LAGA_chapter07.03theorem7.07.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

Reflect in the geometric algebra, G4
Theorem 7.7 is needed for the sections: Reflect Vectors and Reflect Blades

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

Initialization

(%i45)
```
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,e4}$
Pvar:listofvars(Pseudos)$
Plen:length(Pvar)$
I:Pseudos$
ni:(Plen-1)*Plen/2$
Ii:(-1)^ni*I$
kill(ni)$
ldisplay(Pvar)$
```

(%t8) $Pvar=[e1,e2,e3,e4]$

(%i9)
```
batchload("initialize_lsts")$
```

(%t9) $lstblds=[[\{e1\},\{e2\},\{e3\},\{e4\}],[\{e1,e2\},\{e1,e3\},\{e1,e4\},\{e2,e3\},\{e2,e4\},\{e3,e4\}],[\{e1,e2,e3\},\{e1,e2,e4\},\{e1,e3,e4\},\{e2,e3,e4\}],[\{e1,e2,e3,e4\}]]$

(%t10) $allblds=[\{e1\},\{e2\},\{e3\},\{e4\},\{e1,e2\},\{e1,e3\},\{e1,e4\},\{e2,e3\},\{e2,e4\},\{e3,e4\},\{e1,e2,e3\},\{e1,e2,e4\},\{e1,e3,e4\},\{e2,e3,e4\},\{e1,e2,e3,e4\}]$

(%t11) $invblds=[\{e1\},\{e2\},\{e3\},\{e4\},-\{e1,e2\},-\{e1,e3\},-\{e1,e4\},-\{e2,e3\},-\{e2,e4\},-\{e3,e4\},-\{e1,e2,e3\},-\{e1,e2,e4\},-\{e1,e3,e4\},-\{e2,e3,e4\},\{e1,e2,e3,e4\}]$

end of Initialization

Theorem 7.7
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form the vector, a in G4

(%i12)
```
lstga:[1]$
namea:"a"$
makelistgrademv(namea,lstga)$
ldisplay(a)$
```

(%t15) $a=a_{1,4}*\{e4\}+a_{1,3}*\{e3\}+a_{1,2}*\{e2\}+a_{1,1}*\{e1\}$

for j=3 in G4, form the j-blade, A

(%i16)
```
j:3$
lstgA:[j]$
nameA:"A"$
makelistgrademv(nameA,lstgA)$
ldisplay(A)$
```

(%t20) $A=a_{3,4}*\{e2,e3,e4\}+a_{3,3}*\{e1,e3,e4\}+a_{3,2}*\{e1,e2,e4\}+a_{3,1}*\{e1,e2,e3\}$

form the two geometric products

(%i21)
```
G1:facsum(a&*A,allblds)$
G2:facsum(A&*a,allblds)$
ldisplay(G1,G2)$
```

(%t23) $G1=(a_{1,2}*a_{3,4}+a_{1,1}*a_{3,3})*\{e3,e4\}-(a_{1,3}*a_{3,4}-a_{1,1}*a_{3,2})*\{e2,e4\}+(a_{1,4}*a_{3,4}+a_{1,1}*a_{3,1})*\{e2,e3\}-(a_{1,3}*a_{3,3}+a_{1,2}*a_{3,2})*\{e1,e4\}+(a_{1,4}*a_{3,3}-a_{1,2}*a_{3,1})*\{e1,e3\}+(a_{1,1}*a_{3,4}-a_{1,2}*a_{3,3}+a_{1,3}*a_{3,2}-a_{1,4}*a_{3,1})*\{e1,e2,e3,e4\}+(a_{1,4}*a_{3,2}+a_{1,3}*a_{3,1})*\{e1,e2\}$

(%t24) $G2=(a_{1,2}*a_{3,4}+a_{1,1}*a_{3,3})*\{e3,e4\}-(a_{1,3}*a_{3,4}-a_{1,1}*a_{3,2})*\{e2,e4\}+(a_{1,4}*a_{3,4}+a_{1,1}*a_{3,1})*\{e2,e3\}-(a_{1,3}*a_{3,3}+a_{1,2}*a_{3,2})*\{e1,e4\}+(a_{1,4}*a_{3,3}-a_{1,2}*a_{3,1})*\{e1,e3\}-(a_{1,1}*a_{3,4}-a_{1,2}*a_{3,3}+a_{1,3}*a_{3,2}-a_{1,4}*a_{3,1})*\{e1,e2,e3,e4\}+(a_{1,4}*a_{3,2}+a_{1,3}*a_{3,1})*\{e1,e2\}$

Eq.(7.13), the sum of six bivectors in G4

(%i25)
```
lhs:facsum(a&.A,allblds)$
1/2*(G1-(-1)^j*G2)$
rhs:facsum(%,allblds)$
is(equal(lhs,rhs))$
ldisplay(%,lhs)$
```

(%t29) $\%=true$

(%t30) $lhs=(a_{1,2}*a_{3,4}+a_{1,1}*a_{3,3})*\{e3,e4\}-(a_{1,3}*a_{3,4}-a_{1,1}*a_{3,2})*\{e2,e4\}+(a_{1,4}*a_{3,4}+a_{1,1}*a_{3,1})*\{e2,e3\}-(a_{1,3}*a_{3,3}+a_{1,2}*a_{3,2})*\{e1,e4\}+(a_{1,4}*a_{3,3}-a_{1,2}*a_{3,1})*\{e1,e3\}+(a_{1,4}*a_{3,2}+a_{1,3}*a_{3,1})*\{e1,e2\}$

Eq.(7.14), a multiple of the pseudoscalar in G4

(%i31)
```
lhs:facsum(a&^A,allblds)$
1/2*(G1+(-1)^j*G2)$
rhs:facsum(%,allblds)$
is(equal(lhs,rhs))$
ldisplay(%,lhs)$
```

(%t35) $\%=true$

(%t36) $lhs=(a_{1,1}*a_{3,4}-a_{1,2}*a_{3,3}+a_{1,3}*a_{3,2}-a_{1,4}*a_{3,1})*\{e1,e2,e3,e4\}$