Introduction & Installation Drawings vs. Geometric Constructions

GeoGebra Workshop Handout 1

Judith and Markus Hohenwarter
www.geogebra.org

Table of Contents

1. Introduction and Installation of GeoGebra

Background information about GeoGebra

GeoGebra is dynamic mathematics software for schools that joins geometry, algebra, and calculus.
On the one hand, GeoGebra is an interactive geometry system. You can do constructions with points, vectors, segments, lines, and conic sections as well as functions while changing them dynamically afterwards.
On the other hand, equations and coordinates can be entered directly. Thus, GeoGebra has the ability to deal with variables for numbers, vectors, and points. It finds derivatives and integrals of functions and offers commands like *Root* or *Vertex*.
These two views are characteristic of GeoGebra: an expression in the algebra window corresponds to an object in the geometry window and vice versa.

GeoGebra's user interface

GeoGebra's user interface consists of a graphics window and an algebra window. On the one hand you can operate the provided geometry tools with the mouse in order to create geometric constructions on the drawing pad of the graphics window. On the other hand, you can directly enter algebraic input, commands, and functions into the input field by using the keyboard. While the graphical representation of all objects is displayed in the graphics window, their algebraic numeric representation is shown in the algebra window.

The user interface of GeoGebra is flexible and can be adapted to the needs of your students. If you want to use GeoGebra in early middle school, you might want to hide the algebra window, input field, and coordinate axes and just work with the drawing pad and geometry tools. Later on, you might want to introduce the coordinate system using a grid to facilitate working with integer coordinates. In high school, you might want to use algebraic input in order to guide your students through algebra on into calculus.

Installing GeoGebra and saving workshop files

Preparations

Create a new folder called *GeoGebra_Introduction* on your desktop.
Hint: During the workshop, save all files into this folder so they are easy to find later on.

WITH Internet access

Install GeoGebra WebStart on your computer. Open your Internet browser and go to www.geogebra.org/webstart. Click on the button called *GeoGebra WebStart*.

Note: The software is automatically installed on your computer. You need to confirm all messages that might appear with *OK* or *YES*.

Hint: Using GeoGebra WebStart has several advantages for you provided that you have an Internet connection available for the initial installation:
- You don't have to deal with different files because GeoGebra is installed automatically on your computer.
- You don't need to have special user permissions in order to use GeoGebra WebStart, which is especially useful for computer labs and laptop computers in schools.
- Once GeoGebra WebStart was installed you can use the software off-line as well.
- Provided you have Internet connection after the initial installation, GeoGebra WebStart frequently checks for available updates and installs them automatically. Thus, you are always working with the newest version of GeoGebra.

Download the zipped workshop files from www.geogebra.org/book/intro-en.zip and save the zipped file in your GeoGebra_Introduction folder.
Extract the files on your computer. Depending on your operating system there are different ways to do this:
- *MS Windows XP*: Right-click the zipped file and follow the instructions of the Extraction Wizard.
- *MacOS*: Double click on the zipped file.

WITHOUT Internet access

Your workshop presenter will provide the GeoGebra installer files via USB drives or CDs. Copy the installer file from the storage device into the created GeoGebra_Introduction folder on your computer.
To install the software, double-click the GeoGebra installer file and follow the instructions of the installer assistant.
Hint: Make sure you have the correct version for your operating system, e.g. GeoGebra_3_0_0_0.exe (MS Windows) or GeoGebra_3_0_0_0.zip (MacOS).

Your workshop presenter will provide the workshop files via USB drives or CDs. Copy the folder *GeoGebra_Introduction_Files* from the storage device into the created GeoGebra_Introduction folder on your computer.

2. Basic Use of GeoGebra

How to operate GeoGebra's geometry tools

- Activate a tool by clicking on the button showing the corresponding icon.
- Open a toolbox by clicking on the lower part of a button and select another tool from this toolbox.
  Hint: You don't have to open the toolbox every time you want to select a tool. If the icon of the desired tool is already shown on the button it can be activated directly.
  Hint: Toolboxes contain similar tools or tools that generate the same type of new object.
- Check the toolbar help in order to find out which tool is currently activated and how to operate it.

How to save and open GeoGebra files

Saving GeoGebra Files

- Open the *File* menu and select *Save*.
- Select the folder *GeoGebra_Introduction* in the appearing dialog window.
- Type in a *name* for your GeoGebra file.
- Click *Save* in order to finish this process.

Hint: A file with the extension '.*ggb*' is created. This extension identifies GeoGebra files and indicates that they can only be opened with GeoGebra.

Hint: Name your files properly: Avoid using spaces or special symbols in a file name since they can cause unnecessary problems when transferred to other computers. Instead you can use underscores or upper case letters within the file name (e.g. First_Drawing.ggb).

Opening GeoGebra Files

- Open a **new GeoGebra window** (menu *File – New window)*
- Open a **blank GeoGebra interface** within the **same window** (menu *File – New)*
- Open an **already existing GeoGebra file** (menu *File – Open)*
  o Navigate through the folder structure in the appearing window
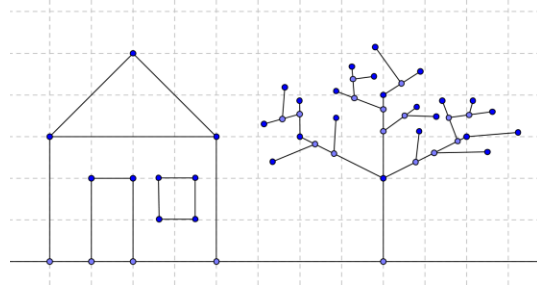 o Select a GeoGebra file (extension '.*ggb*') and click *Open*.

Hint: If you didn't save the existing construction yet GeoGebra will ask you to do so before the blank screen / new file is opened.
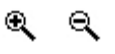
3. Creating drawings with GeoGebra

Preparations

- Hide the *algebra window* and *coordinate axes* (*View* menu)*.*
- Show the *coordinate grid* (*View* menu).

Draw a picture with GeoGebra

Use the mouse and the following selection of tools in order to draw figures on the drawing pad (e.g. square, rectangle, house, tree,…).

●A	**New point**	**New!**
	Hint: Click on the drawing pad or an already existing object to create a new point.	
⟋	**Move**	**New!**
	Hint: Drag a free object with the mouse.	
⟋	**Line through two points**	**New!**
	Hint: Click on the drawing pad twice or on two already existing points.	
⟋	**Segment between two points**	**New!**
	Hint: Click on the drawing pad twice or on two already existing points.	
⟋	**Delete object**	**New!**
	Hint: Click on an object to delete it.	
↩↪	**Undo / Redo**	**New!**
	Hint: Undo / redo a construction step by step.	
✛	**Move drawing pad**	**New!**
	Hint: Click and drag the drawing pad to change the visible part.	
🔍 🔍	**Zoom in / Zoom out**	**New!**
	Hint: Click on the drawing pad to zoom in / out.	

Hint: Don't forget to read the toolbar help if you don't know how to use a tool.

What to practice

- How to select an already existing object.
  Hint: When the pointer hovers above an object it highlights and the pointer changes its shape from a cross to an arrow. Clicking selects the corresponding object.
- How to create a point that lies on and object.
  Hint: The point is displayed in a light blue color. Always check if the point really lies on the object by dragging it with the mouse (*Move* tool).
- How to correct mistakes step-by-step using the *Undo* and *Redo* buttons.

Note: Several tools allow the creation of points "on the fly". This means that no existing objects are required in order to use the tool.
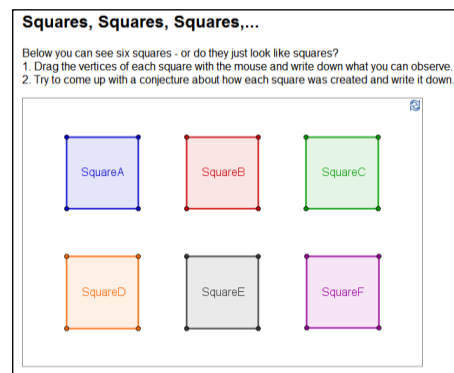
Example: The tool *Segment between two points* can be applied to two already existing points or to the empty drawing pad. By clicking on the drawing pad the corresponding points are created and a segment is drawn in between them.

4. Drawings, Constructions, and Drag Test

Back to school…

Open the dynamic worksheet *01_Drawing_Construction_Squares.html*. Explore this dynamic worksheet as your students would do in class.

The dynamic figure shows several squares constructed in different ways. Follow the instructions on the dynamic worksheets to find out which of theses squares are 'real' squares and which of them just happen to look like squares.

Squares, Squares, Squares,...

Below you can see six squares - or do they just look like squares?
1. Drag the vertices of each square with the mouse and write down what you can observe.
2. Try to come up with a conjecture about how each square was created and write it down.

SquareA   SquareB   SquareC

SquareD   SquareE   SquareF

5. Rectangle Construction

Preparations

- Open new GeoGebra file.
- Hide algebra window, input field and coordinate axes (*View* menu).
- Change the labeling setting to *New points only* (menu *Options – Labeling*).
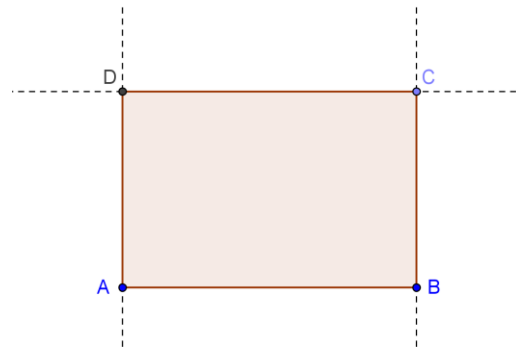
Introduction of new tools

	Perpendicular line New!
	Hint: Click on an already existing line and a point in order to create a perpendicular line through this point.
	Parallel line New!
	Hint: Click on an already existing line and a point in order to create a parallel line through this point.

✕	**Intersect two objects** New! Hint: Click on the intersection point of two objects to get this one intersection point. Successively click on both objects to get all intersection points.	
◁	**Polygon tool** New! Hints: Click on the drawing pad or already existing points in order to create the vertices of a polygon. Connect the last and first vertex to close the polygon! Always connect vertices counterclockwise!	

Hints: Don't forget to read the toolbar help if you don't know how to use a tool. Try out all new tools before you start the construction.

Instructions

1		Segment *AB*
2		Perpendicular line to segment *AB* through point *B*
3		New point *C* on perpendicular line
4		Parallel line to segment *AB* through point *C*
5		Perpendicular line to segment *AB* through point *A*
6		Intersection point *D*
7		Polygon *ABCD* Hint: To close the polygon click on the first vertex again.
8		Save the construction
9		Apply the drag test to check if the construction is correct

6. Navigation Bar and Construction Protocol

Show the **Navigation bar** (*View* menu) to review your construction step-by-step using the buttons.

Show the **construction protocol** (*View* menu) and use it to review your rectangle construction step-by-step.

What to practice

- Try to change the order of some construction steps by dragging a line with the mouse. Why does this NOT always work?

- Group several constructions steps by setting breakpoints:
  - Show the column *Breakpoint* (*View* menu of the construction protocol window).
  - Group construction steps by checking the *Breakpoint* box of the last one of the group.
  - Change setting to *Show only breakpoints* (*View* menu of the construction protocol window).
  - Use the navigation bar to review the construction step-by-step. Did you set the breakpoints correctly?

7. Equilateral Triangle Construction

Preparations

- Open new GeoGebra file.
- Hide algebra window, input field and coordinate axes (*View* menu).
- Change the labeling setting to *New points only* (menu *Options – Labeling*).
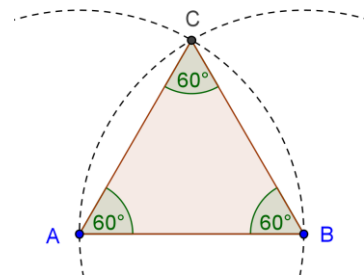
Introduction of new tools

	Circle with center through point **New!**	
	Hint: First click creates center, second click determines radius of the circle.	
	Show / hide object **New!**	
	Hints: Highlight all objects that should be hidden, then switch to another tool in order to apply the visibility changes!	
	Angle **New!**	
	Hint: Click on the points in counterclockwise direction! GeoGebra always creates angles with mathematically positive orientation.	

Hints: Don't forget to read the toolbar help if you don't know how to use a tool. Try out all new tools before you start the construction.

Instructions

1		Segment *AB*
2		Circle with center *A* through *B*
		Hint: Drag points *A* and *B* to check if circle is connected to them.
3		Circle with center *B* through *A*

4		Intersect both circles to get point *C*
5		Polygon *ABC* in counterclockwise direction
6		Hide circles
7		Show interior angles of triangle Hint: Clockwise creation of the polygon gives you the exterior angles!
8		Save the construction
9		Apply the drag test to check if the construction is correct.

# 8. GeoGebra's Properties Dialog

How to access the *Properties dialog*

- Right-click (MacOS: Ctrl-click) an object OR
- Select *Properties…* from the *Edit* menu OR
- Double click an object in *Move* mode

What to practice

- Select different objects from the list on the left hand side and explore the available properties tabs for different types of objects.
- Select several objects in order to change a certain property for all of them at the same time.
  Hint: Hold the *Ctrl*-key (MacOS: *Ctrl*-click) pressed and select all desired objects.
- Select all objects of one type by clicking on the corresponding heading.
- Show the value of different objects and try out different label styles.
- Change the properties of certain objects (e.g. color, style,…).
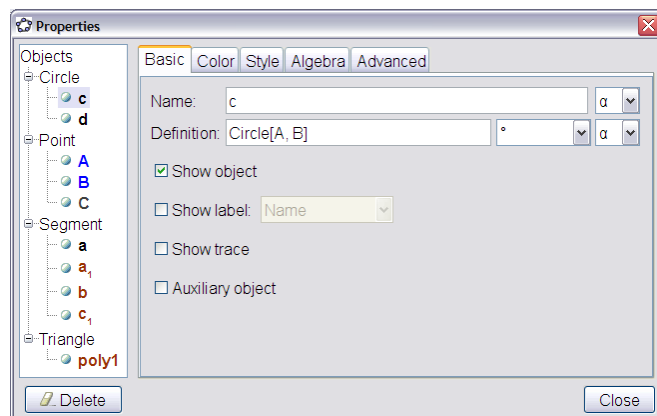
9. Challenge of the Day: Isosceles Triangle Construction

Construct an **isosceles triangle** whose length of the base and height can be modified by dragging corresponding vertices with the mouse.
You will need the following tools in order to solve this challenge:

	Segment between two points			New point
	Midpoint or center	**New!**		Polygon
	Perpendicular line			Move

Hints: Don't forget to read the toolbar help if you don't know how to use a tool. Try out all new tools before you start the construction.