Scientific Figures and Presentations in Ipe
Winter Term 2026/27
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Karlsruhe Institute of Technology

Exercise Sheet 1: Basics

Submision due by November 8

1 The Basics

Open the file *basics.ipe* and follow the instructions.

What to hand in? Nothing. So you could skip this part, if you think you already know the basics. However, you'll miss out on the cookies (and maybe on some details you were not aware of).

2 Grouped Polygons

Create a figure similar to Figure 1a with three orange, three green, and two blue polygons [shift + p]. Group [ctrl + g] the orange polygons and group the green polygons. Then group both groups together. Observe that you now have three objects you can select [s] and move around [t]: the group of orange and green polygons and two individual blue polygons.

Try ungrouping [ctrl + u] the group of orange and green and see that you can now move the orange and green independently. Group them again to get the state from before: blue, blue, ((orange, orange, orange), (green, green, green)).

Then edit the groups [right click → edit group][1] and observe that you now have two obejcts you can select [s] and move [t]: the group of orange polygons and the group of green polygons. But you can no longer interact with the blue polygons.

Exit the group edit [edit → end group edit][1] and observe that you are now back to having one group and two blue polygons.

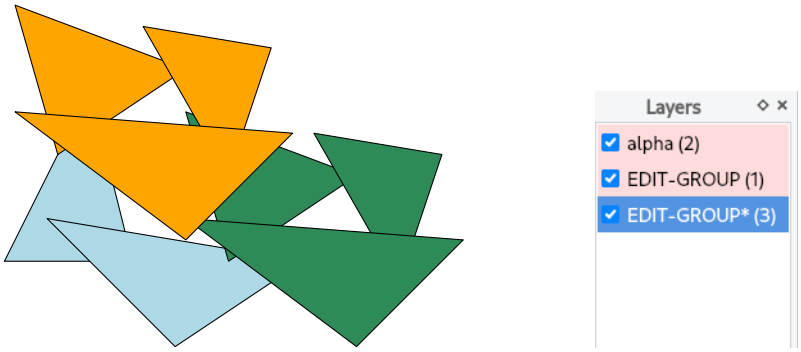
What to hand in? Hand in a file named *group.ipe* with the colored polygons grouped as described above. Store the file in a state where you are currently editing the (sub)group of orange polygons. The panel on the left should look roughly as in Figure 1b.

3 Snappy

The file *snappy.pdf* contains all pieces you need to create a picture of crocodiles, but you have to assemble it yourself. The instructions consist of four steps: The assembly of the pieces, coloring the crocodile, creating an arrangement of crocodiles, and naming (some) of the crocodiles.

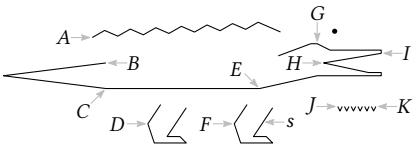
What to hand in? Hand in a file named *snappy.pdf* that contains the final result after all four steps.

[1] We will recommend in the next lesson that you create your own shortcut for this.

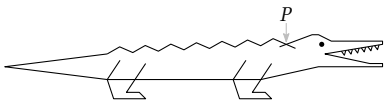


(a) **(b)**

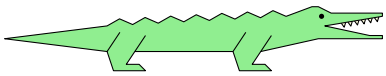
Figure 1: Grouped Polygons (a) and what the layers panel on the left looks like when editing groups (b).



(a) The pieces you find in *snappy.pdf* with some labeled points.



(b) The result after the initial assembly in Section 3.1



(c) The result after cleanup and coloring in Section 3.2

Figure 2: Assembly instructions for snappy.

3.1 Assembly

It is of utmost importance that you place all pieces precisely as instructed below. Otherwise, the constructed crocodile will be in horrific pain. The snapping tools of Ipe will help you to be precise. Figure 2a shows the labeled pieces and Figure 2b shows the result you should have after the assembly.

Placing the Back. Select [s] and translate [t] the back of the crocodile such that points A and B are identified. Use snap to vertex [F4] for precise placement.

Placing the Left Leg. Use the same technique as for the back to identify C and D.

Placing the Right Leg. Do *not* identify E with F. Instead F should be placed on the line CE such that E lies on the segment s. Here is one way to achieve this: Use snap to grid [F7] to create a horizontal helper line [p]. Move the helper line such that it starts in F and intersects the segment s. Then use snap to intersection [F6] and snap

to vertex [F4] to move that intersection point to E. Don't forget to delete [del] the helper line afterwards.

Placing of the Eye. The goal is to place the eye exactly in the midpoint between G and H. You can do this by creating a helper line between G and H. Snap to control point [shift + F4] allows you to snap to the center of a circle (the eye) and to the midpoint of the helper line.

Placing the Teeth. The goal is to translate and rotate the teeth such that both points J and K lie on the line HI. This can be done in two steps:

- Use snap to vertex [F4] and snap to boundary [F5] to move J on the line HI (somewhere close to H).
- Place the cursor on J and set the origin [F1] to this point (you should see green axes showing a coordinate system centered at J). Then rotate [r] the teeth around J, using snap to vertex [F4] and snap to boundary [F5] to place K exactly on the line HI. In the end, hide the axes [ctrl + F1].

3.2 Coloring

To color the crocodile (the result should look like Figure 2c), first you need to clean up the place where the head meets the back and actually connect the back to the rest of the body:

- In Figure 2b, the least segment of the back and the first segment of the head intersect in point P. Edit [ctrl + e] the back and the rest of the body with snap to intersection [F6] and snap to vertex [F4] such that the back ends in P and the head starts in P. You can accept your edit using [space] or abort it using [esc].
- Select [s] the back and the body and join them into a single path [right click → joint paths].

Select the paths and use the properties panel on the left to cycle through *stroked*, *stroked & filled*, and *filled* [click the diamond on the yellow background]. Make sure that the body, both legs, and the teeth are filled with colors of your choice.

Observe that now some paths hide others (e.g., the eye is hidden behind the body). You can fix this, by selecting [s] objects and moving them to the back [ctrl + b] or to the front [ctrl + f]. You can also move objects just one step backwards [ctrl + shift + b] or one step forwards [ctrl + shift + f]. Make sure that the following is true:

- The eye is in front of the body.
- The legs are in front of the body.
- The teeth are behind the body (also observe closely how it looks different, when the teeth are in front of the body).

3.3 Making Friends

To make the crocodile less lonely, create multiple copies and arrange them exactly as shown in Figure 3. You probably want to start by grouping [ctrl + g] all elements of the crocodile. The you can create multiple copies of it using copy [ctrl + c] and paste [ctrl + v] or by duplicating [d] it.

Make sure to use snapping tools to get precisely the arrangement shown in Figure 3. Here are some additional tools that will probably be useful.

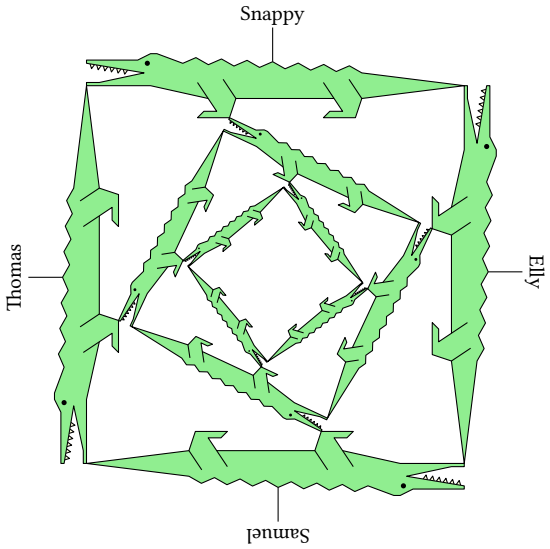


Figure 3: Snappy and their friends.

- Mirroring things [Ipelets → Goodies → Mirror horizontal] (observe that the crocodiles in Figure 3 are mirror images of the one in Figure 2c).
- Rotate by fixed angles [ctrl + r] (e.g., by 90°).
- When stretching [e] something, you can keep the aspect ratio (i.e., scale by the same factor in both dimensions) by holding [shift].
- To align one level of crocodiles with the previous level, use a similar technique as for the teeth before. A helper line might help. Try to first get the angle right and then the size. (Use snapping!)

3.4 Giving Names

Finally, label some of the crocodiles with their name (again see Figure 3). First construct the lines as follows:

- Draw a helper circle through the eyes [alt + o] of the crocodiles on the outer layer. (Use snapping!)
- Draw a vertical line upwards from the central back-spike of the top-most crocodile such that it intersects the circle. You can use automatic snap [F9] to make sure it is vertical.
- Shorten the vertical segment such that it ends on the circle. (Use snapping!)
- Repeat this for the other three crocodiles on the outer layer.

To add the text, first create labels [ℓ] somewhere. To place the labels properly, do the following:

- Set their alignment to center bottom [right click → horizontal/vertical alignment].
- Make the labels transformable [Properties → Transformable text → yes].
- Rotate the labels [ctrl + r].
- Place the labels snapping their anchor points to the ends of the lines.

- Change the font by putting `\usepackage[ttscale=.85]{libertine}` and `\usepackage{libertinust1math}` into the preamble [ctrl + shift + p].
- Bonus tip: if you put `\strut{}` at the beginning of the label, the spacing is more consistent.

4 Graphs

Here you find three smaller tasks for working with graphs.

What to hand in? Hand in a file named *graphs.pdf* that contains the three graphs created in the following subsections.

4.1 Petersen Graph

Recreate the drawing of the Petersen graph shown in Figure 4a. Here are some notes for this:

- Use marks [m] for the vertices. You can choose their style in the left properties panel.
- Use a single segment [p] for each edge.
- With a disk [o] selected, you can use [Ipelets → Goodies → Regular k-gon] to create a regular k-gon.
- Make sure that edges are behind the marks.
- Use snapping for precise placement.

4.2 Crossing Minimization

Copy the drawing of the Petersen graph you have created before. Use the "move graph nodes" tool [2] to move the vertices and observe how the edges follow along. Use this to create a drawing of the Petersen graph with as few crossings as you can.

4.3 Labeled Vertices

Create a drawing that looks roughly like the one in Figure 4b. Make sure that:

- Each vertex is a group [ctrl + g] of a filled disk [o] and a label [ℓ].
- The label is aligned centrally with the disk.
- The edges are behind the disks.
- Note: Even when grouped with the disk, you can still edit the label [ctrl + e].
- Note: You can still move vertices and the edges follow.

5 Use What You Have Learned!

Here you find a handful of smaller tasks. But this time, we only tell you the goal and not so much how to achieve it.

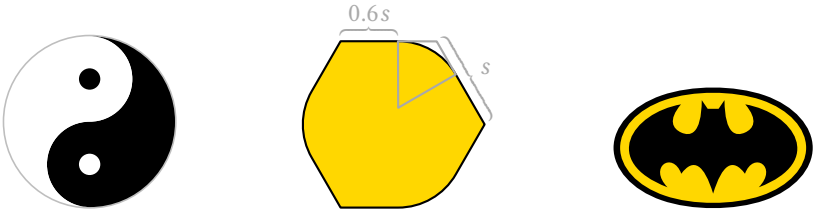
What to hand in? Hand in a file named *final.pdf* that contains all the drawings created here.

[2] We will recommend in the next lesson that you create your own shortcut for this.



(a) **(b)**

Figure 4: The Petersen graph (a) and a graph with vertex labels (b).



(a) Yin Yang **(b)** Rounded Hexagon **(c)** Batman

Figure 5: Illustrations for the final Task.

5.1 Yin Yang

Create a Yin Yang symbol as shown in Figure 5a.

5.2 Round Hexagon

Draw a regular hexagon with every other corner rounded; see Figure 5b. Make sure that it has the following properties:

- It is a single filled path.
- The rounded "corners" are circular arcs.
- The sides of the hexagon are tangential to the circular arcs (i.e., there is a smooth transition between the straight segments and the circular arcs).
- For each side of the original hexagon, 60 % remain straight; see Figure 5b.

Hint: A tool we have not used before that is probably useful is scaling by a given factor [ctrl + k].

5.3 Batman

Create a picture that resembles the Batman logo in Figure 5c. Feel free to insert a screenshot of Figure 5c into Ipe (either paste [ctrl + v] it from clipboard or open an image file [ctrl + shift + o]) as a reference. Mare sure of the following:

- The outer shape is a closed spline [shift + i].
- The bat is a single path consisting of splines [i], except for the three segments between the ear tips, which are straight segments [p].
- Don't use too many control points for the splines.
- The logo is *exactly* symmetrical to a vertical line.
- The horizontal segment between the ears is *exactly* horizontal.

5.4 Favorite Graph

Create a drawing of your favorite graph.