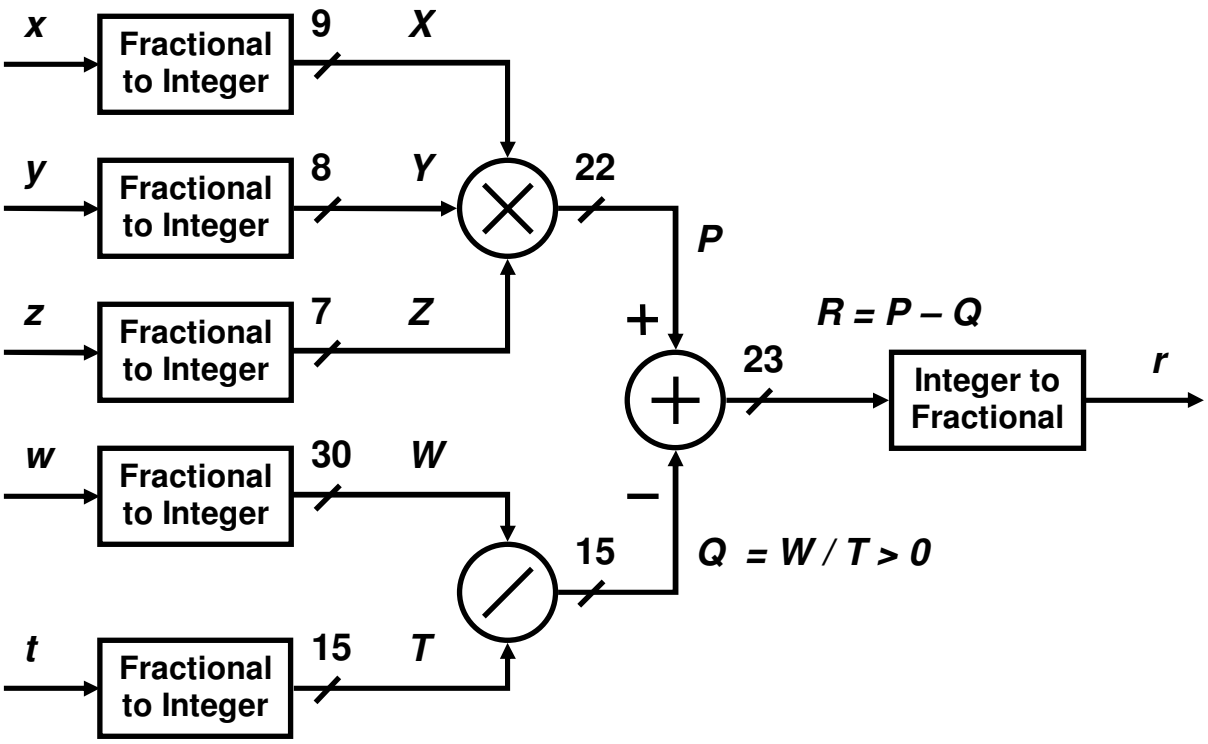
Fixed-point arithmetic

Assume the structure below in which

$-0.25 < x < +0.25$, $-1.0 \leq y \leq +1.0$, $-1.0 < z < +1.0$, $0 \leq w \leq +0.5$, $0 < t < +1.0$



The circuit performs as follows.

- First, a conversion from fractional representation to integer representation is carried out (capital letters signify integer values).
- Then ***X***, ***Y***, and ***Z*** are multiplied together. The product ***P*** is represented over a 22-bit signed field.
- ***W*** is divided by ***T***. The quotient ***Q*** is represented over a 15-bit unsigned integer. Note, the quotient ***Q*** is set to $\mathbf{7FFF_h}$ on overflow.
- ***Q*** is subtracted from ***P*** to yield a 17-bit signed integer ***R***.
- Finally, a conversion from integer representation to fractional representation is carried out.

1. Assuming that the fractional-to-integer conversions are performed to ensure the highest numerical accuracy over the considered fields, specify the scale factors which ***x***, ***y***, ***z***, ***w***, and ***t*** are multiplied with
2. Assuming $x = -0.22$, $y = 1.0$, $z = -0.95$, $w = 0.33$, and $t = 0.6$, compute the integers ***X***, ***Y***, ***Z***, ***W***, ***T***, ***P***, ***Q***, and ***R***. Assume von Neumann rounding
3. Perform the final integer-to-fractional conversion and provide the value of ***r***