Quick course background

To gain a basic understanding of statistical and quantum mechanics, in 2013 I started teaching an alternate year graduate course in Statistical Thermodynamics. My learning experience is well-captured by Einstein in his review of Lorentz's Statistical Theories in Thermodynamics, ca 1916 [which Einstein liked]:

"Whoever has studied mathematical theories has had the following, embarrassing experience: he verifies every step in a deduction with diligence and eagerness, and at the end of his efforts he understands nothing. He did not get the guiding idea of the whole concept because the author himself suppressed it, either from an incapacity to phrase it concisely, or worse, from an almost comical coquettishness-as the insightful would say-which was especially popular in the past. This evil can only be overcome by unrestrained openness of the author, who should not shy away from familiarizing the reader even with his incomplete guiding ideas if they have furthered [p. 376] his own work. There is hardly a field in theoretical physics where this commandment is more difficult to fulfill than in statistical mechanics."

The situation, unfortunately, hasn't changed much. To gain functional, problem-solving understanding – and consistent with Einstein's view - an effective learning (and teaching) approach should, in my opinion, focus on developing simple arguments, detailed derivations and clear problem-solving strategies. Every intuitive, physically consistent argument that we can make builds our intuition and confidence as researchers.

Experts and students will find many errors but will also hopefully find a few non-traditional approaches and recipes for applying statistical mechanics to actual problems. I'm posting the notes as a (very) rough, still-developing guidebook that can hopefully ameliorate some of the confusion and frustration that still attends study of this beautiful (and powerful) subject.

Note: Most of the Spring 2023 notes were written out (and projected on a screen) during each lecture hour. Because I'm still a student, the notes are rough and sometimes repetitive.