

Mathematics 1262 (C++ Programming) Hilary 2014

Sixth assignment, due 14/3/14

This assignment spans two weeks. Complete and test the code for the following class

```
typedef class Quaternion {
public:
    Quaternion ();
        // should set w=x=y=z=0
    Quaternion ( double ww, double xx, double yy, double zz);
    Quaternion product ( Quaternion other );
    Quaternion inverse();
    void print ();

    double w, x, y, z;
} Quaternion;
```

Quaternion multiplication boils down to

$$(\alpha, \beta, \gamma, \delta)(w, x, y, z) = \\ (\alpha w - \beta x - \gamma y - \delta z, \\ \alpha x + \beta w + \gamma z - \delta y, \\ \alpha y - \beta z + \gamma w + \delta x, \\ \alpha z + \beta y - \gamma x + \delta w).$$

The input should be like in the following file `conj`:

```
.8660254 .2886751 .2886751 .2886751 1 0 0
.8660254 .2886751 .2886751 .2886751 0 1 0
```

The input comes in groups of 7: call them w, x, y, z, a, b, c . Your program should interpret (w, x, y, z) as a quaternion q , and x, y, z as a vector in $\mathbb{R}^3$, so $(0, x, y, z)$ is a quaternion v : it should compute the conjugate

$$qvq^{-1}$$

More than that, it should produce the following kind of output

```
Quaternion q (0.866025, 0.288675, 0.288675, 0.288675)
Inverse (0.866025, -0.288675, -0.288675, -0.288675)
Vector (0, 1, 0, 0)
Conjugated (-2.00306e-17, 0.666667, 0.666667, -0.333333)
```

```
Quaternion q (0.866025, 0.288675, 0.288675, 0.288675)
Inverse (0.866025, -0.288675, -0.288675, -0.288675)
Vector (0, 0, 1, 0)
Conjugated (-2.00374e-17, -0.333333, 0.666667, 0.666667)
```

(qvq^{-1} should have zero real part. The numbers with e-17 in them are nonzero due to rounding error.)

Note about constructors. If your code includes a declaration like

```
Quaternion q;
```

q will be initialised using the constructor `Quaternion::Quaternion()` (with no arguments). You could also write

```
Quaternion p1 = Quaternion(), p2,
p3(1,2,3,4), p4=Quaternion(4,3,2,1);

p1.print();
p2.print();
p3.print();
p4.print();
```

producing output

```
(0, 0, 0, 0)
(0, 0, 0, 0)
(1, 2, 3, 4)
(4, 3, 2, 1)
```
