Homework assignment 2: Green functions at zero temperature (Chapter 7 from Coleman' textbook)

- Problem 1.

  Starting from the definitions derive the unperturbed electron and phonon propagators at zero temperature.

- Problem 2. Calculate the Hartree-Fock self energy of interacting Fermi gas and find the effective mass of quasiparticles. Compare the cases of short-range (point) and long-range (Coulomb) interactions.

- Problem 3. Within Hartree-Fock approximation calculate the total energy of interacting Fermi gas. Find the energy dependence on the particle density in two particular cases:

  (a) Point attractive interaction $U(\boldsymbol{r}) = U_0 \delta(\boldsymbol{r})$ with $U_0 < 0$

  (b) Coulomb interaction $U(\boldsymbol{r}) = e^2/r$.