

LECTURE 4 TERM 2:

MSIN0097

UCL
SCHOOL OF
MANAGEMENT

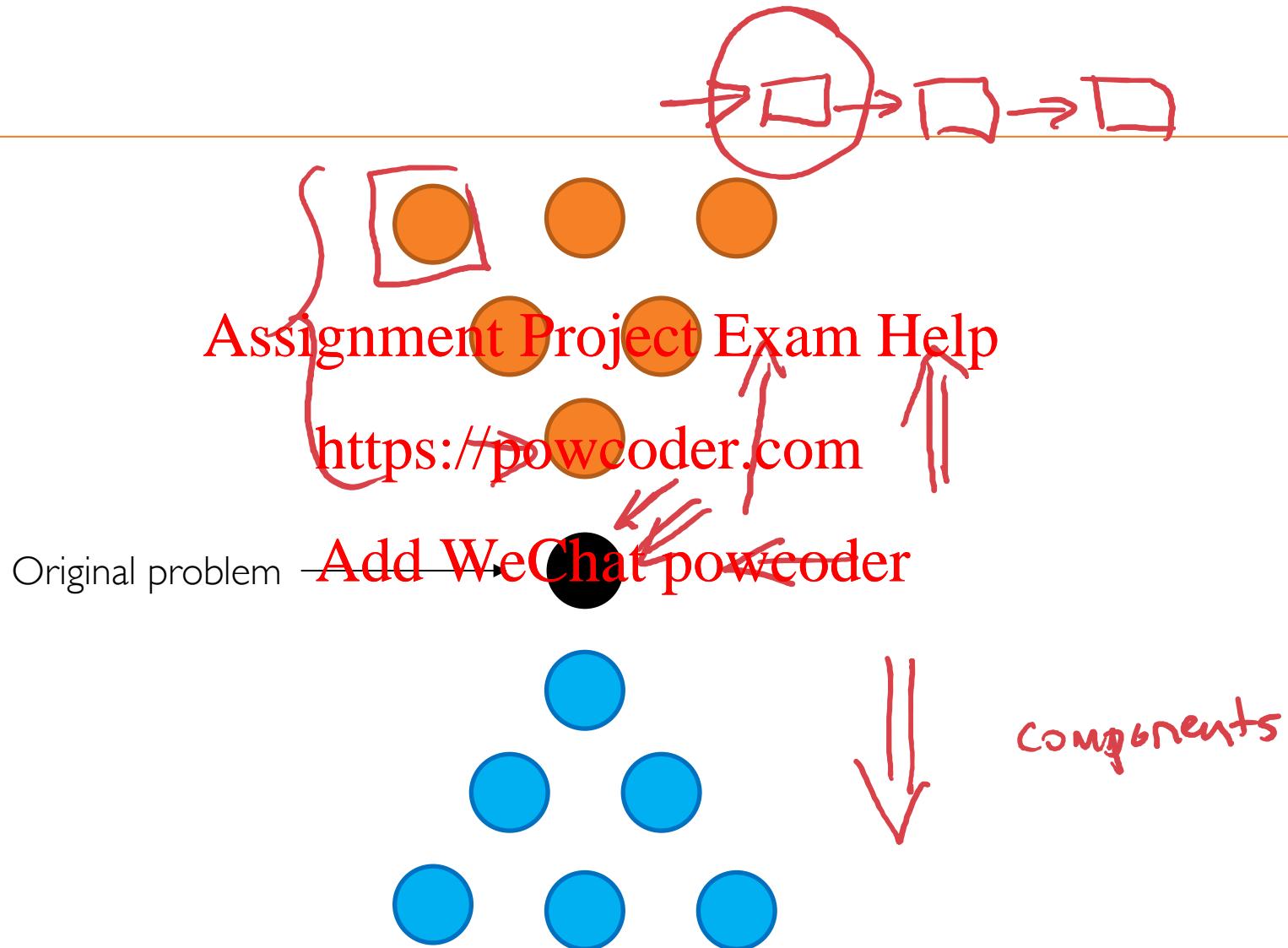
PREDICTIVE ANALYTICS Assignment Project Exam Help

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A P MOORE

SYSTEMS DESIGN



Improving bad solutions

- Start with a bad Solution (weak learner) and improve it
- Build up a better solution by thinking about how partial solutions can support/correct each others mistakes

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- Improving bad solutions
 - Start with a bad Solution (weak learner) and improve it
 - Build up a better solution by thinking about how partial solutions can support/correct each others mistakes

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- Make the problem simpler
 - Divide and conquer
 - Problem decomposition

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DEALING WITH DIFFICULT PROBLEMS

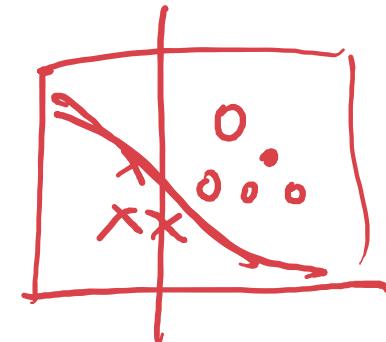
- Improving bad solutions
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- Make the problem simpler
 - Divide and conquer
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- Building much better solutions
 - Deep models



- Start with a bad Solution (weak learner) and improve it
- Build up a better solution by thinking about how partial solutions can support/correct each others mistakes

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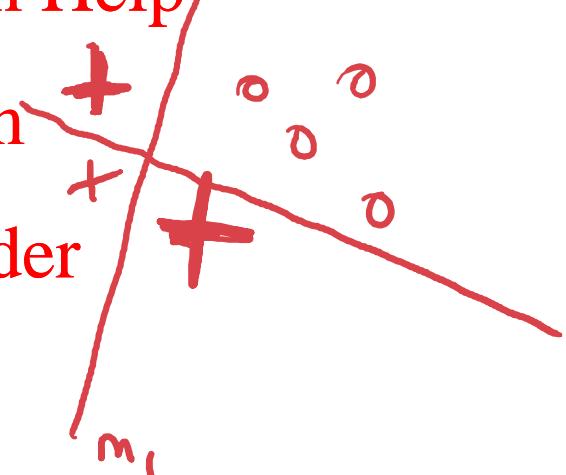
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- Voting
 - Majority voting
- Bagging and Pasting
 - Out-of-bag evaluation
- Boosting
 - Adaptive Boosting (Adaboost)
 - Gradient Boosting
 - XGBoost
- Stacking

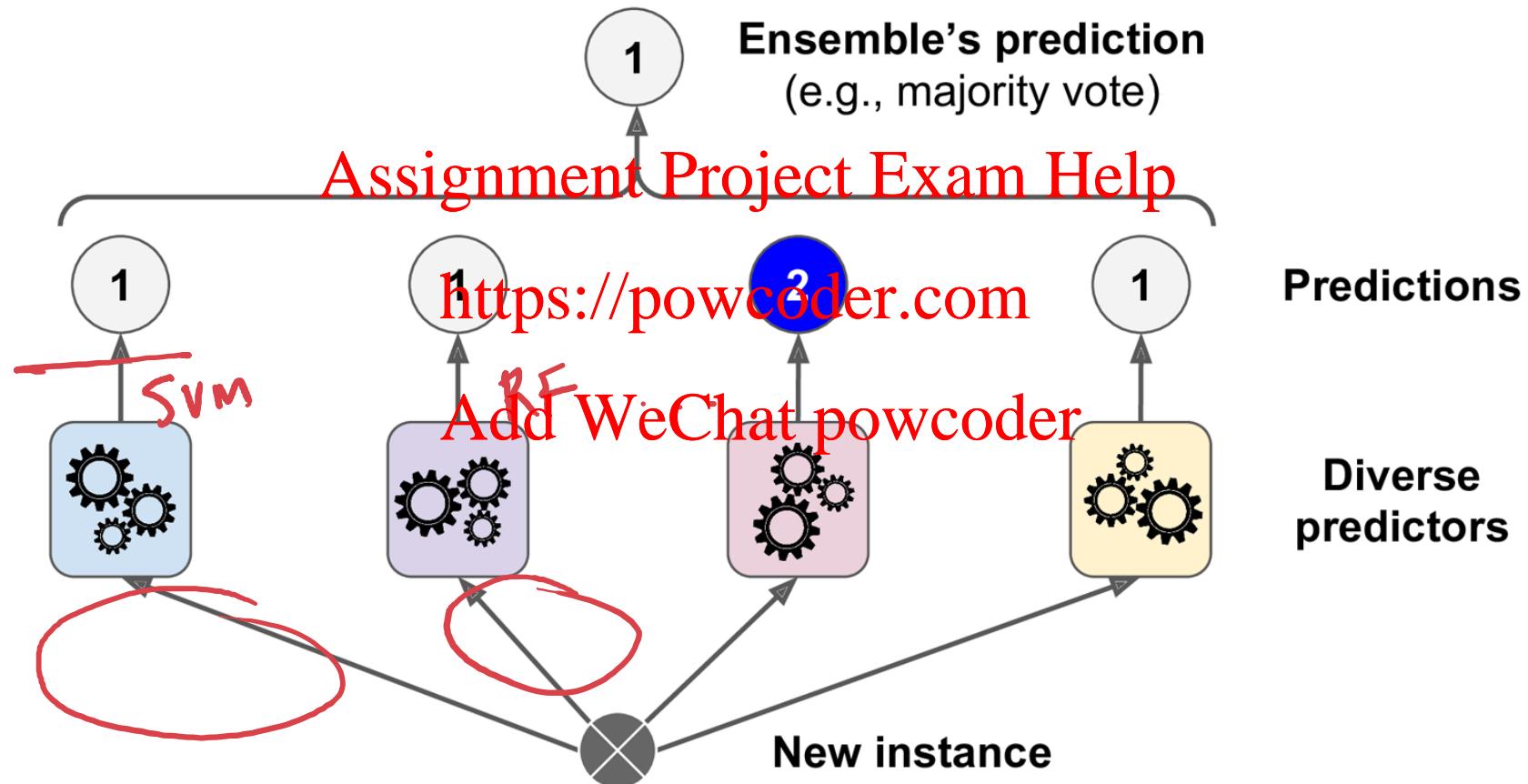
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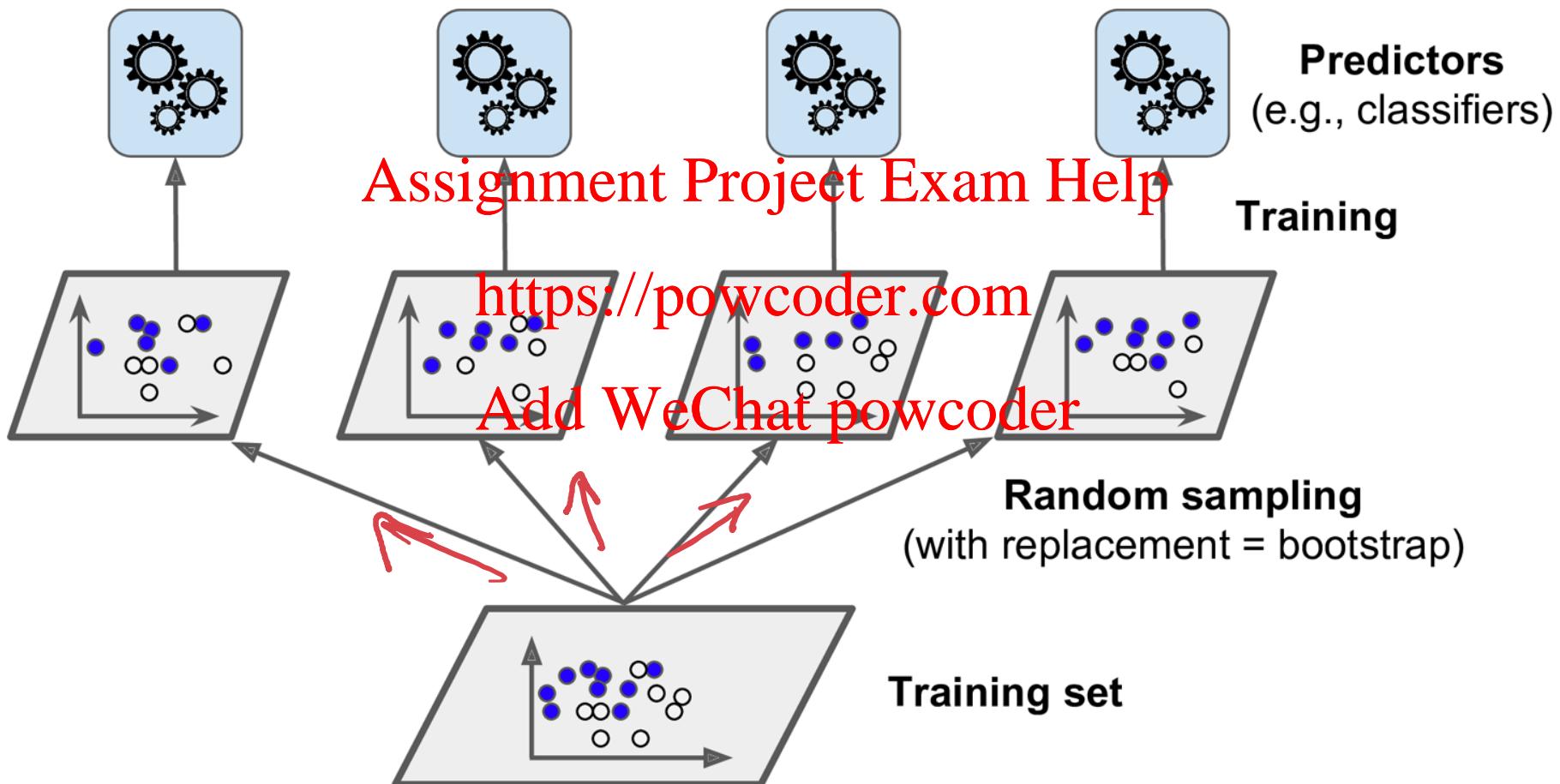
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MAJORITY VOTING

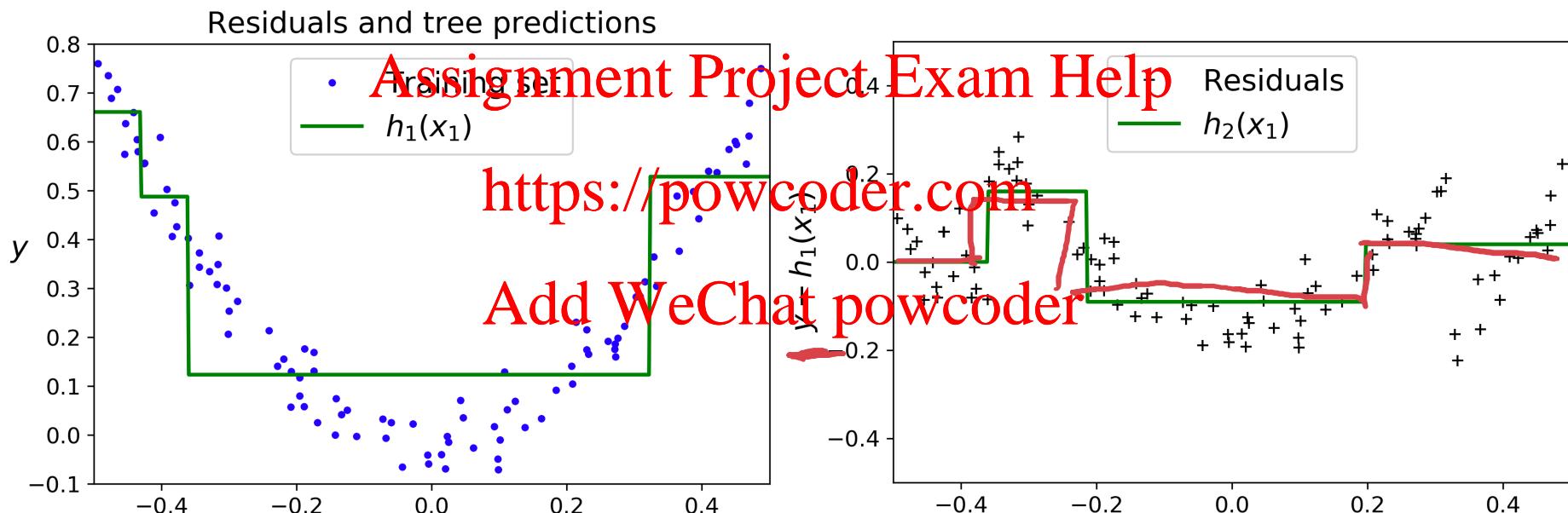


BAGGING



GRADIENT BOOSTING

FITTING RESIDUAL ERRORS



DECOMPOSITION

STARTING WITH EASIER PROBLEMS

- Start with a hard Problem
- Break the problem into a lot of easier sub-tasks
- Make each subtask support the analysis in subsequent tasks easier

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A. CIAssification

Model requirements

Classification

$$x \in [-\infty, \infty]$$
$$y \in \{0, N\}$$

B. Regression

Model requirements

Regression

$$x \in [-\infty, \infty]$$
$$y \in [-\infty, \infty]$$

C. Clustering

Model requirements

Clustering

$$x \in [-\infty, \infty]$$
$$y \in \{0, N\}$$

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Regression

$$x \in [-\infty, \infty]$$
$$y \in [-\infty, \infty]$$

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D. Decomposition

Model requirements

Decomposition

$$x \in [-\infty, \infty]$$
$$y \in [-\infty, \infty]$$

Supervised

Svm

Unsupervised



1

A. Classification

Model requirements

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D. Decomposition

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We know what the right answer is

Supervised

Unsupervised

A. Classification

Model requirements

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Decomposition

Model requirements

Decomposition

$$x \in [-\infty, \infty]$$
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Supervised

Unsupervised

We don't know what the right answer is — but we can recognize a good answer if we find it

A. Classification

Model requirements

Classification

$$x \in [-\infty, \infty]$$
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Unsupervised

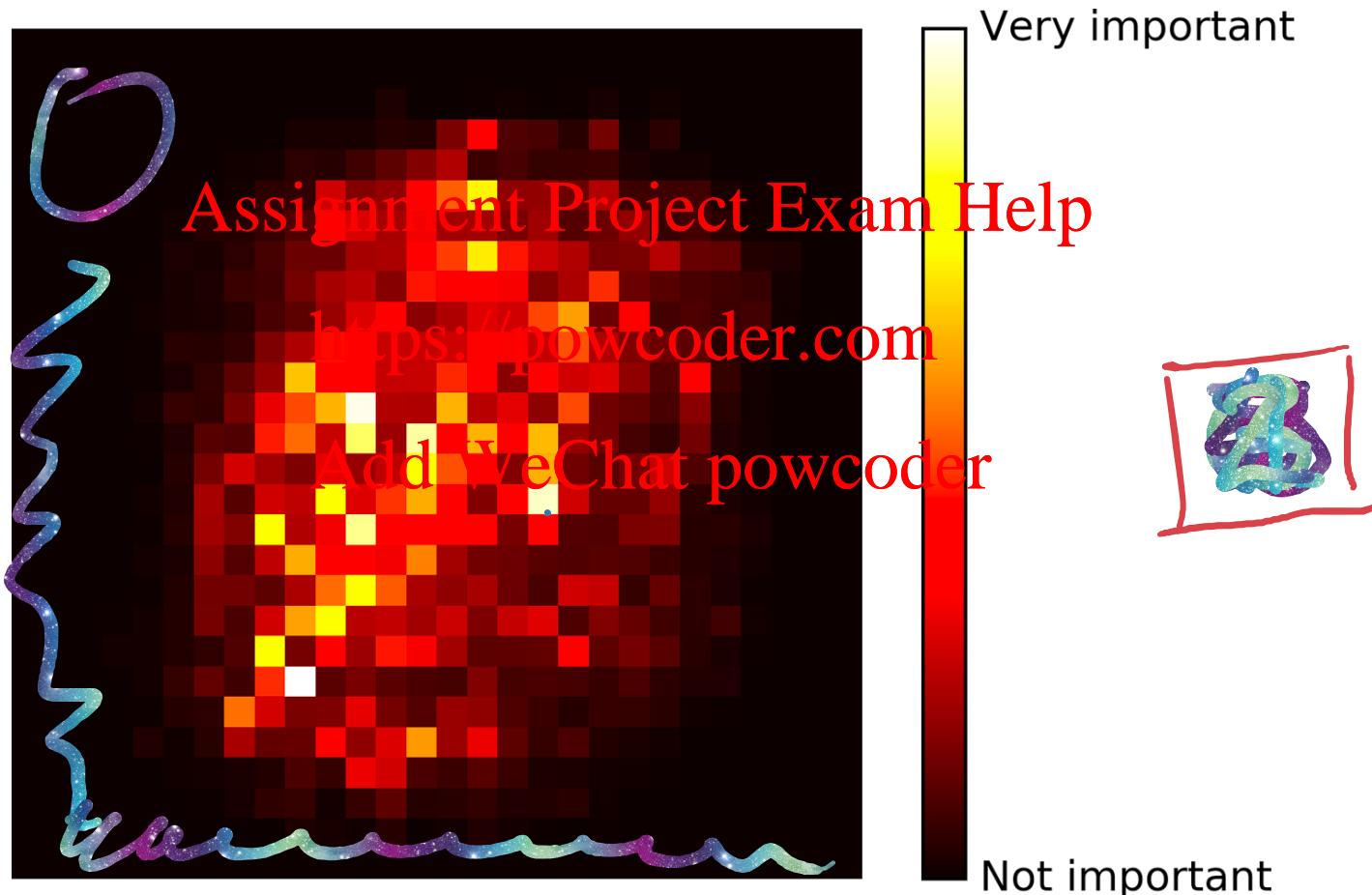
We don't know what the right answer is — but we can recognize a good answer if we find it

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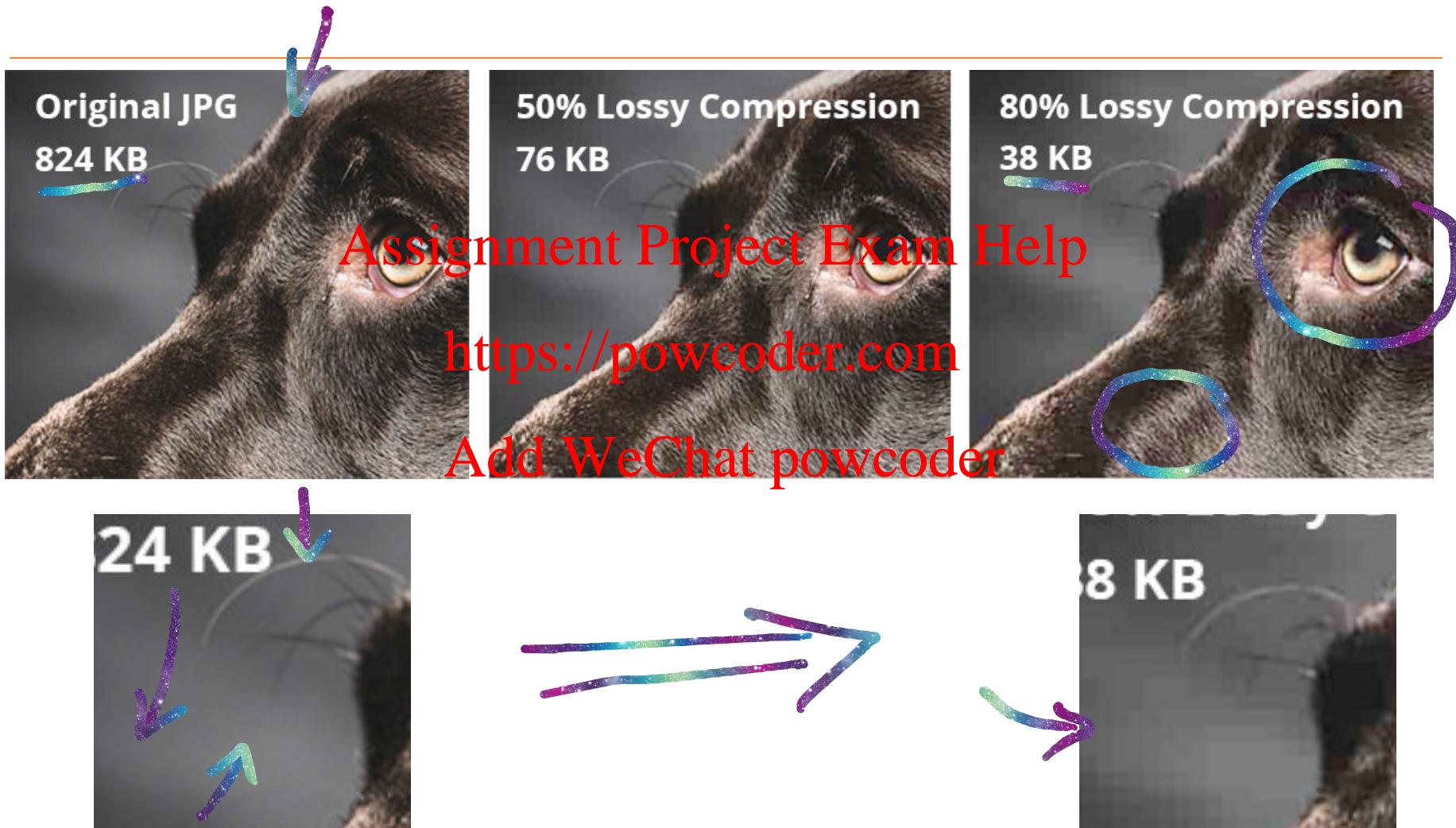
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MOTIVATING DECOMPOSITION



COMPRESSION



D. DECOMPOSITION

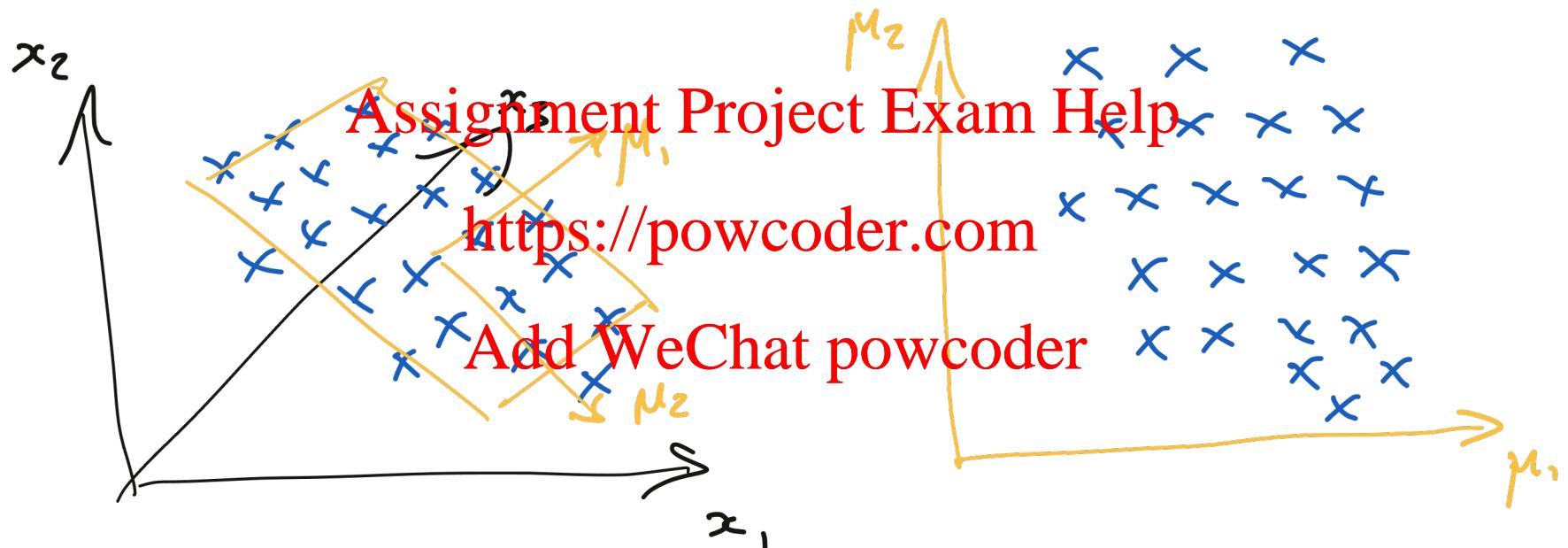
2. PROJECTION METHODS

Model requirements

Decomposition

$$x \in [-\infty, \infty]$$

$$y \in [-\infty, \infty]$$



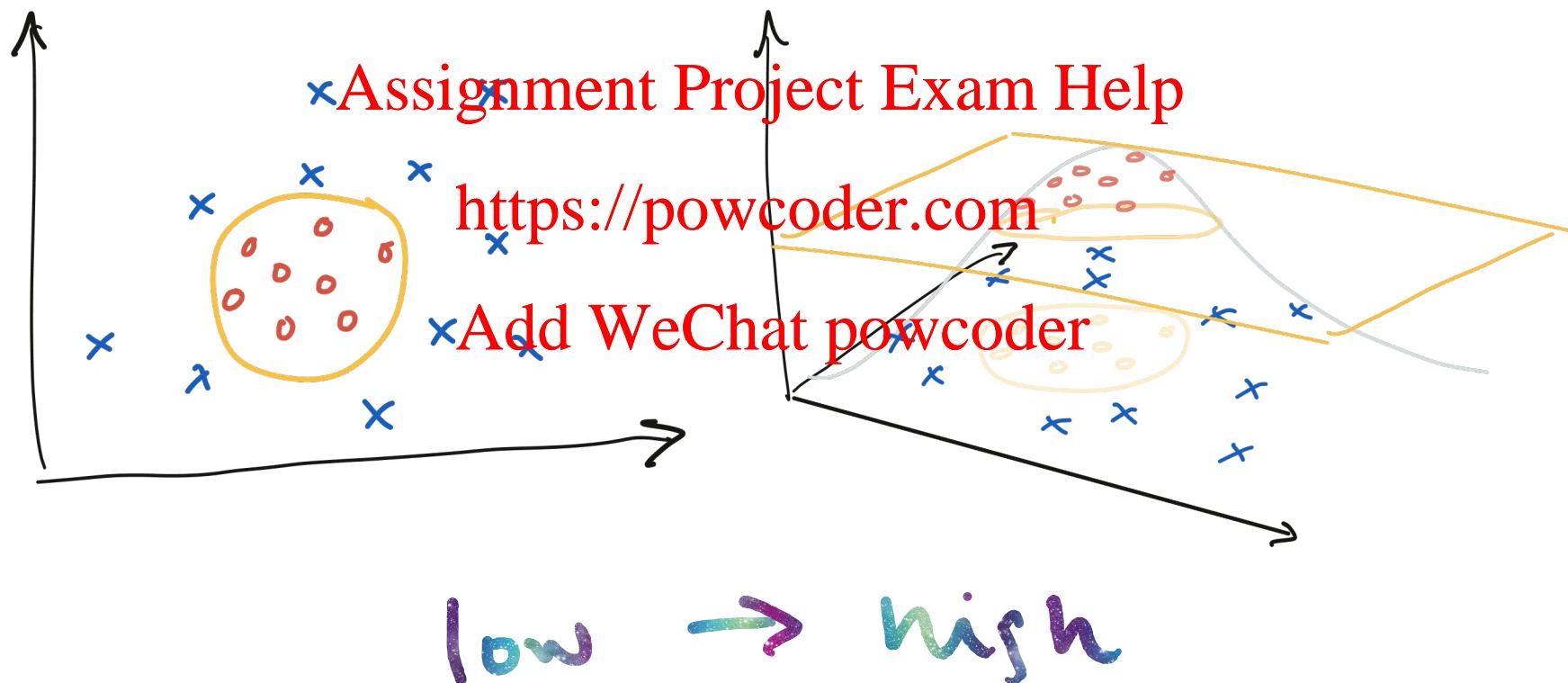
PCA

high → low



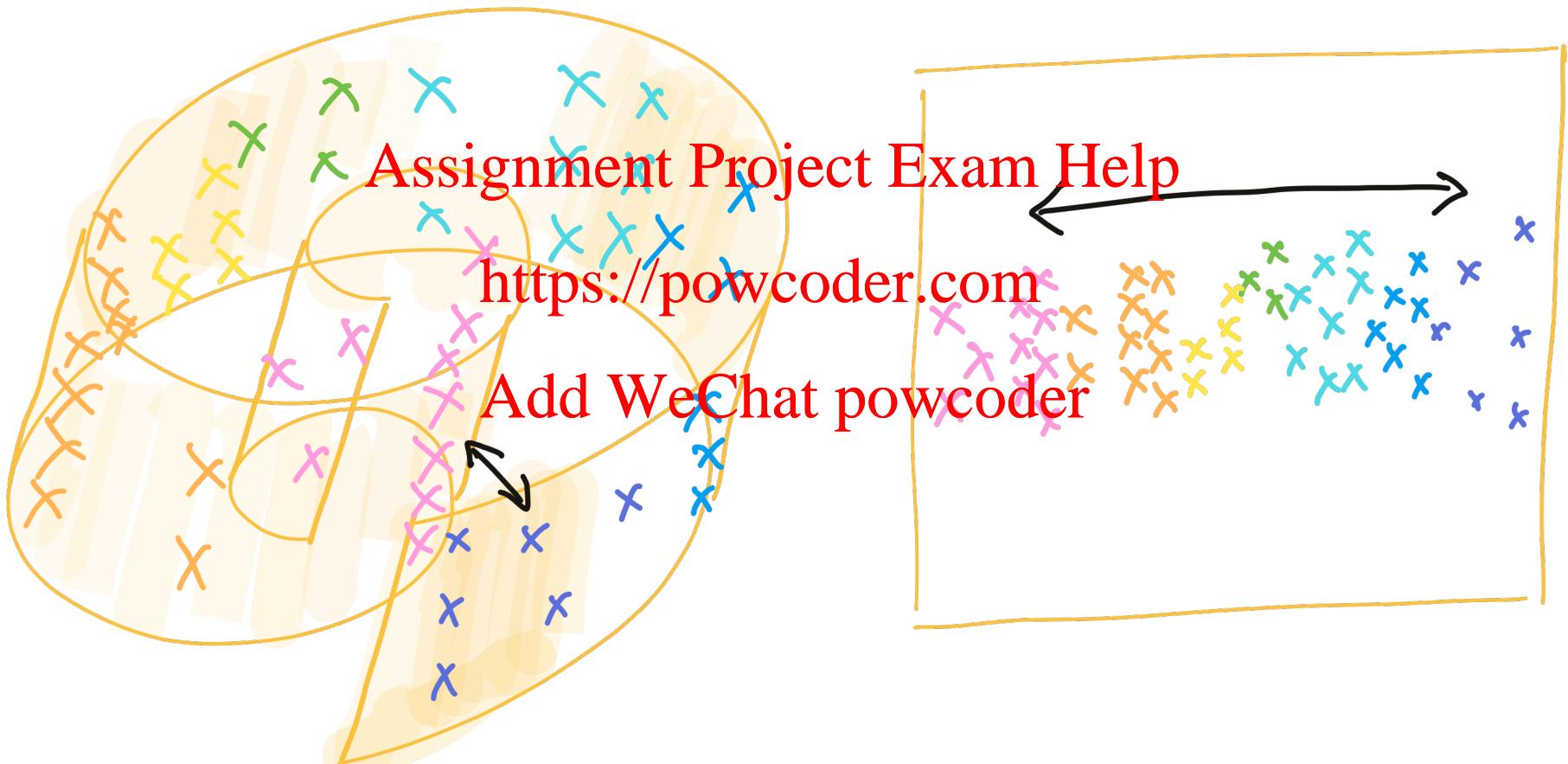
D. DECOMPOSITION

2. KERNEL METHODS

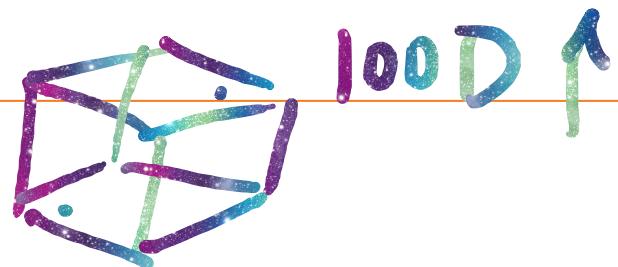


D. DECOMPOSITION

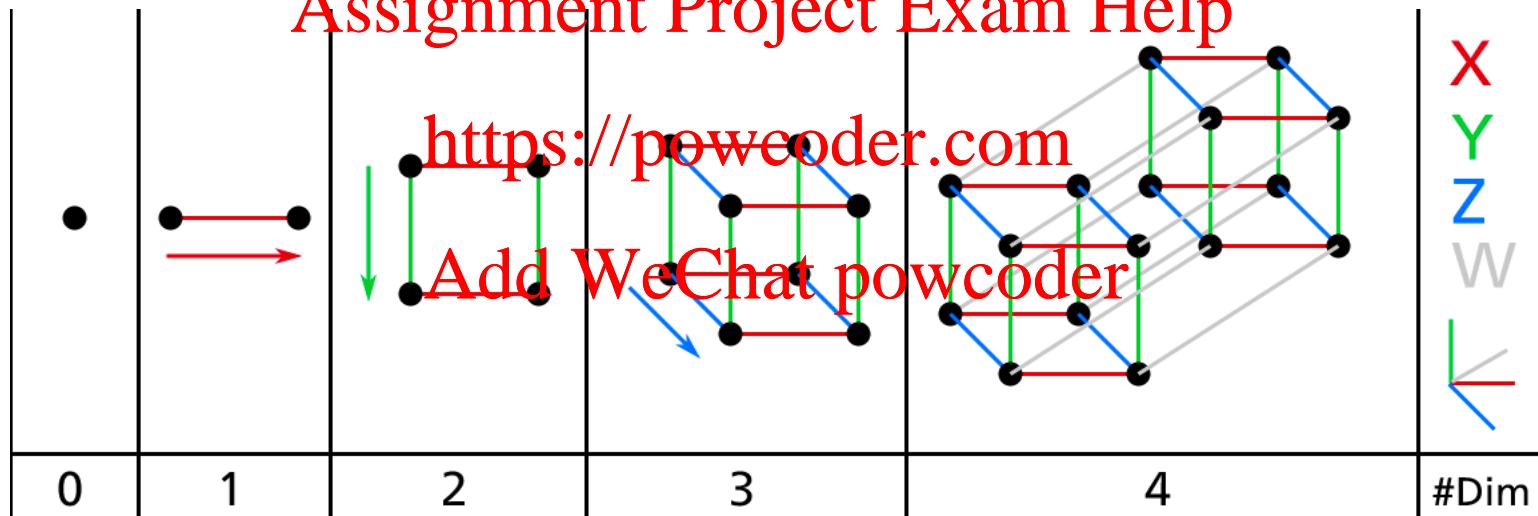
3. MANIFOLD LEARNING



CURSE OF DIMENSIONALITY

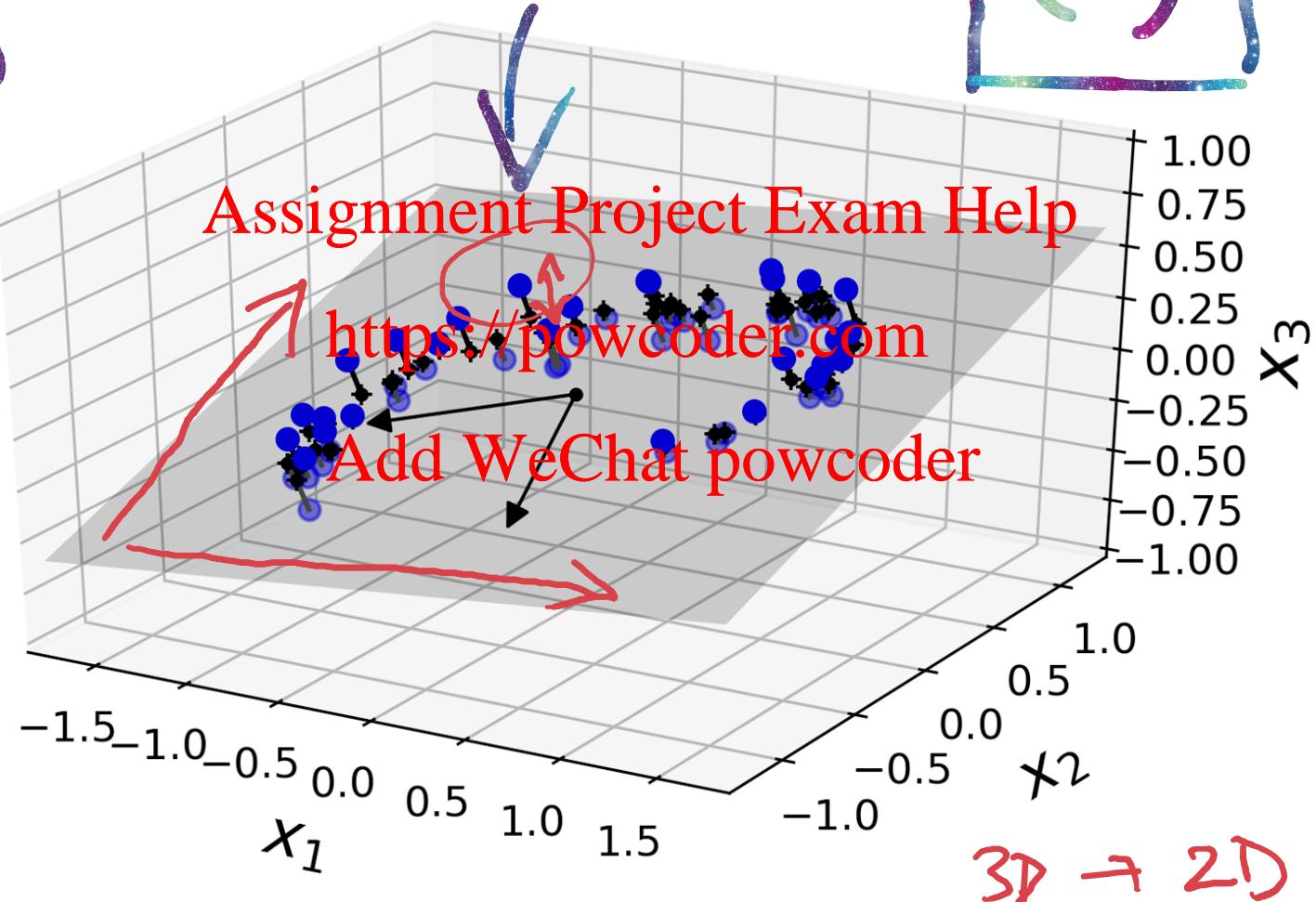


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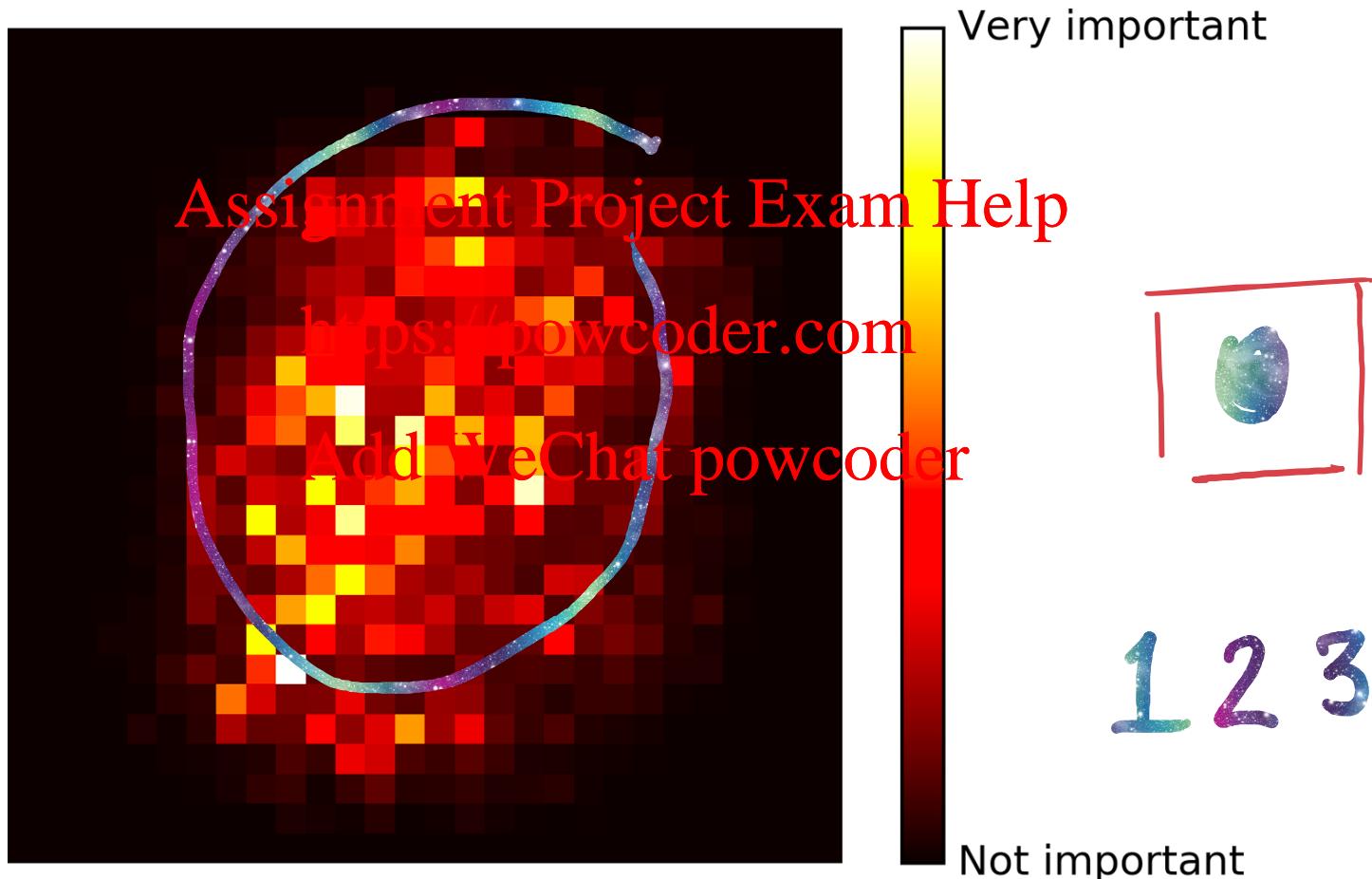


SUBSPACES

3D



MOTIVATING DECOMPOSITION

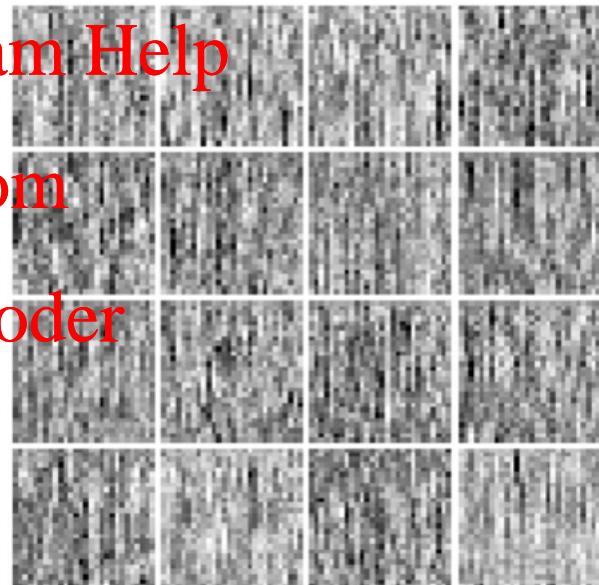


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6746807831

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1 - 9 + b

DECOMPOSITION

THREE APPROACHES

- Dimensionality Reduction / Projection
- Kernel Methods **Assignment Project Exam Help**
- Manifold Learning <https://powcoder.com>

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B. REGRESSION

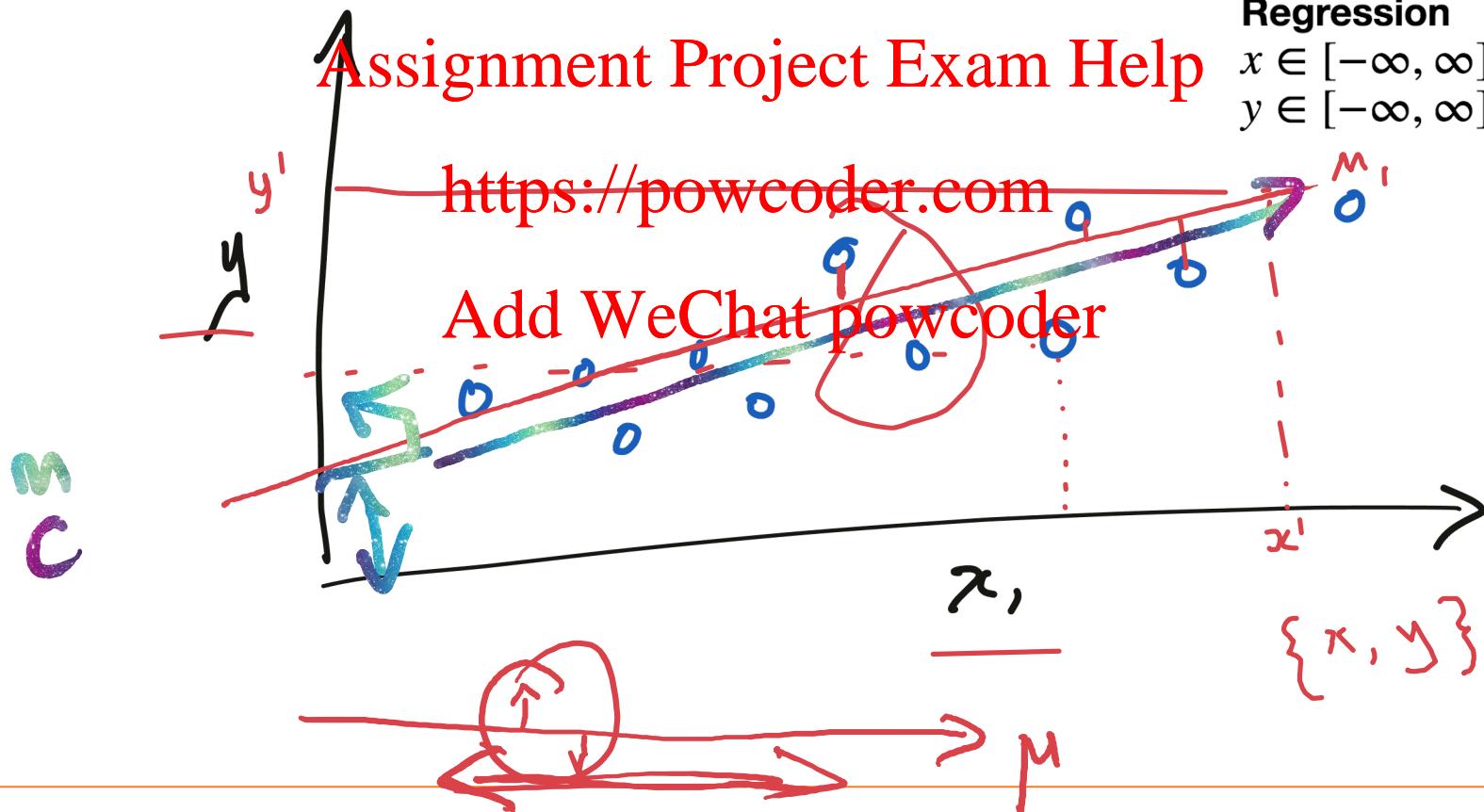
REAL VALUED VARIABLE

Model requirements

Regression

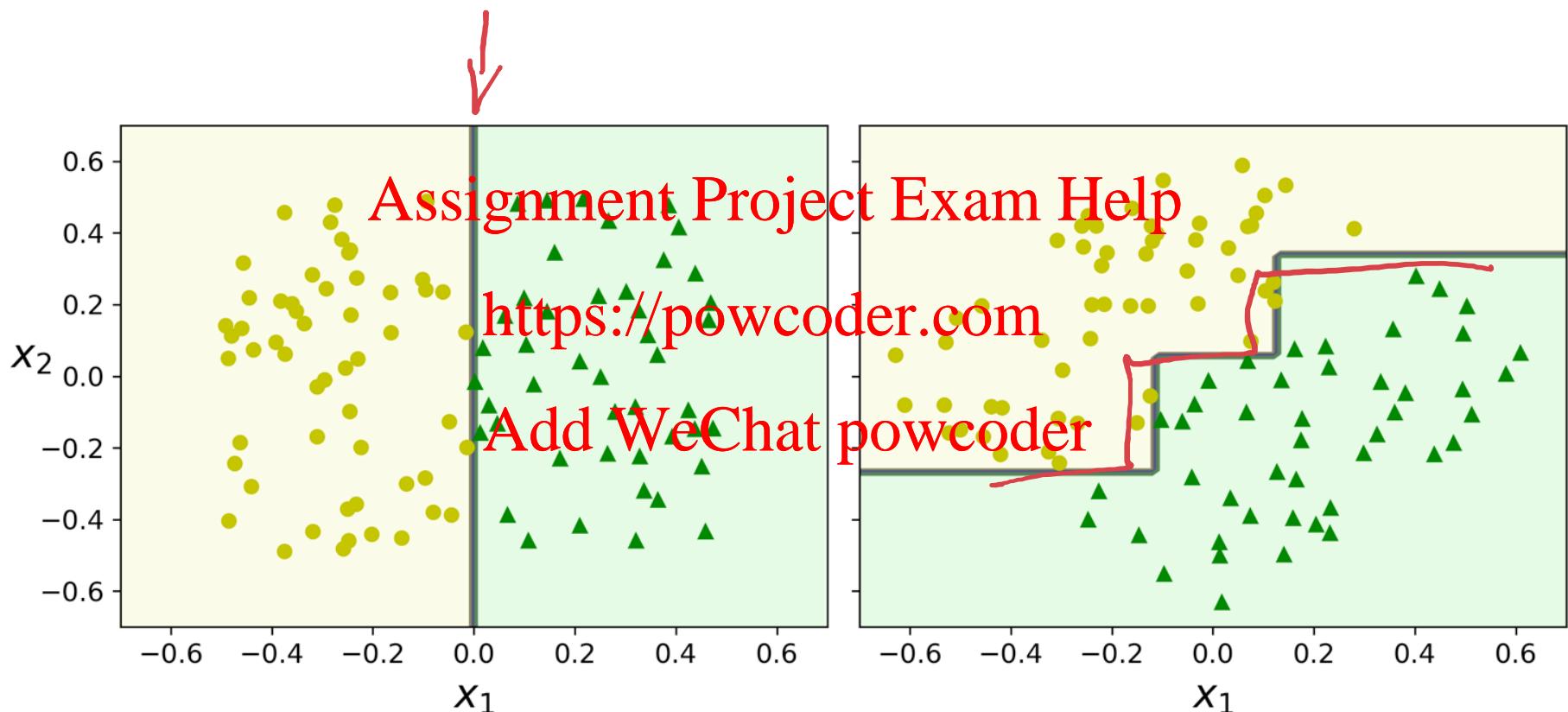
$$x \in [-\infty, \infty]$$

$$y \in [-\infty, \infty]$$

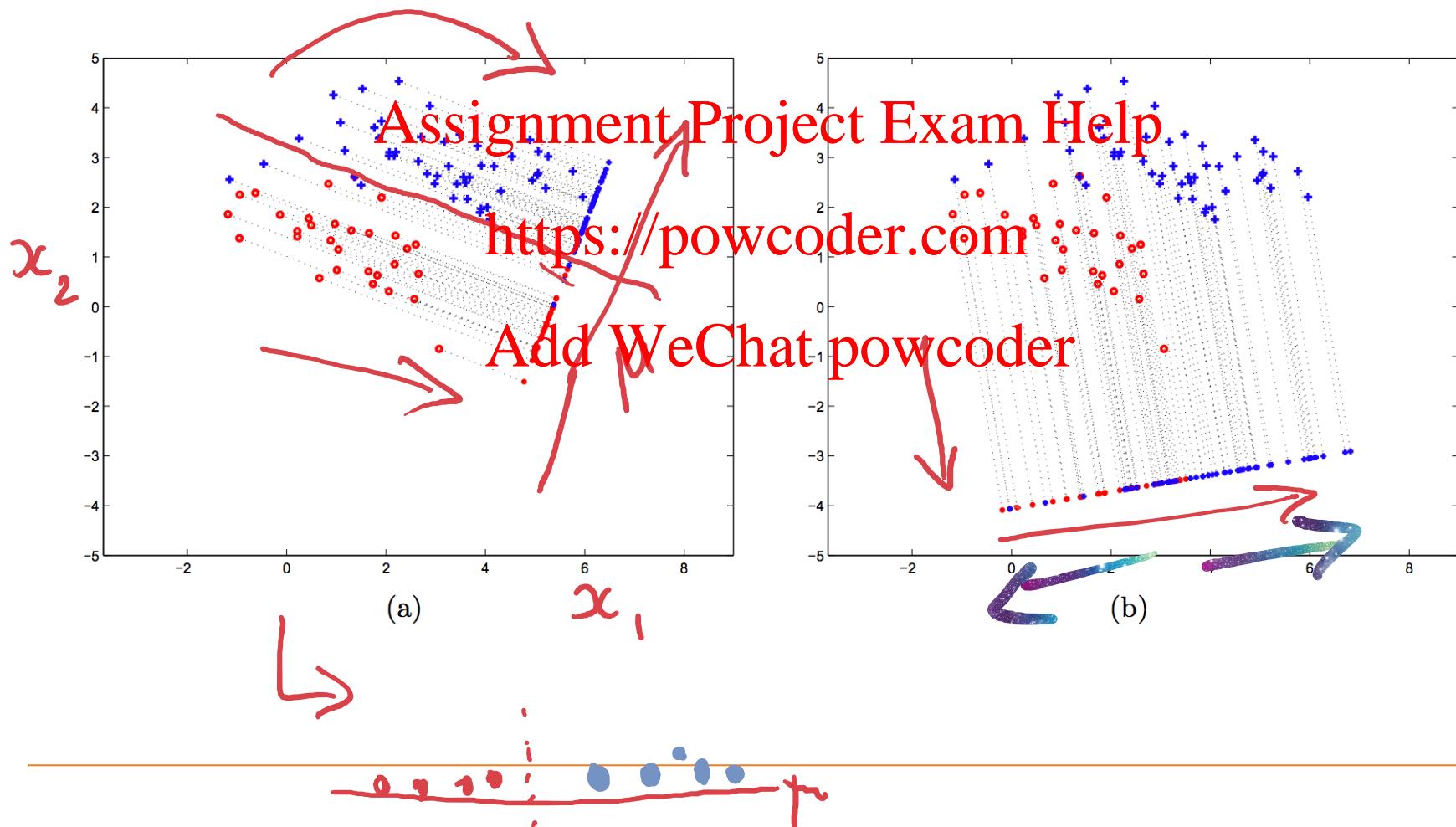


MOTIVATING PROJECTION

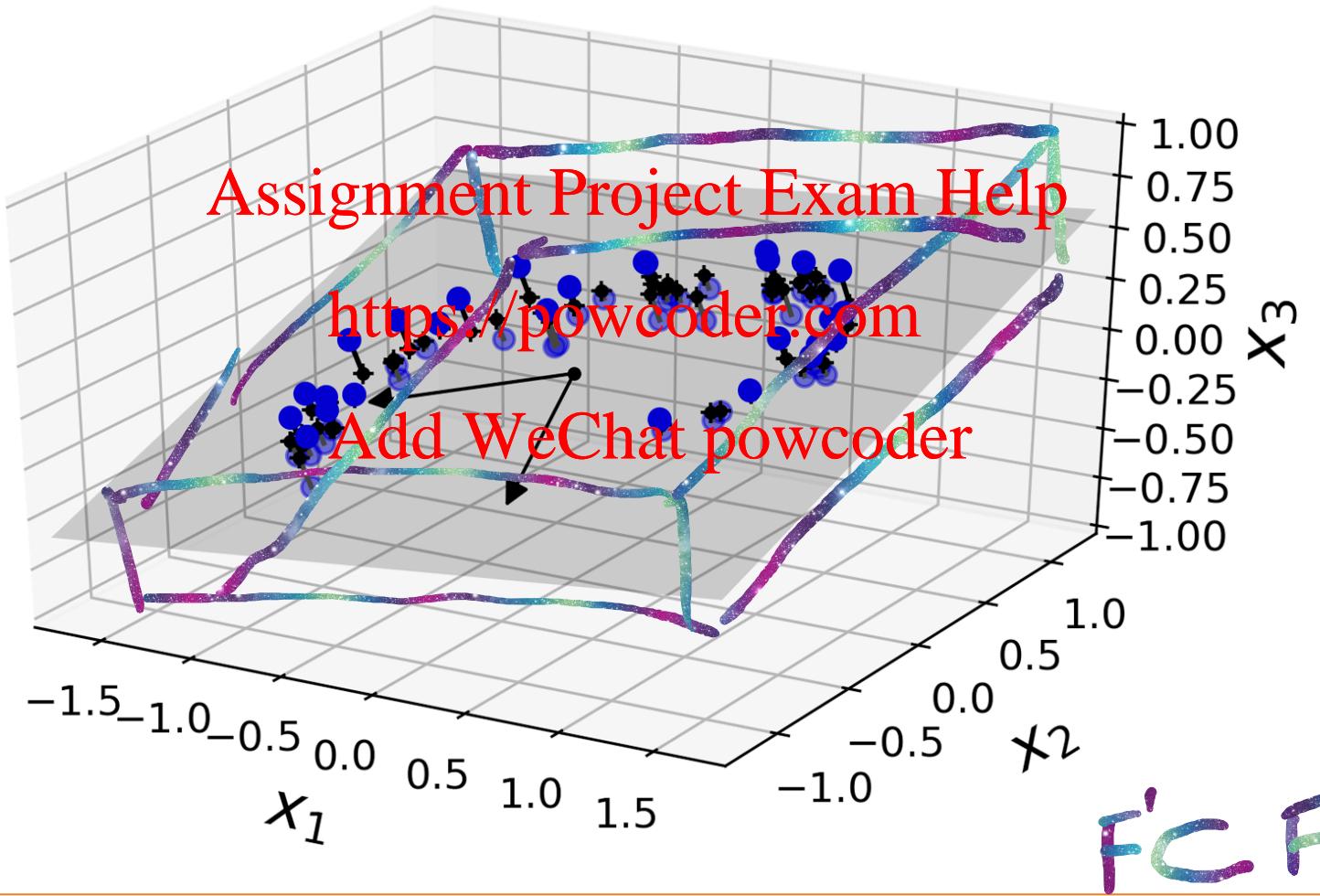
INSTABILITY



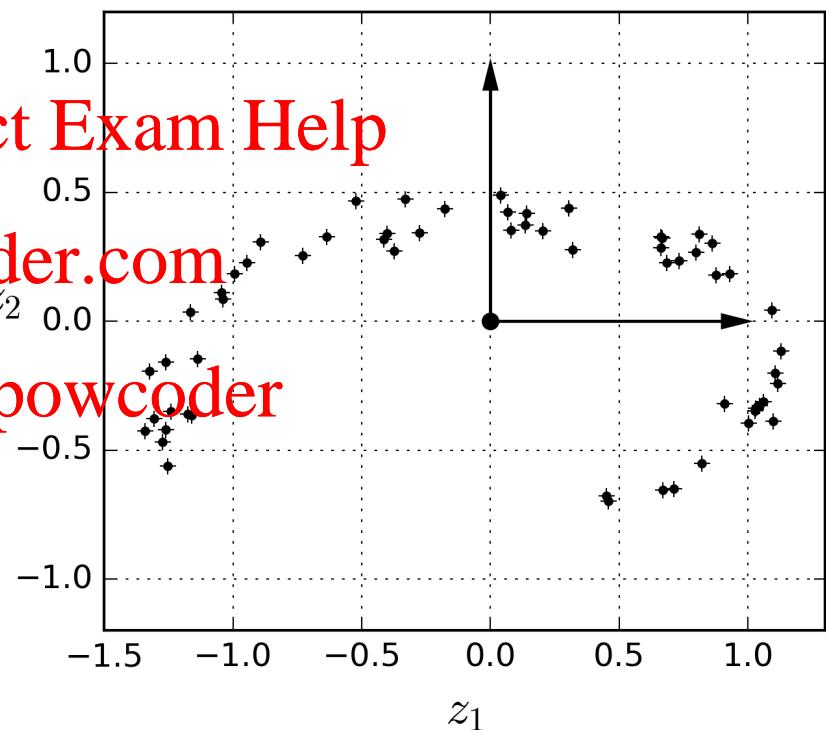
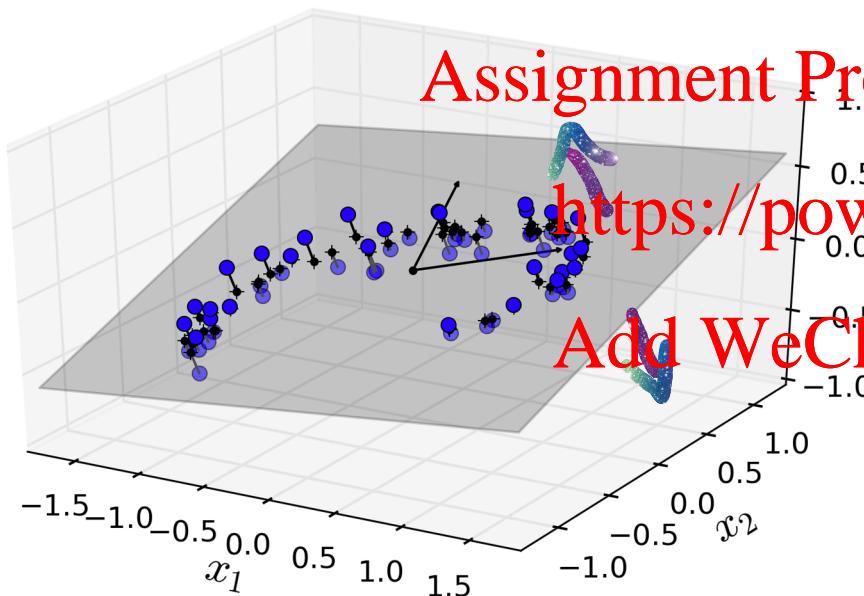
FINDING THE RIGHT DIMENSION



SUBSPACES

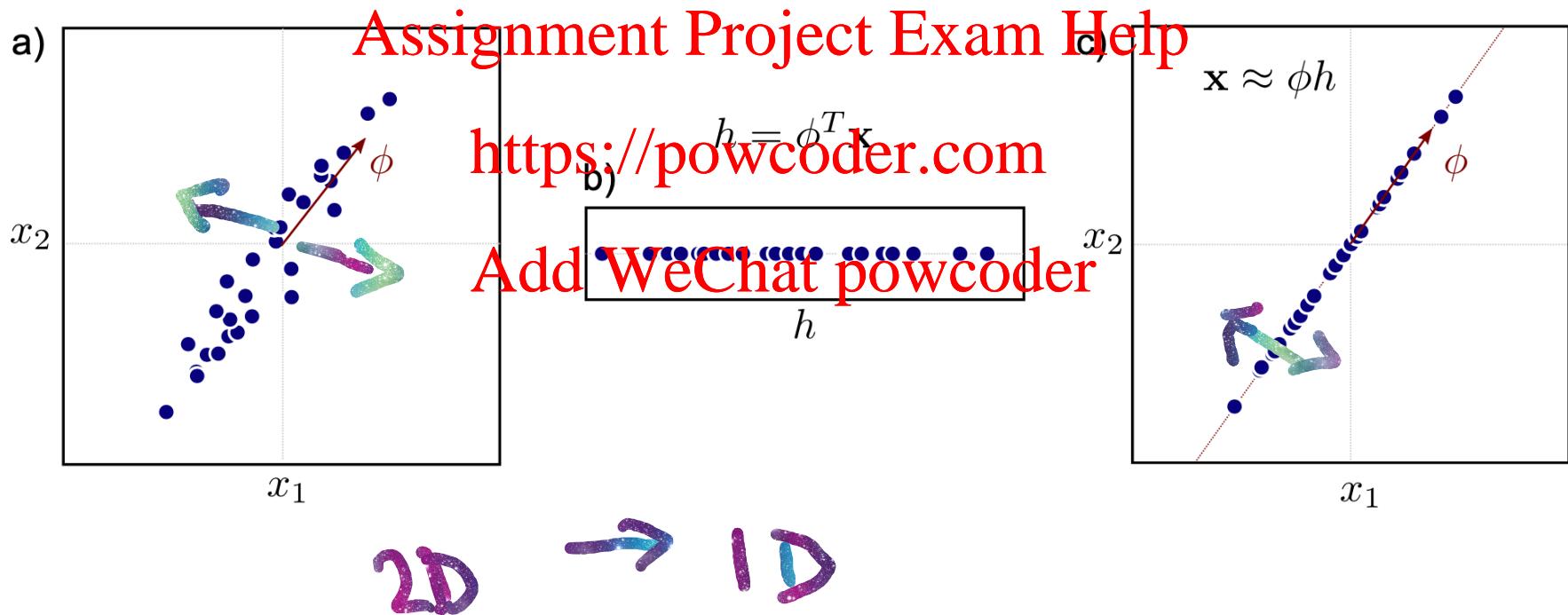


PROJECTION IN MULTIPLE DIMENSIONS



3D → 2D

REDUCTION TO A SINGLE DIMENSION



COMPRESSION

MNIST 95% VARIANCE PRESERVED

Original

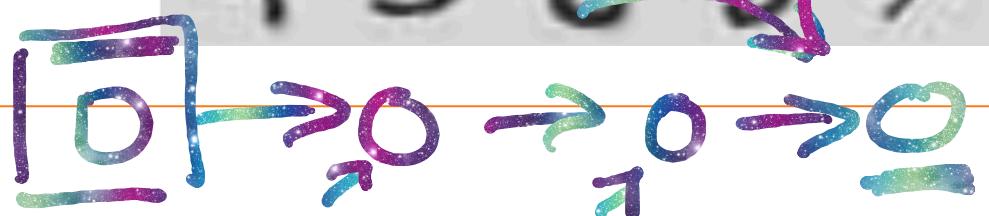


Compressed

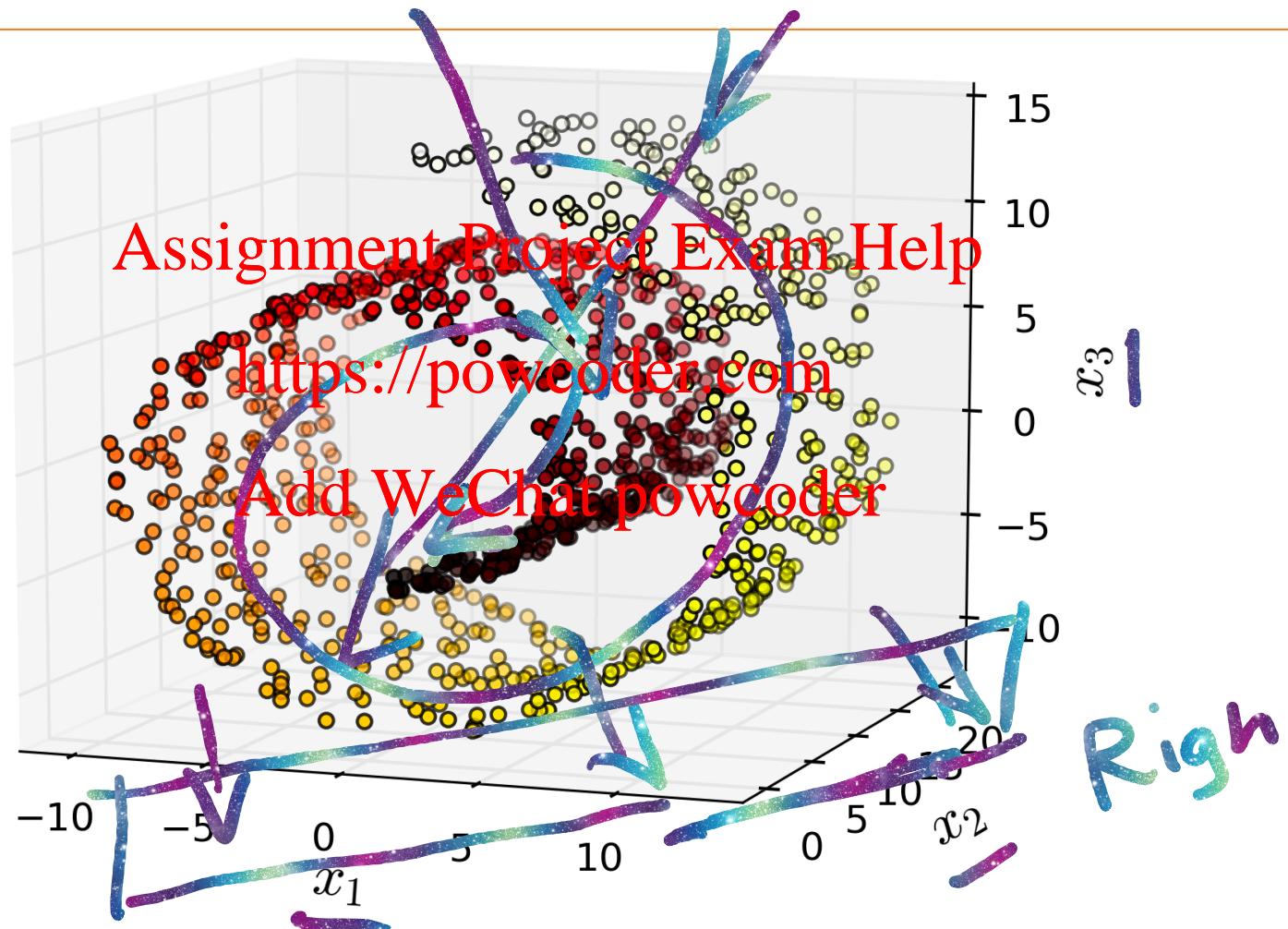
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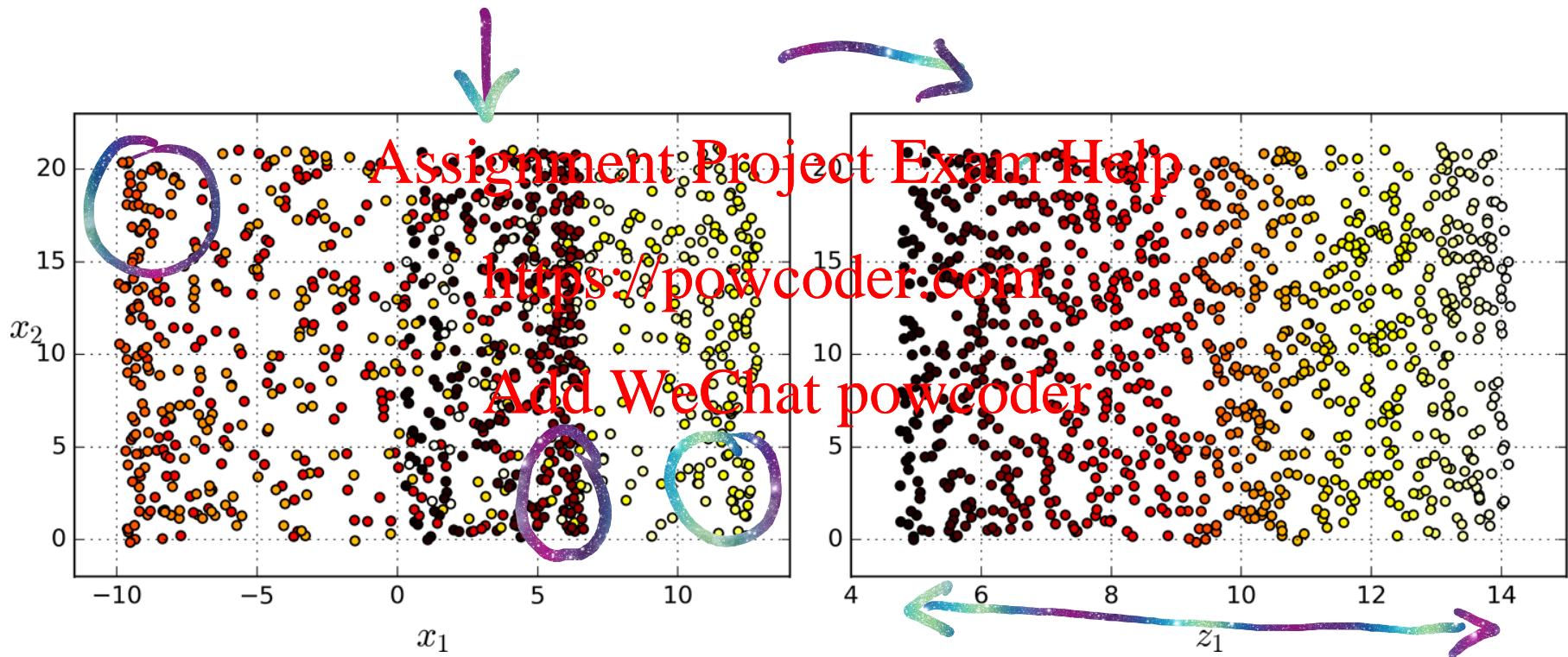
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PROBLEMS WITH PROJECTION



PROBLEMS WITH PROJECTION

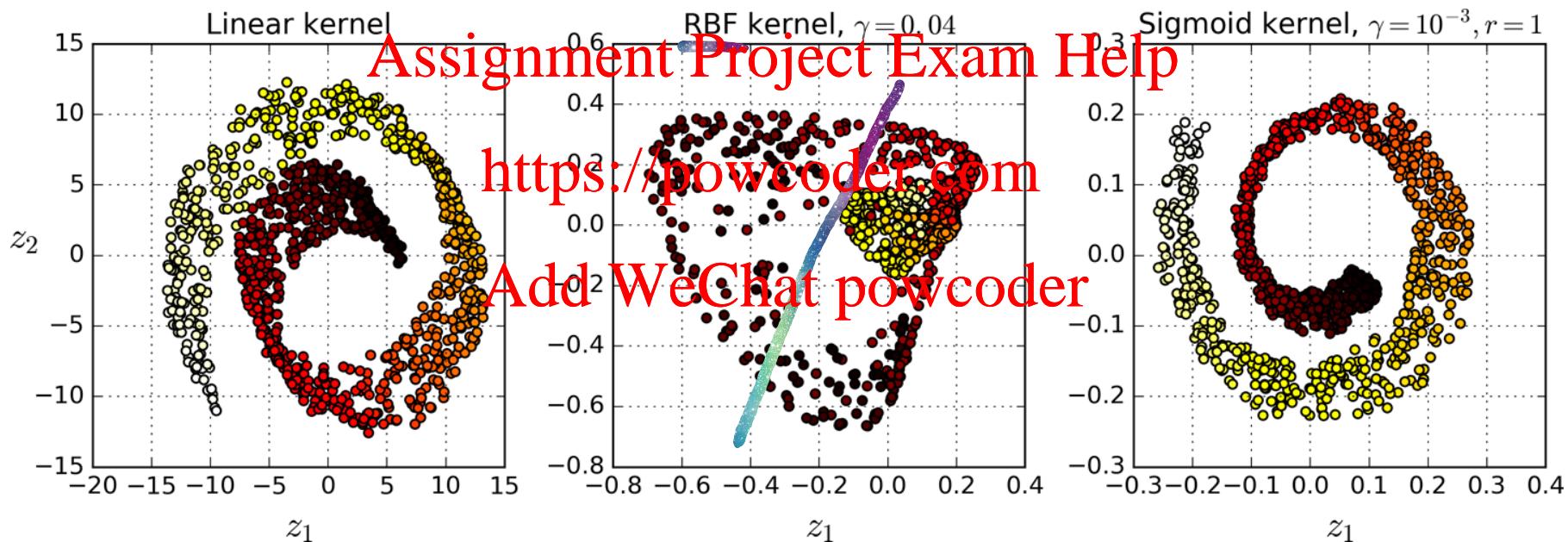


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Kernel spaces
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KERNEL PCA

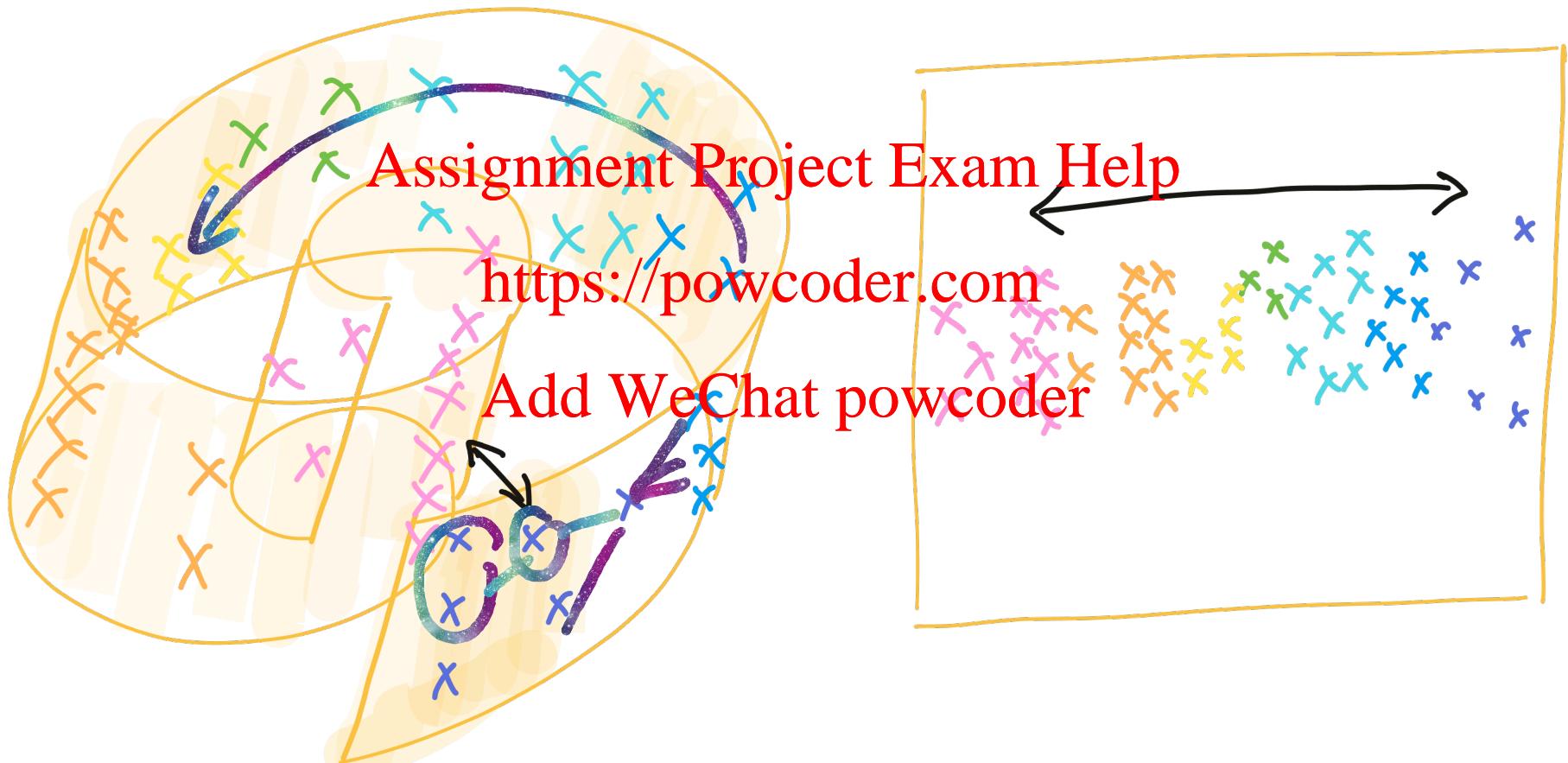


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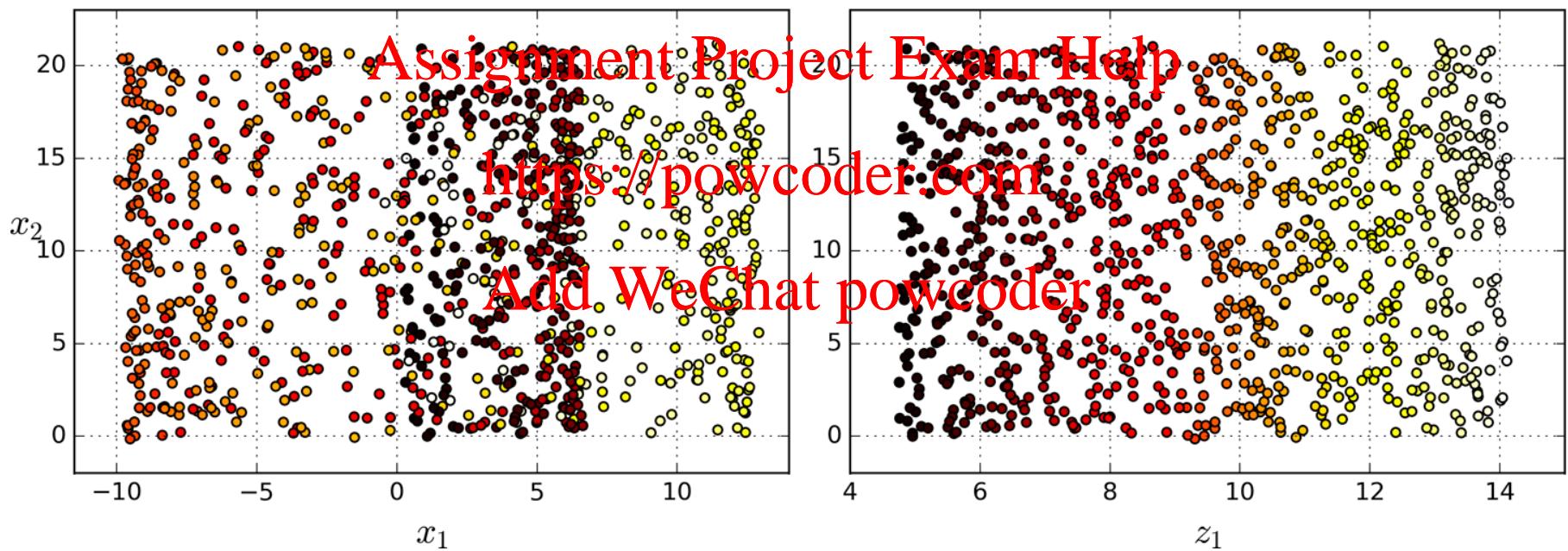
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Manifold learning
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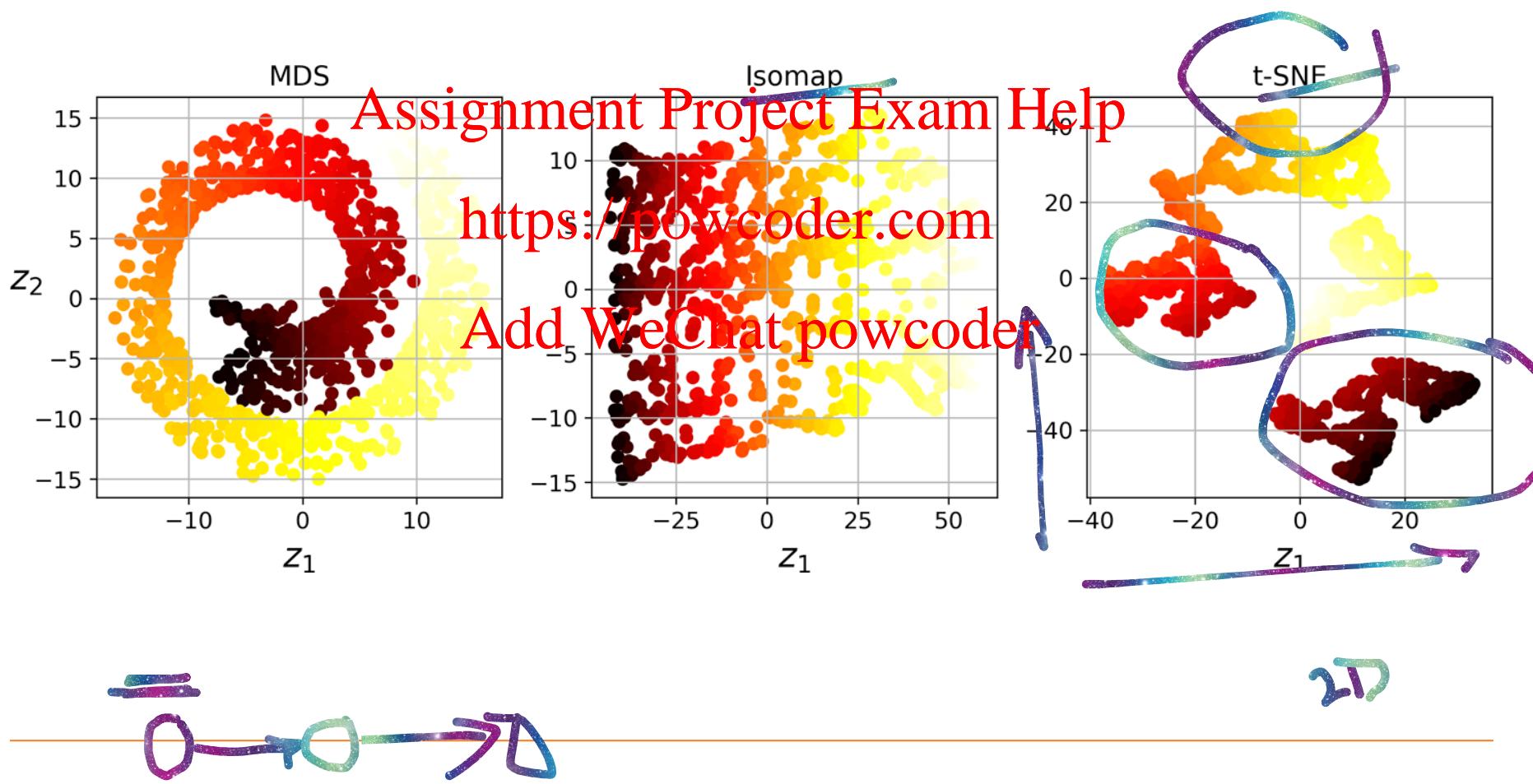
MANIFOLD LEARNING



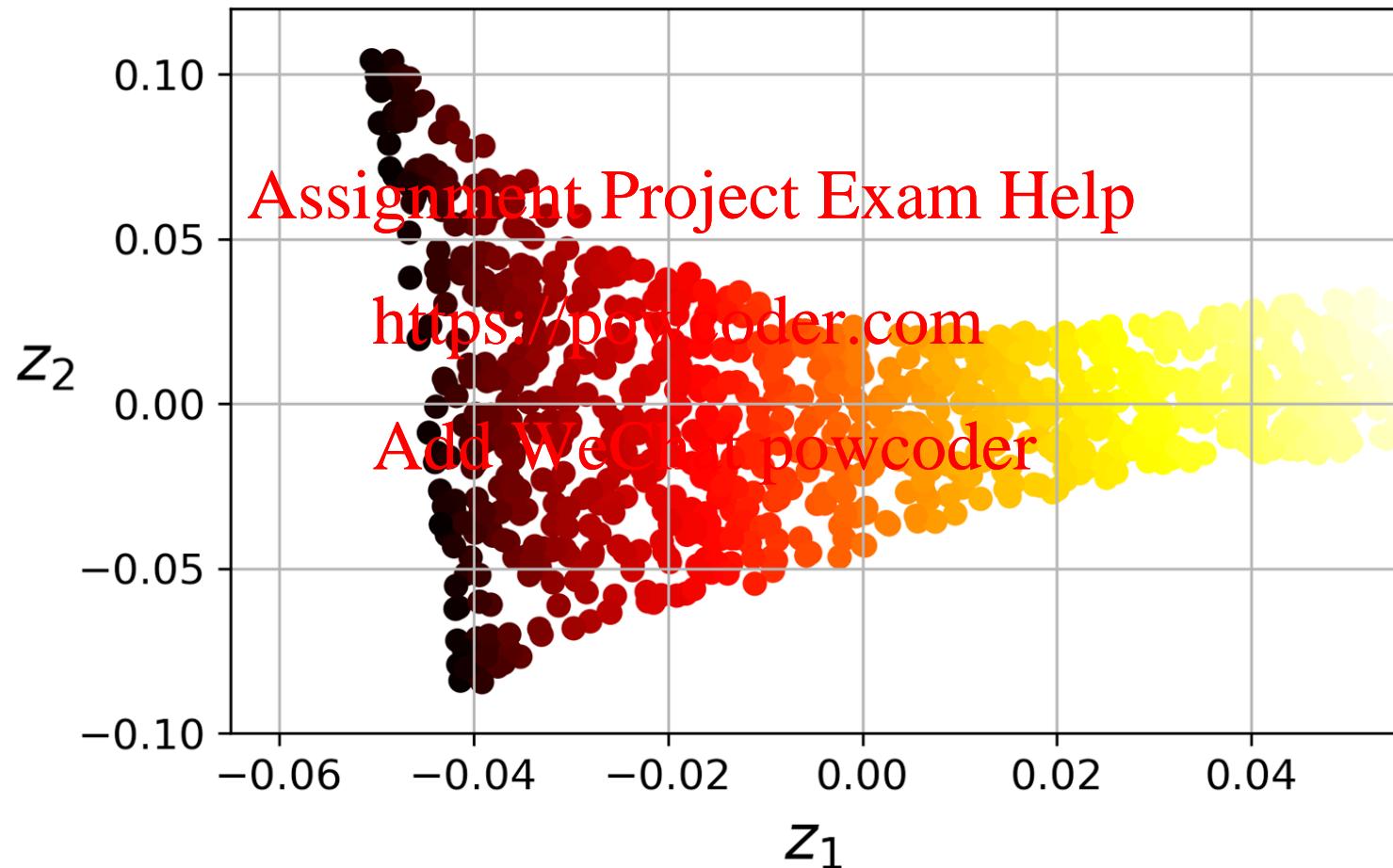
MANIFOLD LEARNING



OTHER TECHNIQUES



LOCAL LINEAR EMBEDDING



- Random Projections
- Multidimensional Scaling (MDS)
- Isomap
- Linear Discriminant Analysis (LDA)

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The main motivations for dimensionality reduction are:

- To speed up a subsequent training algorithm (in some cases it may even remove noise and redundant features, making the training algorithm perform better).
- To visualize the data and gain insights on the most important features.
- Simply to save space (compression)

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DISADVANTAGES

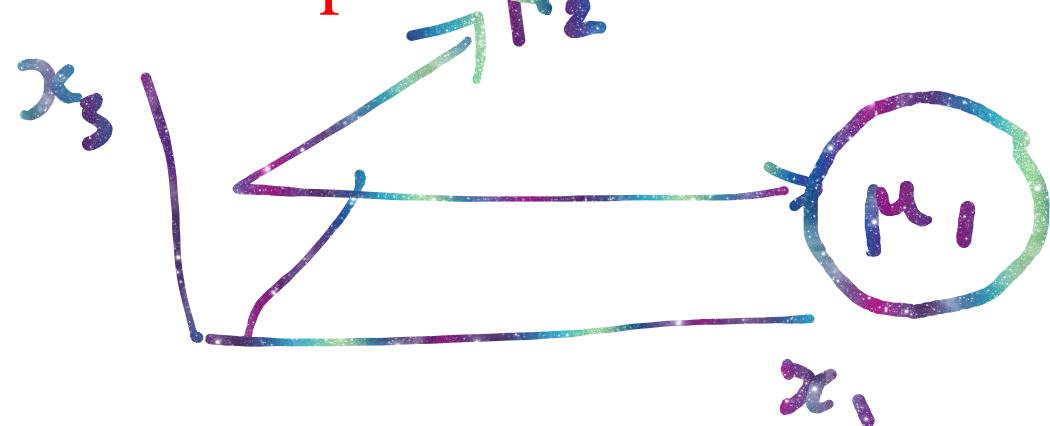
The main drawbacks are:

- Some information is lost, possibly degrading the performance of subsequent training algorithms.
- It can be computationally intensive.
- It adds some complexity to your Machine Learning pipelines.
- **Transformed features are often hard to interpret.**

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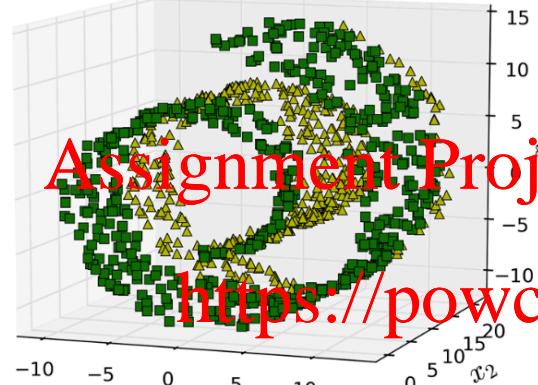
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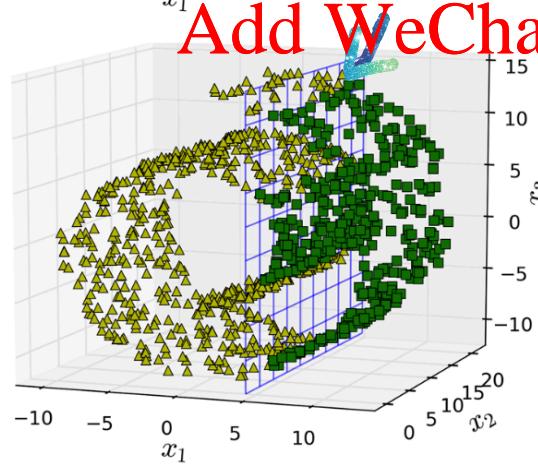


WHEN IT DOESN'T WORK

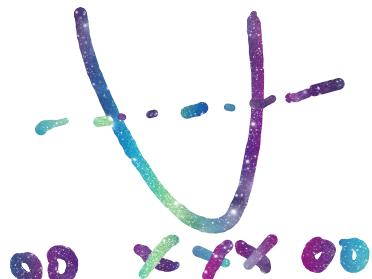
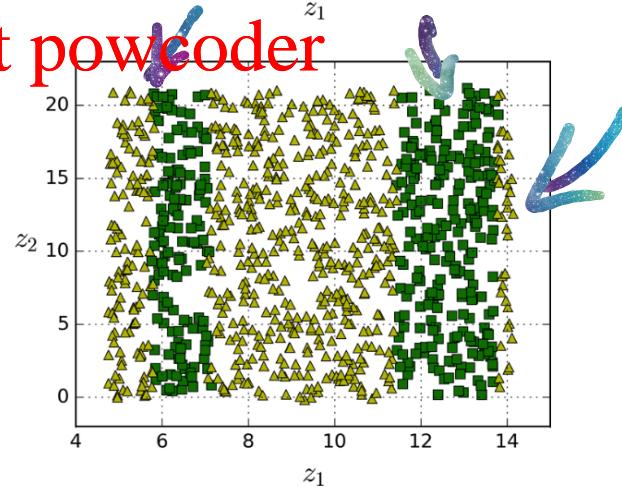
IMPLICIT ASSUMPTION IT MAKES THE PROBLEM EASIER



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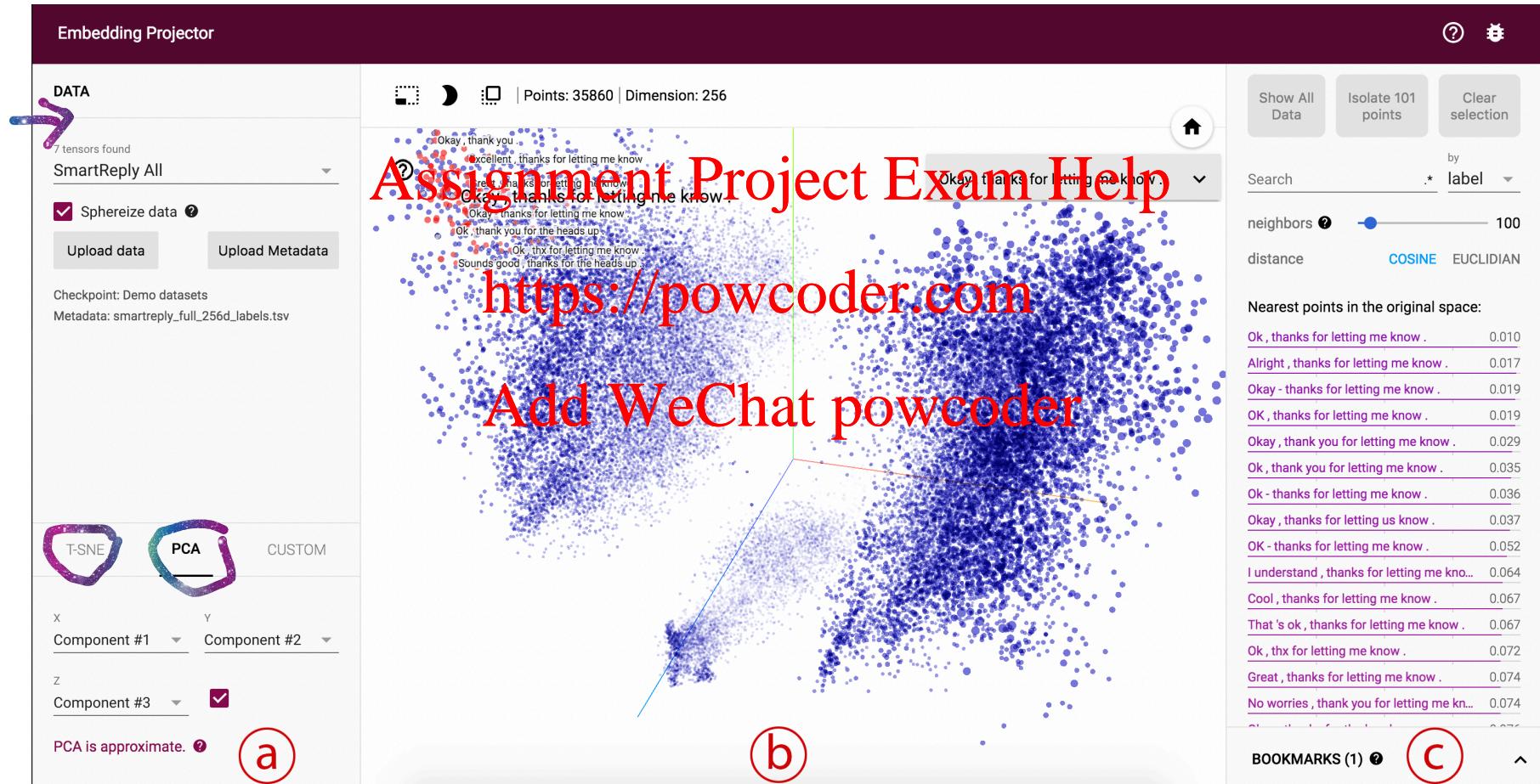


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