

# Designing effective scientific figures

## Introduction to Inkscape to finalise figures

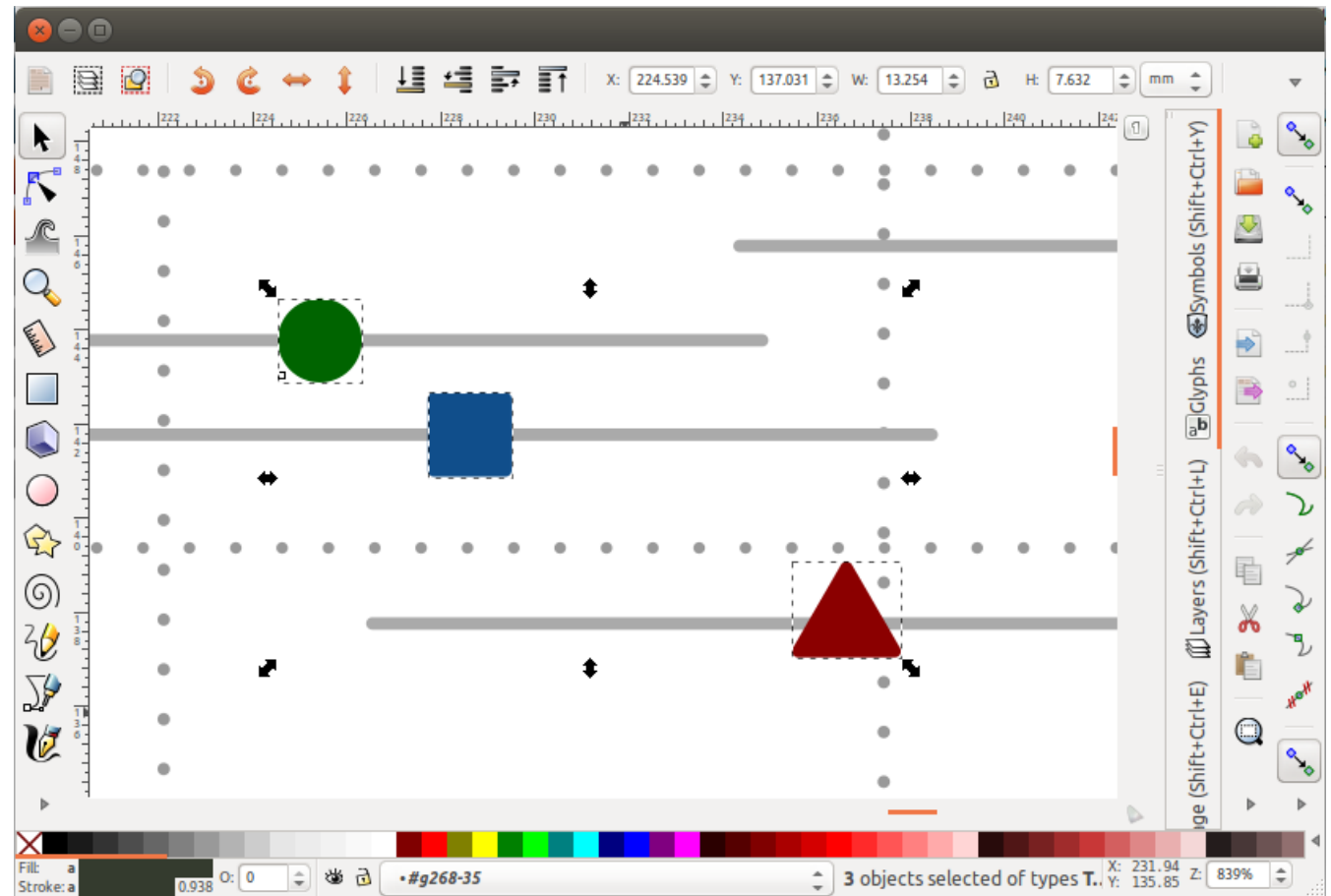
Aiora Zabala, based on slides by Simon Andrews and Boo Virk

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



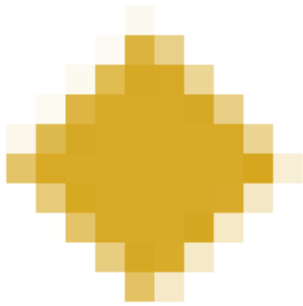
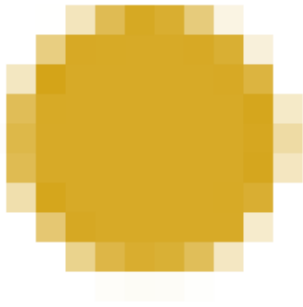
# What is Inkscape?

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

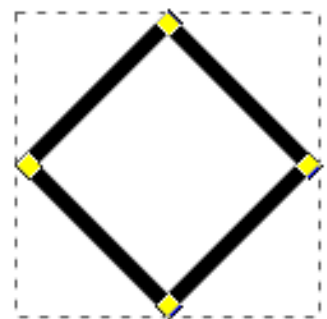
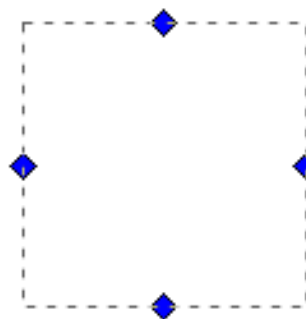
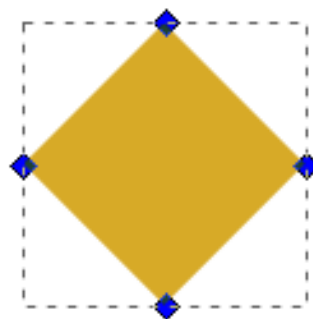
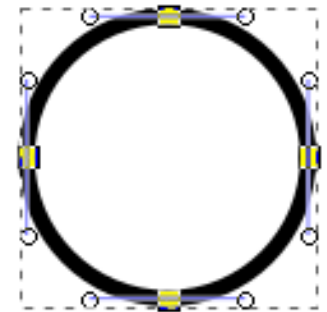
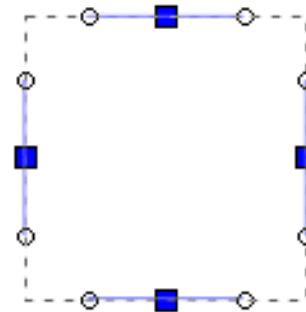
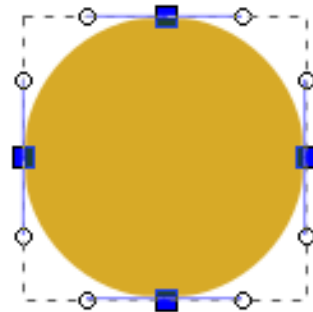


# Bitmap and vector graphics

Images are made of pixels and a colour value

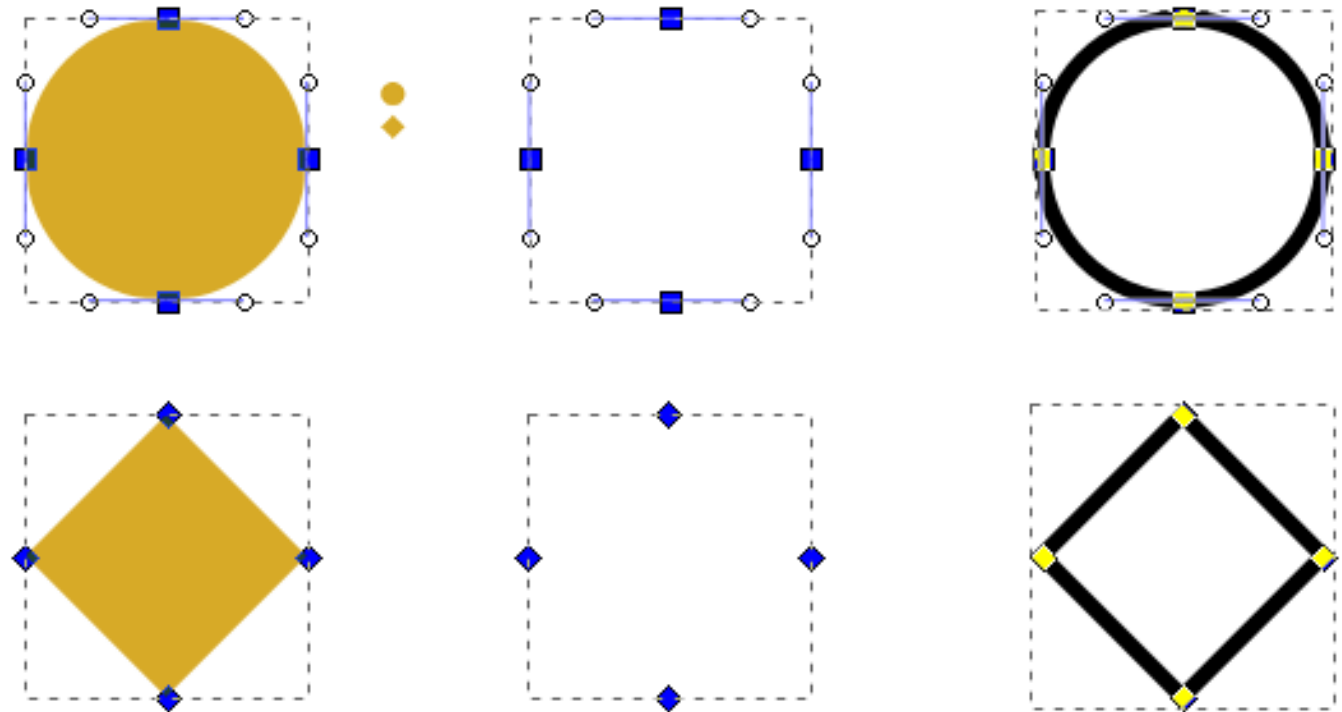


Images are made by points and their connections.  
Connections can be straight or smooth



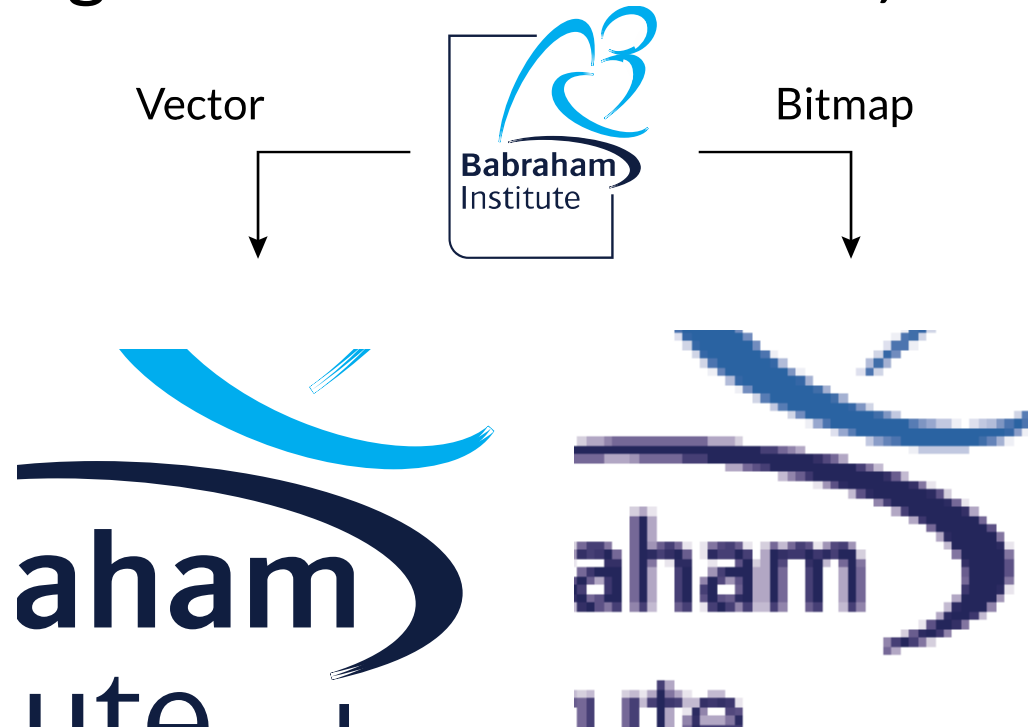
# Bitmap and **vector** graphics

- No inherent resolution
- Fully editable

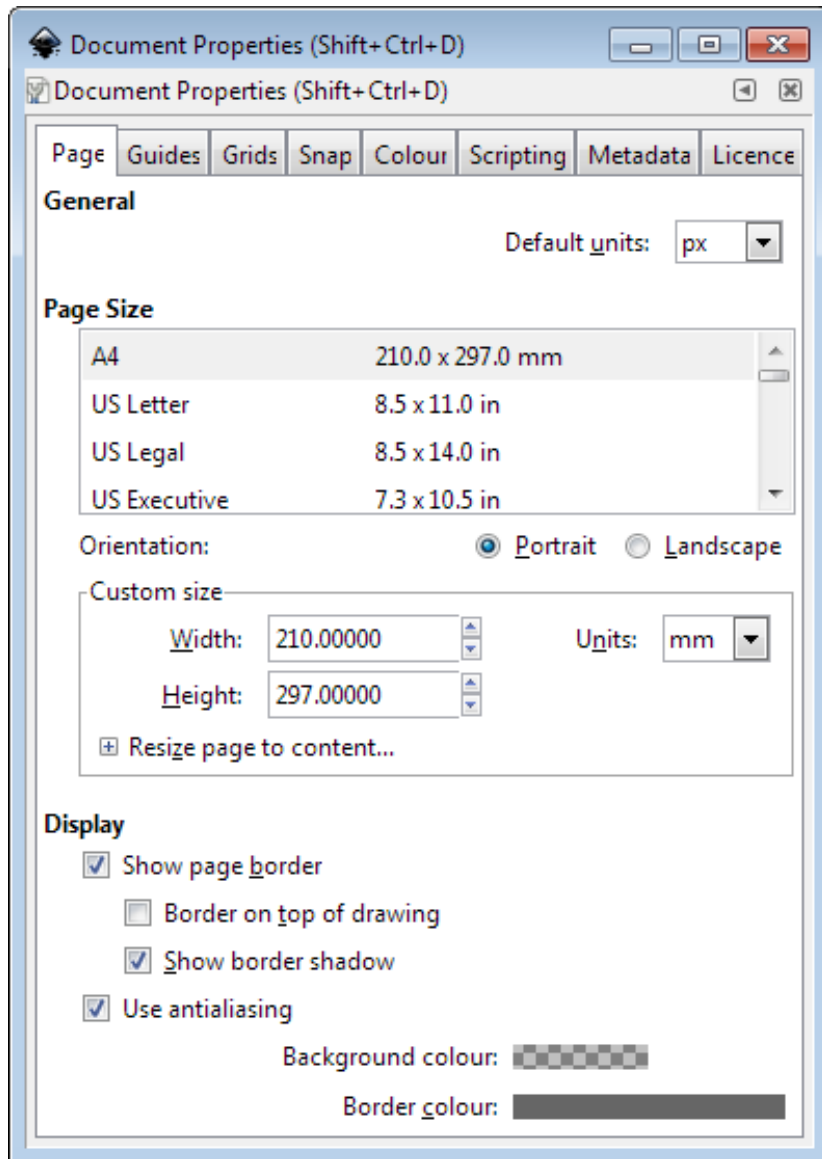


# Scaling figures

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




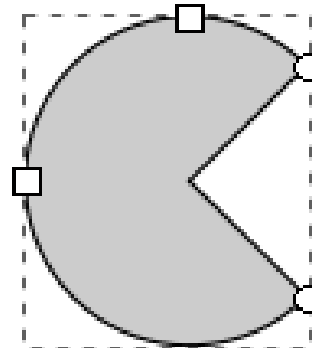
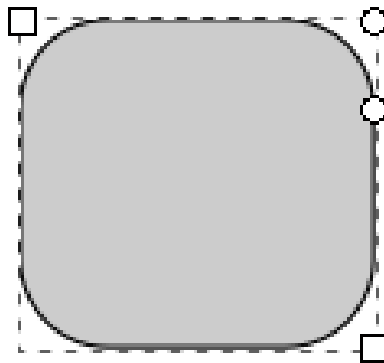
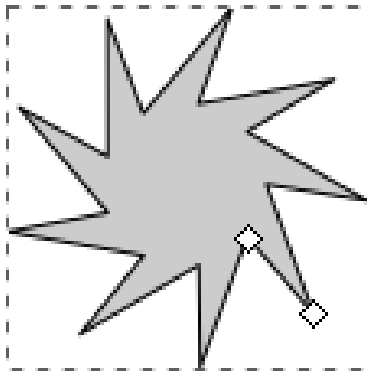
# Create basic shapes



- 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

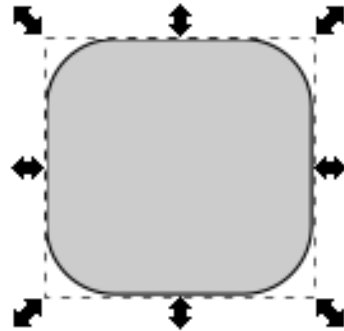
- Use the Edit Nodes tool 
- Two types of control points, squares and circles
  - Squares generally change the size of the shape
  - Circles change the appearance



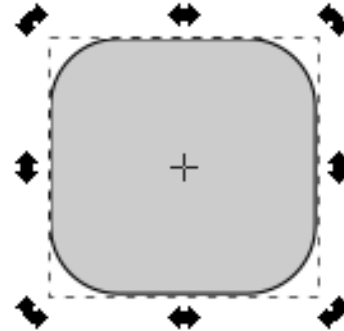
# General Transformations

- 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



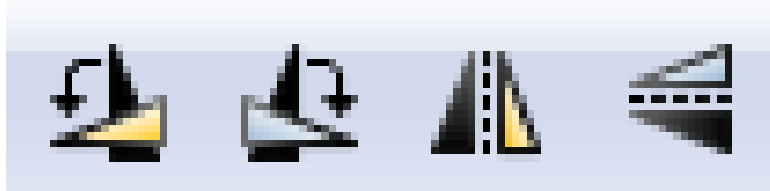
Resize



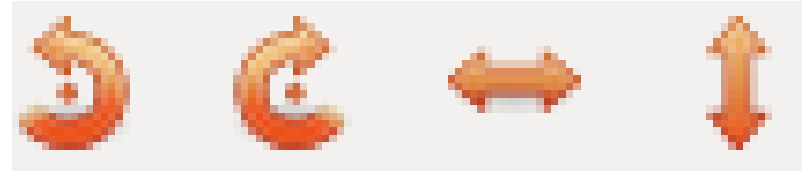
Rotate

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

# Transform Shortcuts



or



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

# Selecting

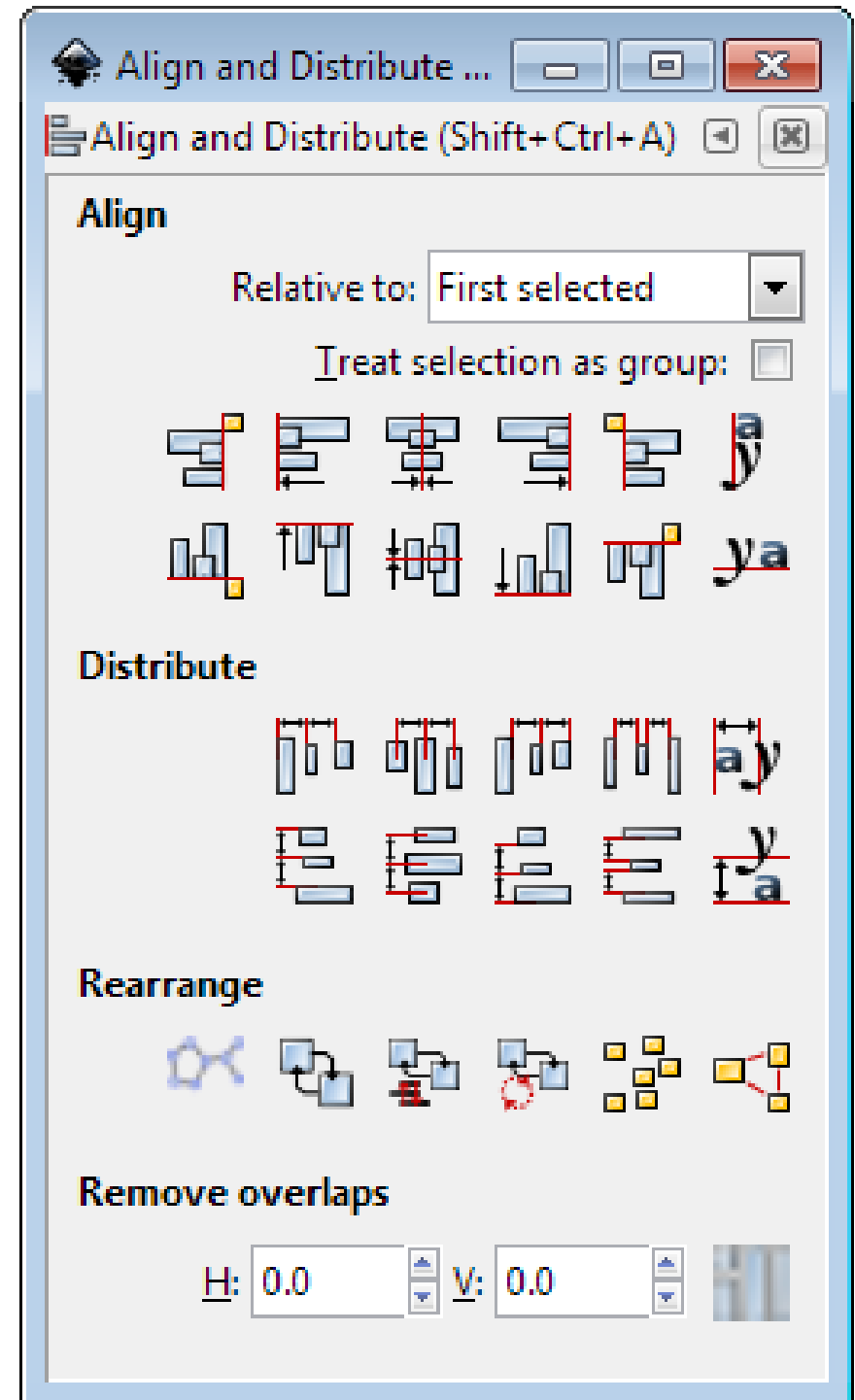
- Selecting multiple objects, either:
  - Drag a box to cover multiple objects
  - Shift+click:
    - to add an object to a selection
    - on a selected object to remove it from the selection

# Grouping

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

# Aligning and distributing

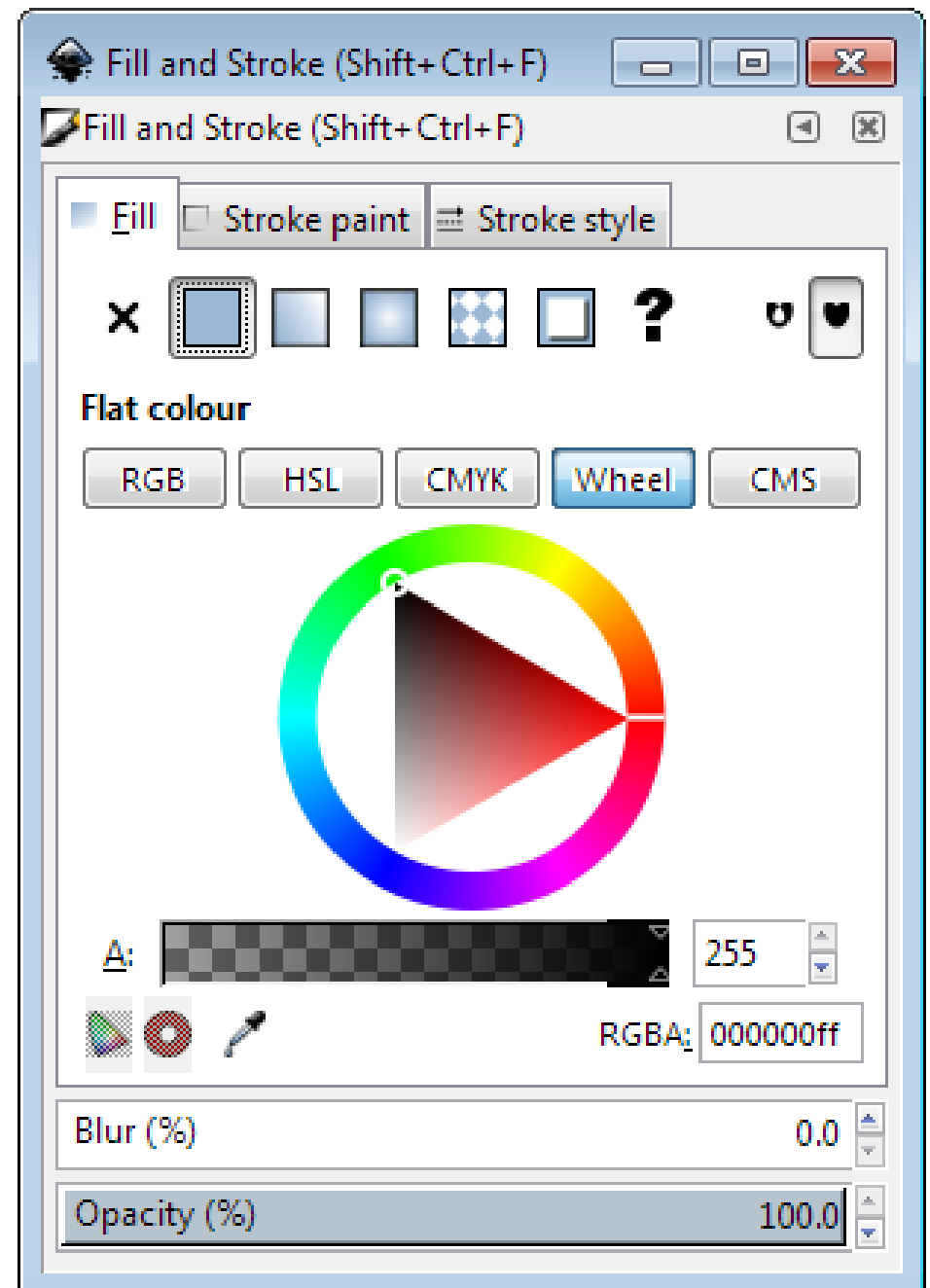
- Object > Align and Distribute
  - Align = Give objects the same centre/edge position
  - Distribute = Space objects evenly
- Align relative to
  - First/Last selected object in group
  - Largest/Smallest object in group
  - Page
  - Drawing
- Never align anything by eye!





# 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 Stroke

- Fill types
  - Flat colour
  - Linear gradient
  - Circular gradient
  - Pattern fill
  - Swatch (bitmap) fill
- Specify colour and alpha (opacity)

Flat colour

Flat colour

RGB HSL CMYK Wheel CMS

R: 165  
G: 28  
B: 28  
A: 255

RGB HSL CMYK Wheel CMS

H: 0  
S: 181  
L: 97  
A: 255

RGB HSL CMYK Wheel CMS

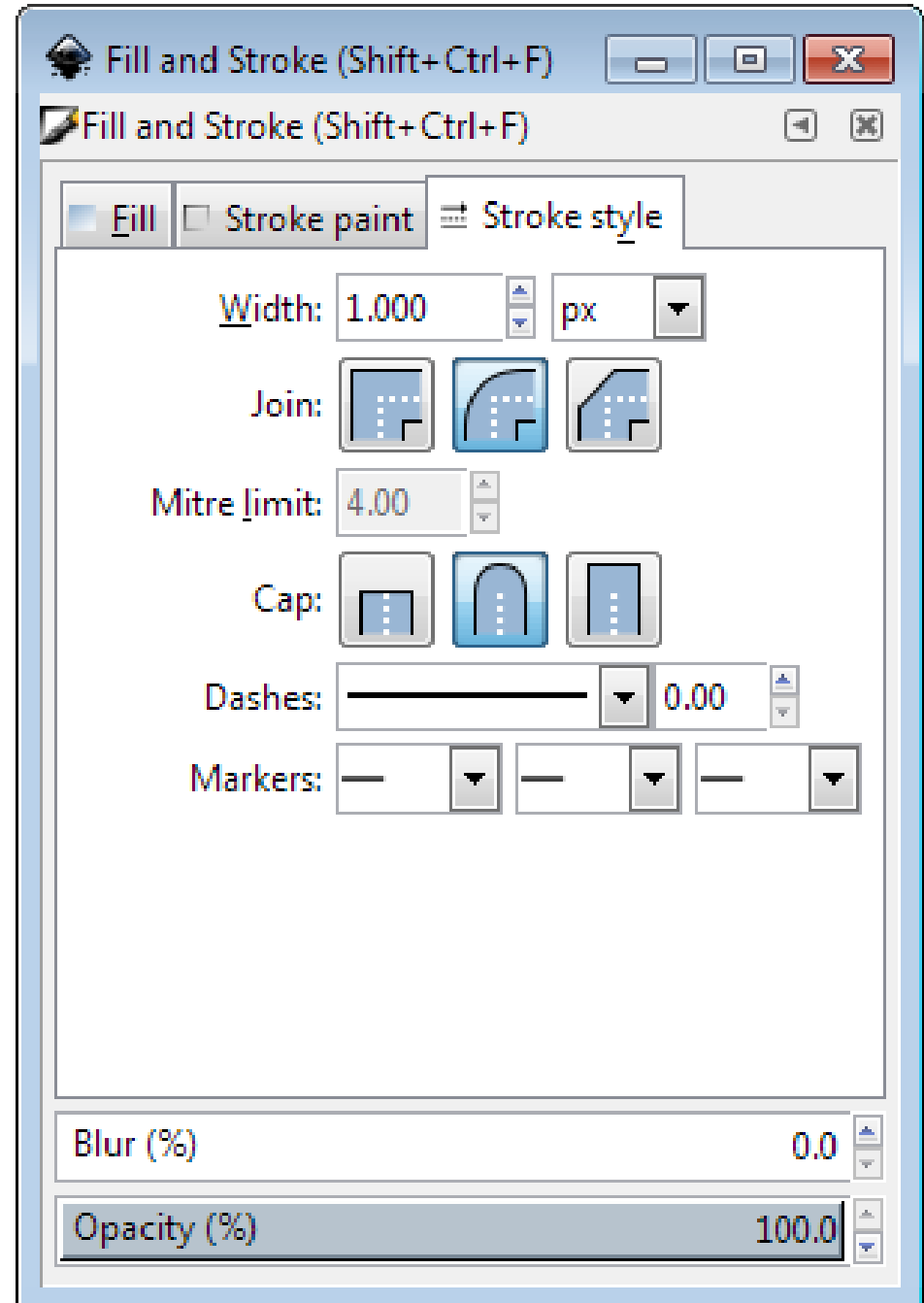
C: 0  
M: 83  
Y: 83  
K: 35  
A: 100

RGB HSL CMYK Wheel CMS

A: 255

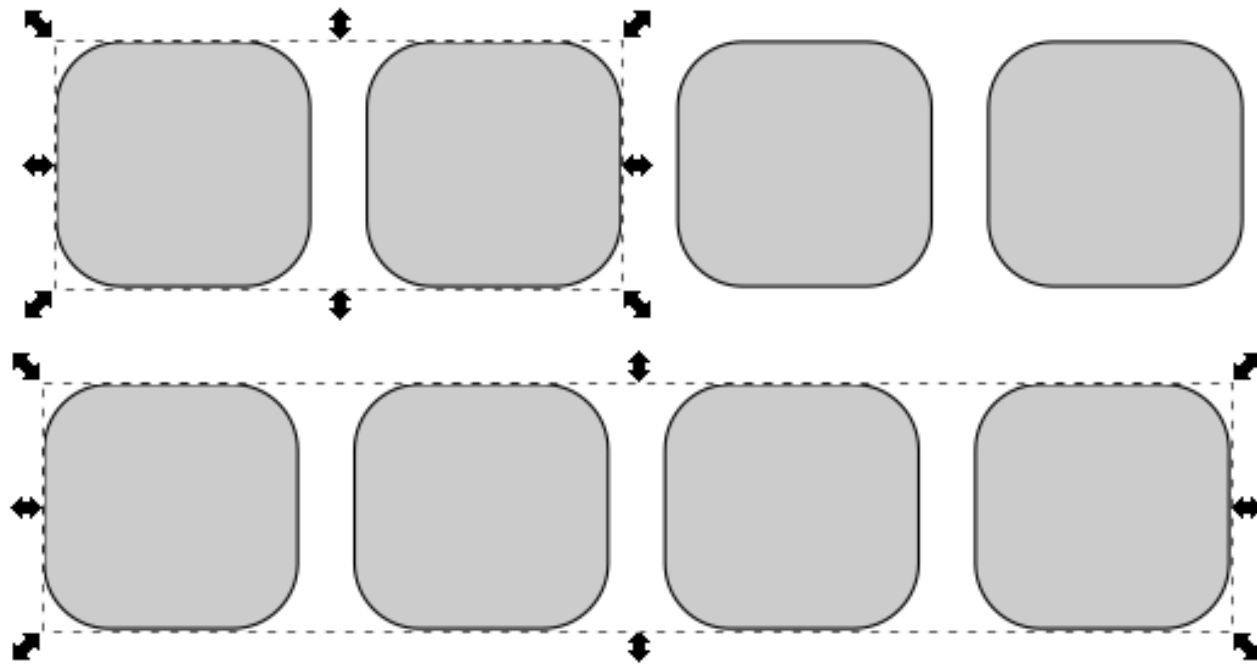
# Stroke Options

- Width of line
- Shape of corners
- Shape of line ends
- Dashes
- Arrowheads



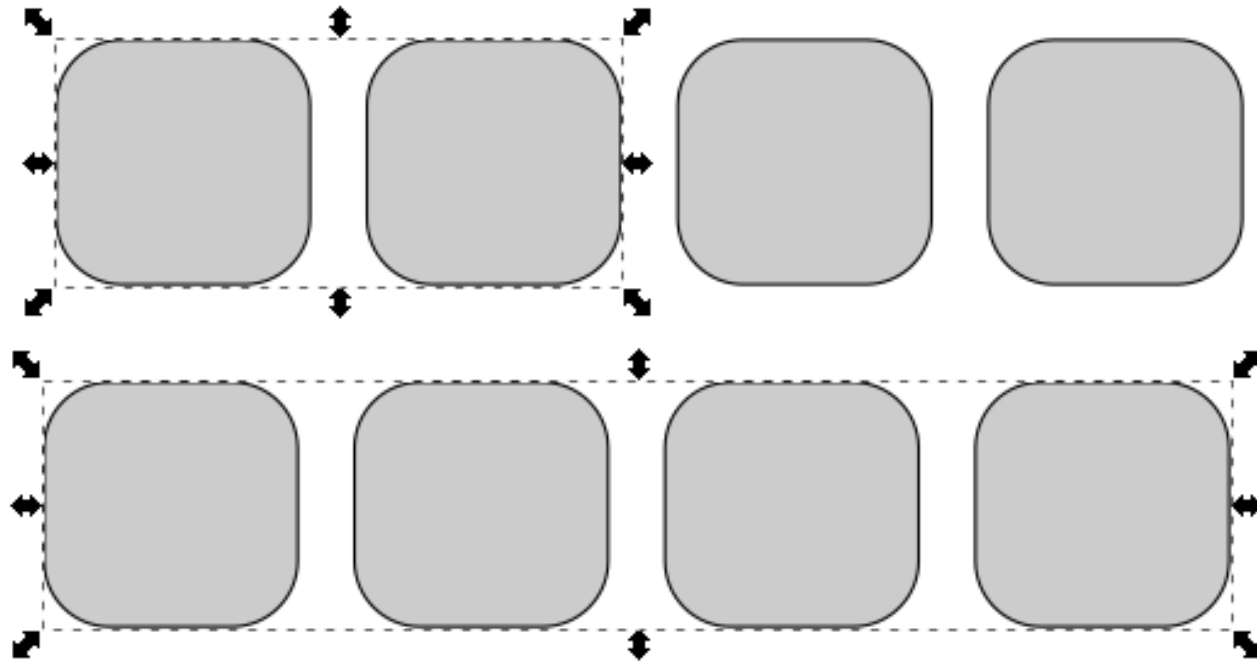
# Exercise 2: create and align shapes

**Create this:**



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

# Exercise



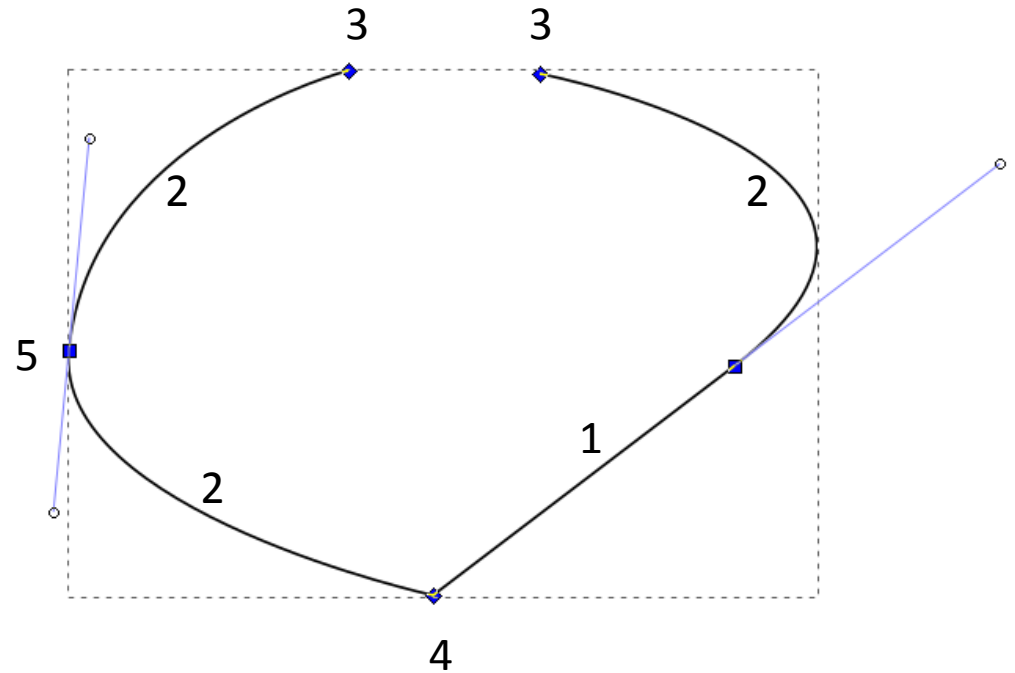
Tools/ attributes to do this: ***rectangle, corner radius, fill and stroke, select (and group if necessary) and alignment***

# Creating and Editing Paths

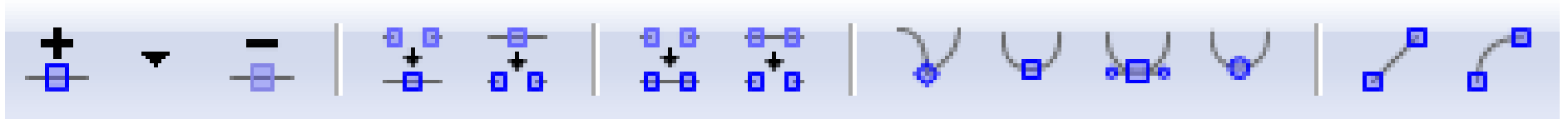
- Created using freehand or line tool
- Can convert other objects to become a path
- Paths are composed of nodes and segments
- There are different types of node and segment

# 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



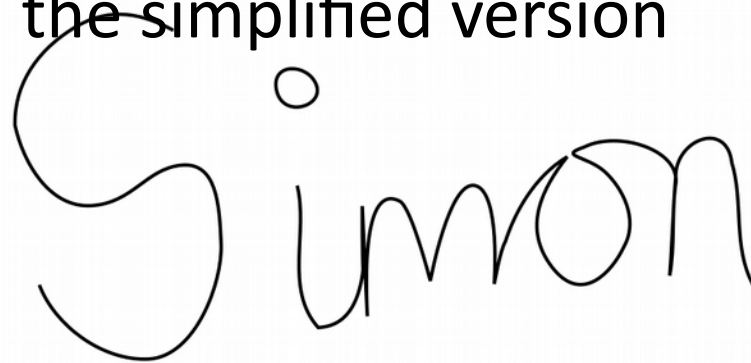
# Exercise 3: freehand drawing

- 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)



Simon Simon Simon

- Edit nodes directly on the simplified version



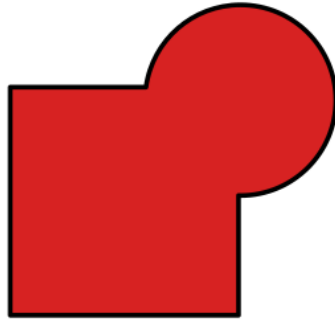
Simon

# 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



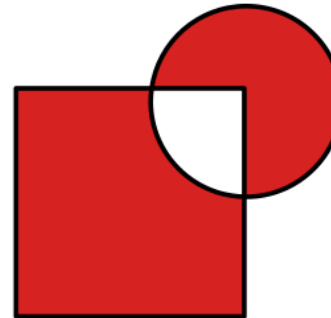
Difference



Intersection

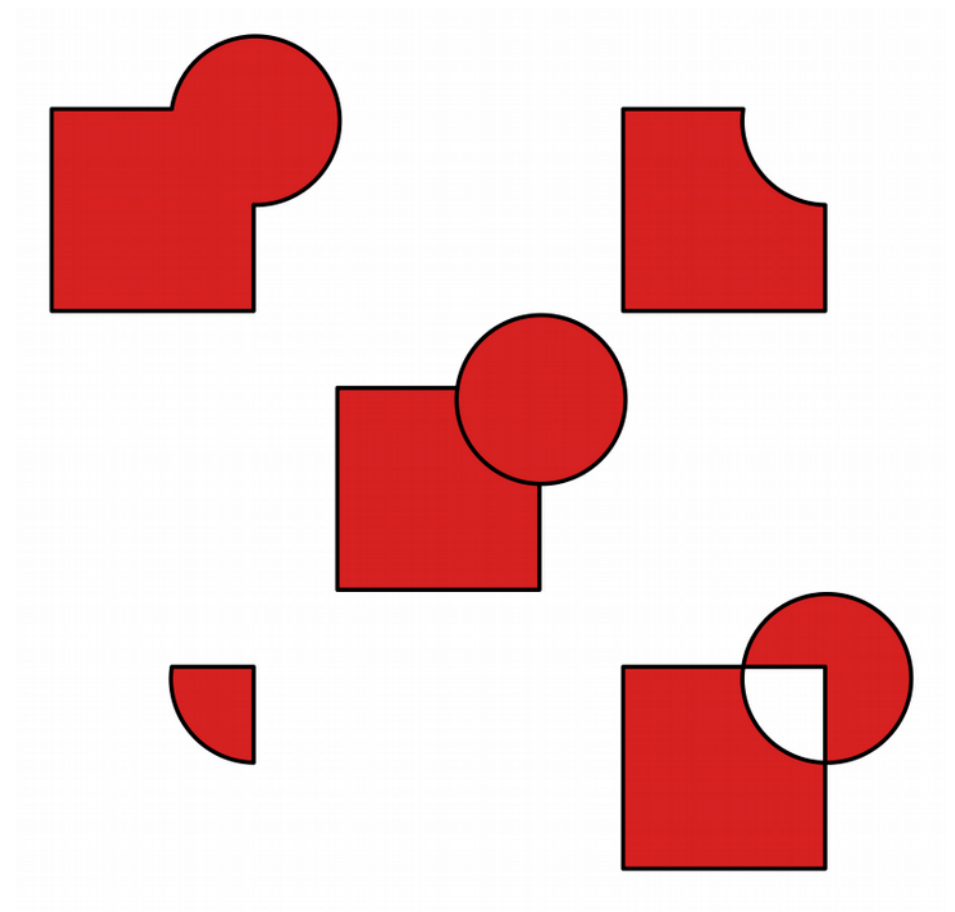


Exclusion



# 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



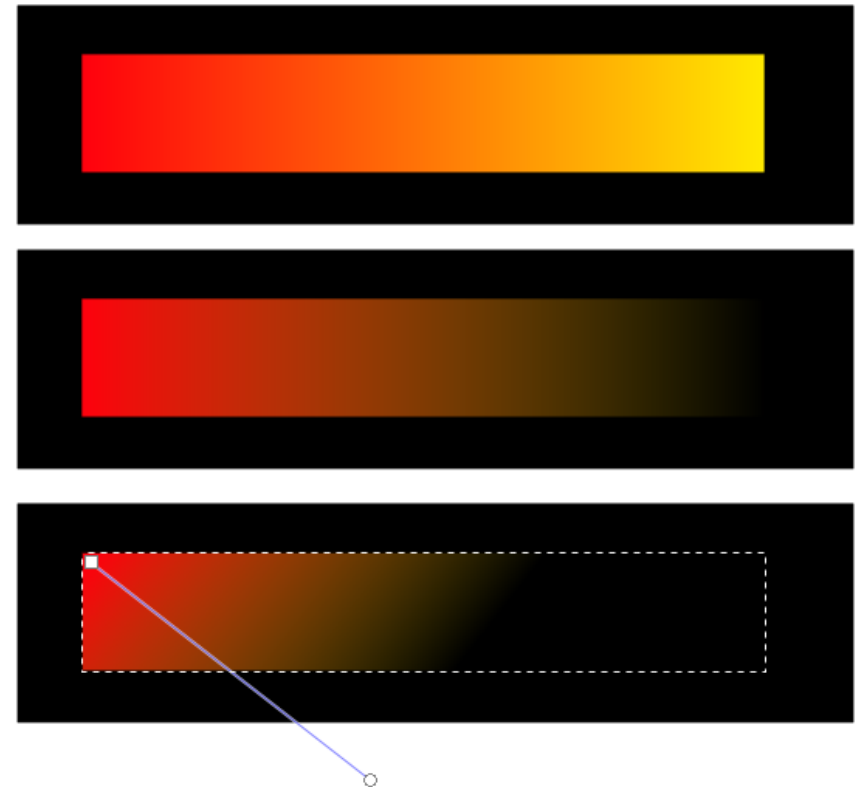
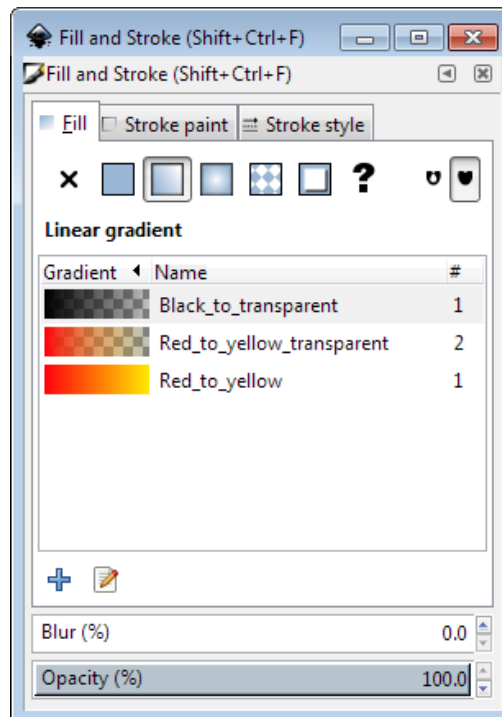
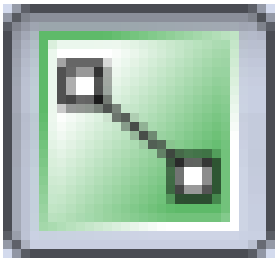
Opacity



Blur  
Blur  
Blur

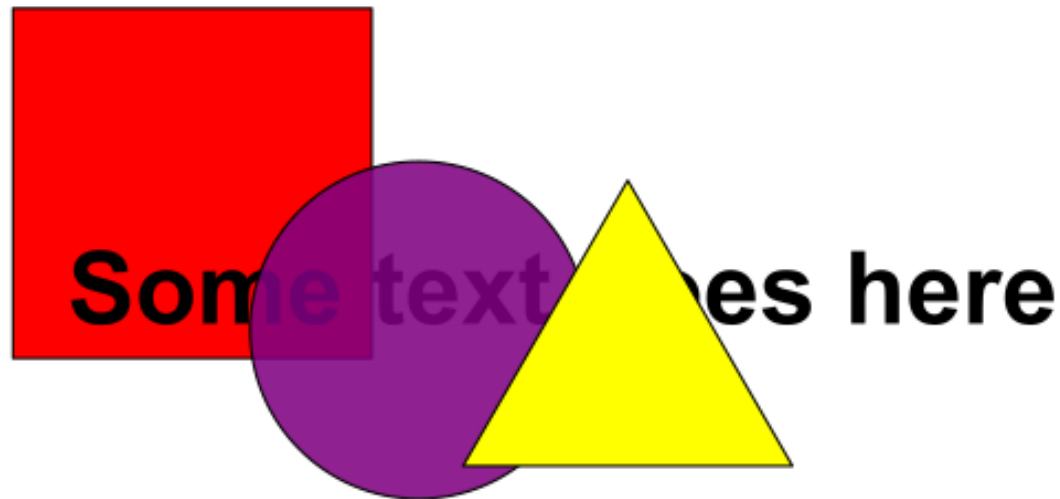
# Gradients

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



# Z axis - Ordering

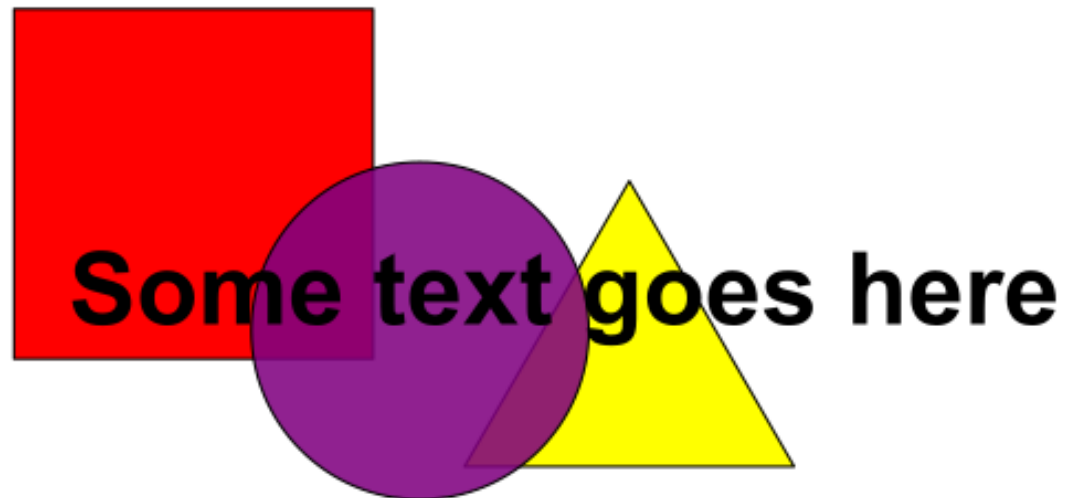
- New objects sit over the top of old objects
- Objects obscure those underneath them (except for transparency)



# 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)

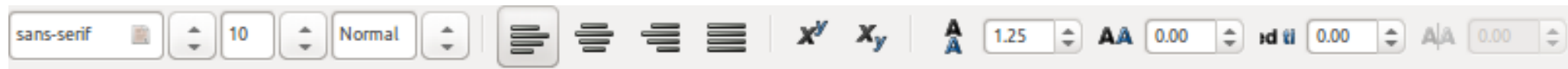
- Inkscape can include bitmaps in images
- Appear as objects alongside vector objects
- Can't edit the images
- Can't increase the resolution of the image
- Transparency (from PNG etc) is preserved
- ***File > Import***
- Formats: PNG, JPEG, SVG, PDF etc.

# Exercise 5: add text

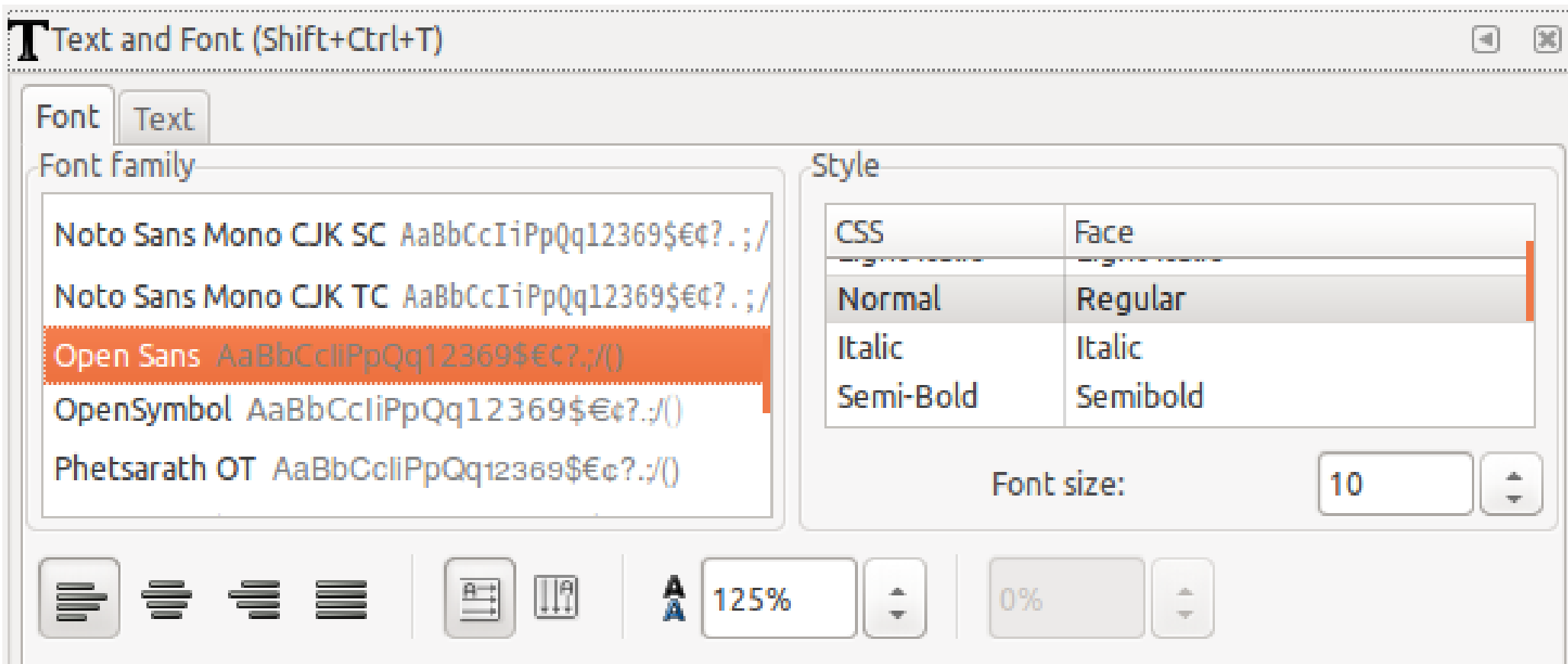
- Use the text tool to add text. 
- Click and type to generate text
- Text can be scaled or rotated as any other object
  - Always hold Ctrl when scaling otherwise the aspect ratio will be messed up

# 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 A4 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 9: 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.

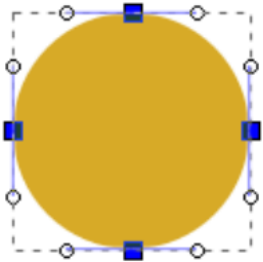
Once you're happy with the image you can delete the original photo to leave just your vector drawing.

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

# Exporting, saving & importing files

# 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**

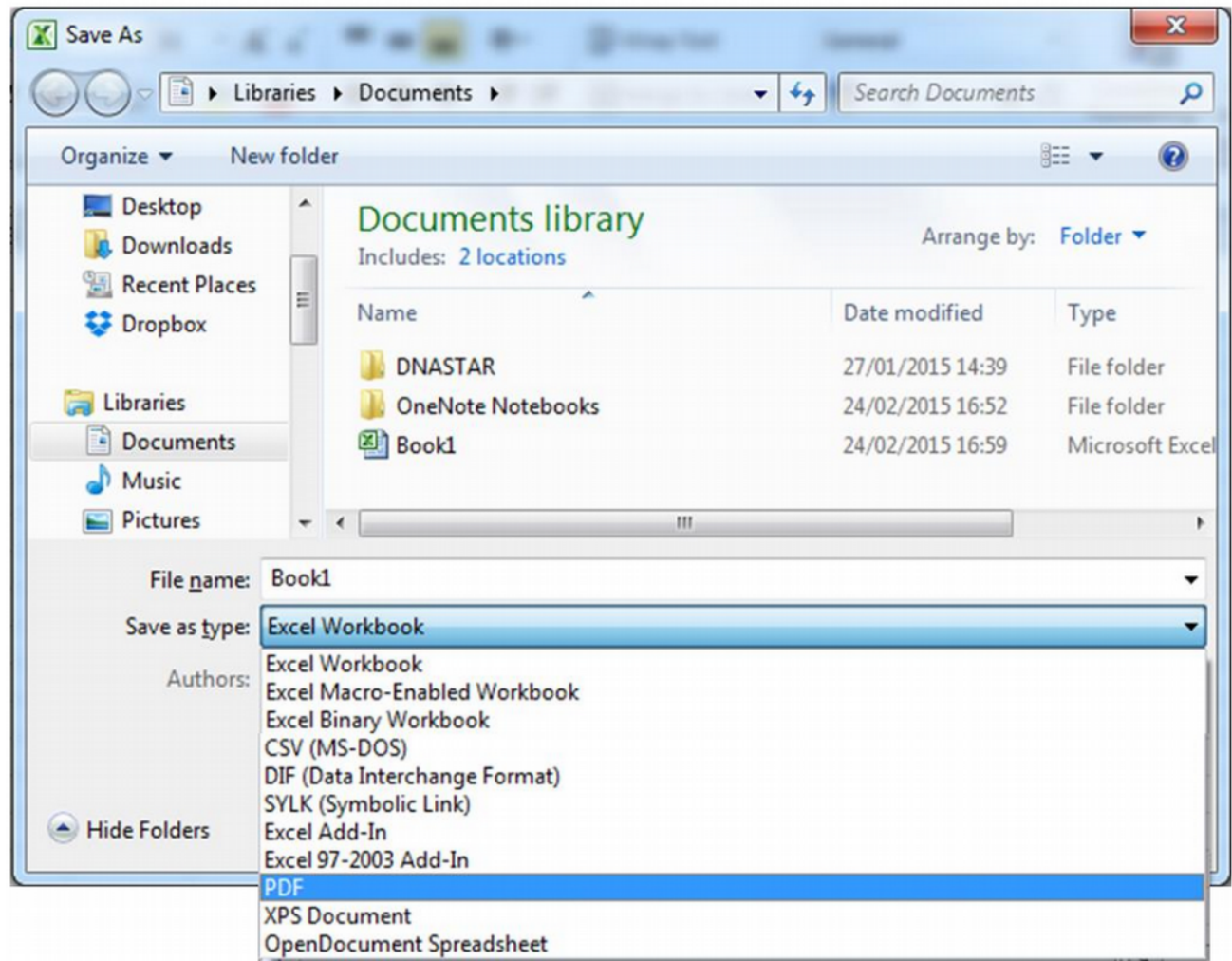
# File formats

- 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 common programs to edit in Inkscape: Excel

Move/copy your plot to its own worksheet, then  
*File > Save As*  
and choose PDF  
file format



# 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:**

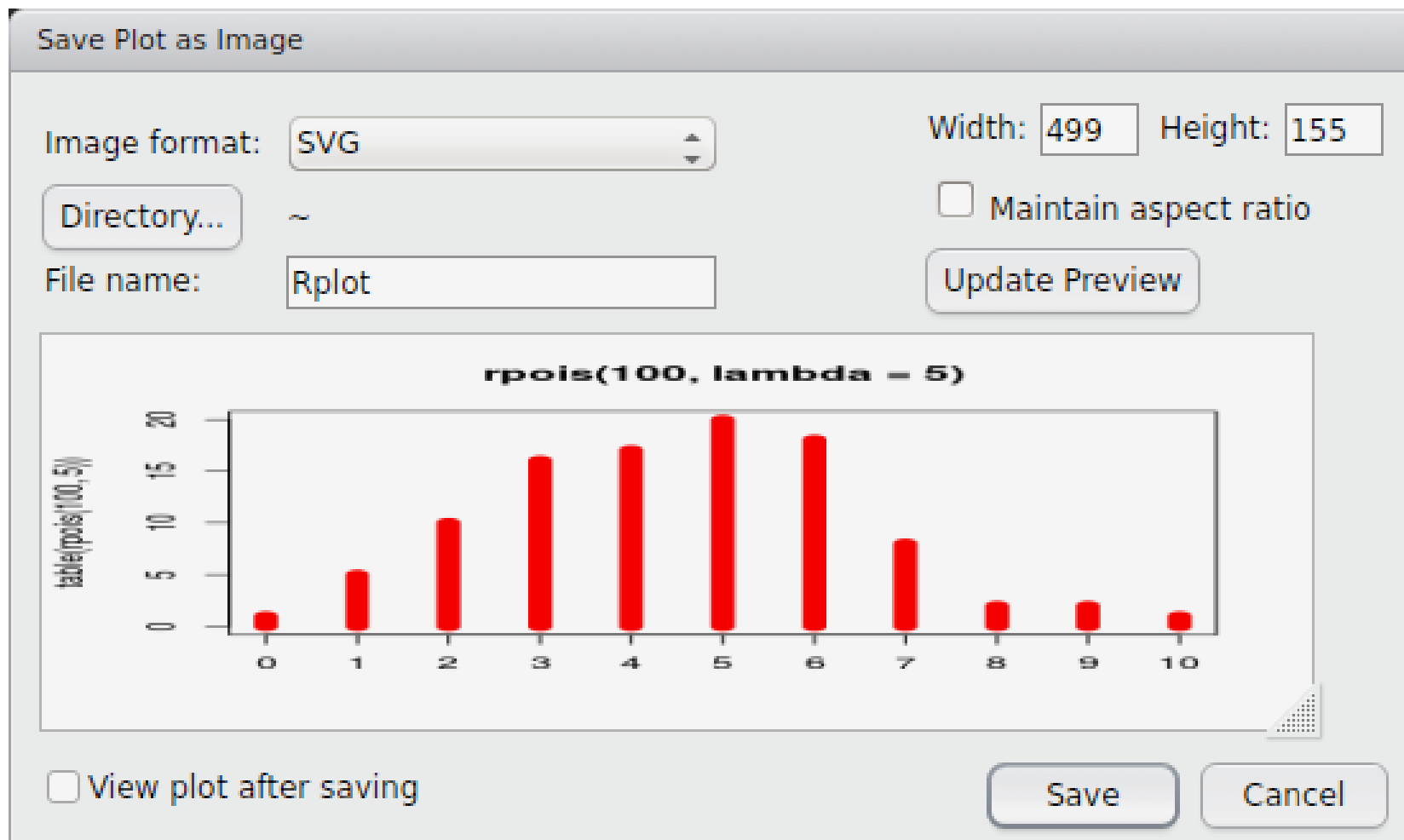
```
png()
jpeg()
bmp()
tiff()
svg()
postscript()    Alternative to PDF, when they are too large to render if plots
                  contain many data points
```

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*)



# Exercise 8: annotate an imported graph

- Create a plot of your choice and export it as PDF (in R or in Excel, see next slide)
- 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: annotate an imported graph

Create a plot of your choice **using R**. For example, 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()
```

OR, create a plot of your choice **using Excel**. For example, copy and paste the table on the right:

And plot a barplot.

Export from Excel into a PDF, e.g. using 'Save As'

Alternatively, use the file *Inkscape\_7\_excelFigures.pdf*

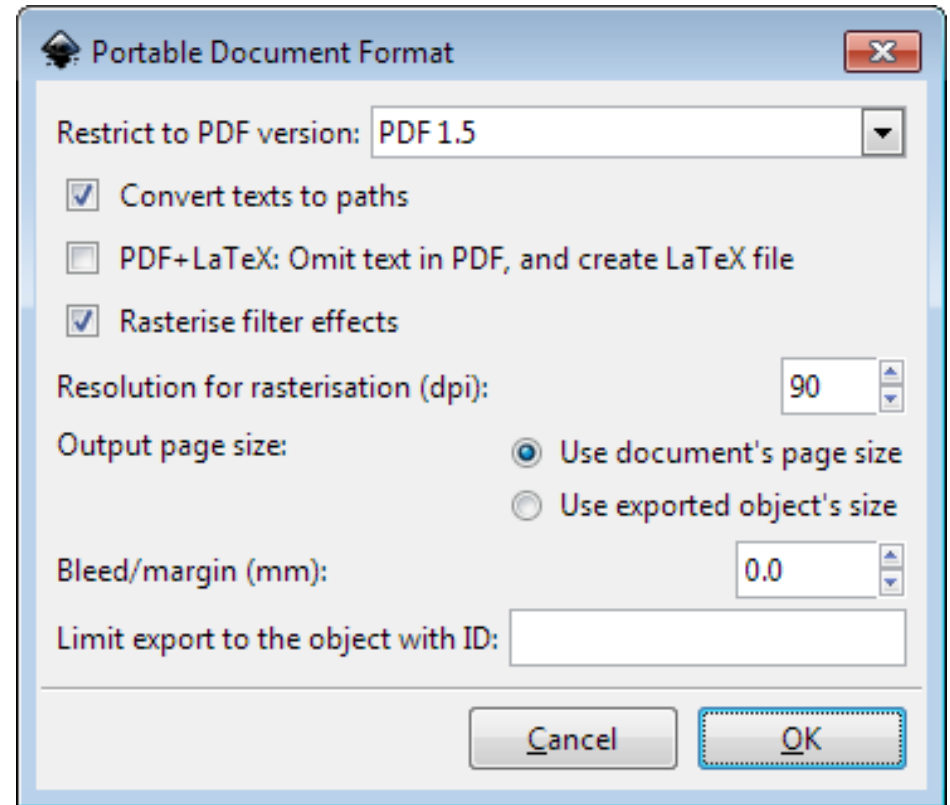
1	2
2	9
3	17
4	15
5	16
6	21
7	6
8	6
9	7
10	1

# 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

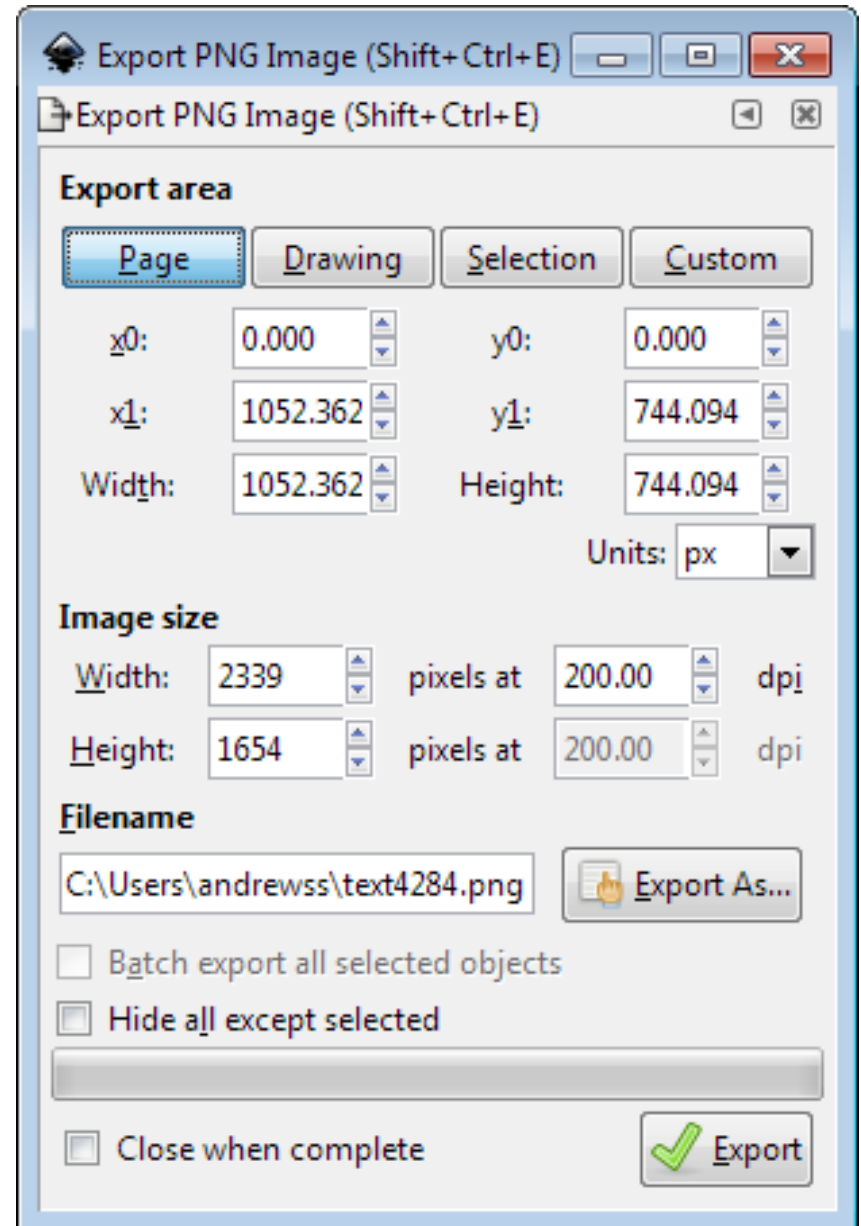
# Exporting files from Inkscape: Vector

- 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

**Submitting to journals**

# Preparing for Submission

- Initially figures will be assessed by reviewers
- 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, thickness of lines
- Figure in colour, grayscale or black and white
- Resolution
- Acceptable File format: choose the best one
- Colourspace: CMYK or RGB

# 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: composing for publication

- In Inkscape, open the SVG file '*Inkscape\_9\_palmitic\_acid.svg*'. This is a reconstruction, in vectorial format, of the figure used as an example at the beginning of the course
- Using the tools you have learnt in Inkscape, improve the figure.
  - For example, reorganising, using alignments, making the text labels consistent, etc.
- Tip for using grids: you can set a grid in ***File > Document Properties > Grid***. You can also use the Snap tools in order to align the objects to the grid (***View > Show/hide > Snap control bars***).
- Remember to **save** working copies of your files in an appropriate format, i.e. SVG.
- **Export** your final figure in an appropriate format.