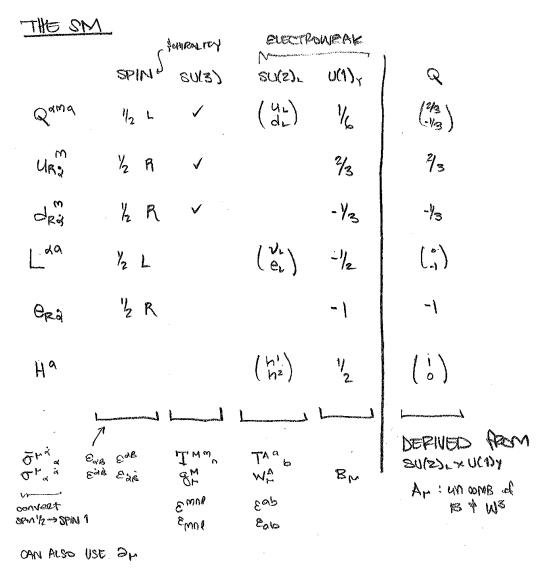
## Short HW 6: Index structure of fundamental interactions

Course: Physics 165, Introduction to Particle Physics (2022)

INSTRUCTOR: Prof. Flip Tanedo (flip.tanedo@ucr.edu)

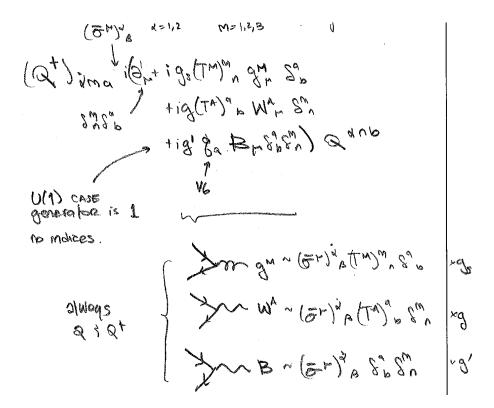
Due by: **Thursday**, May 5

In class on Tuesday we wrote out all of the particles in the Standard Model in all of their indexed glory:



## 1 Interactions of matter with fundamental forces

Write out the index structure for the fundamental vertex for each Standard Model fermion (the spin-1/2 particles): Q,  $u_R$ ,  $d_R$ , L,  $e_R$  (the 'Qudle' or 'cuddly' particles). For example, for the quark doublet, Q, we wrote in class that the covariant derivative  $iQ^{\dagger}\bar{\sigma}^{\mu}D_{\mu}Q$  gives:



Write out the interactions and index structure of the other four fermions with the SU(3), SU(2), and U(1) gauge bosons (the gluon, the Ws, and the hypercharge boson). You should use the appropriate SU(N) and spin tensors that are available (listed on the first page).