Detection of melanoma through image recognition and artificial neural networks

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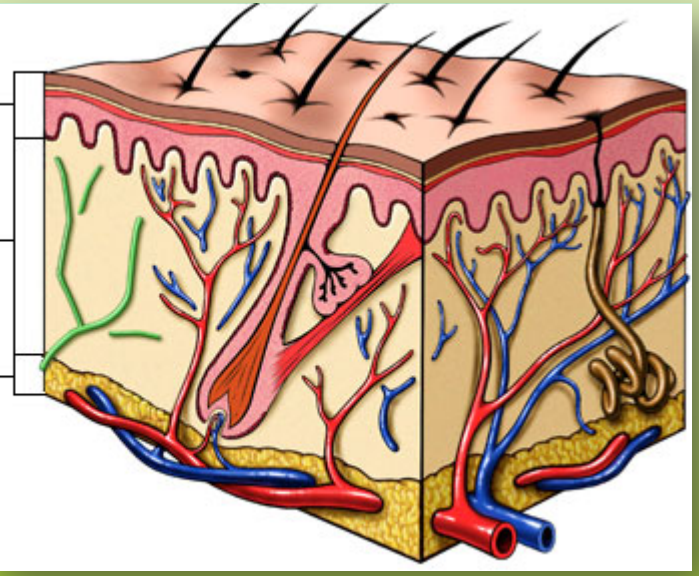
- Introduction
- Problem Statement
- Justification
- Questions
- Objetives
- Limitations and Delimitations
- Related Work
- Methodology
- Tools
- Results
- Conclusions and Future Work

Introduction

- The skin



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

- Malignant melanom

Problem Statement

vel of knowledge

Infrastructure

Geographic zones

Justification

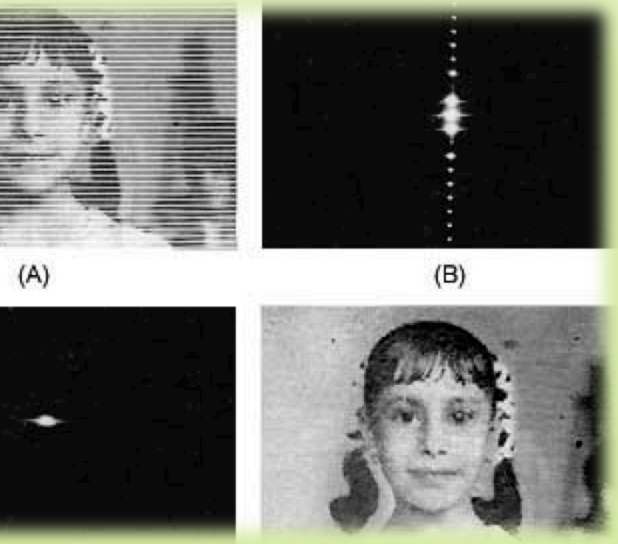
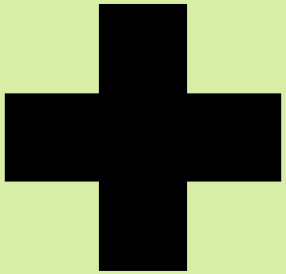


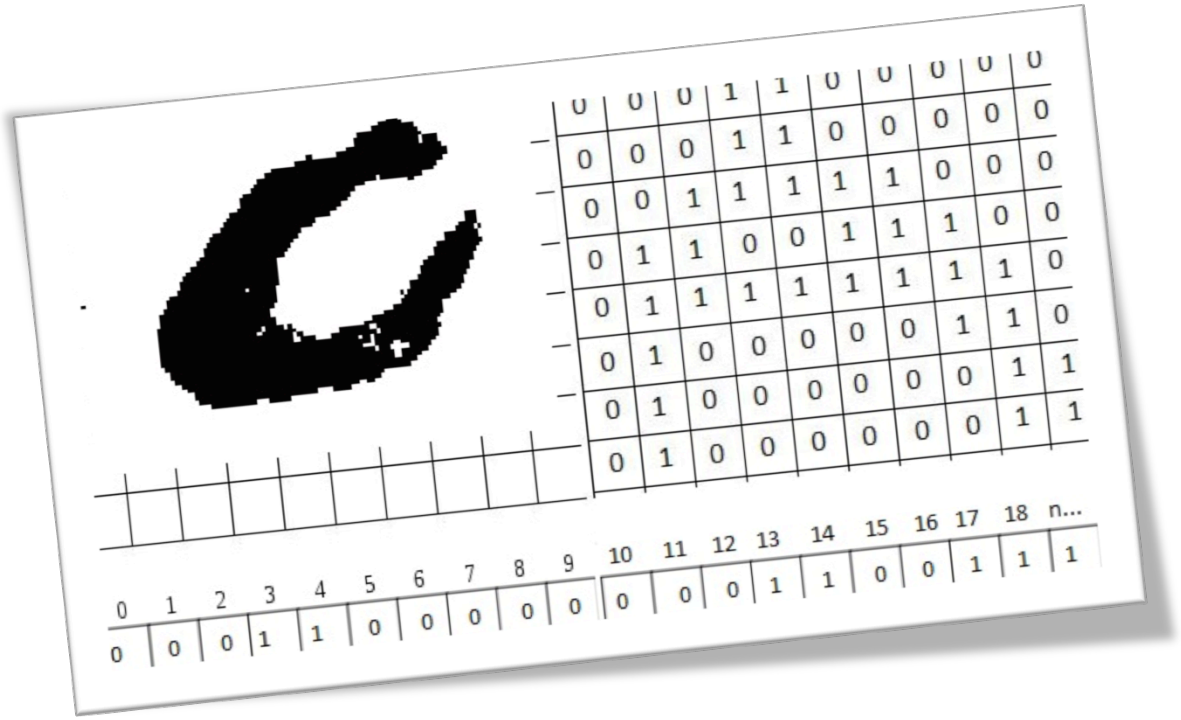
Image Processing



Artificial Neural Networks

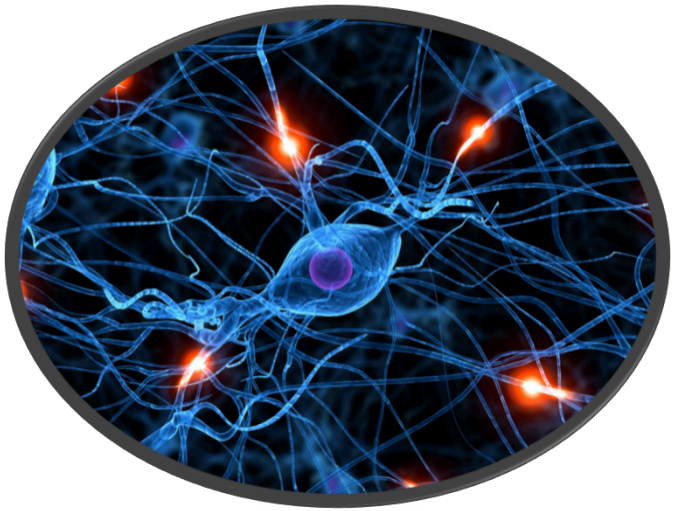
Question

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



Objetive

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



mitations

omplete access to images

elimitations

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

nly skin cancer (malignant melanoma)

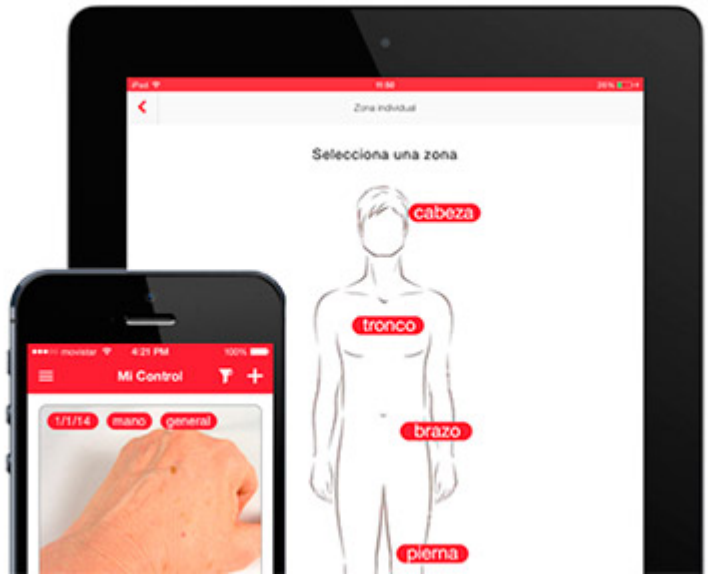
ne variable of elevation (“E”) is omitted

nly the ABCDE of lesions is used

lated Work

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

natoscopy



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].

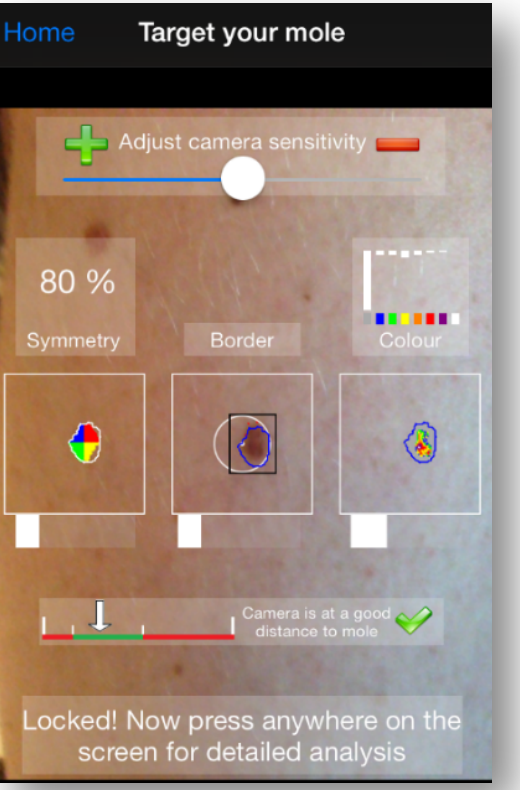
Related Work

esearch made in Taiwan compared the
gnosis cabability of CADx (computer
sted diagnosis) and a group of
matologists [2].

sensibility of 85.63% was found in
e diagnosis made by the CADx and
n 83.33% in the clinical diagnosis.

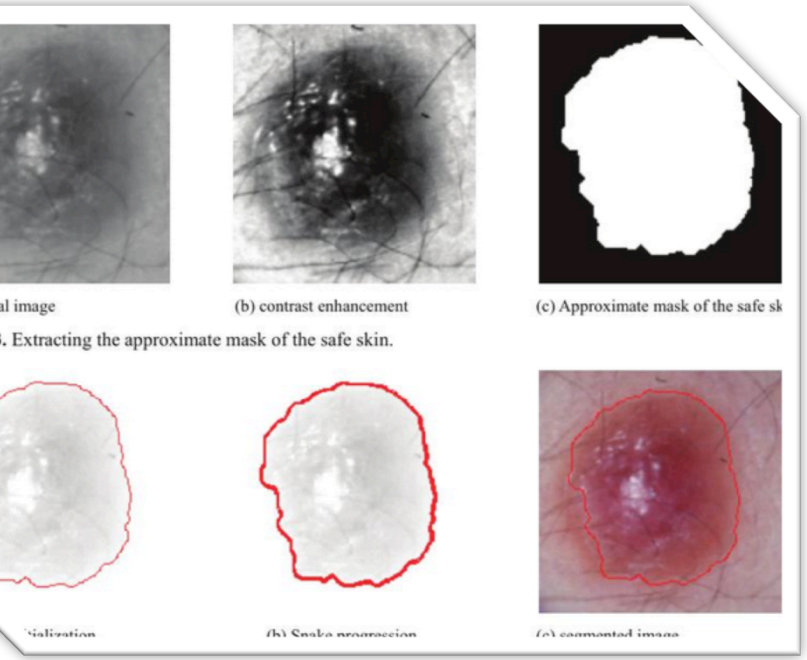
http://www.naturallyhealthyskin.org/wp-content/uploads/2012/01/skin-cancer-melafind-182x300.jpg

Related Work



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

elated 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!

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k=ugRgrhdX

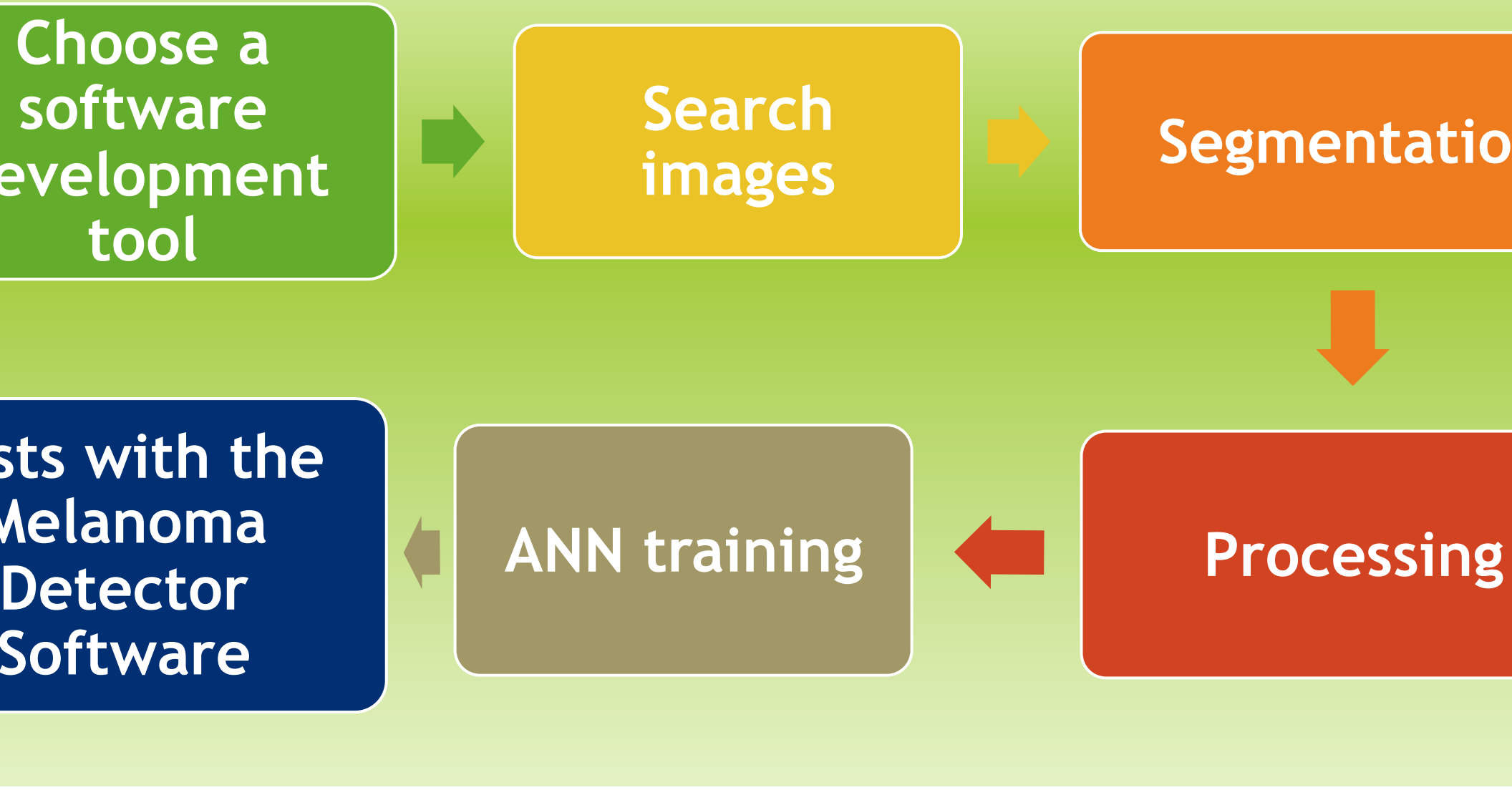
Nothing substitutes a doctor

http://melafind.com/de/wp-content/themes/melafind/img/hp-promo-m

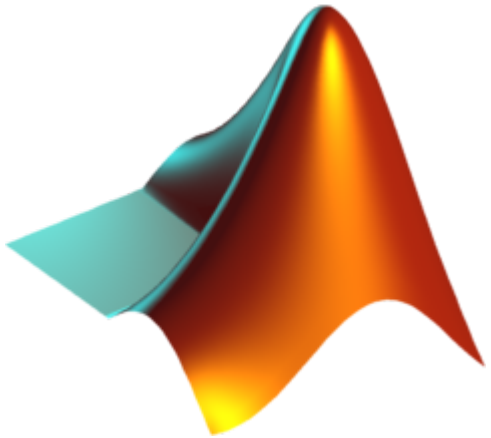
ing substitutes a biopsy

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

Methodology

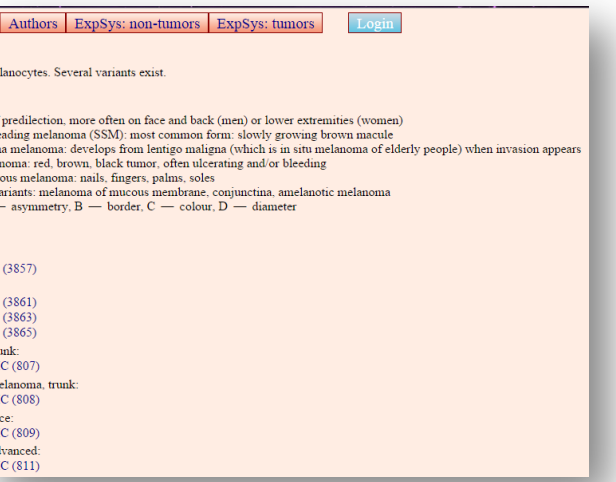


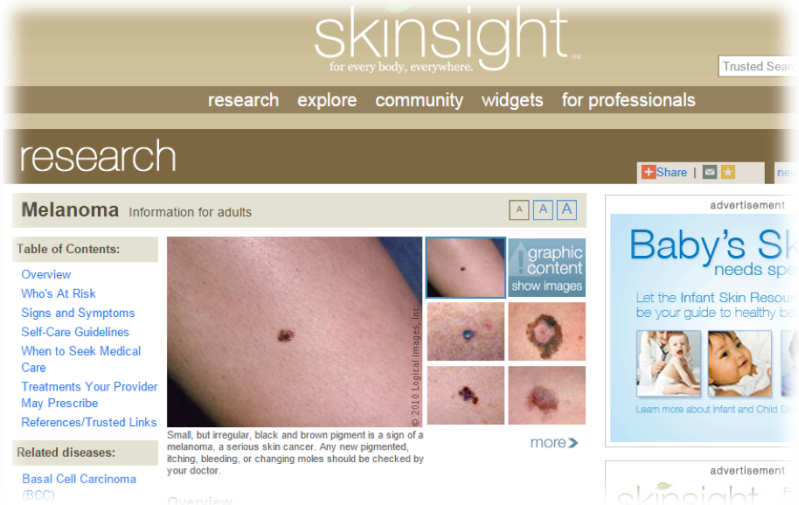
oose a Software Development Tool

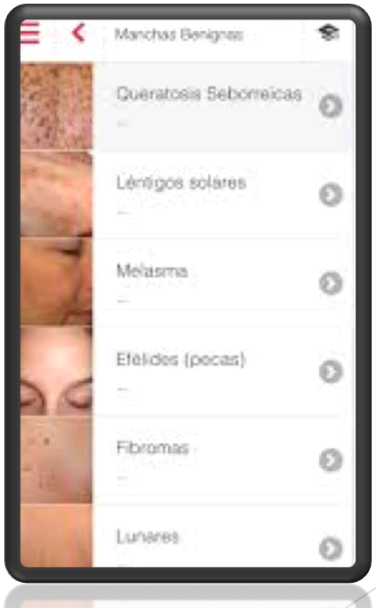


- **Simulink (multidomain simulation platform)**
- **GUIDE (user's interfaces editor - GUI)**
- **Tool boxes**

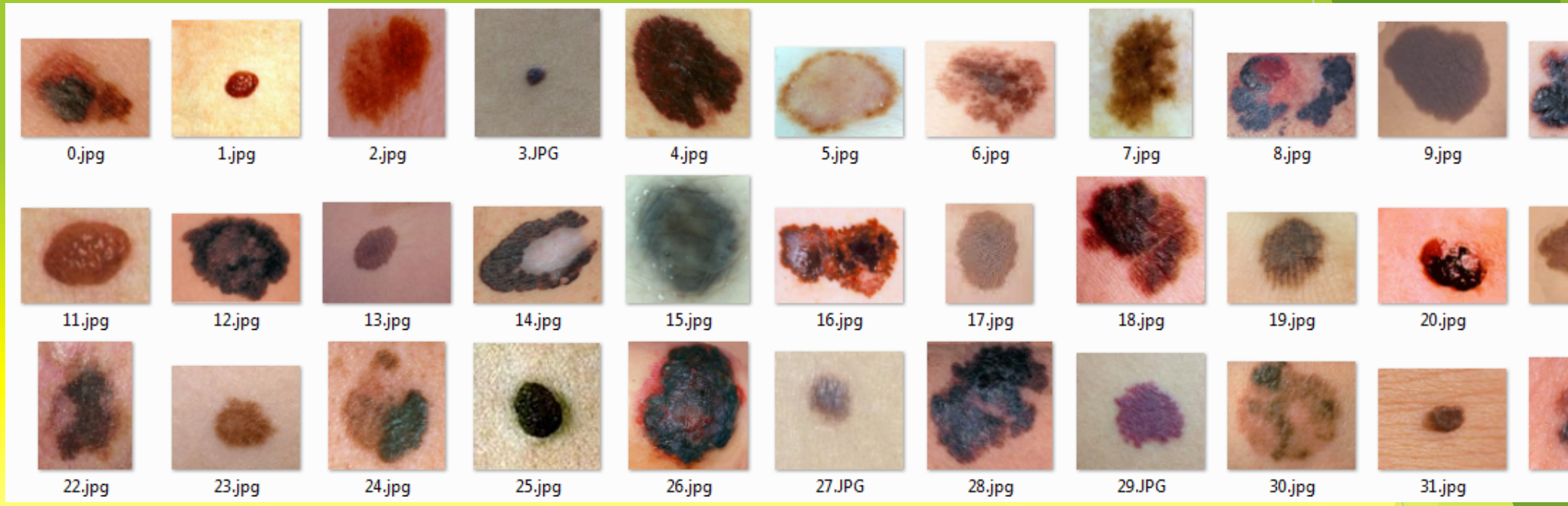
Image Search







Population and sample



tal of images used: 355 images of nevi. 205 images of nevi diagnosed with melanoma
0 images of benign nevi.

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

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

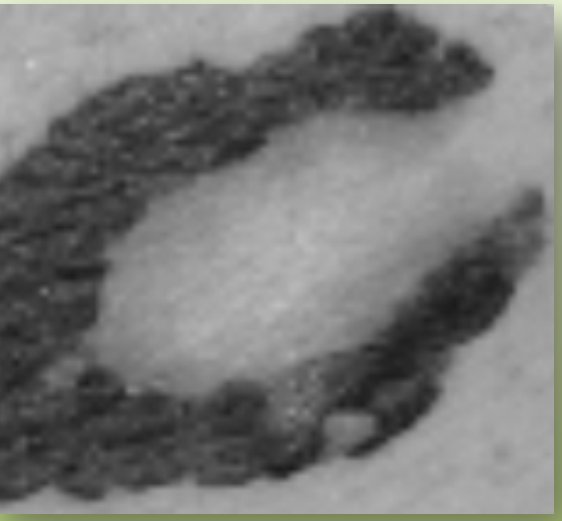
r the test (Benign): 90 images of nevi diagnosed like benign.

Segmentatio

ected nevus

Separated segme

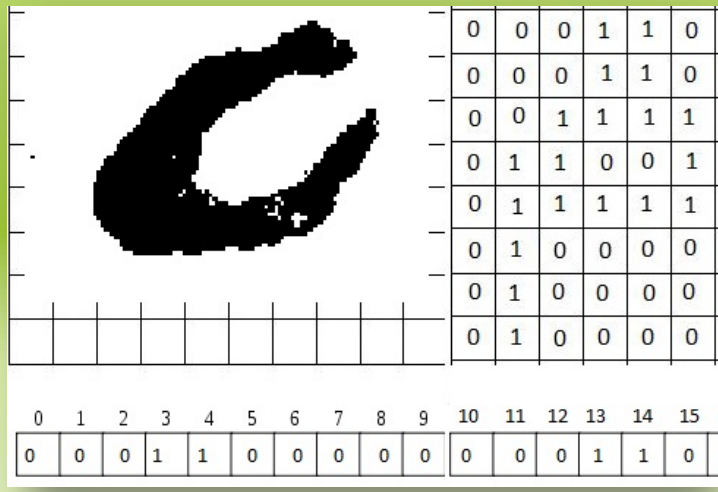
Processing



imgGray = rgb2gray(img_crop);

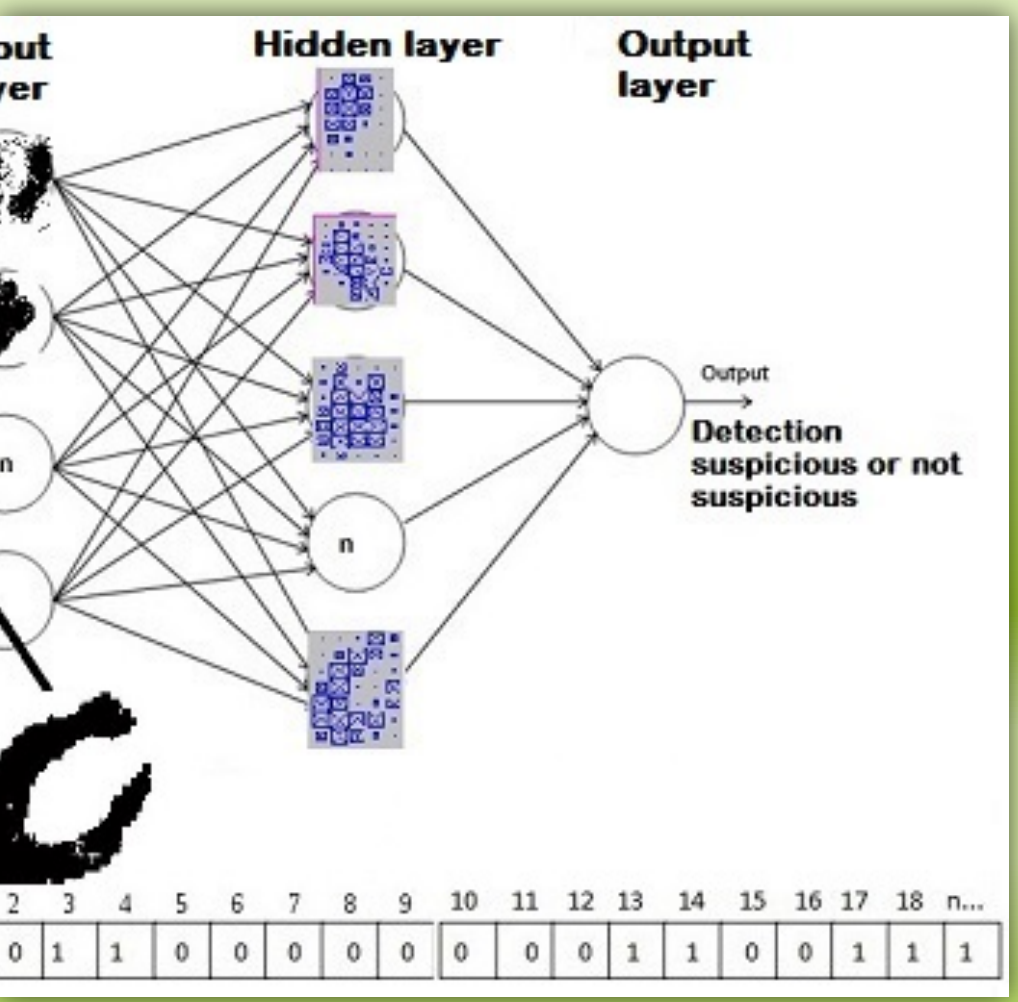
im2bw(img_crop,graythresh(imgGray));

or=bwareaopen(bw,30);



NN Training

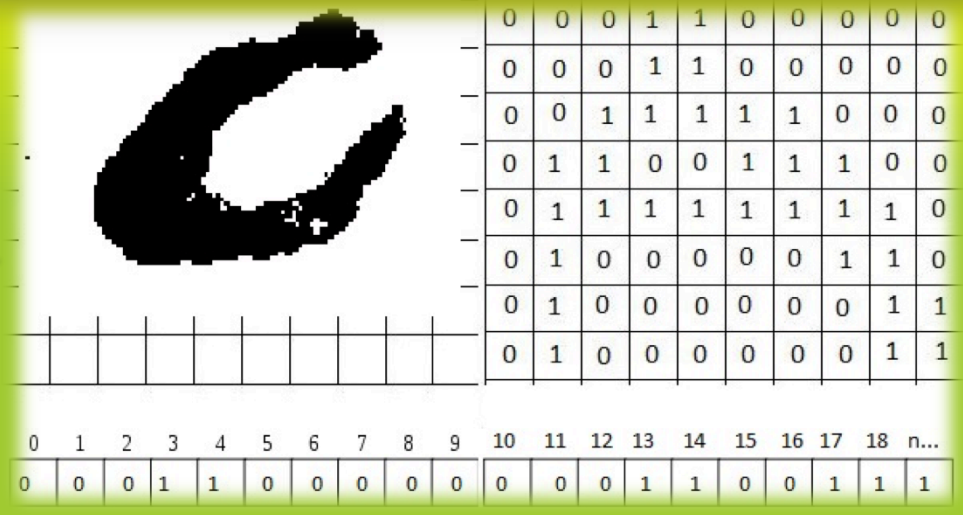
Multilayer perceptron



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

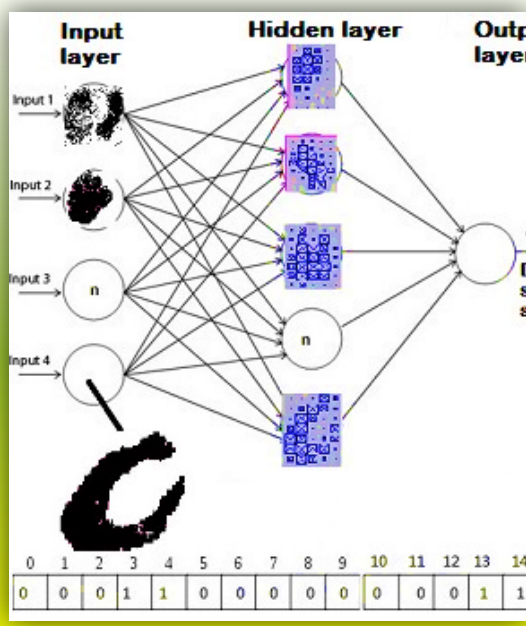
IN Training

```
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']);%readi
 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 = ajustarAlTamanioDeLaImagen(BMejor);
    axes(handles.imagenAjustado);
    imshow(bw2);
```



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 crearRedN
rearRedNeuronal(P,T);%Variable para alamcenar el entrenamient
anningAnn net%guardamos red neuronal en un archivo en el path
```

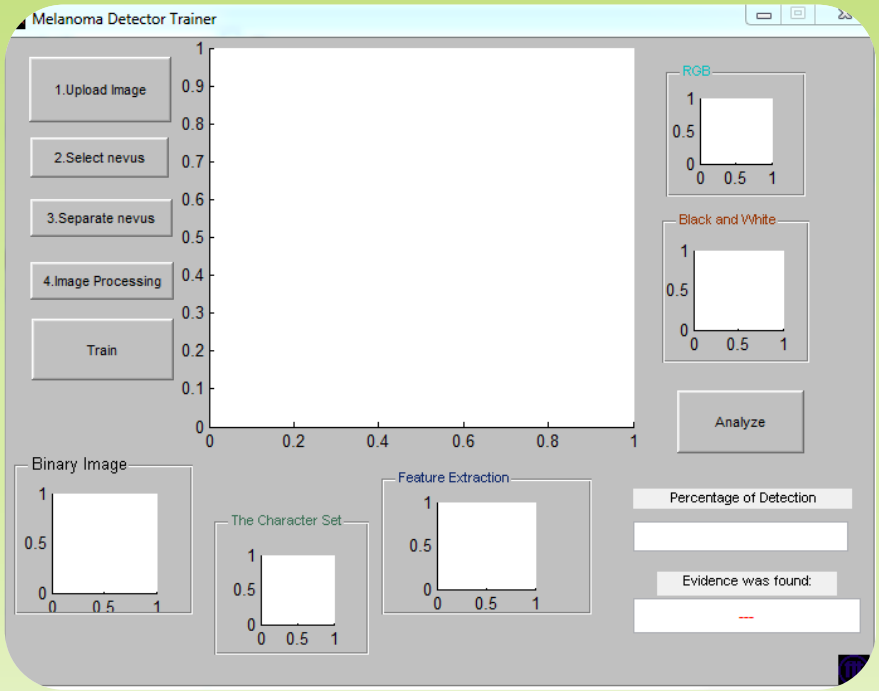
```
ed = newff(minmax(nevos),[S1 S2],{'tansig' 'logsig'},'traingdx');
ed.LW{2,1} = red.LW{2,1}*0.01;
ed.b{2} = red.b{2}*0.01;
ed.performFcn = 'sse';  %%Suma Square error
ed.trainParam.goal = 0.01;  %%Objetivo para converger
ed.trainParam.show = 20;   %%Actualizar salida de entrenamiento cada ciertos 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.
```

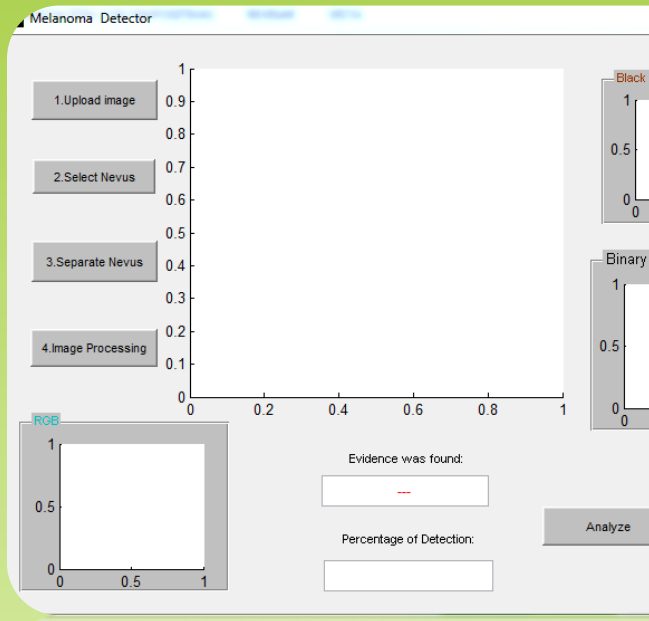
Create the Artificial Neural Network

Melanoma Detector Software

Menu

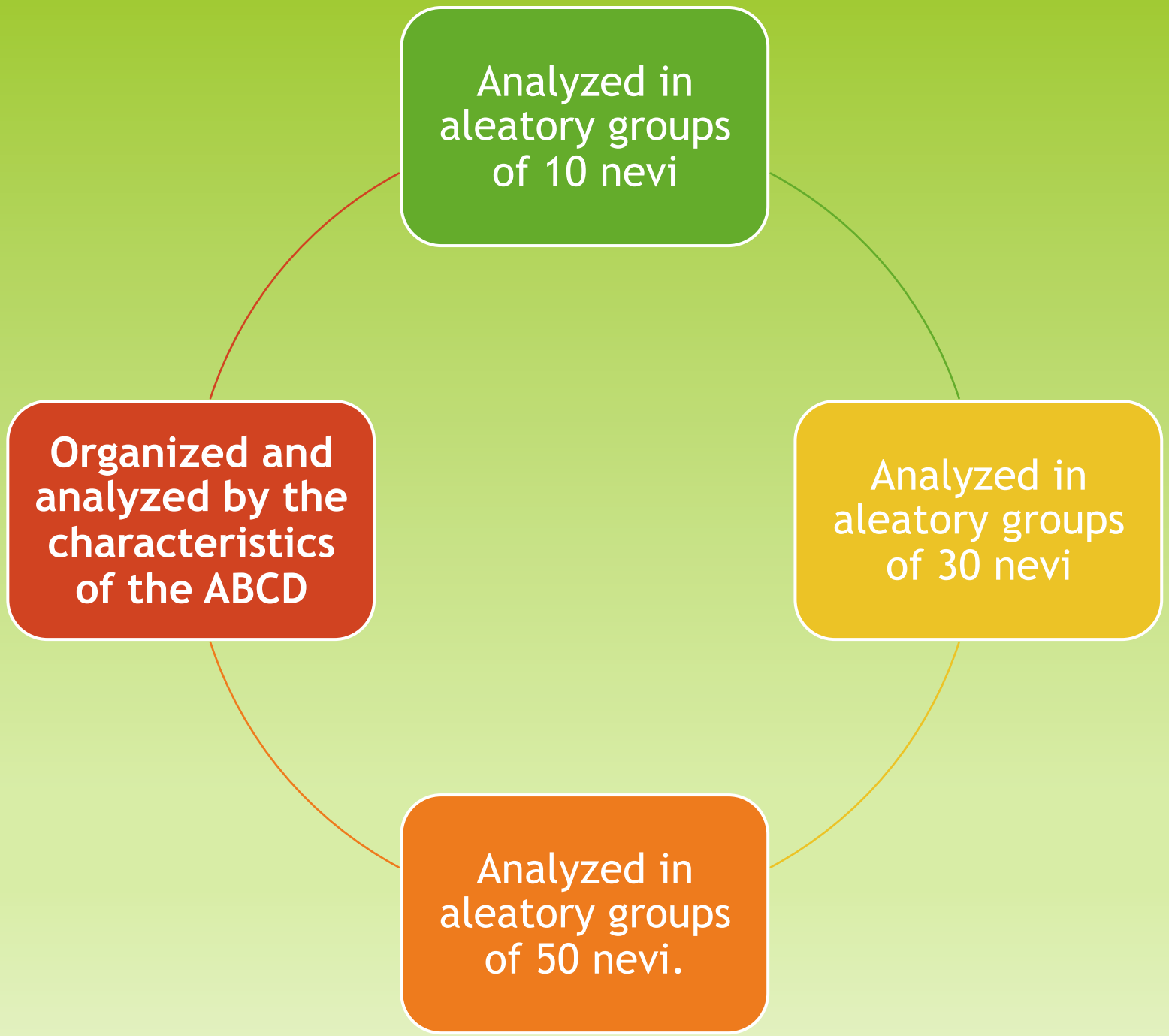
Melanoma Detector Trainer





Melanoma Detec

Tests


Analyzed in aleatory groups of 10 nevi
Analyzed in aleatory groups of 30 nevi
Analyzed in aleatory groups of 50 nevi.
Organized and analyzed by the characteristics of the ABCD

Results

nsibility: $TP/TP+FN$

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 aining	# 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	**90.00%**	**93.01%**

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

Conclusions

oftware that enables the analysis of suspicious skin esions for the detection of melanoma with image ecognition techniques and ANNs.

/e plan to freely distribute this software to medical octors 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

- onsider and add parameters of evaluation: skin color, ge, sex, nationality, location of the nevus, etc.
- est the tool with a control group and a case group.
- igrate the software to a mobile application.
- xclusively use normal nevi pictures taken by our team or software training.
- evelop a bank of clinical images with biopsy-iagnosed melanoma in people of Latin American rigin.

References

rewer, A. C., D. C. Endly, et al. (2013). "Mobile lications in dermatology." JAMA dermatology **149**(11): 0-1304.

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