Machine Learning with Opponents

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Slides: https://goo.gl/cjW7jn


MAN, I SUCK AT THIS GAME. CAN YOU GIVE ME A FEW POINTERS?
0x3A28213A
0x6339392C,
0x7363682E.
I HATE YOU.

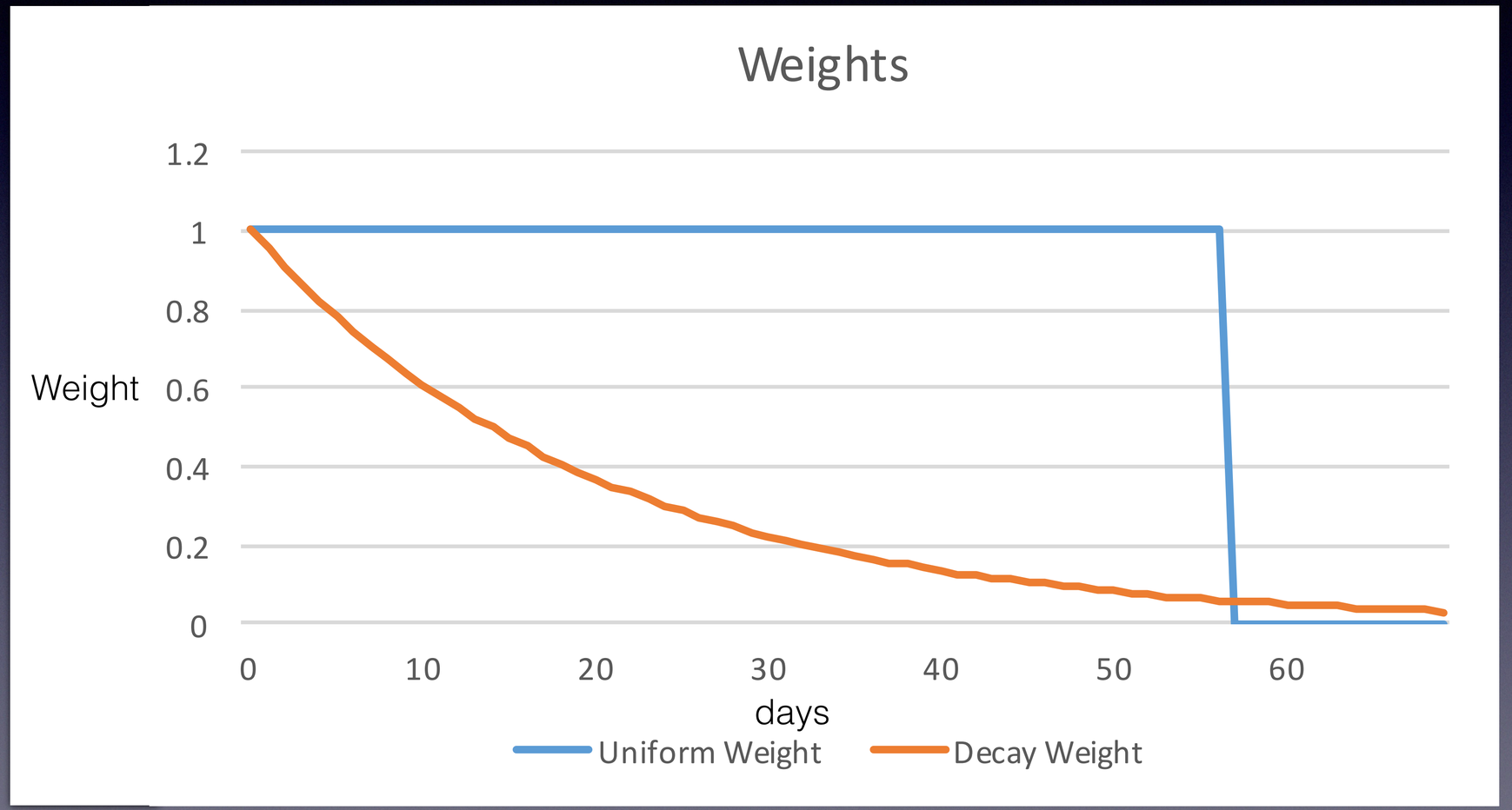
Observations
Feature engineering
Models

Observations

Observation Weighting

- Re-weight observations, based on:
  - Uniform weight
  - Observation age (staleness)
  - Random down-sampling (randomly set weight to 0)
  - Up-sampling known opponent attacks (raise weight for known attacks)

Observation Weighting



SMOTE

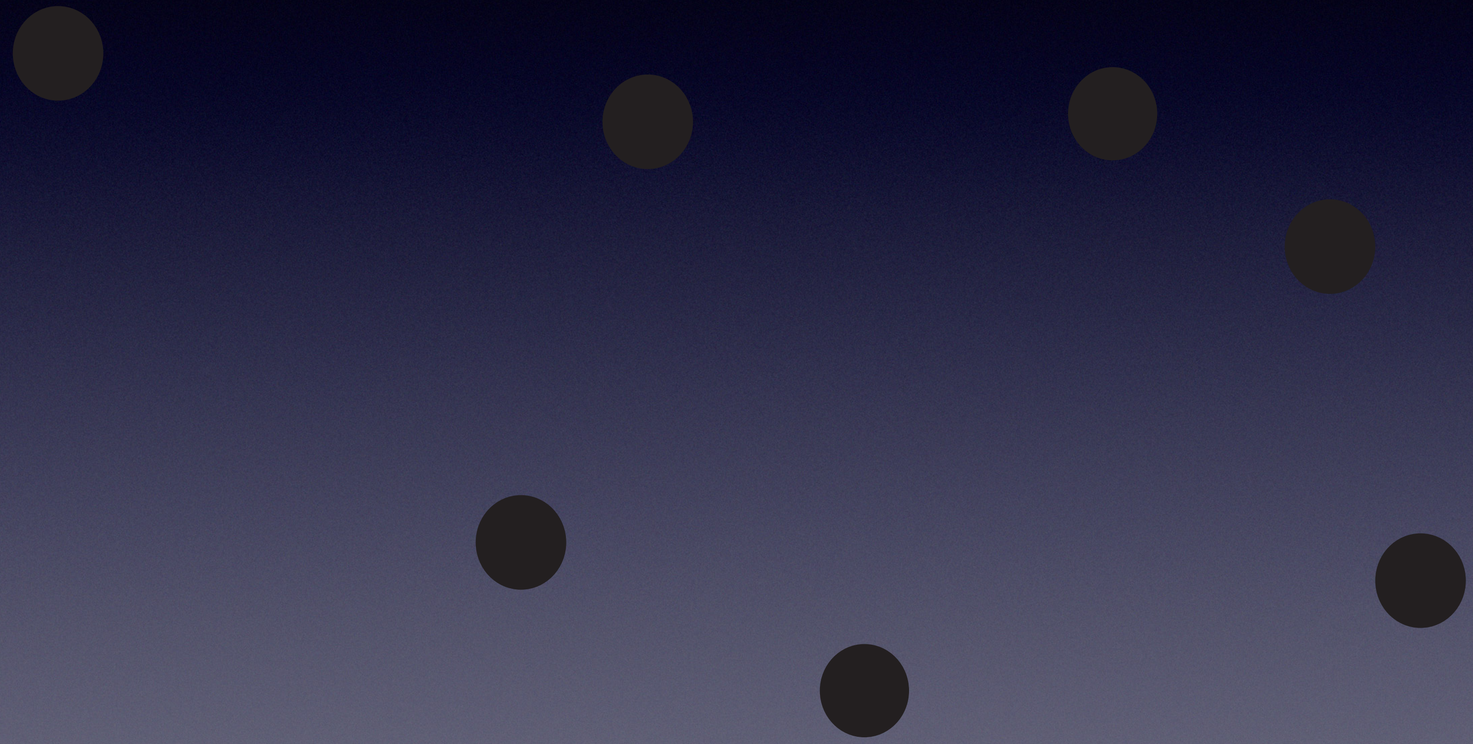
(Synthetic Minority Over-sampling Technique)

- Create synthetic observations, similar to actual attacks
- **Goal:** Better model rare events (opponent attacks)
- **Majority class:** Down sample, with some probability
- **Minority class:** Create ‘synthetic’ observations

https://www.jair.org/media/953/live-953-2037-jair.pdf

SMOTE

1. Select minority point
2. Select neighbor
3. Create new point



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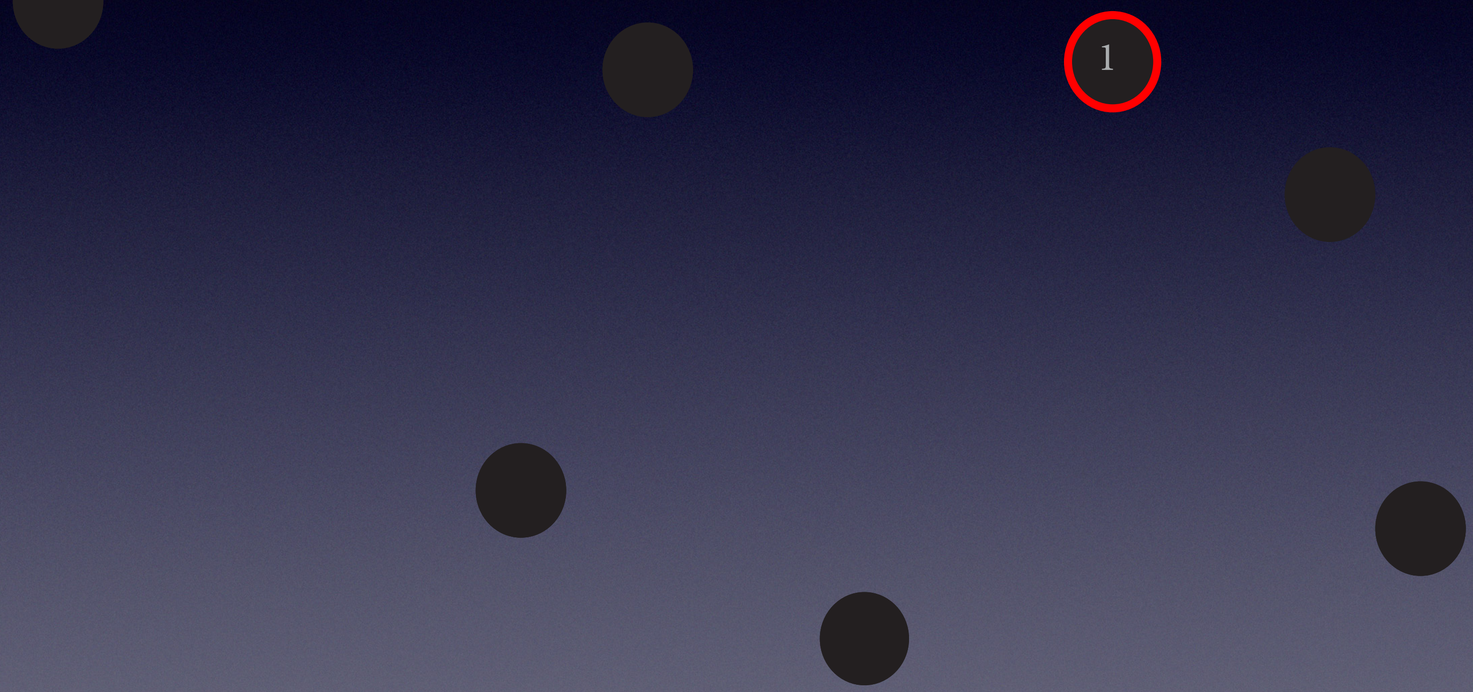

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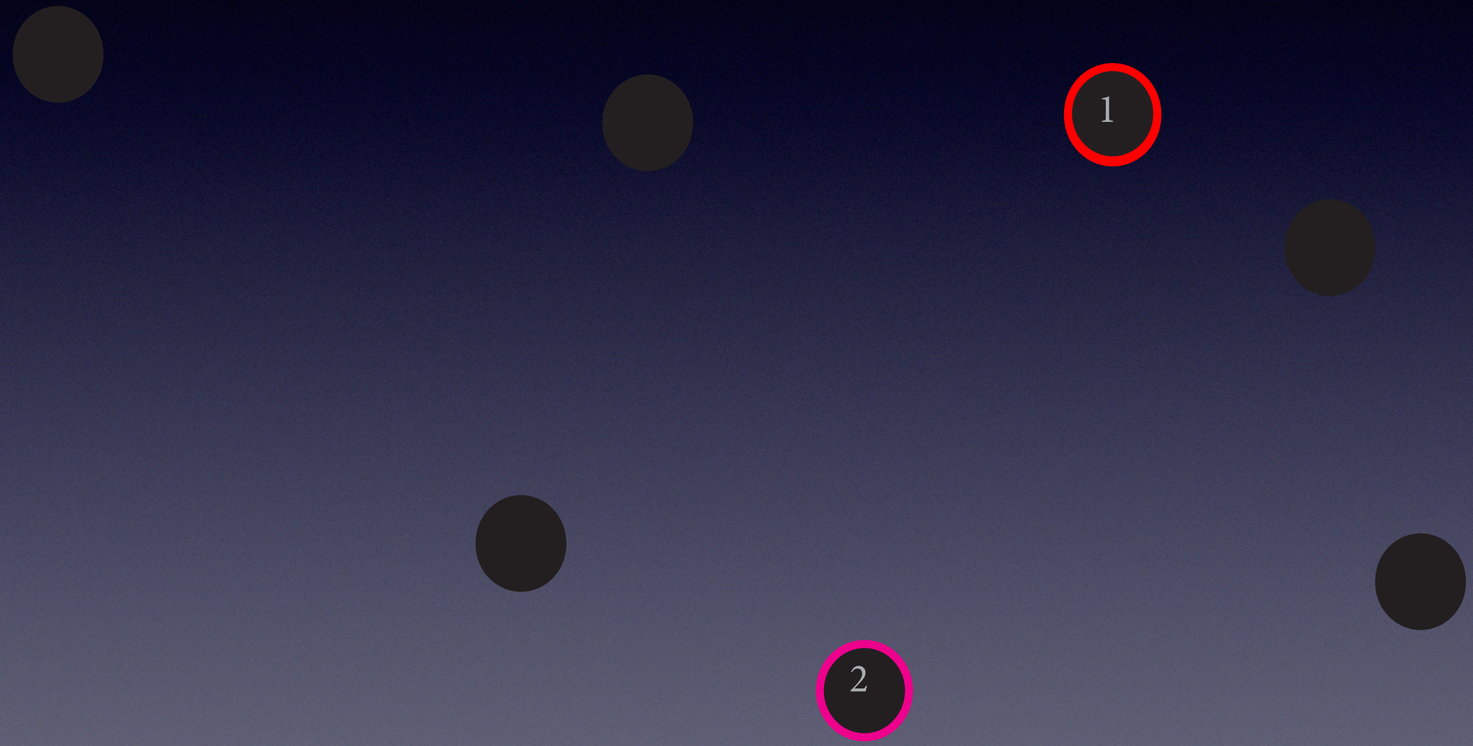

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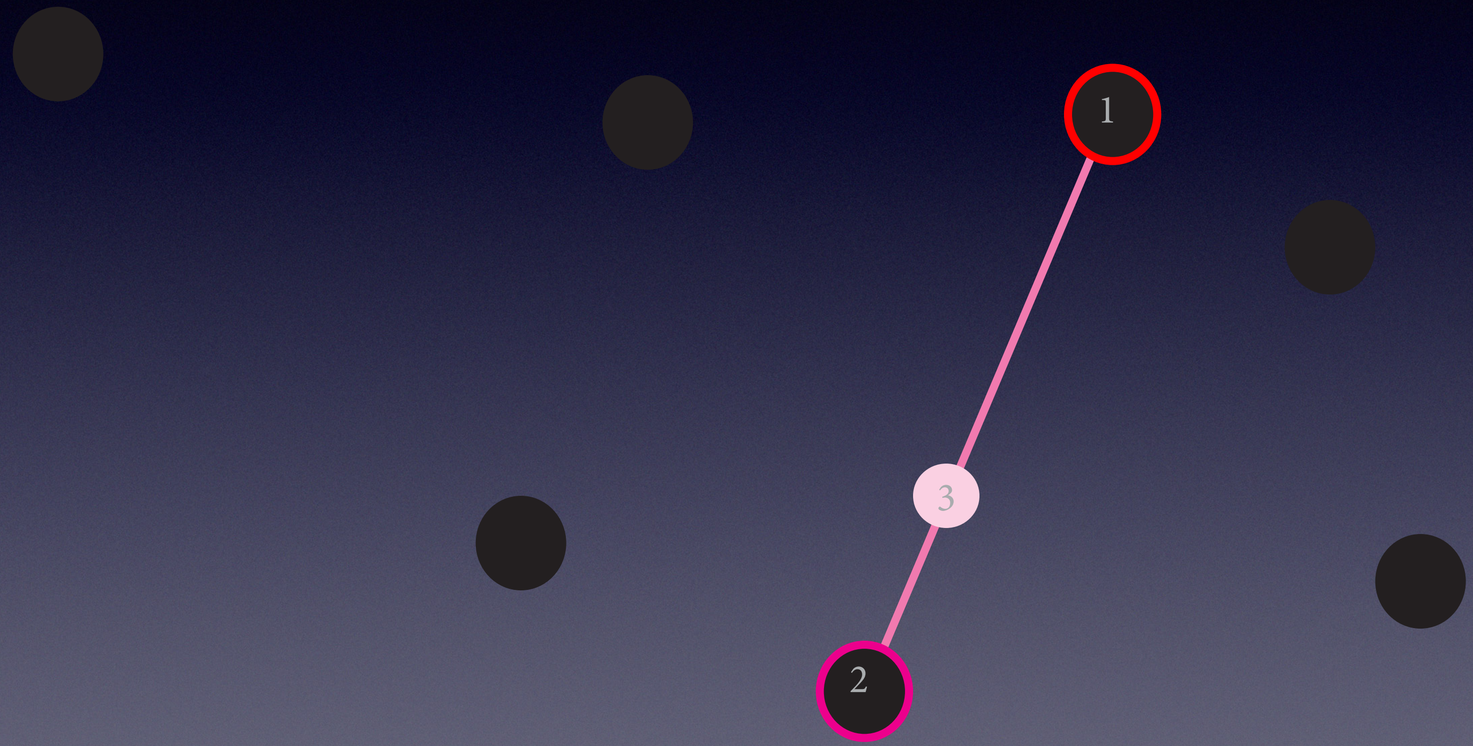

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Observation Weighting
SMOTE Sampling

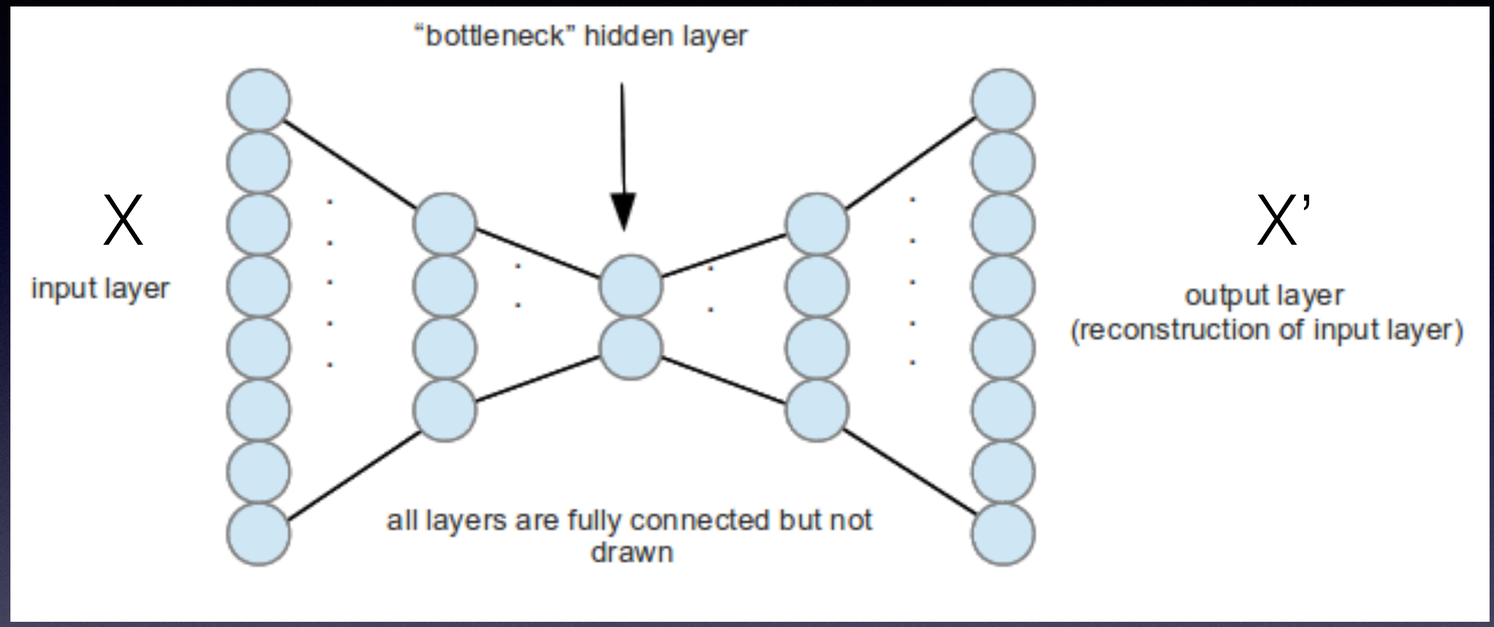
Feature engineering

Outlier Detection

- **Goal:** Create outlier score
- **Method:** Train learner to re-create input vector
  - PCA: Reduce dimensionality, increase dimensionality
  - Neural Network: Train auto-encoder, with bottleneck
- **Score:** Measure distance from output vector to input vector

https://github.com/h2oai/h2o-training-book/blob/master/hands-on_training/anomaly_detection.md

Outlier Detection



Outlier score: |X'-X|

https://github.com/h2oai/h2o-training-book/blob/master/hands-on_training/anomaly_detection.md

Microclustering

- **Goal:** Capture what is ‘normal’ for this user
- **Method:**
  - Cluster users into small cohorts of similar users
  - Train a model for each cohort
- **Score:** Fraud likelihood score for user’s cohort

https://github.com/h2oai/h2o-training-book/blob/master/hands-on_training/anomaly_detection.md

Historical aggregates

- **Goal:** Capture what is ‘normal’ for this user
- **Method:** Perform aggregates for various time windows
  - E.g. Average spend for past 30, 60, 90 days
  - E.g. Maximum spend for past 30, 60, 90 days

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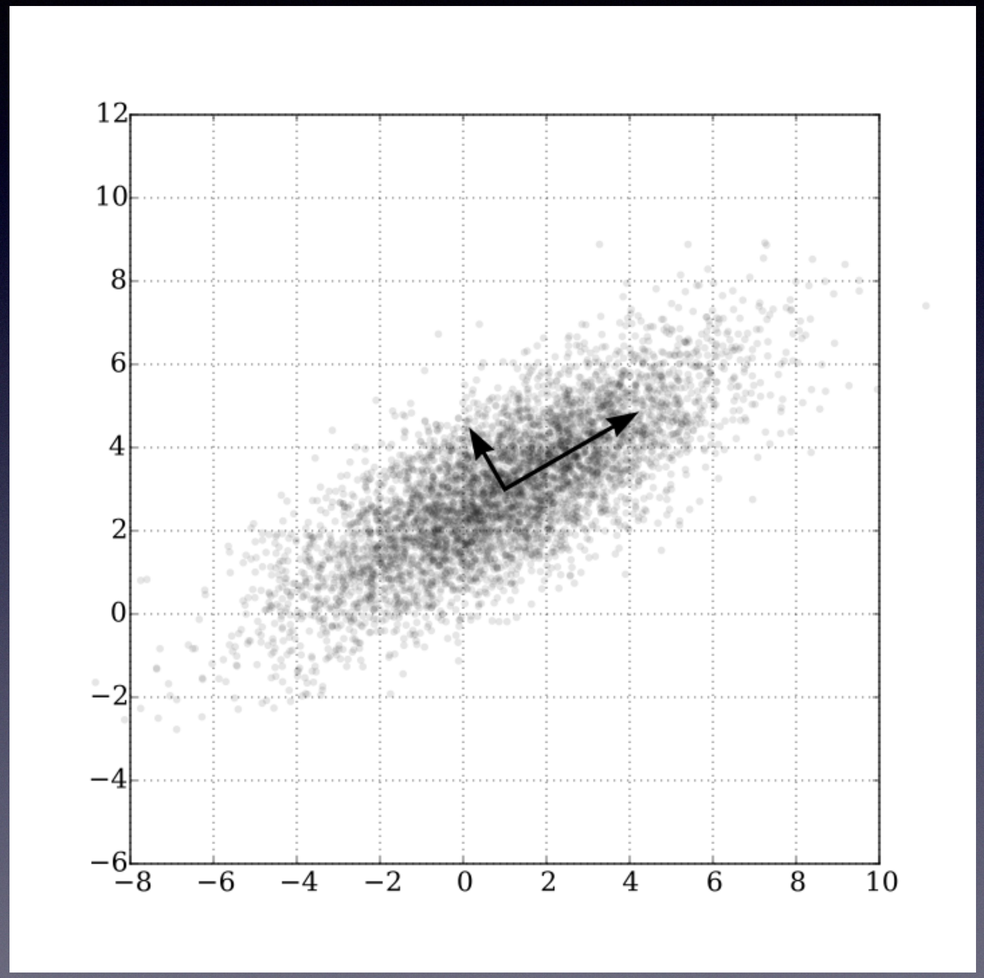
Low Rank Models

- **Goal:** Reduce dimensionality, to include sparse or previously unused variables
- **Method:** Reduce dimensionality with generalized PCA
  - Model directly on components (latent factors)

https://web.stanford.edu/~boyd/papers/pdf/glrm.pdf
https://github.com/h2oai/h2o-tutorials/blob/master/tutorials/glrm/glrm-tutorial.md

Low Rank Models



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Outlier Detection
Microclustering
Historical aggregates
GLRM

Models

Grid search

- **Goal:** Find optimal hyper-parameters for given class of models
- **Method:** Create every possible permutation of hyper-parameters, and compute models until heat death of universe

https://github.com/h2oai/h2o-3/blob/master/h2o-docs/src/product/tutorials/GridSearch.md

Neural Networks

- **Goal:** Deep, non-linear models perform well with rare cases
- **Method:** Try many different architectures, with many different hyper parameters
  - Feed previous user transactions to Bidirectional LSTM
  - Auto-encoder

Ensemble Modeling

- **Goal:** Leverage a diverse set of algorithms
- **Method:** Train multiple classes of algorithms (tree based, linear, neural network), possibly with multiple hyper-parameters. Combine scores with meta model (such as Logistic Regression w/ non-negative betas)

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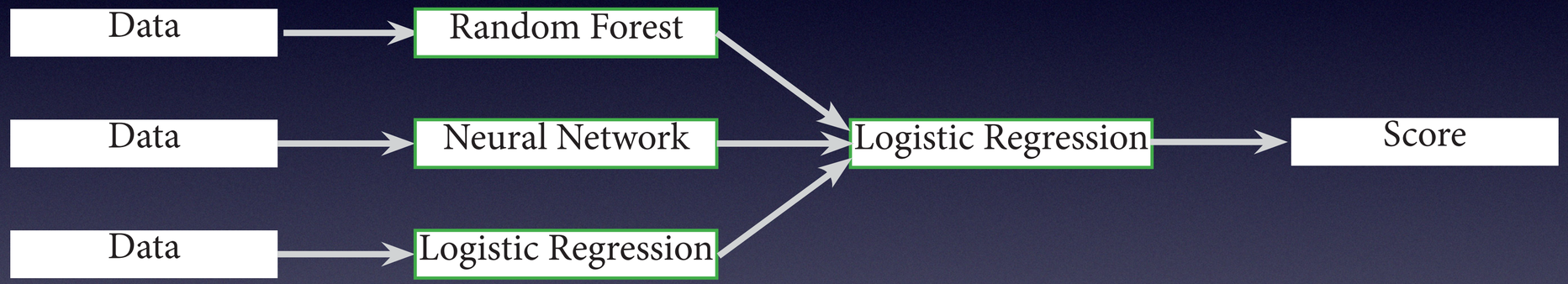
Ensemble Modeling



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Grid Search
Neural Networks
Ensemble models

Thanks!

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