Digital image processing and analysis
Introduction

Professor Ela Claridge
School of Computer Science

In this lecture we shall find out about:

- FIJI (ImageJ) image processing and analysis software

- Essentials
- Basic concepts
- Overview of functions and tools
- Macros and programming

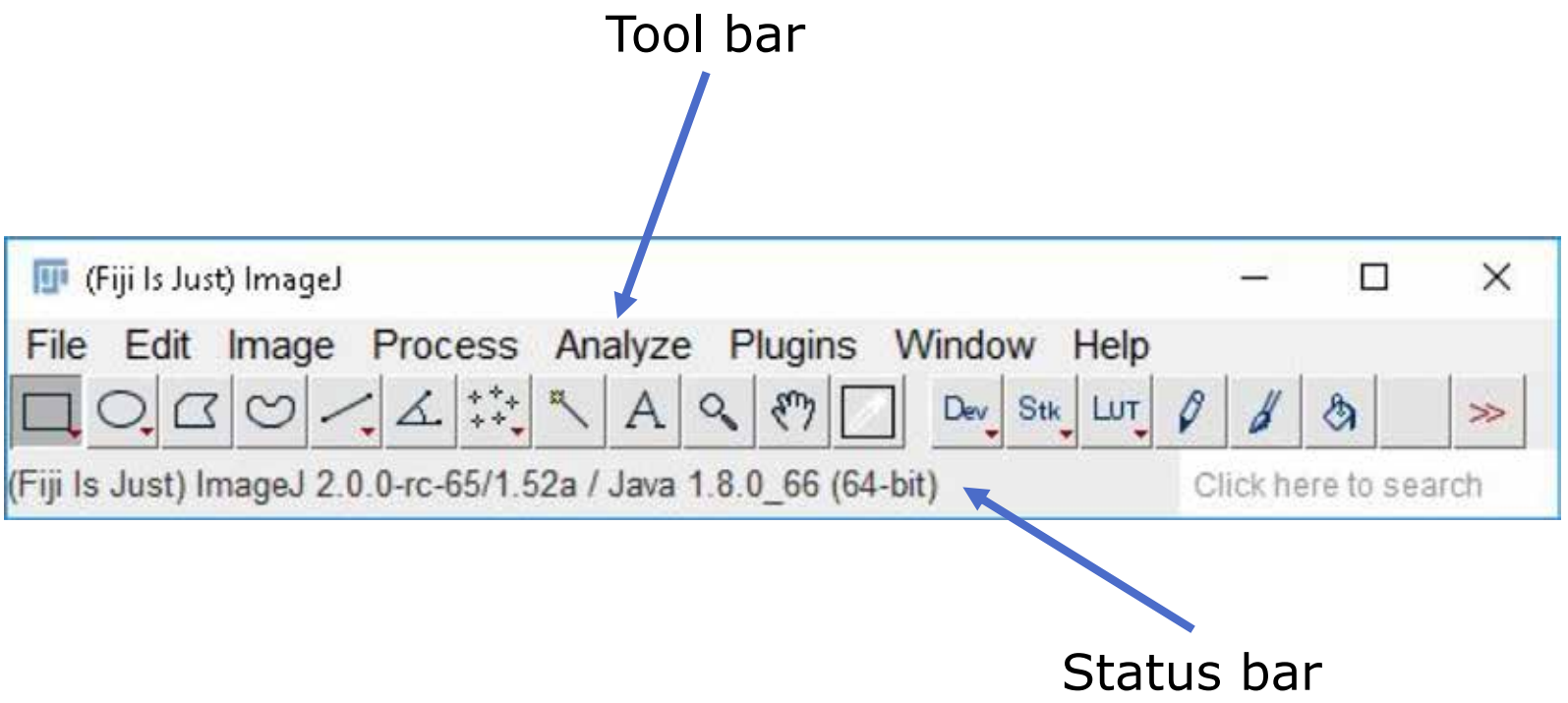
ImageJ is Free Software

- ImageJ is public domain open source software. An ImageJ user has the four essential freedoms defined by the Richard Stallman in 1986:
  - The freedom to run the program, for any purpose.
  - The freedom to study how the program works, and change it to make it do what you wish.
  - The freedom to redistribute copies so you can help your neighbor.
  - The freedom to improve the program, and release your improvements to the public, so that the whole community benefits.

Essentials

- FIJI package is available on several computer clusters on the campus
- To start-up
  - Open the package by selecting ImageJ-Fiji from the applications menu. Ignore any warnings / requests for updates etc.

FIJI menu bar



Images

- Formats
  - TIFF, GIF, JPEG, PNG, DICOM, BMP, PGM and FITS
- Types

Colour image

Greyscale image

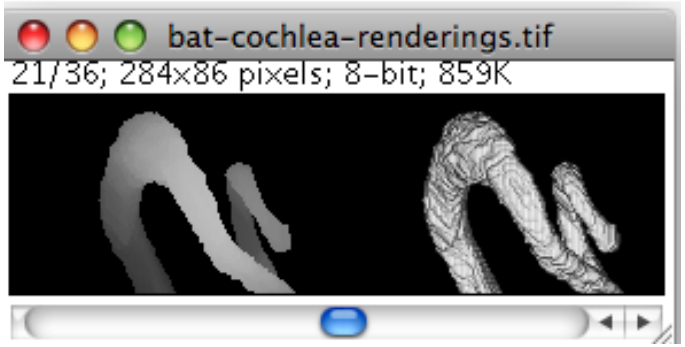


Image stack

Images

- Opening image – options

  File → **New** (new blank image canvas)
  Open (an existing image from a folder)
  Samples (a collection of FIJI sample images)
  Recent (previously opened images)

- Multiple images
  - The active window has its title bar highlighted
  - All operations are performed on the active image

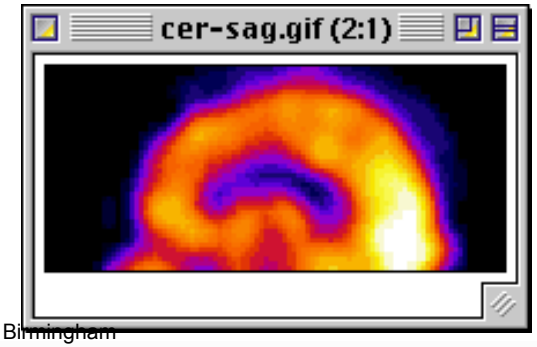
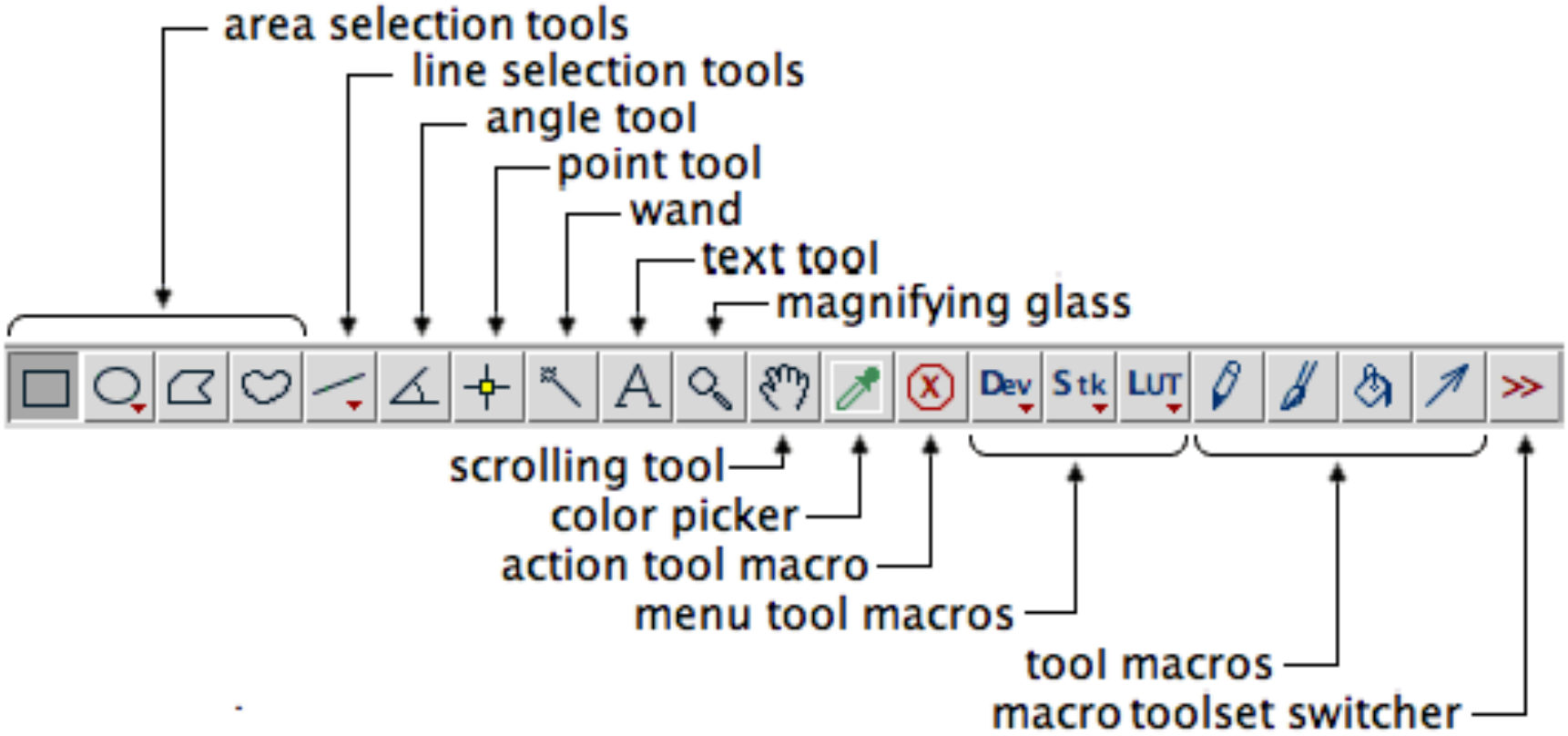


Image duplication, selection and copying

- It is often necessary to compare the results of different operations applied to the same image.
  - Duplicate image (**Image → Duplicate**)
  - You can give the image a new name, or leave a default name suggested by the system

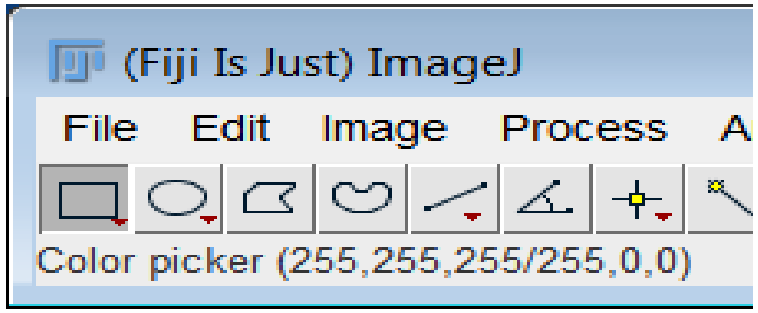
- To insert a copy of an image to your document (e.g. Word, Powerpoint)
  - Select an image by clicking on it
  - Choose **Edit → Copy to System** then paste into the document

Tools



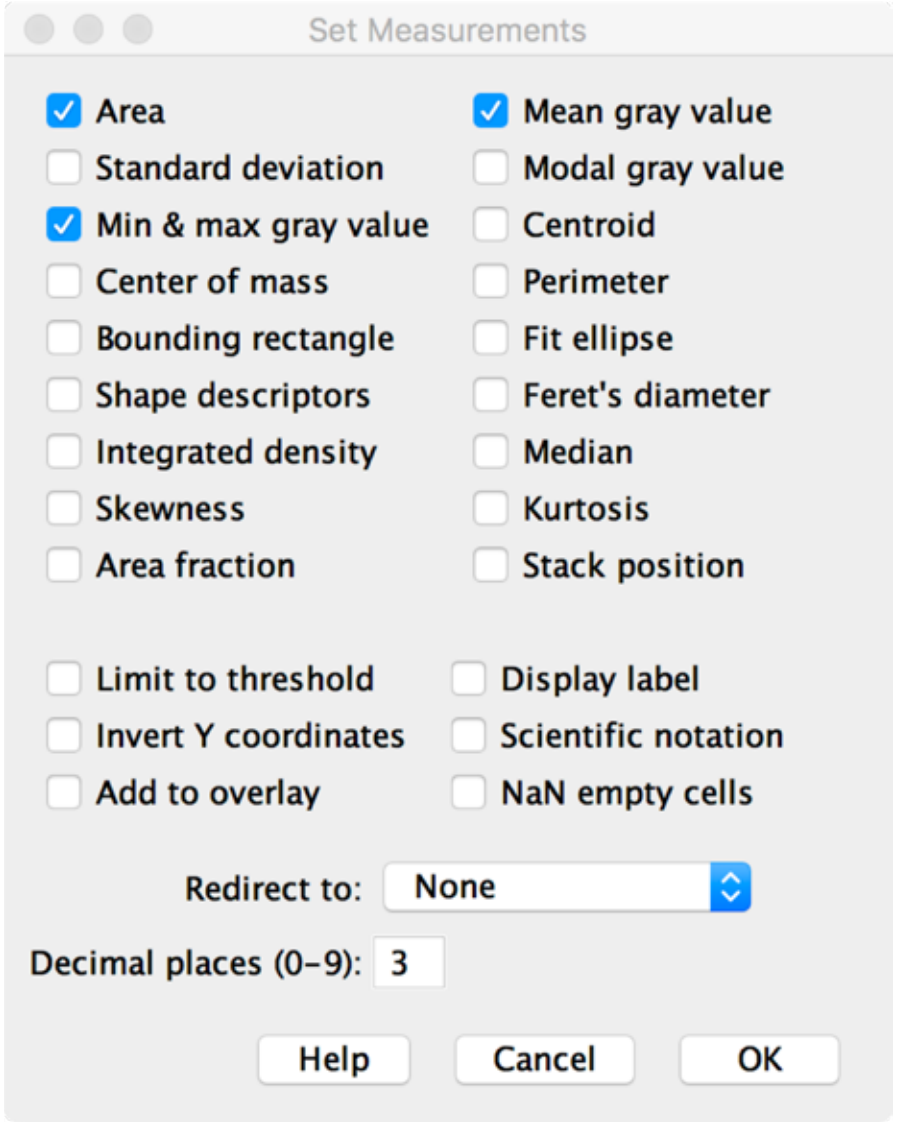
Selections

- Selections: user defined areas or lines within an image
- Only one selection can be active at a time
- Selections can be moved by clicking and dragging
- Area selections can be measured, filtered and filled
- Line selections can be measured

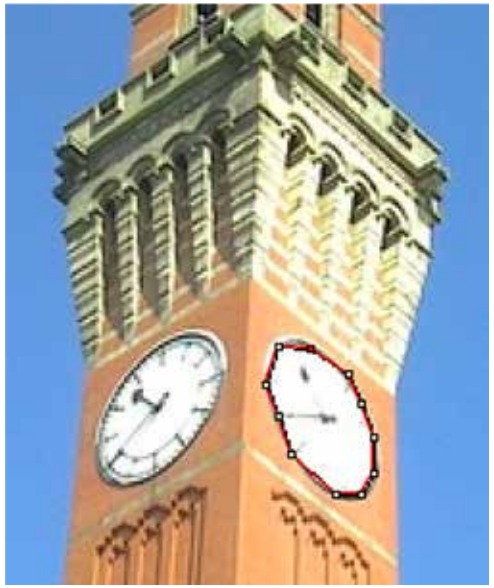


Measurements

- **Analyze→ Set Measurements** lets you select the desired measurements



Measurements



Results

	Angle	Length
1	-92.932	410.537

Results

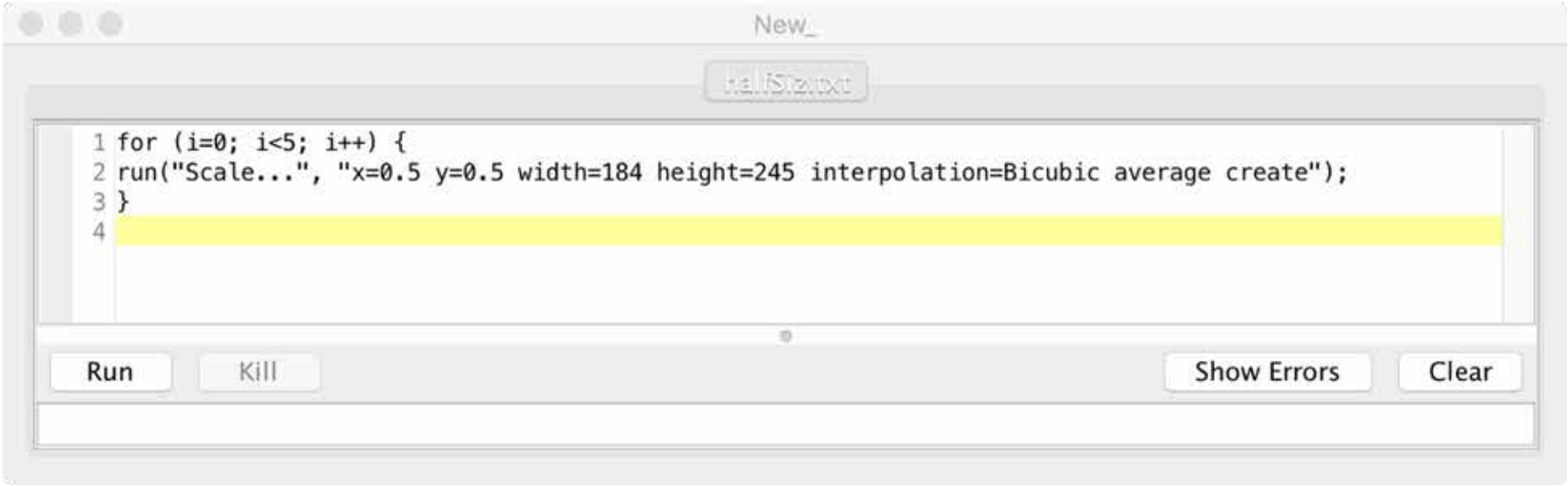
	Area	Mean	Min	Max	XM	YM	Perim.
1	1062	244.275	69	255	408.892	306.387	128.261

Macros and macro language

- A macro is a simple program that automates a series of ImageJ commands
- A series of commands can be recorded using the command recorder (**Plugins → Macros → Record**)
- A macro is saved as a text file (**Plugins → Macros → Run**)
- It can be executed by selecting a menu command (**Plugins → Macros → Record**)

Macros and macro language

- Additional commands can be added with a macro editor (**Plugins → Macros → Edit**)
- This example shows how to repeat the image scaling five times by adding the "for loop" around a single command



The result is shown on the next slide

Macros and macro language

Further reading and exploration

- FIJI: Introduction and basics https://imagej.nih.gov/ij/docs/intro.html
- FIJI: Macros https://imagej.nih.gov/ij/developer/macro/macros.html
- FIJI package is available on most computer clusters on the campus. **Familiarise yourself with FIJI in your own time before the next lab session**

In this lecture we have covered:

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- Essentials
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Next lecture

- Colour: physical origins, perception and characterisation