Homework 2

1. Consider the Euclidean field theory with $N$ real scalar fields $\phi_i$ with Lagrangian density

$$\mathcal{L} = \frac{1}{2} \partial_\mu \phi_i \partial_\mu \phi_i + \frac{1}{2} m^2 \phi_i \phi_i + \frac{\lambda}{4} (\phi_i \phi_i)^2.$$ 

(a) Calculate $\gamma_m(\lambda)$ and $\beta(\lambda)$ to lowest order in perturbation theory.

(b) What is the location of the Wilson-Fisher fixed point in $4 - \epsilon$ dimensions?

(c) What is the value of the critical exponent $\nu$ in this theory in $d = 3$, to lowest order in the epsilon expansion?

2. Questions abcde in Problem 1 from Silviu Pufu’s lectures at the Sao Paulo bootstrap school, http://bootstrap.ictp-saifr.org/school

3. Srednicki problems 51.1 and 52.2 (loops in Yukawa theory).