

## **GAwxM is Geometric Algebra using wxMaxima**

It has been found that wxMaxima (a front-end for the Maxima computer algebra system) can be used to develop Maxima code functions for Geometric Algebra.

The code was developed from the online published paper, A Survey of Geometric Algebra and Geometric Calculus, and examples from Projective Geometry and Space-time Algebra were coded.

Worked examples have been taken from the reference books...Linear and Geometric Algebra (LAGA) and Vector and Geometric Calculus (VAGC) as far as the Fundamental Theorem of Geometric Calculus. Each replicated result helped to validate the GAwxM syntax and to some extent, the theorems themselves.

### **How to set up a development system**

#### ***Windows***

Install wxMaxima from Github. <https://github.com/andrejv/wxmaxima>

Open wxMaxima

Select Edit tab; Configure; Worksheet and then...

deselect (untick) all of:

- Intelligently hide cell brackets

- Enter evaluates cells

- Open a cell when Maxima expects input

- Use centered dot character for multiplication

- Insert % before an operator at the beginning of a cell

select (ensure ticked):

- Keep % sign with special symbols:%e, %i, etc.

OK the ticked selections

Ctrl Q to quit wxMaxima and save the untitled document to folder GAwxM/

Download the compressed gawxm repository from Github

Extract into your own user folder C:/Users/< your user folder > to create...

C:/Users/< your user folder >/GAwxM/

Make a copy of folder GAwxM/ as a backup e.g. GAwxM\_bak/

Alongside the GAwxM/ folder, locate or create a (dot)maxima folder, C:/Users/< your user folder >/.maxima

Find the file maxima-init.mac in the GAwxM folder and copy it to the (dot)maxima folder

Start wxMaxima

Ctrl O to open say, wxM\_tutorial.wxm and Ctrl R to run and experiment with the cog icon (Configure wxMaxima) to generate a useful appearance and save the style.ini file.

## ***Ubuntu and other Linux systems***

There needs to be a working version of wxMaxima on the machine and this is usually a pre-installed package under Ubuntu. The Ubuntu operating system is freely available and can be installed alongside any Microsoft Windows system. Ubuntu 12.04 LTS was used for the early development.

Download the compressed gawxm repository from Github

The compressed file should be extracted into the home/ folder and should contain the file named... maxima-init.mac and the main project folder named... GAwxM/

The contents of the file named ...maxima-init.mac are the Maxima commands...

```
wxMuserdir:strimr(".maxima",maxima_userdir)$  
fynames:simplode([wxMuserdir,"GAwxM/GA_functions/###.wxm"])$  
file_search_maxima: append (file_search_maxima,[fynames])$  
fynames:simplode([wxMuserdir,"GAwxM/GC_functions/###.wxm"])$  
file_search_maxima: append (file_search_maxima,[fynames])$
```

These commands are required under Ubuntu (and Windows) because the path name for the main project folder expands into /home/username/GAwxM/, and this differs for every user.

Refer to the *Windows* section for how to configure wxMaxima Worksheet.

## **A typical workflow to get started**

Make a backup copy of folder GAwxM/ as GAwxM\_bak/ say

Start wxMaxima

Ctrl-O to open the file ...GAwxM/GA\_syntax/geometric\_product\_syntax.wxm

Select the File tab; select save as; save with a new filename e.g.

product\_1.wxm

Ctrl-R to run the active document (program file)

Examine the embedded results and find the comment "end of Initialization"

After this, any comment blocks or code blocks can be altered or deleted without affecting the Initialization

Open a new code block at the end of the document

Enter  $(a \cdot e_1) \& (b \cdot e_2)$ ; including the semi-colon at the end

Ctrl-R to run the document

Confirm that the infix operator,  $\&$ , for the multivector geometric product, can also handle simple scalar\*base inputs within parentheses

Ctrl-S to save the document and continue