Special Topic in Solid State Physics:
Machine Learning for Physical Scientists

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Communication Channel

- Announcement & Course Materials: https://github.com/TChotibut/ml-for-physical-scientists
- Announcement & Reminder: https://www.facebook.com/groups/1033694817095022

Attendance

- One-hour Zoom virtual meeting (discussion and Q&A): Monday 11.00 - Noon.
- Two one-hour video lectures per week.
- Hands-on workshop (from time to time)

Grading Scheme

- 50% Homework
- 20% Exam
- 30% Final Project and Presentation

Warning! This course is totally different from other physics courses you have taken!

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Standard Physics Course

Deduction

God-given Rules	→	Consequences
Newton's Laws		Periodic motions in our solar system
Maxwell's Equations		Light is electromagnetic waves
Schrodinger's Equation		Quantum tunneling, superposition,…
Quantum Field Theory		Scattering amplitude measured at LHC

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This Course

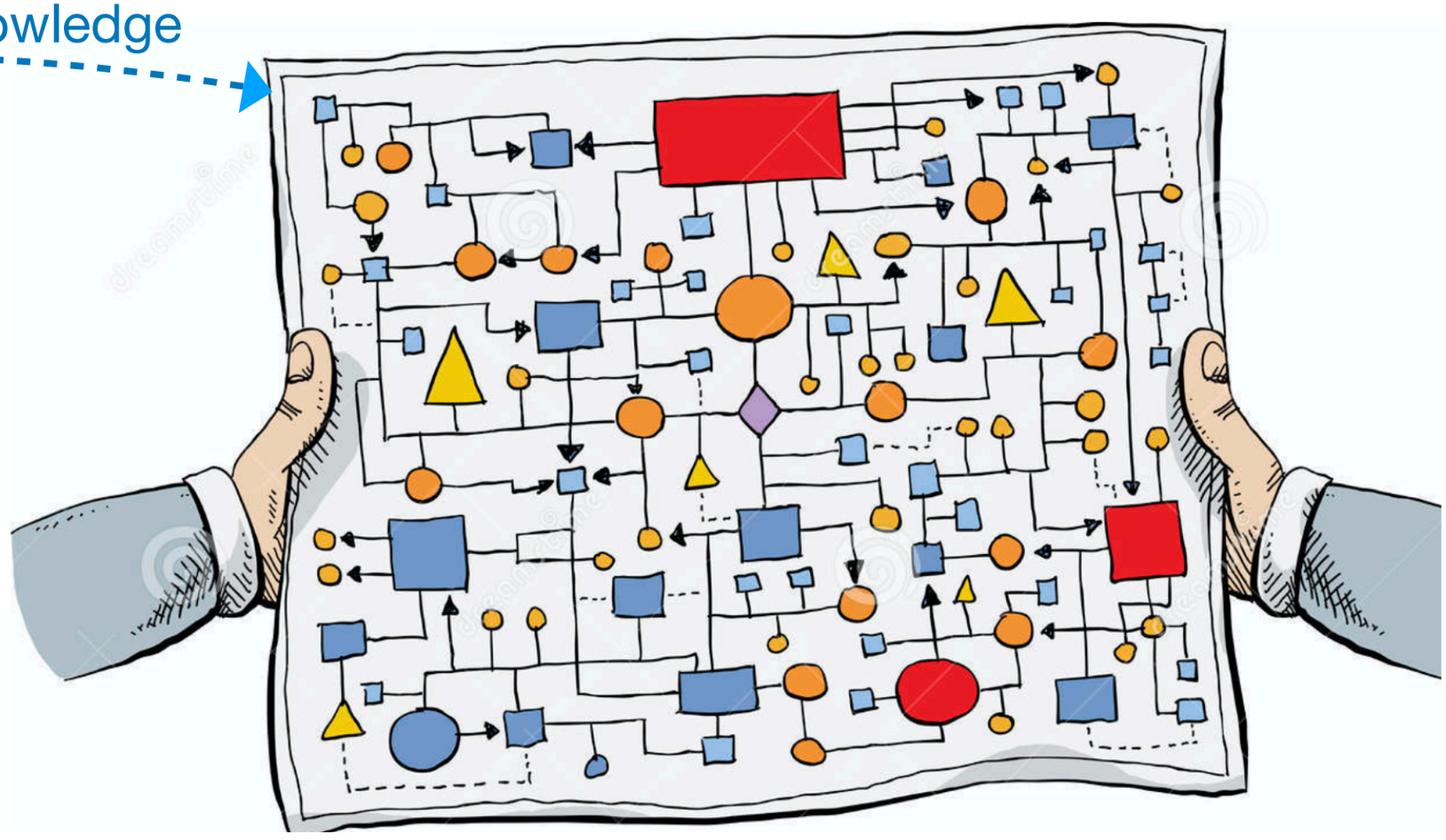
Inference/Learning

Rules or Patterns ← Lots of Data

Given tons of data, we'll learn how to identify their statistical patterns/rules, using modern computational methods of "*Machine Learning*".

Standard problem-solving methodology

domain knowledge



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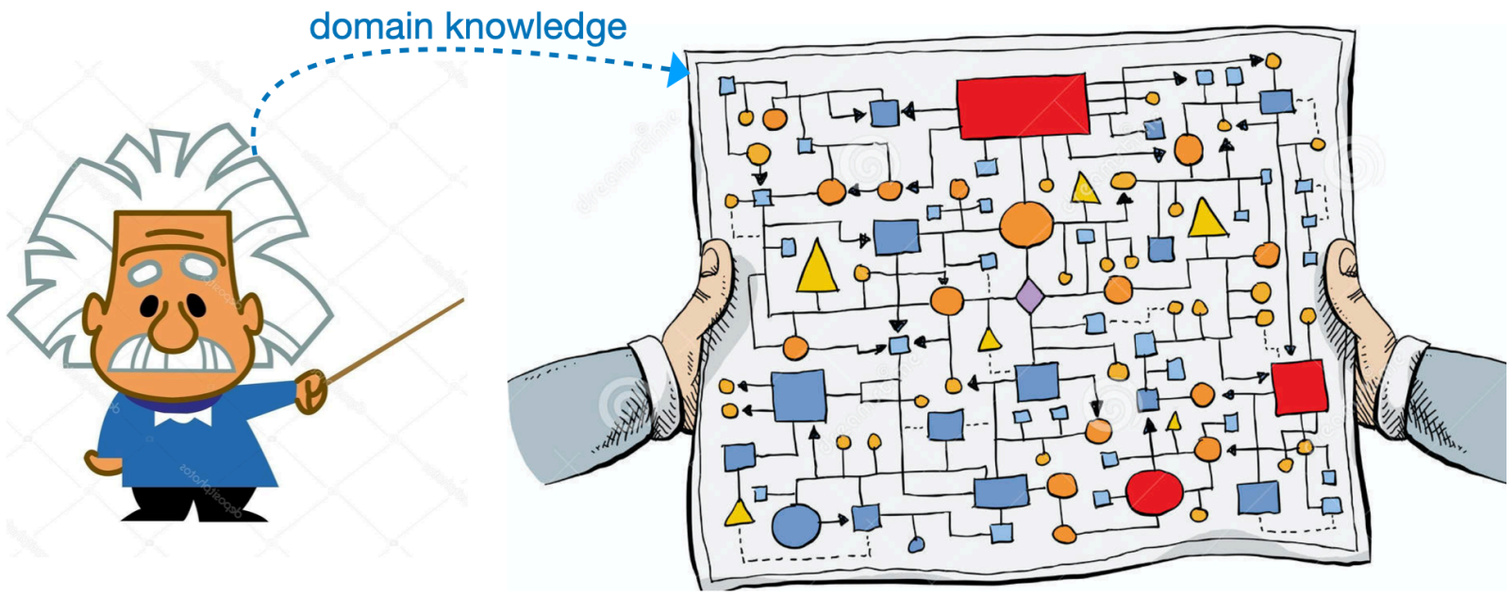

Pros

- Understandable
- Work well in many cases

Cons

- Some tasks are too complex to solve directly
- Some others are solvable, but require lengthy development cycles.

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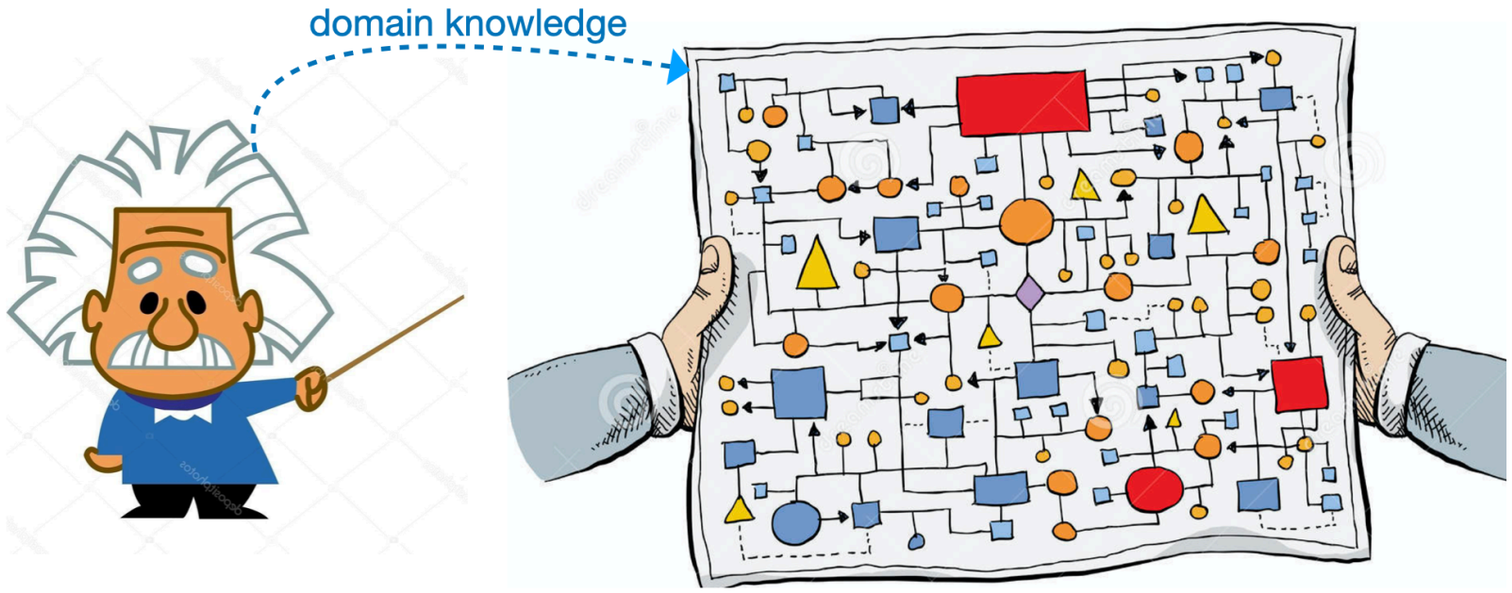

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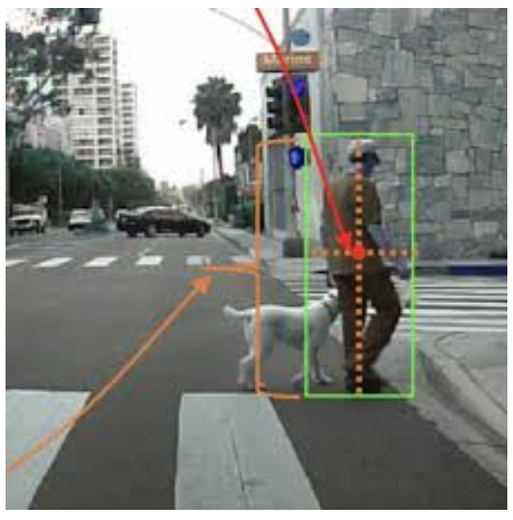
Example - Pedestrian Detection



Simple tasks, but infinitely large variability!

Statistical Machine Learning

- Rather than explicitly designing a solution, learn one from data!
- Successful approach for numerous applications, which you'll also develop one in a final project!

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Inference/Learning

Rules or Patterns ⟵ Data or Observations

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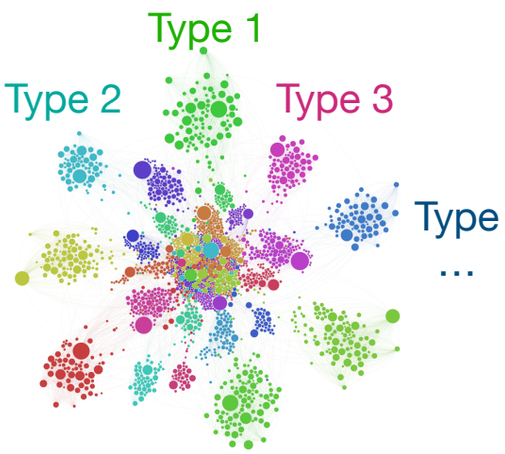
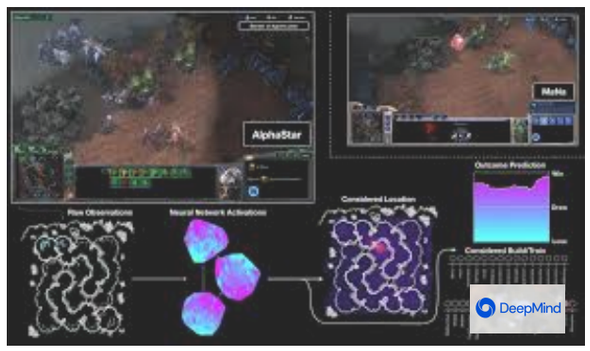


Unsupervised Learning

Supervised Learning



Reinforcement Learning

https://www.nature.com/articles/s41586-019-1724-z

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1. Pre-Deep Learning 2. Deep Learning 3. Quantum Machine Learning

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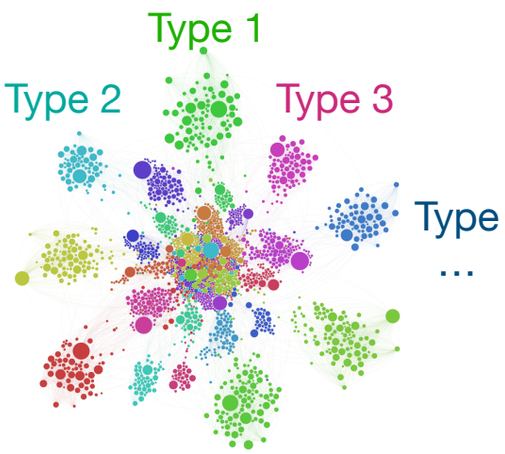

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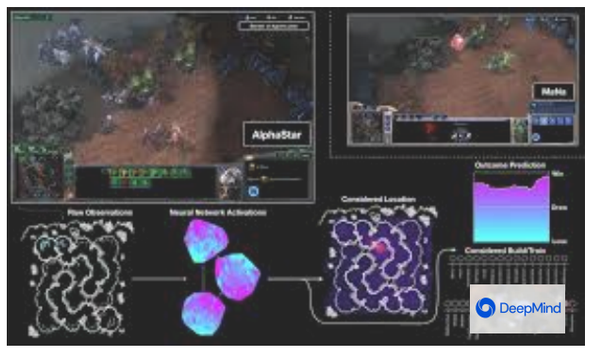

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