CONTENTS

VQS - DEFINITIONS

$$Let\ T = [v, q, s] = [position, quaterion, scale]$$

$$data\ types = [vector\ 3, quaterion, vector3]$$

OPERATORS

$$Let\ r = vector3, \quad Let\ T_1 = [v, q, s], \quad T_2 = [u, p, t], \quad T_n[\dots]\dots$$

ADDITION AND SUBTRATION

$$T_2 \pm T_1 = [u, p, t] \pm [v, q, s] = [u \pm v, p \pm q, t \pm s]$$

IDENTITY

$$I = [\ vector3(0,0,0), \quad quaterion(0,0,0,1), \quad vector3(1,1,1)]$$

INVERSE

$$T_1^{-1} = [q^{-1}(s^{-1} * -v)q, \quad q^{-1}, \quad s^{-1}] = [q^{-1}(s^{-1} * -v)q, \quad quaterion(-x,-y,-z,w), \quad vector3\left(\frac{1}{x},\frac{1}{y},\frac{1}{z}\right)]$$

$$T_1 T_1^{-1} = IT = T_1^{-1} T$$

MULTIPLICATION WITH VECTOR/POINT

$$T_1 * r = [v, q, s] * r = q(s * r)q^{-1} + v$$

$$T_1^{-1} * r == [q^{-1}(s^{-1} * -v)q, \quad quaterion(-x,-y,-z,w), \quad vector3\left(\frac{1}{x},\frac{1}{y},\frac{1}{z}\right)] = q^{-1}(s^{-1} * r)q + q^{-1}(s^{-1} * -v)q$$

CONCATENATION

$$T_2(T_1 * r) = (T_2 T_1) * r = [u, p, t][v, q, s]r$$

$$= \big[[u, p, t]v, pq, ts\big] * r$$

$$= [p(tv)p^{-1} + u, \quad pq, \quad ts] * r$$

Prove (hard to observe? Observe again):

$$T_2(T_1 * r) = (T_2 T_1) * r = [u, p, t][v, q, s]r$$

$$= [u, p, t]\ (q(sr)q^{-1} + v)\ = p\big(t(q(sr)q^{-1} + v)\big)p^{-1} + u$$

$$= p(q(tsr)q^{-1} + tv))p^{-1} + u\ , \quad (multiply\ by\ t)$$

$$= pq(tsr)q^{-1}p^{-1} + (p(tv)p^{-1} + u),$$

$$= [p(tv)p^{-1} + u, \quad pq, \quad ts] * r,$$

$$= \big[[u, p, t]v, pq, ts\big] * r$$