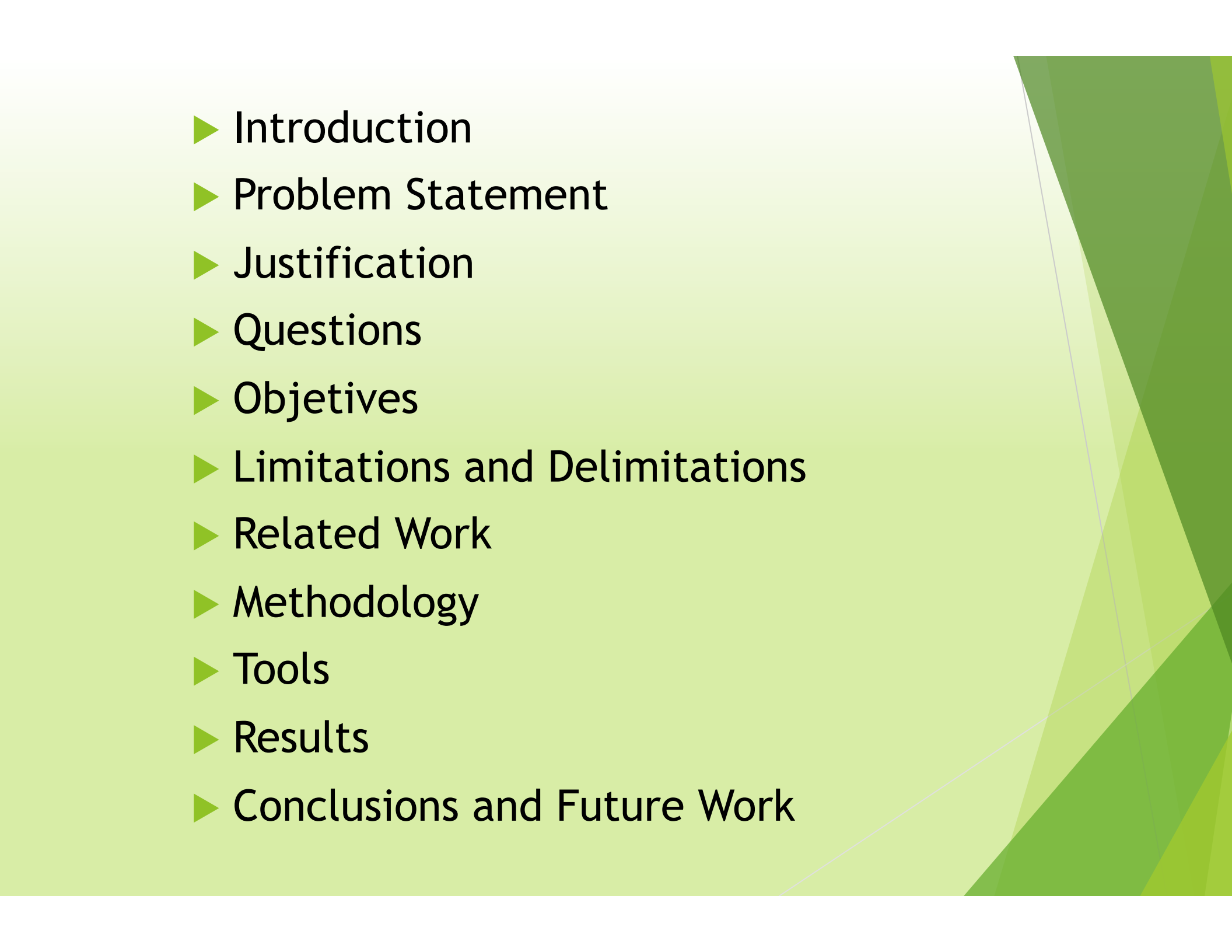


Detection of melanoma through image recognition and artificial neural networks

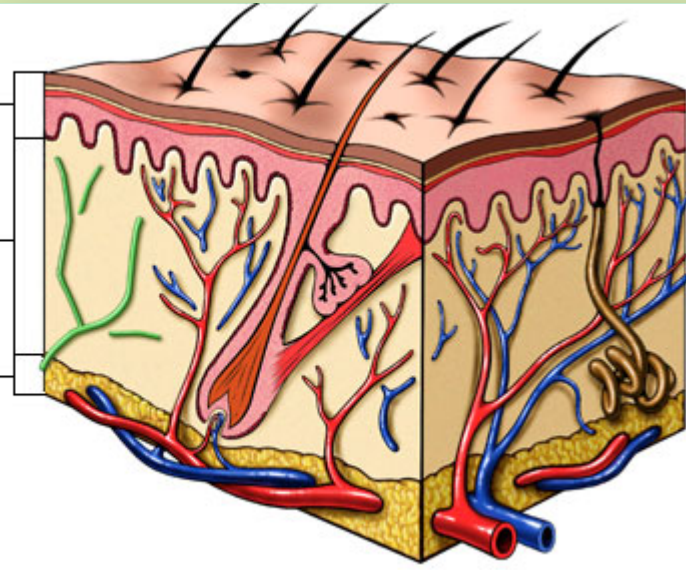
Cristofer Marín, Germán H. Alférez, Jency Córdova and Verenice González
Universidad de Montemorelos, Mexico



- 
- The background of the slide features an abstract design with various shades of green. On the right side, there are overlapping geometric shapes, including triangles and polygons, in different tones of green, creating a modern, layered effect. The rest of the background is a solid, light green color.
- ▶ Introduction
 - ▶ Problem Statement
 - ▶ Justification
 - ▶ Questions
 - ▶ Objectives
 - ▶ Limitations and Delimitations
 - ▶ Related Work
 - ▶ Methodology
 - ▶ Tools
 - ▶ Results
 - ▶ Conclusions and Future Work

Introduction

► The skin



anaturaldots.files.wordpress.com/2014/06/skinn.png?w=300&h=205



► Malignant melanom

Problem Statement

Level of knowledge



Infrastructure



Geographic zones

Justification

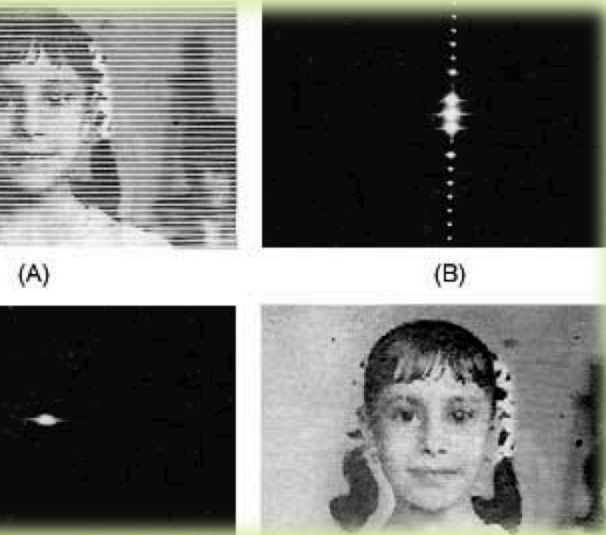
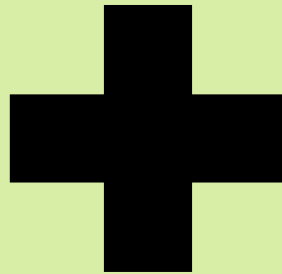


Image Processing

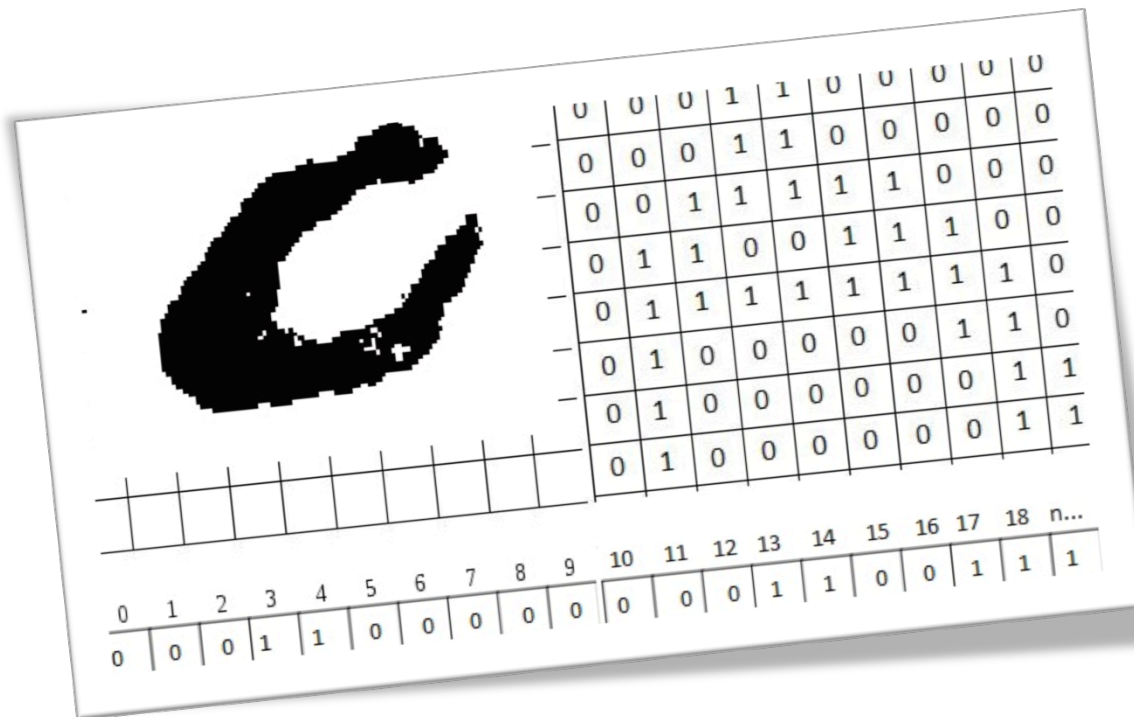


Artificial Neural Networks



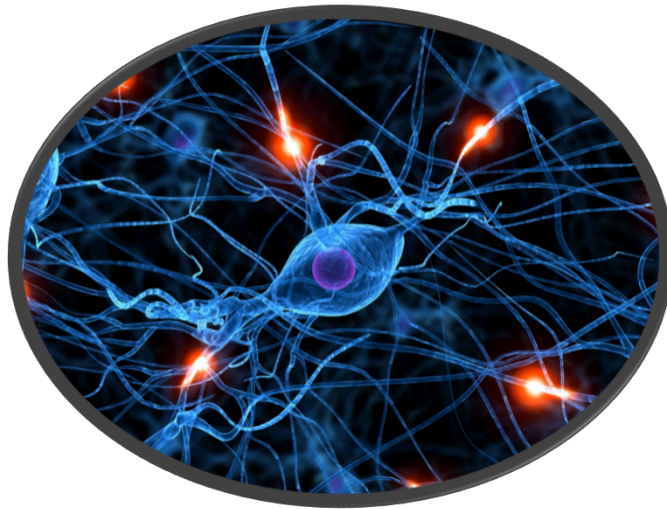
Question

Could the processing of nevi images and their analysis through artificial neural networks be used for the detection of malignant melanoma?



Objective

develop a simple, fast, automatic, non-invasive, and inexpensive software that detects malignant melanoma through the analysis of nevi, using image processing and artificial neural networks.



Limitations

Complete access to images

Limitations

Images with the least possible noise (luminosity, hairs, etc.)

Only skin cancer (malignant melanoma)

The variable of elevation (“E”) is omitted

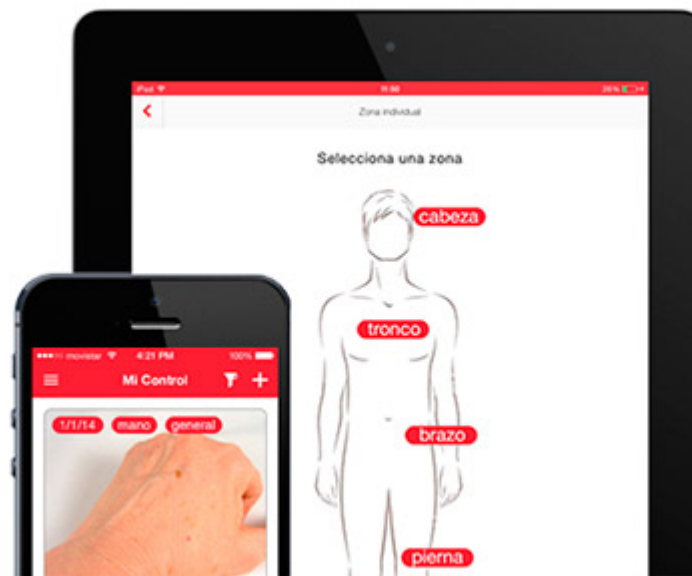
Only the ABCDE of lesions is used

lated Work



calexpo.es/prod/dermlite/dermatoscopio-luz-led-79388-506338.html

matoscopy



<http://fotoskinapp.com/sites/default/images/ipad2.png>

- There are approximately 300 applications for both Android and iOS (DoctorMole, DermoScreen, FotoSkin, etc.) with dermatological purposes and 22% of them have diagnostic purposes [1].

Related Work

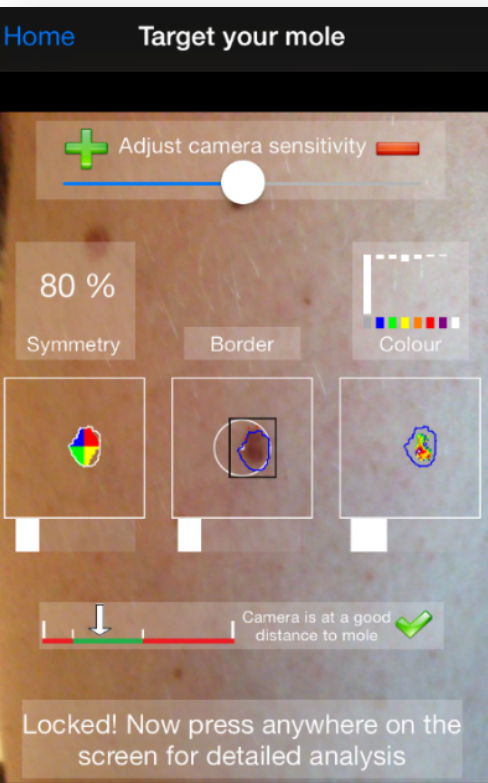
Research made in Taiwan compared the diagnosis capability of CADx (computer assisted diagnosis) and a group of dermatologists [2].

Sensitivity of 85.63% was found in the diagnosis made by the CADx and 83.33% in the clinical diagnosis.



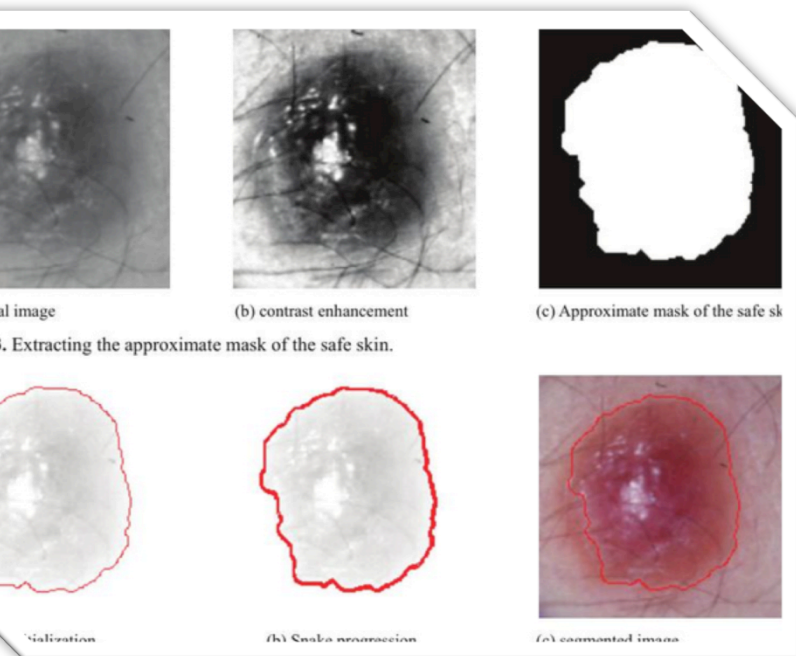
<http://www.naturallyhealthyskin.org/wp-content/uploads/2012/01/skin-cancer-melafind-182x300.jpg>

Related Work



Other authors reported mobile applications with a sensibility up to 98%. Nevertheless, the specificity remained in 30.4% [3].

Related Work



Khaled Taouil and his colleagues reported the design of a tool for the analysis of images through ANNs [4]. The sensibility reached in this work was of 74.9% and the specificity of 76.4%

!Caution!



Nothing substitutes a doctor

<http://melafind.com/archivos/styles/nota/public/portada/k=ugRgrhdX>



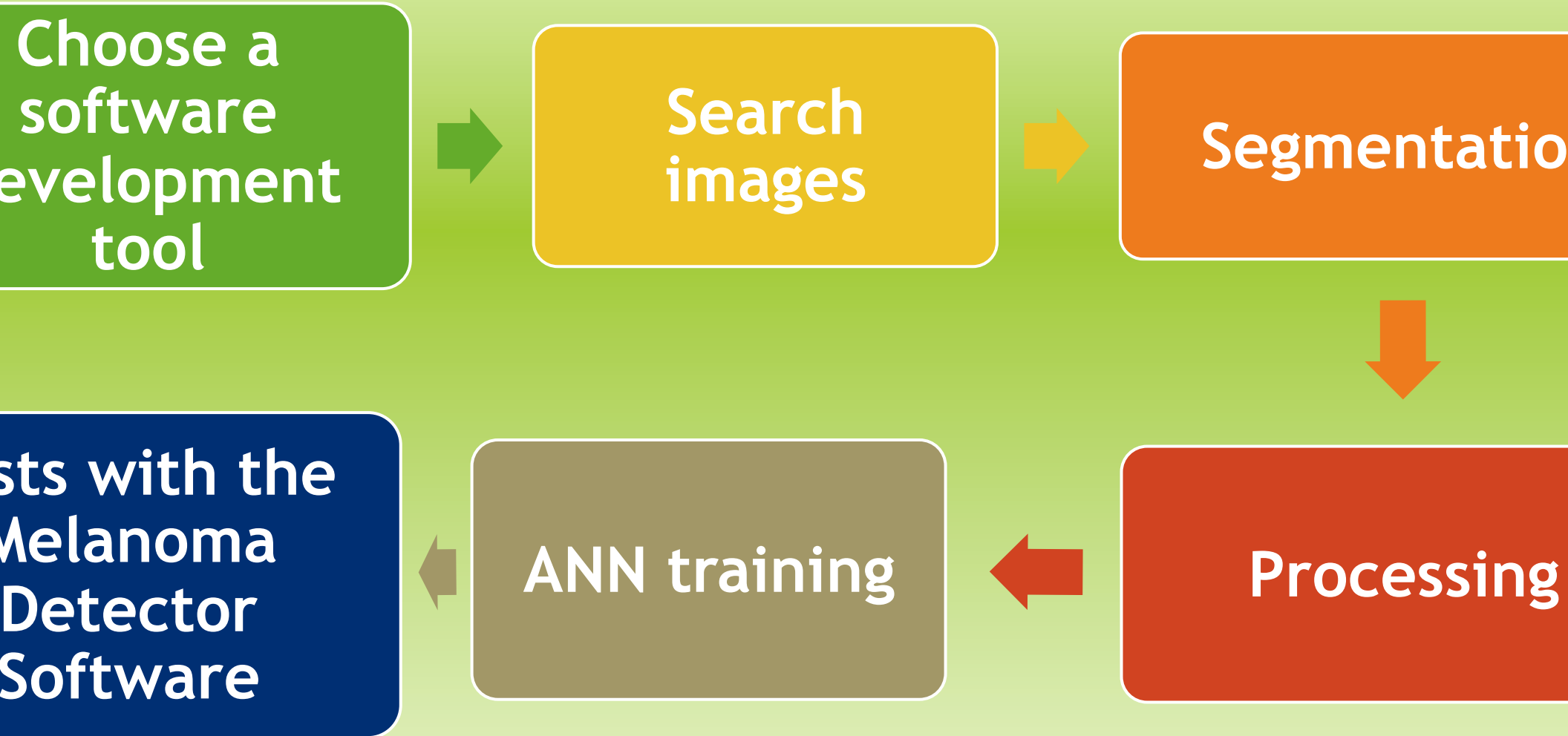
<http://melafind.com/de/wp-content/themes/melafind/img/hp-paciente.jpg>

ing substitutes a biopsy

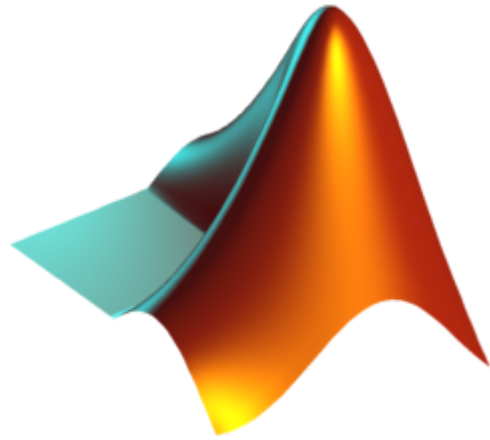


<http://consejosgratis.com/wp-content/uploads/2013/11/C%C3%B3mo-determinar-si-un-lunar-es-canceroso.jpg>

Methodology



Choose a Software Development Tool



Simulink (multidomain simulation platform)

GUIDE (user's interfaces editor - GUI)

Tool boxes

Image Search

Authors ExpSys: non-tumors ExpSys: tumors Login

lanocytes. Several variants exist.

predilection, more often on face and back (men) or lower extremities (women)

nding melanoma (SSM): most common form: slowly growing brown macule

a melanoma: develops from lentigo maligna (which is in situ melanoma of elderly people) when invasion appears

nomia: red, brown, black tumor, often ulcerating and/or bleeding

ous melanoma: nails, fingers, palms, soles

ariants: melanoma of mucous membrane, conjunctiva, amelanotic melanoma

- asymmetry, B — border, C — colour, D — diameter

(3857)

(3861)

(3863)

(3865)

unk:

C (807)

elanoma, trunk:

C (808)

ce:

C (809)

vanced:

C (811)

skinsight
for every body, everywhere.

research explore community widgets for professionals

research

Melanoma Information for adults

Table of Contents:

- Overview
- Who's At Risk
- Signs and Symptoms
- Self-Care Guidelines
- When to Seek Medical Care
- Treatments Your Provider May Prescribe
- References/Trusted Links

Related diseases:

- Basal Cell Carcinoma (BCC)

Small, but irregular, black and brown pigment is a sign of a melanoma, a serious skin cancer. Any new pigmented, itching, bleeding, or changing moles should be checked by your doctor.

Overview

advertisement

Baby's Skin needs special care

Let the Infant Skin Resource be your guide to healthy baby skin

Learn more about Infant and Child Skin Care

advertisement

skinsight

La sentencia "A.B.C.D"

Asymmetry Border Irregularity Color 1/4 inch diameter

Evolution

Melanoma de Piel

Melanoma

Do you have any moles on your body that look like these?

de dos lesiones pigmentadas en el tórax anterior.

n del caso

un paciente masculino de 42 años de edad, residente del Distrito Federal, que acudió al servicio por presentar dos lesiones pigmentadas, localizada en el hombro derecho, por una neoformación pigmentada de

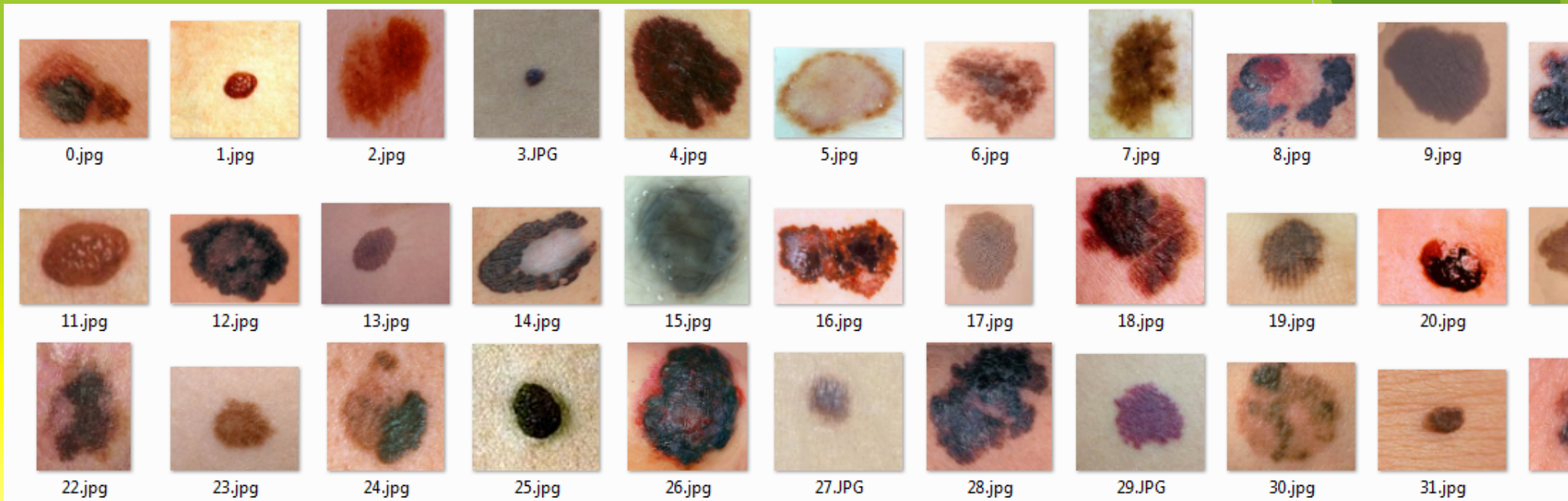
Figura 2. A: neoformación pigmentada de color negro, bien delimitada, con bordes irregulares. B: dermoscopia con patrón de pigmento homogéneo de color azul-blanquecino y proyecciones radiales en la periferia. C y D: histopatología que muestra una proliferación asimétrica mal delimitada de melanocitos atípicos; algunos epiteloides otros fusiformes, con núcleo grande, pleomórfico e hiper cromático.

Manchas Benignas

- Queratosis Seborreicas
- Lentigos solares
- Melasma
- Efélides (pecos)
- Fibromas
- Lunares



Population and sample



total of images used: 355 images of nevi. 205 images of nevi diagnosed with melanoma
150 images of benign nevi.

training: 50 images of nevi with melanoma and 50 images of nevi without melanoma.

for the test (Melanoma): 155 images of nevi diagnosed with melanoma.

for the test (Benign): 90 images of nevi diagnosed like benign.

Segmentation

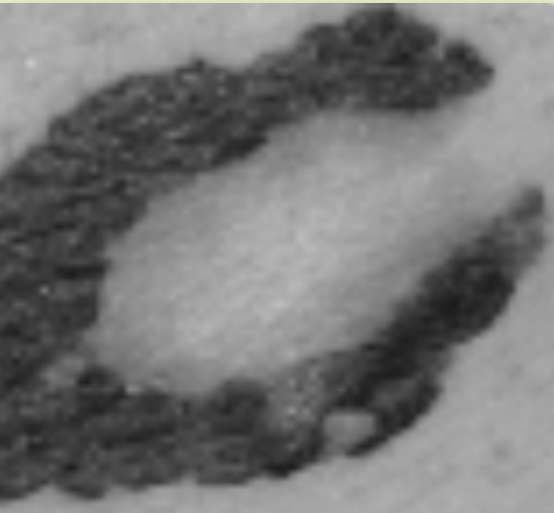


ected nevus



Separated segme

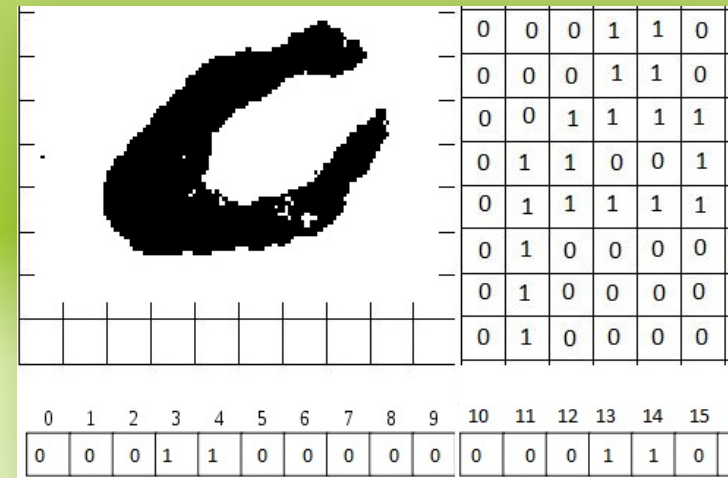
Processing



```
imgGray = rgb2gray(img_crop);
```

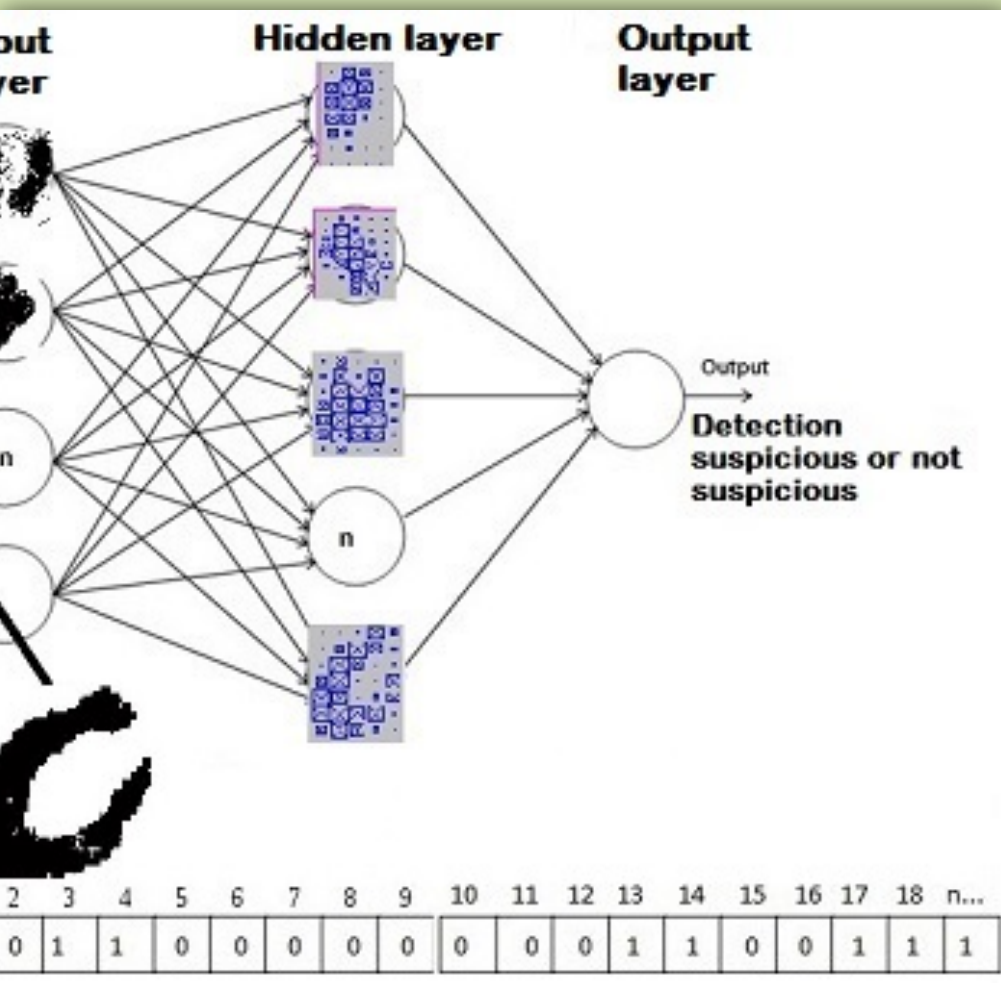


```
im2bw(img_crop,graythresh(imgGray));  
or=bwareaopen(bw,30);
```



NN Training

Multilayer perceptron

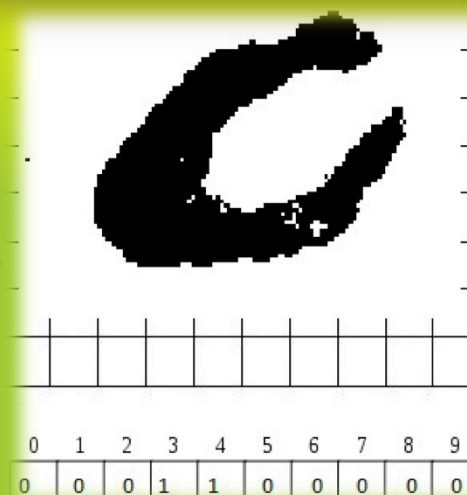


- Maximum number to converge: 5,000
- Minimal error: 0.01
- Feedforward Backpropagation
- Supervised Learning

IN Training



```
function botonentrenar_Callback(hObject, eventdata, handles)
%% Read the image
for cnt = 0:99 %%for image ordered 0-89
imagen = imread(['C:/Users/iam/Documents/MATLAB/CancerDetector/imagenes/', int2str(cnt), '.jpg']);%read
axes(handles.imagenRGB);
imshow(imagen);
imgGray = rgb2gray(imagen);%escala de grises
bw = im2bw(imagen,graythresh(imgGray));%Convertir imagen a imagen binaria, basado en umbral
%Imprime binario
BMejor=bwareaopen(bw,30);%Encuentra pixeles desconectados y los elimina
axes(handles.imagenbinaria);
imshow(BMejor);
axes(handles.imagenGrises);
imshow(imgGray);
bw2 = ajustarAlTamanoDeLaImagen(BMejor);
axes(handles.imagenAjustado);
imshow(bw2);
```



0	0	0	1	1	0	0	0	0	0
0	0	0	1	1	0	0	0	0	0
0	0	1	1	1	1	1	0	0	0
0	1	1	0	0	1	1	1	0	0
0	1	1	1	1	1	1	1	1	0
0	1	0	0	0	0	0	1	1	0
0	1	0	0	0	0	0	0	1	1
0	1	0	0	0	0	0	0	1	1

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	n...
0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	1	1	1

IN Training

```

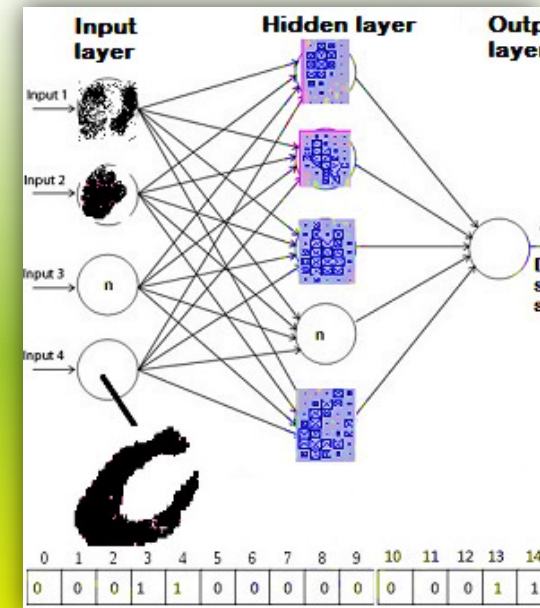
rea los vectores para los patrones y su respectiva salida ()
untoDeEntrenamiento(:,1:100); %%Número de imagenes
tores de dos
e(2) eye(2) eye(2) eye(2) eye(2) eye(2) eye(2) eye(2) eye(2)
mos,entrenamos y guardamos la red neuronal
.net = crearRedNeuronal(P,T);%%Llamamos a la función crearRedNe
rearRedNeuronal(P,T);%%Variable para almacenar el entrenamiento
anningAnn net%guardamos red neuronal en un archivo en el path

```

```

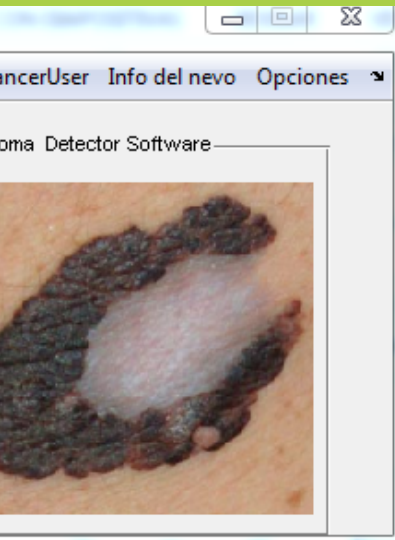
ed = newff(minmax(nevos),[S1 S2],{'tansig' 'logsig'},'traingdx');
ed.LW{2,1} = red.LW{2,1}*0.01;
ed.b{2} = red.b{2}*0.01;
ed.performFcn = 'sse'; %%Suma Square error
ed.trainParam.goal = 0.01; %%Objetivo para converger
ed.trainParam.show = 20; %%Actualizar salida de entrenamiento cada ciertos epoch
ed.trainParam.epochs = 5000; %%número máximo de iteraciones para que la red converja
ed.trainParam.mc = 0.95; %%Momentum constante
ed = train(red,nevos,salidaDeseada); %%Entrenamiento de la red se le envia la red
%%los patrones a reconocer en este caso los nevos y además las salidas
%%deseadas que representan un caracter.

```



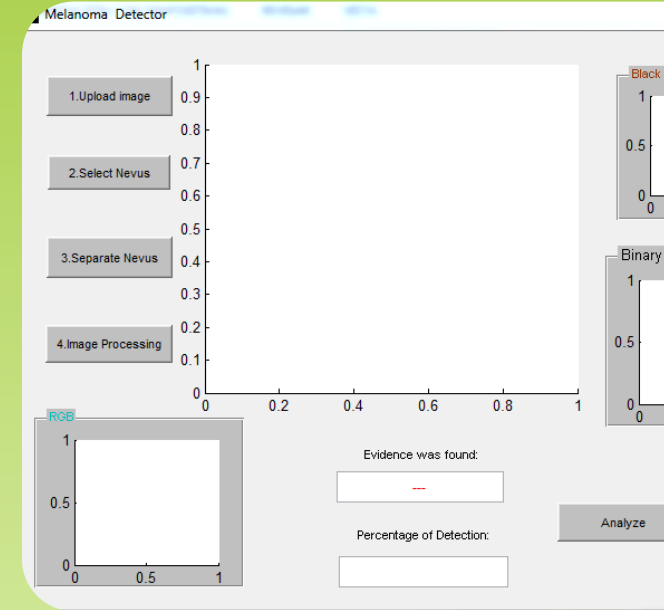
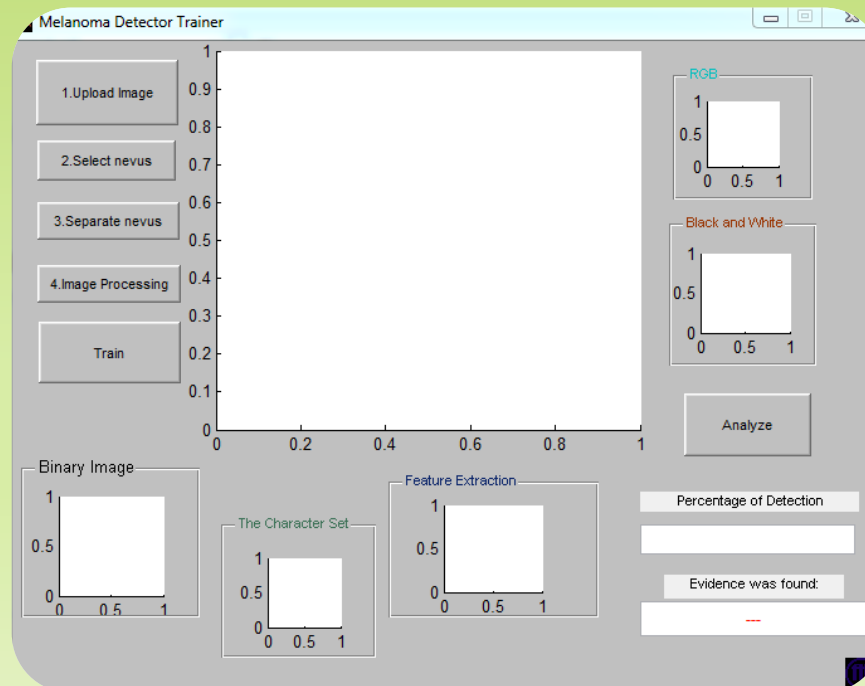
Create the Artificial Neural Network

Melanoma Detector Software



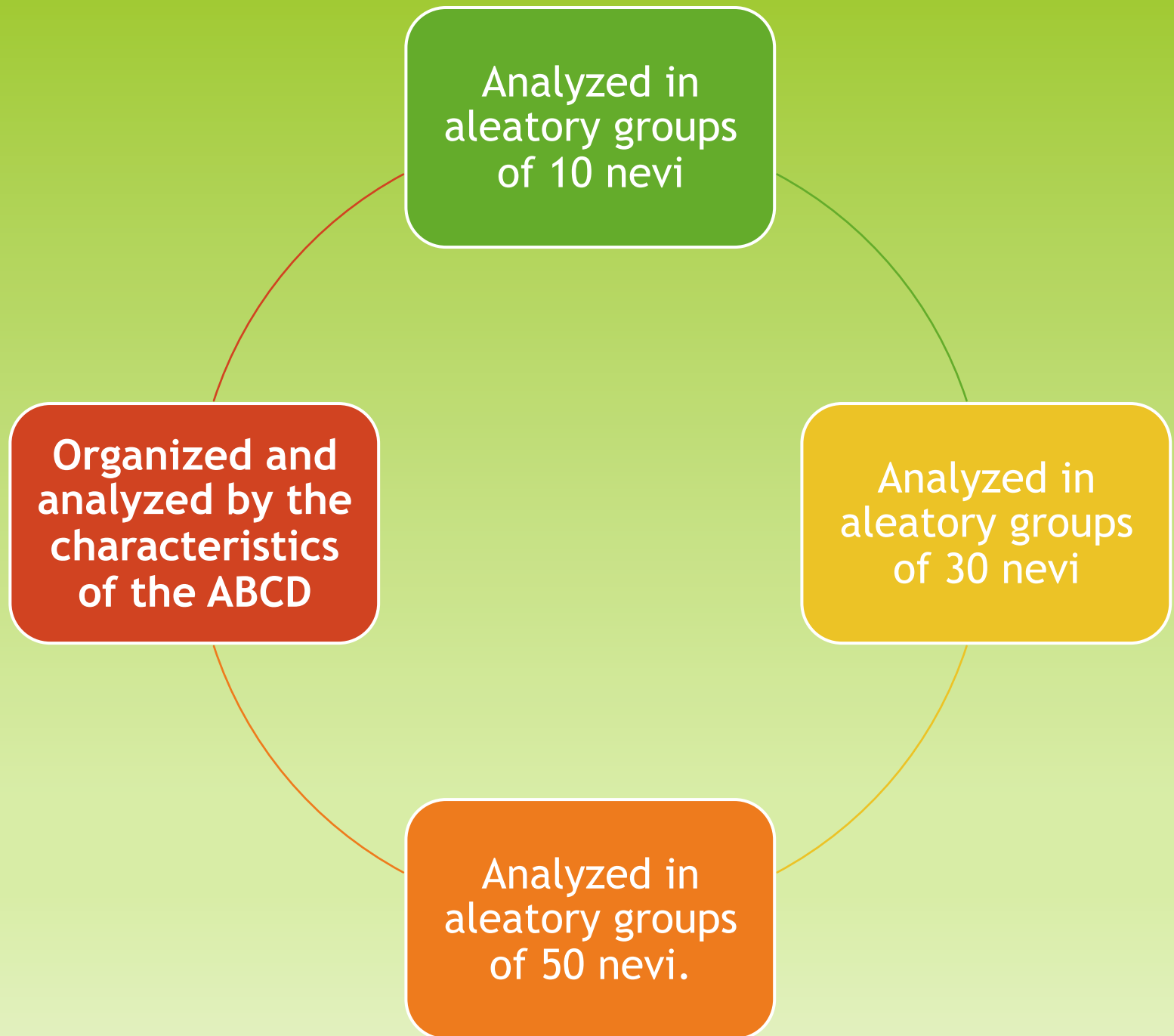
Menu

Melanoma Detector Trainer



Melanoma Detector

Tests



Results

Sensitivity: $TP/TP+FN$

Positive predictive value: $TP/TP+FP$

Specificity: $TN/TN+FP$

Negative predictive value: $TN/TN+FN$

TN: True negatives
FP: False positives

TP: True positives
FN: False negatives

Results

benign nevi training	# of malign nevi in training	Sensibility	Specificity
	15	76.75%	87.14%
	24	76.06%	87.18%
	25	76.89%	87.82%
	30	80.34%	89.03%
	40	89.01%	91.03%
	50	<u>90.00%</u>	<u>93.01%</u>

“Melanoma Detector” has an average predictive positive value (PPV) of **86.5%** and a predictive negative value (PNV) of **79.09%**.

Conclusions

software that enables the analysis of suspicious skin lesions for the detection of melanoma with image recognition techniques and ANNs.

We plan to freely distribute this software to medical doctors in rural or remote areas.

- ▶ The software will allow them to carry out objective evaluations of suspicious nevi in spite of limited experience in the area of dermatology and/or the lack of state-of-the-art equipment.

Future Work

Consider and add parameters of evaluation: skin color, age, sex, nationality, location of the nevus, etc.

Test the tool with a control group and a case group.

Migrate the software to a mobile application.

Exclusively use normal nevi pictures taken by our team for software training.

Develop a bank of clinical images with biopsy-diagnosed melanoma in people of Latin American origin.

References

rewer, A. C., D. C. Endly, et al. (2013). "Mobile applications in dermatology." JAMA dermatology **149**(11): 1300-1304.

hang, W.-Y., A. Huang, et al. (2013). "Computer-aided diagnosis of skin lesions using conventional digital photography: a reliability and feasibility study." PloS one **8**(1): e76212.

neidenari, S., G. Pellacani, et al. (2006). "Asymmetry in dermoscopic melanocytic lesion images: a computer description based on colour distribution." Acta dermato-venereologica **86**(2): 123-128.

ouil, K., Z. Chtourou, et al. (2010). "A robust system for melanoma diagnosis using heterogeneous image databases." Journal of Biomedical Science and Engineering **3**(06): 576.