HWSW mOBILE! - APPLIED AI SECTION

‘WHAT TO DO IF WE DON’T HAVE ENOUGH DATA?’

INTRO

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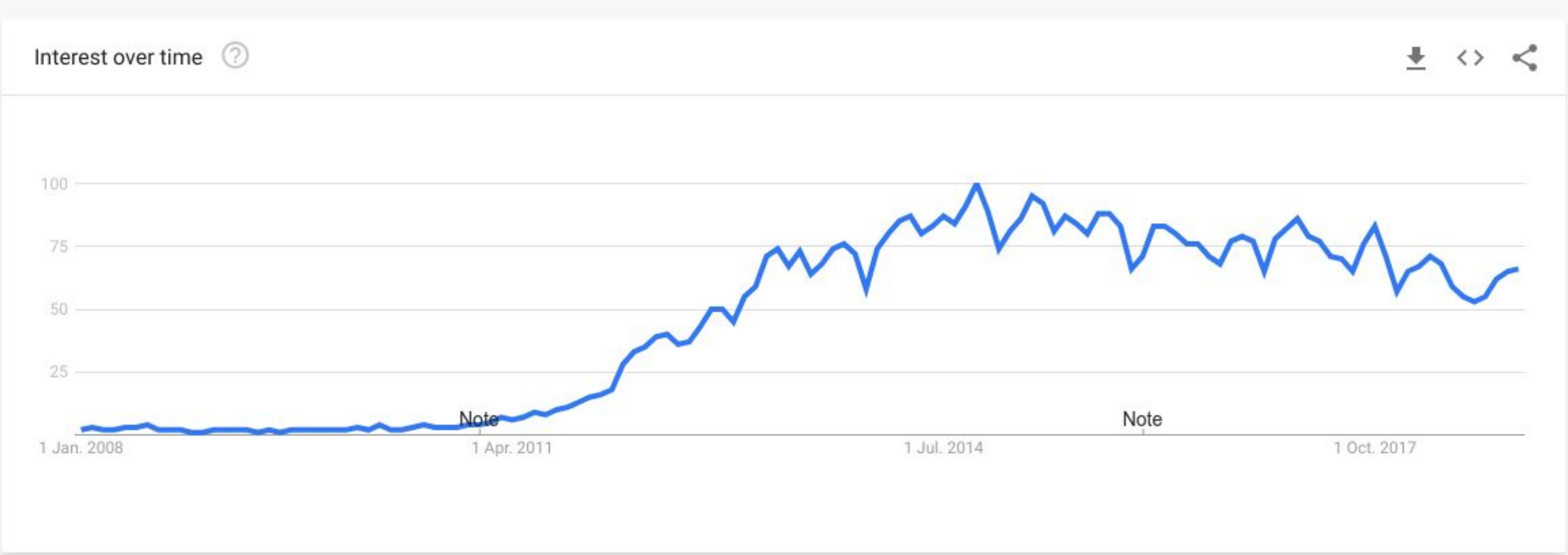
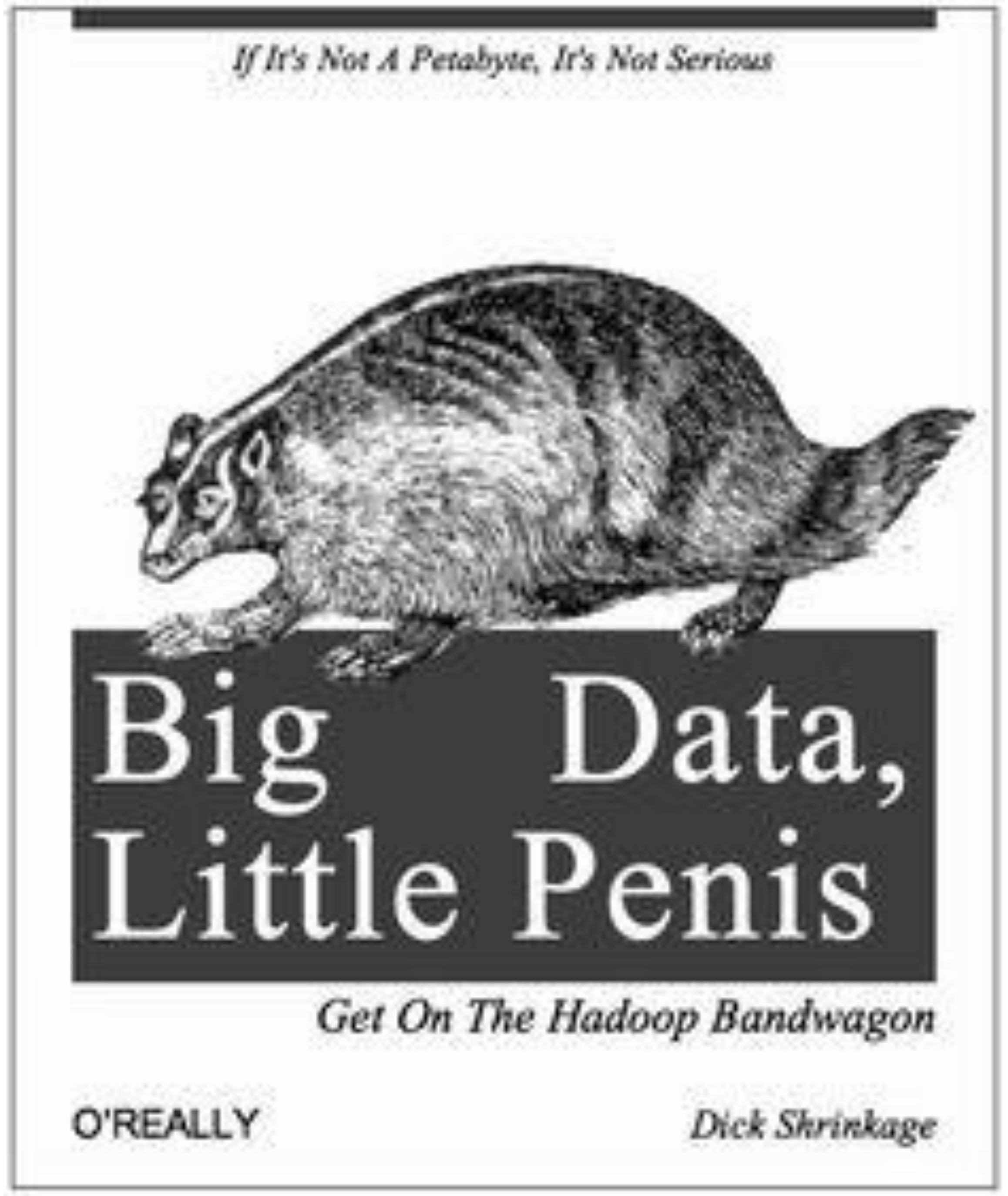
"BIT OVERHYPED?"

BIG DATA IS - NOT EVERYTHING - IS BIG DATA!





DETAILS:
Google trends - Big Data topic 2008-2018
"Don't use HADOOP - Your data isn't that big"

‘NOT ENOGH INFORMATION“

SMALL DATASETS VIOLATE BASIC ASSUMPTIONS

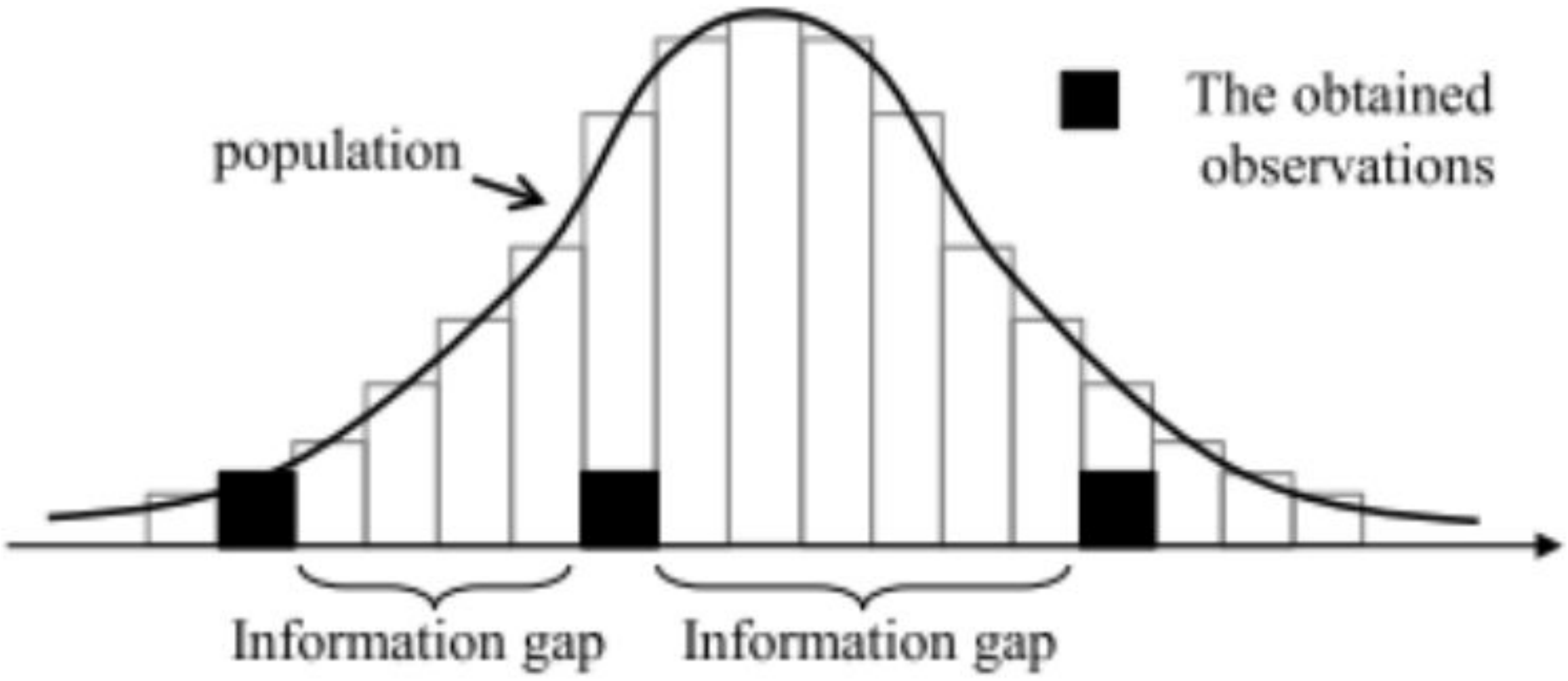
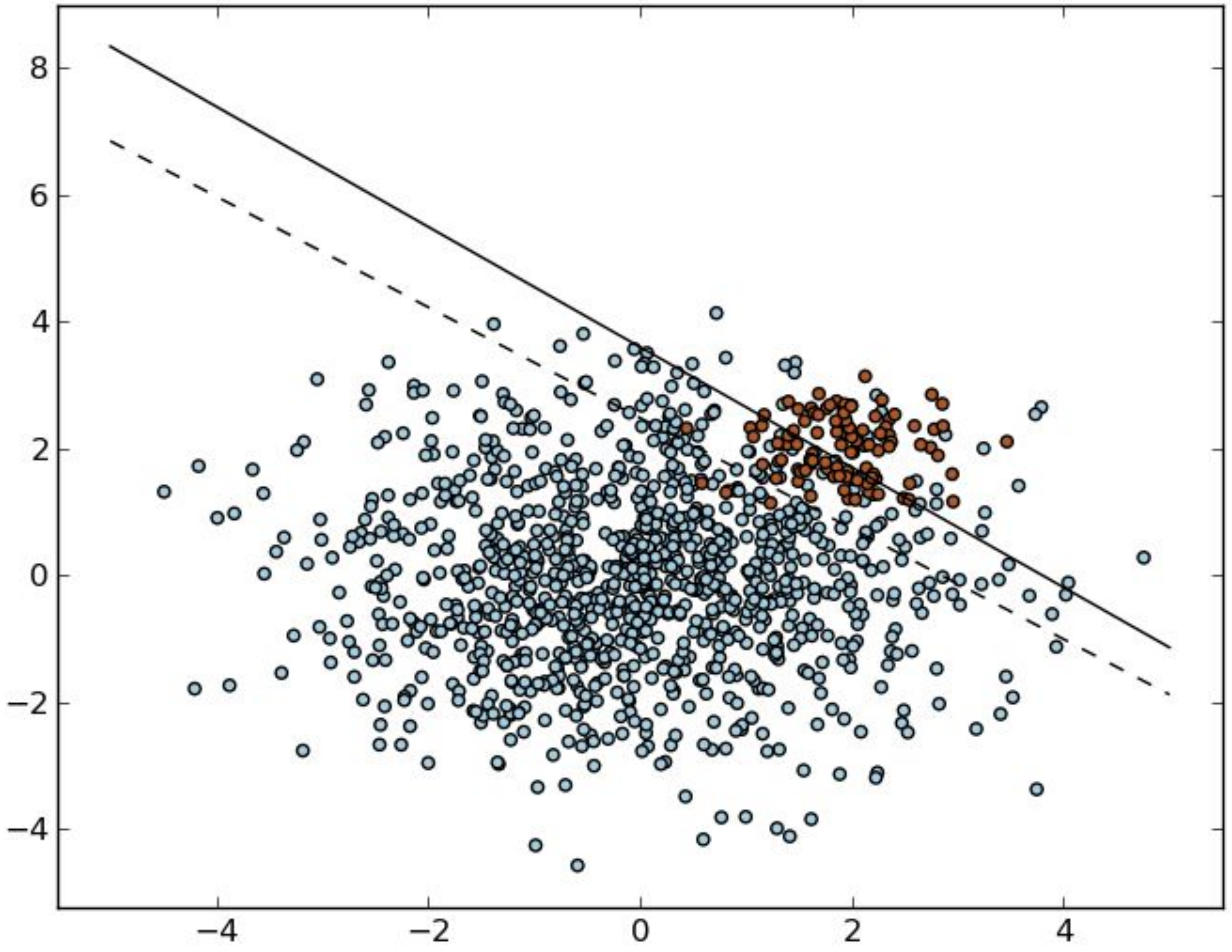


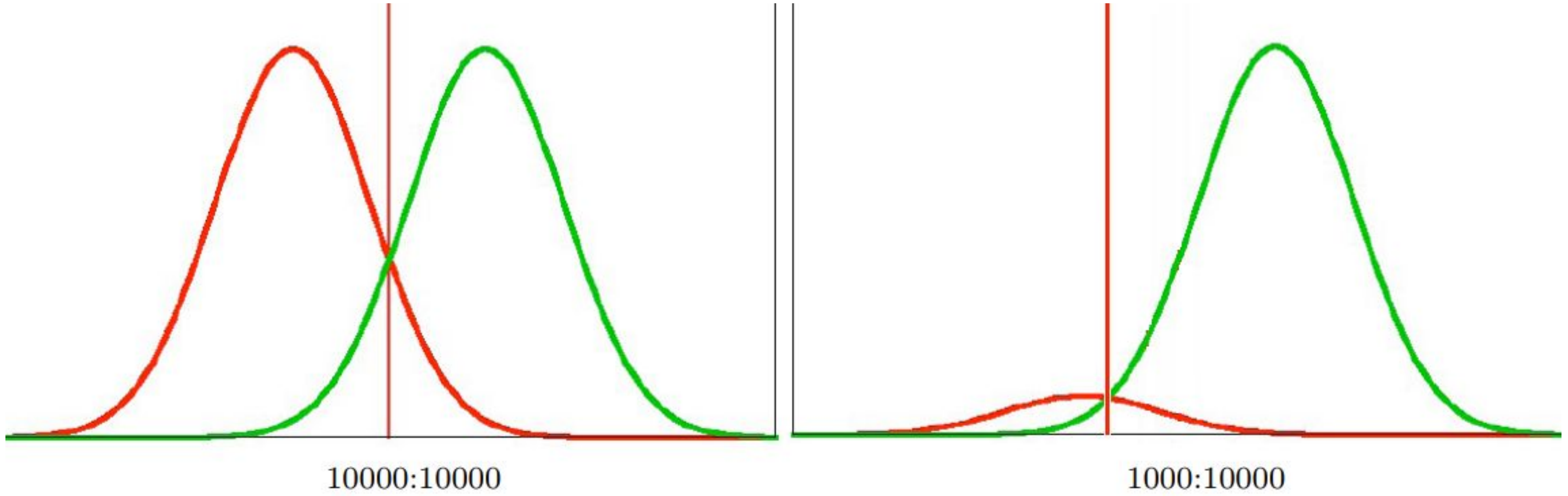
Figure 2. The distribution of a small dataset relative to its population [6]

source:
[‘Handling a Small Dataset Problem in Prediction Model by employ Artificial Data Generation Approach: A Review’]

"THE BIAS NAMED CLASS IMBALANCE"

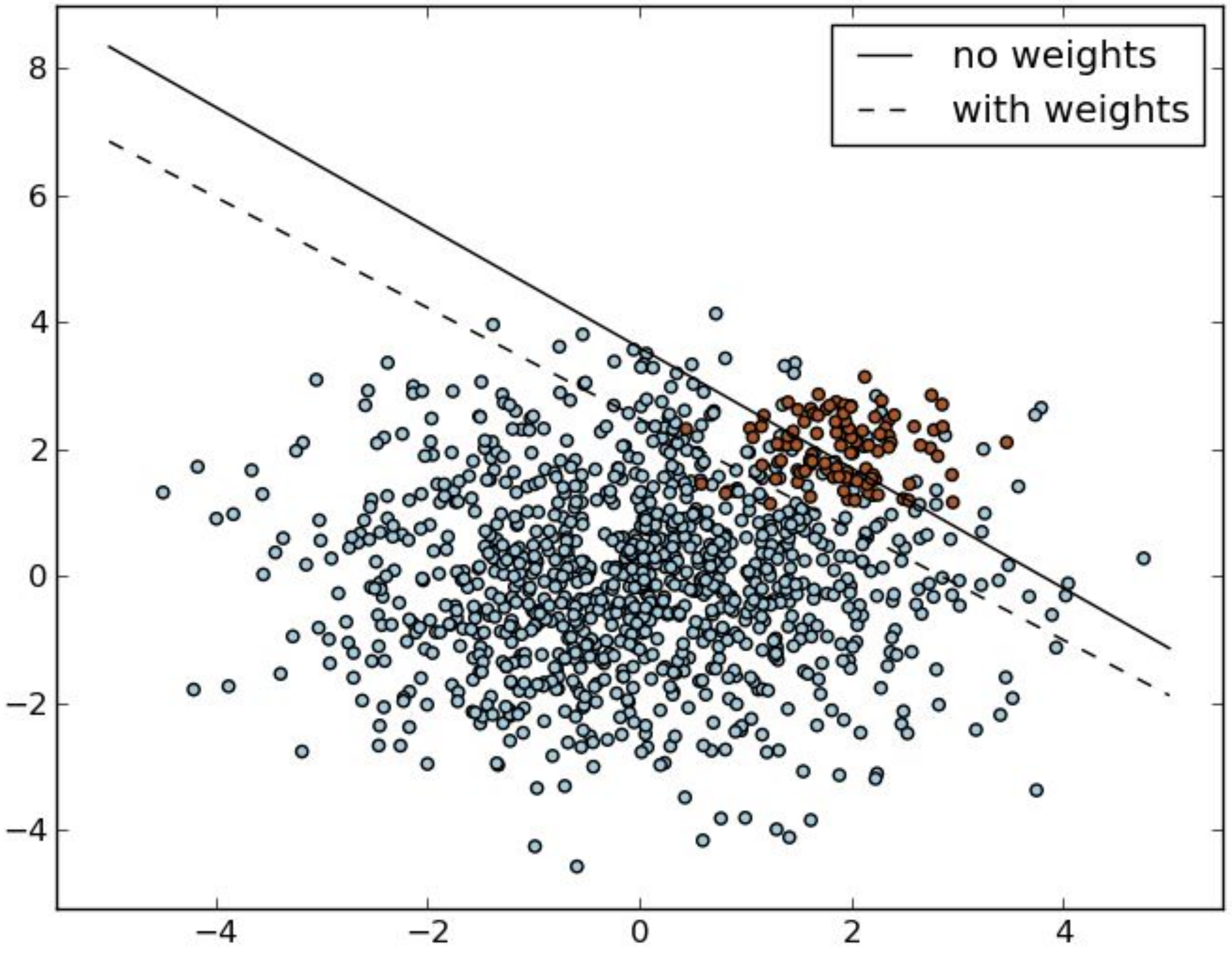
CASE I. - WE DON'T HAVE ENOUGH OF *ONE* THING





source:
"Classification in imbalanced datasets"

SOLUTION 1. - “COST SENSITIVE LEARNING”

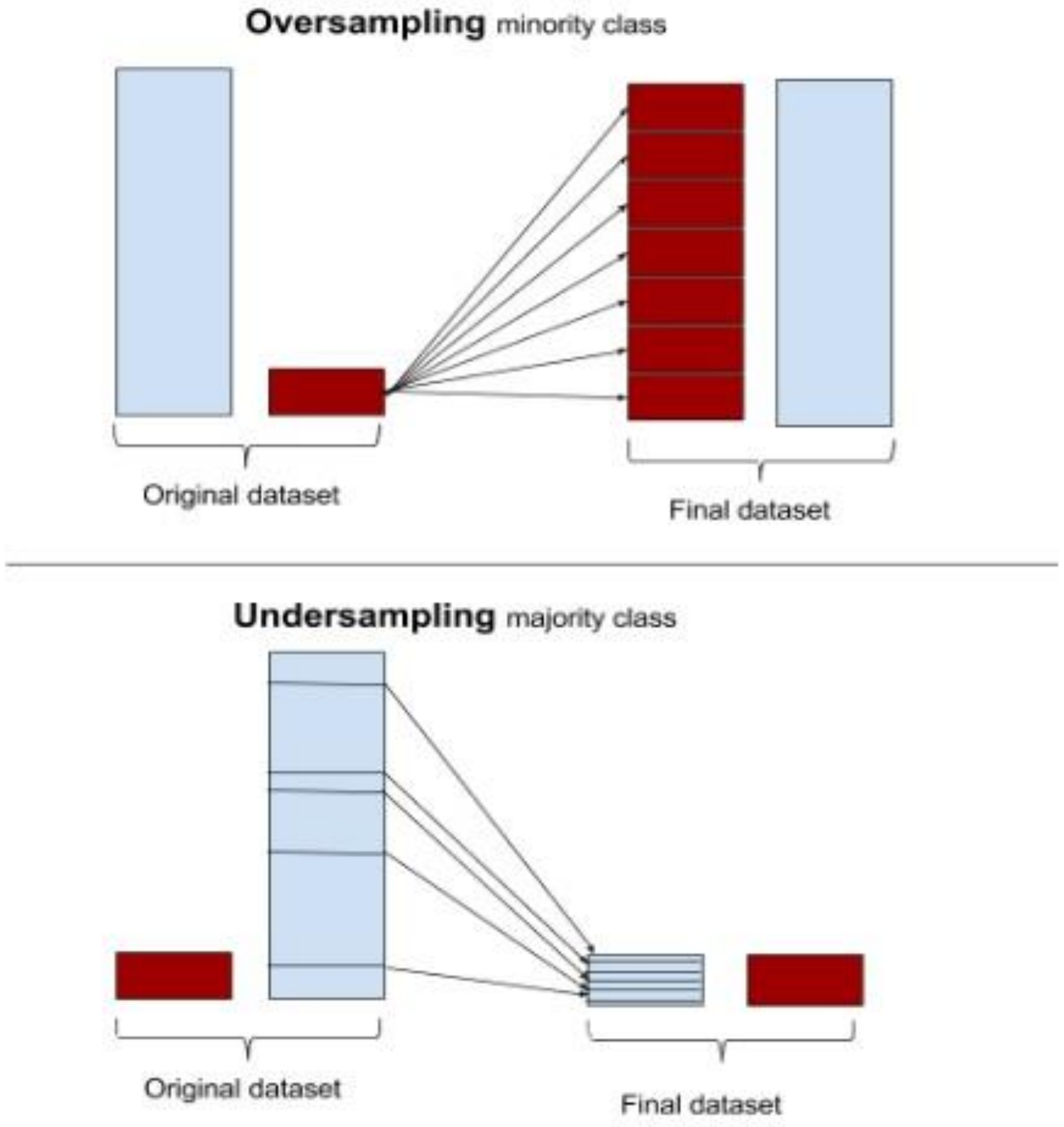


Actual \ Predicted	Category-A	Category-B
Category-A	90	0
Category-B	10	0

We can try to **modify our objective** / cost calculation to accomodate the fact, that making an errőr on the minority class is a “more serious issue”.

source:
“Cost sensitive learning and the class imbalance problem”

SOLUTION 2. - “SAMPLING”



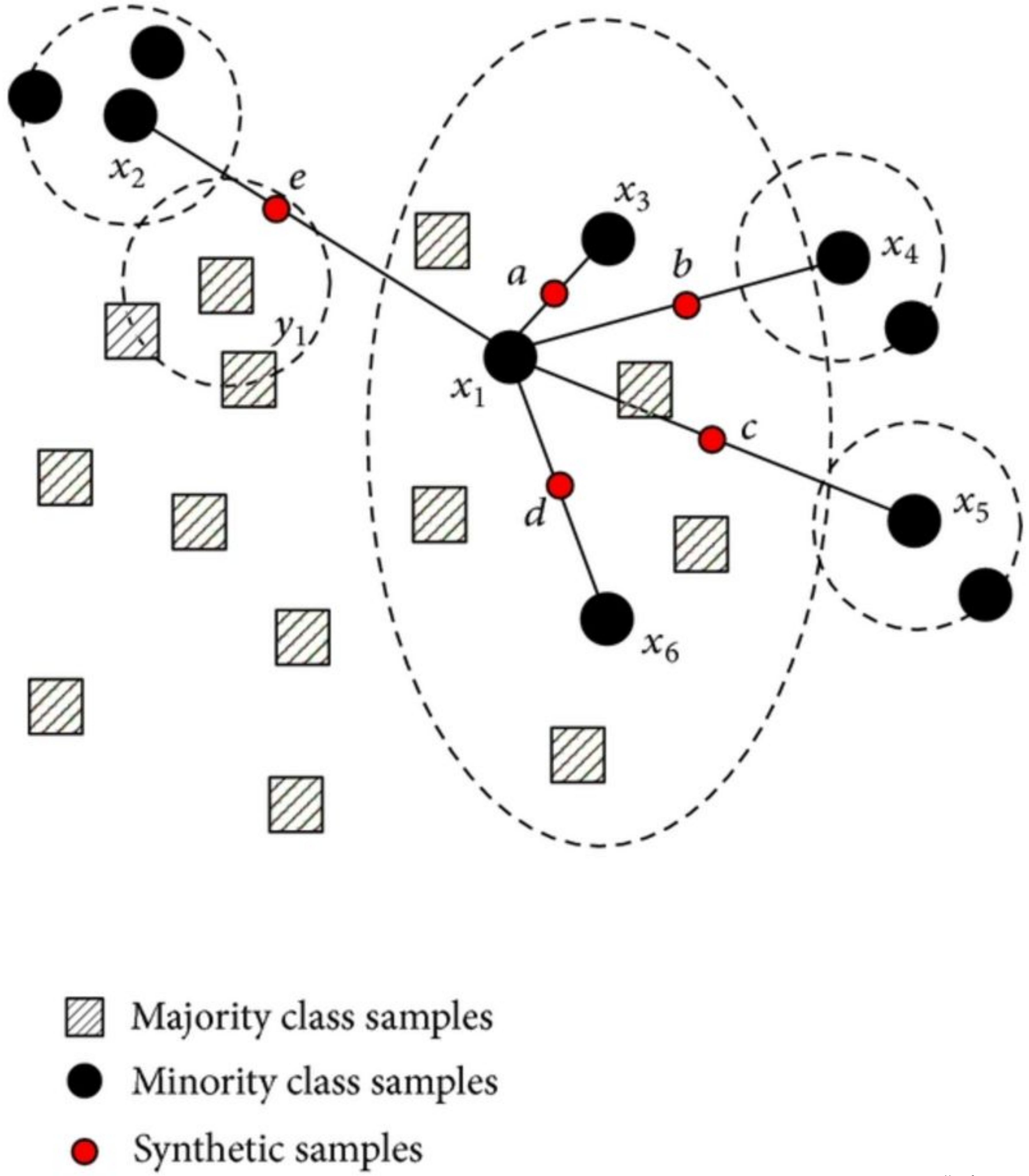
- **Undersampling:**
  - Choose only some of the majority class datapoints
  - Reduces the overall dataset, **not recommended**

- **Oversampling**:
  - Repeatedly use some of the minority class datapoints
  - Good question is: Which ones?
    - Can we be more intelligent then random choice?

source:
Undersampling and oversampling questions

“IF YOU DON‘T HAVE IT-CREATE IT““

SOLUTION 3. - DATA SYNTHESIS



- **Create new datapoints! (SMOTE)**

  “First it finds the n-nearest neighbors in the minority class for each of the samples in the class . Then it draws a line between the the neighbors an generates random points on the lines.”

- **...and add some noise! (ADASYN)**

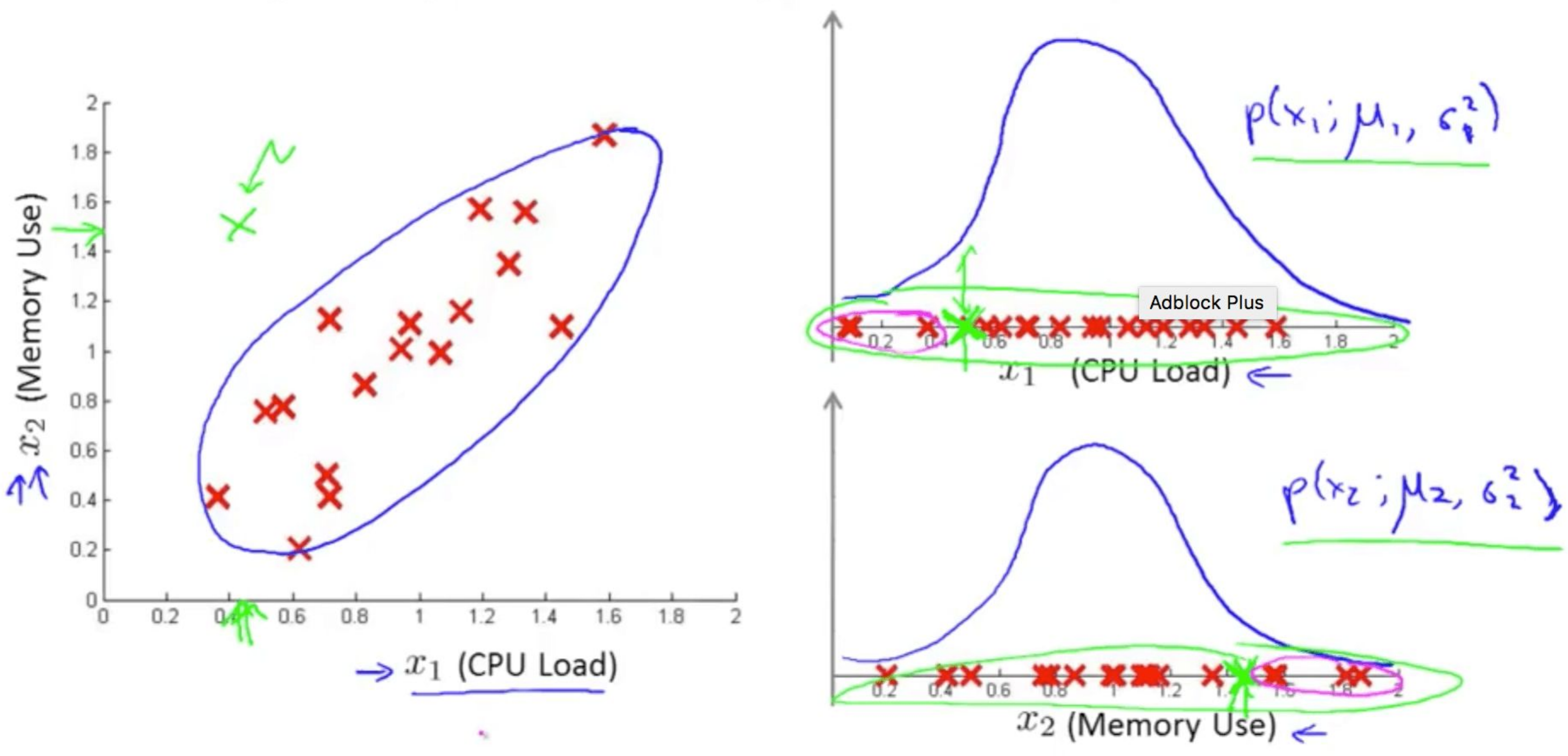
  “After creating those sample it adds a random small values to the points thus making it more realistic. In other words instead of all the sample being linearly correlated to the parent they have a little more variance in them i.e they are bit scattered.”

- **...and use clusters! (Cluster Based Oversampling)**

source:
SMOTE and ADASYN
“Clustering and Learning from Imbalanced Data”

“WELL IF YOU LOOK IT THAT WAY“

SOLUTION 4. - RECAST PROBLEM!

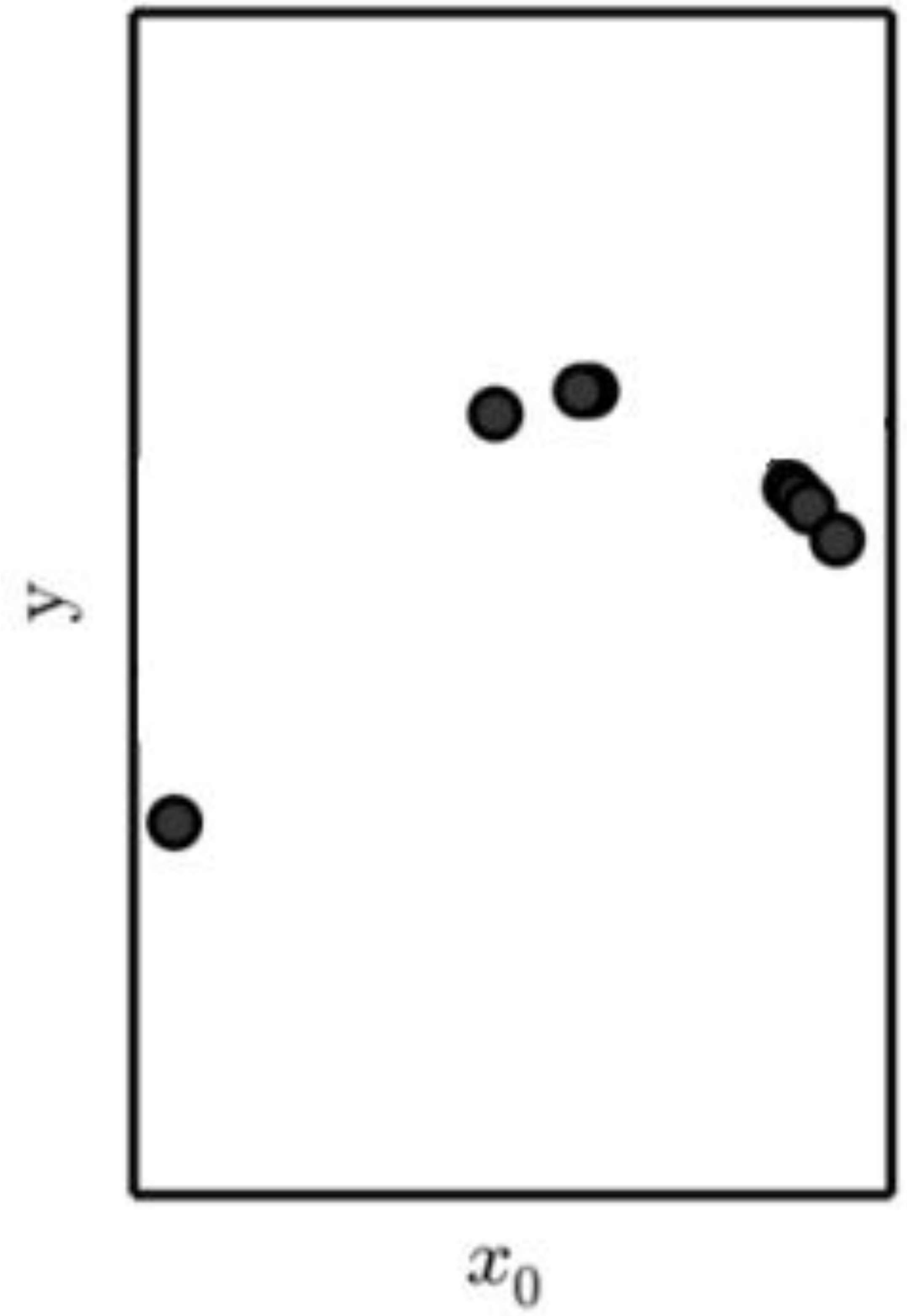


- If the minority class points are so rare, they can be considered “exceptions”, or **“anomalies”**
- There are tools for “one class” classification (eg.: “One class SVM” and “Isolation forests”)
- But if we basically get a good **probabilistic model** of the majority class distribution, we are done.
- This will lead us to **“representation learning”**

source:
Classification based outlier detection techniques
Anomaly Detection using the Multivariate Gaussian Distribution
Ritchie Ng: Anomaly detection

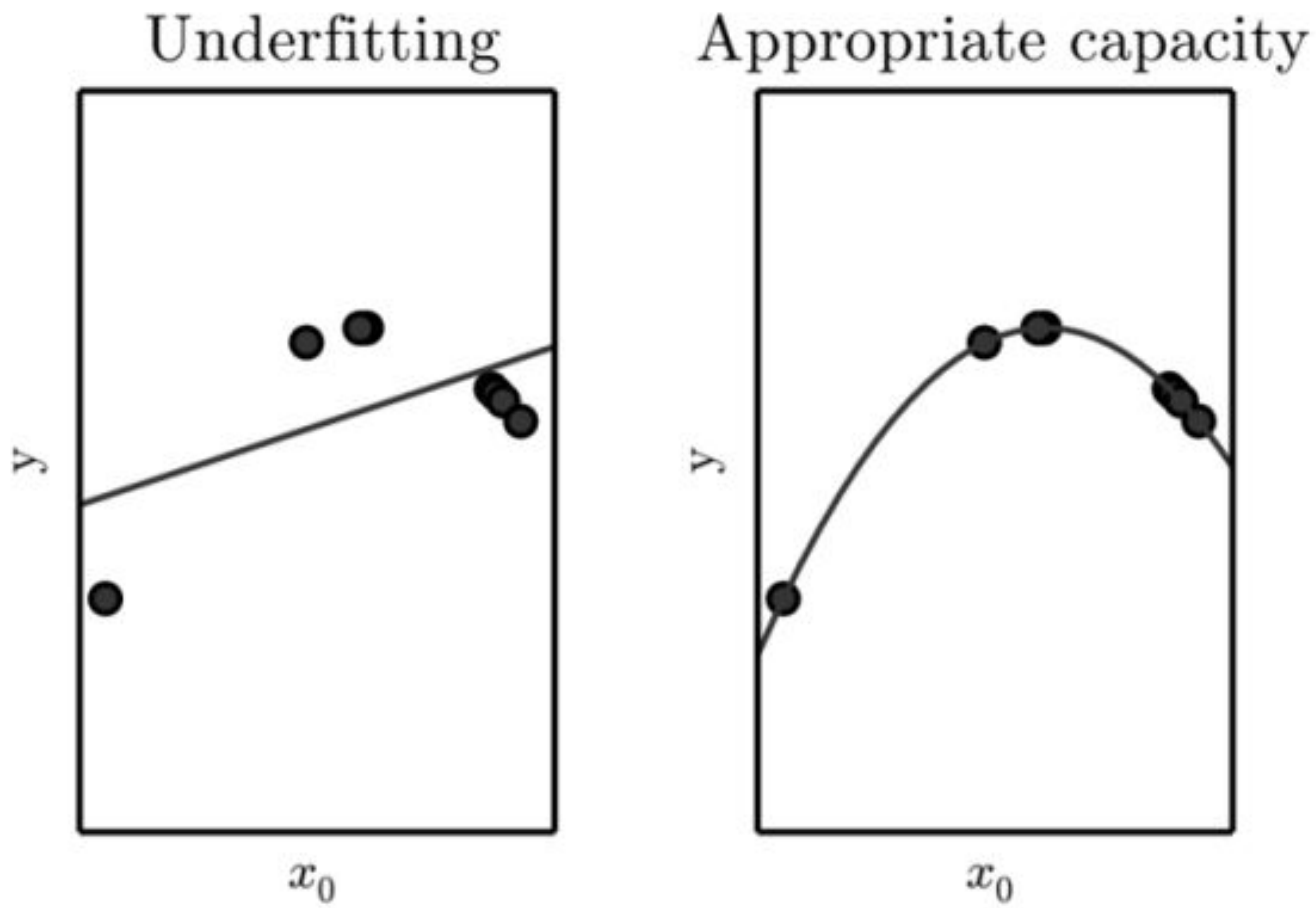
“SIMPLY: NOT ENOUGH DATA

CASE II. - WE DON’T HAVE ENOUGH *ANYTHING*



“NOT ENOUGH IN WHAT SENSE?“

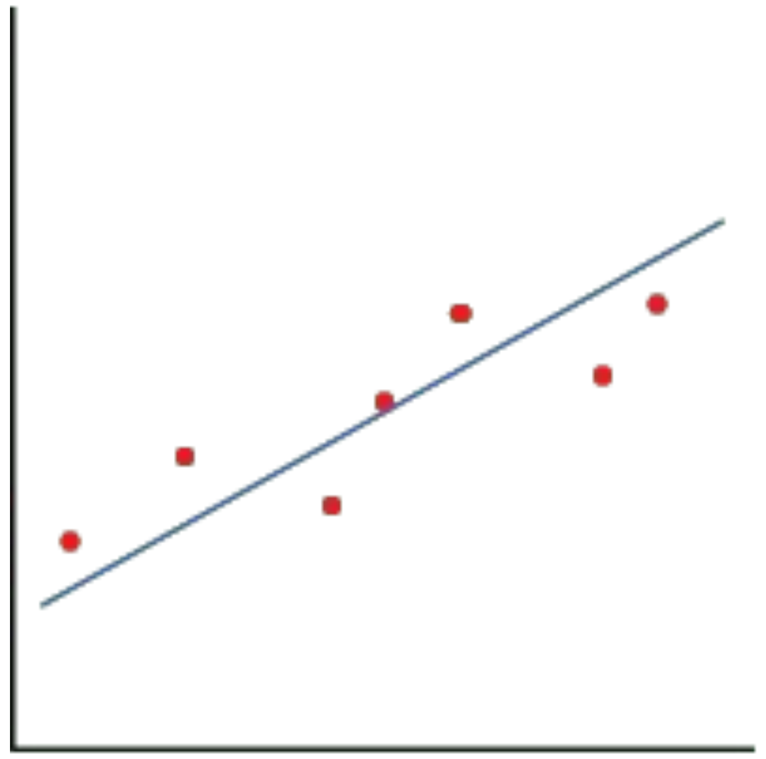
CONNECTION WITH OVERFITTING



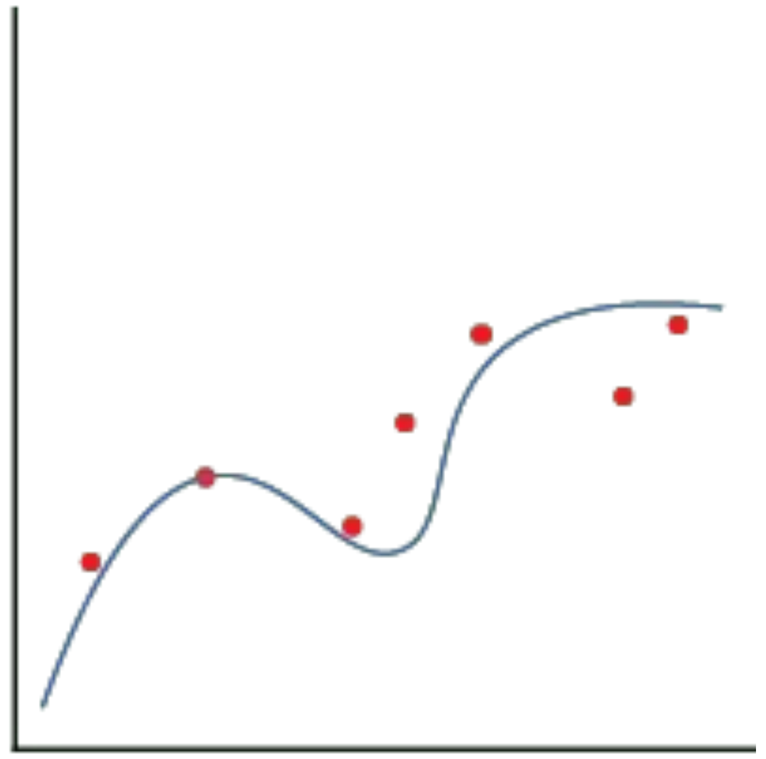
source:
Overfitting - Wikipedia

“TRY THE CLASSICS FIRST“

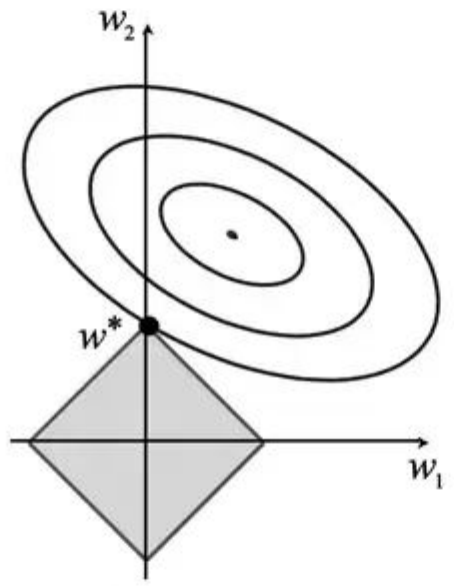
FIRST TRY - CLASSIC METHODS FOR STABILITY



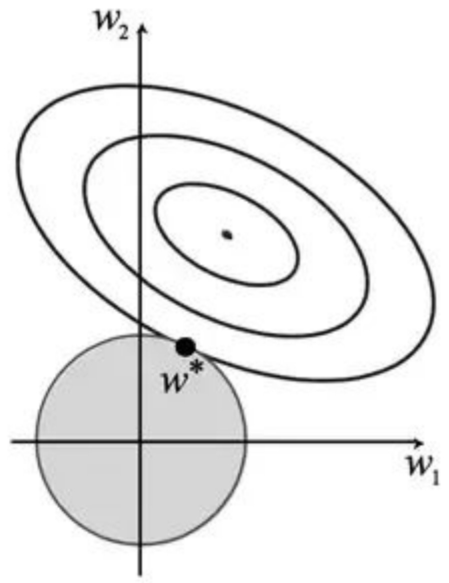
Simple model



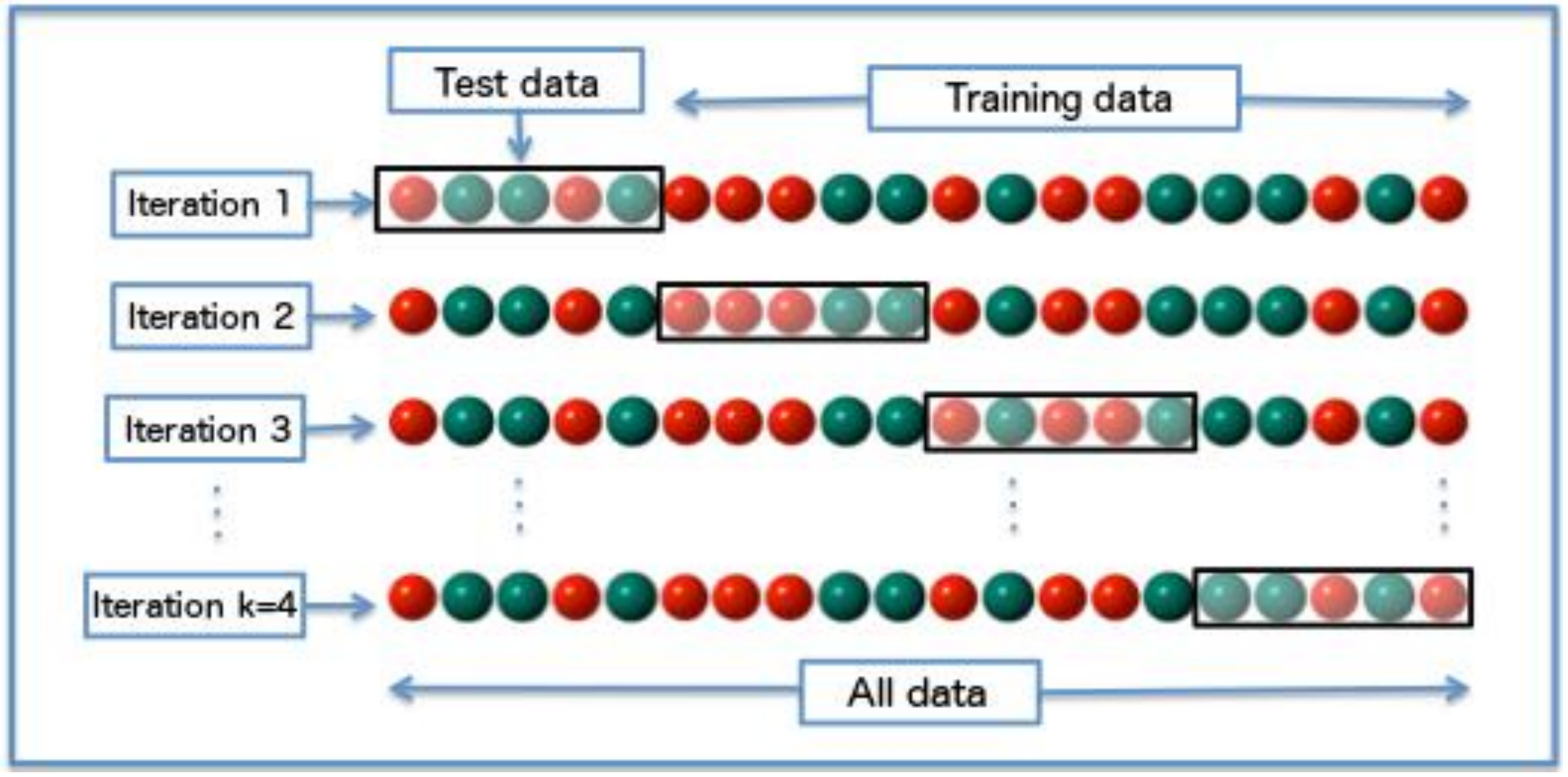
Complex model



L1



L2



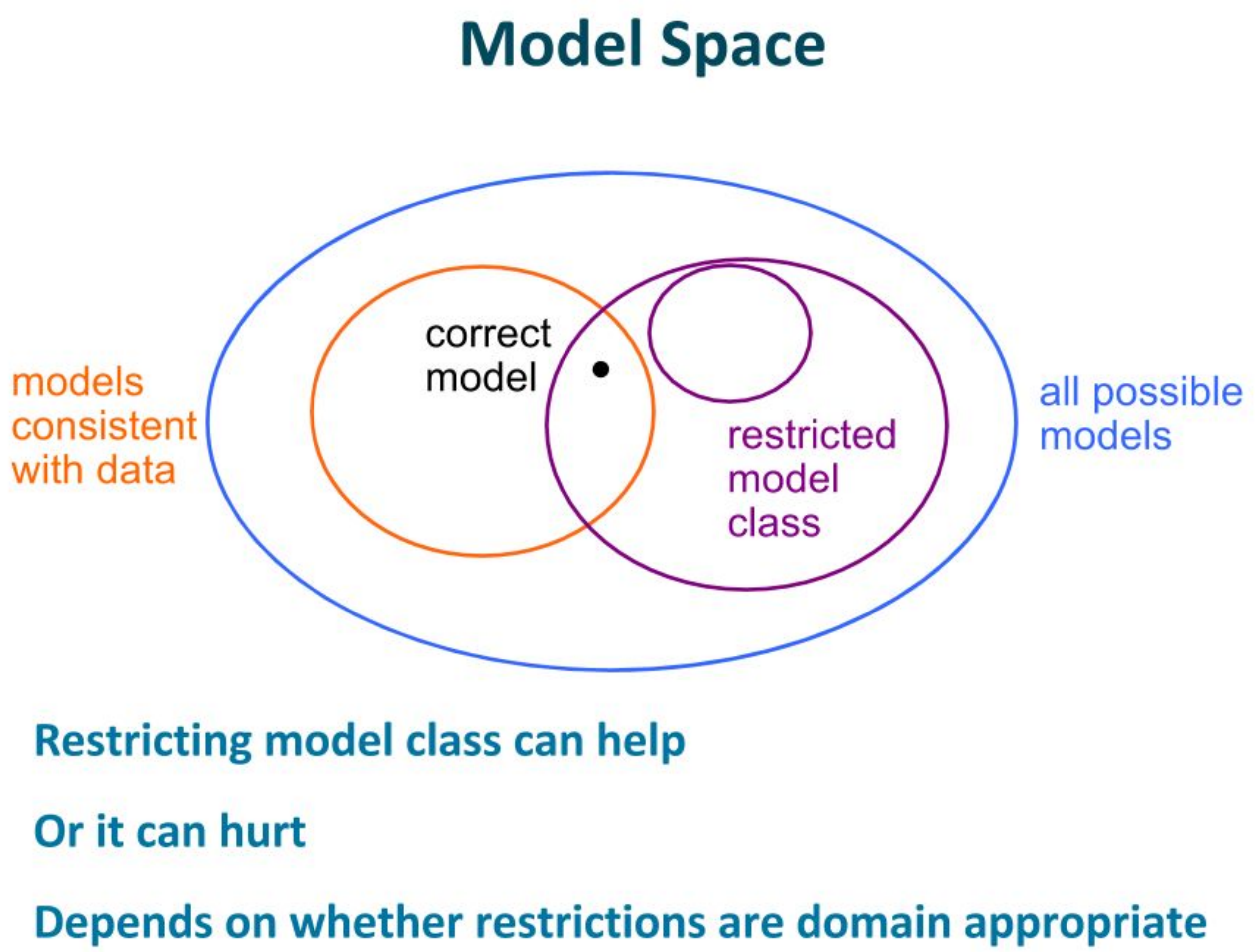
- **Modify the model:**
  - Use a simple model
    - We are often forced to use a complex one since the data itself is complex (dimensions, non-linearity...)
  - Use special models (eg. SUFTware)

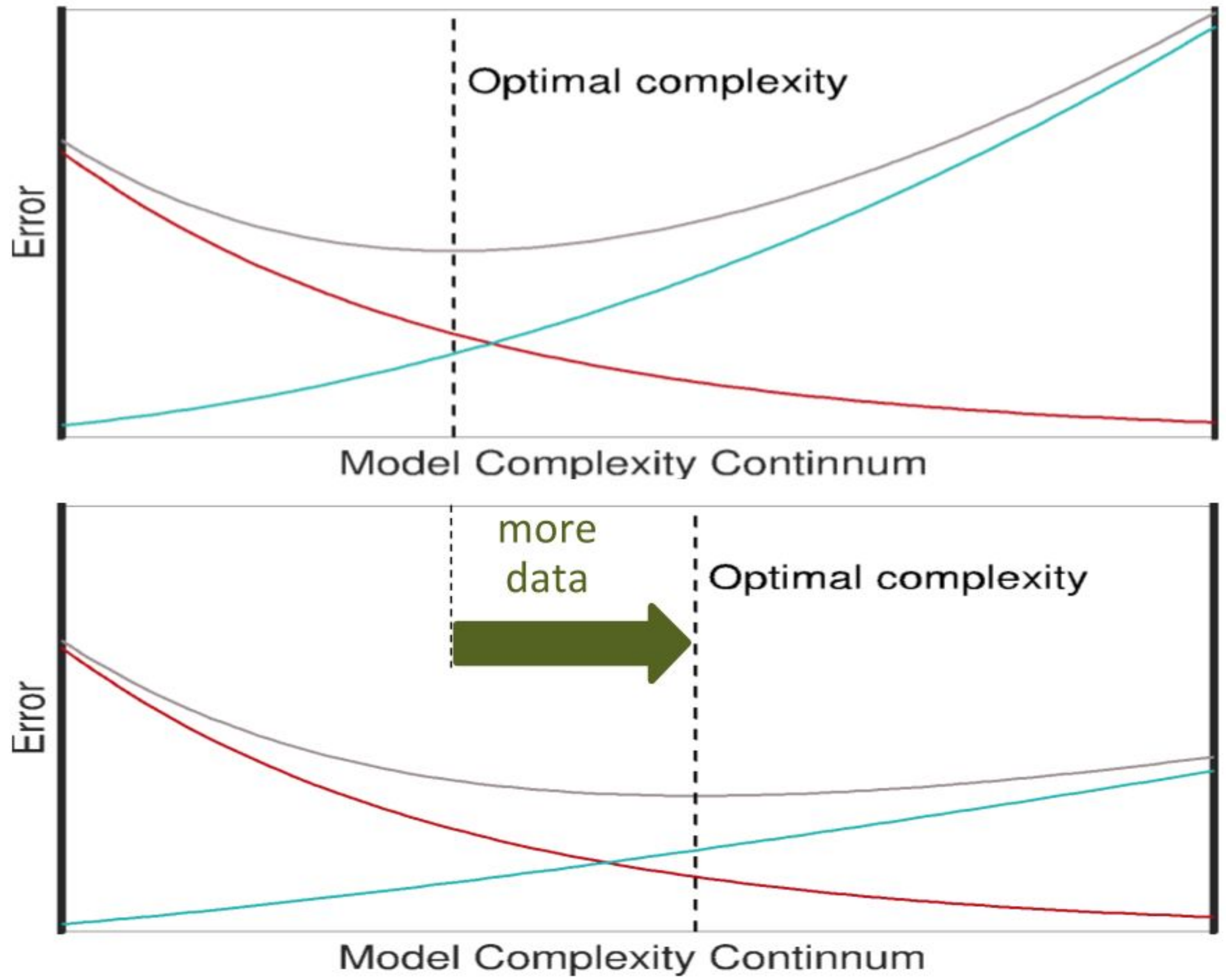
- **Modify the objective:**
  - Add regularization term (Capacity control)
  - Use “max margin” objective (like in SVMs)

- **Modify the training:**
  - Use crossvalidation for getting a bit more out of the data
  - Use PU Learning

“THE MORE THE MERRYER“

REMARK: ADDING MORE DATA ACTS AS “REGULARIZER”

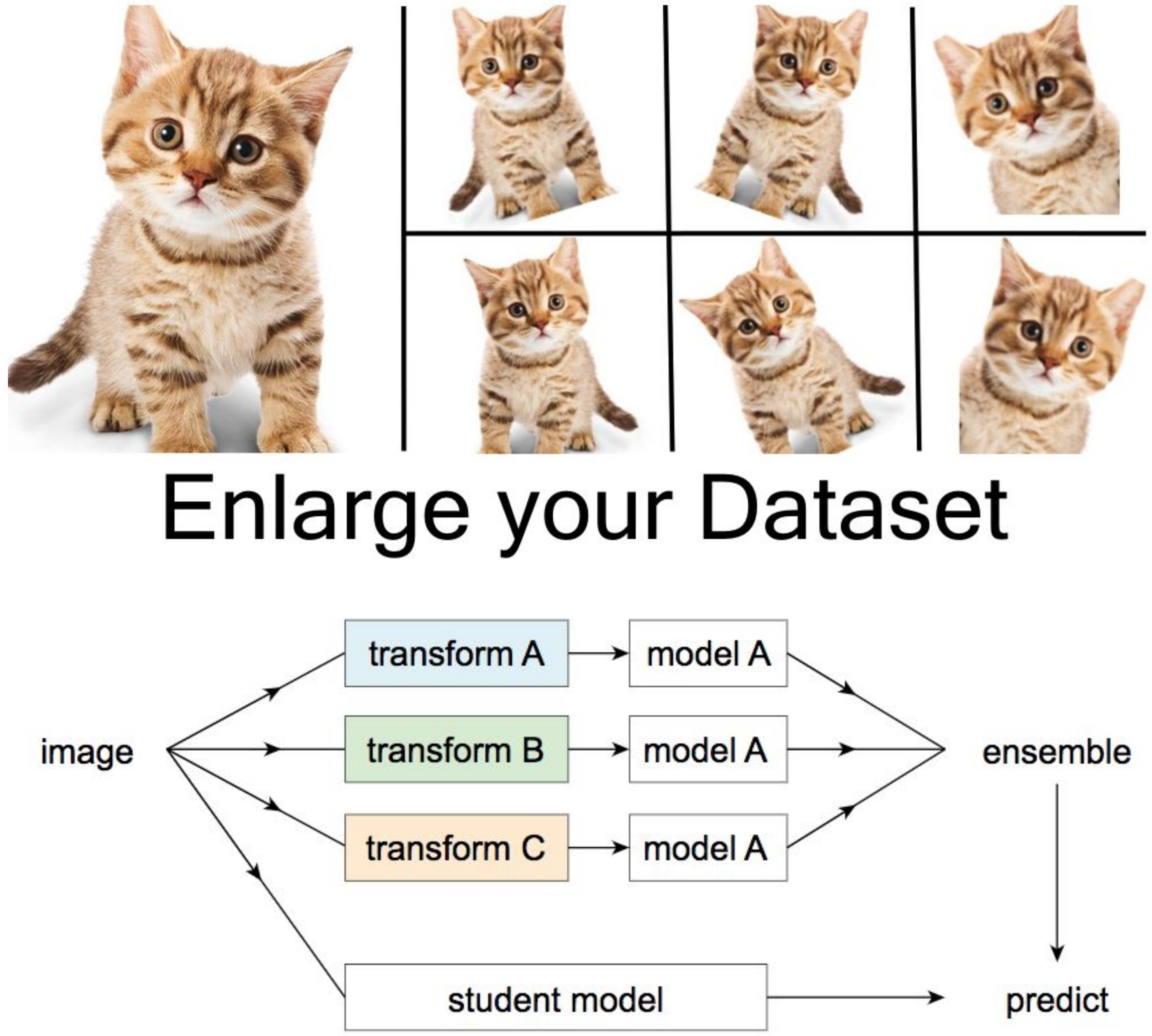




source:
: Lecture series of Michael C. Mozer at DeepLearn2017 Bilbao”

"THE MORE THE MERRIER"

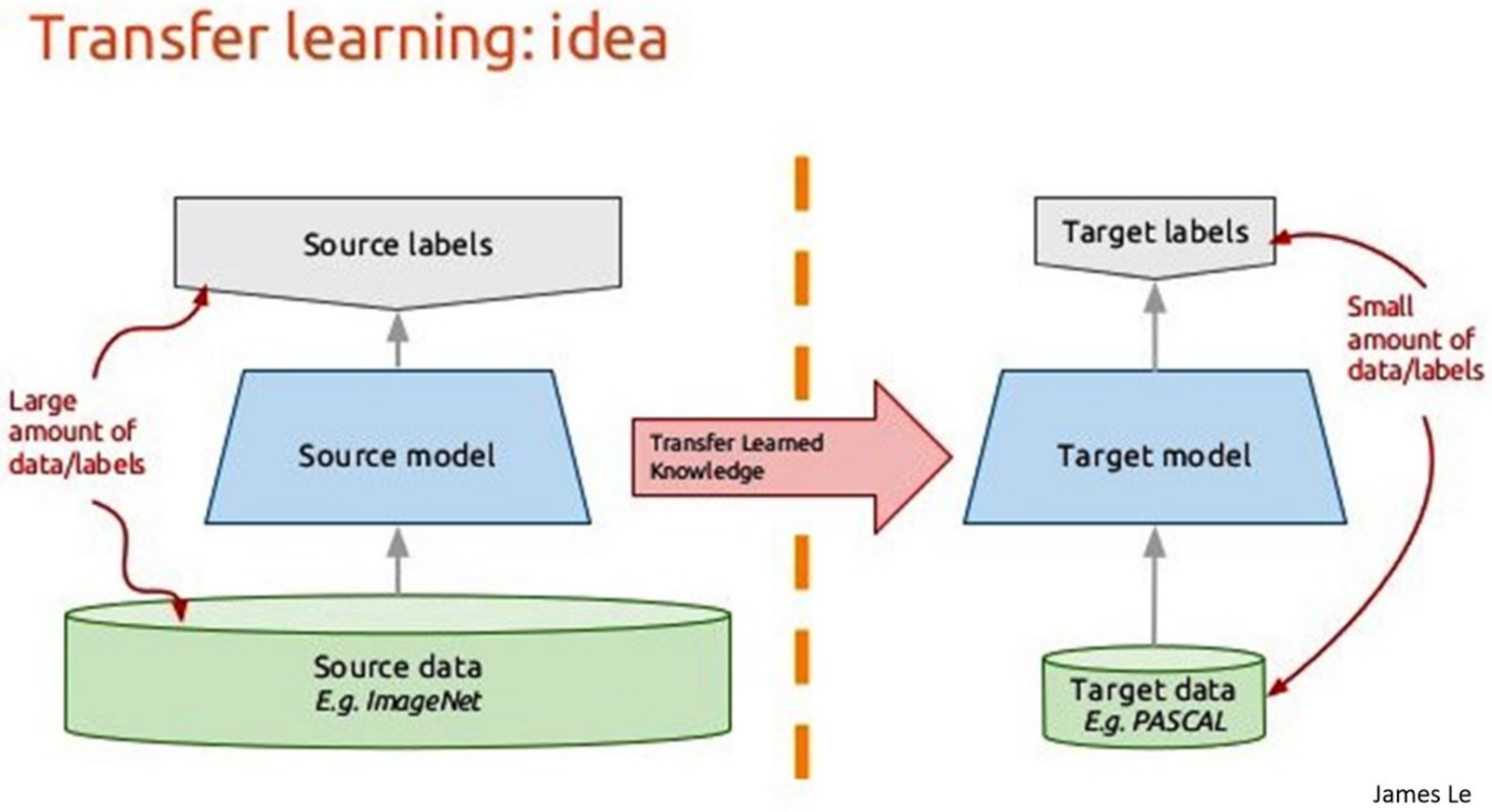
GET MORE "DATA" 1. - GENERATE OR AUGMENT



- **Data augmentation:**
  - Use simple operations to modify the data
    - Images: rotate, mirror, crop,...
    - **MUST be realistic for the domain distribution**
- **Data distillation:**
  - Transform data, train subclassifiers, use them on new data, add predictively labelled data to original.
- **Weak supervision:**
  - Can be, that labels wil be noisy - crowdsourcing

source:
"Data augmentation - How to use Deep Learning when zou have limited data?"
"Data distillation: Towgards omni-supervised learning"
"A brief introduction to weakly supervised learning"

GET MORE “DATA” 2. - TRANSFER IT! (COMPRESSED)



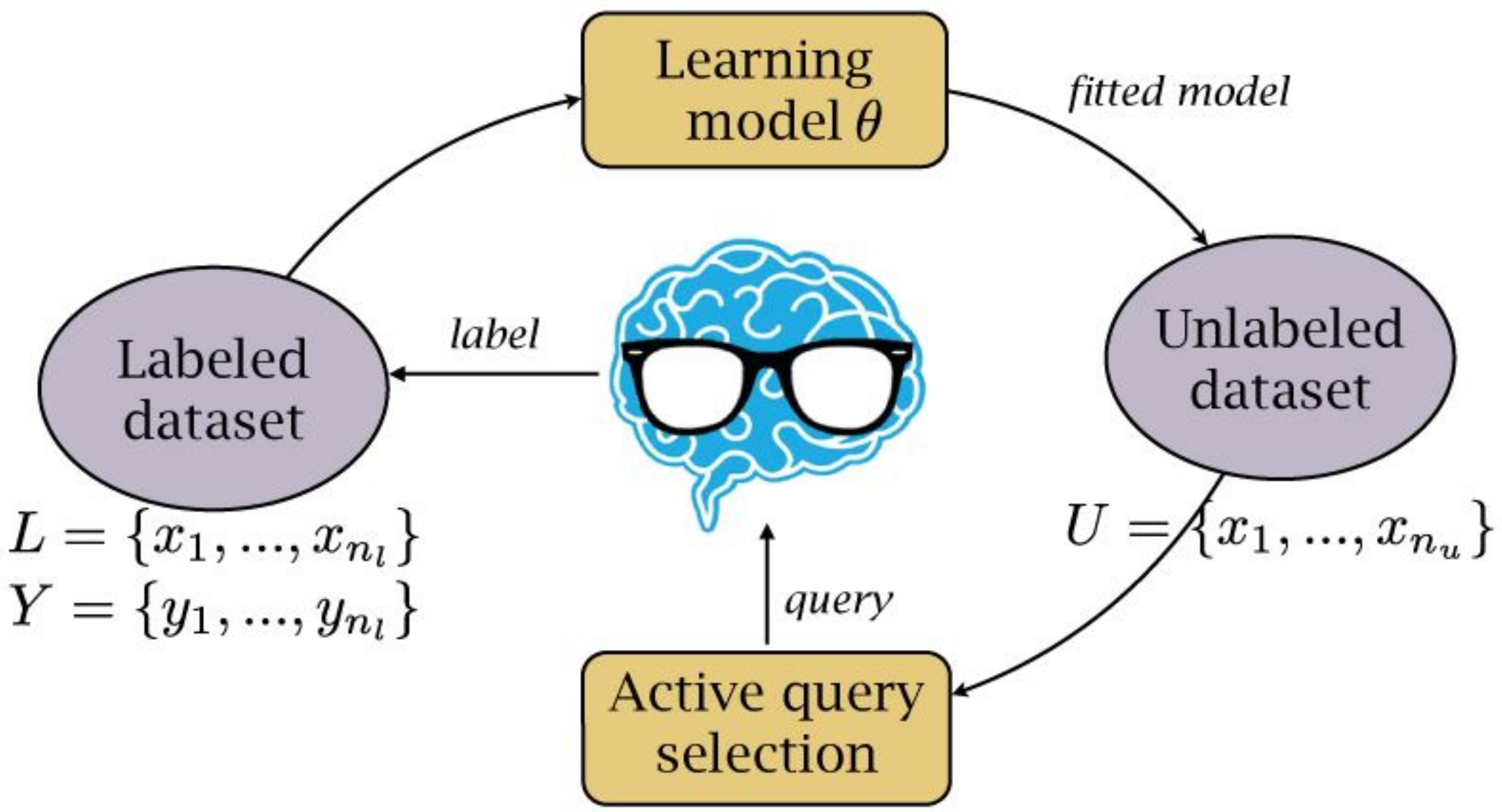
- **Transfer learning!**
  - A **HUGE** topic in itself (with more and more spohisticated methods for preventing **“catastrophic forgetting”**)
  - **We have to see, that models are “storing” data, albeit compressed.**
  - There are **plenty of pre-trained models available, USE THEM!**

- What model to “transfer”?
  - Notion of “learning a whole representation space” (see eg.: Mixup method)
  - **GANs or VAEs** are generally strong candidates (+ few labeled data case)

source:
“Transfer Learning - Machine Learning's Next Frontier”
“”Data Augmentation in Emotion Classification Using Generative Adversarial Networks”

"PLEASE?"

GET MORE "DATA" 3. - ASK FOR IT! :-)



- **Crowdsource!**
  - Amazon Mechanical Turk
  - or CrowdFlower.

- **Design a learning loop!**
  - Continuous, **Online learning**
  - There are key points worth asking for (margin, adversarial examples) -> **Active learning**

source:
"Adversarial sampiing for active learning"
"Atacking machine learning with adversarial examples"

MEASUREMENT VS BUSINESS RISK
- THE FALSE FOCUS ON ACCURACY

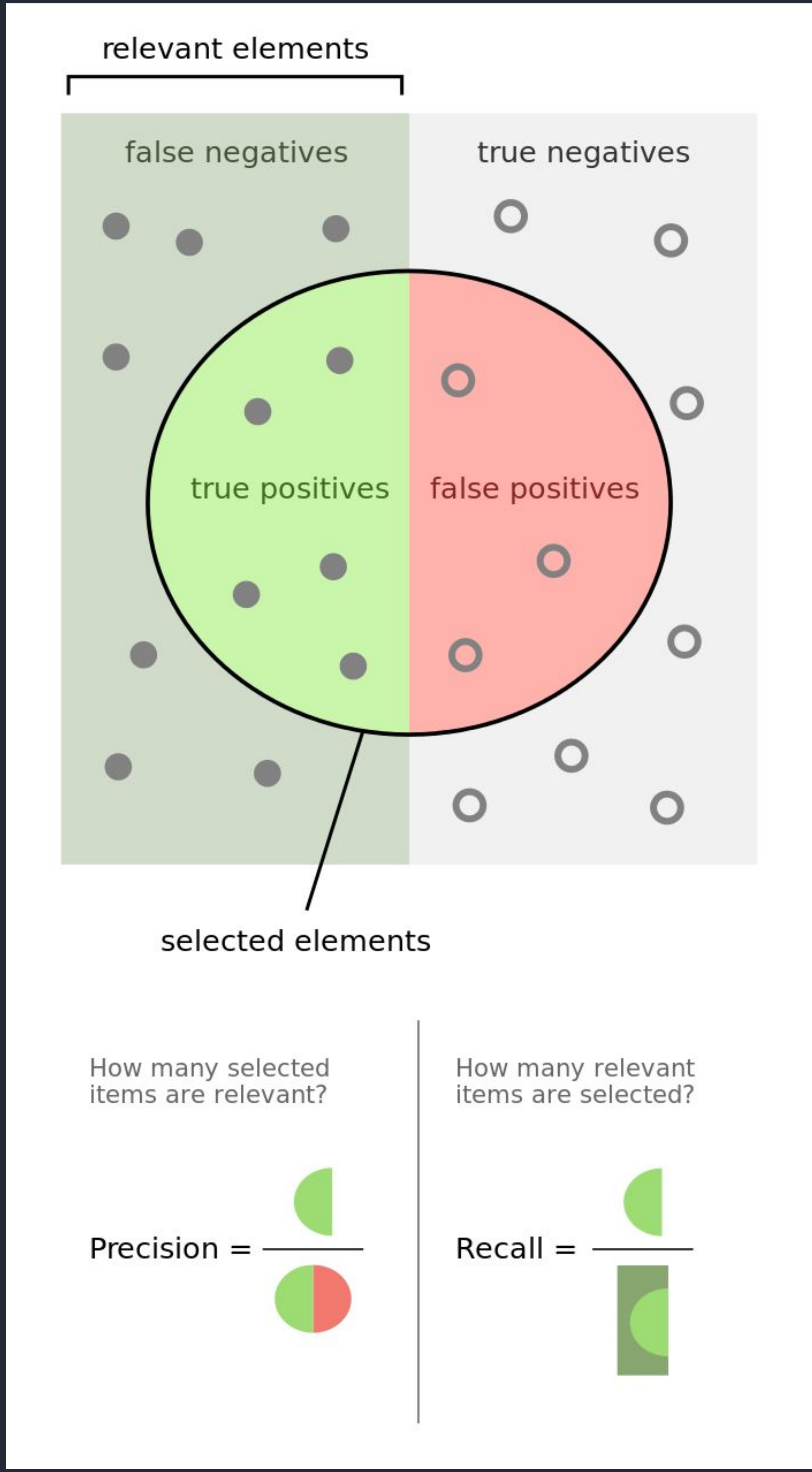
“I HAVE 90% ACCURACY!”

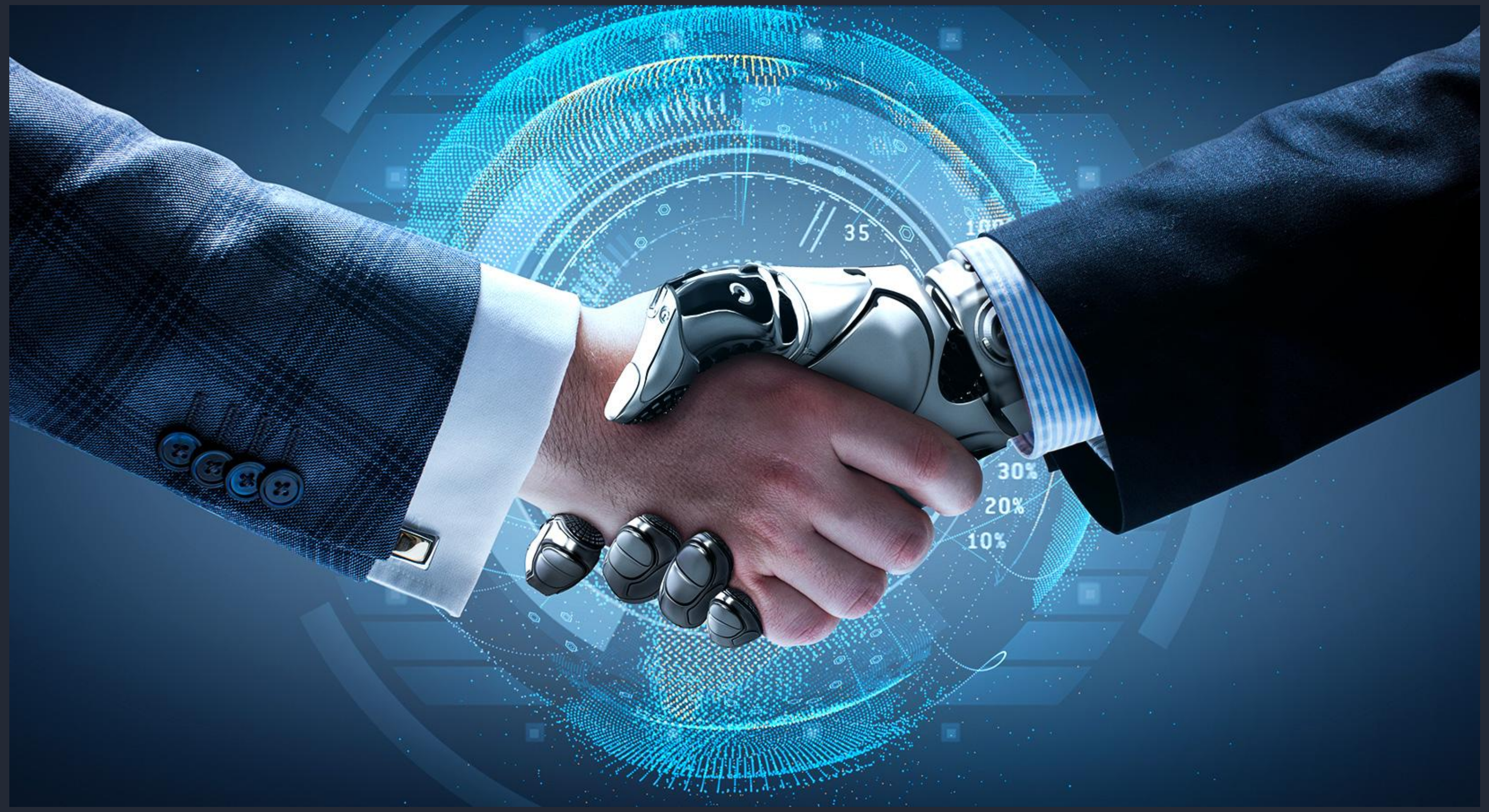
CLASSIFICATION RISK:

“Your cancer predictions are 90% accurate.
We have 10 dead people.”

SOLUTION:

Substitution of huiman expertise is not the way!
Think in cooperative systems!





DON'T REPLACE, AUGMENT!

COOPERATIVE SYSTEMS ARE MINIMIZING RISK

Artificial intelligence VS Augmented intelligence

THANKS FOR THE ATTENTION!

LET'S CONTINUE!

PRESENTATION

COMMUNITY

MYSELF