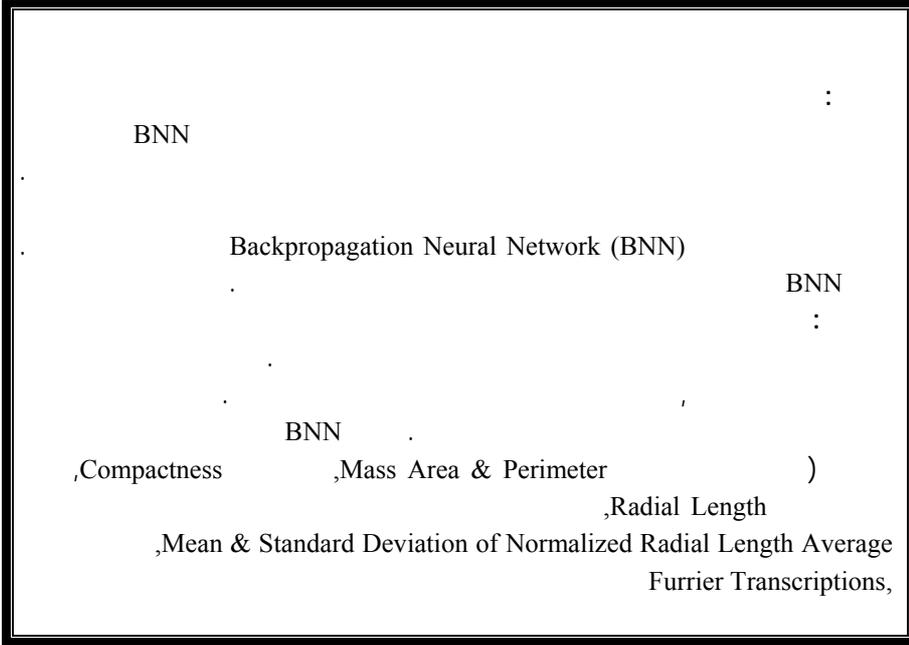
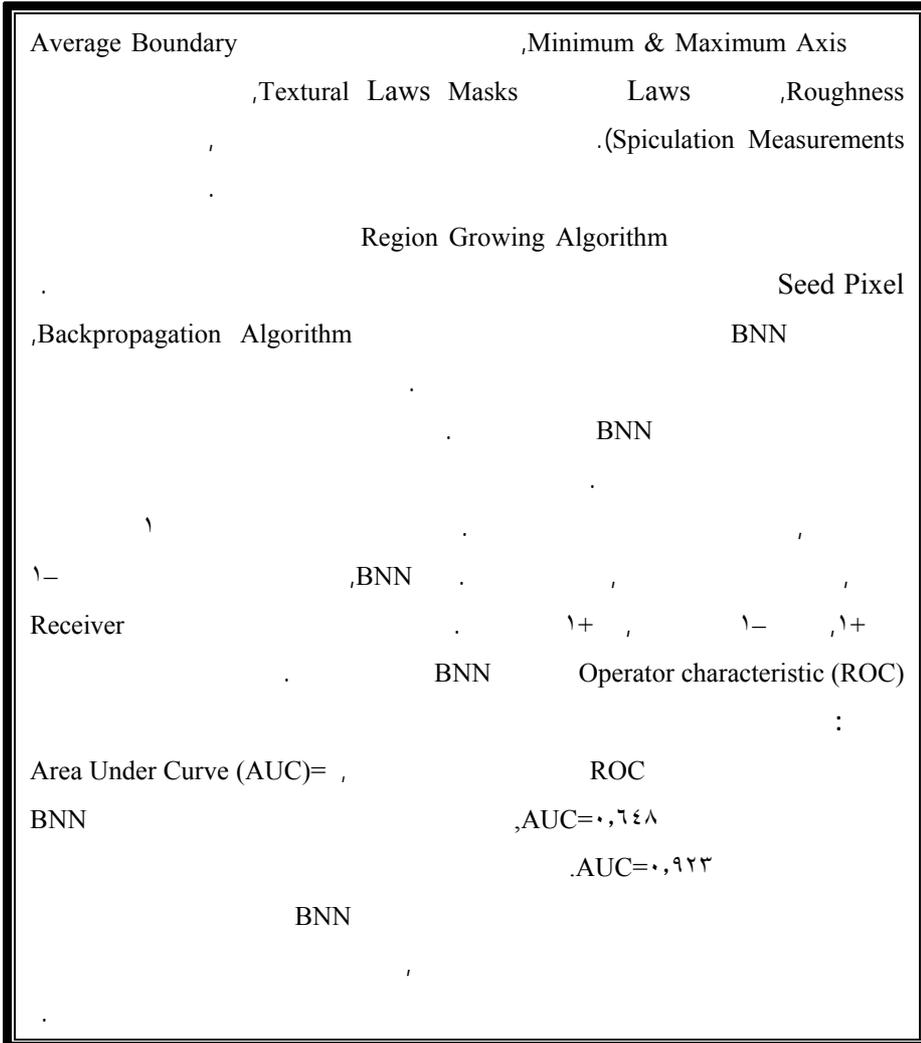


BNN



^١ أعد البحث في سياق رسالة الدكتوراه للطالبة لنا عريش بإشراف الدكتور غسان فلوح والدكتور جوزيف راينهروت.

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Introduction

Image Acquisition

:

.Image Interpretation

:

Magnetic

,Computed Tomography

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,Resonance Imaging

:

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.Computer Aided Diagnosis (CAD) Systems

CAD Systems

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Second Opinion

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Masses

,Masses detection

Breast

.classification

,density

% -%

. []

CAD Systems

Detection

Classification

Artificial Neural Networks (ANN)

ANN

. [] Data Classification

Pattern Recognition

Methods

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:

,Data Digitizing

,Data Acquisition

,Classification

,Image Segmentation

.Clinical Experiments

Data Acquisition

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(1-2)

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- Image Digitization

dpi

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 . , Unshapemask

Image Segmentation -

()

Region Growing ()

[] Shen Segmentation Technique Algorithm

Region : []

.Seeded Pixel

, Connected

.Region

٣٧	٢٨	٩	-
٧٤	٤٨	٢٦	-
٤٩	٣٤	١٥	- -

:(-)

Seed pixel (SP)

$p(i, j)$

region

$(1-\tau)$

$$(1 + \tau)(F_{\max} + F_{\min})/2 \geq p(i, j) \geq (1 - \tau)(F_{\max} + F_{\min})/2 \quad (-)$$

$F_{\min} \quad F_{\max}$

$$(0 \leq \tau \leq 1)$$

τ

$(1-\tau)$

Multi-

[]

resolution procedure

Step increment (SS)

$[\cdot, \cdot \cdot \cdot, \xi]$

$SS = 1/SP$

Center of

Compactness

Size (number of pixels)

gravity (x, y)

Binary

$(\tau - \tau)$

:

Unlabeled

- 1

.pixels

- 2

.Seeded pixel

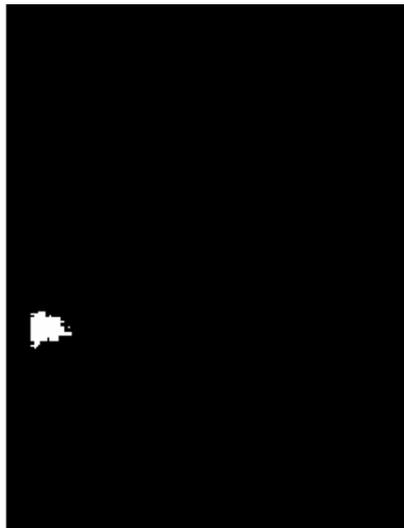
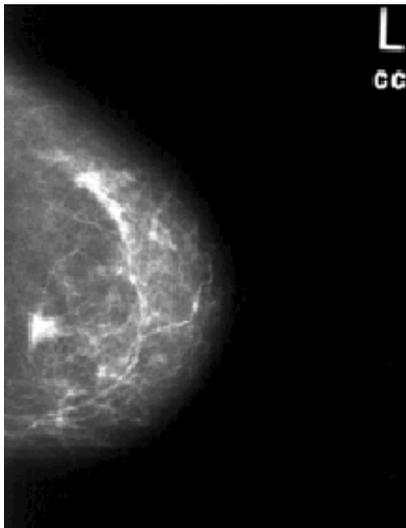
,

.)

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-

.Region



:(-)

Classification

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Backpropagation Neural

Network (BNN)

1-4-2

(3-2)

(-)

Intuitive feelings

Mass shape

Features	Malignant	Benign
Mass shape	Spiculated, or undefined	Round
Mass boundaries	Rough	Smooth
Mass density	Inhomogeneous	Homogenous
Microcalcification	Small & clustered	Big & sparse

:(-)

٢-٤-٢

.BNN

Mass Area & : [°]
 ,Radial Length ,Compactness ,Perimeter
 Mean & Standard Deviation of
 ,Fourier Transcriptions ,Normalized Radial Length Average
 ,Minimum & Maximum Axis
 Textural Laws Laws ,Average Boundary Roughness
 Spiculation Measurement ,Masks

BNN

3-4-2

ANN

BNN

Artificial Neurons

Hidden layer

BNN

(4-2)

[9]

[^]

Parallel Pattern Recognition

Inputs

Compactness, BNN

Single Output

[10]

(0-2)

...w1, w2

v1, v2...

$$x = \sum_{i=1}^n v_i w_i \quad (-)$$

: Transfer Function

$$f(x) = \frac{1}{1 + e^{-x}} \quad (-)$$

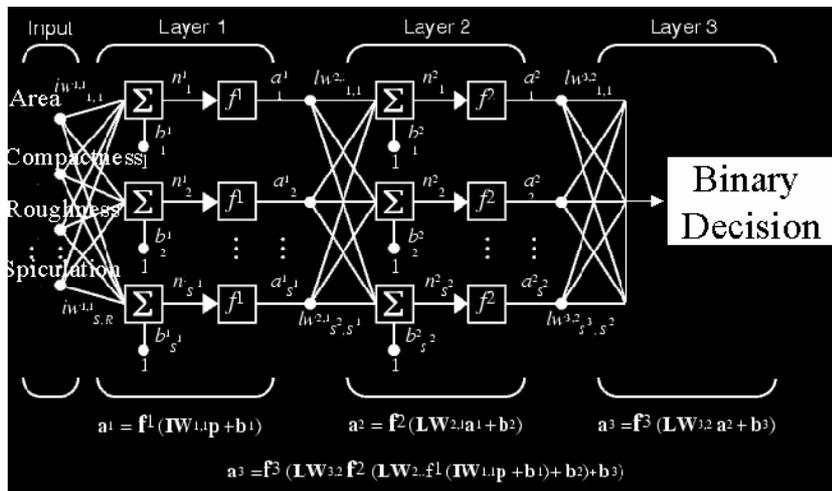
() Interconnected

Supervised

BNN

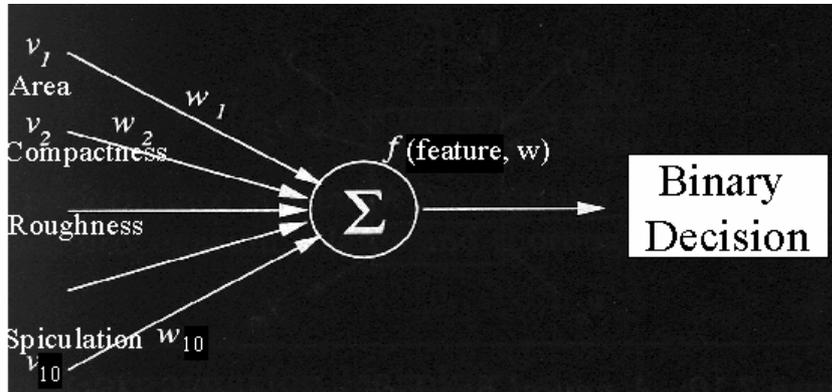
Targets

BNN



BNN

:(-)



:(0-2)

Backpropagation Algorithm

BNN

[11]

Clinical Experiments

0-2

,BNN

1-0-2

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14. [A]

14.

14

%7.

Training group

Testing group
BNN
()
BNN Mean Squared Difference
Minimize
BNN .Minimum Performance (MP)=
Robustness Epochs=
Runs
Sample +
(* *) points
[12] Receiver Operator Charecteristic (ROC) Curve
,BNN
.Area Under Curve (AUC)
Blinded Test :
,BNN
(,BNN)

١-٢-٥-٢

١٤٠١

.BNN

BNN

Epochs=)

(...

MP=٠,١

.Blinded Test

BNN

١+

- Floating

ROCCurve

٢-٢-٥-٢

University of Iowa Hospital &

,Clinics

,ROC Curve

BNN

Results

-۳

۱-۳

BNN

Receiverz Operator Characteristic (ROC)

BNN- ROC (۱-۳)

,SE

,Area (-)

.۹۵% CI of area % ,P

۲-۳

:

,BNN Blinded Test

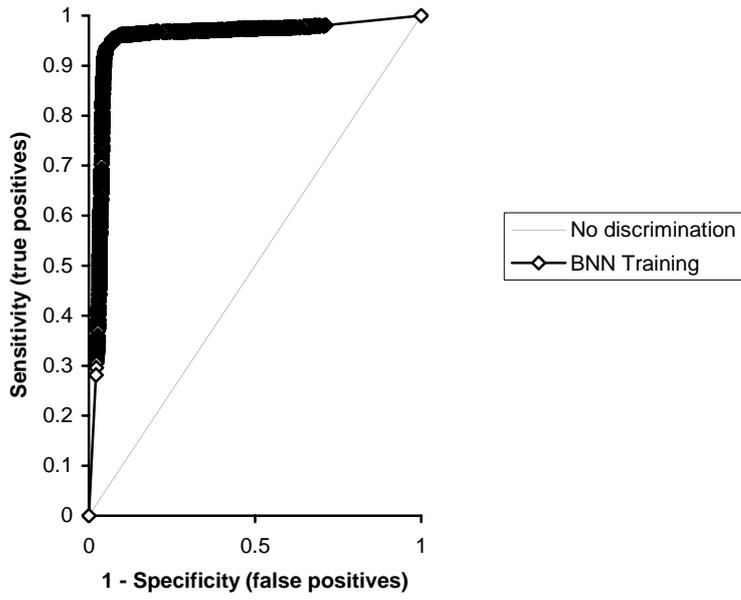
.Human Readers Blinded Test

۱-۲-۳

BNN

ROC

()



ROC : (-)

Curve	Area	SE	p	95% CI of Area	Biopsy = Malignant
BNNTraining	0,948	0,0037	<0,0001	0,941 to 0,955	have higher values

ROC : (-)

ROC (-)

(1-3) ,BNN
 % ,P ,SE ,Area
 .95% CI of area

- - - - -

Discussion

-

ROC

ROC

ROC

False Negative

Specificity

(-)

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%100

Sensitivity

BNN

BNN

False Negative

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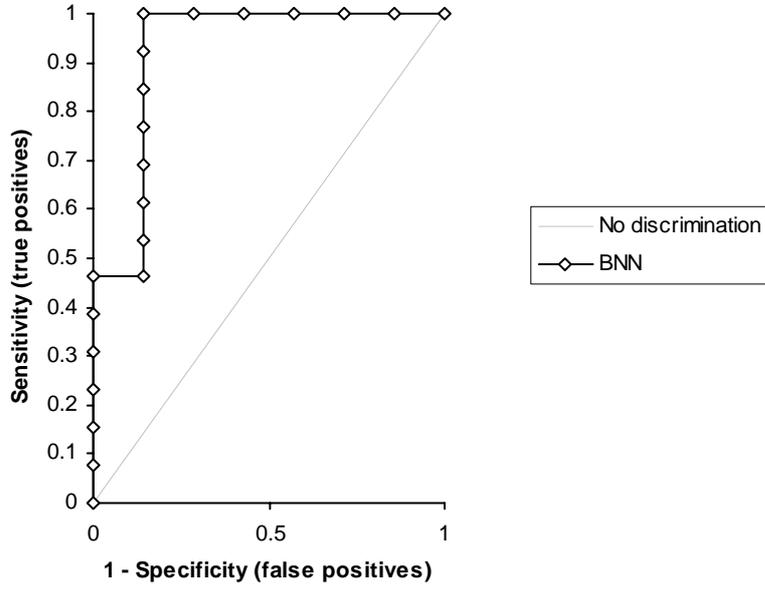
False

, Negative

%

BNN

.(γ - ϵ)



ROC : (-)

Curve	Area	SE	p	95% CI of Area	Biopsy = Malignant
BNN	0,923	0,076	<0,0001	0,774 to 1,000	have higher values

ROC : (-)

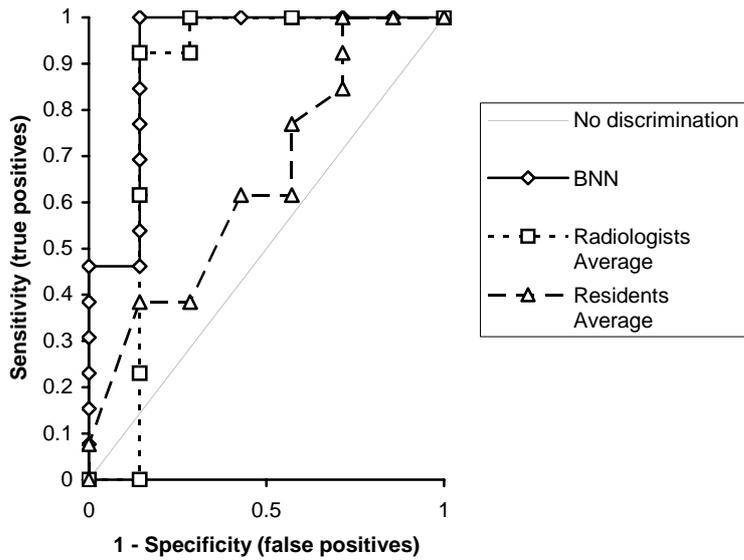
FN= BNN , (1-ε)

BNN ROC

ROC

BNN ROC

ROC



ROC : (-)

Curve	Area	SE	p	95% CI of Area	Biopsy = Malignant
BNN	0,923	0,0761	<0,0001	0,774 to 1,000	have higher values
Radiologists Average	0,846	0,1317	0,0043	0,588 to 1,000	have higher values
Residents Average	0,748	0,1321	0,1308	0,389 to 0,907	have lower values

(-) ROC : (-)

Method	Sensitivity = 100%, FN=0
	Specificity%

BNN

BNN	٨٥,٧
Radiologists	٧١,٤
Residents	٢٨,٦

.FN=٠ و %١٠٠

:(١-٤)

Method	Sensitivity = ٩٢,٣%, FN=١
	Specificity%
BNN	٨٤,٤
Radiologists	٧٠,٥
Residents	٢٧,٢

.FN=١ عدد و %٩٢,٣

:(٢-٤)

Conclusion

BNN

1 **Giger ML, Computer Aided Diagnosis. In: Haus AG, Yaffe MJ, eds. Syllabus: a categorical course in physics – technical aspects of breast imaging. Oak Book, III: Radiological Society of North America, 1993; 283-298.**

2 **Chan HP, et al, Improvement of radiologist' characterization of mammographic masses by using computer-aided diagnosis: an ROC study. Radiology, 1999; 212:817-827.**

3 **Y. Wu, et al, Simulation studies of data classification by artificial neural network: Potential applications in medical imaging and decision making, Proc. SPIE Med. Imaging 1990, 104-113, 1998.**

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0 M. J. Yaffe, Technical Aspects of Digital Mammography, In Proceedings of the 1st International Workshop on

Digital Mammography, pp. 1-10, Chicago, USA, June 1990.

1 H. P. Chen, W. Wei et al, Computerized Detection and Classification of Microcalcifications on Mammograms, In Proceedings of the Medical Imaging, pp. 1-10, Society of Photo-Optical Instrumentation Engineers (SPIE),

Vol. 10, San Diego, California, Feb. 1991.

2 Lina Arbach, G. Fallouh, Distinguishing between Malignant and Non-malignant Breast Masses from Mammograms Using AI Technique, Basel al-Assad Journal for Engineering Sciences, No. 16, P. 103-121, July 2002.

3 Lina Arbach, Lee Bennett, Joseph Reinhardt, G. Fallouh, "Breast mass classification: A comparison between human readers and a back-propagation neural network", in Pro. SPIE Conf. Medical Imaging, San Diego, CA, 2003. (In press).

4 Milan Sonka, et al, Image Processing and Machine Vision, PWS, 1998.

5 W S McCulloch, et al, A Logical Calculus of Ideas Immanent in Nervous Activity, Bulletin of Mathematical biophysics, 5:115-133, 1943.

6 R. Duda, P. Hart, and D. Stork, Pattern Classification, John Wiley & Sons, Inc, 1996.

7 Zweig M. Campbell G., Receiver Operating Characteristic (ROC) Plots: A Fundamental Evaluation Tool in Clinical Medicine, Clin Chem., 39:561-577, 1993.

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