suna similar, se scriu similar ...**



grid

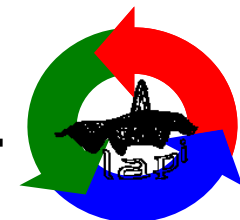


greed



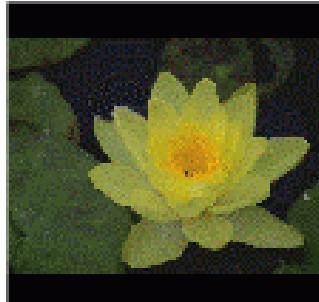
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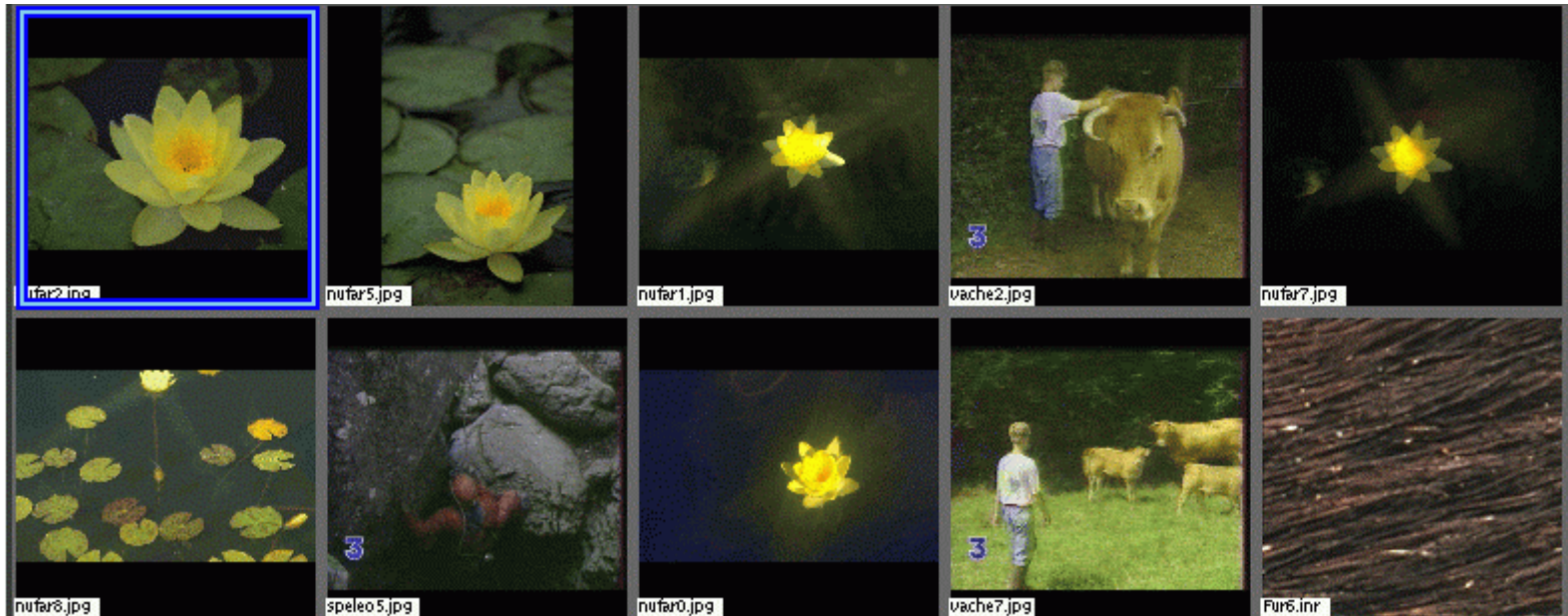




# Rezultatul cautarii de imagini



Exemplu: nufar galben





# Surfimage

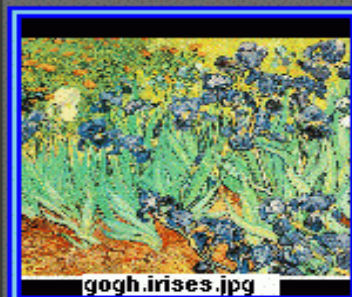
Copyright INRIA - projet IMEDIA 1999

load

user

expert

exit

Your image volumes ( **3670** images ) : **BigDatabase** **go**

&lt;&lt; &lt; Page 1 &gt; &gt;&gt;

367

Next image of **databases**

Image filename

Mode : Standard Mode



reset



shuffle



retrieve



learn



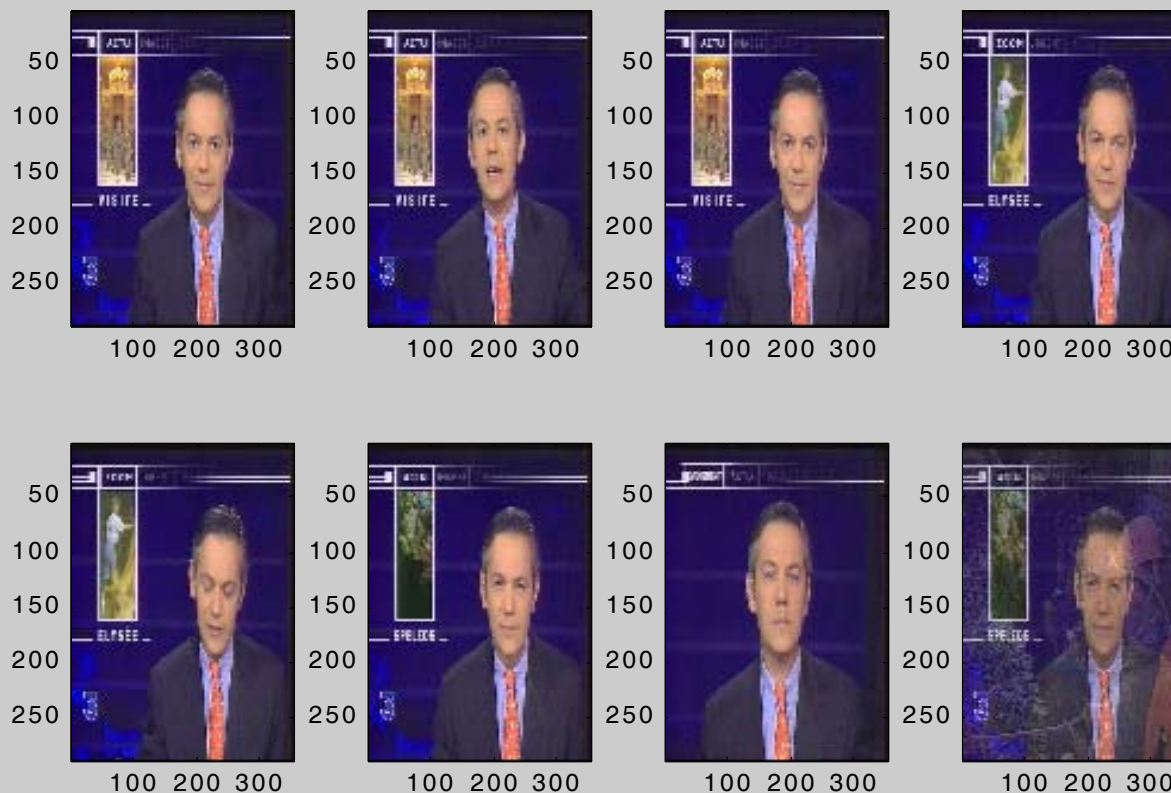
extern

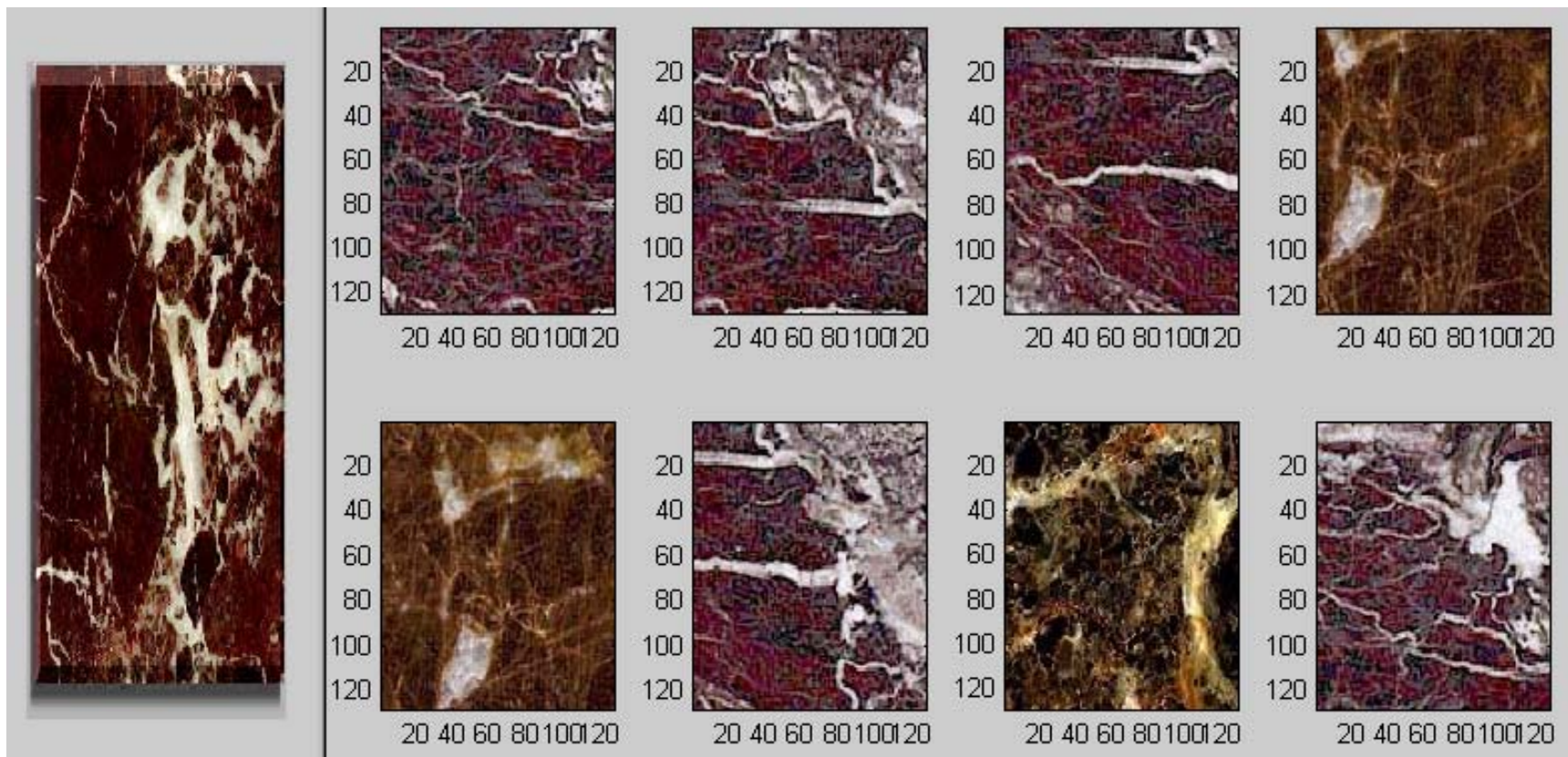


# IRIS (demonstrator LAPI)



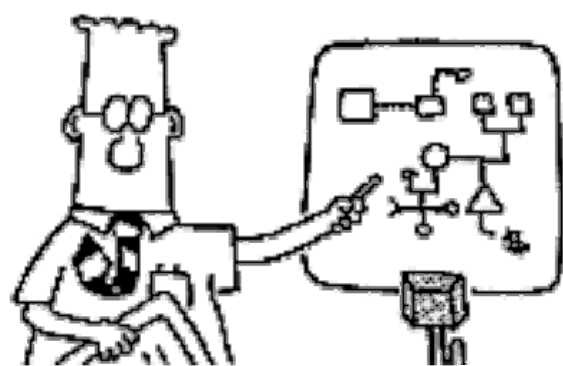
# IRIS (demonstrator LAPI)





Interogare externa:  
marble *rosso levanto*  
[Ankur Intl. Inc.]

Imagini similare: marbles  
*rojolevanto, brecianouvella, marronbrown*  
[Marble and Granite Inc.]



# Aplicatii ale PAI: imagistica medicala

Parte a modului de obtinere a imaginii

Interpretarea automata a imaginii

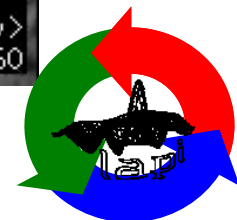


# Detectia cancerului mamar

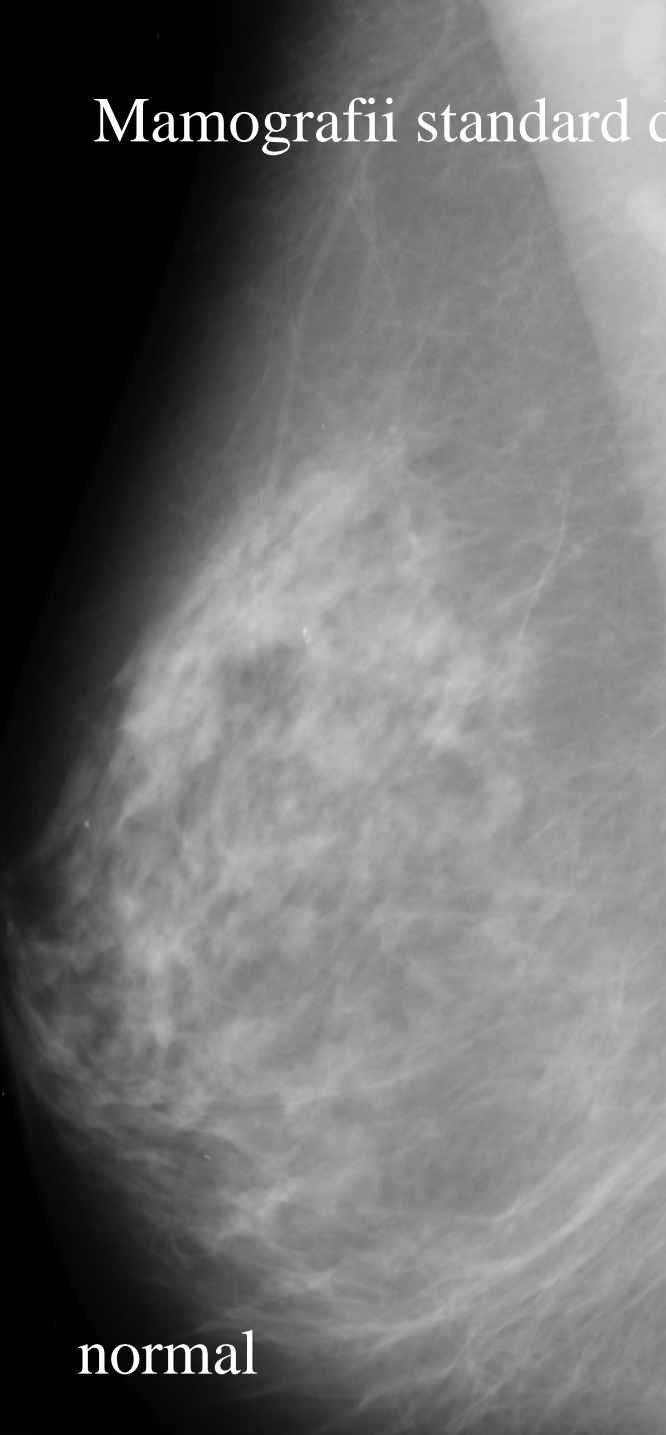


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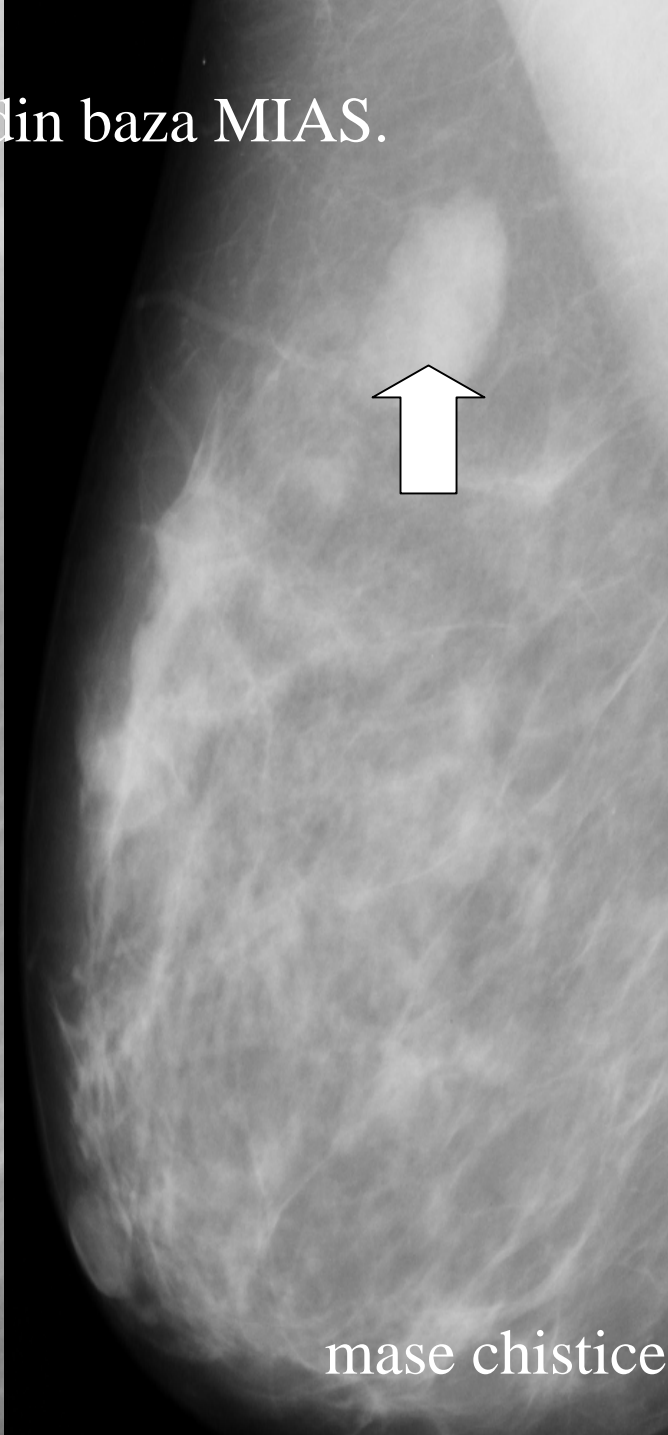
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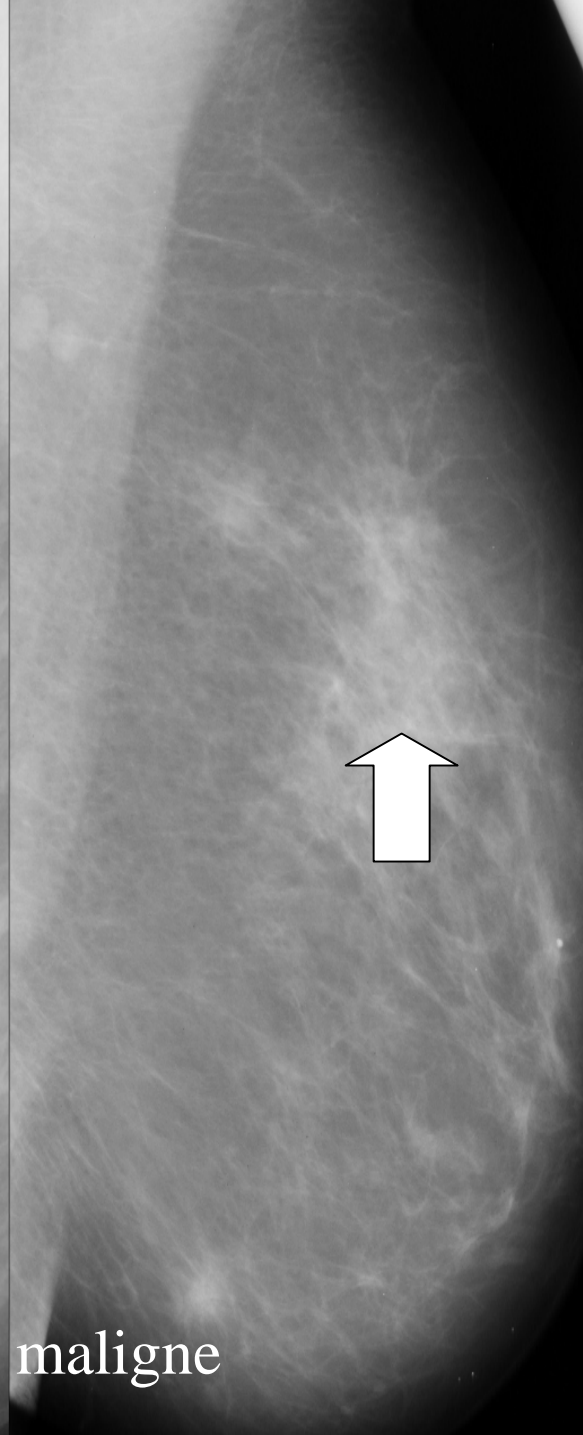
Mamografii standard din baza MIAS.



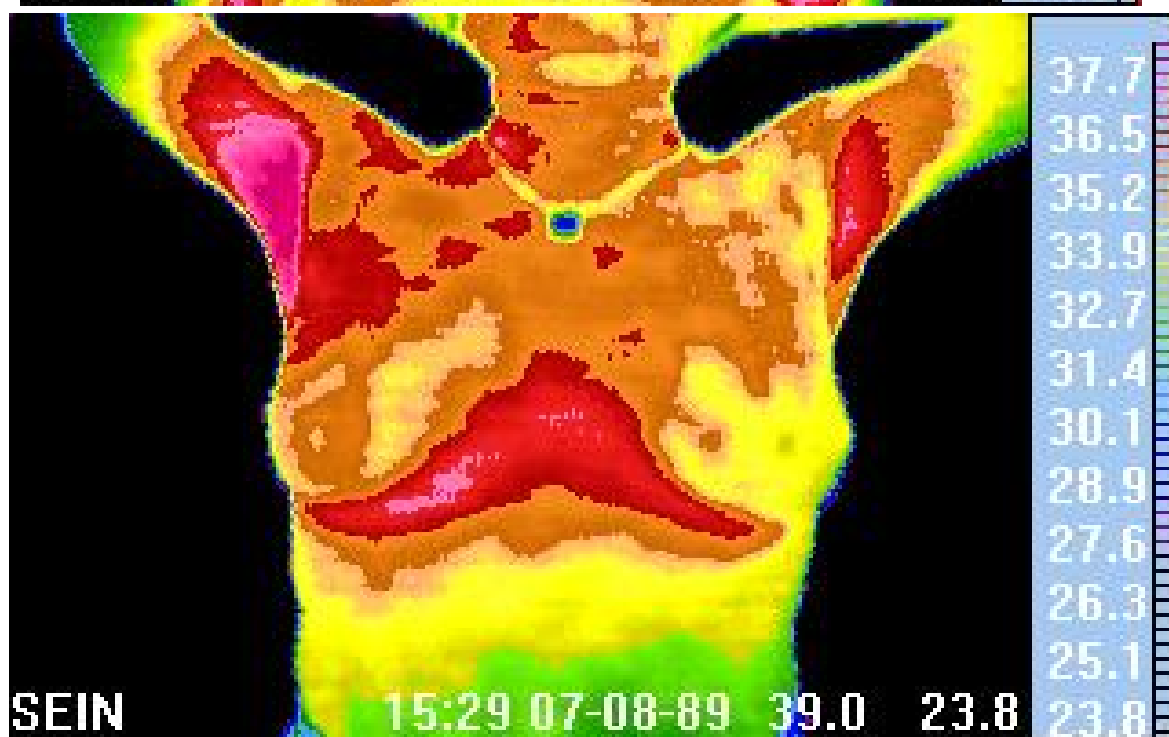
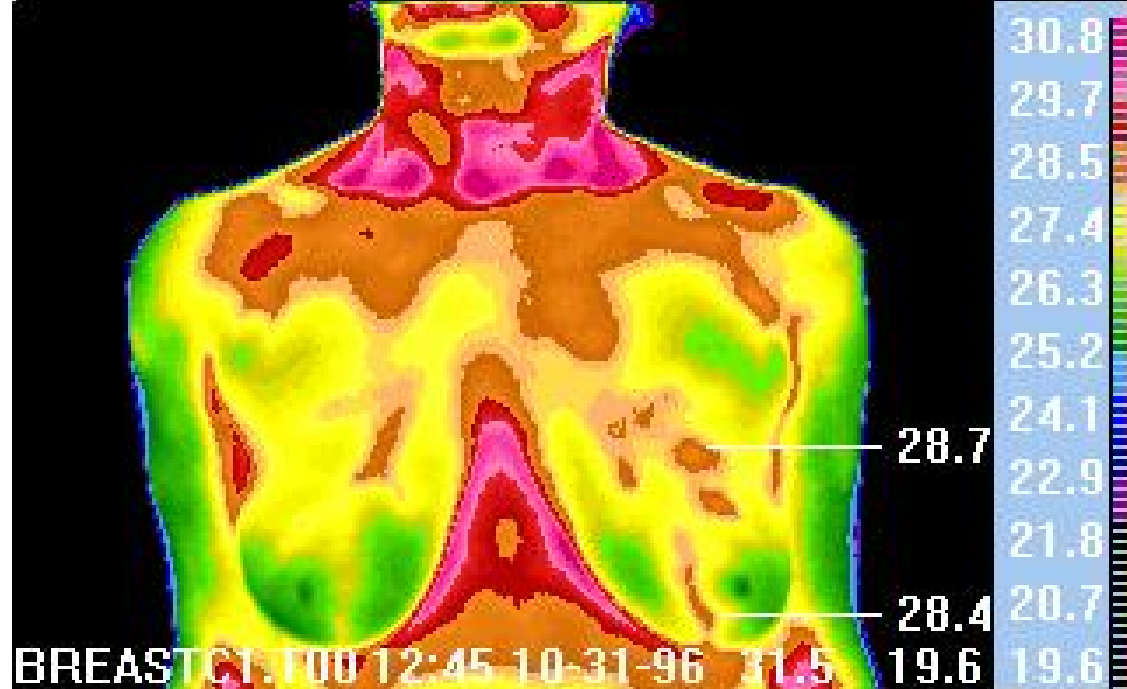
normal



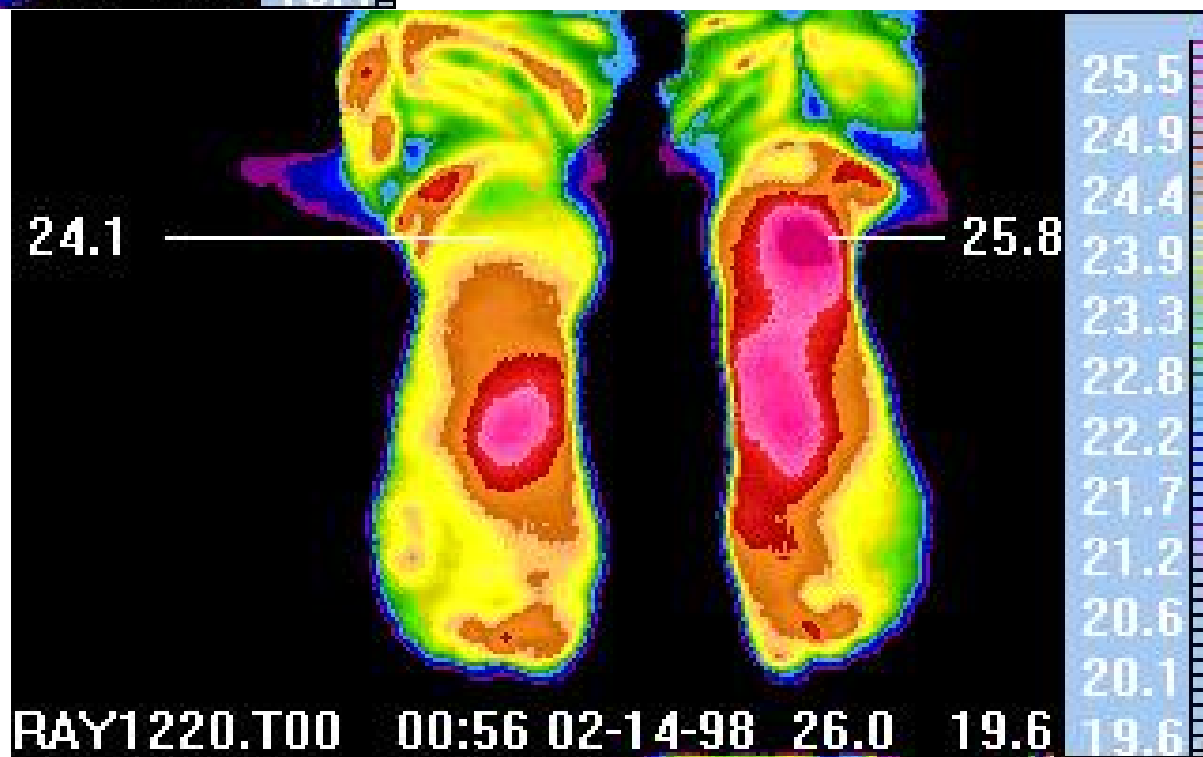
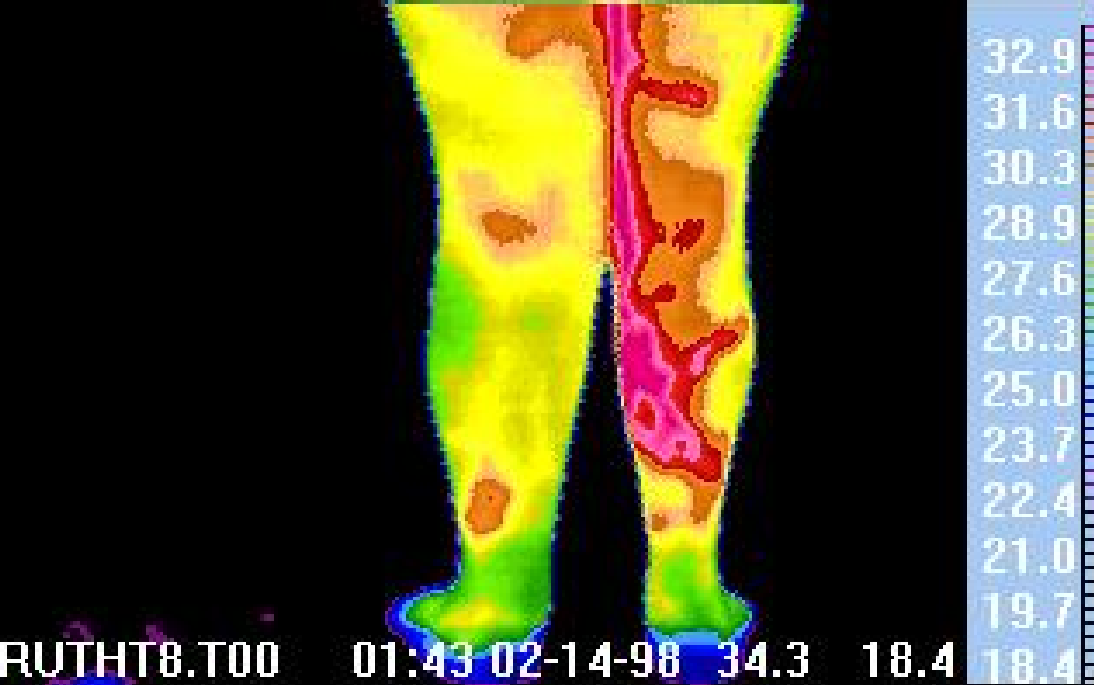
mase chistice maligne



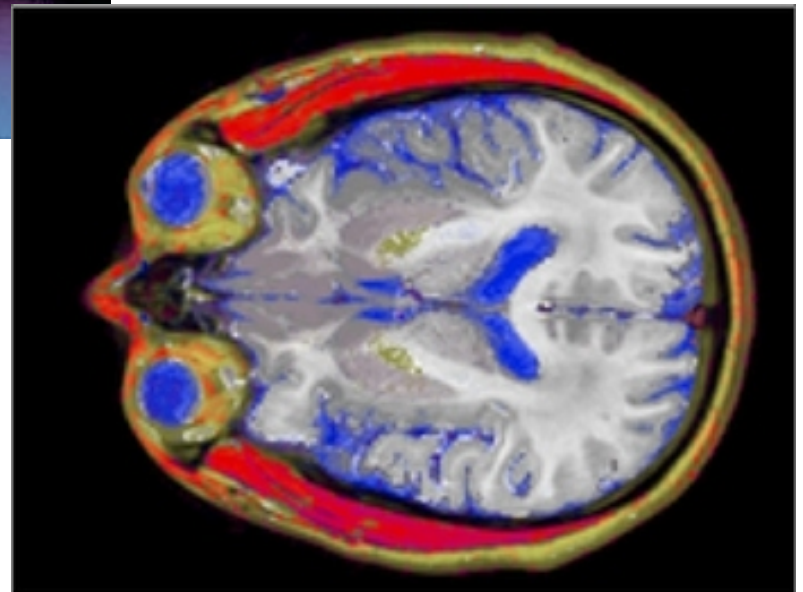
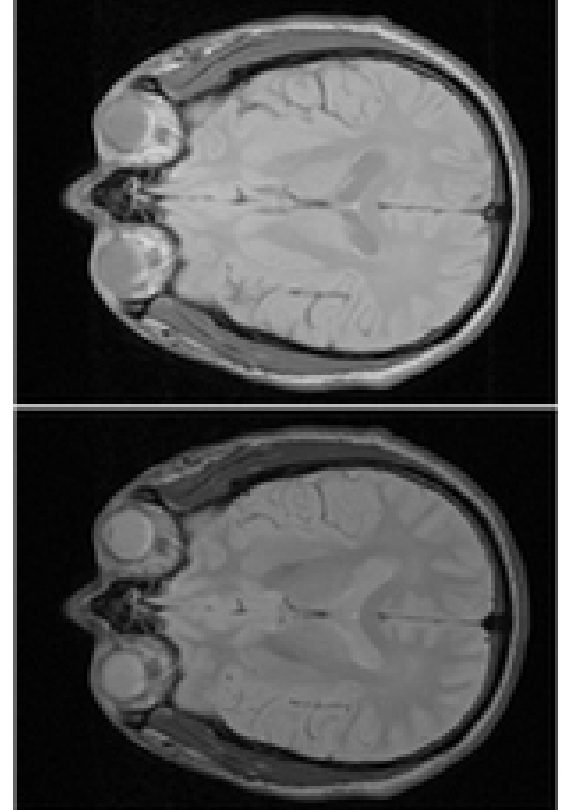
# Imagini termografice







# NMR tomography



# Melanoame de piele

Descrierea automata: criteriul ABCD

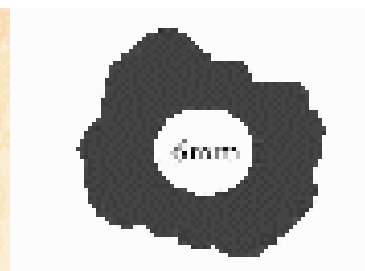
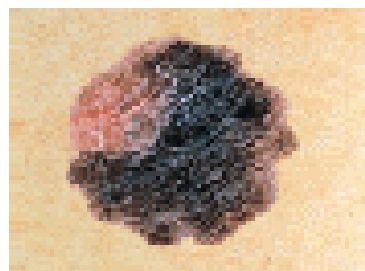
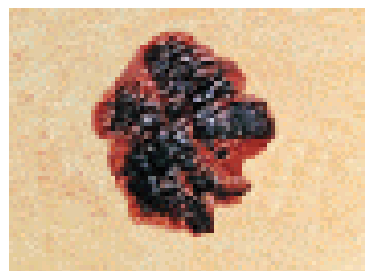
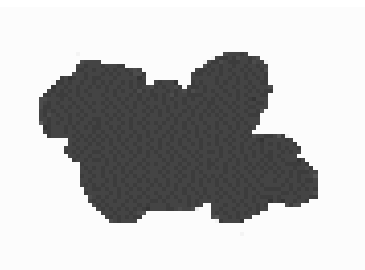
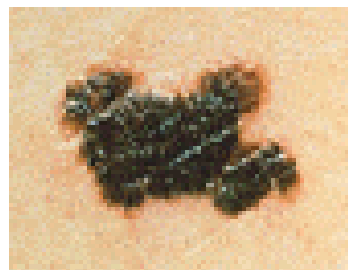
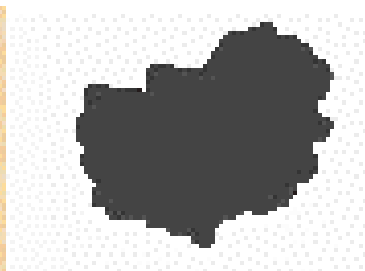
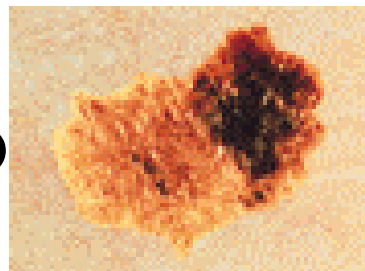
A - asimetrie

B - bordura

C - culoarea

D - diametrul

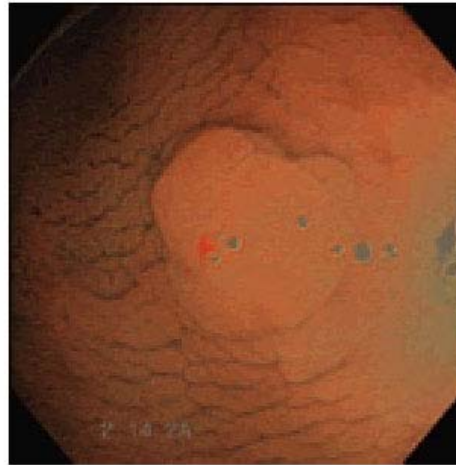
Problema : stabilitatea achizitiei  
culorii



# Dependenta culorii de iluminare



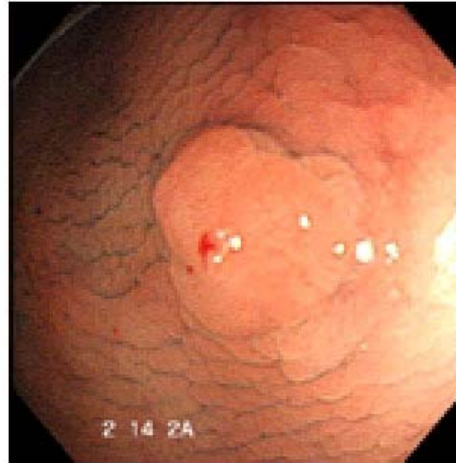
(b) D65



(d) Tungsten

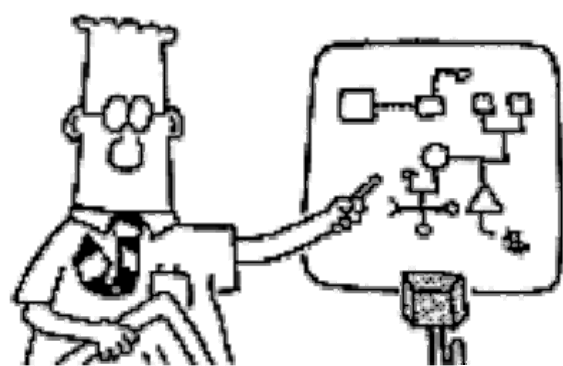


(c) Daylight



(a) Xenon





# Aplicatii ale PAI: imagini satelitare

Interpretarea automata a imaginii

Compresie

Gestiunea continutului



# IKONOS





# QuickBird





# Imagistica satelitara

**SPOT (1: 1986, ... 5: 2002) : 2.5m panchromatic  
10m multispectral  
60Km x 60 Km**

**IKONOS (1999) : 1m pan/ 4m multispectral**

**EROS (2001) : 0.67m hyperesantionat panchromatic  
9Km x 9 Km**

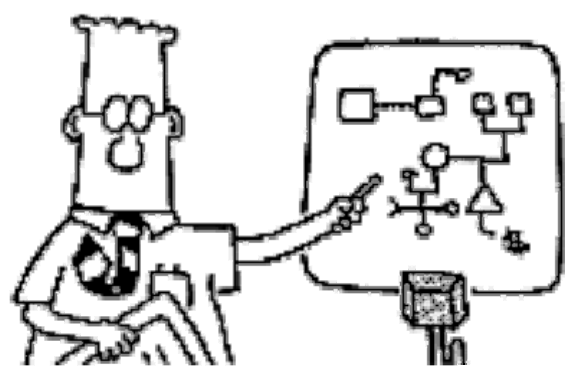
**QuickBird (2001) : 0.61m pan/ 2.4m multispectral  
16.5Km x 16.5 Km**



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# Aplicatii ale PAI: supraveghere

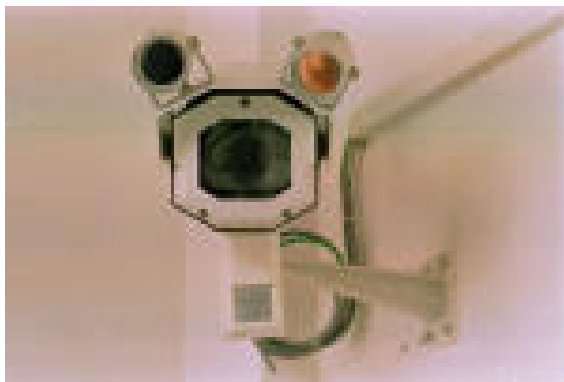
Securitatea incintelor

Prevenirea furtului la statiile de benzina

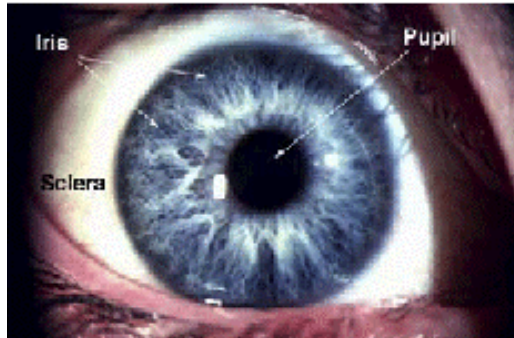
Prevenirea copierii la examene ?

Biometrie

Protectia persoanei



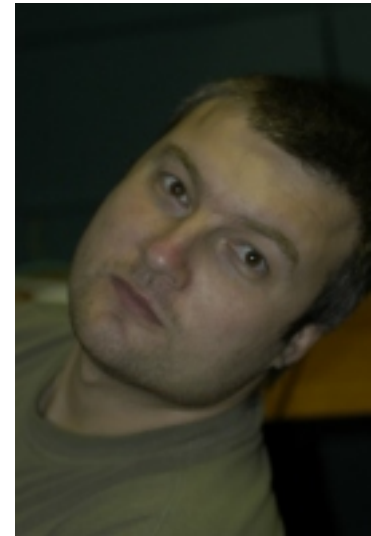
# Identificarea persoanelor



Iris



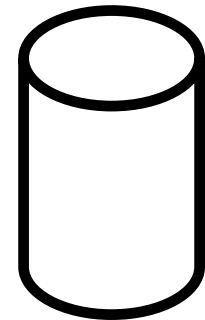
Amprenta digitala



Fata

01110010111.....

Recunoastere ?



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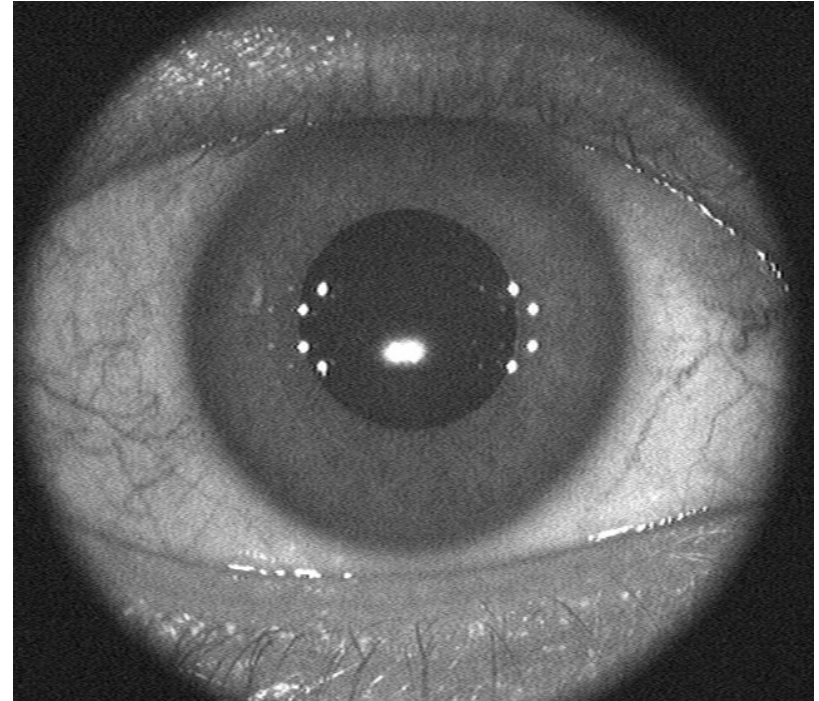
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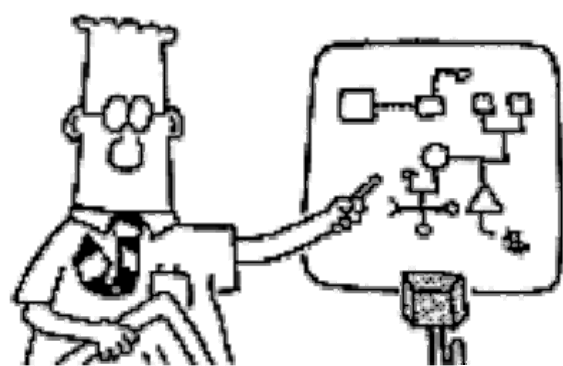
# Eye tracking and measurement

eye surgery

driver fatigue detection

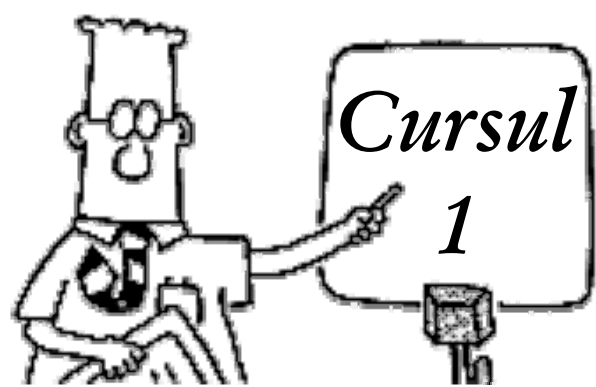
media and publicity





# Aplicatii ale PAI:

sky is the limit....



# Notiuni fundamentale



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# Tentative de definire

*Image processing holds the possibility of developing the ultimate machine that could perform the visual functions of all living beings.*

(Anil K. Jain, 1989)

*Prelucrarea si analiza imaginilor reprezinta un ansamblu de metode de transformare si interpretare a informatiei vizuale, reprezentate in forma digitala.*

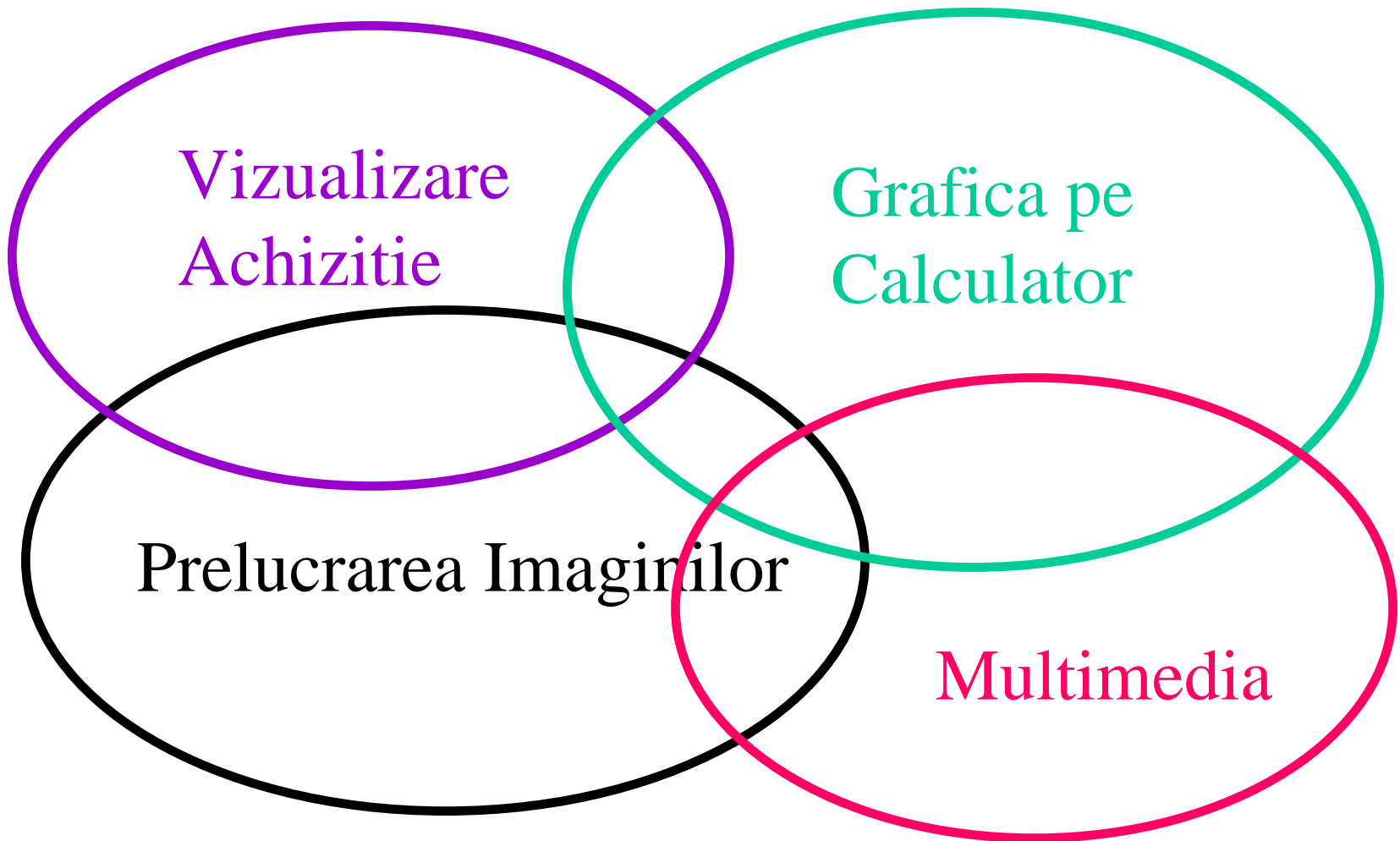
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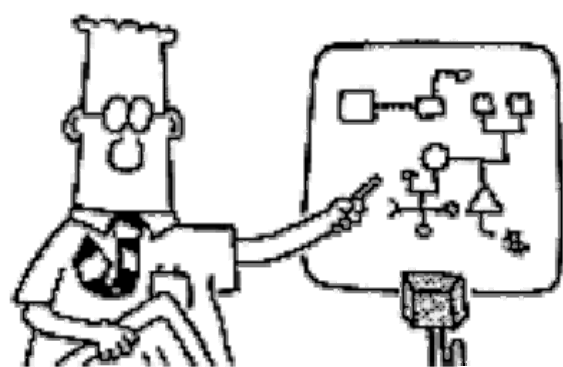
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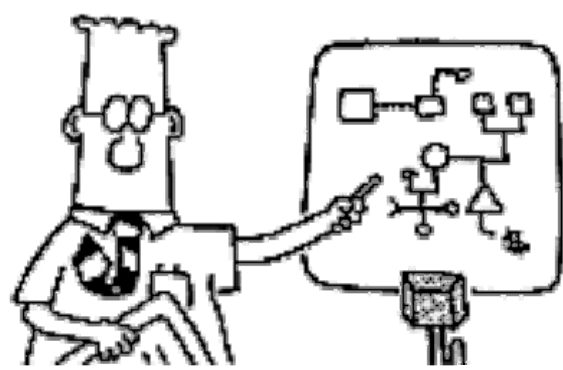
# Notiuni fundamentale

Sistemul tipic de PAI

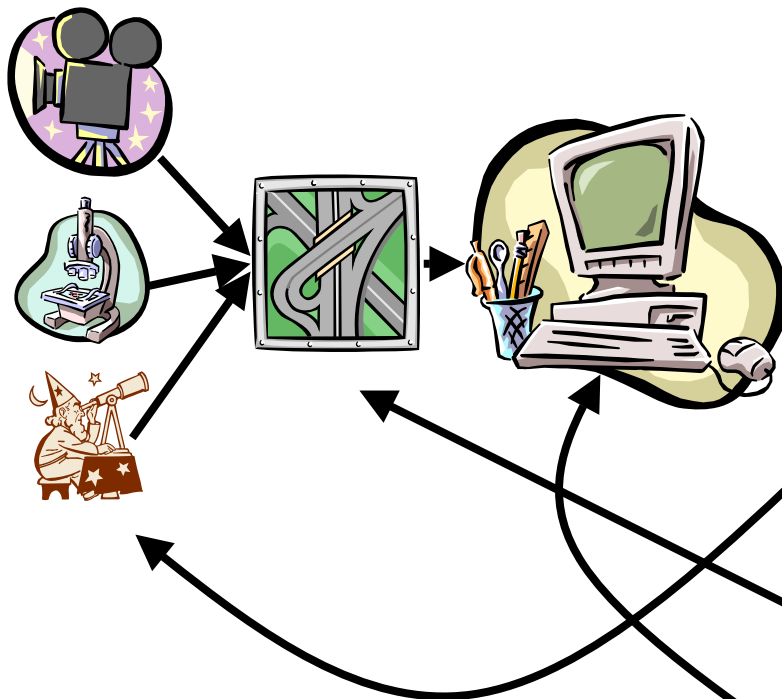
Pixelul

Clasificari

# Sistemul tipic de PAI

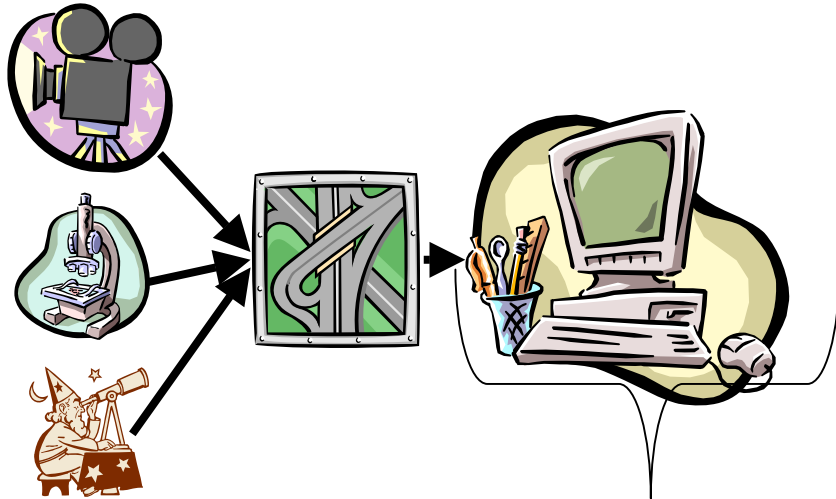
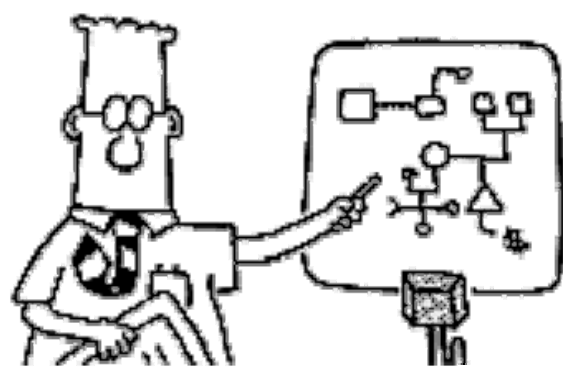


Compunere la nivel fizic :

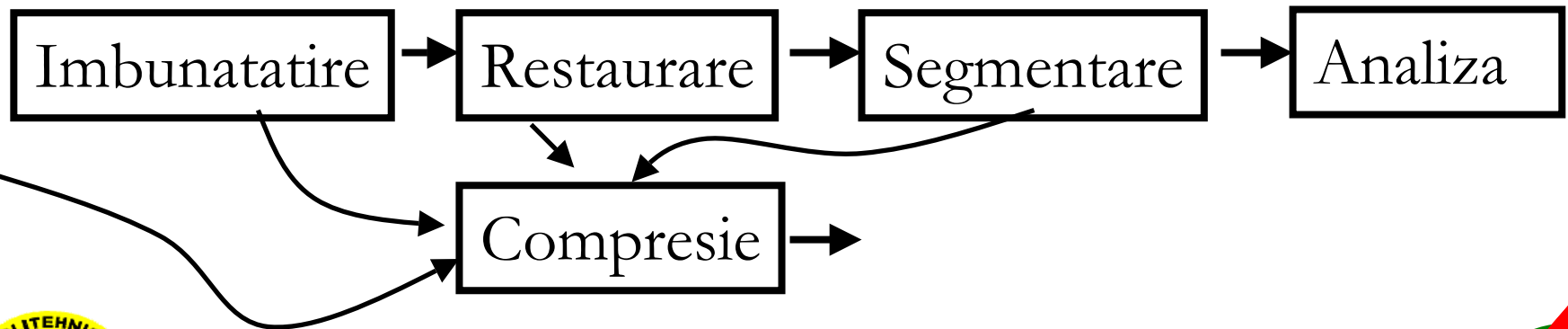


- senzor (traductor)
- esantionare si cuantizare
- sistem de calcul

# Sistemul tipic de PAI



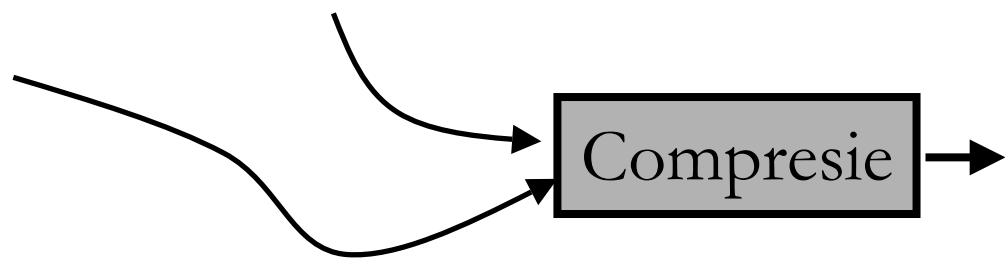
Compunere la nivel logic  
(in sistemul de calcul):



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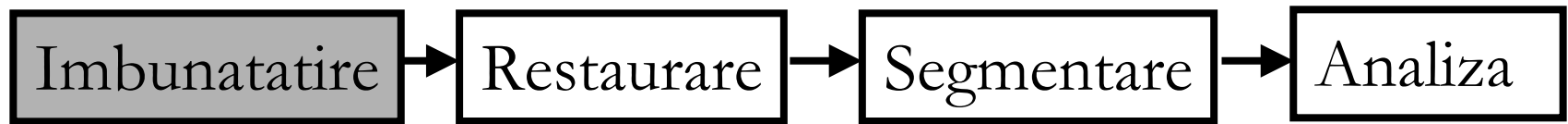
## Compresia:

Reducerea cantitatii de informatie (date) necesara stocarii/ transmiterii imaginii.



Compresie JPEG;  
Raport compr.=50

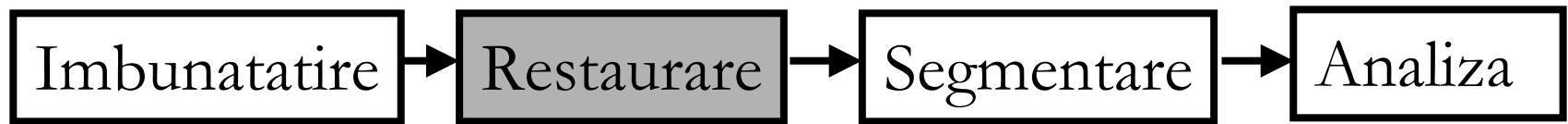




## Imbunatatirea:

Reducerea degradarilor perceptuale si/ sau aleatoare ale imaginii

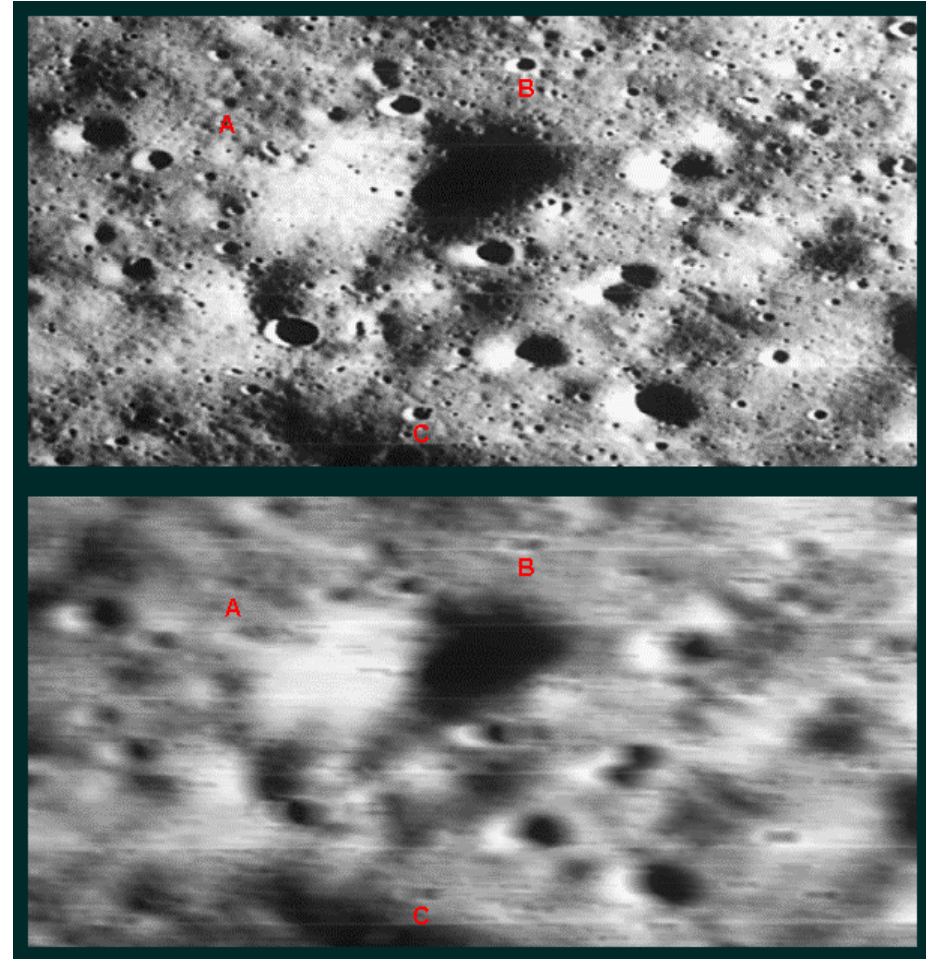


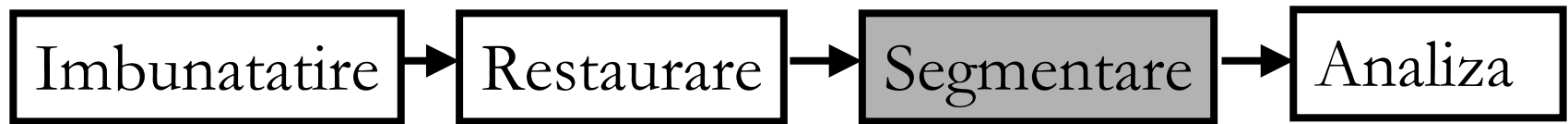


## Restaurarea:

Reducerea degradarilor deterministe ale imaginii:

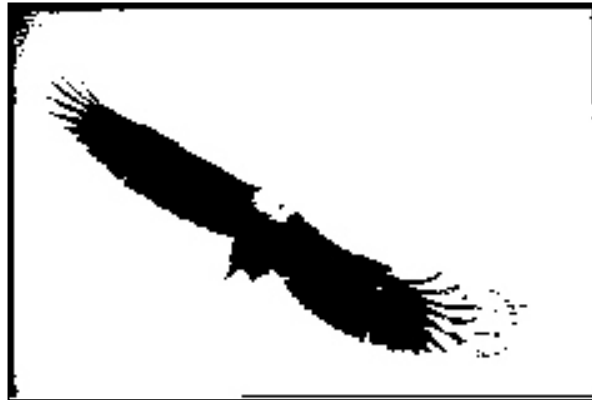
- focalizare
- compensarea miscarii
- defecte de optica ....

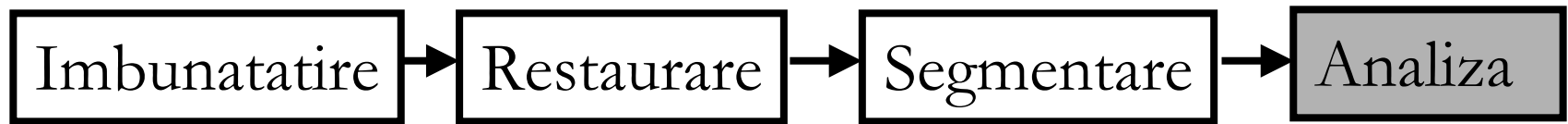




## Segmentare:

Descompunerea  
imaginii (scenei)  
in partile sale  
constituente.

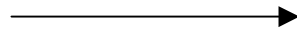
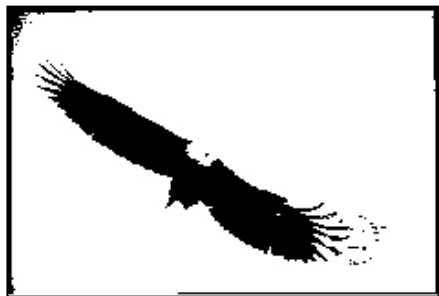




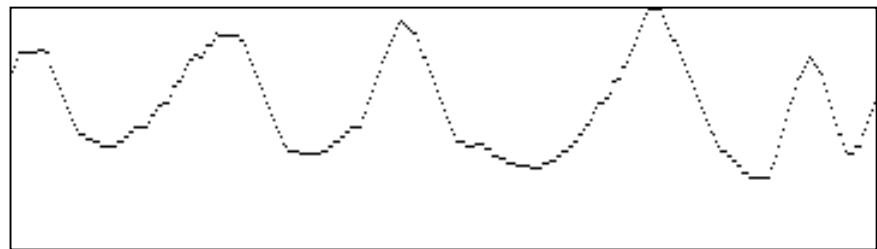
## Analiza:

Descrierea partilor (obiectelor) din imagine si a relatiilor dintre ele; decizii/ clasificari ...

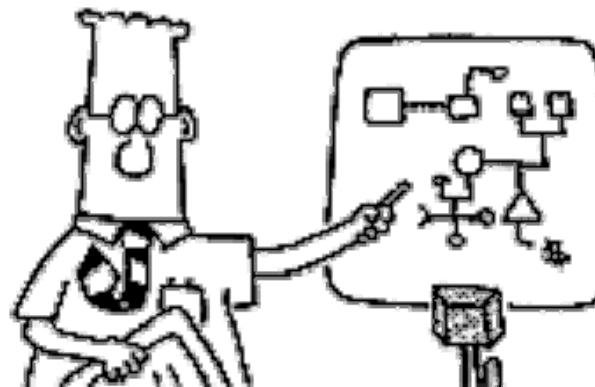
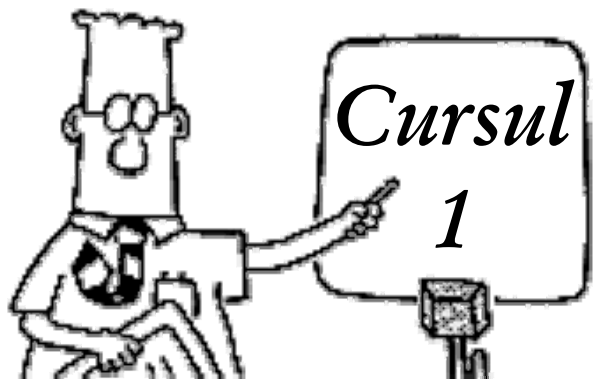
De la obiecte la numere (functii, schite, ...):



*011 000 111 ....*



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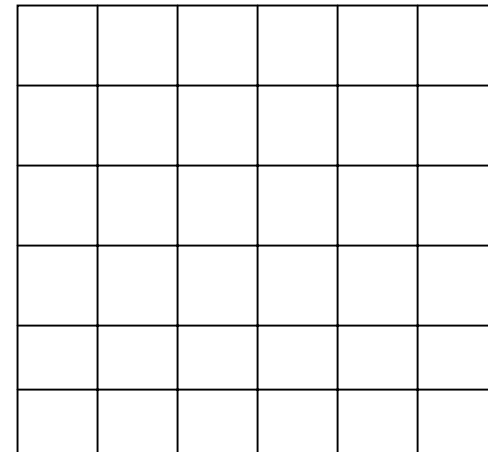




# Ce este imaginea ?

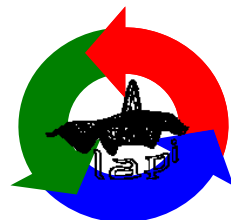
Imaginea este un ansamblu de valori plasate dupa o forma spatiala de dimensiune supra-unitara (plan, volum, ... dar nu o dreapta).

Simplist, imaginea poate fi interpretata ca un tablou sau matrice.



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# Elementul de baza al unei imagini

picture element = pixel

O mica analogie :

Imagine = mozaic sau puzzle

Pixel = pietricica din care se construiește mozaicul



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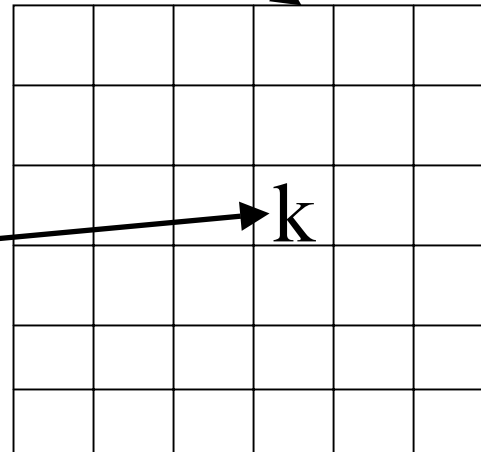
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# Caracteristicile pixelului

pozitie : linie, coloana

valoare



imagine

dimensiune

forma

legatura cu realitatea fizica

# Dimensiunea pixelului

Ce dimensiune are in scena reala obiectul care in imagine are 1 pixel ?

Dimensiune pixel =  $1 / \text{Rezolutie}$

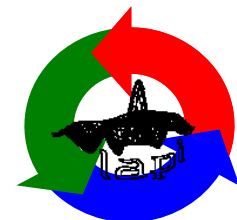
Ex: un document scanat

300 dpi  $\longrightarrow$  1 pixel =  $1 / 300''$



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# Forma pixelului

Esantionare

Problema acoperirii planului.



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# Ce fel de valori sunt in imagine ?

Valori **digitale**: numere reprezentate cu un numar finit de biti, dupa un format standard pentru un calculator [digital].

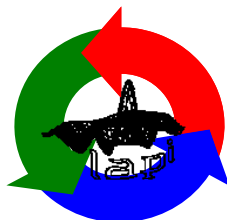
**Digital  $\neq$  Numeric**

Rezultatul oricarui calcul este numeric, dar nu orice numar este digital.



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# Clasificarea imaginilor dupa tipul valorilor

## Imagini scalare

Orice valoare e un scalar:

imagini monocrome (binare)

imagini alb-negru (cu nivele de gri)

## Imagini vectoriale

Orice valoare este un vector; imaginea vectoriala este un “sandwich” de imagini scalare.



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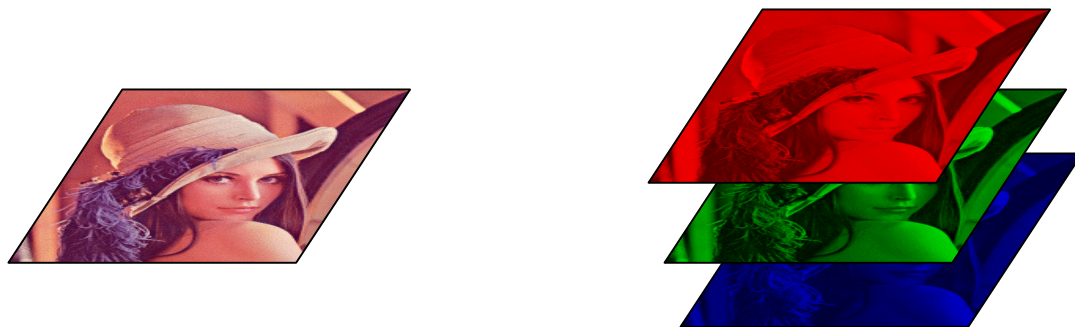
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# Imagini vectoriale

Imagini color: vectori de 3 componente

(R, G, B) - reprezentare tipica, dar nu unica



Imagini satelitare: vectori de 3 - 200 componente

Imagini termografice: vectori de 2 - 5 componente  
in banda de infrarosu



# Clasificarea imaginilor dupa semnificatia valorilor

## Imagini de intensitate

Valorile sunt direct proportionale cu marimea fizica masurata in scena.

## Imagini indexate

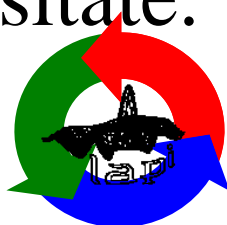
Valorile NU proportionale cu marimea fizica masurata in scena.

Valorile sunt indici (adrese) intr-un tabel asociat imaginii, in care se gaseste informatia de intensitate.

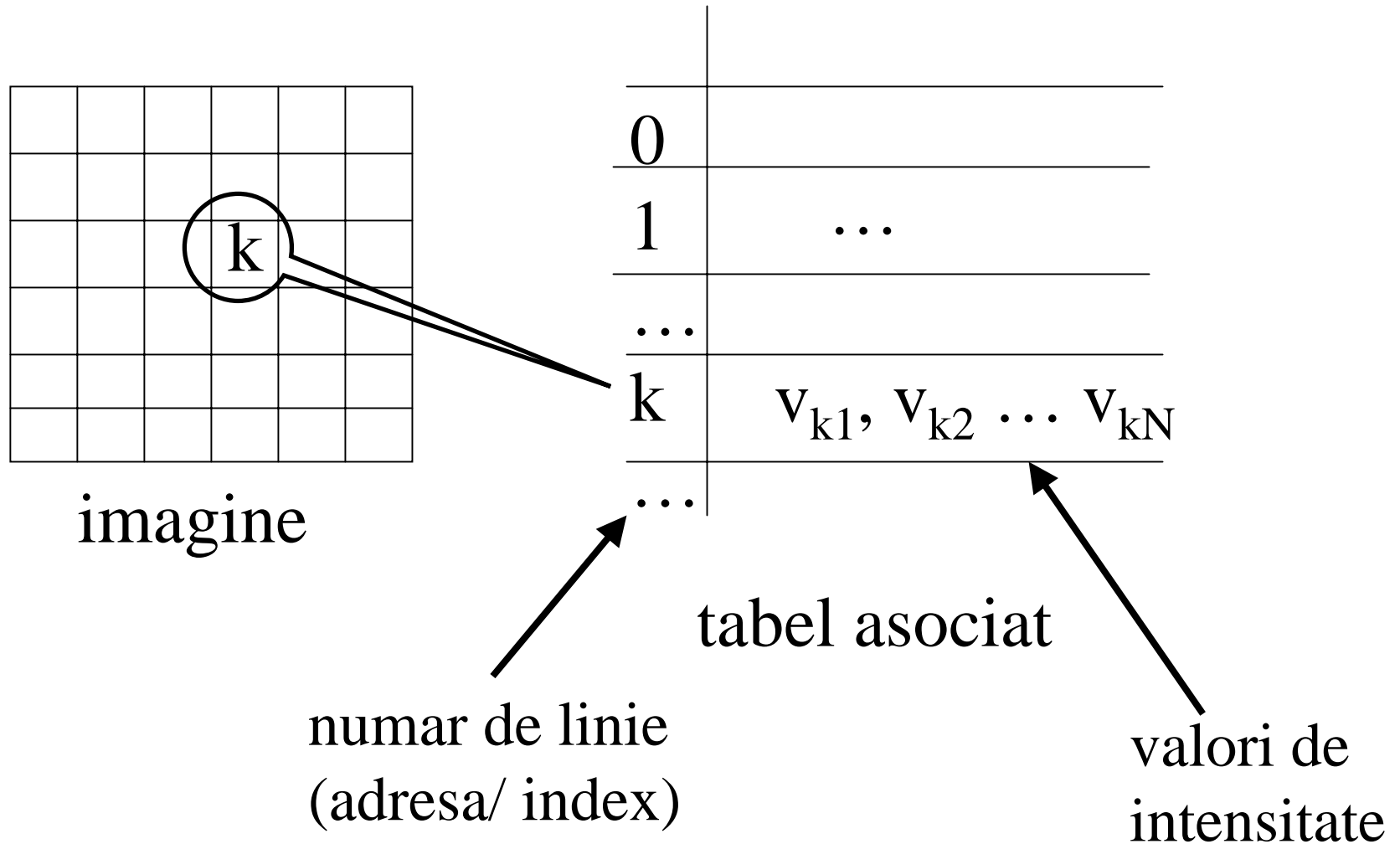


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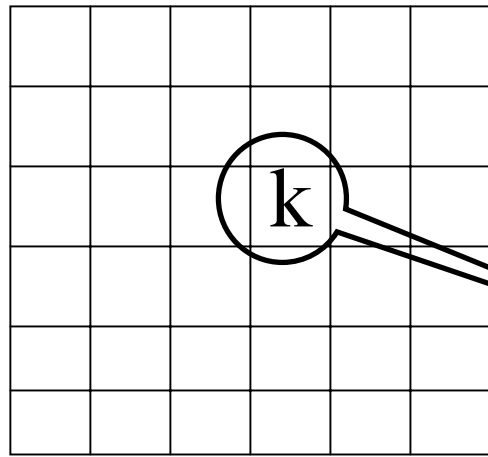
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# LUT - Look Up Table (mecanismul de indexare)



# Imagini color indexate



image

0	
1	
...	...
k	$R_k, G_k, B_k$
...	

tabel de culoare

Image  $\longrightarrow$  tabela de culoare  $\longrightarrow$  Afisare

# Valoarea pixelului vs. conventii de afisare

Imaginea ce se vede pe un ecran nu este neaparat informatia reala achizitionata din scena investigata.

In general, imaginilor li se adauga si conventiile de afisare a valorilor, ce sunt stabilite de utilizator.

Aceste conventii sunt deci subiective si independente de continutul imaginii.

Actiunea este de modificare a perceptiei vizuale a imaginii, si nu a continutului imaginii.



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