$\rightarrow$ ex1.frm

Exercise 1

Evaluate $$q_\mu \frac{\partial}{\partial q_\mu} T_1(n_1, n_2, n_3, n_4, n_5)$$

for various values of $n_1, \ldots, n_5$

using the routine t1.frm (in MINCER/)

1) On paper, choose a routing for q through T_1 (
2) Find the operator $(1^\pm, 2^\pm, \ldots)$ relation:

$$q_\mu \frac{\partial}{\partial q_\mu} T_1(\ldots) = [\cdots 1^+ \cdots 2^- 4^+ \cdots] T_1(\ldots)$$

3) Implement this relation into t1.frm

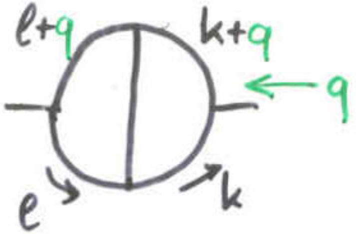
$$\text{L dia} = \cdots I(n_1+1, n_2, \cdots) + \cdots I(n_1, n_2, n_3-1, \cdots) + \cdots$$

4) Could you derive the result without comp. algebra?

5) Choose a different routing for q

6) Try 3-loop.

Solution to Exercise 1 (1)



$$= \int dk\, d\ell \, \frac{1}{[(\ell+q)^2]^{n_1}[(k+q)^2]^{n_2}[k^2]^{n_3}[\ell^2]^{n_4}[(k-\ell)^2]^{n_5}} \equiv I$$

$$q_\mu \frac{\partial}{\partial q_\mu} \frac{1}{[(\ell+q)^2]^{n_1}} = -2n_1 \frac{1}{[(\ell+q)^2]^{n_1+1}} \{ q\cdot(\ell+q) \}$$

$$= -\frac{n_1}{[(\ell+q)^2]^{n_1+1}_{\nwarrow 1^+}} \{ 2q^2 + \underbrace{(\ell+q)^2}_{1^-} - \underbrace{\ell^2}_{4^-} - q^2 \}$$

$$q_\mu \frac{\partial}{\partial q_\mu} \frac{1}{[(k+q)^2]^{n_2}} = -\frac{n_2}{[(k+q)^2]^{n_2+1}_{\nwarrow 2^+}} \{ q^2 + \underbrace{(k+q)^2}_{2^-} - \underbrace{k^2}_{3^-} \}$$

$$\Rightarrow q_\mu \frac{\partial}{\partial q_\mu} I = \left[-n_1 \left(q^2\, 1^+ + 1 - 1^+ 4^- \right) - n_2 \left(q^2\, 2^+ + 1 - 2^+ 3^- \right) \right] I$$

Solution to Exercise 1 (2)

- mass dim of I: $\underbrace{2 \cdot D}_{\text{loop integr.}} - \underbrace{2 \cdot (n_1 + \cdots + n_5)}_{\text{propagators}}$

only dimensional parameter: q^2

$$\Rightarrow \quad I \sim (q^2)^{D - n_1 - \cdots - n_5}$$

$$\Rightarrow \quad q_\mu \frac{\partial}{\partial q_\mu} I = 2(D - n_1 - \cdots - n_5) \cdot I$$

Exercise

Using AIR, calculate $T_1(2,1,1,1,1)$
by modifying script_T1.map
and check_T1.map

Compare the result to MINCER using t1.frm.

While AIR runs, watch the calc.map file.