LAGA_chapter04.03.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

Coordinates and the inner product

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

Initialization

```
(%i1) 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

LAGA examples
Chapter 4.3

let the left and right sides of an equation have values lhs and rhs

Exercise 4.14 (Polarization identity)
page 58

```
(%i12) ub:u1*{e1}+u2*{e2}+u3*{e3}$
       vb:v1*{e1}+v2*{e2}+v3*{e3}$
       lhs:ub&.vb$
       rhs:1/2*((ub+vb)&.(ub+vb)-(ub&.ub)-(vb&.vb))$
       is(equal(lhs,rhs))$
       ldisplay(lhs,rhs,%)$
```

$$(\%t17)/R/\ lhs=v3*u3+v2*u2+v1*u1$$
$$(\%t18)/R/\ rhs=u3*v3+u2*v2+u1*v1$$
$$(\%t19)\ \%=true$$

Theorem 4.12 (Pythagorean theorem)
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if ub and vb are orthogonal then ub&.vb=0 and so lhs=0, giving the result

```
(%i20) lhs:(ub+vb)&.(ub+vb)-(ub&.ub)-(vb&.vb)$
       rhs:2*ub&.vb$
       is(equal(lhs,rhs))$
       ldisplay(lhs,rhs,%)$
```

$$(\%t23)/R/\ lhs=2*u3*v3+2*u2*v2+2*u1*v1$$
$$(\%t24)/R/\ rhs=2*v3*u3+2*v2*u2+2*v1*u1$$
$$(\%t25)\ \%=true$$

Exercise 4.16 (Parallelogram identity)
page 58

```
(%i26) ub:u1*{e1}+u2*{e2}+u3*{e3}$
       vb:v1*{e1}+v2*{e2}+v3*{e3}$
       lhs:(ub+vb)&.(ub+vb)+(ub-vb)&.(ub-vb)$
       rhs:2*(ub&.ub)+2*(vb&.vb)$
       is(equal(lhs,rhs))$
       ldisplay(lhs,rhs,%)$
```

$$(\%t31)/R/\ lhs=2*v3^2+2*v2^2+2*v1^2+2*u3^2+2*u2^2+2*u1^2$$
$$(\%t32)/R/\ rhs=2*u3^2+2*u2^2+2*u1^2+2*v3^2+2*v2^2+2*v1^2$$
$$(\%t33)\ \%=true$$