LAGA_chapter06.05problem6.5.5.wxm (LAGA examples)

A test document for Geometric Algebra with wxMaxima
contains...
Initialization
Loading of functions (intrinsic and GA specific)
Pseudoscalar definition (specifies the space dimension) and
calculation of the inverse pseudoscalar used to generate the dual of a multivector
Enumeration of the standard basis for the specified dimension

Product Properties in the geometric algebra, G3

Reference book...Linear and Geometric Algebra (LAGA)
by Alan Macdonald

Initialization

```
(%i54) ext:["wxm"]$
       file_type_maxima:append(ext,file_type_maxima)$
       batchload("initialize_fns")$
```

the pseudoscalar and its inverse
the lowest useable dimension pseudoscalar should be {e1,e2} i.e. Plen = 2
e.g. for four dimensions edit Pseudos:{e1,e2,e3}$ to Pseudos:{e1,e2,e3,e4}$

```
(%i1) Pseudos:{e1,e2,e3}$
      Pvar:listofvars(Pseudos)$
      Plen:length(Pvar)$
      I:Pseudos$
      ni:(Plen-1)*Plen/2$
      Ii:(-1)^ni*I$
      kill(ni)$
      ldisplay(Pvar)$

 (%t8) Pvar=[e1,e2,e3]

(%i9) batchload("initialize_lsts")$

 (%t9) lstblds=[[{e1},{e2},{e3}],[{e1,e2},{e1,e3},{e2,e3}],[{e1,e2,e3}]]
(%t10) allblds=[{e1},{e2},{e3},{e1,e2},{e1,e3},{e2,e3},{e1,e2,e3}]
(%t11) invblds=[{e1},{e2},{e3},-{e1,e2},-{e1,e3},-{e2,e3},-{e1,e2,e3}]
```

end of Initialization

Problem 6.5.5
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first use function makelistgrademv() to make two bivectors;

```
(%i12) lstgA:[2]$
       nameA:"A"$
       makelistgrademv(nameA,lstgA)$
       ldisplay(A)$
       lstgB:[2]$
       nameB:"B"$
       makelistgrademv(nameB,lstgB)$
       ldisplay(B)$

(%t15) A=a_{2,3}*{e2,e3}+a_{2,2}*{e1,e3}+a_{2,1}*{e1,e2}
(%t19) B=b_{2,3}*{e2,e3}+b_{2,2}*{e1,e3}+b_{2,1}*{e1,e2}
```

display both geometric products

```
(%i20) M1:A&*B$
       M2:B&*A$
       ldisplay(M1,M2)$

 (%t22)/R/ M1=(b_{2,1}*a_{2,2}-b_{2,2}*a_{2,1})*{e2,e3}+(-b_{2,1}*a_{2,3}+b_{2,3}*a_{2,1})*{e1,e3}+
(b_{2,2}*a_{2,3}-b_{2,3}*a_{2,2})*{e1,e2}-b_{2,3}*a_{2,3}-b_{2,2}*a_{2,2}-b_{2,1}*a_{2,1}
 (%t23)/R/ M2=(a_{2,1}*b_{2,2}-a_{2,2}*b_{2,1})*{e2,e3}+(-a_{2,1}*b_{2,3}+a_{2,3}*b_{2,1})*{e1,e3}+
(a_{2,2}*b_{2,3}-a_{2,3}*b_{2,2})*{e1,e2}-a_{2,3}*b_{2,3}-a_{2,2}*b_{2,2}-a_{2,1}*b_{2,1}
```

use the function grader() to find the bivector content of the two products,
noting that the denominator is held in the cell grarr[Plen+1]=grarr[4]

```
(%i24) grarr:grader(M1)$
       B1:grarr[2]/grarr[4]$
       grarr:grader(M2)$
       B2:grarr[2]/grarr[4]$
       ldisplay(B1,B2)$

 (%t28)/R/ B1=(-a_{2,1}*b_{2,2}+b_{2,1}*a_{2,2})*{e2,e3}+(a_{2,1}*b_{2,3}-b_{2,1}*a_{2,3})*{e1,e3}+
(-a_{2,2}*b_{2,3}+b_{2,2}*a_{2,3})*{e1,e2}
 (%t29)/R/ B2=(a_{2,1}*b_{2,2}-b_{2,1}*a_{2,2})*{e2,e3}+(-a_{2,1}*b_{2,3}+b_{2,1}*a_{2,3})*{e1,e3}+
(a_{2,2}*b_{2,3}-b_{2,2}*a_{2,3})*{e1,e2}
```

now compare the two sides of the equation

```
(%i30) lhs:M1-M2$
       rhs:B1-B2$
       is(equal(lhs,rhs))$
       ldisplay(lhs,rhs,%)$

 (%t33)/R/ lhs=(-2*a_{2,1}*b_{2,2}+2*b_{2,1}*a_{2,2})*{e2,e3}+(2*a_{2,1}*b_{2,3}-2*b_{2,1}*a_{2,3})*{e1,e3}
+(-2*a_{2,2}*b_{2,3}+2*b_{2,2}*a_{2,3})*{e1,e2}
 (%t34)/R/ rhs=(-2*a_{2,1}*b_{2,2}+2*b_{2,1}*a_{2,2})*{e2,e3}+(2*a_{2,1}*b_{2,3}-2*b_{2,1}*a_{2,3})*{e1,e3}
+(-2*a_{2,2}*b_{2,3}+2*b_{2,2}*a_{2,3})*{e1,e2}
 (%t35) %=true
```