**Heat Capacity**

**Heat Capacity via GL Free Energy**

We’ve more or less done a similar calculation in the context of Ferromagnetism in the Stat Mech folder. So let’s look at the GL Free energy (really action since haven’t minimized it yet).



Of course r = a(T-Tc) or something. We’ll specialize to zero field, and let’s say uniform ψ too,



Need to minimize Fs w/r to ψ0 to get the actual Free energy. So,



If r < 0, i.e., we’re below the critical temperature, then we have a non-zero solution. Otherwise not. So our solution is:



where the θ function enforces the inequality. If we plug this back into F, we get:



Now we’re in position to get the heat capacity, which is technically 0-field heat capacity.



And so near the critical point, which where our GL free energy is valid, we have:



Of course the total C would be obtained by adding the heat capacity of the normal metal. This is linear in T for small T. So we should get something like this overall,

