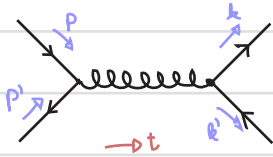**1**　Consider the following Feynman diagram:

Where the fermions are in the fundamental representation of SU(N) and the propagator in the s channel is the Gauge boson. Calculate:

$$\frac{1}{Avg}\sum |\mathcal{M}|^2$$

The sum is over all the appropriate quantum numbers for initial and final states. Determine what is the value of "Avg" so that we are averaging over the states of the initial states.

(Tip: at some point the answer will be in terms of the trace of gamma matrices, no need to go beyond that point. The traces should be the same obtained in electron-positron annihilation - see QFT 1 lecture notes, eq. 207.1 - the only change is the factor outside the traces.)

2　Optional exercise: if you are willing to practice SU(3) algebra, try to write one or two diagrams involving gluons in the initial/final states, using the tri-linear or quartic couplings and obtain $\mathcal{M}$ (no need to go for $|\mathcal{M}|^2$, but you should figure out what sums and averages would be needed)