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CT ML

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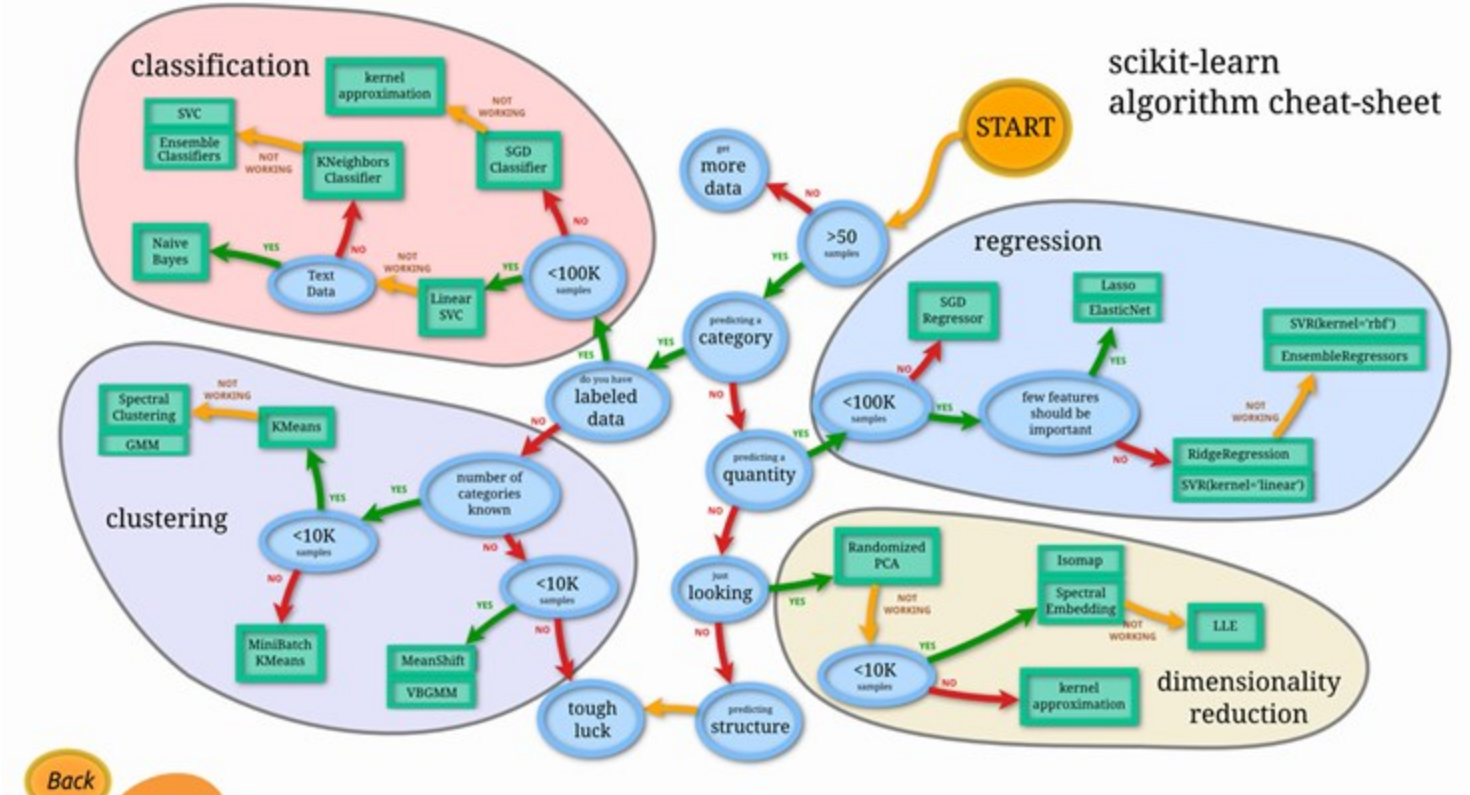
Agenda

- Comparing ML Classifiers (Was already covered in respective modules. Confusion matrix based metrics , RMSE, R2, AUC-ROC, Cross Validation)
- Emerging Requirements
  - Bias and Fairness
  - Interpretability

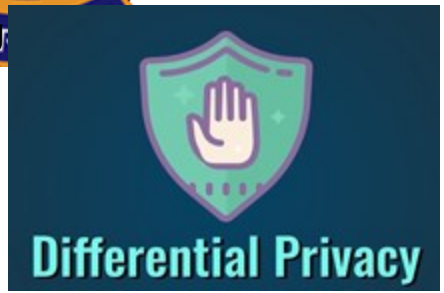
Model Guide

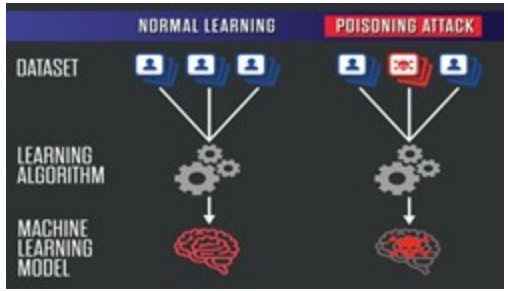


Source Credit : https://scikit-learn.org/stable/tutorial/machine_learning_map/index.html

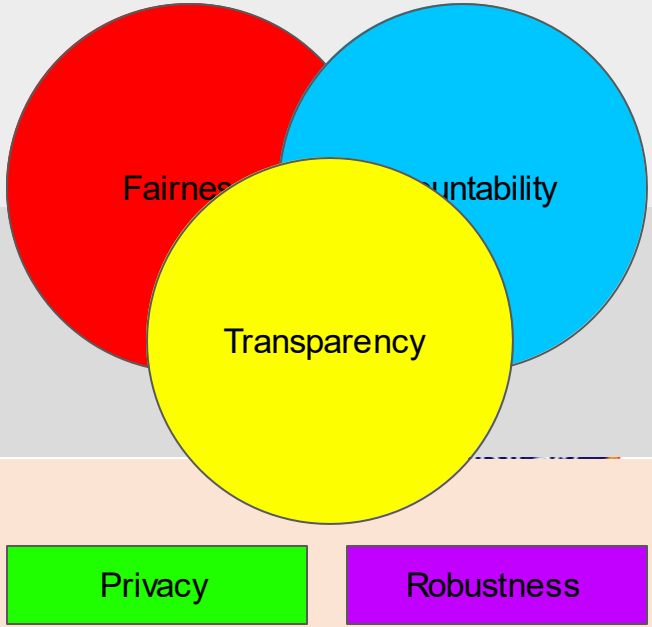
Emerging Requirements

- **Fairness**
  - What to do to ensure gender and ethnic fairness in ML models?
- **Accountability**
  - Who takes the responsibilities for failed ML models?
- **Transparency**
  - What to do to make ML models transparent and comply with regulations?
- **Privacy Issues**
  - How to protect user privacies when exposing data to ML models?
- **Security Issues**
  - How do we defend ML models against data poisoning?





FAccT Overview (More on this is a part of next semester elective)



Psychology
Social Science
Public Policy

Statistics
Theory

Machine
Learning

Real World Example

Amazon's Secret AI Hiring Tool Reportedly 'Penalized' Resumes With the Word 'Women's'

Rhett Jones
10/10/18 10:32AM • Filed to: ALGORITHMS

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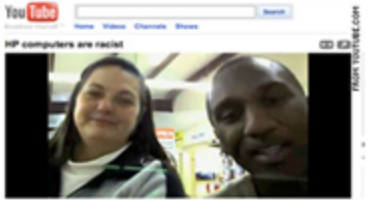
Photo: Getty

HP looking into claim webcams can't see black people

By **Mallory Simon**, CNN
December 23, 2009 7:25 p.m. EST



an HP webcam
tware.

(CNN) -- Can Hewlett-Packard's motion-tracking webcams see black people? It's a question posed on a now-viral YouTube video and the company says it's looking into it.

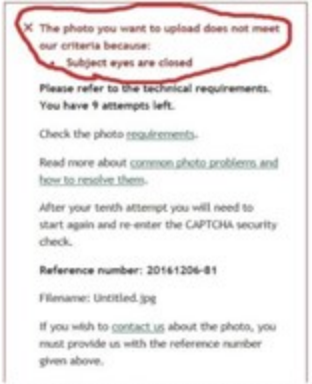
In the video, two co-workers take turns in front of the camera -- the webcam appears to follow Wanda Zamen as she sways in front of the screen and stays still as Desi Cryer moves about.

HP acknowledged in a statement e-mailed to at the cameras may have issues with contrast recognition in ighting situations. The webcams, built into HP's new ers, are supposed to keep people's faces and bodies in on and centered on the screen as they move.

so went viral over the weekend, garnering more than 400,000 e page views and a slew of comments on Twitter.

New Zealand passport robot thinks this Asian man's eyes are closed

By James Griffiths, CNN
Updated 1:46 AM ET, Fri December 9, 2016



✕ The photo you want to upload does not meet our criteria because:
- Subject eyes are closed

Please refer to the technical requirements.
You have 9 attempts left.

Check the photo requirements.

Read more about common photo problems and how to resolve them.

After your tenth attempt you will need to start again and re-enter the CAPTCHA security check.

Reference number: 20161206-81

Filename: Untitled.jpg

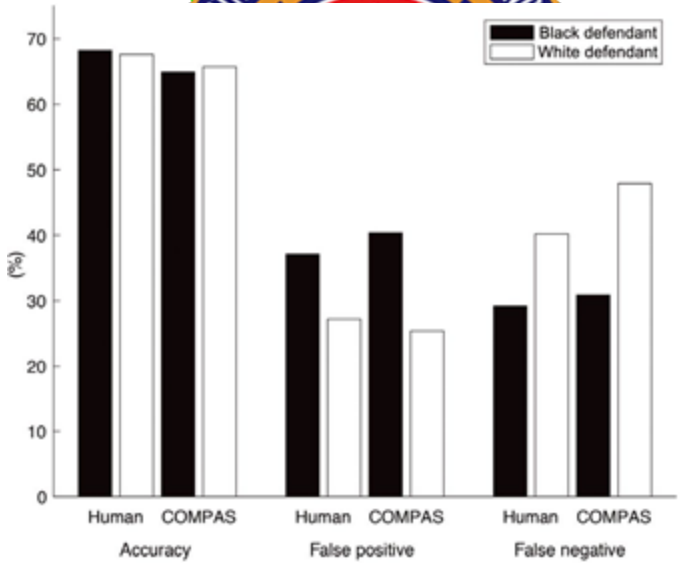
If you wish to contact us about the photo, you must provide us with the reference number given above.

New Zealand's online passport application system couldn't recognize Richard Lee's open eyes.

Algorithmic Bias

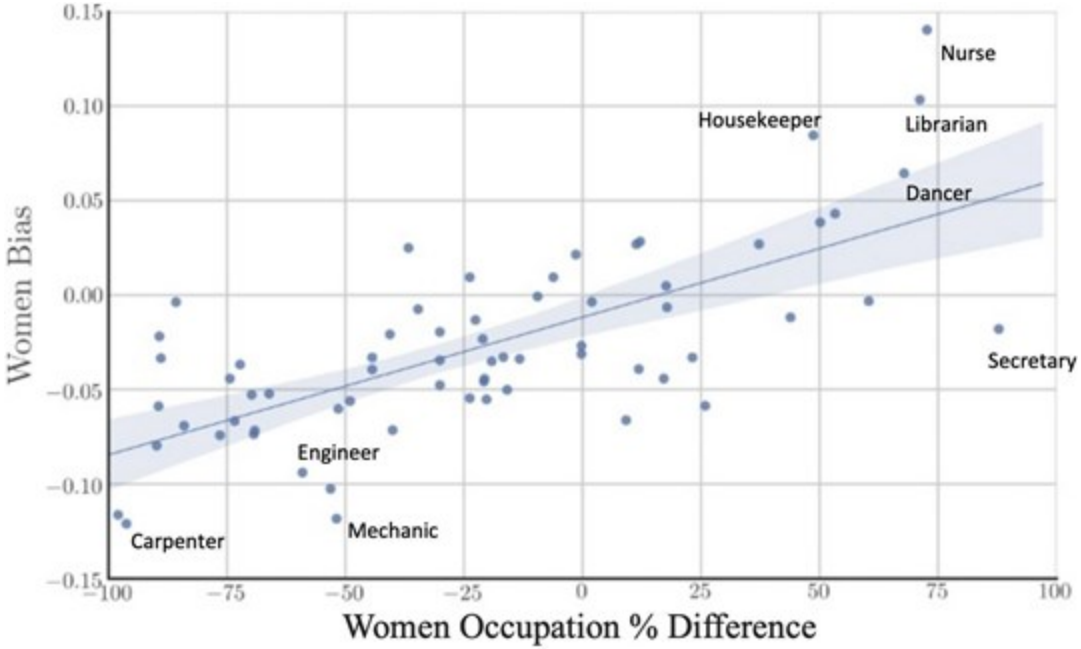
Commercial risk assessment software known as COMPAS

- Assess more than 1 million offenders since 2000
- Predicts a defendant's risk of committing a misdemeanor or felony
- 137 features



Dressel et al, 2018

Bias in Historical Data – Negative Legacy



Gard et al, 2018

Fairness

https://www.borealisai.com/research-blogs/tutorial1-bias-and-fairness-ai/

- What is Fairness?
  - The absence of bias towards an individual or a group (Mehrabi et al, 2019)
- Can ML Models Discriminate?
  - Aren't machines just follow human's instructions?
  - ML models approximate patterns in the data
  - Learns/Amplifies biases at the same time

Fairness Through Unawareness

A ML Algorithm Achieves Fair Through Unawareness If

- None of the sensitive features are directly used in the model

Race and Ethnicity	Skills	Years of Exp	Hired?
Hispanic	Javascript	1	no
Hispanic	C++	5	yes
White	Java	2	yes
White	C++	3	yes

Training →

Fair ML Model

- Sensitive Features May Still Be Used
  - Inferred from indirect evidence

- Protected

- Inferred

Race and Ethnicity	Skills	Years of Exp	Often Goes to Mexican Markets	Hiring Decision
Hispanic	Javascript	1	yes	no
Hispanic	C++	5	yes	yes
White	Java	2	no	yes
White	C++	3	no	yes

Training → Discriminatory ML Model

- Processing Sensitive Features
  - Fairness through unawareness requires sensitive features to be masked out
  - Not easy to do in real life
  - Referred to as individual fairness criteria

❖ Stereotypical dataset

The physician hired the secretary because he was overwhelmed with clients.

The physician hired the secretary because she was highly recommended.

❖ Anti-stereotypical dataset

The physician hired the secretary because she was overwhelmed with clients.

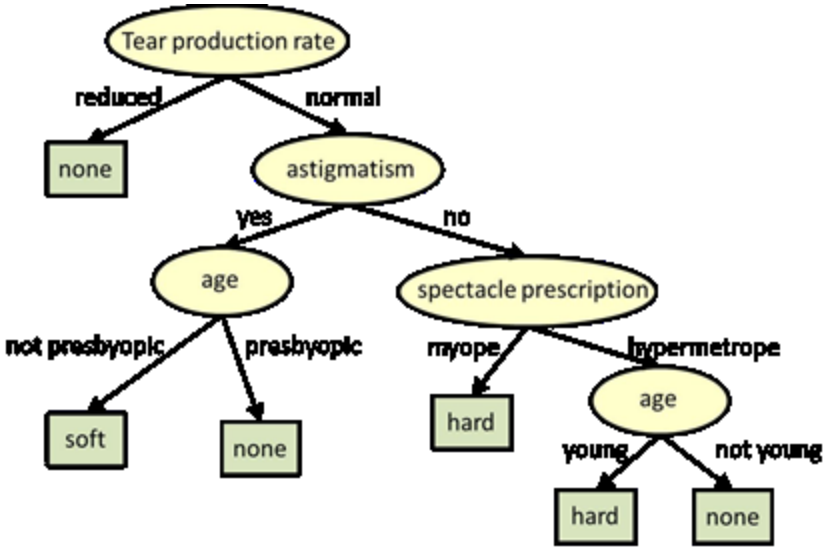
The physician hired the secretary because he was highly recommended.

Need for ML Interpretability

- Our society has been shifted to rely on AI more than ever
  - autonomous vehicles
  - Security
  - Finance
  - many others
- Who will benefit from ML Interpretability?
  - End Users: enhance trust, understand the consequences of the decisions, e.g., privacy, fairness.
  - Regulatory Agencies: compliance, audits, and accountability.
  - Model Designers: diagnose model performance

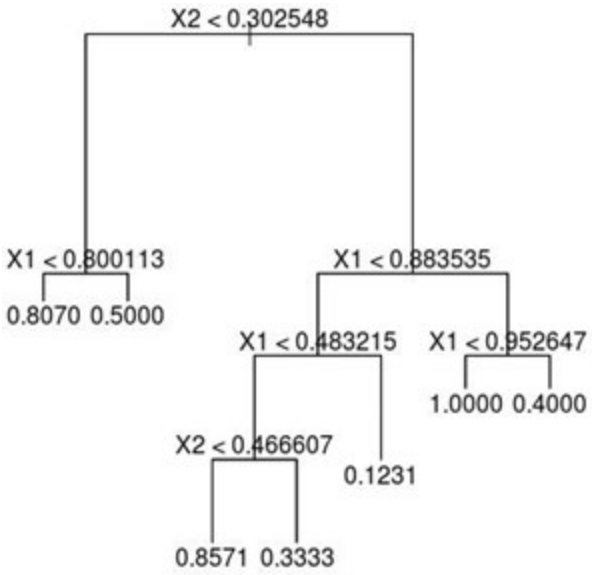
Interpretability in Decision Tree

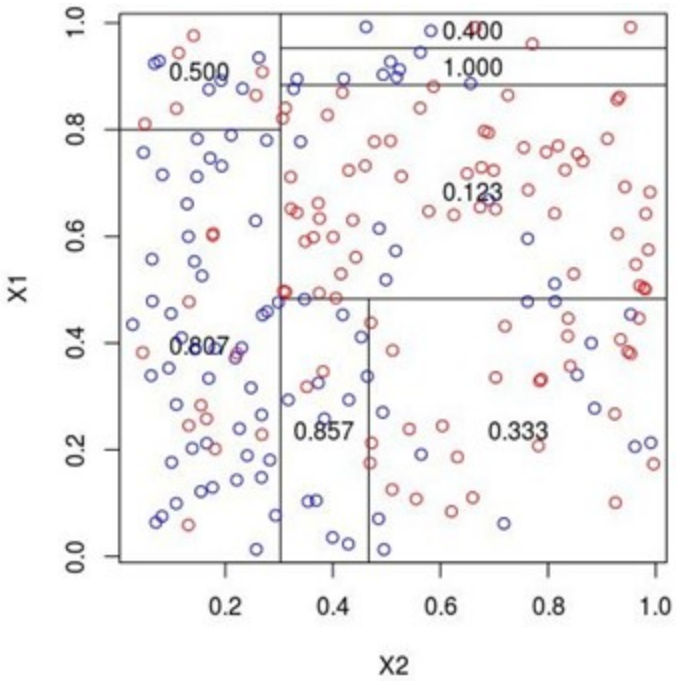
ML interpretability allows one to examine model's basis in its decision making process



An interpretable tree model to find out the kind of contact lens a person may wear

Interpretability in Decision Trees

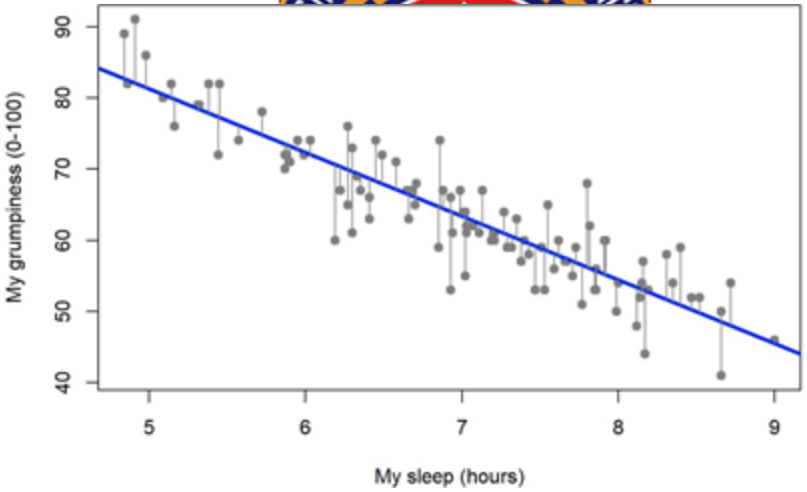




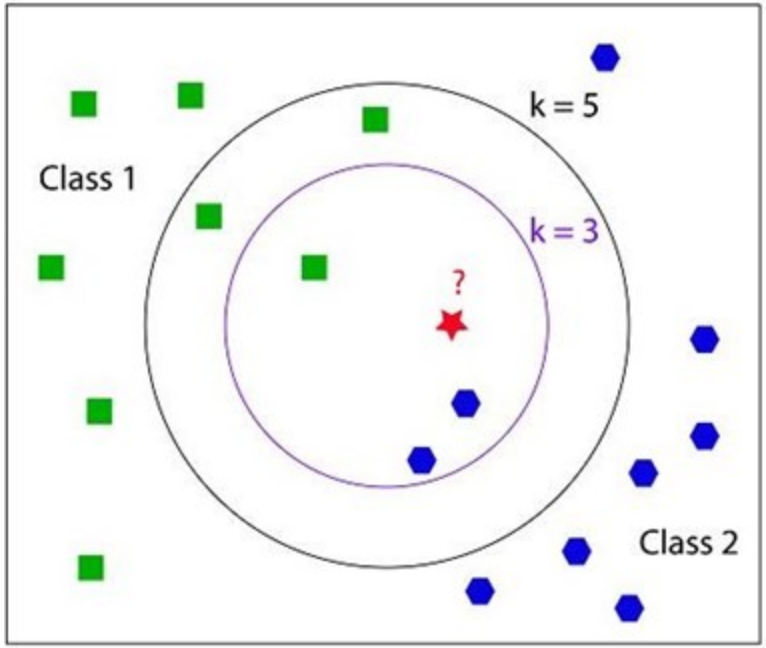
Interpretability in Linear Regression

$$y_i = \beta_0 + \beta_1 x_{i1} + \cdots + \beta_p x_{ip} + \varepsilon_i = \mathbf{x}_i^\mathsf{T} \boldsymbol{\beta} + \varepsilon_i, \qquad i = 1, \ldots, n,$$

interpretable components



Interpretability in K-Nearest Neighbors



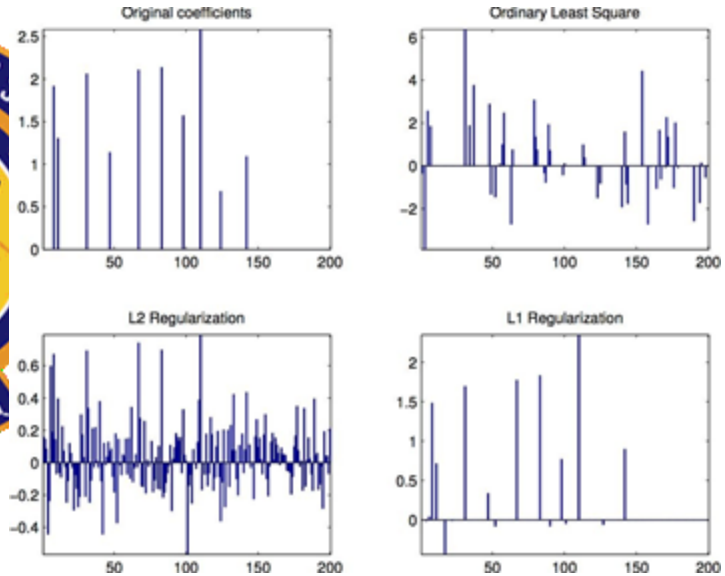
Sparsity for Interpretable Linear Regression

- In the case of linear regression
  - $\hat{y} = w_1 x_1 + w_2 x_2 + \ldots + w_N x_N + b$
- Linear regression with L1 regularization

$$Loss = Error(y, \hat{y}) + \lambda \sum_{i=1}^{N} |w_i|$$

- Linear Regression with L2 regularization

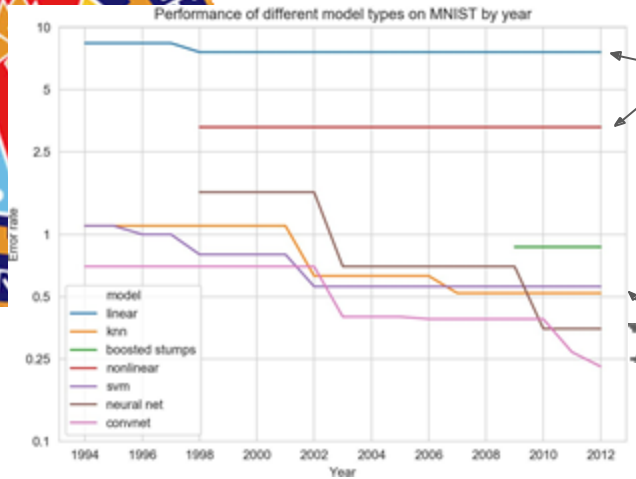
$$Loss = Error(y, \hat{y}) + \lambda \sum_{i=1}^{N} w_i^2$$



Interpretability and Performance Trade-offs

- Highly performed models tend to be less interpretable.
- Can powerful models with complex structures be interpretable at the same time?

MNIST Dataset

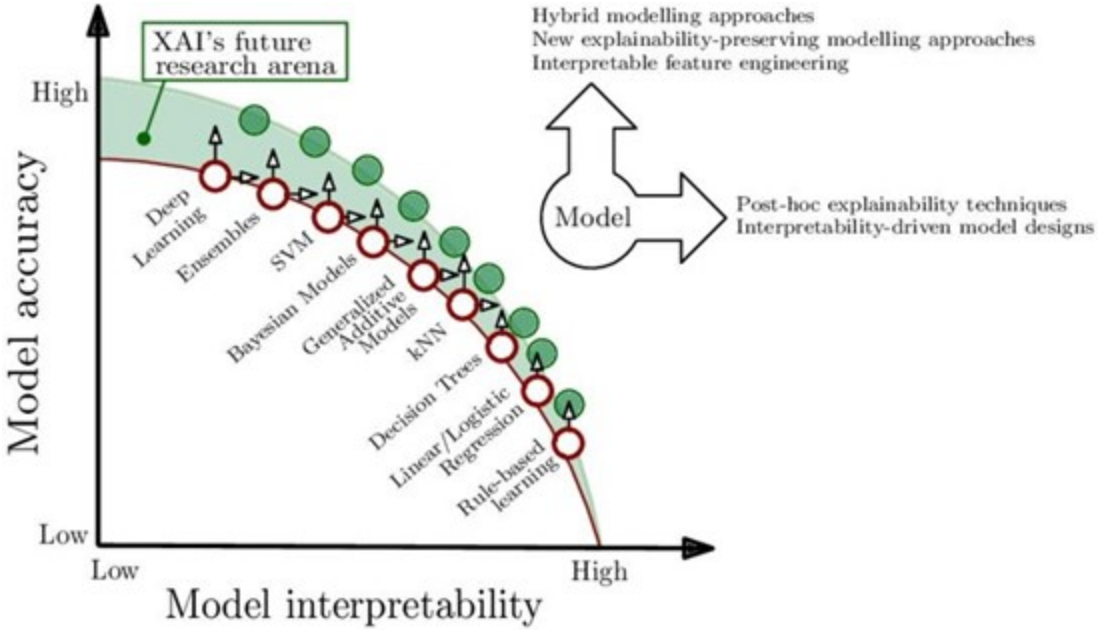


more interpretable

less interpretable

http://yann.lecun.com/exdb/mnist/
https://soph.info/2018/11/08/mnist-history/

Interpretability and Performance Trade-offs



Arrieta et al., 2019