Exercise 4

1. Using

$$V^a = \theta\sigma^\mu\bar{\theta}A^a_\mu + \theta^2\bar{\theta}\lambda^{\dagger a} + \bar{\theta}^2\theta\lambda^a + \frac{1}{2}\theta^2\bar{\theta}^2 D^a \ , \tag{1}$$

perform the superspace integration for the term

$$\mathcal{L} = \int d^4\theta \, (\bar{D}_{\dot{\alpha}}\bar{D}^{\dot{\alpha}}V^a)(D^\alpha D_\alpha V^a) \ . \tag{2}$$

Hint: if you are having trouble look at Wess and Bagger.

2. For a SUSY gauge theory with a single chiral superfield, and renormalizable interactions find the soft SUSY breaking terms that are produced by giving θ^2 spurion components to the background chiral superfields corresponding to the mass and Yukawa coupling,

$$\tilde{m} = m + \theta^2 F_m \ , \tag{3}$$
$$\tilde{y} = y + \theta^2 F_y \ , \tag{4}$$

the coefficient of $W_\alpha W^\alpha$,

$$\tilde{\tau} = \tau + \theta^2 M_\lambda \ , \tag{5}$$

and the wavefunction renormalization:

$$Z = 1 + b\,\theta^2 + b^*\bar{\theta}^2 + c\,\theta^2\bar{\theta}^2 \ . \tag{6}$$

Write the soft SUSY breaking terms as functions of F_m, F_y, M_λ, b, and c.

3. Evaluate the crossed bird-track diagram: