LAGA_chapter06.01.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

Canonical Bases

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

Initialization

```
(%i28) 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

Exercise 6.1
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Express a geometric product in terms of a canonical basis

use the blade (basis) tilda products to form the the multivector factors
and then use the ampersand (multivector) product;

```
(%i12) M1:3+4*{e1}~*{e2}+{e1}~*{e2}~*{e3}$
       M2:{e2}-5*{e2}~*{e3}$
       M:M1&*M2$
       ldisplay(M)$
```

(%t15)/R/ M=-15*{e2,e3}+3*{e2}-21*{e1,e3}+9*{e1}

or without using the blade (basis) tilda products and using the sets of base
vectors themselves that constitute our canonical basis, giving the same result;

```
(%i16) M1:3+4*{e1,e2}+{e1,e2,e3}$
       M2:{e2}-5*{e2,e3}$
       M:M1&*M2$
       ldisplay(M)$
```

(%t19)/R/ M=-15*{e2,e3}+3*{e2}-21*{e1,e3}+9*{e1}

Exercise 6.4
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Express a particular 2-vector (bivector) as a 2-vector in the canonical basis

```
(%i20) f1:({e1}-{e2})/sqrt(2)$
       f2:({e1}+{e2})/sqrt(2)$
       f3:{e3}$
       fbv:f1&*f2+sqrt(2)*f1&*f3$
       ldisplay(fbv)$
```

(%t24)/R/ $fbv=-\frac{(\{e2,e3\}-\{e1,e3\})*\sqrt{2}^2-2*\{e1,e2\}}{\sqrt{2}^2}$

display this clearly as a 2-vector in the canonical basis

```
(%i25) fpprintprec:4$
       f:expand(ev(fbv,numer))$
       ldisplay(f)$
```

(%t27) f=-1.0*{e2,e3}+1.0*{e1,e3}+1.0*{e1,e2}

Created with wxMaxima.