Problem Set 0

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1. EQUIPARTITION THEOREM

One of my favorite equations is the Equipartition Theorem,

$$\langle \mathscr{H} \rangle = n\left(\frac{1}{2}k_B T\right) \tag{1}$$

which relates the total energy of a system to the average temperature of the system. In Eq. 1, n represents the degrees of freedom of a system. For example, a 3-dimensional system where a single particle is free to move throughout the system would have 3 degrees of freedom. If there was also a potential energy function acting on the particle in this 3-dimensional system, it would confer 3 additional degrees of freedom. Adding particles to the system also impacts the degrees of freedom.

A useful application of the Equipartition Theorem is in finding the heat capacity of a system at constant volume,

$$C_V = \left(\frac{\partial U}{\partial T}\right)_V \tag{2}$$

If the system is in thermal equilibrium, we can use the Equipartition Theorem to simplify Eq. 2 since the energy of the system has a linear dependence on temperature:

$$C_V = n\left(\frac{1}{2}k_B\right) \tag{3}$$

This result is relevant for certain applications in thermodynamics and condensed matter physics. The Equipartition Theorem holds a special place in my heart because despite its simplicity it has a broad scope of applications.

2. UNGRADED EXERCISES

- Complete all Unix tutorials on Moodle. (complete)
- Complete one LaTeX tutorial on Moodle and browse through the other. (complete)
- Complete github tutorials on Moodle. (complete)
- Install python on your computer. (complete)