Welcome to Physics 694

"Applied AI" (for LHC)

ML is a general and powerful tool. → LHC
→ other fields?

} in this course

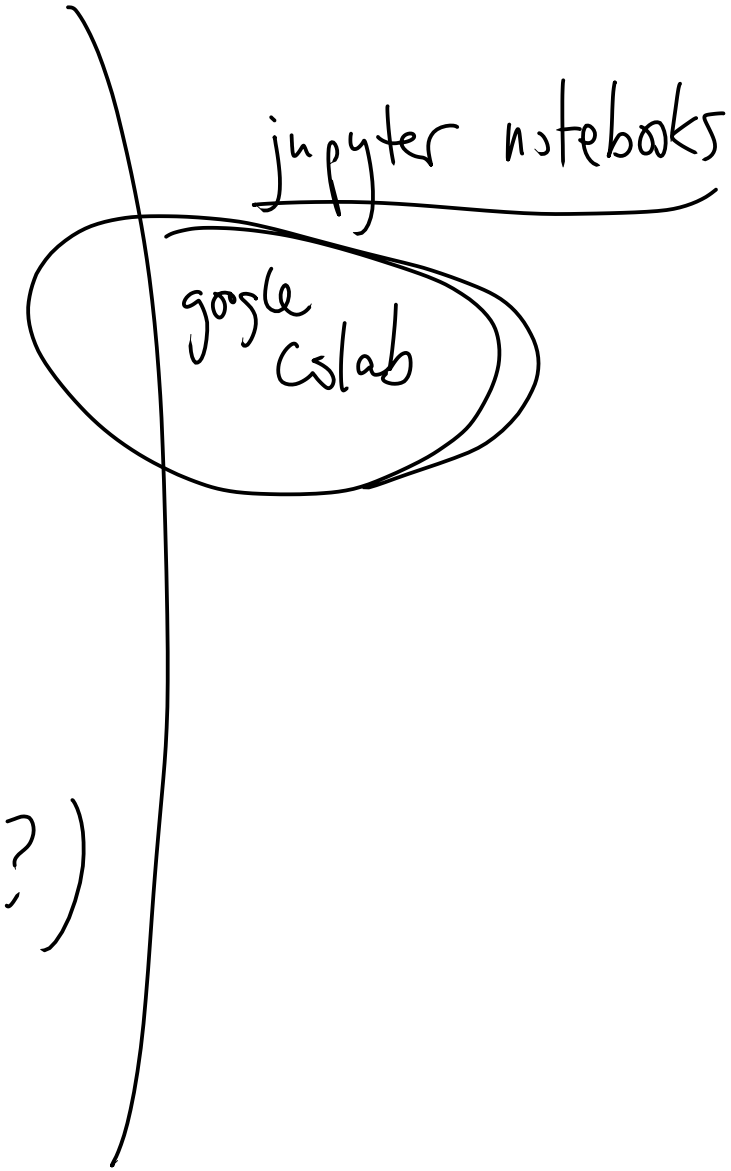
introduce general concepts
popular deep learning architectures

Not covered: "theory of AI, ML, deep learning"
heavy statistics

} Physics 568 (?)

Format of the course (course website)

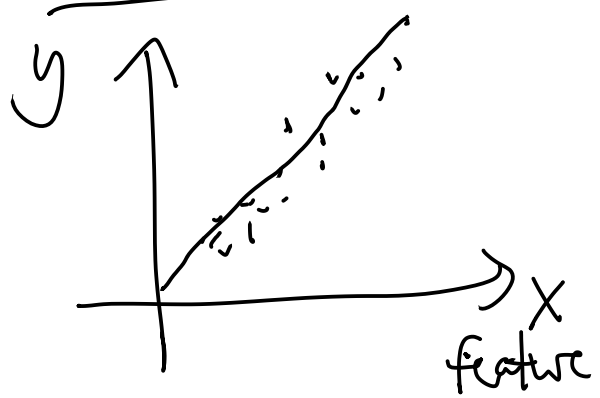
- Lectures on W & F
  10:20 3:20
- Hands-on component even in class (?)
- Reading material — textbooks (?)
  - blog posts
  - papers
- Transition to seminar style or final projects (?)
- Homeworks (not required)



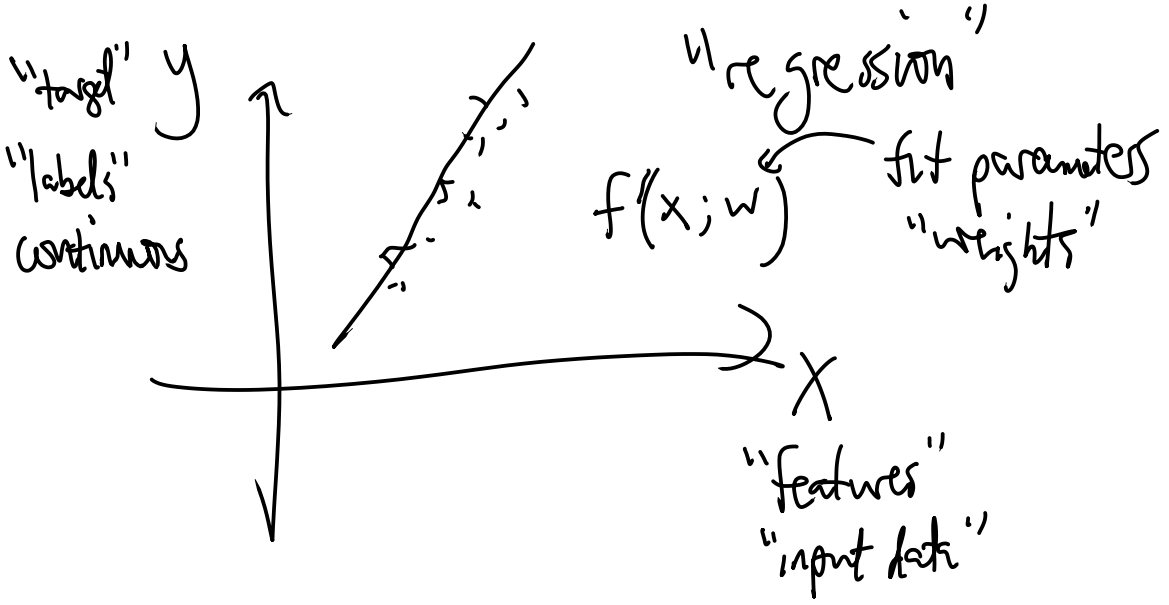
What is Machine learning?

- "glorified curve fitting" → modern ML, deep learning
  - data very high dim'l.
  - fns have many params
    highly nonlinear
    "expressive"
- learning from examples, from data
  finding patterns

What are some common ML tasks?



What are some common ML tasks?



"regression"

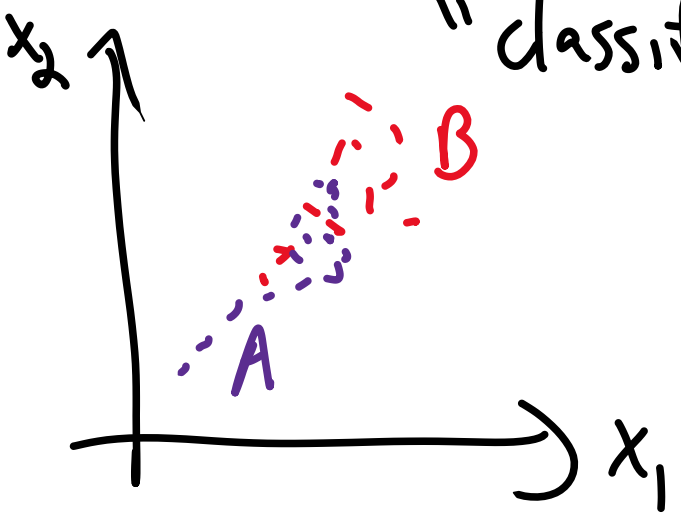
$f(x; w)$ ← fit parameters "weights"

modern DL → Neural Networks

(binary)

"classification" ← logistic regression

logistic regression ← regression w/ discrete labels

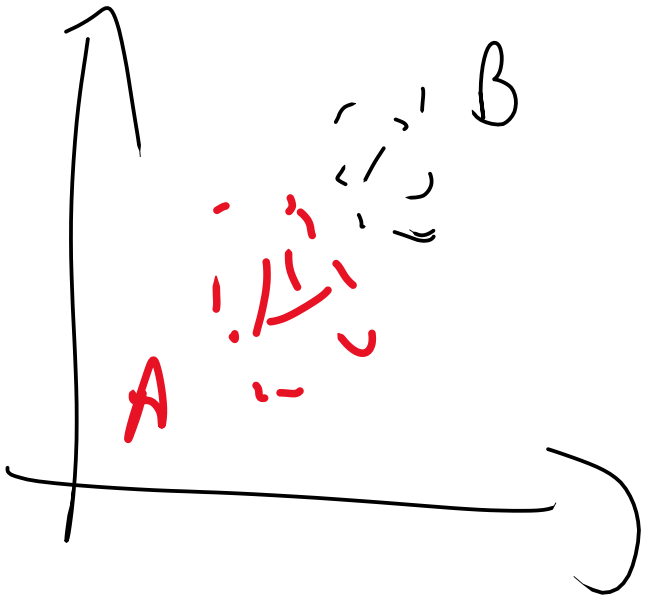


(x_1, x_2) input data

A, B target labels ← discrete

$f(x; w)$ = "prob. x came from A"

regression
classif. → supervised ML



all data is labeled = "supervised"

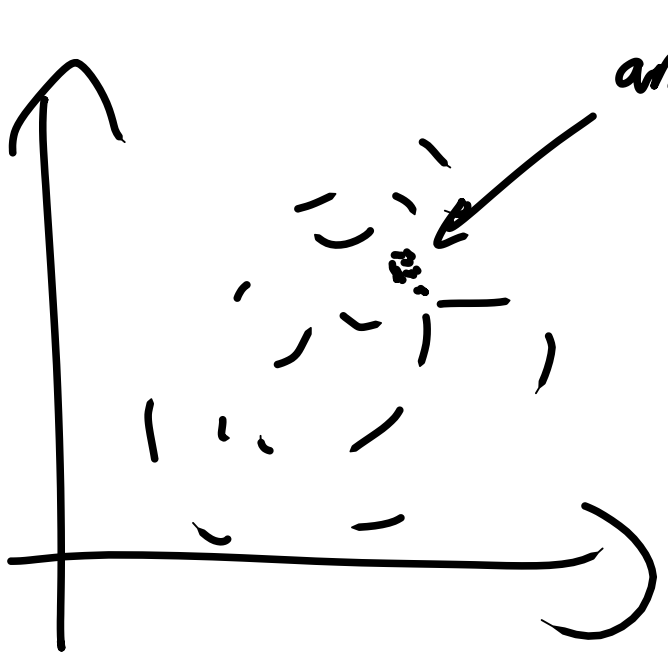
noisy labels = "weakly supervised"

partial labels = "semi supervised"

← "Anomaly detecti"

out of sample anomalies

outlier detection

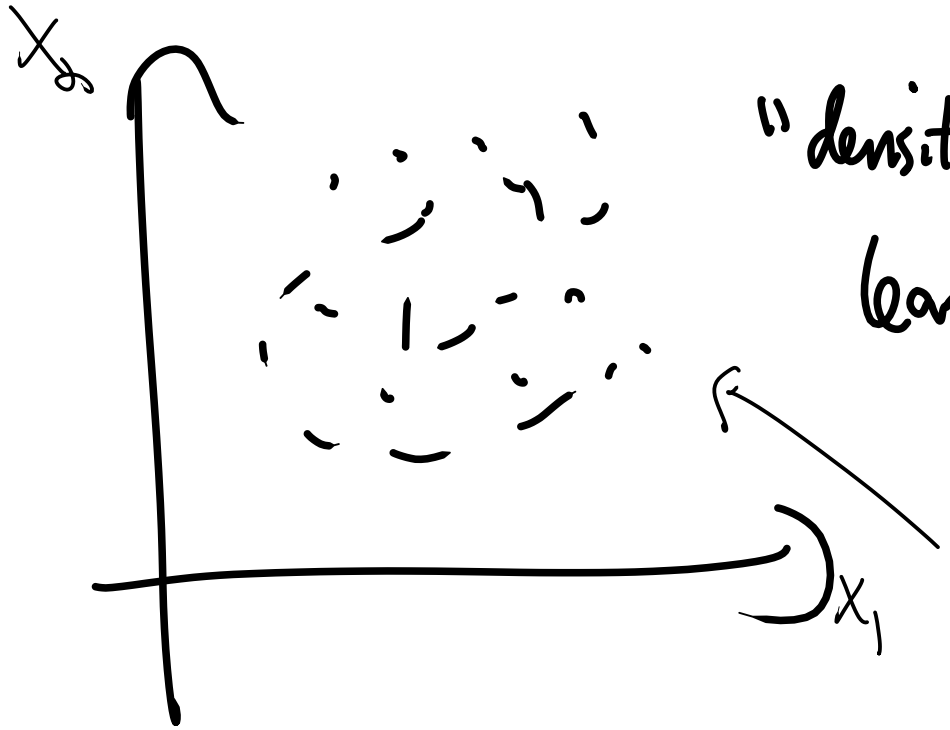


"group anomaly detection"

"collective anomaly"

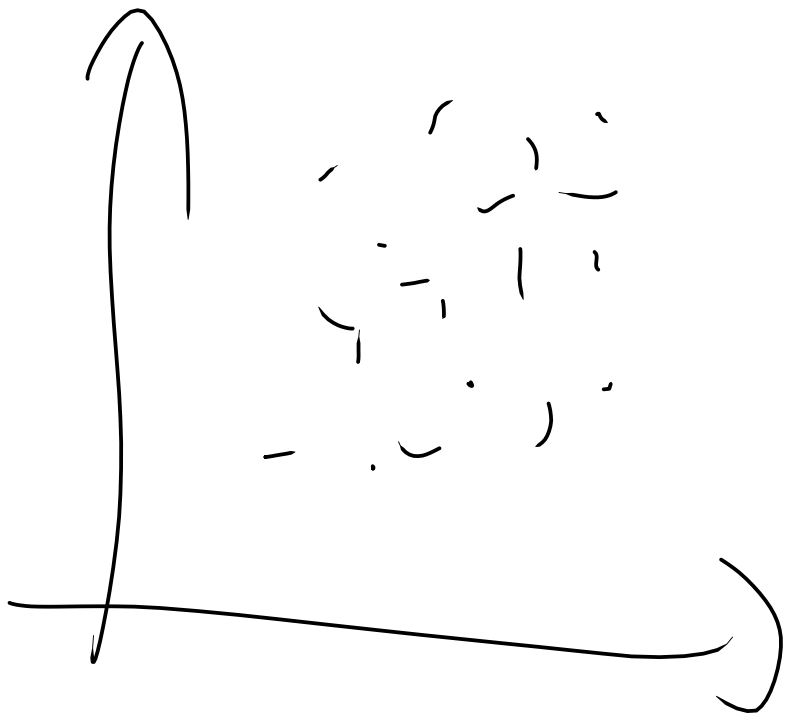
insample

need precise bg. estimate



"density estimation"

learning the prob. dist'n the data was drawn from.



generate more examples

"generation"

$P(x)$

don't require knowing $P(x)$ explicitly.

- "GANs"
  generative adversarial networks

Not covered probably: reinforcement learning
"game playing"

Cover a comprehensive list of DL methods
for these tasks and show how they can be applied to LHC.