GAwxM version 2 is a rewrite

The rewrite was prompted by several weaknesses in the first version;

- the unsatisfactory display of members of the canonical basis with the occurrence of whitespaces within bivectors etc.
- the need to replicate the initialization within each new document so that any change to initialization needed changes to many active documents
- the use of poorly defined arrays in the Initialization

The rewrite is described in the three corresponding sections below.

- The precedence of the intrinsic maxima infix parentheses cannot be redefined by the user. This means that the parentheses are applied when maxima tries to resolve the meaning of 'tilda'. So e1~e2~e3 becomes (e1~e2)~e3. On a second run this becomes e1 ~ e2 ~e3 including unwanted whitespaces. The resolution of this needed a new way to hold the base vectors together and to abandon a major operational feature. The 3D pseudovector is held in version 2 as an ordered set of base vectors, {e1,e2,e3} and the basis then becomes 1,{e1},{e2},...,{e2,e3},{e1,e2,e3}. The conversion of a file from version1 to version 2 requires this replacement. The folder for the function testing, /GA_syntax/ and the folders for the development of those functions, /Working_*/ have all been converted together with some significant applications. The examples from the books have not been converted but the answers should be unchanged if a particular example needed conversion.
- The initialization sequence now requires three files, held in the folder named …/GA_GC_Initialize. This initialization sequence, occurs at the beginning of every active document in version 2. So the short document named... …/GA_GC_Initialize/initialize.wxm...may be used as a template to generate any new document. Any future change in the Initialization now needs just one of the other two files to be edited. Many development files e.g. in folders /GA_syntax/, /Working_code/ and /Working_debug/ will retain the long form of Initialization for reference during development and held in /GA_syntax/left_inner_template.wxm.
- There are now three global lists holding bases, lstblds[], allblds[] and invblds[]. Lists are indexed from element 1 and so lstblds[] now holds the (grade 1) basis vectors in element 1. The implied unit of grade zero is not held in the lists. However, since arrays are indexed from zero, the array, nbases, can hold the number of bases of each grade and they can be indexed by grade.

GAwxM version 2 is also Geometric Algebra using wxMaxima

Version 2 is a rewrite of version 1. It could have been re-launched as a new project but that would lose the internet links. It has been trimmed down to a standalone GAwxM version 2 in Github but the examples from books may not ever be converted. However, they should still be available in Github.

Both versions can be retained under the original project name, GAwxM while retaining the examples. The two versions should give the same results just with a different representation of the bases.

The mathematical 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.

How to set up a development system

Windows

Install wxMaxima from Sourceforge...Installation of Maxima in Windows

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.

Download the project, GAwxM from Github.
Extract into your own user folder C:/Users/< your user folder > to create…
C:/Users/< your user folder >/GAwxM/ alongside the other extracted files.
Make a copy of folder /GAwxM/ as a backup e.g. /GAwxM_bak/

Alongside the /GAwxM/ folder, create or find the (dot)maxima folder, C:/Users/< your user folder >/.maxima
Find the file maxima-init.mac and move it to the (dot)maxima folder

Start wxMaxima
Ctrl O to open say, /GA_syntax/blade_operator_syntax.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 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 and wxMaxima was pre-installed as in many other linux-like systems. The source code for this early version of wxMaxima (5.24.0) used to be available elsewhere and could be downloaded for the history.

If using an up to date version of wxMaxima then refer to the *Windows* section for how to configure the wxMaxima Worksheet.

Download the project GAwxM from Github.
The compressed project file should be extracted into the /home/ folder.

For version 2, the contents of the file named ...maxima-init.mac are the Maxima commands…

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

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.

There needs to be a copy of the file, maxima-init.mac above the code folder named, /GAwxM/, although an (inactive) reference copy is also held within the code folder.

Also within the code folder there is another documentation file named... readme_functions.odt containing a list of the names of the user (extrinsic) function files with the functions contained within them. The function files are held in two of the folders within the pathnames above.

A typical workflow

- Make a backup copy of folder /GAwxM/ as /GAwxM_bak/ say
- Start wxMaxima
- Ctrl-O to open the file …/Your_folder/geometric_product_1.wxm
- Edit the name of the file at the top of the file (for reference only) to e.g.
- geometric_product_2.wxm
- Select the File tab; select save as; save with the new filename, geometric_product_2.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 by clicking the cursor there and tapping Return
- Enter (a*{e1})&*(b*{e2}); including the semi-colon at the end and now including the curly brackets for version 2. (The expression may be copied from this Open Office readme file)
- Ctrl-R to run the active 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

- Ctrl-N to open a second wxMaxima window
- Ctrl-O to open the file …/Your_folder/your_initialization.wxm
- Ctrl-R to run
- Examine the list named allblds[]
- For four dimensions edit Pseudos:{e1,e2,e3}$ to Pseudos:{e1,e2,e3,e4}$
- Ctrl-R to run
- Examine the list named allblds[]
- Ctrl-Q and select answer NO to "Save changes before closing?"
- The first window should still be open so this section could be repeated