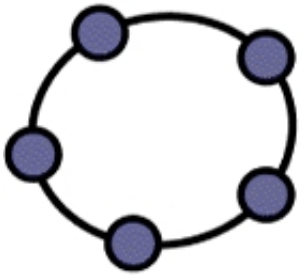

GeoGebra Workbook 5 — Additions

Spreadsheet, Calculus

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1 - Newton-Raphson and the Spreadsheet

In the file on the Internet, spread.html, you will notice that there is a slider, a, that controls whether a particular iteration is visible or not. The method of doing this is quite long and tedious so I have separated it from the main instructions. The problem is that GeoGebra, in its current release, does not accept the 'If' command in the Dynamic Color menu. This forces us to define different numbers to control the colours of the different iterates. The instructions that follow will tell you how to cycle through the colours red, green and blue. You can experiment with these and use the colour wheel you created in the last section to try different colours.

We need to consider two different problems here:

(i) How can we ensure that the objects and cells are coloured red, green and blue in succession?

(ii) How can we keep them invisible until we need them?

The first problem can be solved by realising that

red is represented by Red = 1, Green = 0, Blue = 0

green is represented by Red = 0, Green = 1, Blue = 0

blue is represented by Red = 0, Green = 0, Blue = 1

To do this we will create a sequence of numbers for each colour.

The second problem is solved by realising that an object and a spreadsheet cell are essentially colourless if the Red, Green and Blue components are each equal to $0 \cdot 99$. The figure of $0 \cdot 99$ seems a bit strange. Why not 1? This is simply a problem with the current version of GeoGebra and will undoubtedly be fixed in the near future.

Step-by-step Instructions Continued

Before we list the instructions a word of explanation is called for.

1. The slider, a, governs the number of rows of the spreadsheet that are visible.

2. The sequences r, g and b will control whether the visible cells and objects are red, green or blue.

3. The sequence, red, returns the number $0 \cdot 99$ if the row value is greater than the value of the slider a. Otherwise it returns the appropriate value from the sequence r.

4. The sequences green and blue work similarly to red.

5. Instruction 17, for example, colours all objects in the second row of the spreadsheet with the correct colour - in this case red.

From Step 16 on use Copy and Paste to shorten your work.

10.		Create the slider a to go from 1 to 10 in steps of 1
11.		Create the list of values of red by typing in the Input Field `r = {1, 0, 0, 1, 0, 0, 1, 0, 0}`
12.		Create the list of values of green by typing in the Input Field `g = {0, 1, 0, 0, 1, 0, 0, 1, 0}`
13.		Create the list of values of blue by typing in the Input Field `b = {0, 0, 1, 0, 0, 1, 0, 0, 1}`
14.		Create the list of values of red to display by typing in the Input Field `red = Sequence[If[a > i, Element[r, i], 0.99], i, 1, 9]`
15.		Create the list of values of green to display by typing in the Input Field `green = Sequence[If[a > i, Element[g, i], 0.99], i, 1, 9]`
16.		Create the list of values of blue to display by typing in the Input Field `blue = Sequence[If[a > i, Element[b, i], 0.99], i, 1, 9]`
17.		Click on the Number 2 at the left of the spreadsheet to highlight all the objects and cells in Row 2. Go to Edit → Properties. Click on the Advanced Tab. Into the appropriate fields type `Element[red, 1]` `Element[green, 1]` `Element[blue, 1]`
18.		Click on the Number 3 at the left of the spreadsheet to highlight all the objects and cells in Row 3. Go to Edit → Properties. Click on the Advanced Tab. Into the appropriate fields type `Element[red, 2]` `Element[green, 2]` `Element[blue, 2]`
19.		Continue like this until all the rows have been edited.

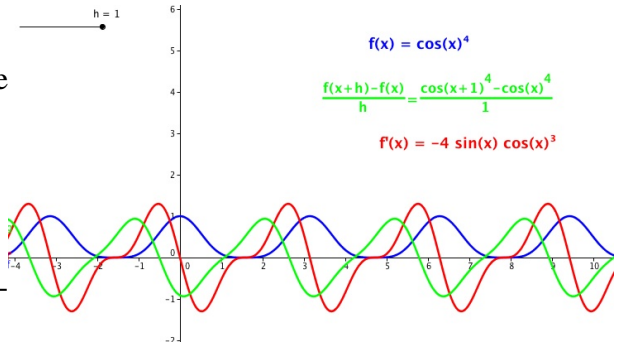
Tasks: Drag the slider to see the objects and cells appear. Make the objects and cells be different colours, not just cycle through red, green and blue as they do here. Remember that the lists r, g and b contain the components of the colours that you want your objects to be. The lists red, green and blue contain the condition as to whether objects are visible or not.
Modify the sequences defined at steps 14, 15 and 16 so that when the tangents begin to converge a previous tangent will be made invisible before a new one is drawn.

Hint: You will have to shorten each sequence and create new ones. Remember the difference between $>$ and $\stackrel{?}{=}$ when you do this.

2 - Differential Calculus

Preparation

- Open a new GeoGebra file.
- Show the algebra window and the coordinate axes. (View Menu).
- Change the labelling setting to "Automatic" (menu Options → Labelling).
- You can view the file diff.html to see the completed product.



GeoGebra is able to differentiate functions of a single variable. There are two different commands that you can use to do the differentiation. If you define a function as `f(x) = sin(x)` it can be differentiated by typing into the Input field either of the commands;

(i) `Derivative[ f ]`

(ii) `f'(x)`

Notice that when you do this the function `f'(x) = cos(x)` appears in the Algebra window. `f'(x)` is a normal GeoGebra object and can be treated like any other function.

In this section we are going to create a calculator that will differentiate functions of x. In the process we will also see the plots of $f(x)$, $\dfrac{f(x+h)-f(x)}{h}$ and $f'(x)$. We will use a slider for h which will help students to see that

$$\lim_{x\to 0}\frac{f(x+h)-f(x)}{h} = f'(x)$$

We will have to avoid zero in order not to get the monster $\frac{0}{0}$!

We will also learn a new technique in this section. If you want your students to have the full use of the GeoGebra toolbar within the applet then, of course, you can allow them to access it. However sometimes, as in this example, you may want to allow them access to only a subset of the GeoGebra toolbar. In this lesson we will learn how to edit the menu so that only some of the toolbar appears on an applet that you will export to html.

Step-by-step Instructions

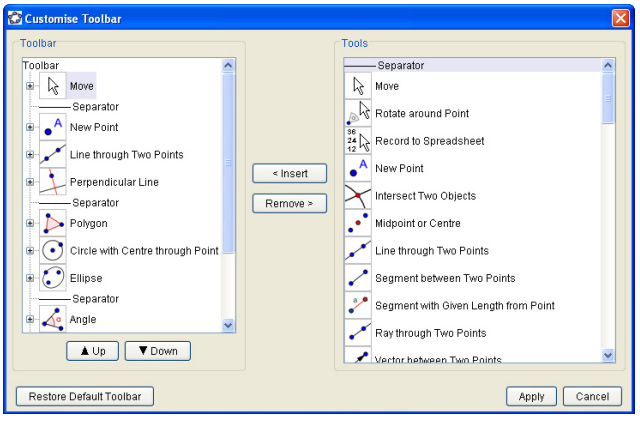
1.		Create the slider h to go from 0·01 to 1 in steps of $0 \cdot 01$
2.		Create the function f by typing into the Input field: `f(x) = (cos(x)) ∧ 4`

3.		Create the function g by typing into the Input field: `g(x) = (f(x + h) − f(x))/h`
4.		Create the derivative by typing into the Input field: `f′(x)`
5.	ABC	Type in the following text `"f(x) = " + f`
6.	ABC	Tick the LaTeX formula checkbox and type in the following text `"\frac{f(x + h) − f(x))}{h} = " + g`
7.	ABC	Type in the following text `"f′(x) = " + f′`

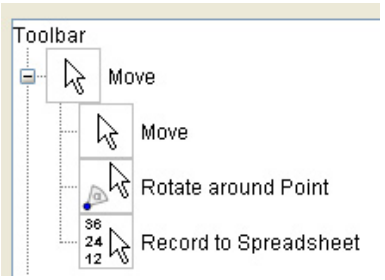
The next thing to do is change the toolbar so that only the tools we choose are available to the student within the applet. The students will be able to change the function using the Input field. This means that they have to be able to control what part of their function they can see. We want the student to be able to

	**Move Objects** We need this tool to select and move objects.
	**Move Graphics View** We need this tool to allow the students explore interesting parts of the function they create.
	**Zoom In** We need this tool to allow the student get a closer view of parts of the graph.
	**Zoom Out** We need this tool because the students may enter functions where a larger viewpoint is needed.

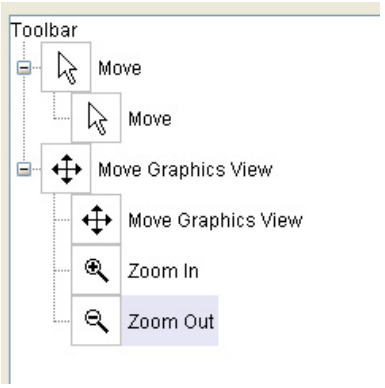
Go to the Main Menu and click Tools → Customize Toolbar. The following menu will appear:



Click on the + symbol to the left of the Move icon to see the selection on the right. Highlight the Rotate around Point tool and click the Remove button. You will find that Record to Spreadsheet is now highlighted. Click on the Remove button. Continue to remove every tool until Move Graphics View (the last option) is highlighted. Click on the + symbol to the left of Move Graphics View to open up it's submenu.



Highlight the first Separator and click Remove. Continue until all that remains are the Move, Move Graphics View, Zoom In and Zoom Out tools. Click Apply. Save your file. Make sure to select the "Show Toolbar" option in the Advanced settings when you are exporting your file to html.



Tasks: Enhance the colours and attributes of the objects in your file. Export the file as html. Make sure to select the "Show Toolbar" option in the Advanced settings (very important).