konferenca EDUvision 2019

November 28-30, 2019

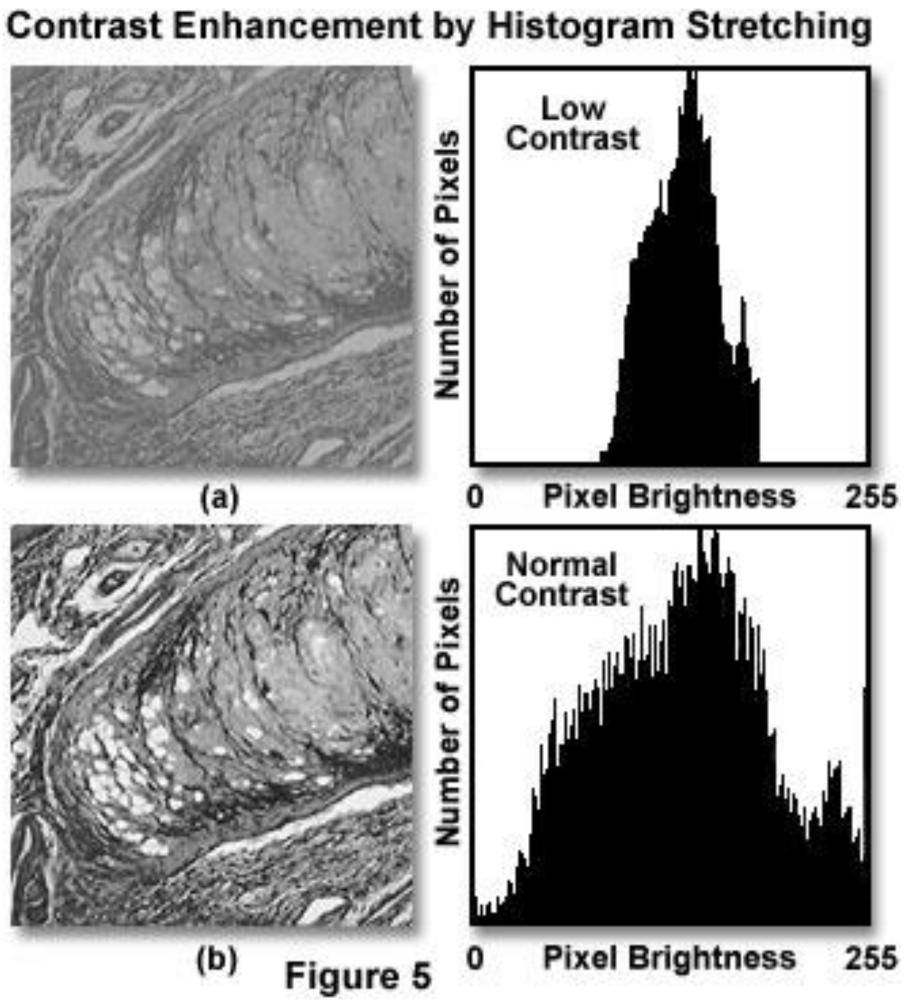
Ljubljana

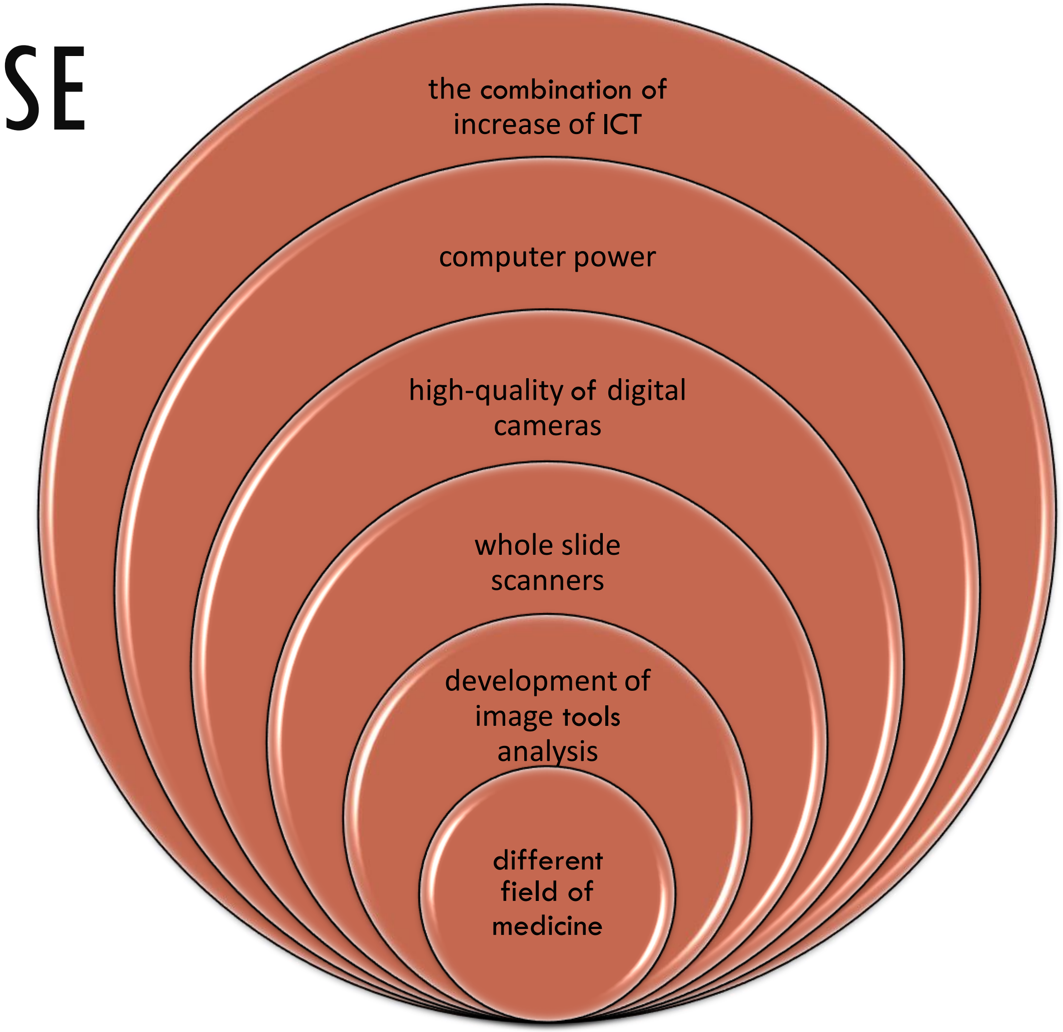
THE BENEFITS OF LEARNING MORPHOLOGICAL CELL IMAGE ANALYSIS FOR MEDICAL STUDENTS

Velickova, N.

Associate prof.
Faculty of medical sciences,
University «Goce Delcev» Stip,
R. of North Macedonia

POSSIBILITY FOR FAST AND PRECISE ANALYZING





the combination of increase of ICT

computer power

high-quality of digital cameras

whole slide scanners

development of image tools analysis

different field of medicine

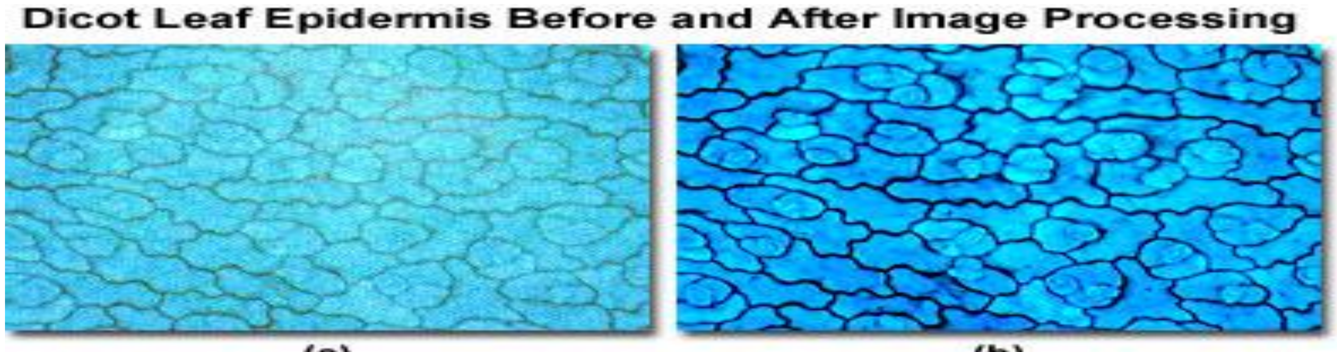
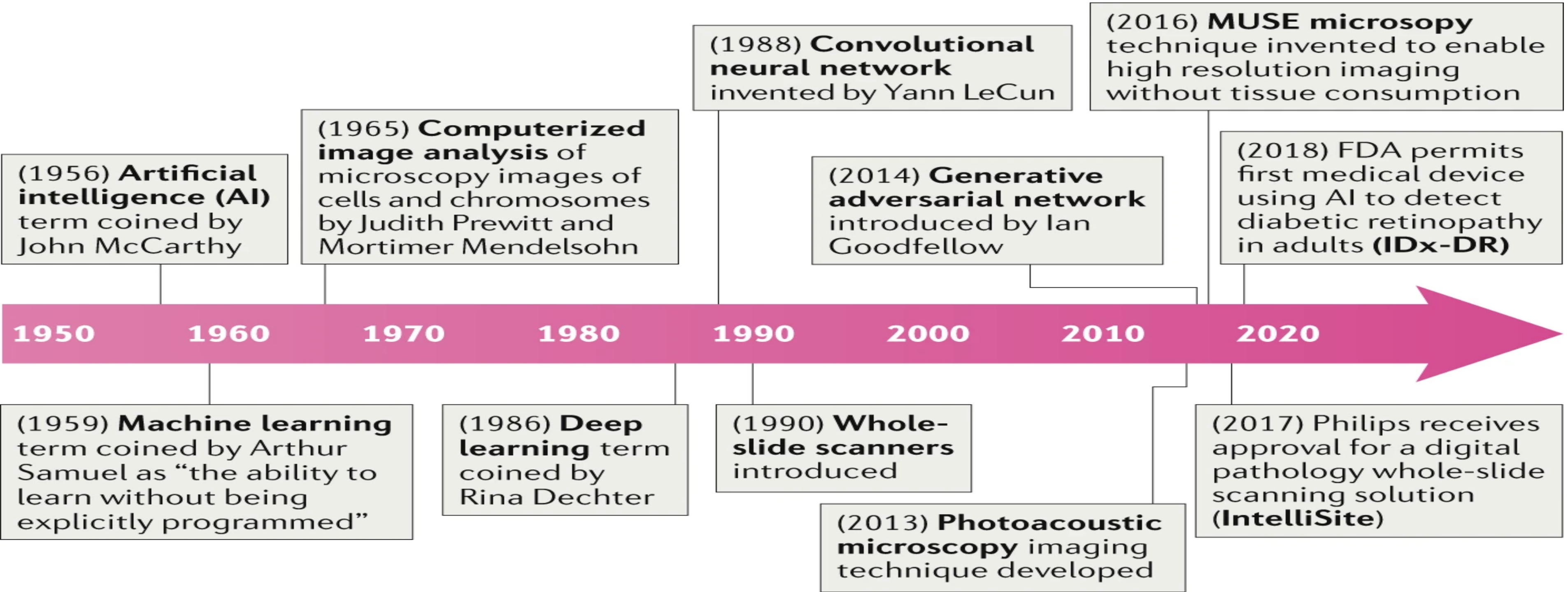

Dicot Leaf Epidermis Before and After Image Processing

IMAGE ANALYSIS

- using algorithms to extract information from digital images
- involves different types of techniques
- the goal of most applications is to extract quantitative information from images
- Astronomy
- Medicine
- Archeology
- Technology



(1956) **Artificial intelligence (AI)** term coined by John McCarthy

(1959) **Machine learning** term coined by Arthur Samuel as “the ability to learn without being explicitly programmed”

(1965) **Computerized image analysis** of microscopy images of cells and chromosomes by Judith Prewitt and Mortimer Mendelsohn

(1986) **Deep learning** term coined by Rina Dechter

(1988) **Convolutional neural network** invented by Yann LeCun

(1990) **Whole-slide scanners** introduced

(2013) **Photoacoustic microscopy** imaging technique developed

(2014) **Generative adversarial network** introduced by Ian Goodfellow

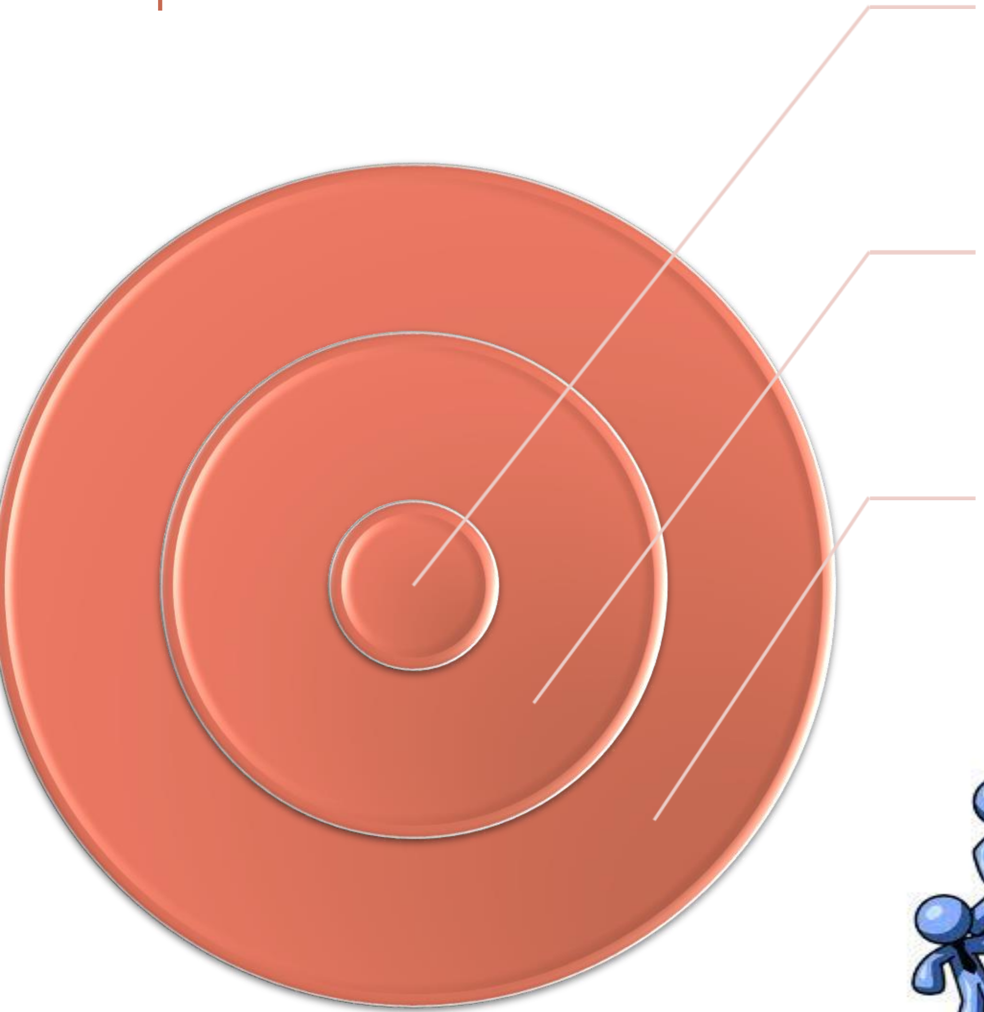
(2016) **MUSE microsopy** technique invented to enable high resolution imaging without tissue consumption

(2017) Philips receives approval for a digital pathology whole-slide scanning solution **(IntelliSite)**

(2018) FDA permits first medical device using AI to detect diabetic retinopathy in adults **(IDx-DR)**

INPUT \ OUTPUT	IMAGE	DESCRIPTION
IMAGE	DIGITAL IMAGE PROCESSING	COMPUTER VISION
DESCRIPTION	COMPUTER GRAPHICS	ARTIFICIAL INTELLIGENCE

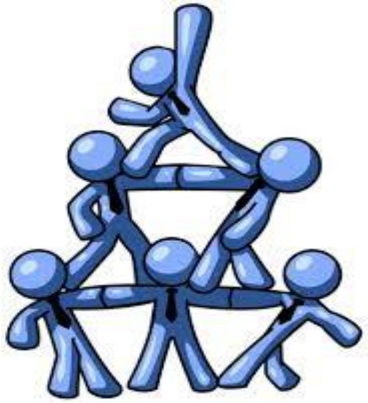
MEDICAL STUDENTS IN THEIR PRACTICE



Aims: observe the benefits of learning morphological cell image analysis

course of cytology and histology

free downloaded software (Digimizer, Image tool ets.)



Data mining
AI
MACHINE LEARNING
Algorithms
Artificial intelligence
Strategy
Science
Statistics
Prediction
Analysis

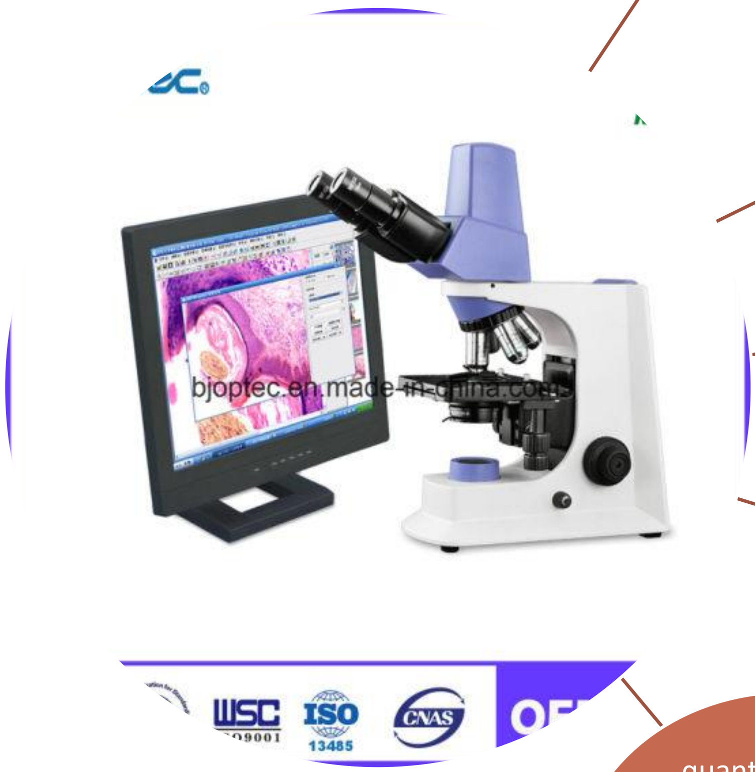
COMPARATION

Subjectivity (analysis “on foot”)

involves the risk for human errors

Subjectivity in interpretation of the results and report

Image tools analysis


bjoptec.en.made-in-china.com
WSC
ISO 13485
CNAS

provide additional automatic

fast

reproducible analyses

accurate diagnosis

quantitative and qualitative data approve the presence, extent, size and shape of these structures as a indicators for early diagnosis

APPROPRIATE IMAGE TOOLS ANALYSIS IS DEPENDENT

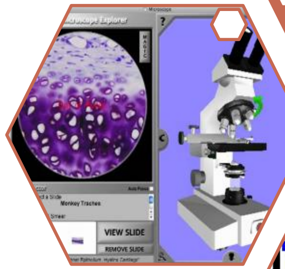
competitive of researchers

of the aim

E. Coli
MAGNIFICATION x10,000

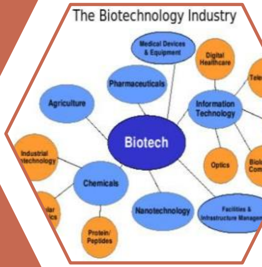
field of the study

image analysis methods


Microscope Explorer
Monkey Trachea
VIEW SLIDE
REMOVE SLIDE

1-1: The Use of the Microscope
Virtual Microscope
Total Magnification
60X
150X
600X
Field Of View Width
250 µm
Magnification of Ocular Lens = 15X

computer programming

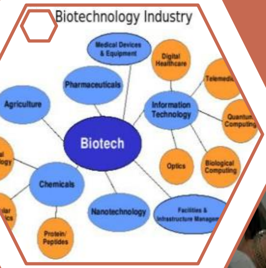

The Biotechnology Industry
Medical Devices & Equipment
Digital Healthcare
Telemedicine
Pharmaceuticals
Agriculture
Information Technology
Quantum Computing
Biotech
Optics
Biological Computing
Industrial Biotechnology
Chemicals
Nanotechnology
Facilities & Infrastructure Management
Protein/ Peptides

fixation

image analysis expertise

gital image processing/analysis tools in Light Microscopy: From the basics and beyond
10-17 June 2013

QUICK START GUIDE
Click here to move the stage
VIEW SLIDE


Biotechnology Industry
Medical Devices & Equipment
Digital Healthcare
Telemedicine
Pharmaceuticals
Agriculture
Information Technology
Quantum Computing
Biotech
Optics
Biological Computing
Industrial Biotechnology
Chemicals
Nanotechnology
Facilities & Infrastructure Management
Protein/ Peptides

cost

DATA ANALYSIS

Processing

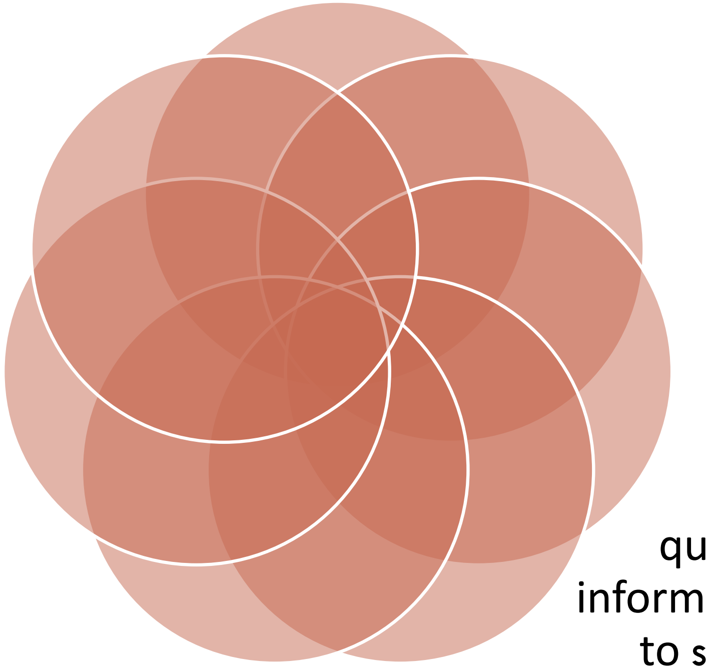
such as tissue collection

previously procedures steps

embedding

mbed Tiny Specim

THE GOAL OF IMAGE ANALYSIS



to increase the amount and quality of data

providing quantitative measurements of histologic features

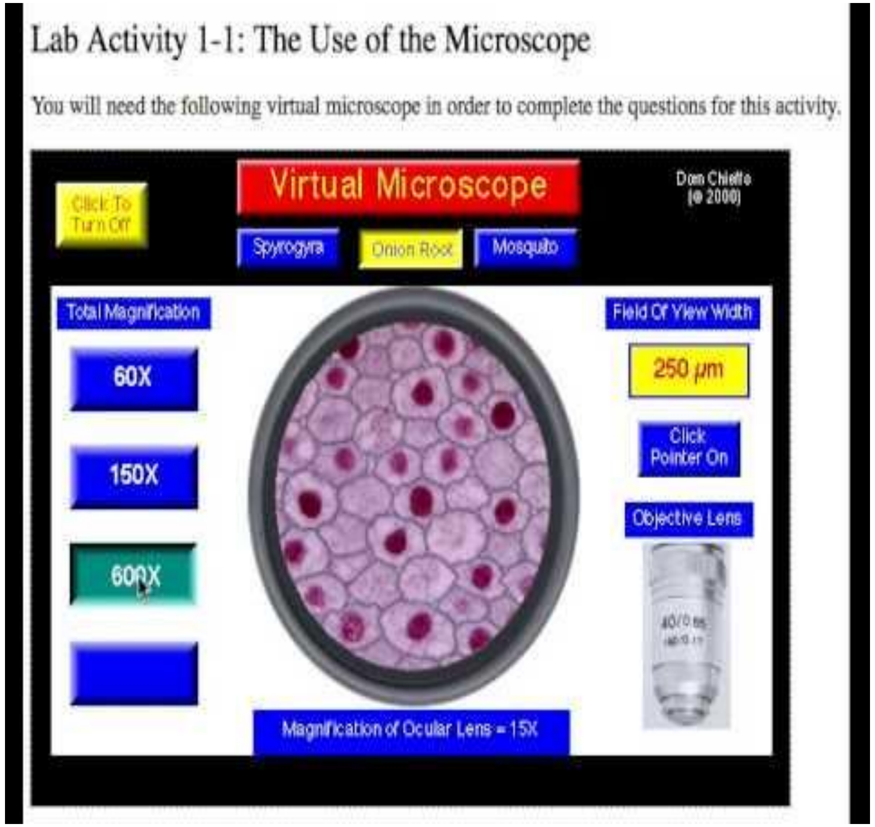
define of cells or cellular

quantitative information relevant to some of the diagnosis can be the size, morphology and irregularity distribution of cells, or the ratio of cells as a diagnostic biomarker

nuclear area and shape

nuclear/cytoplasmic ratio

automated mitotic detection carry prognostic value independent of other informations

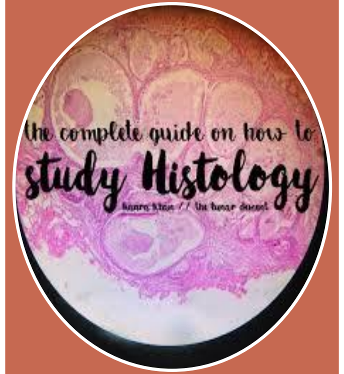


Lab Activity 1-1: The Use of the Microscope

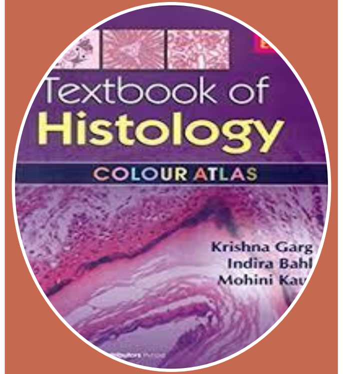
You will need the following virtual microscope in order to complete the questions for this activity.

Click To Turn Off
Virtual Microscope
Don Chielto (© 2000)
Spyrogyra
Onion Root
Mosquito
Total Magnification
60X
150X
600X
Field Of View Width
250 μm
Click Pointer On
Objective Lens
Magnification of Ocular Lens = 15X

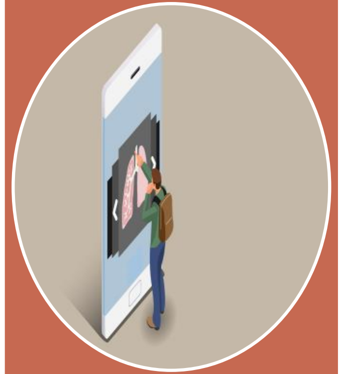
MEDICAL STUDENTS IN THEIR PRACTICE


the complete guide on how to
study Histology

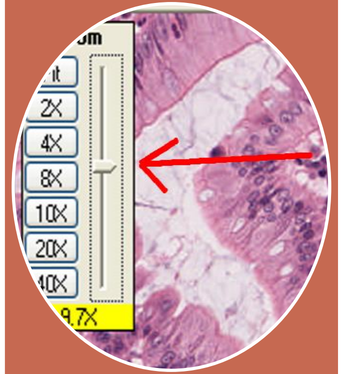
Applications of whole-slide imaging


Textbook of
Histology
COLOUR ATLAS
Krishna Garg
Indira Bahl
Mohini Kau

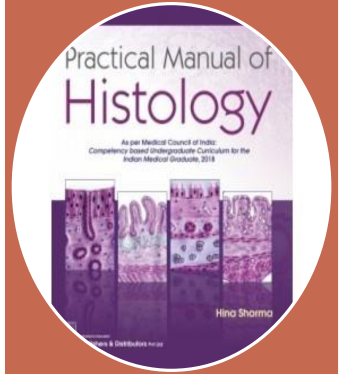
rapid transmission of the data basis for consultations



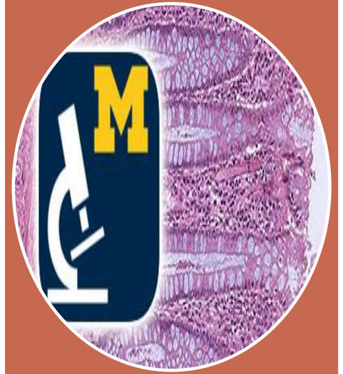
Collaborations


2X
4X
8X
10X
20X
40X
9.7X

standardization


Practical Manual of
Histology
Hina Sharma

distribution of the materials for education



tissue specimen archiving

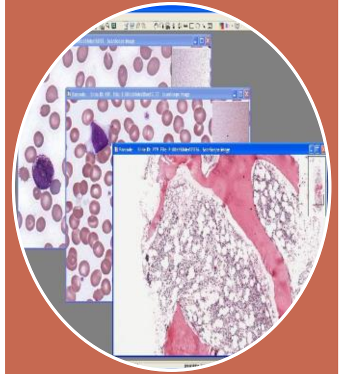
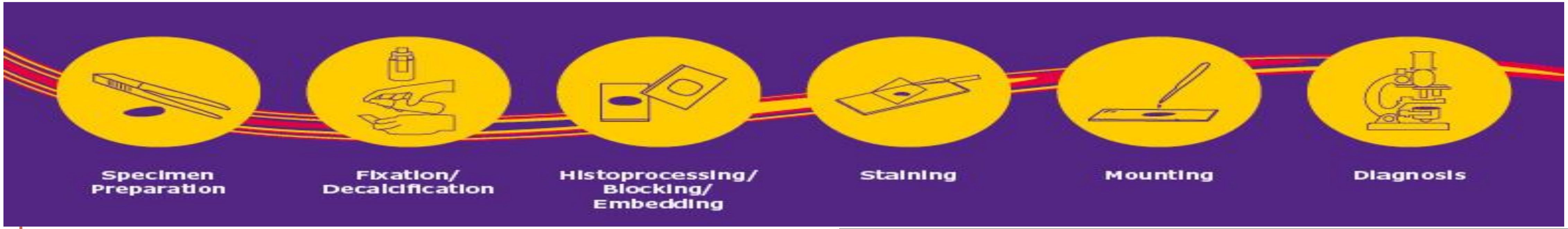
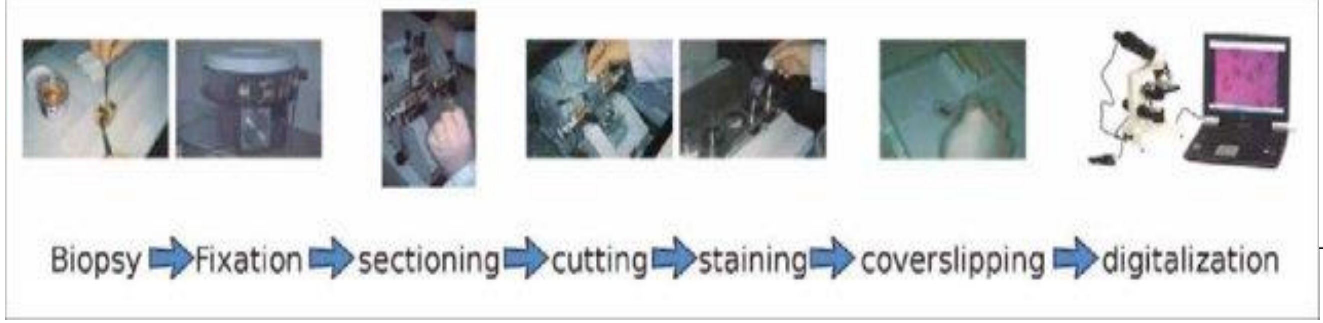
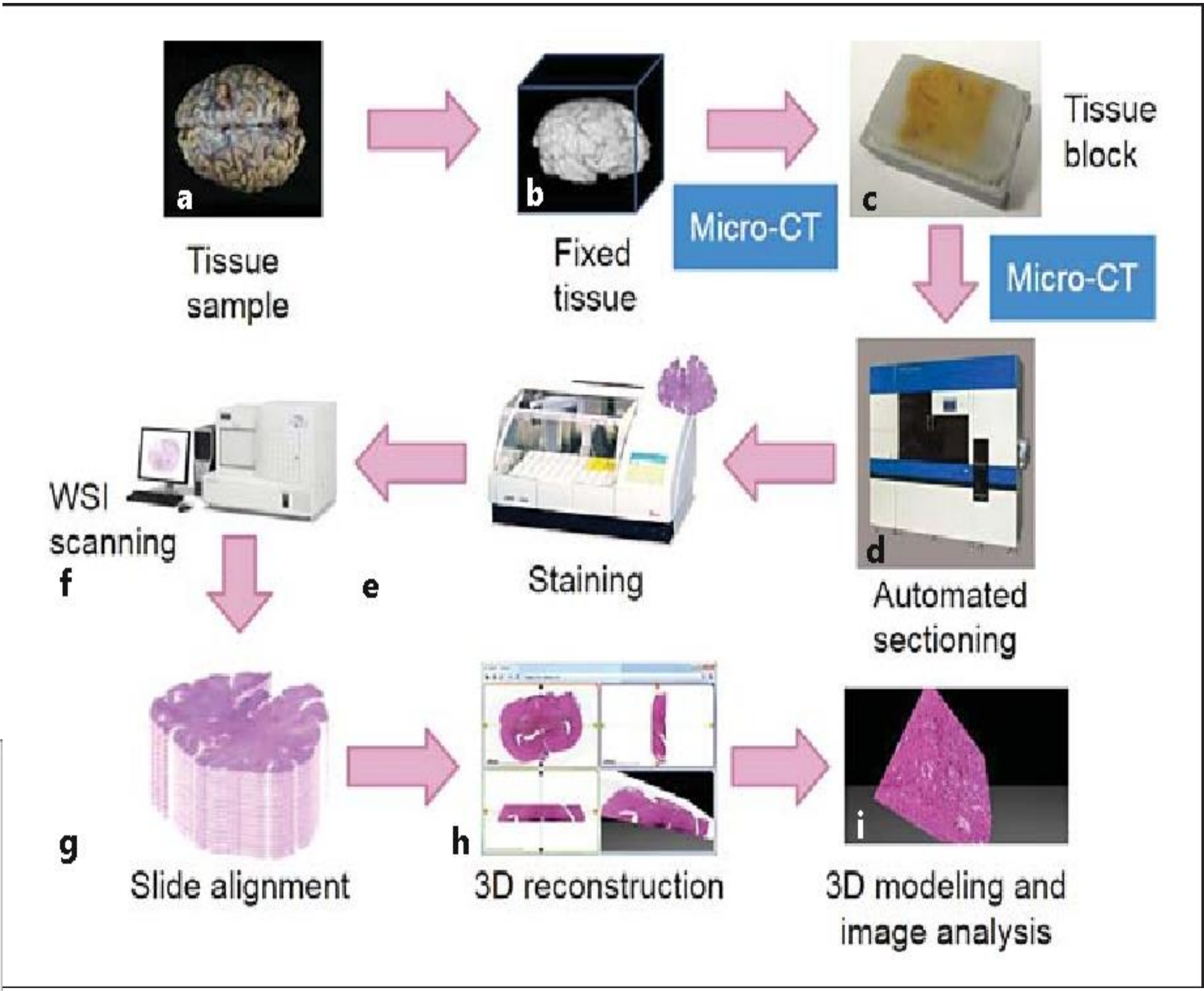


image analysis of histologic specimens

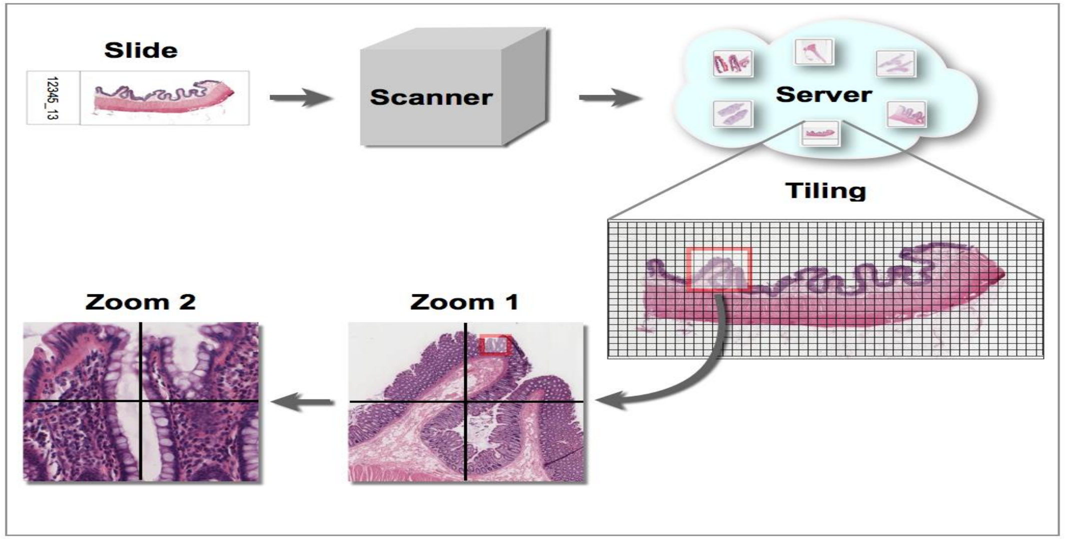

Specimen Preparation
Fixation/ Decalcification
Histoprocessing/ Blocking/ Embedding
Staining
Mounting
Diagnosis

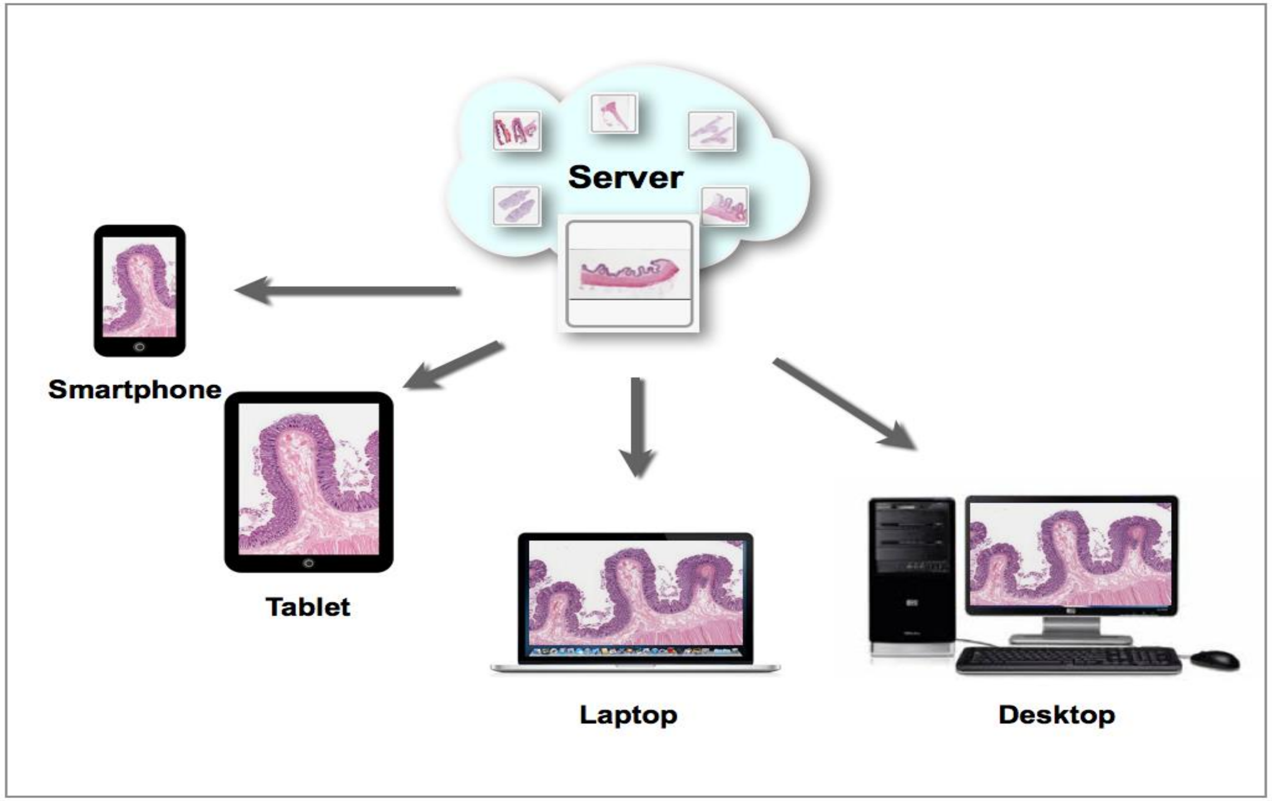
- histologic tissue sections can be created
- placed on web servers
- made available to the entire student population
- in medical training and practice in histopatology
- creates unique learning opportunities
- evaluation of histologic specimens on screens
- increases interactions between students


Biopsy
Fixation
sectioning
cutting
staining
coverslipping
digitalization


a
Tissue sample
b
Fixed tissue
Micro-CT
c
Tissue block
Micro-CT
d
Automated sectioning
Staining
e
WSI scanning
f
g
Slide alignment
h
3D reconstruction
i
3D modeling and image analysis

MATERIAL AND METHODS


Slide
12345_13
Scanner
Server
Tiling
Zoom 2
Zoom 1


Server
Smartphone
Tablet
Laptop
Desktop

virtual microscopy

on-line access to entire scanned sections of tissue

can be viewed on a computer in exactly the same way as conventional glass slides

can be explored by the learner at several magnifications

It is provide substantial educational benefits esspecialy to part-time students product of MedCalc Software

developer of medical and statistical software

Digital image file sizes vary from approximately 200 MB to 1 GB.42. The last version of the software Digimizer 4.3.0 can be free download https://digimizer.en.downloadastro.com/download/

easy-to-use

flexible image analysis software packages

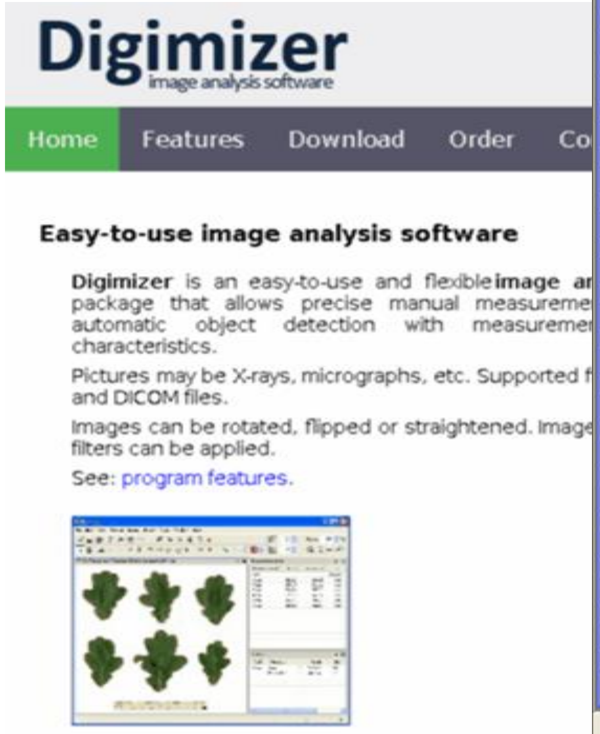
that allows precise manual measurements

automatic object detection

measurements of object characteristics.

Supported file formats are JPG, GIF, TIFF, BMP, PNG, WMF, EMF and DICO file

IMAGE ANALYSIS SOFTWARE DIGIMIZER


Digimizer
image analysis software
Home
Features
Download
Order
Co

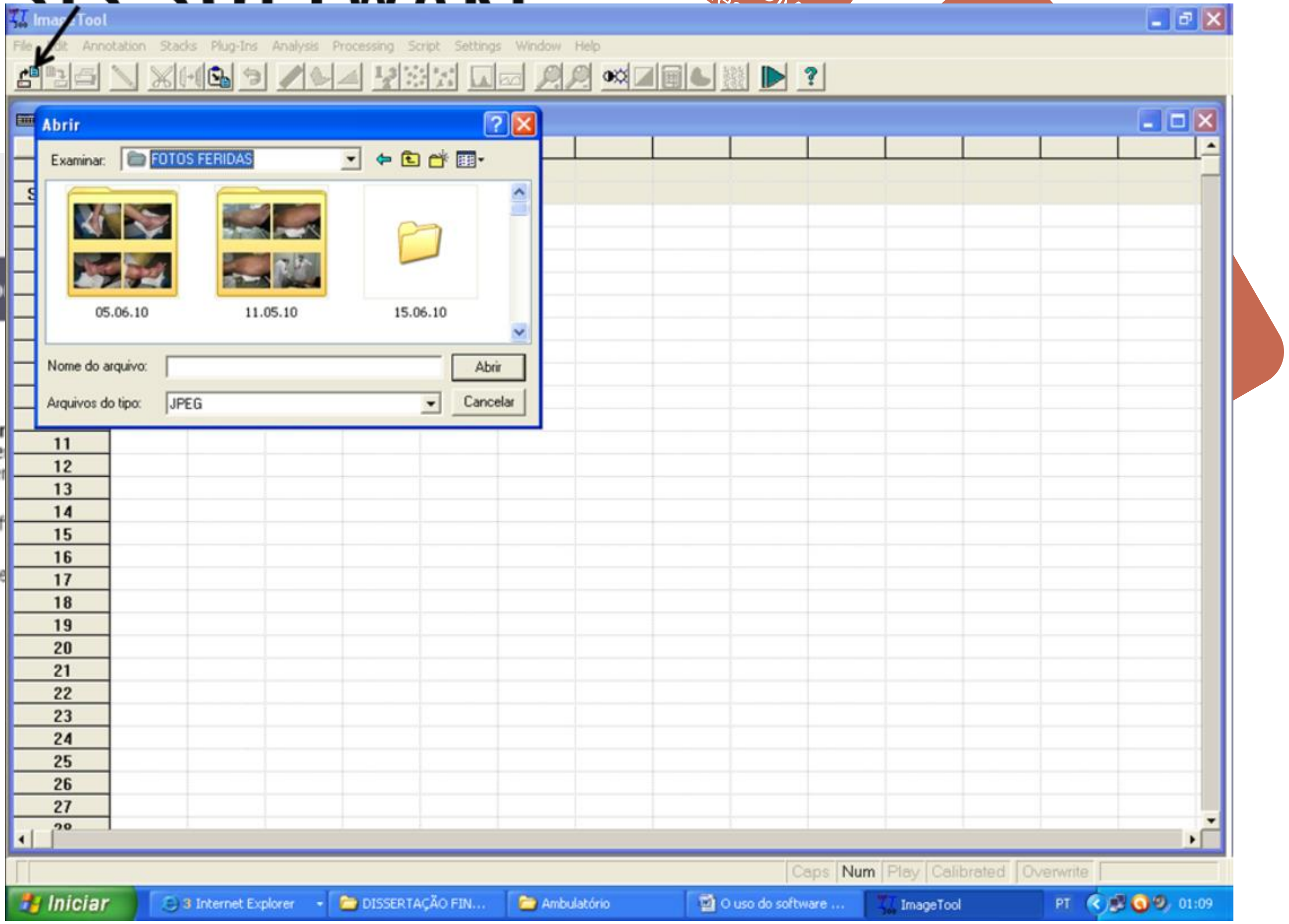
Easy-to-use image analysis software

Digimizer is an easy-to-use and flexible **image an** package that allows precise manual measureme automatic object detection with measuremen characteristics.

Pictures may be X-rays, micrographs, etc. Supported f and DICOM files.

Images can be rotated, flipped or straightened. Image filters can be applied.

See: program features.

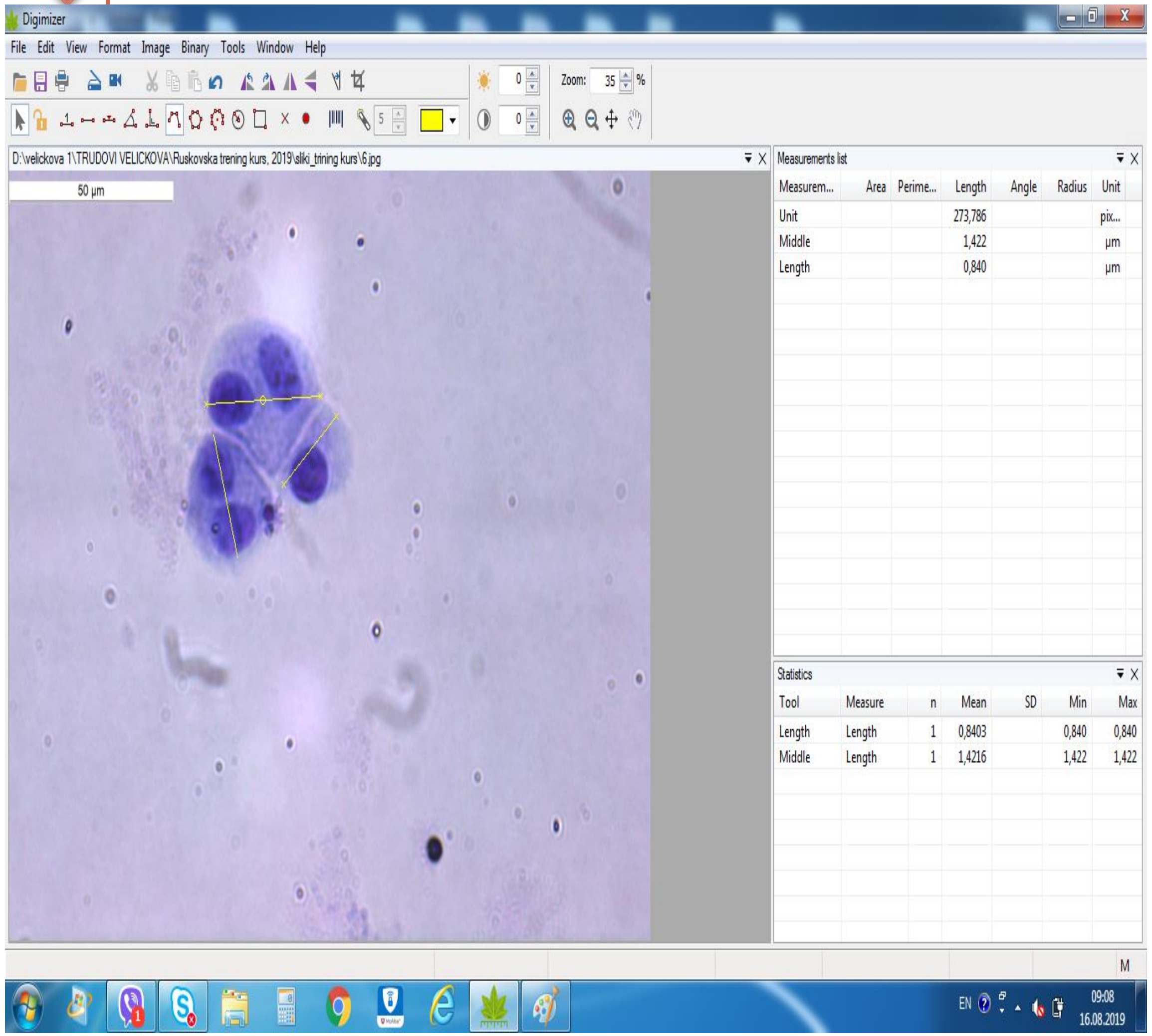

ImageTool
File
Edit
Annotation
Stacks
Plug-Ins
Analysis
Processing
Script
Settings
Window
Help
Abrir
05.06.10
11.05.10
15.06.10
Abrir
Cancelar
Caps
Num
Play
Calibrated
Overwrite
Iniciar
3 Internet Explorer
DISSERTAÇÃO FIN...
Ambulatório
O uso do software ...
ImageTool
PT
01:09

Examinar: FOTOS FERIDAS

Nome do arquivo:

Arquivos do tipo: JPEG

RESULTS


Digimizer
File Edit View Format Image Binary Tools Window Help
Zoom: 35 %
D:\velickova 1\TRUDOVI VELICKOVA\Ruskovska trening kurs, 2019\sliki_trining kurs\6.jpg
50 µm
EN
09:08
16.08.2019

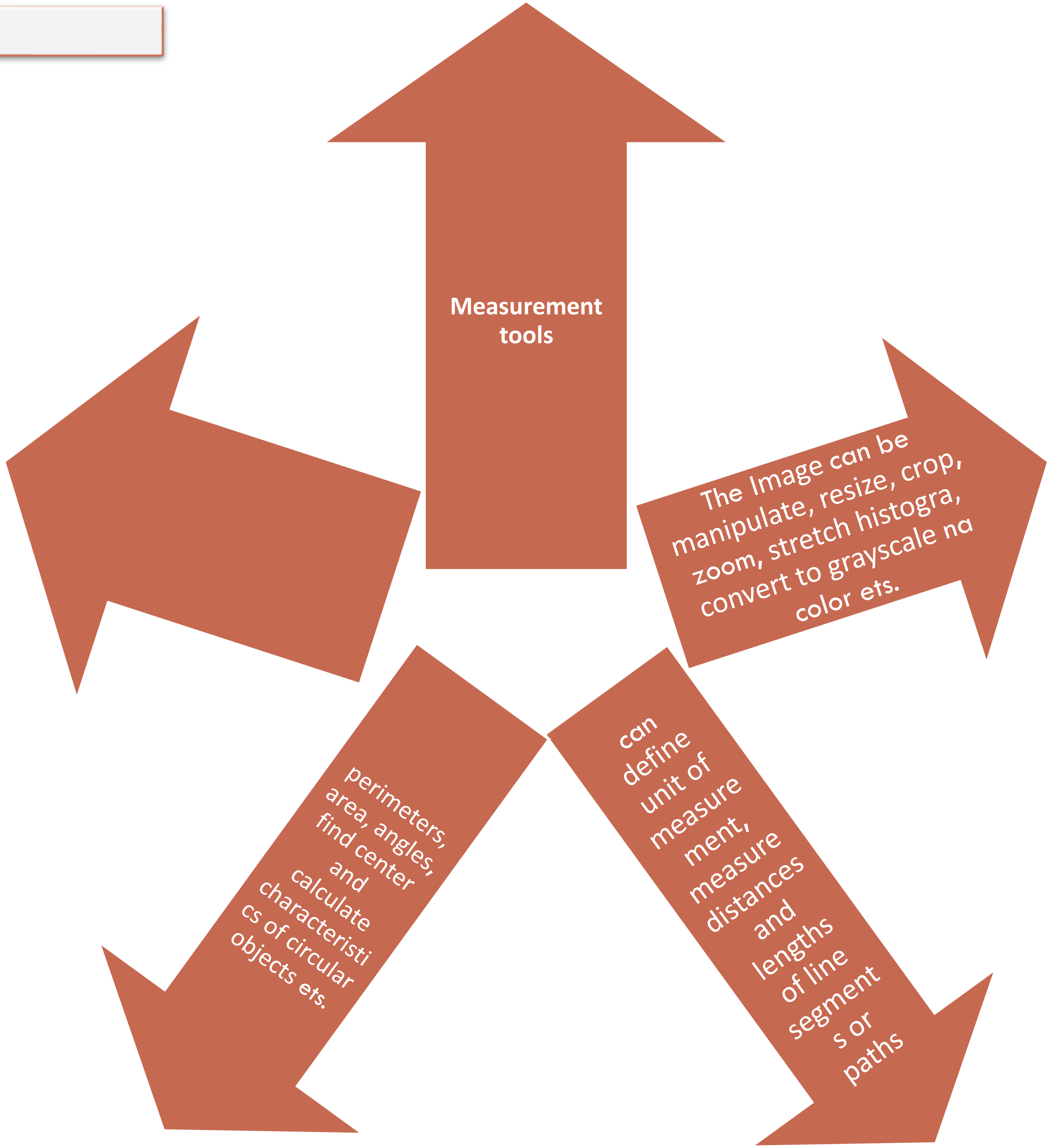
Measurements list

Measurem...	Area	Perime...	Length	Angle	Radius	Unit
Unit			273,786			pix...
Middle			1,422			µm
Length			0,840			µm

Statistics

Tool	Measure	n	Mean	SD	Min	Max
Length	Length	1	0,8403		0,840	0,840
Middle	Length	1	1,4216		1,422	1,422

mesurments of the lengths of human lymphocites



Measurement tools

The Image can be manipulate, resize, crop, zoom, stretch histogra, convert to grayscale na color ets.

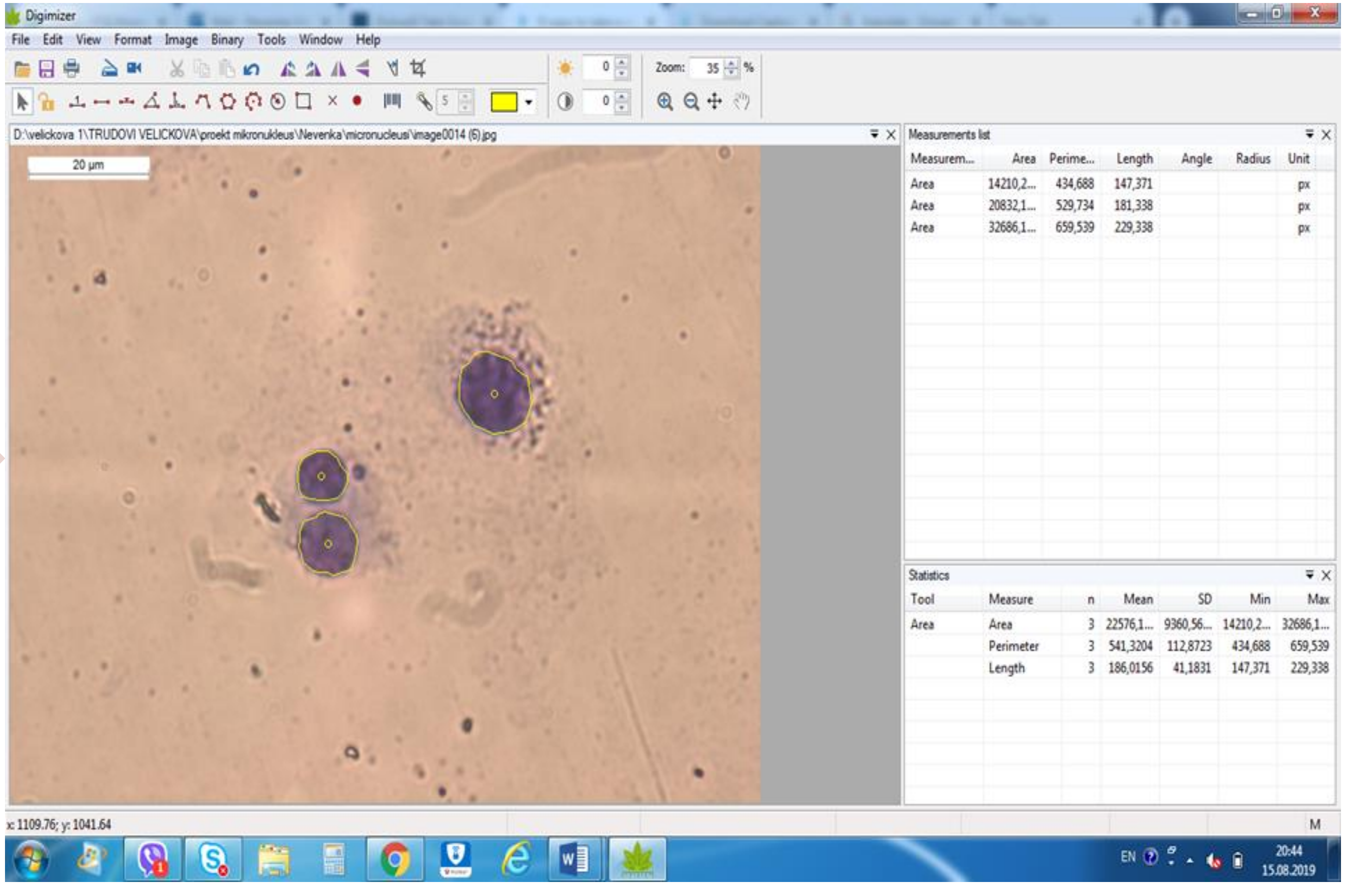
can define unit of measurement, measure distances and lengths of line segments or paths

perimeters, area, angles, find center and calculate characteristics of circular objects ets.

MESURMENTS OF THE CENTER AND CALCULATE CHARACTERISTICS OF HUMAN LYMPHOCITES

object detection

measurement of perimeter and area


Digimizer
File
Edit
View
Format
Image
Binary
Tools
Window
Help
Zoom: 35 %
20 µm
EN
20:44
15.08.2019
M

D:\velickova 1\TRUDOVI VELICKOVA\proekt mikronukleus\Nevenka\micronucleus\image0014 (6).jpg

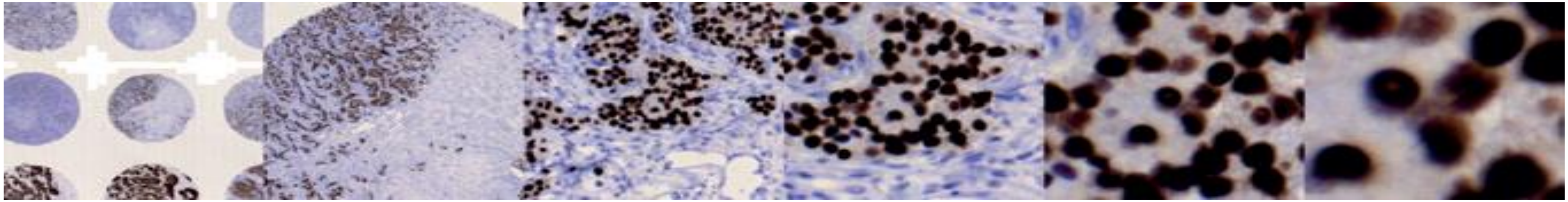
Measurements list

Measurem...	Area	Perime...	Length	Angle	Radius	Unit
Area	14210,2...	434,688	147,371			px
Area	20832,1...	529,734	181,338			px
Area	32686,1...	659,539	229,338			px

Statistics

Tool	Measure	n	Mean	SD	Min	Max
Area	Area	3	22576,1...	9360,56...	14210,2...	32686,1...
	Perimeter	3	541,3204	112,8723	434,688	659,539
	Length	3	186,0156	41,1831	147,371	229,338

x: 1109.76; y: 1041.64



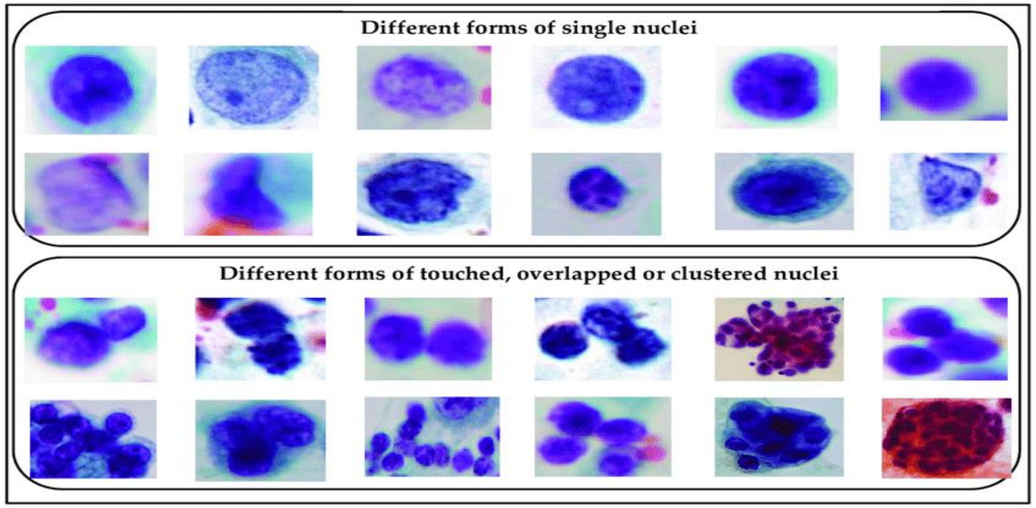
Examples of different magnifications of a histological sample

NUCLEAR/CYTOPLASM RATIO IN HUMAN LYMPHOCITES

Measurements list

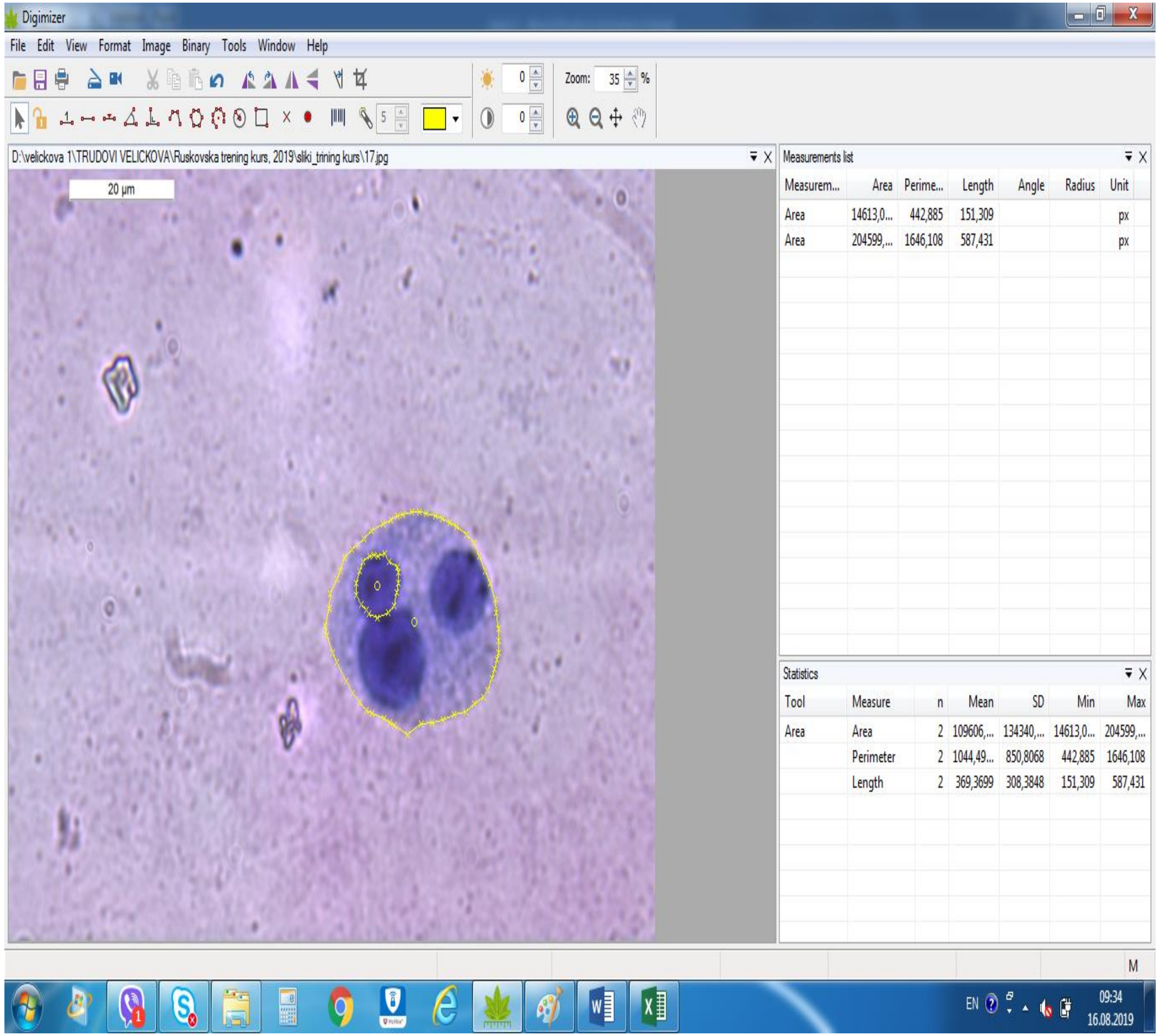
cell morphology, size, dimensions, esspecially nuclear/cytoplasm ratio

displays statistics (n, mean, SD, minimum and maximum)



Different forms of single nuclei

Different forms of touched, overlapped or clustered nuclei



Digimizer
File
Edit
View
Format
Image
Binary
Tools
Window
Help
Zoom: 35 %
20 μm
M
EN
09:34
16.08.2019

D:\velickova 1\TRUDOVI VELICKOVA\Ruskovska trening kurs, 2019\sliki_trining kurs\17.jpg

Measurements list

Measurem...	Area	Perime...	Length	Angle	Radius	Unit
Area	14613,0...	442,885	151,309			px
Area	204599,...	1646,108	587,431			px

Statistics

Tool	Measure	n	Mean	SD	Min	Max
Area	Area	2	109606,...	134340,...	14613,0...	204599,...
	Perimeter	2	1044,49...	850,8068	442,885	1646,108
	Length	2	369,3699	308,3848	151,309	587,431

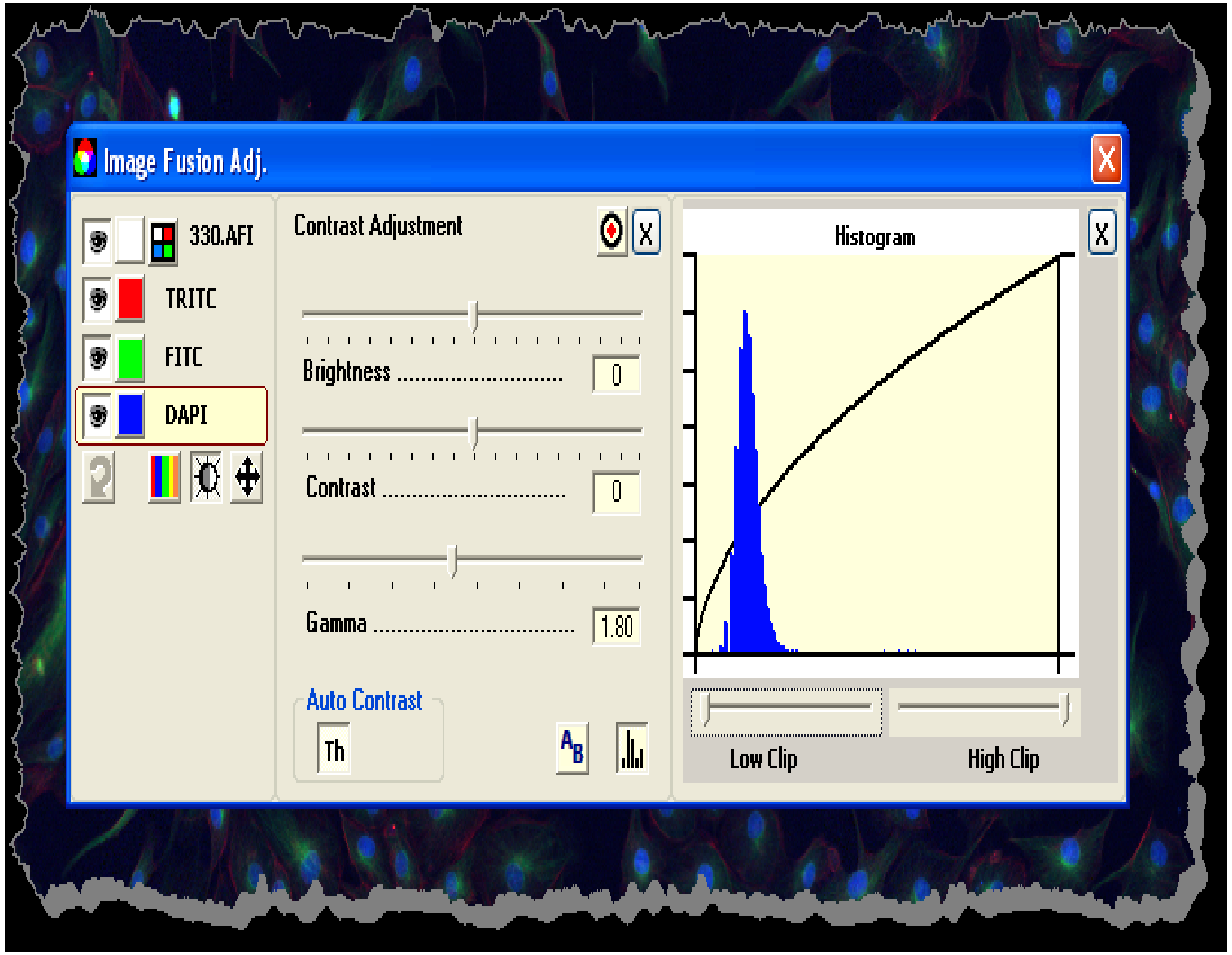


Image Fusion Adj.
330.AFI
TRITC
FITC
DAPI
Contrast Adjustment
Histogram
Auto Contrast
Th
Low Clip
High Clip

Brightness 0

Contrast 0

Gamma 1.80

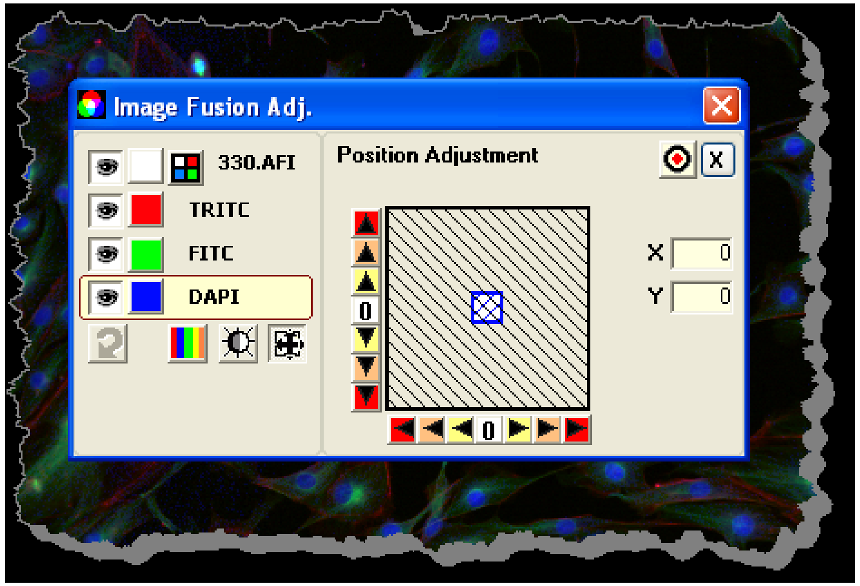
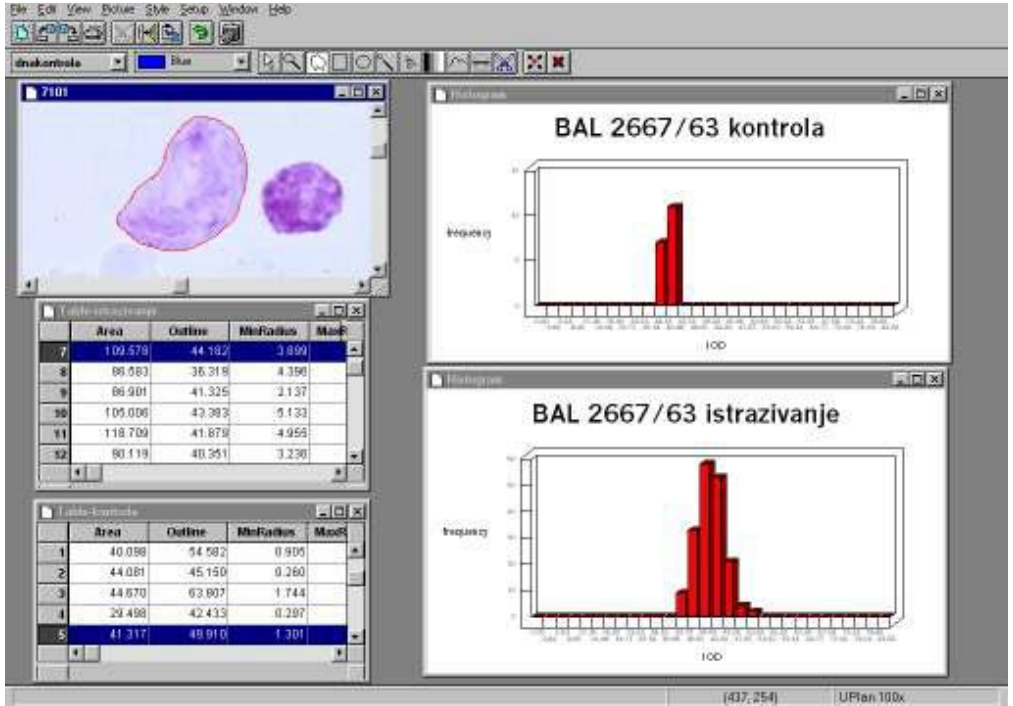


Image Fusion Adj.
330.AFI
TRITC
FITC
DAPI
Position Adjustment
0
0

X 0

Y 0


File Edit View Picture Style Setup Window Help
7101
Histogram
BAL 2667/63 kontrola
frequency
IOD
Histogram
BAL 2667/63 istrazivanje
frequency
IOD
(437, 254)
UPlan 100x

	Area	Outline	MinRadius	MaxR
7	109.578	44.182	3.899	
8	86.583	36.318	4.398	
9	86.901	41.325	2.137	
10	105.006	42.383	5.133	
11	118.709	41.879	4.959	
12	80.119	40.351	3.230	

	Area	Outline	MinRadius	MaxR
1	40.098	54.582	0.906	
2	44.081	45.150	0.260	
3	44.670	63.807	1.744	
4	29.498	42.433	0.297	
5	41.317	49.910	1.301	

IMAGE ANALYSIS SOFTWARE COMMERCIALLY AVAILABLE

http://imagej.nih.gov/ij/

http://fiji.sc/Fiji

- **AFNI** - Software for Analysis of Functional NeuroImages
- **Bio7** - Ecological Modeling, Scientific Image Analysis, and Statistical Analysis
- **BioImage Suite** - Integrated Image Analysis Software Suite of Yale University
- **BioImageXD** - Analysis, Processing, Visualization of Multi-Dimensional Microscopy Images
- **CellProfiler** - Cell Image Analyis Software Developed at the Broad Institute
- **Crystal Image** - Software Program for Image Processing and Analysis
- **CVIPTools** - Software Package for Exploration of Computer Vision and Image Processing

- **FSL** - Library of Analysis Tools for fMRI, MRI, DTI Brain Images
- **Icy** - Open Community Platform for Bioimage Informatics
- **Ilastik** - Interactive Image Classification, Segmentation, and Analysis
- **ImageJ** - Java Tool for Image Processing and Analysis
- **IMAL** - Image Measurement and Analysis Lab
- **KNIME** - Data Analytics, Reporting, and Integration Platform
- **NEFI** - Tool for Network Extraction From Images

Conclusion

collection of teaching quality specimen
+
objective measures for research end points
+
quantification of sub-cellular data, e.g., nuclei, cytoplasm, membran
+
quantitative and qualitative assessment
+
very important for medical students in the advance course of their study program
+
standard method for defining morphologic changes in the cells and tissuues
+
can identify potential clinical biomarkers
=
confirm the diagnosis

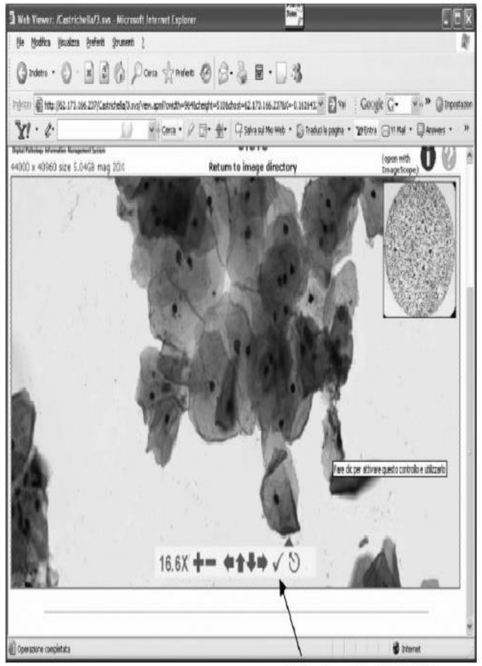
INTERNATIONAL JOURNAL OF

Reliable and Quality E-Healthcare

IGI PUBLISHING

Premier Reference Source

Mobile Health Applications for Quality Healthcare Delivery



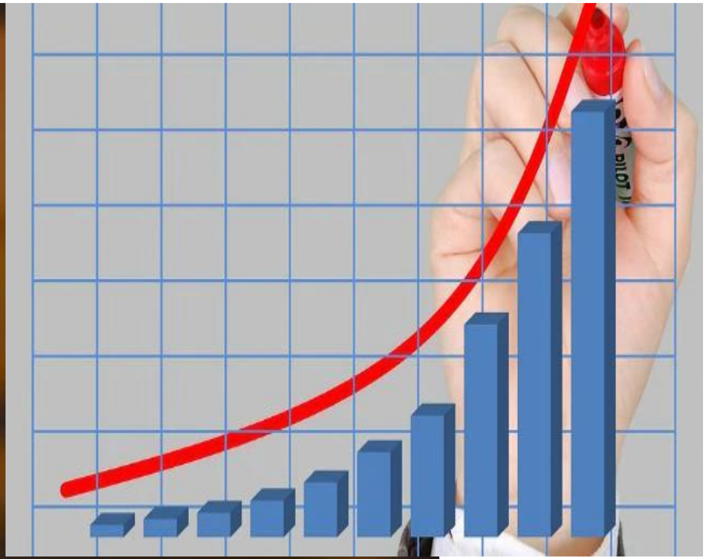
Web Viewer: /Castrichella/3.svs - Microsoft Internet Explorer
44000 x 40960 size 5.04GB mag 20X
Return to image directory
(open with ImageScope)
16.6X
Operazione completata
Internet

Button to push to obtain URL:

http:// dummy/3.svs/view.apml?X=-0.1616432103461398Y=-0.2658836059338158zoom=83.3333333333333

Fig. 3 | *The way to exchange information towards the internet using spectrum web-viewer.*

Thank you for your vision, your extraordinary ability and leadership to guide us at all times. We appreciate the efforts taken by you.



MOTIVATING E-LEARNING