* Pluto notebooks is jupyter notebook but any changes automatically update

* Looks at Dr. Watson Julia package

Drwatson

- makes reproducible systems that people can rerun to confirm results

- makes a git repo that can then be shared

* - Look into git.ignore cuz idk that

- Source: modules/ base code libraries

- Scripts: Actual things that is made

- can ~~include~~ make custom templates of projects

- Other neat features (Take a look on website.)

Dice

- The professors repo.

- Model is the main data structure.

- There are docstrings near each function.

* Look into Propogation source code.

- Don't write too much of your own code. Ask prof abt complicated functions, maybe they already exist.

* - Look out for example project.

- Providing types will make things easier

* - Look at Typst (blend of laTEX and Markdown)

- Adopt Typst conventions for math

- Latex & Typst compatibility

Things to do

- Play w/ Dr. Watson and try things out
- Organize links, papers and stuffs into Dr. Watson
- Look into keywords, quick ~~look~~ look, just get familiar w/ them DON'T SPEND TOO MUCH TIME on them RN!
- Do foundational Graph Theory (find on email)

|15+8i|
225+64=

cos 60 $\frac{1}{2}$

$\frac{1}{2}$+i

25+i

7+1 = 50
$5\sqrt{2}$

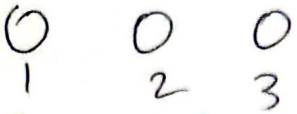
25-i
5+i

24
$2\sqrt{6}$

49-1
48
$4\sqrt{3}$

spins ↑↓

Keywords: Spin glasses, Frustration



↑ = +1
↓ = -1

* Take a look at them

Any config of spins is a spin config

$\underline{\sigma} = \{1, -1, 1\}$
1 2 3

Statistical physics deal w/ systems w/ lots of parts (like spins)

We no longer care abt individual info, rather statistical properties.

Partition function contains all info to compute statistical properties. And all observables can be represented by a statistical computation.

Generic view = we picked a random config

# of configs = 2^n
where n = # of spins

$P(\underline{\sigma}) = \frac{1}{2^N}$ ← Uniform distribution

Every config has equal chance of getting picked

Comes up a lot so thus we define it as this.

$Z = \frac{1}{\text{const.}} = \sum_{\underline{\sigma}} \exp(H(\underline{\sigma})/T)$

↳ parameterized as energy & Temp

3 spins = 8 config ↓ video

$H(\underline{\sigma}) = E(\vec{s})$
↑ (energy function)

$\sum_{\underline{\sigma}} P(\underline{\sigma}) = 1 \Rightarrow \sum_{\underline{\sigma}} \text{const.} \cdot e^{H(\underline{\sigma})/T} = 1$

$\text{Const.} = \frac{1}{\sum_{\underline{\sigma}} \exp(H(\underline{\sigma})/T)}$

↑↑ ← $E_{\uparrow\uparrow}$ ← higher energy

↑↓ ← $E_{\uparrow\downarrow}$ ← lower energy

Our case is anti-ferro magnetic

$T = k_B T$

The system is coupled to its parts

$P(\underline{\sigma}) = e^{\frac{-H(\underline{\sigma})}{T}} \cdot \text{const.}$

The probability of a config is dependent on temp and energy

This is anti-ferro magnetic, this will common throughout research time.

The opposite (all in sign is lower) is ferromagnetic.

Ex: magnetization

$$m = \sum_w \sigma_w$$

$$\langle m \rangle = \sum_w \langle \sigma_w \rangle = \sum_w$$

avg/expected value

$$\langle m \rangle = \frac{1}{Z^2} \frac{\partial}{\partial T} Z(T)$$

All statistical information/formula can be expressed as a combination of partition functions.

Keyword:

Shannon Information (Theory)

V Important for understanding

↳ One application:

Quantify how much info can be compressed

Limit of how much info can be transmitted or had.

Encryption, Quantification of such.

Foundational in encrypting & transmitting information.

Phase transition: Transition from one ~~state~~ general state to another. (Magnetization to non-magnetized)

h/magnetization question:

vector: entries matter at basis

scalar: Doesn't matter

To produce a true value, we need to mix up them to make a value that does not change with respect to our perspective.

With many formulas, this perspective with things that change combining to make things that do not is key to simplifying them.

Ex: Probability of a coin flip (on in general) should not change based on where you are.

Keyword

QUBO

Quadratic Unconstrained Binary Optimization Problem

← Read wikipedia article on this

Connected but large

Exception: Very limited # of results that will be used, but good many are useful to know of.

Ising & QUBO are different but not sure why.