Basic statistics and data handling – Day 3

Introduction to Scientific Figure Design
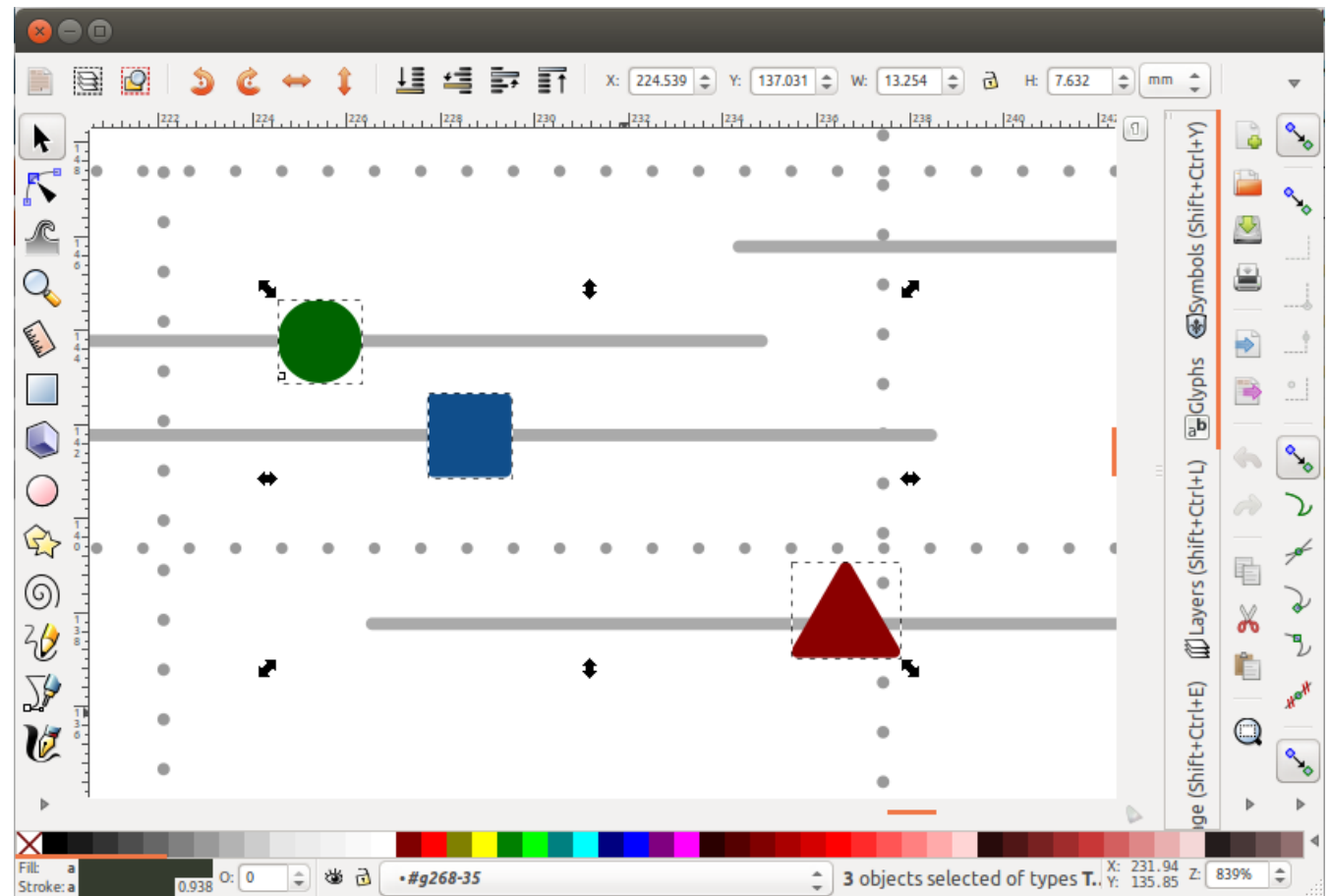## Finalising figures with Inkscape

Aiora Zabala, based on slides by Simon Andrews and Boo Virk (Babraham Bioinformatics)

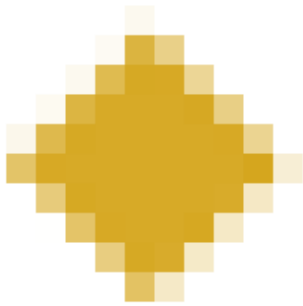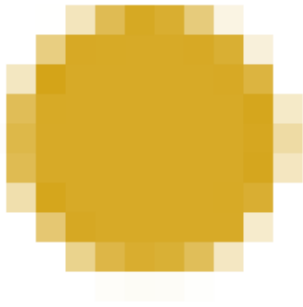*Please, find and click on this icon on your computer:*

What is Inkscape?

- Vector Graphics Editor
- Free Software
- Cross Platform
- Easy to use
- Good for:
  - Compositing
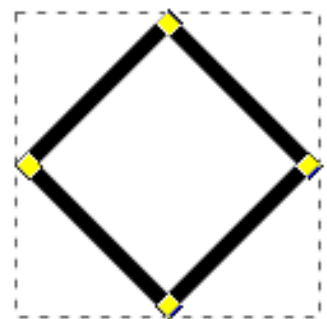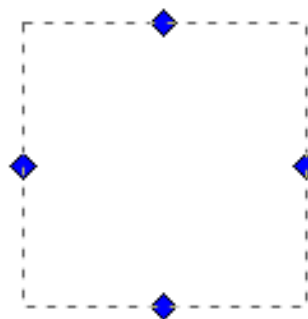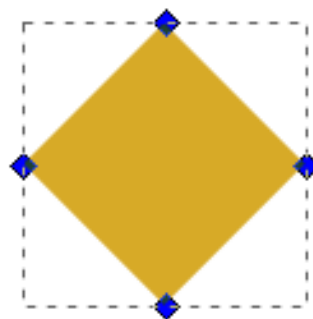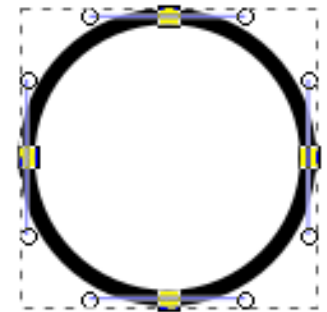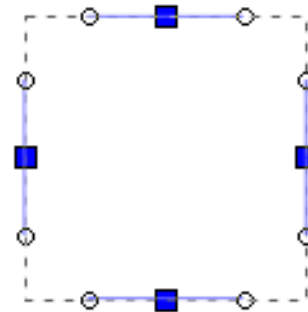 - Drawing
- Not for:
  - Bitmap editing

Bitmap and vector graphics

Images are made of pixels and a colour value

Images are made by points and their connections. Connections can be straight or smooth
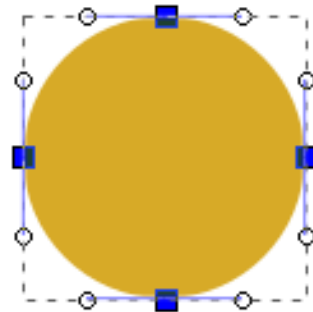
Scaling figures

- Vector images can be scaled freely without loss of quality
- Bitmap images can be scaled down, but not up

Exercise 1: set up a canvas
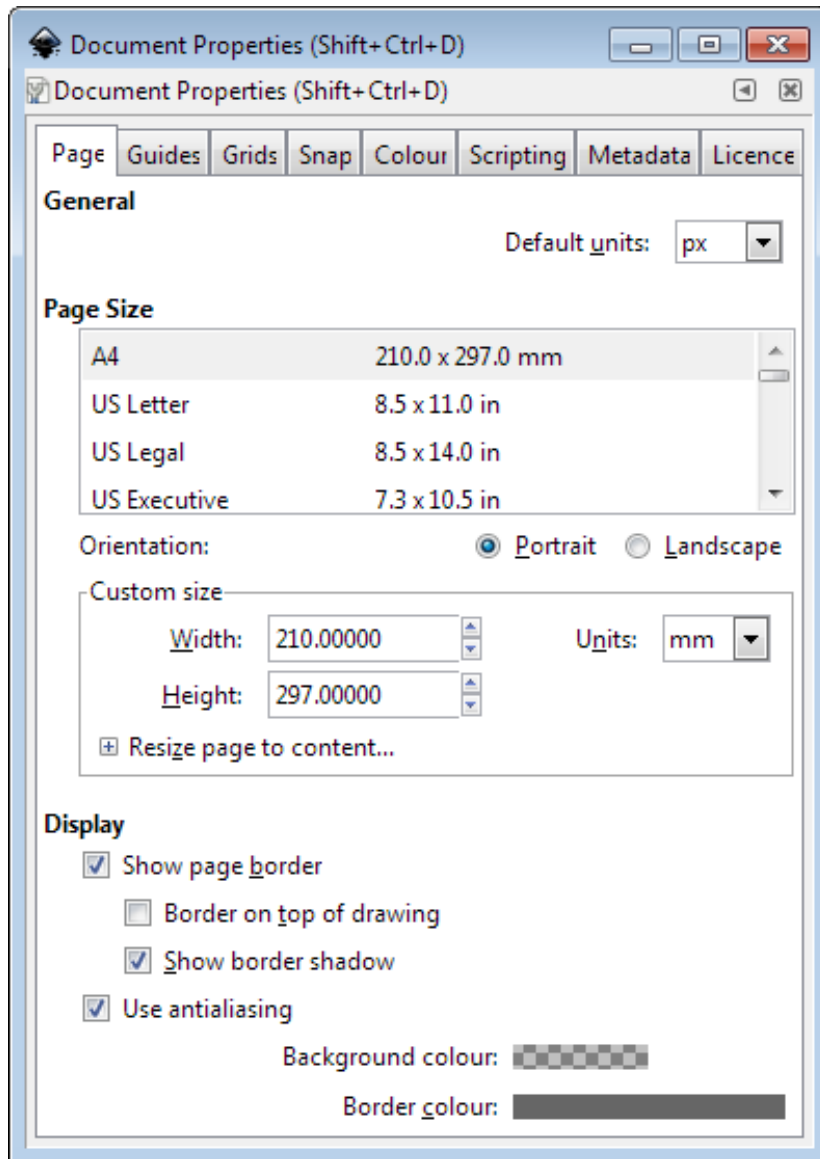
- ***File > Document Properties***
  - Shows page in view
  - Doesn't restrict drawing
  - Useful as a guide
- Change background colour to white
- Change to landscape

Moving around

- Panning
  - Scroll bars on bottom / right
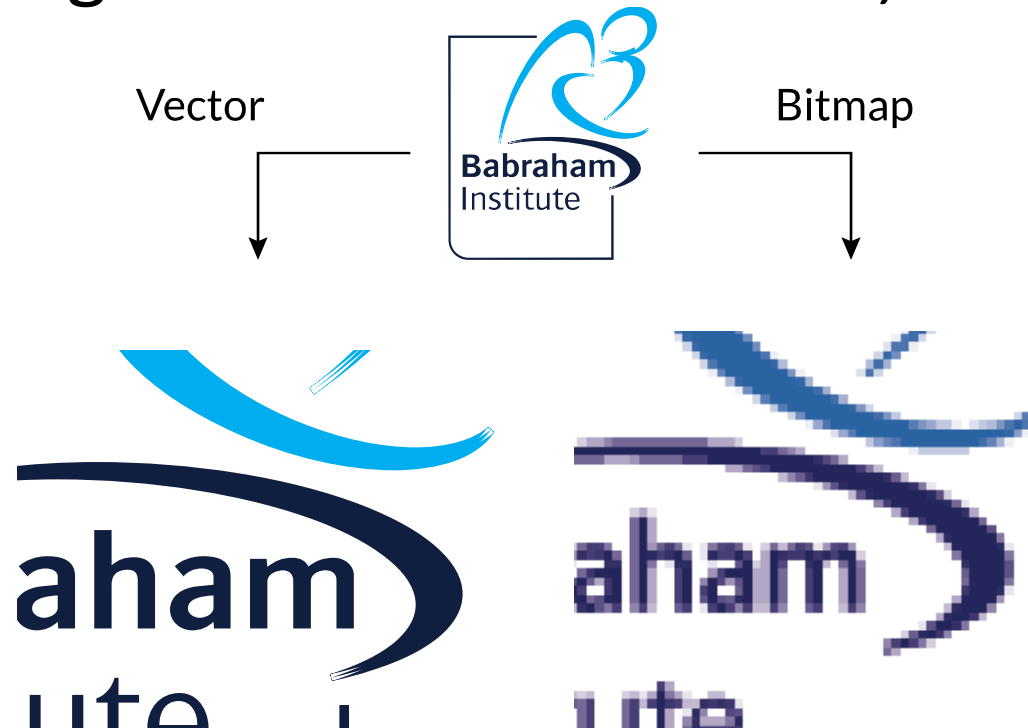 - Scroll up/down, Shift+scroll for left/right
- Zooming in / out
  - Click to zoom in, shift+click to zoom out
  - Control + Scroll Up/Down to zoom in/out to cursor
- Shortcuts
  - Fit page, drawing, selection in window

The main toolbar

Selection tool, F1
Edit nodes tool, F2
Sculpt tool
Zoom tool, F3
Measurement tool
Make rectangles, F4
Make 3D boxes
Make ellipses / arcs, F5
Make polygons / stars
Make spirals, F9
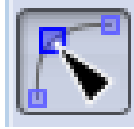
Draw freehand lines, F6
Draw straight lines / curves
Calligraphy tool
Add text, F8
Sculpt with spray
Erase
Fill
Edit gradients
Select colour
Create diagram connectors

Create basic shapes

- Select tool from toolbar
- **Click and drag on canvas**
  - Box selects the bounds of the new shape
  - Colours are remembered from the last shape
- Basic options appear in **top toolbar**
  - Number of spokes on stars
  - Rounded corners on rectangles
  - Circle vs segment vs arc

Control nodes

- Use the Edit Nodes tool
- Two types of control points, squares and circles
  - Squares generally change the size of the shape
  - Circles change the appearance
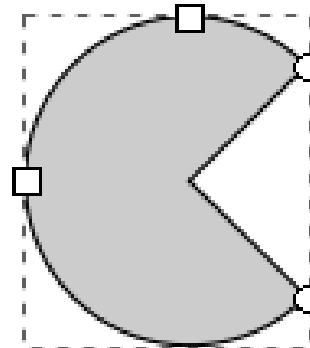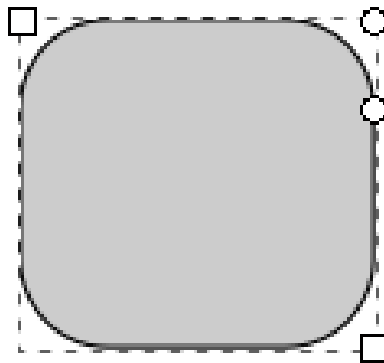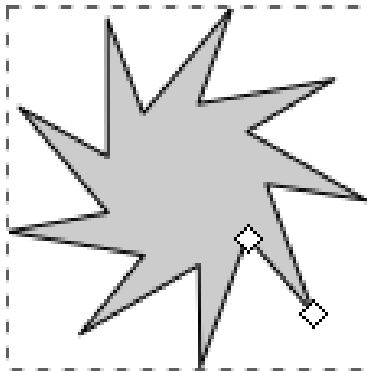
General Transformations

- Select the Selection tool
- Moving – Click and drag an object
- Duplicating – Select object and press Ctrl+D
- Resizing / Rotating
  - Click on object
  - Click again to change control arrow type
  - Click and drag arrows to resize / rotate

Resize / Rotate
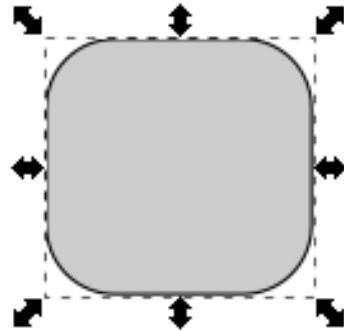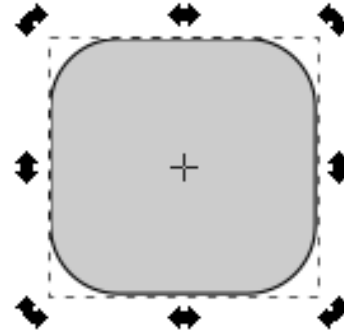
Resize   Rotate

- Can use shift/control keyboard modifiers as before
- For rotation you can move the crosshair to change the centre of rotation

Transform Shortcuts
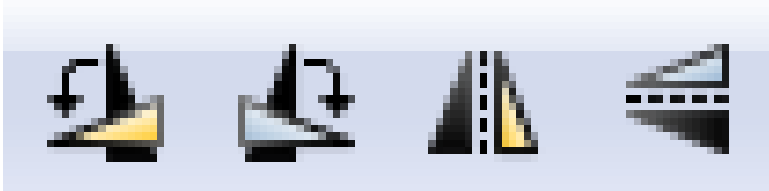
- Rotate 90 degrees anticlockwise
- Rotate 90 degrees clockwise
- Mirror object around the vertical axis
- Mirror object around the horizontal axis

Selecting

- Selecting multiple objects, either:
  - Drag a box to cover multiple objects
  - Shift+click:
    - to add an object to a selection
    - on a selected object to remove it from the selection

Grouping

- Grouping (right click > Group or Ctrl + G)
    - Combine multiple objects into a single object
    - Reversible: Ungroup (Control+Shift+G)

Aligning and distributing

- Object > Align and Distribute
  - Align = Give objects the same centre/edge position
  - Distribute = Space objects evenly
- Align relative to
  - First/Last selected object in group
  - Largest/Smallest object in group
  - Page
  - Drawing
- Never align anything by eye!
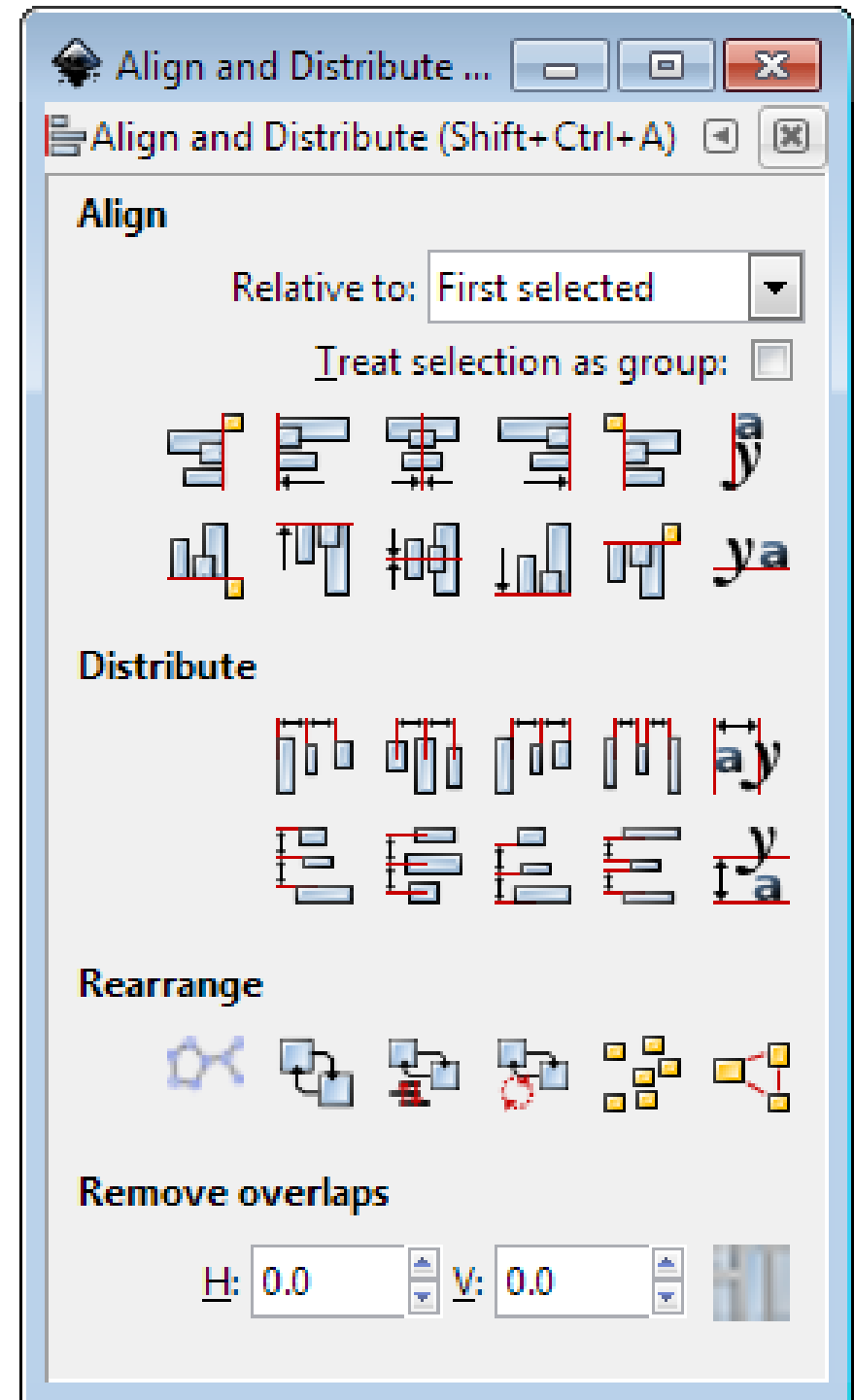
Fill and Stroke

- Fill = Colour/ Gradient/ Pattern within a shape
- Stroke = The line around a shape
- Object > Fill and Stroke (Shift+Ctrl+F)
- Edit
  - Colours
  - Opacity
  - Blur

Fill and Stoke

- Fill types
  - Flat colour
  - Linear gradient
  - Circular gradient
  - Pattern fill
  - Swatch (bitmap) fill

  - Specify colour and alpha (opacity)

Stroke Options

- Width of line
- Shape of corners
- Shape of line ends
- Dashes
- Arrowheads
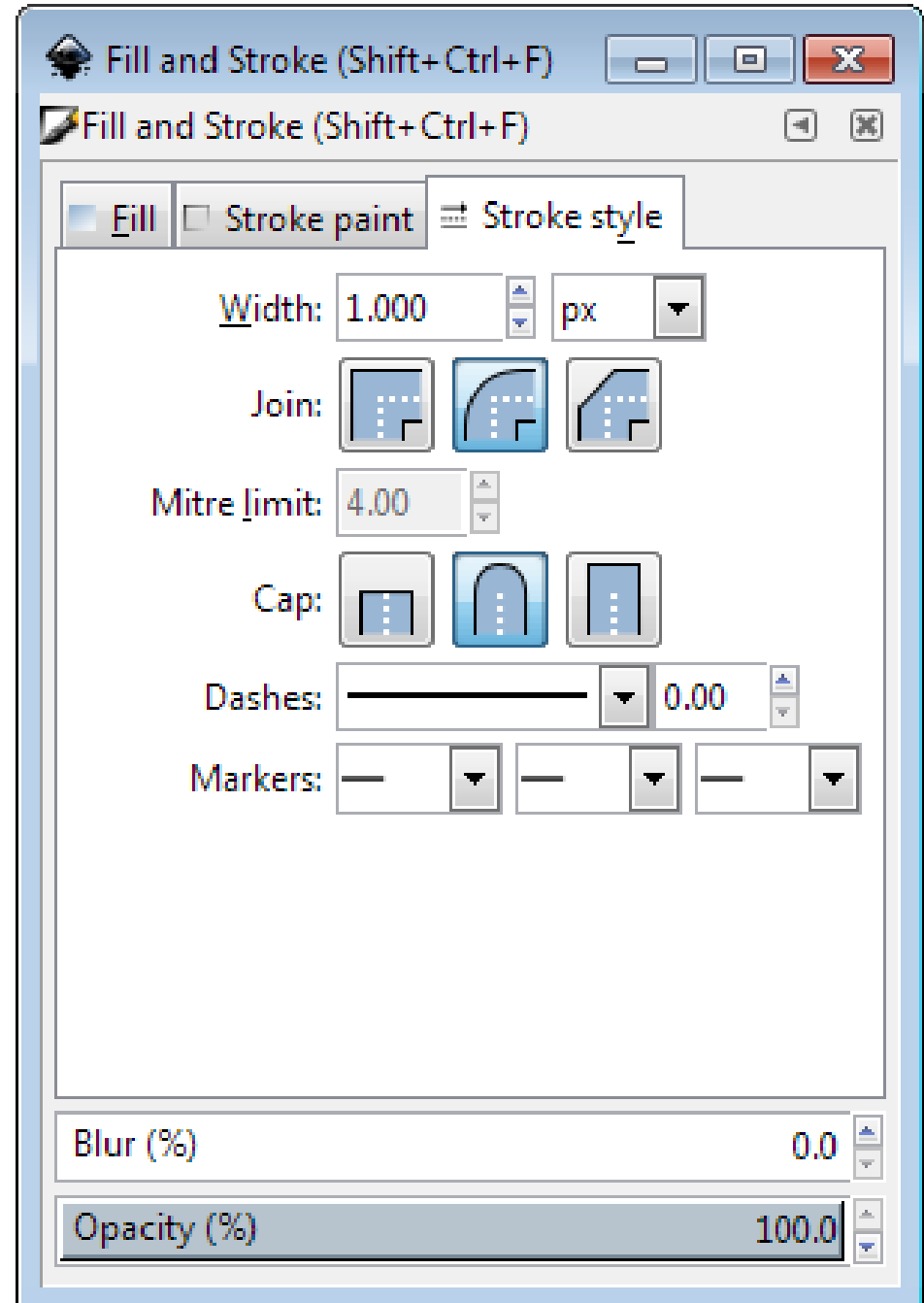
Exercise 2: create and align shapes

Create this:
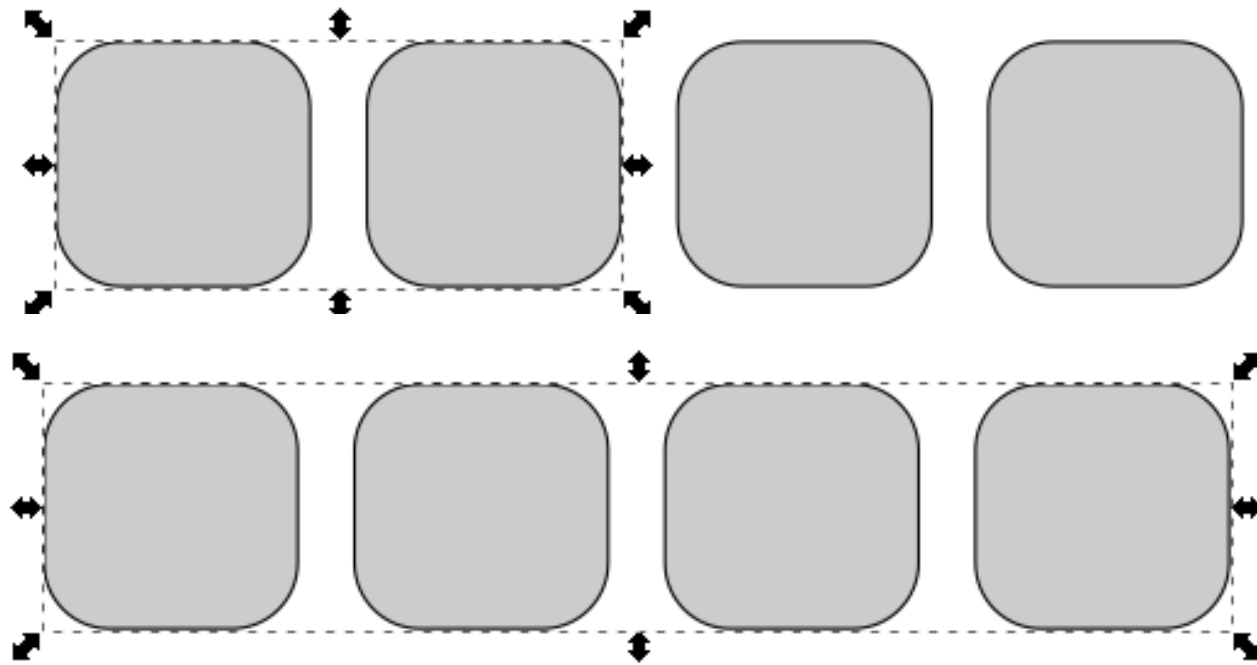
Draw a rectangle with curved corners, duplicate it as necessary, align the figures

Exercise
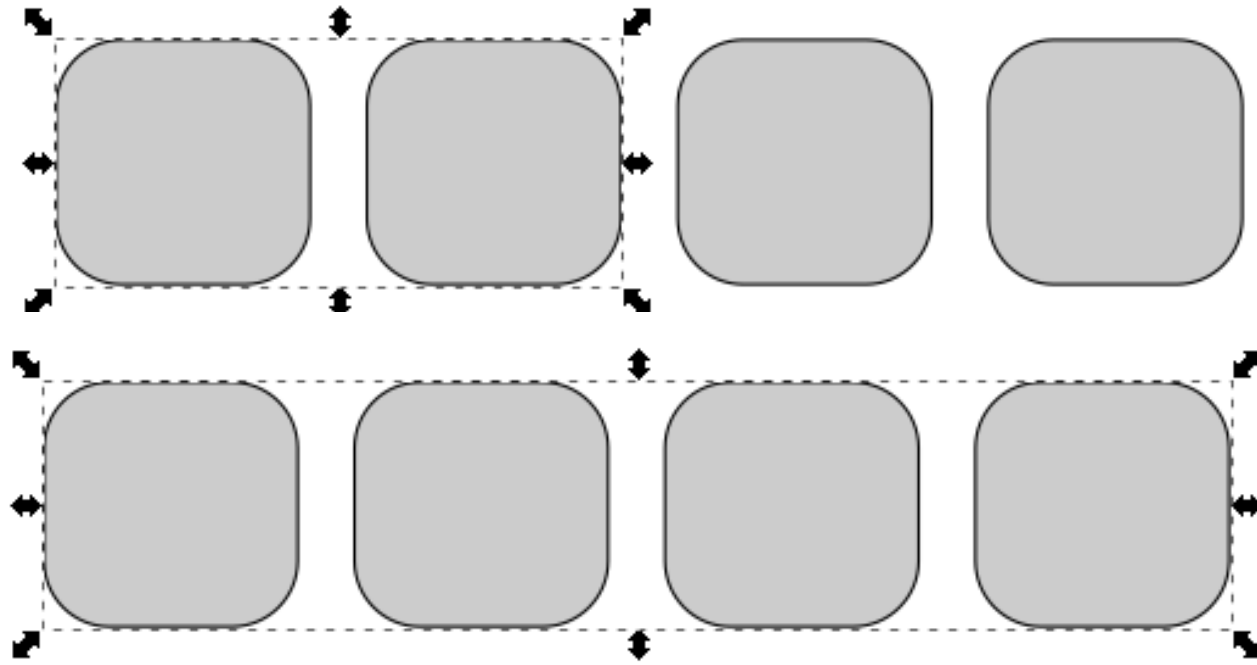
Tools/ attributes to do this: *rectangle, corner radius, fill and stroke, select (and group if necessary)* and *alignment*

Creating and Editing Paths

- Created using freehand or line tool
- Can convert other objects to become a path

- Paths are composed of nodes and segments
- There are different types of node and segment

Nodes and Segments

- ## Segment types
  - – Lines (1)
  - – Curves (2)
- ## Node types
  - – End (3)
  - – Corner (4)
  - – Smooth (5)
    - • Normal
    - • Symmetric
    - • Auto
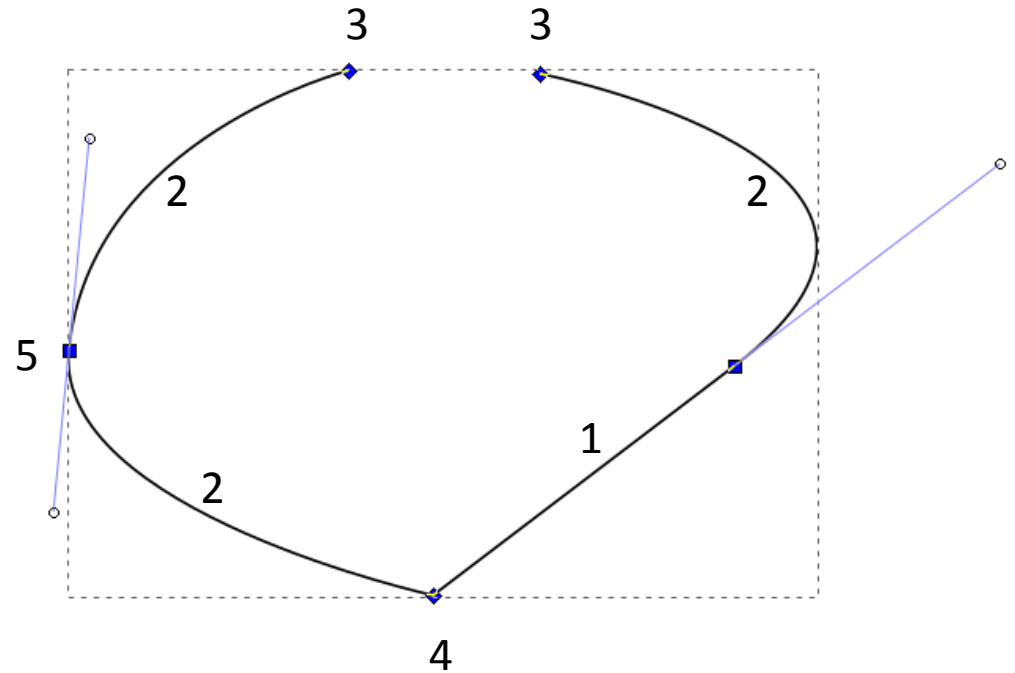
Editing nodes
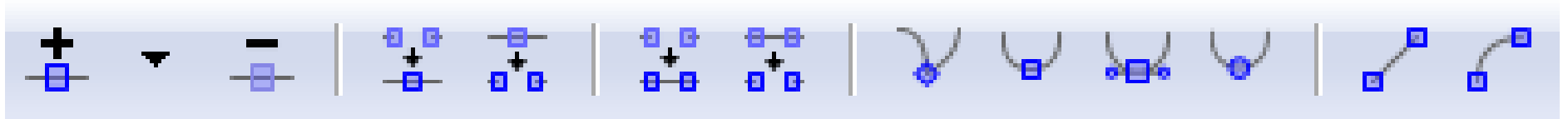
- Use nodes toolbar to add, remove or convert nodes or segments
- Select nodes or segments to make their handles visible
- Drag handles to change the arc of curves

Exercise 3: freehand drawing

- Freehand drawings tend to have large numbers of nodes, and be quite messy

- **Write your name using the freehand tool (with your mouse) and edit to make it smoother:**

  - Use simplification (Path > Simplify, Ctl+L)

  - Edit nodes directly on the simplified version

Combining paths

- Often want to add or subtract objects from each other
- Have to do this as paths (Path > Object to Path)
- Lots of options for joining paths together

Combining Paths

Union
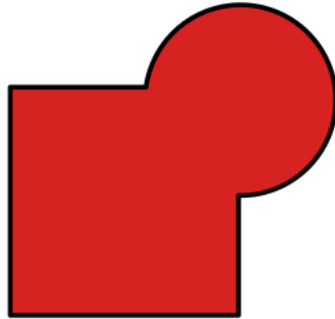
Difference

Intersection

Exclusion
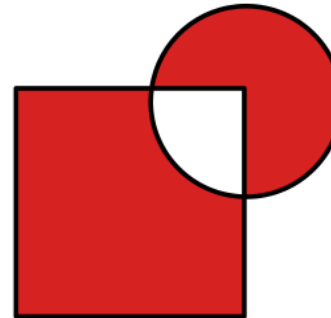
Exercise 4: path combinations

- Create two shapes

- Copy & paste them four or more times

- Apply path combinations to each pair of shapes
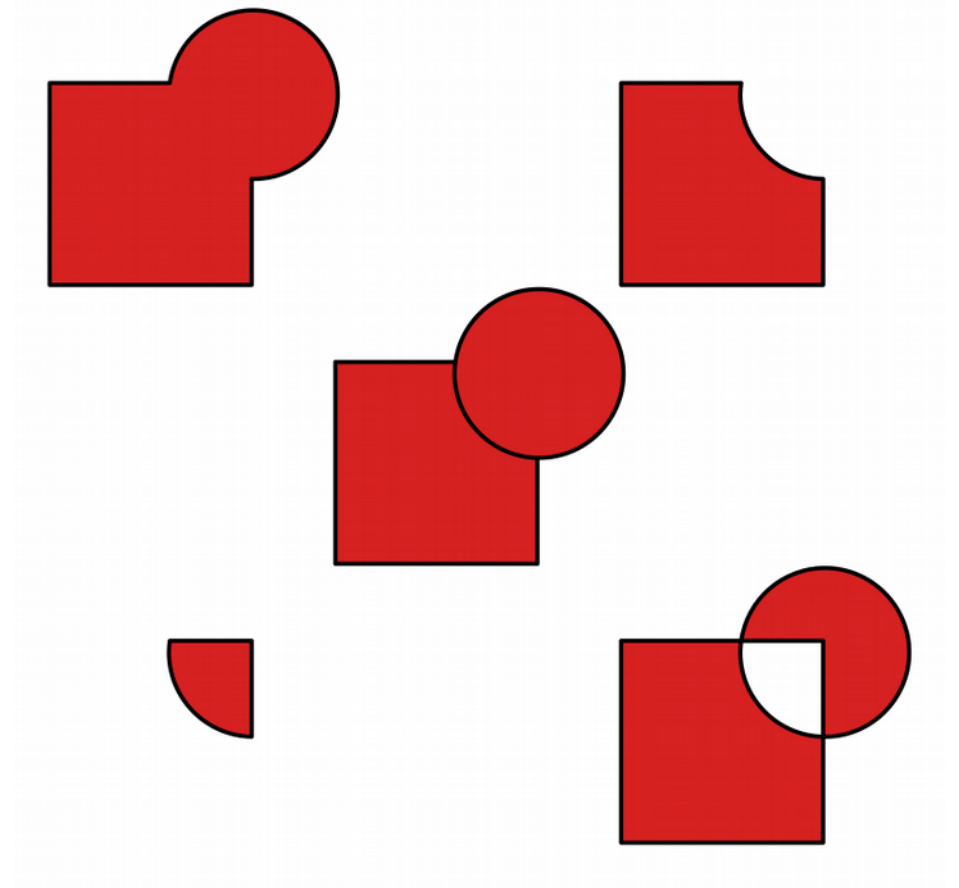
Opacity / Blur

- Applies to whole object
- Separate from alpha in colours
- Works on all Objects

Gradients

- Standard colour option
- Set multiple colours / opacities to go through
- Set the direction and extent of the gradient
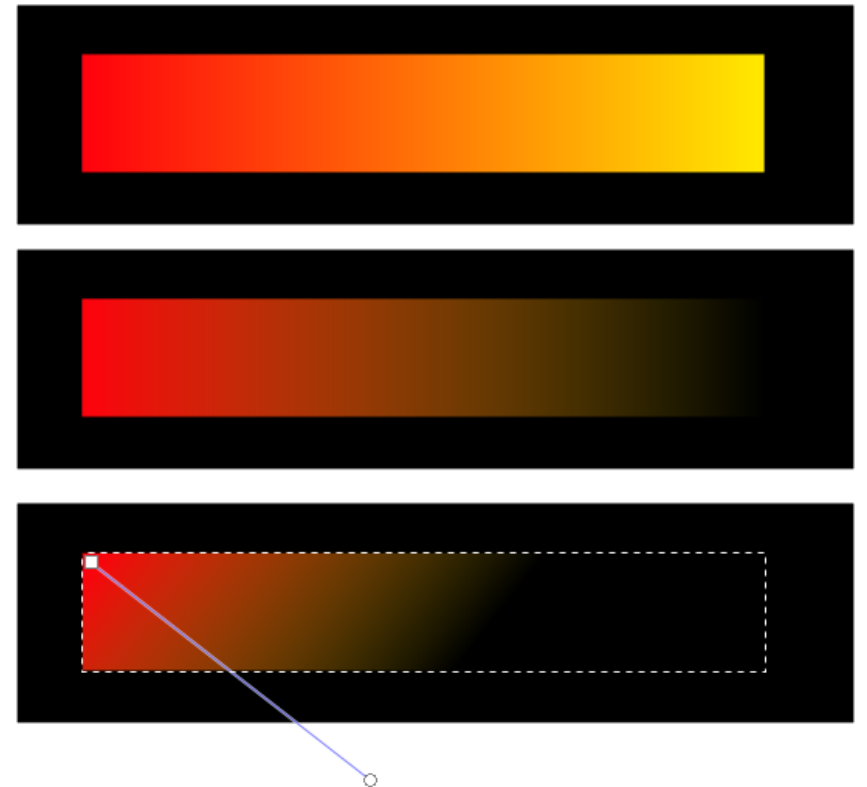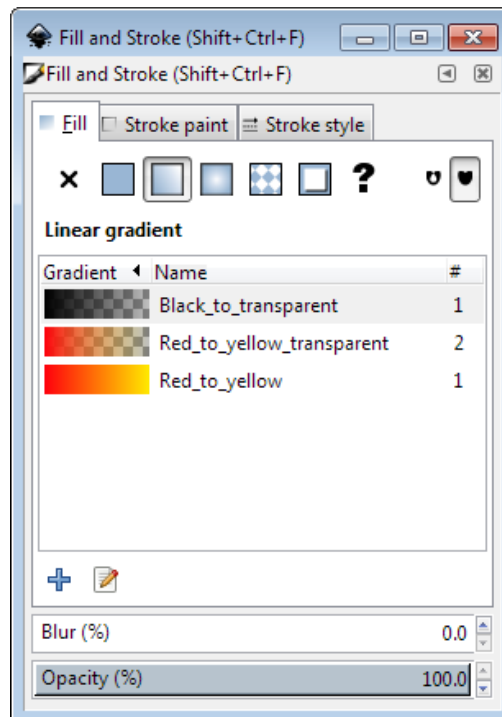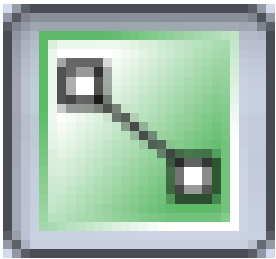
Z axis - Ordering

- New objects sit over the top of old objects
- Objects obscure those underneath them (except for transparency)
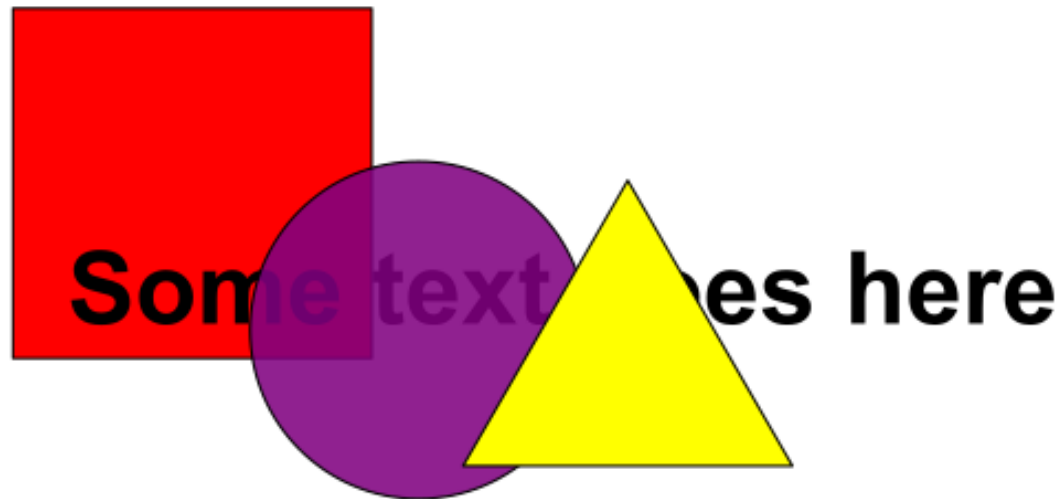
Z-axis Ordering

- Send object to bottom of z-stack

- Lower object one level

- Raise object one level

- Bring object to top
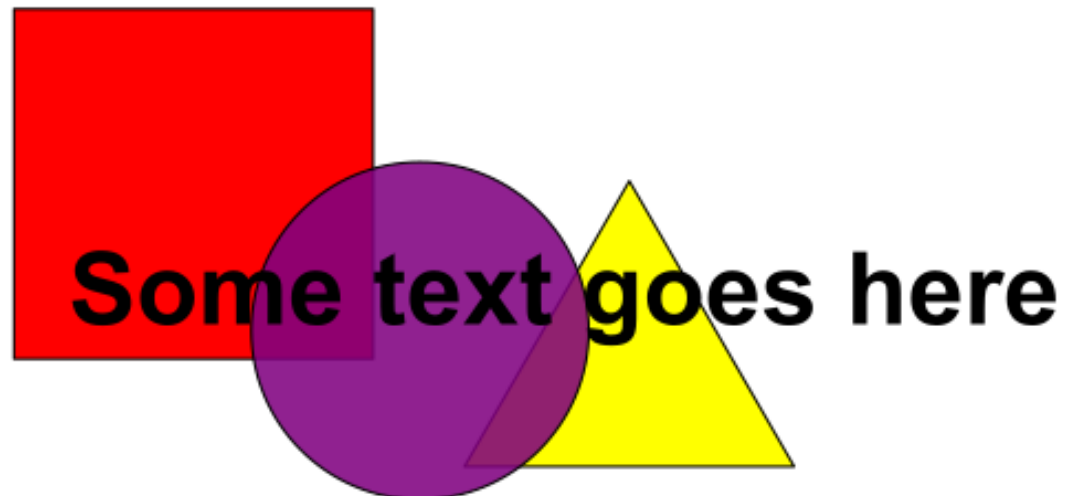
Working with bitmaps (photos)

- Inkscape can include bitmaps in images
- Appear as objects alongside vector objects
- Can't edit the images
- Can't increase the resolution of the image
- Transparency (from PNG etc) is preserved

- File > Import
  - PNG, JPEG, SVG, PDF etc. etc.

Working with bitmaps (photos)

- Inkscape can include bitmaps in images
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- ***File > Import***
- Formats: PNG, JPEG, SVG, PDF etc.

Exercise 5: add text

- Use the text tool to add text.
- Click and type to generate text
- Text can be scaled or rotated as any other object
  - Always hold Ctrl when scaling otherwise the aspect ratio will be messed up

Text options

Text toolbar
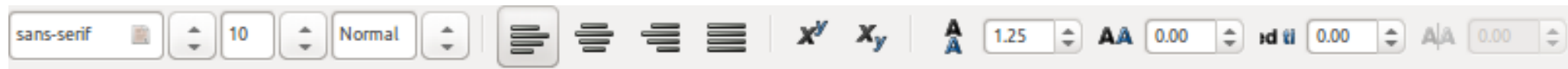
Text and font settings: font, alignment, spacing
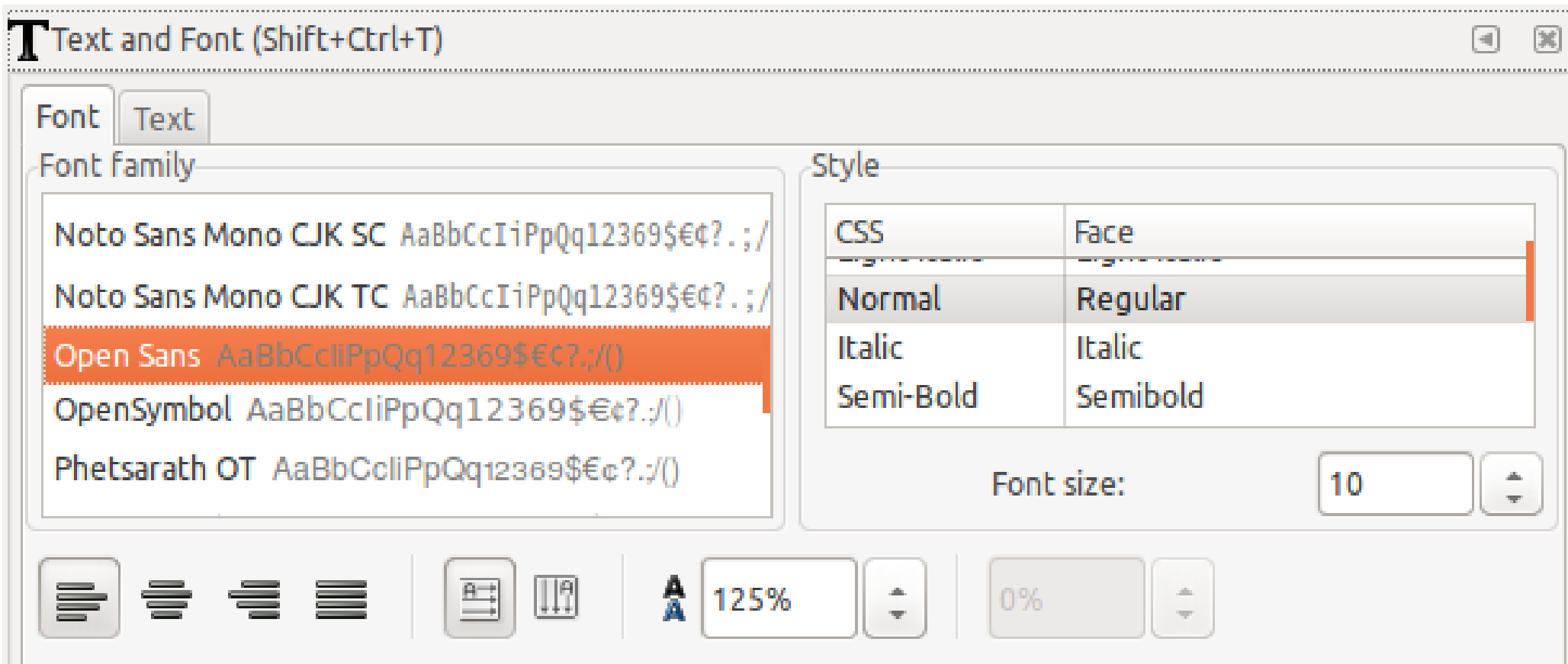
Exercise 6: basic shapes

- Create a standard page layout and figures using block shapes.
- Open Inkscape and go to document properties: File > Document Properties
- Set the page template to be a landscape A5 page.
- Alter the view so that it is zoomed and centred on the page you have just created.
- Draw the flags below, using basic shapes:

Japan	Iceland	Turkey

- Make sure all flags are the same size. Use the appropriate tools to ensure that regions supposed to be aligned or symmetrical really are

Exercise 7: annotate an imported graph

- Create a plot of your choice in R and export it as PDF. Use the following code:

```
pdf("myplot.pdf") # See ?pdf for more options
# … code of plot here
plot(table(rpois(100, 5)), type = "h",
    col = "red", lwd = 10,
    main = "rpois(100, lambda = 5)")
# end of plot code
dev.off()
```

- Import the saved PDF into Inkscape: *File > Import*
- **Ungroup** the graph and add or edit the titles in axis and axis ticks (e.g. change the names and/or the fonts). You will see that the text in the imported graph isn't actually text, but has been converted to paths, so you'll need to re-type the text.
- Change the **thickness of lines** so that they have the same weight
- Change the colour of the **background**
- Add a figure **title**

Exercise 8: freehand drawing & editing

Copy and paste the image below into your Inkscape project:

In the PDF viewer, press
Shift + Print screen and hold them while you select the image with your mouse. Then ***Save to clipboard***.

In ***Inkscape***, press ***Ctrl + V*** (or Paste)

Scale it to an appropriate size and use the image as a template for you to **draw a vector illustration.**
There are two main options:
- Draw the initial sections **freehand** using either the drawing or curves tool
- Draw the main curves and shapes using **Add shape** tools, and then combining paths

Then use simplification and node editing to create a more refined image.

Once you're happy with the image you can delete the original photo to leave just your vector drawing.

Finally you can label the major components of the eye: iris, pupil, eye lid, tear duct, eyelashes.

File formats

Vectors: for anything that has been generated by a computer: graphs, illustrations and text.
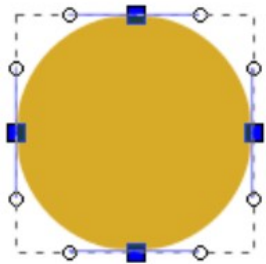
File Types:

.svg

.eps

.pdf

.ai

Bitmaps: for figure components generated by a camera (e.g. microscopy or blot photos).

File Types:

.png

.jpg / .jpeg

.gif

.bmp

.tif / .tiff

File formats

- Bitmap images can be embedded within a vector image.

- Ideally, **publication figures** should be **vector** graphics for assembly and annotation of figure panels, with **bitmap images embedded** within.

  – This ensures that no resolution will be lost

Export from R to edit in Inkscape

In **PDF:**
```
getwd() # Make sure you know where the figure is saved
pdf(file="myplot.pdf")
# … code of plot here
dev.off()
```

Other formats:
```
png()
jpeg()
bmp()
tiff()
svg()
postscript()    Alternative to PDF, when they are too large to render if plots
                contain many data points
```

They all have arguments to set dimensions, resolution, etc. although the syntax can vary slightly.

Remember to always close graphic devices by using **dev.off()**

Export from R to edit in Inkscape

- From Rstudio (only for *quick & dirty*)
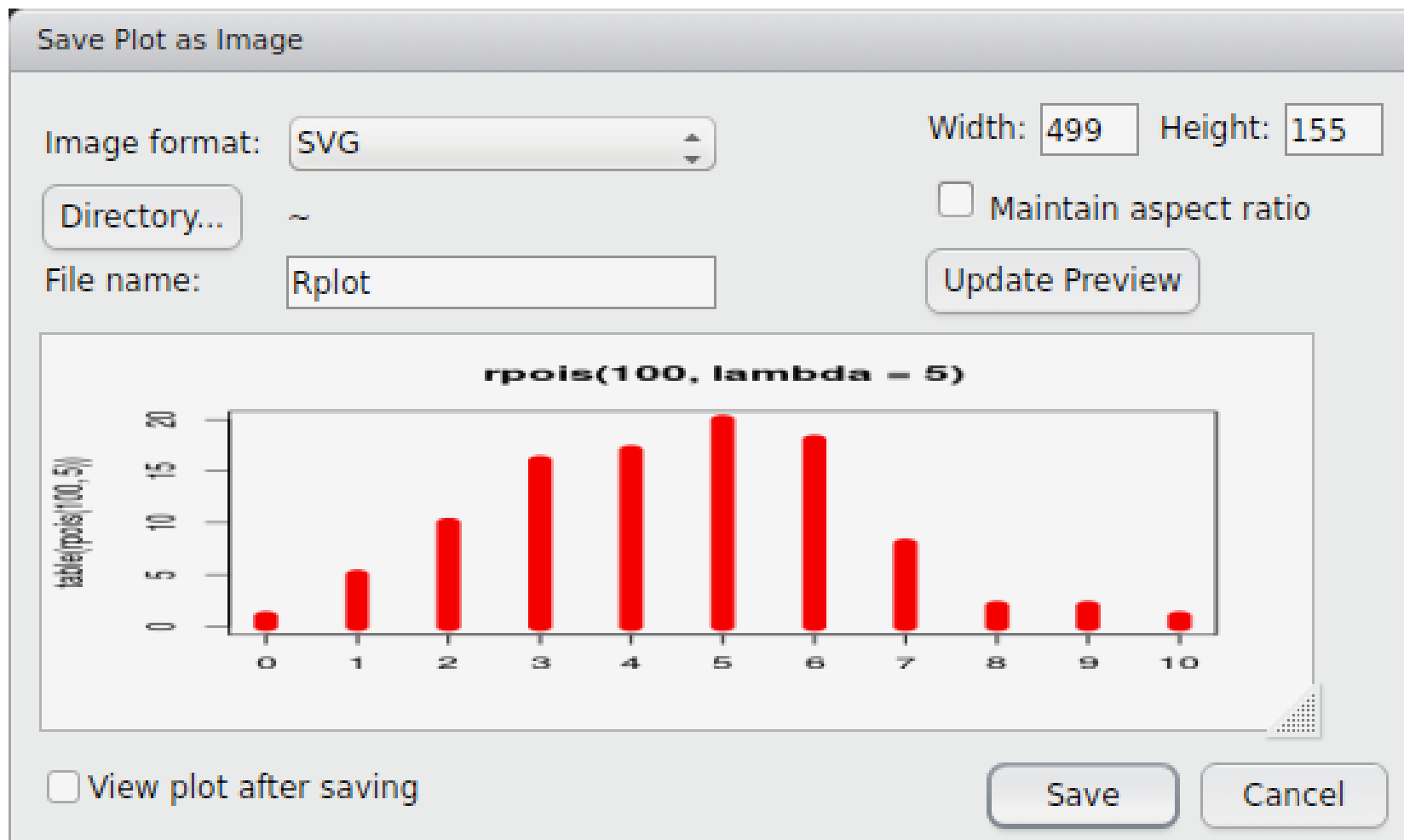
Saving files in Inkscape

- Saving
  - ***File > Save (As)***
  - Default is Scalable Vector Graphics (SVG)
  - Adds custom extensions to SVG standard
  - Can select plain SVG for maximum compatibility
  - Can compress SVG (svgz) for disk space saving

Exporting files from Inkscape: Vector

- In theory, SVGs can be seen in any web browser, however it has some caveats.
- To share the figure in vectorial format, PDF is appropriate
- *File > Save (As)*, select PDF
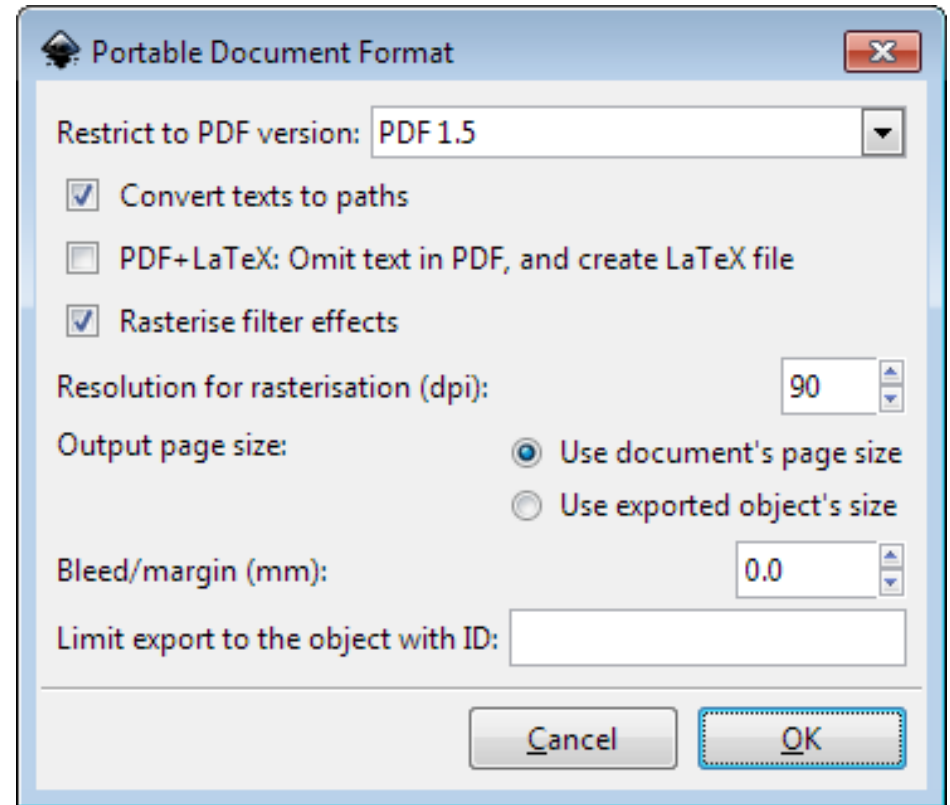
Exporting files from Inkscape: **Bitmap**

- Figures with a lot of the surface covered with photos, or where the figure has many elements (e.g. millions of data points), saving as a bitmap can make files smaller and faster to render

- Inkscape exports high quality PNGs

- ***File > Export PNG Image***
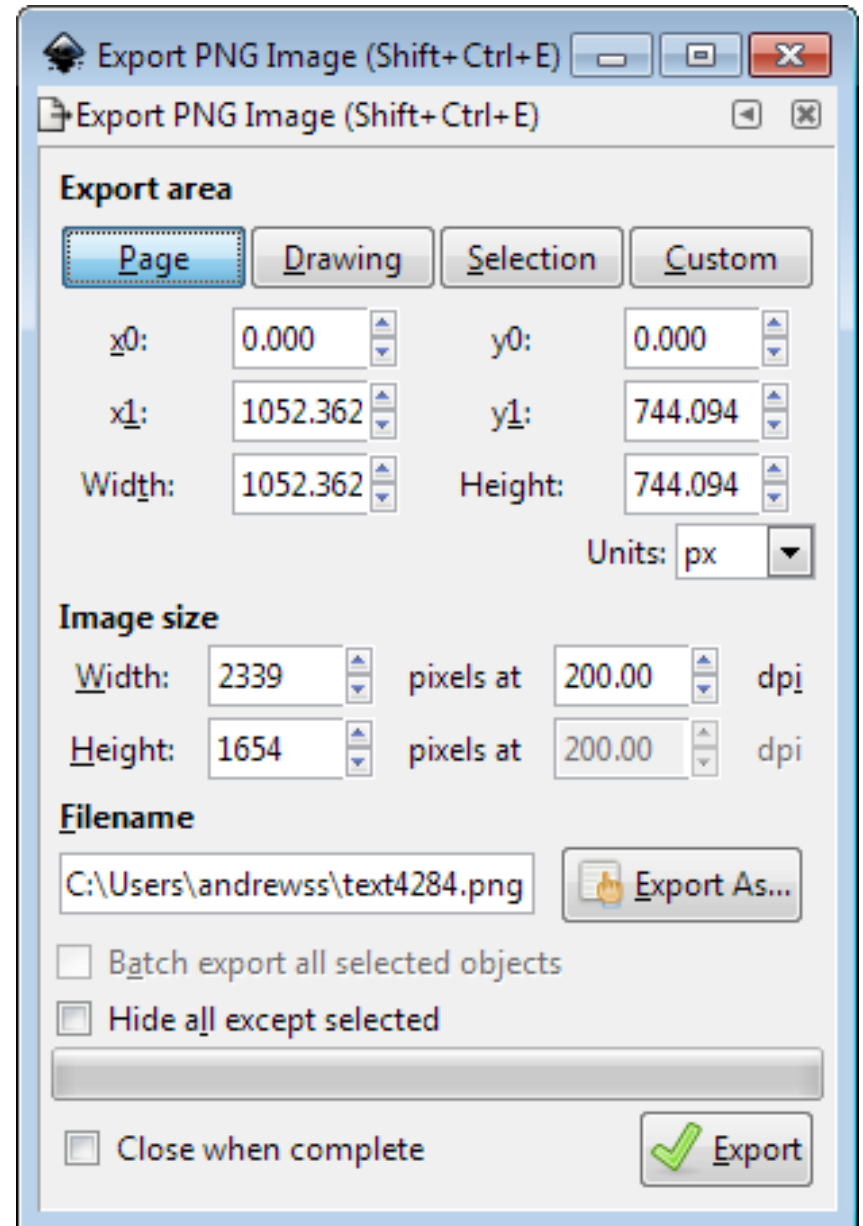
Saving vs Exporting

- In Inkscape (and any other vector software) distinguish between *working or editable* files (e.g. SVG), which are best seen with the software that created them, and files for *sharing or publication* (e.g. PDF or TIFF), which do not keep full editing features

- **Save** the file frequently while working on it

- **Export** the file once it's ready to share

Preparing for Submission

- Initially figures will be assessed by reviewer
- At this stage figures do not need to be print quality production
- Most reviewers will print figures out on a laser or inkjet printer on normal copy paper

- If accepted for publication, high quality figures will be required

Basic Steps in Preparation

- Determine the final size of the figure
- Heights of text, thicknesses of lines
- Figure in colour, grayscale or black and white
- Resolution
- Acceptable File format
  - Choose the best one

Journal Guidelines

- Most journals have guidelines for initial submission
- These differ so it's worth checking
  - **Nature**: JPEG, 150 dpi, included in the manuscript, fit to column width
  - **Science**: PDF, 150 – 300 dpi, included in manuscript, fit to A4 page
  - **BMC Biology**: Several, 300 dpi, separate from manuscript, fit to A4 page

Exercise 9: ready for publication

- **In R:** Export the following plots as PDF:
    - **http://www.sr.bham.ac.uk/~ajrs/R/gallery/plot_cluster_z_vs_kT.txt**
    - **http://www.sr.bham.ac.uk/~ajrs/R/gallery/plot_blackbody_curves.txt**
    - **http://www.sr.bham.ac.uk/~ajrs/R/gallery/plot_XMM_A07_summary.txt**
- Remember to always end with **dev.off()**

- You can use additional plots, for example, from:
    - Previous material in this course
    - **http://www.statmethods.net/graphs/index.html**
    - **http://www.sr.bham.ac.uk/~ajrs/R/r-gallery.html**

- **In Inkscape**: import the plots from PDF files to compose a single figure. Remember to check alignment and size.
- Change the colour of the charts so that they would work in black and white and make any other adjustments you think would make the figures clearer. Use labels to 'create a story'.
- Remember to **save** working copies of your files in an appropriate format, i.e. SVG.
- **Export** your final figure in an appropriate format.