1. **The EOS of a free degenerate Fermi gas**
   — Calculate the pressure p and the energy density ε of a free Fermi gas of particles i of mass m_i as a function of the number density n_i.
   — Can this EOS be written in a polytropic form in the ultra-relativistic limit ($m_i = 0$) and in the non-relativistic limit $m_i \gg p_F$? A polytropic form reads

$$p = \kappa \rho^\gamma \ , \tag{1}$$

   where κ, γ are constants and $\rho = m_i n_i$ is the mass density.

2. **The Chandrasekhar mass**

   There are two ways to derive an approximate expression for the Chandrasekhar mass (limiting mass for a white dwarf in newtonian gravity). We will use here the argument put forward by Landau(1932) based on energetic considerations. Assume N ultra-relativistic fermions in a homogeneous sphere of radius R. The total energy is then $E = E_{int} + E_{grav}$.
   — Derive an expression for both contributions under the above assumptions as a function of N and R. In a white dwarf the mass is dominated by baryons, wheras the pressure is dominated by ultra-relativistic electrons. Introduce therefore $Y = N/N_B$, the ratio of the number of electrons and the number of baryons, to write the mass.
   — Both contributions are $\propto 1/R$. From the requirement that a stable equilibrium solution corresponds to a minimum of the energy, derive an expression for the maximum possible mass of a white dwarf.

3. **Monday afternoon : journal club session** For Monday's journal club session, please find below the references
   — Shapiro delay measurement of pulsar's mass in a NS-WD system, `https://arxiv.org/pdf/1010.5788`
   — Towards relativistic asteroseismology, `https://arxiv.org/pdf/gr-qc/9711088`
   — NS cooling as probe for nuclear superfluidity, `https://arxiv.org/pdf/1012.0045`
   — Universal relations, `https://arxiv.org/pdf/1303.1528`