IPE

The Extensible Drawing Editor by Otfried Cheong

Tutorial for version 7.2.12

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What is IPE

- Integrated Picture Environment;
- Ipe is a drawing editor for creating figures in PDF format;
- Homepage: `https://ipe.otfried.org/`;
- Main features:
  - Entering text in figures as a LaTeX source code;
  - Graphical user interface, but enables editing the source code also;
  - Programmable plug-ins;
  - Compiled for all main OS;
  - Allows making single or multi-frame figures;
- This tutorial follows the official manual;

Prerequisites

- A computer;
- A mouse with a scroll wheel;
- An IPE installation:
  download the package from `https://ipe.otfried.org/`;
- No installation is needed, just extract the files;
- We will work with the version 7.2.12, but most features and concepts are standard;
- The executable file (on Windows) is in bin folder - ipe.exe;

Tutorial method

- This is a hands-on tutorial;
- General topics are described on these slides;
- Everybody should do the examples in parallel with me;
- The exercises should be done individually;

First steps

- Start the program;
- By default, the drawing surface (canvas) is of an A4-paper size (this can be changed);
- If your figures are smaller, the saved file will just be of the size of the figure;
- We can zoom in and out by holding CTRL and scrolling the mouse wheel;

First steps

- Start the program;
- By default, the drawing surface (canvas) is of an A4-paper size (this can be changed);
- If your figures are smaller, the saved file will just be of the size of the figure;
- We can zoom in and out by holding CTRL and scrolling the mouse wheel;
- On the top of the window (below the menu), there are icon bars;
- On the top-right, there are icons for drawing rectangles in different ways;

Draw a rectangle

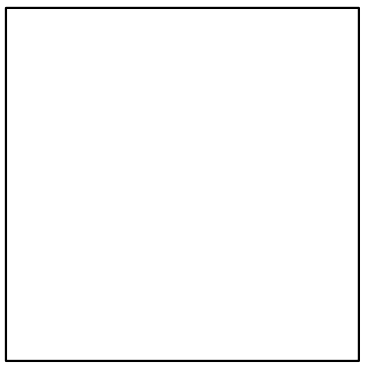
- The sequence of steps for calling commands in IPE is standard:
  1. Left click (or press keyboard shortcut) on the icon/command (IPE is waiting for parameters (coordinates));
  2. Left click on the drawing surface to set parameter coordinates (the number of left clicks depends on the command);
  3. When all parameters are given, right click to execute the command;

Draw a rectangle

- The sequence of steps for calling commands in IPE is standard:
  1. Left click (or press keyboard shortcut) on the icon/command (IPE is waiting for parameters (coordinates));
  2. Left click on the drawing surface to set parameter coordinates (the number of left clicks depends on the command);
  3. When all parameters are given, right click to execute the command;
- Use Axis-parallel rectangles command to draw a rectangle;
- (You can still zoom in or out while drawing);
- To cancel a command, press Escape;
- Save your figure in a file (choose ipe or pdf format);
- Open the pdf file with pdf reader - notice that the size is adjusted;

Example 1

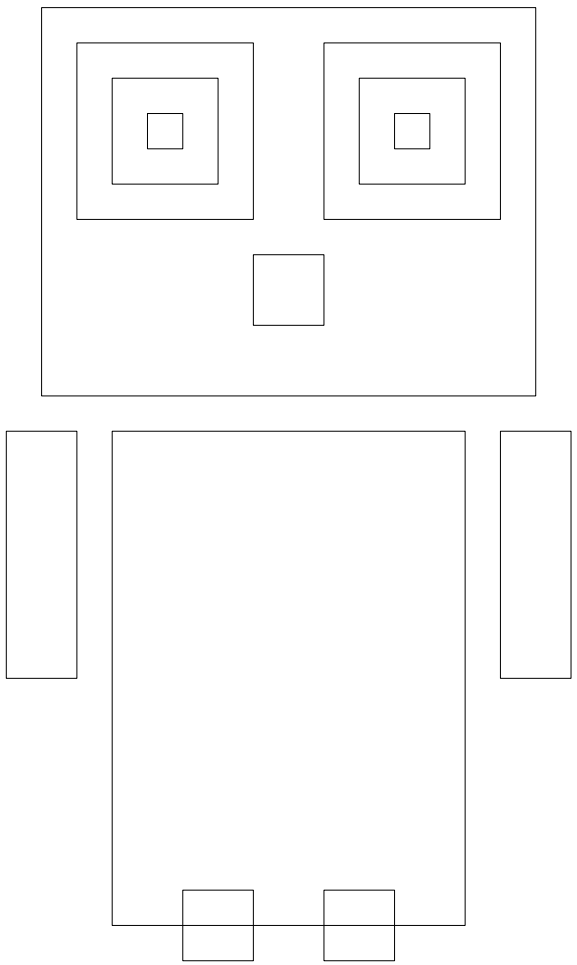
- We have our first figure:



- It is the simplest possible, and we will improve it, but first...

Exercise 1

- With your current knowledge, draw the figure below.

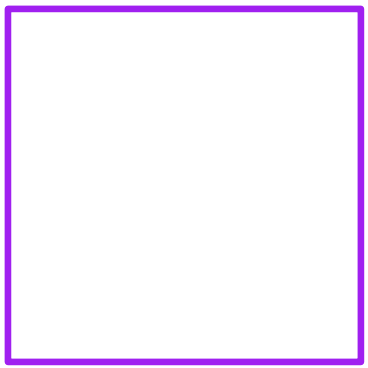


Object properties

- On the left side, there is the Properties menu;
- It allows changing properties of objects such as color, line thickness, font size, etc.;
- To change a property of an object, it must be selected: press S and click on the object or select the command Select objects in the icon bar;
- When an object is selected, right click opens a context menu with additional properties available;

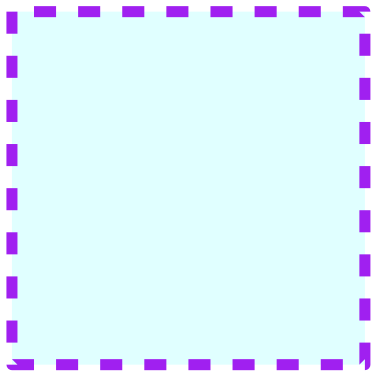
Example 2

- Change the color and line thickness of our rectangle;



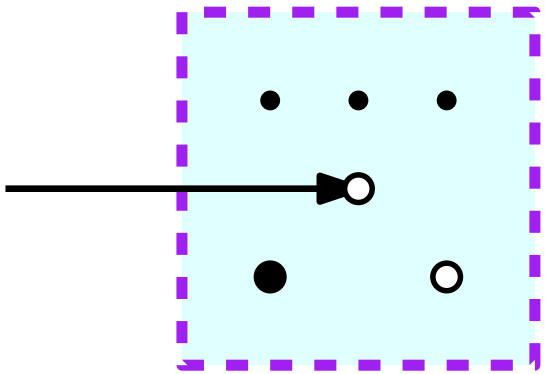
Exercise 2

- Use the properties Stroke & fill, Fill color, and Dash style to draw the figure below.



Other objects

- There are many other objects: lines, polylines, polygons, splines, circles, ars, marks (vertices), text objects,...;
- Let us add some of them to our example:



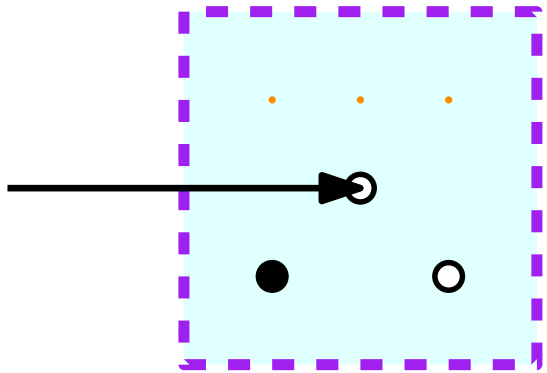
- New objects are added on top of existing ones, i.e., they are in front, others are in the back;
- A selected object can be sent to the front or to the end using the commands in the Edit menu or using shortcuts CTRL + F and CTRL + B;

Selecting objects

- When an object is selected, it is marked with violet color;
- Multiple objects can be selected by holding SHIFT and left clicking on (or near) objects;
- Dragging a rectangle with a mouse, all objects within the rectangle will be selected;
- When objects are close or below each other, the closest object is selected, but other close objects also are put to pending list, we can select different object by pressing SPACE, but still keeping mouse button pressed;

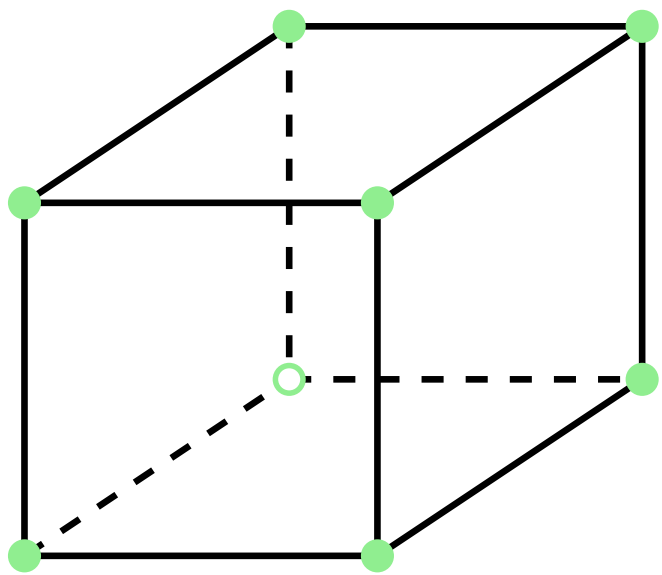
Example 3

- Change the color and size of top three vertices at the same time, and put the arc in front;



Exercise 3

- Draw the below figure.



Moving objects

- Any object can be copied, cut, or pasted with the usual commands/shortcuts;
- An object can also be:
  - translated - press T and move the mouse;
    Holding SHIFT, the object is translated either horizontally or vertically;

Moving objects

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  - translated - press T and move the mouse;
    Holding SHIFT, the object is translated either horizontally or vertically;
  - rotated - press R and move the mouse;
    Press CTRL + R to enter a precise angle of rotation;

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- An object can also be:
  - translated - press T and move the mouse;
    Holding SHIFT, the object is translated either horizontally or vertically;
  - rotated - press R and move the mouse;
    Press CTRL + R to enter a precise angle of rotation;
  - stretched - press E and move the mouse;
    Holding SHIFT, the object is stretched with retaining the aspect ratio; Press CTRL + K for a precise stretch;

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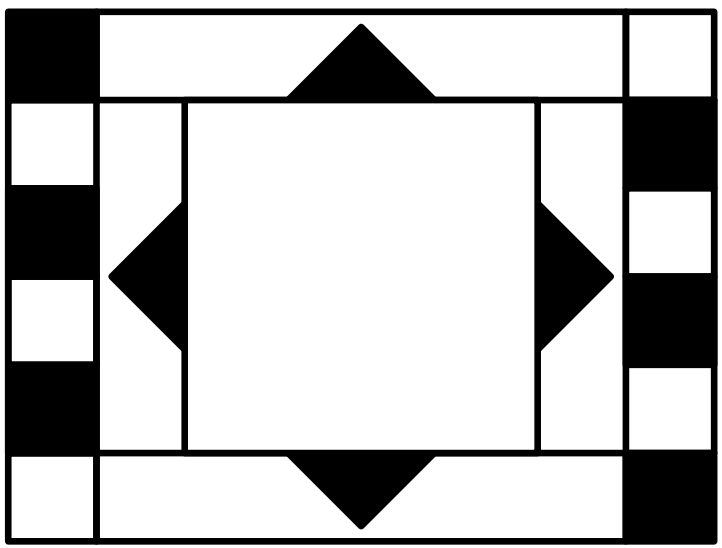
  - rotated - press R and move the mouse;
    Press CTRL + R to enter a precise angle of rotation;
  - stretched - press E and move the mouse;
    Holding SHIFT, the object is stretched with retaining the aspect ratio; Press CTRL + K for a precise stretch;
  - sheared - select Shear and move the mouse;

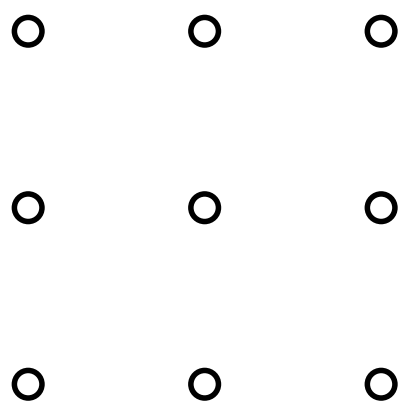
Exercise 4

- Draw the below figure using only one rectangle, which you can copy.



Grouping objects

- When there is a need to manipulate several objects at the same time, we can select them all, or group them, so they are treated as one object;
- A selection of objects is grouped by pressing CTRL + G and ungrouped by pressing CTRL + U;
- When the objects are grouped, they can be selected by one click the next time;



Snapping

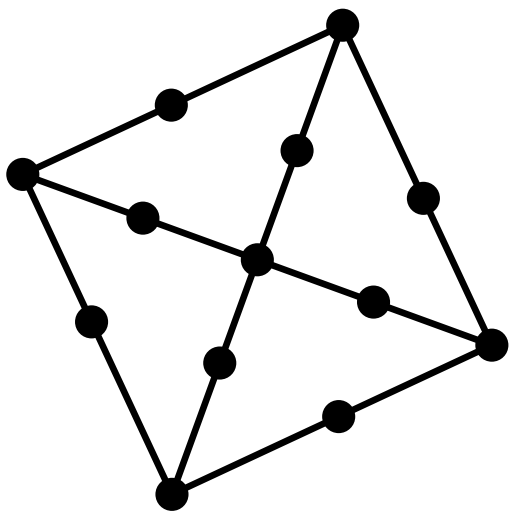
- The drawing surface is covered by a grid (the grid density can be changed in the icon bar);
- The grid can also be hidden by pressing F12;
- Initially all the objects are aligned to the grid points (the points are *magnetic*), this feature is called grid snapping and can be turned on or off by pressing F7;
- The point at which an object will be placed is depicted by a secondary cursor, a small green cross;
- There is also context snapping and angular snapping;

Context snapping

- Snapping to elements of the drawing;
- The elements that the cursor can be snapped to are:
  - vertices (press F4)
    i.e. vertices of polygonal objects, and mark positions;
  - control points (press SHIFT + F4)
    control points of multiplicity three of splines, centers of circles and ellipses, centers and end points of circular arcs;
  - boundaries (press F5)
    object boundaries of polygonal objects, splines and splinegons, circles and ellipses, and circular arcs;
  - intersections (press F6)
    intersection points between the boundaries of path objects;

Exercise 5

- Create a figure using the following steps (in the given order!): create a square, rotate it by 25 degrees, add both diagonals, add five vertices to obtain the wheel graph, subdivide each edge (add one vertex, not necessarily to the half). The result should be as below.

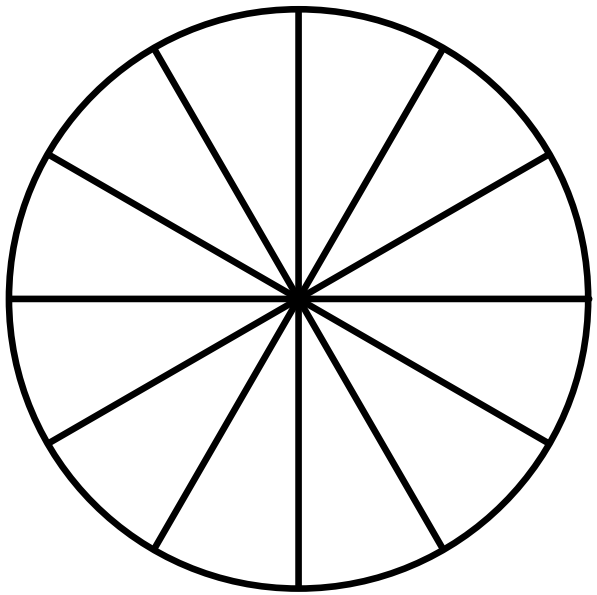


Angular snapping

- Similar to grid snapping, but having an origin and the grid lines going out at angles being multiples of the snap angle;
- The snapping is turned on or off by pressing F8;
- To be able to use angular snapping one should set:
  - the origin (go to origin position and press F1);
  - the base axis (go to axis and press F2);
- The axis system can be hidden or shown by pressing CTRL + F1;
- To reset the orientation, press CTRL + F2;

Exercise 6

- Draw the object below (the angles are 30 degrees);

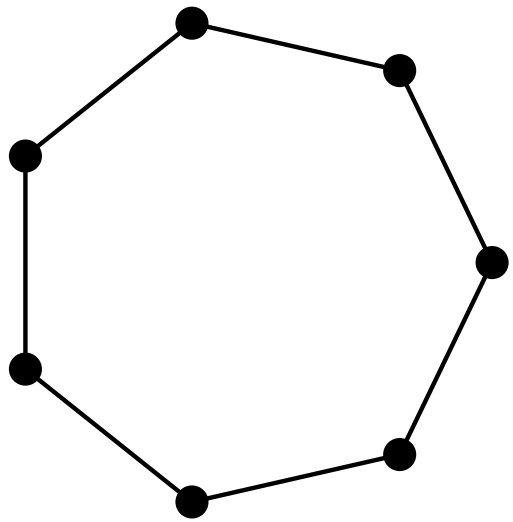


Ipelets

- Ipelets are macros/functions, which can be written by users - hence extensible drawing editor;
- Many ipelets are already available in the Ipelets menu;
- A very useful function in Goodies menu: Regular k-gon: as a parameter it takes a circle, i.e. a circle must be selected when the function is called;

Example 4

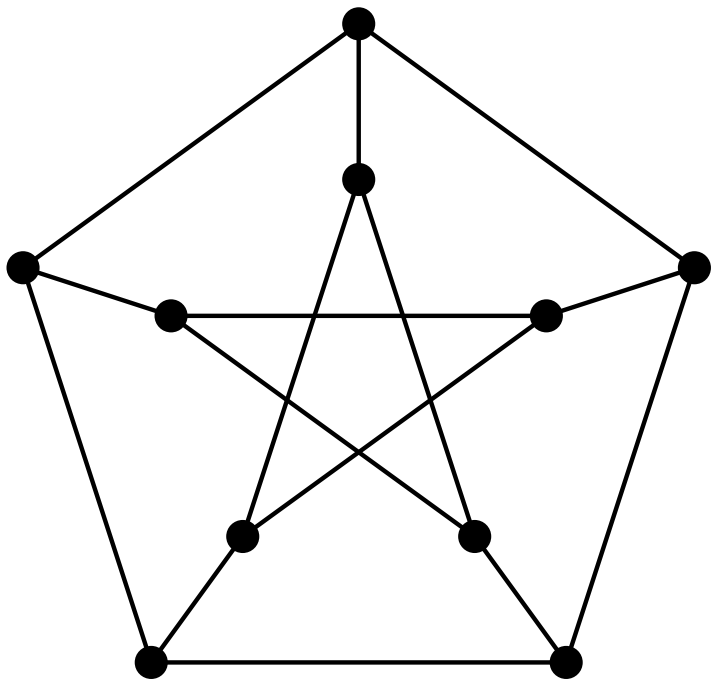
- Let us draw a 7-cycle.



- Note: circles have two control points, the center and a point on the circle usually in the x-direction. The first vertex of a k-gon appears in the control point, so sometimes a rotation of the circle is handy;

Exercise 7

- Draw the Petersen graph;

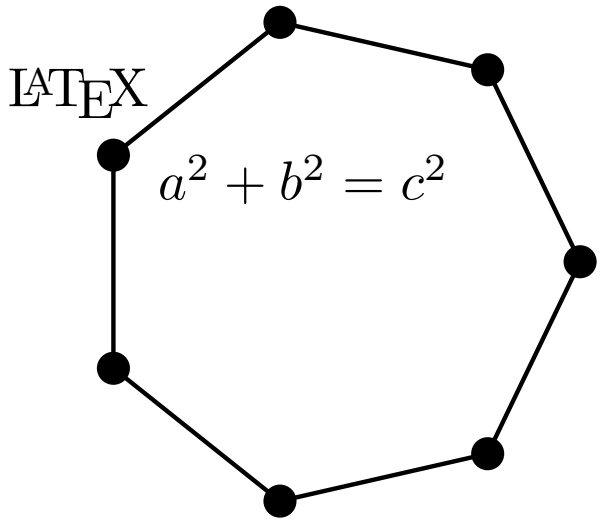


Text

- In IPE, we can write in latex;
- Various types of inserting text (try inserting itemize);
- External editor can be used;
- Additional latex packages can be added in the configuration file (we will cover this later);
- Text can always be edited (press CTRL + E);

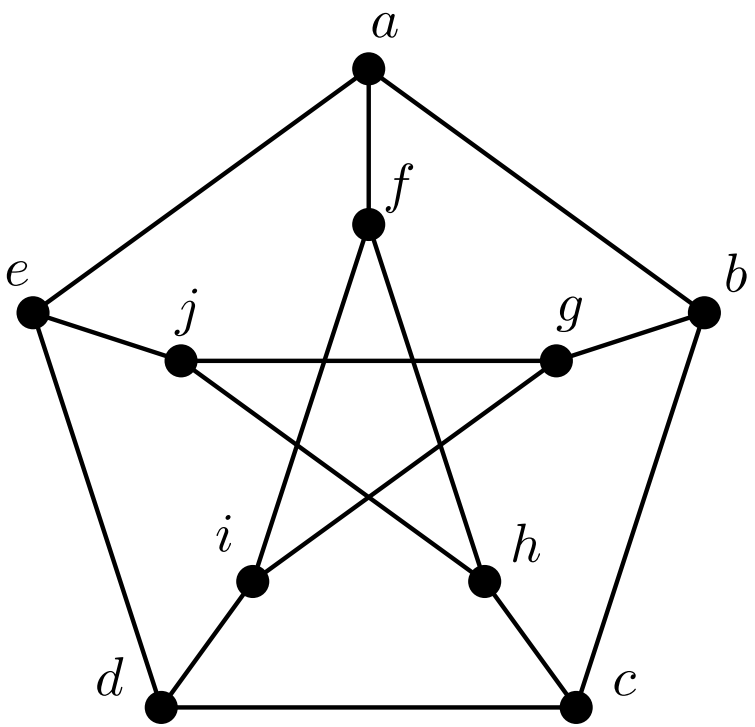
Example 5

- Put our favourite formula in the 7-cycle;



Exercise 8

- Add labels to your Petersen graph;

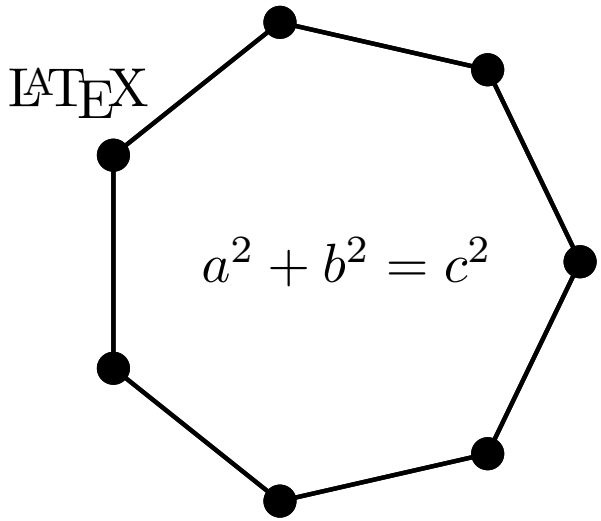


Aligning text

- There are ipelets for aligning text according to existing objects;
- Aligning functions receive two parameters: the object to be aligned and the object to which to align;
- To align to the center horizontally, press SHIFT + H;
- To align to the center vertically, press SHIFT + V;
- To align to the center overall, press SHIFT + C;

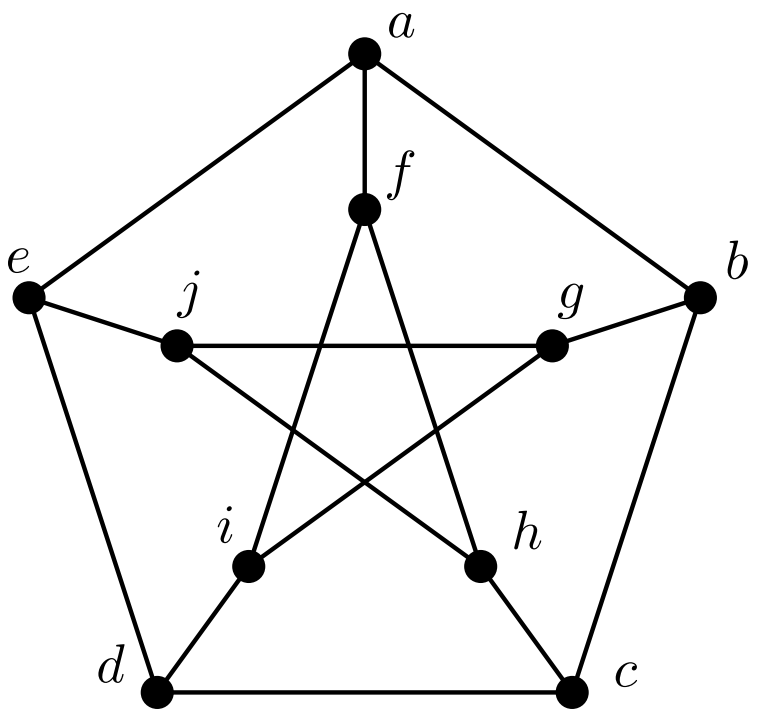
Example 6

- Align the formula to the center of 7-cycle;



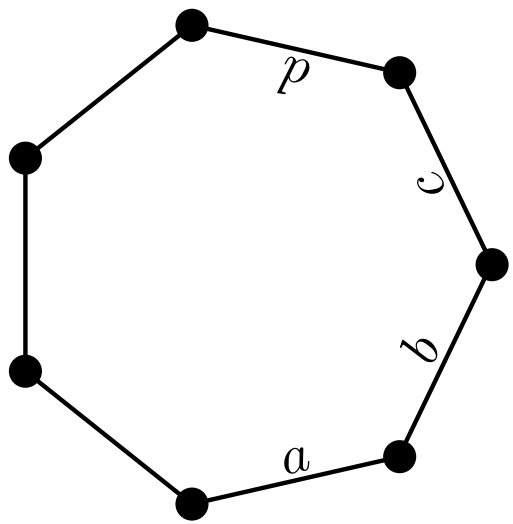
Exercise 9

- Align the labels using the Align menu;



Text rotation

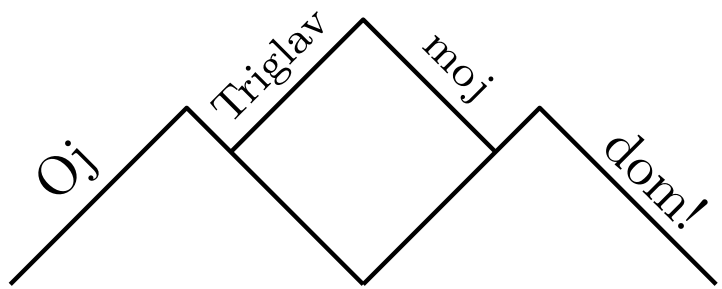
- By default, transformation of text is set to translations;
- To enable rotating of a label, its transformations mode must be set to affine or rigid;



- To construct the above, we use angular snapping!

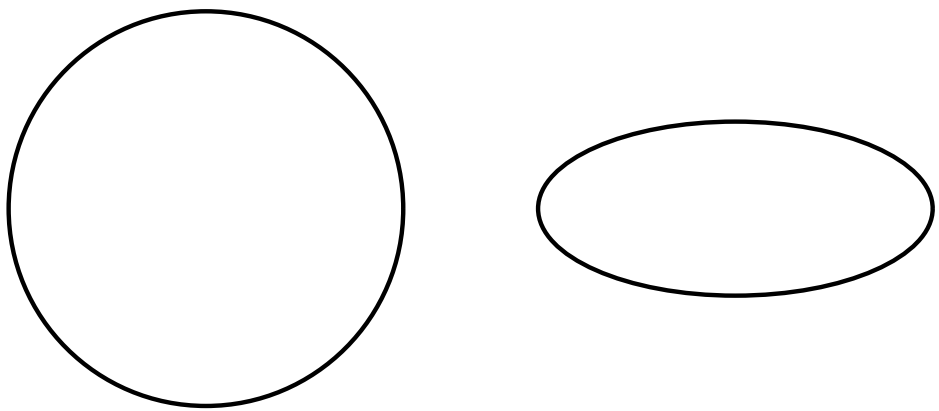
Exercise 10

- Draw the figure below!



XML source

- Every object in IPE is written in XML source which we can edit by selecting Edit as XML in the object's context menu;
- In this way, we can transform a circle to become an ellipse:

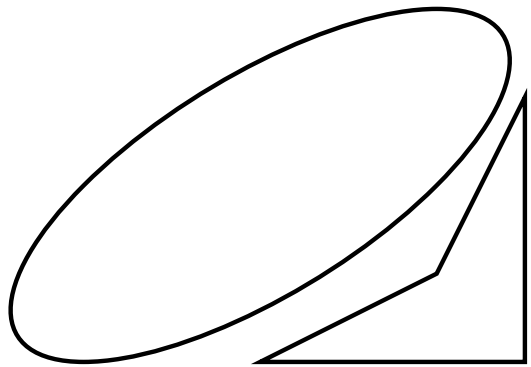


Control points

- Every object can also be modified using its control points;
- Press CTRL + E or select Edit path in the context menu;
- The control points become visible and we can move them to selected coordinates;
- When we are done, we press SPACE;

Exercise 11

- Make the objects in the figure using one square and one circle:

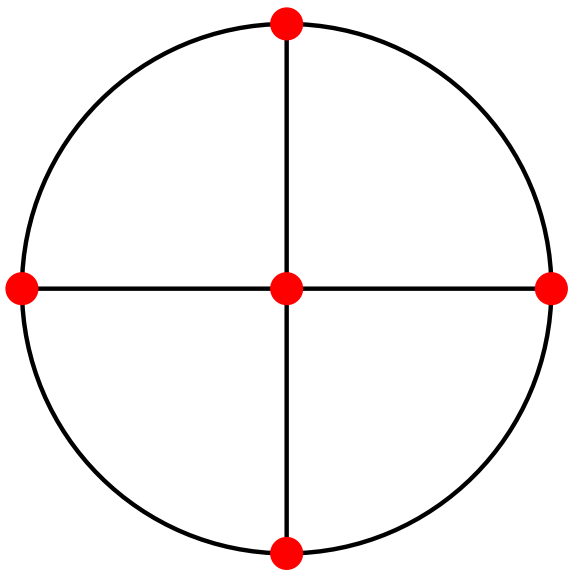


Layers

- A page of an Ipe document consists of one or more layers;
- Each object on the page belongs to a layer;
- The layers of the current page are displayed in the layer list, at the bottom left of the Ipe window;
- The checkmark to the left of the layer name determines whether the layer is visible;
- The layer marked with a yellow background is the active layer;
- New objects are always created in the active layer;
- We can change the active layer by double-clicking on the layer name;
- A new layer is created by pressing CTRL + SHIFT + N;

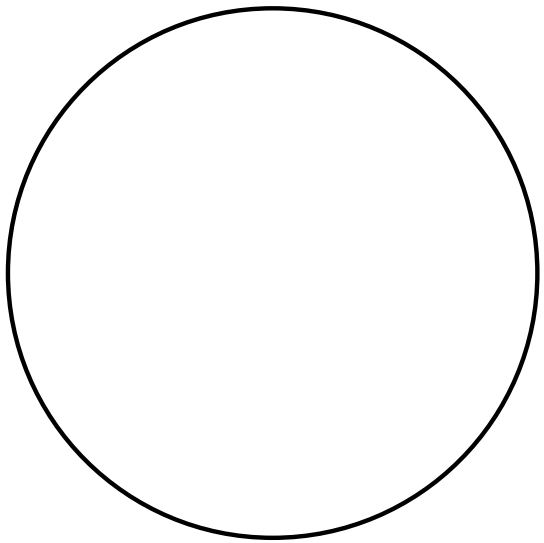
Exercise 12

- Create the figure below on three layers: the first contains the circle, the second the vertices, and the third the lines;



Views

- Having layers, we come to the notion of views;
- Used for changing object partially or incrementally showing parts of a figure;



- A new view can be added by pressing CTRL + SHIFT + I;

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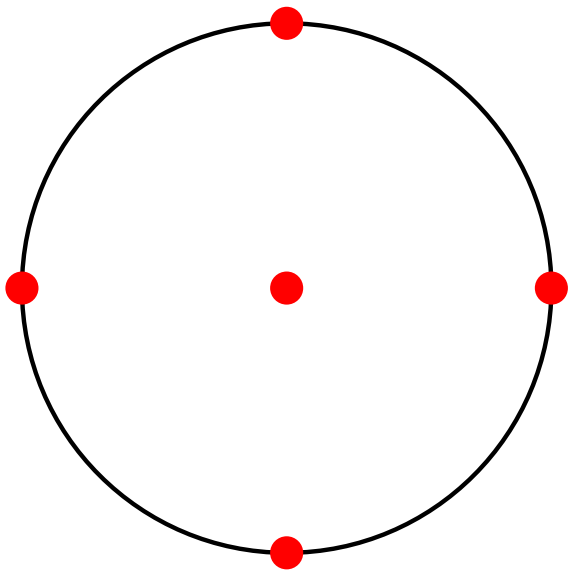

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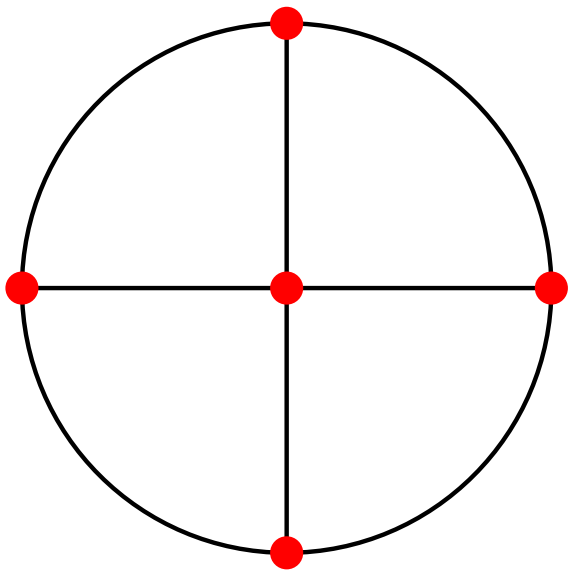


- A new view can be added by pressing CTRL + SHIFT + I;

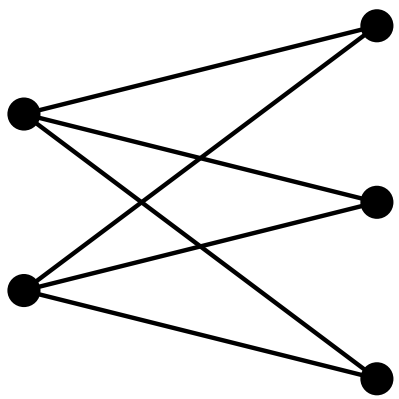
Views

- A view can have different layers selected;
- We can change the current view using the button above layers;
- In latex, we include the figure at a certain view using the page attribute:

  \includegraphics[page=1]{figureName}

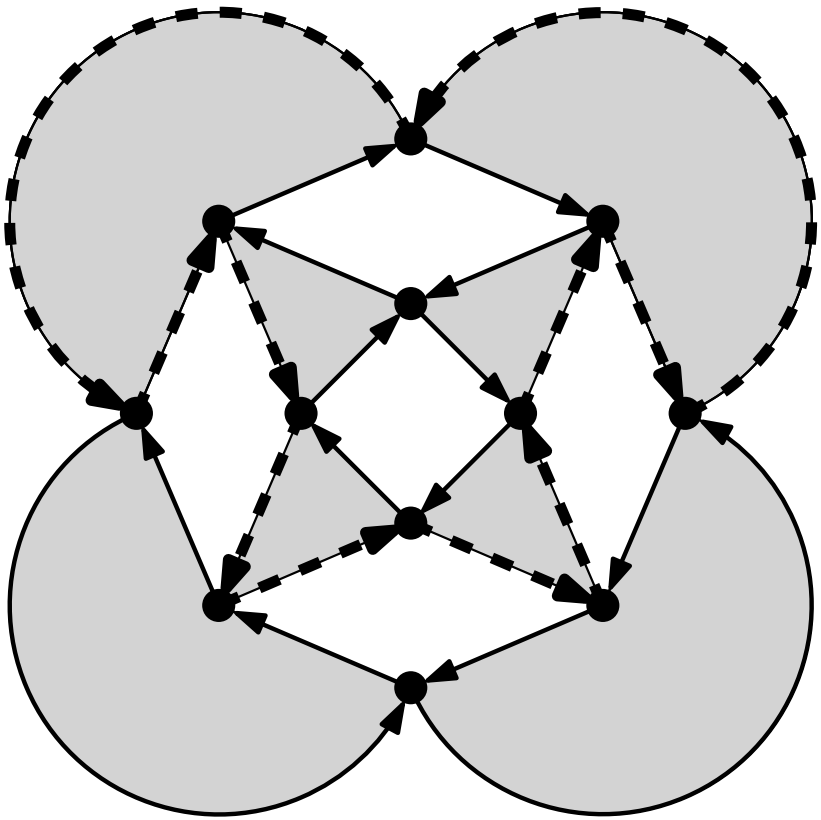
Moving vertices

- When drawing graphs, often we want to move a vertex together with its incident edges to another place;
- For that the Move graph nodes command can be used;
- Let us make a plane embedding of the graph below:



Exercise 13

- Create the graph below:

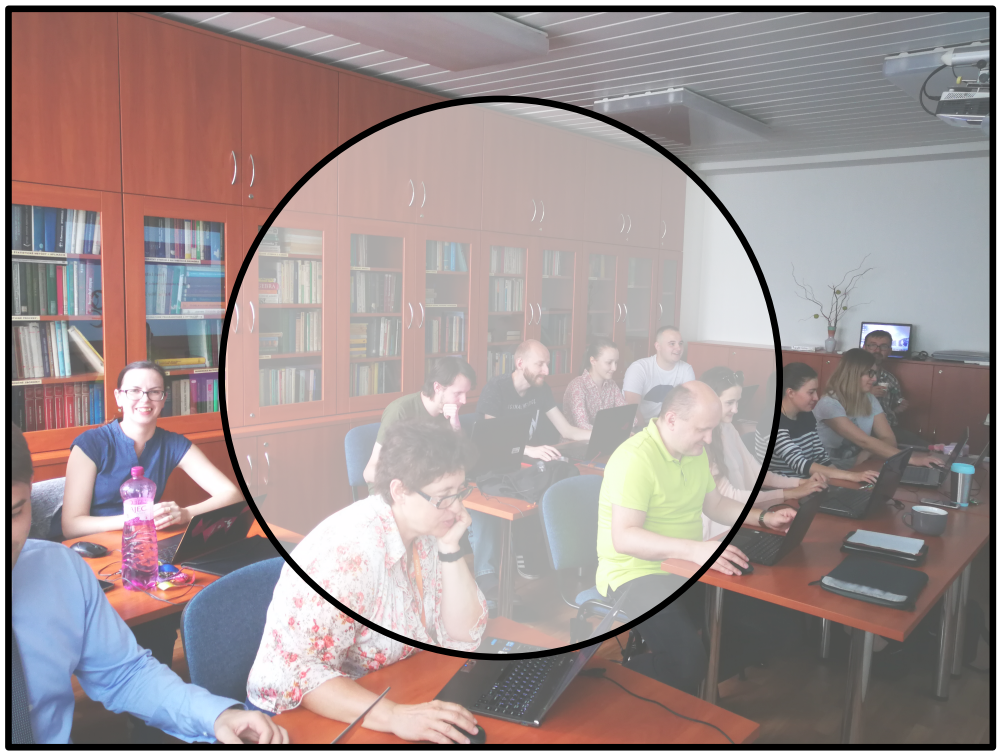


Inserting images

- We can insert a photo or other image by pressing CTRL + SHIFT + O;

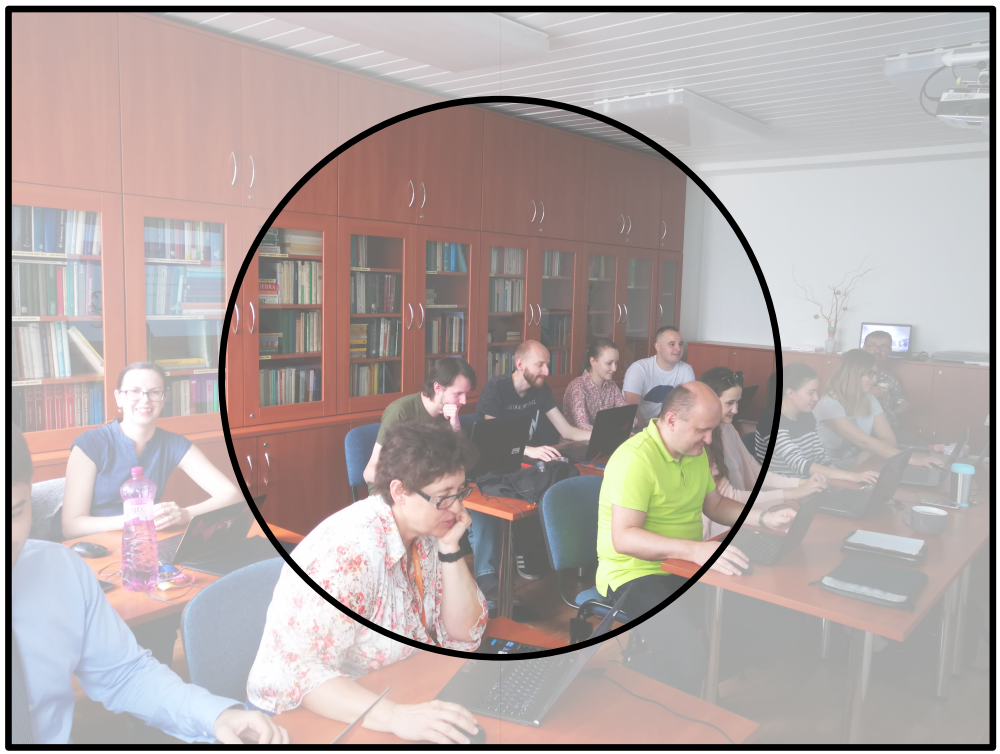
Opacity

- We can also set levels of opacity of objects in the properties;
- Do the example below (the opacities are 30 % and 50 %):



Exercise 14

- Advanced exercise!
- Create the figure below!



- Hint: Modification of XML will be needed!

Exporting figures

- We can export images in other file formats in the File menu;
- The formats available are PNG, EPS, and SVG;

Stylesheets

- The property values in IPE are determined in configuration files, called stylesheets;
- Stylesheets are saved in the styles folder and have extension isy;
- Every IPE document has a default stylesheet assigned, usually basic.isy;
- We can prepare a new one (by e.g. modifying an existing one);
- Be sure to change the name in ipestyle name attribute;
- Add the new stylesheet by pressing CTRL + SHIFT + S;
- After additional changes, we update the stylesheet by pressing CTRL + SHIFT + U;

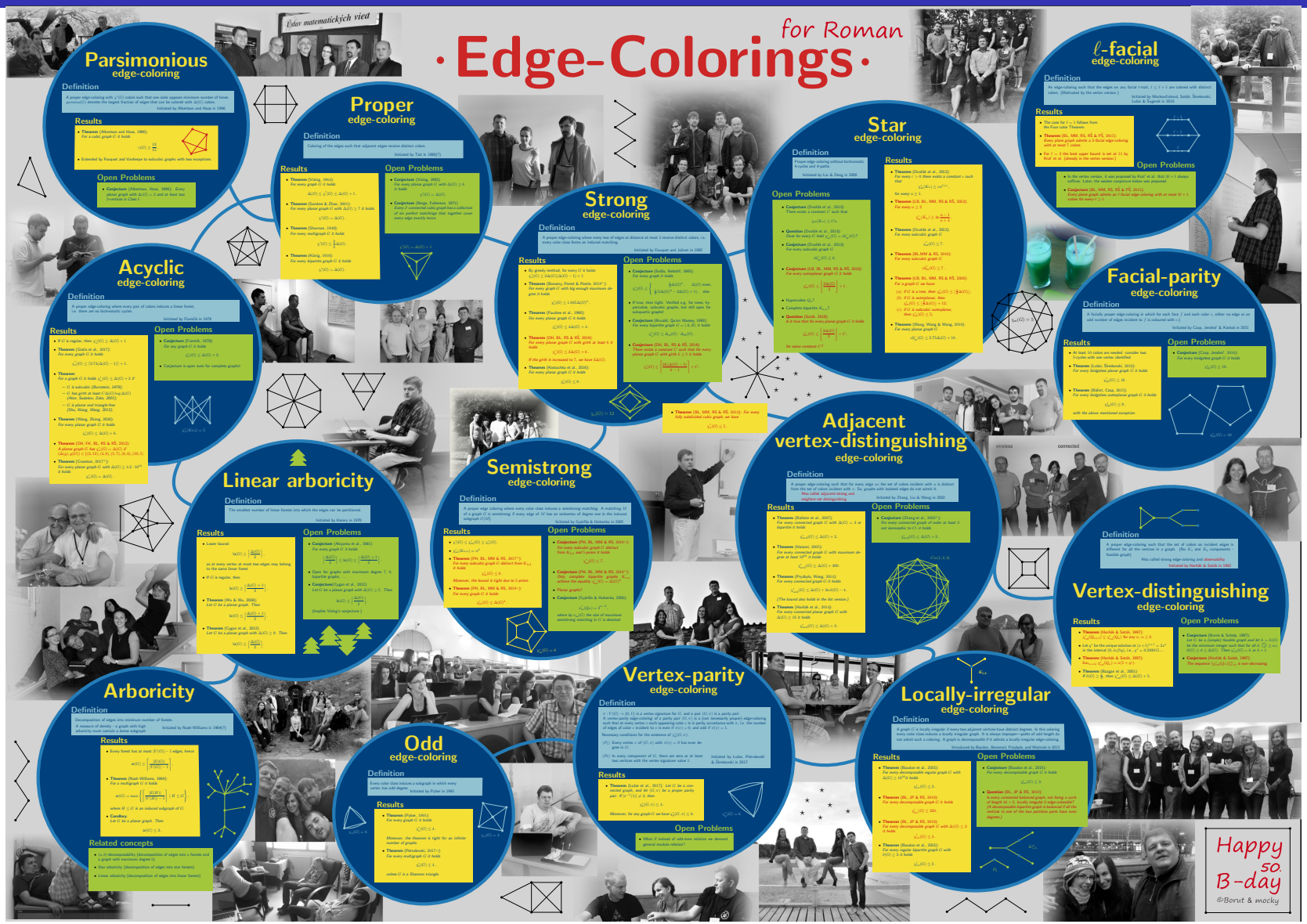
Example 7

- Let us change the size of the canvas (paper) and the working surface (frame).
  Include the following to a new stylesheet:

  ```
  <layout paper="612 792" origin="0 0" frame="512 792"/>
  ```

- Note: Among other, we can also define the document background in the stylesheet;

Example 8


for Roman
·Edge-Colorings·
Parsimonious edge-coloring
Proper edge-coloring
Strong edge-coloring
Star edge-coloring
ℓ-facial edge-coloring
Acyclic edge-coloring
Facial-parity edge-coloring
Linear arboricity
Semistrong edge-coloring
Adjacent vertex-distinguishing edge-coloring
Vertex-distinguishing edge-coloring
Arboricity
Odd edge-coloring
Vertex-parity edge-coloring
Locally-irregular edge-coloring
Definition
Results
Open Problems
Related concepts
Happy 50. B-day
©Borut & mocky

Presentations

- In the bin folder there is a program ipepresenter.exe, which can be used for showing presentations (also beamer) and has some nice features such as timer and notes;
- In IPE, we can also prepare presentations;
- First, choose the stylesheet presentation.isy;
- Then, you prepare each page separately: add page title (CTRL + P), add content (for textbox press F10);
- New page is added by pressing CTRL + I;

Thank you!

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borut.luzar@gmail.com