```
def basic_multivector_operations_3D():
    Print_Function()
    (g3d,ex,ey,ez) = Ga.build('e*x|y|z')
    print 'g_{ij} =',g3d.g
    A = g3d.mv('A','mv')
    A.Fmt(1,'A')
    A.Fmt(2,'A')
    A.Fmt(3,'A')
    A.even().Fmt(1,'%A_{+}')
    A.odd().Fmt(1,'%A_{-}')
    X = g3d.mv('X','vector')
    Y = g3d.mv('Y','vector')
    X.Fmt(1,'X')
    Y.Fmt(1,'Y')
    (X*Y).Fmt(2,'X*Y')
    (X^Y).Fmt(2,'X^Y')
    (X|Y).Fmt(2,'X|Y')
    return
```

Code Output:

$$g_{ij} = \begin{bmatrix} (e_x \cdot e_x) & (e_x \cdot e_y) & (e_x \cdot e_z) \\ (e_x \cdot e_y) & (e_y \cdot e_y) & (e_y \cdot e_z) \\ (e_x \cdot e_z) & (e_y \cdot e_z) & (e_z \cdot e_z) \end{bmatrix}$$

$$A = A + A^{x} e_{x} + A^{y} e_{y} + A^{z} e_{z} + A^{xy} e_{x} \wedge e_{y} + A^{xz} e_{x} \wedge e_{z} + A^{yz} e_{y} \wedge e_{z} + A^{xyz} e_{x} \wedge e_{y} \wedge e_{z}$$

$$\begin{aligned} A =& A \\ &+ A^{x} e_{x} + A^{y} e_{y} + A^{z} e_{z} \\ &+ A^{xy} e_{x} \wedge e_{y} + A^{xz} e_{x} \wedge e_{z} + A^{yz} e_{y} \wedge e_{z} \\ &+ A^{xyz} e_{x} \wedge e_{y} \wedge e_{z} \end{aligned}$$

$$\begin{aligned} A =& A \\ &+ A^{x} e_{x} \\ &+ A^{y} e_{y} \\ &+ A^{z} e_{z} \\ &+ A^{xy} e_{x} \wedge e_{y} \\ &+ A^{xz} e_{x} \wedge e_{z} \\ &+ A^{yz} e_{y} \wedge e_{z} \\ &+ A^{xyz} e_{x} \wedge e_{y} \wedge e_{z} \end{aligned}$$

$$A_{+} = A + A^{xy} e_{x} \wedge e_{y} + A^{xz} e_{x} \wedge e_{z} + A^{yz} e_{y} \wedge e_{z}$$

$$A_{-} = A^{x} e_{x} + A^{y} e_{y} + A^{z} e_{z} + A^{xyz} e_{x} \wedge e_{y} \wedge e_{z}$$

$$X = X^{x} e_{x} + X^{y} e_{y} + X^{z} e_{z}$$

$$Y = Y^{x} e_{x} + Y^{y} e_{y} + Y^{z} e_{z}$$

$$\begin{aligned} XY =& \left(X^{x} Y^{x} \left(e_{x} \cdot e_{x}\right) + X^{x} Y^{y} \left(e_{x} \cdot e_{y}\right) + X^{x} Y^{z} \left(e_{x} \cdot e_{z}\right) + X^{y} Y^{x} \left(e_{x} \cdot e_{y}\right) + X^{y} Y^{y} \left(e_{y} \cdot e_{y}\right) + X^{y} Y^{z} \left(e_{y} \cdot e_{z}\right) + X^{z} Y^{x} \left(e_{x} \cdot e_{z}\right) + X^{z} Y^{y} \left(e_{y} \cdot e_{z}\right) + X^{z} Y^{z} \left(e_{z} \cdot e_{z}\right)\right) \\ &+ \left(X^{x} Y^{y} - X^{y} Y^{x}\right) e_{x} \wedge e_{y} + \left(X^{x} Y^{z} - X^{z} Y^{x}\right) e_{x} \wedge e_{z} + \left(X^{y} Y^{z} - X^{z} Y^{y}\right) e_{y} \wedge e_{z} \end{aligned}$$

$$X \wedge Y = \left(X^{x} Y^{y} - X^{y} Y^{x}\right) e_{x} \wedge e_{y} + \left(X^{x} Y^{z} - X^{z} Y^{x}\right) e_{x} \wedge e_{z} + \left(X^{y} Y^{z} - X^{z} Y^{y}\right) e_{y} \wedge e_{z}$$

$$X \cdot Y = X^{x} Y^{x} \left(e_{x} \cdot e_{x}\right) + X^{x} Y^{y} \left(e_{x} \cdot e_{y}\right) + X^{x} Y^{z} \left(e_{x} \cdot e_{z}\right) + X^{y} Y^{x} \left(e_{x} \cdot e_{y}\right) + X^{y} Y^{y} \left(e_{y} \cdot e_{y}\right) + X^{y} Y^{z} \left(e_{y} \cdot e_{z}\right) + X^{z} Y^{x} \left(e_{x} \cdot e_{z}\right) + X^{z} Y^{y} \left(e_{y} \cdot e_{z}\right) + X^{z} Y^{z} \left(e_{z} \cdot e_{z}\right)$$

```
def basic_multivector_operations_2D():
    Print_Function()
    (g2d,ex,ey) = Ga.build('e*x|y')
    print 'g_{ij} =',g2d.g
    X = g2d.mv('X','vector')
    A = g2d.mv('A','spinor')
    X.Fmt(1,'X')
    A.Fmt(1,'A')
    (X|A).Fmt(2,'X|A')
    (X<A).Fmt(2,'X<A')
    (A>X).Fmt(2,'A>X')
    return
```

Code Output:

$$g_{ij} = \begin{bmatrix} (e_x \cdot e_x) & (e_x \cdot e_y) \\ (e_x \cdot e_y) & (e_y \cdot e_y) \end{bmatrix}$$

$$X = X^{x} e_{x} + X^{y} e_{y}$$

$$A = A + A^{xy} e_{x} \wedge e_{y}$$

$$X \cdot A = -A^{xy} \left(X^{x} \left(e_{x} \cdot e_{y} \right) + X^{y} \left(e_{y} \cdot e_{y} \right) \right) e_{x} + A^{xy} \left(X^{x} \left(e_{x} \cdot e_{x} \right) + X^{y} \left(e_{x} \cdot e_{y} \right) \right) e_{y}$$

$$X \rfloor A = \left(A X^{x} - A^{xy} X^{x} \left(e_{x} \cdot e_{y} \right) - A^{xy} X^{y} \left(e_{y} \cdot e_{y} \right) \right) e_{x} + \left(A X^{y} + A^{xy} X^{x} \left(e_{x} \cdot e_{x} \right) + A^{xy} X^{y} \left(e_{x} \cdot e_{y} \right) \right) e_{y}$$

$$A \lfloor X = \left(A X^{x} + A^{xy} X^{x} \left(e_{x} \cdot e_{y} \right) + A^{xy} X^{y} \left(e_{y} \cdot e_{y} \right) \right) e_{x} + \left(A X^{y} - A^{xy} X^{x} \left(e_{x} \cdot e_{x} \right) - A^{xy} X^{y} \left(e_{x} \cdot e_{y} \right) \right) e_{y}$$