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Encoded features for robust Inter-conditional bearing fault diagnosis

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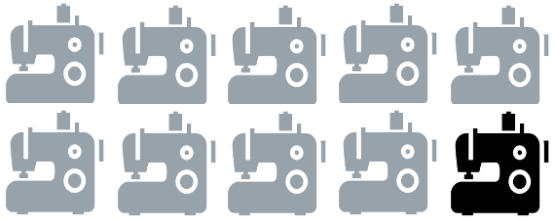
70% costs
are for servicing



9 out of 10
machines are offline

“Replace” or “**Retrofit**”

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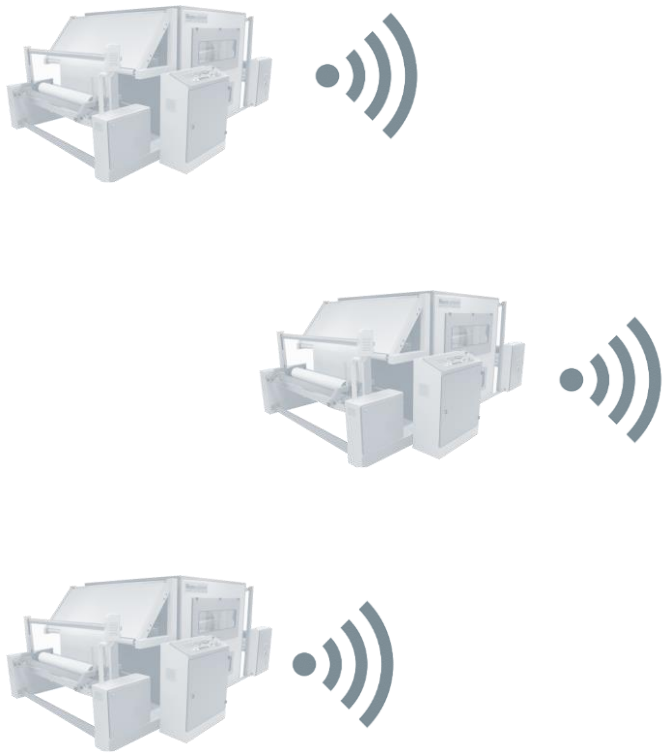
DETECTED
DETECTED
NO
m·group



- Higher **throughput** needed
- Increased **Latency**
- Occupies the bandwidth
- Affects the **existing operations**
- Source of **Interference**

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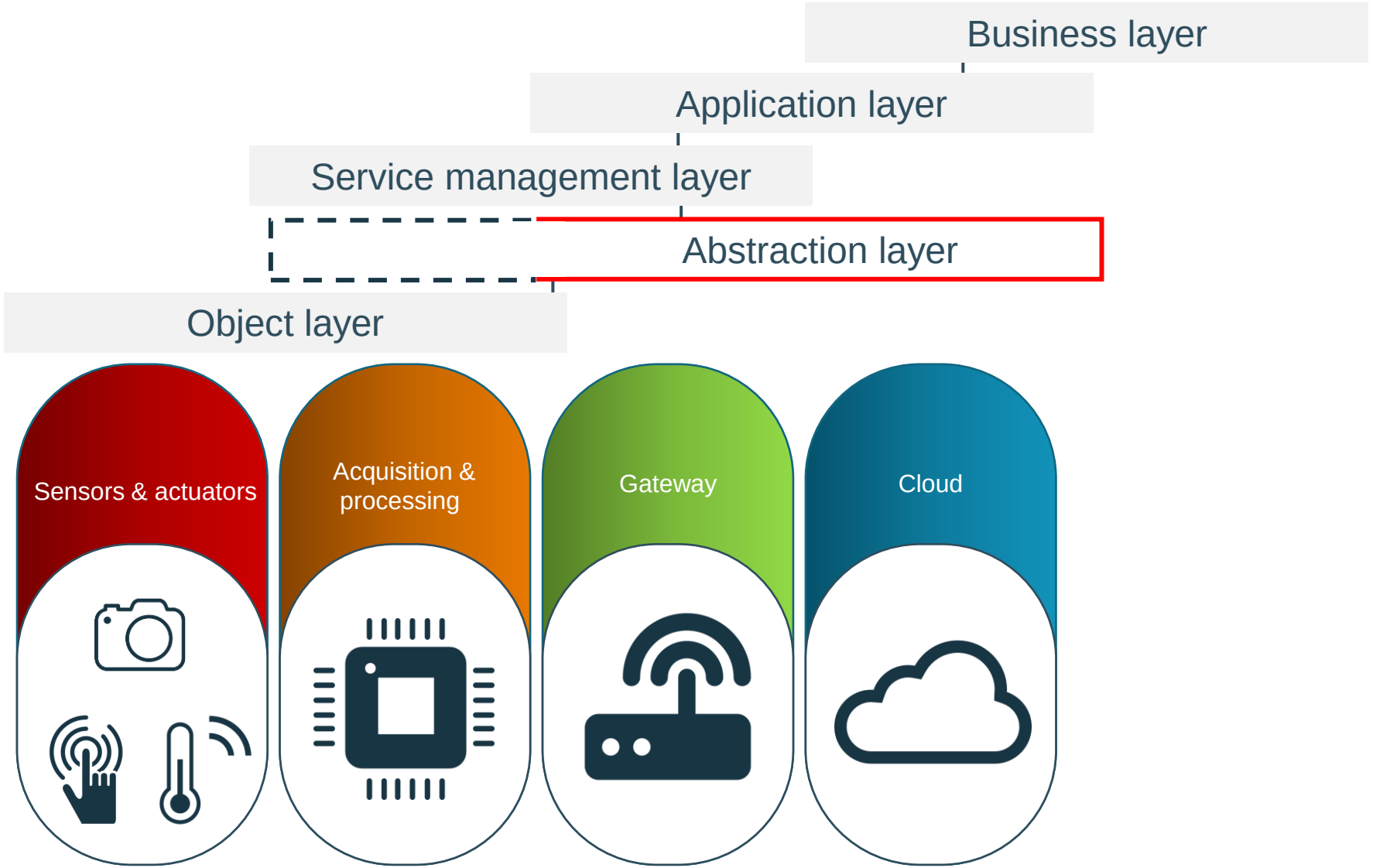

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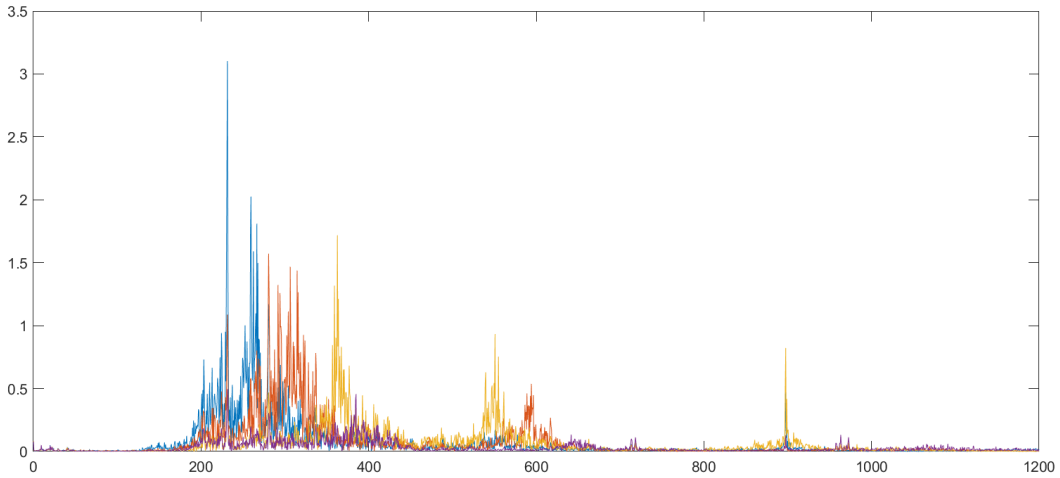
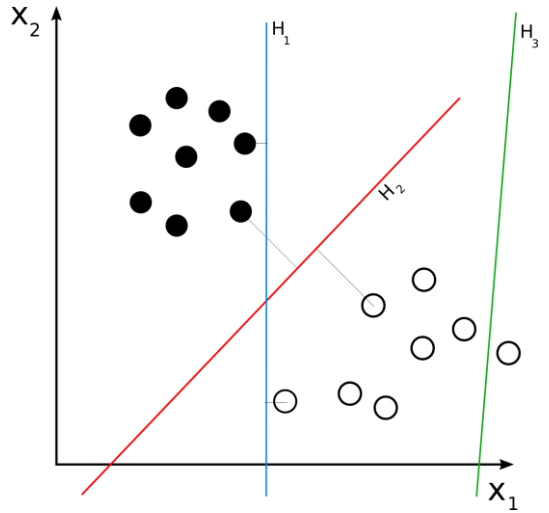
Traditional learning:

Knowledge of the domain → Extract features → Use those to classify





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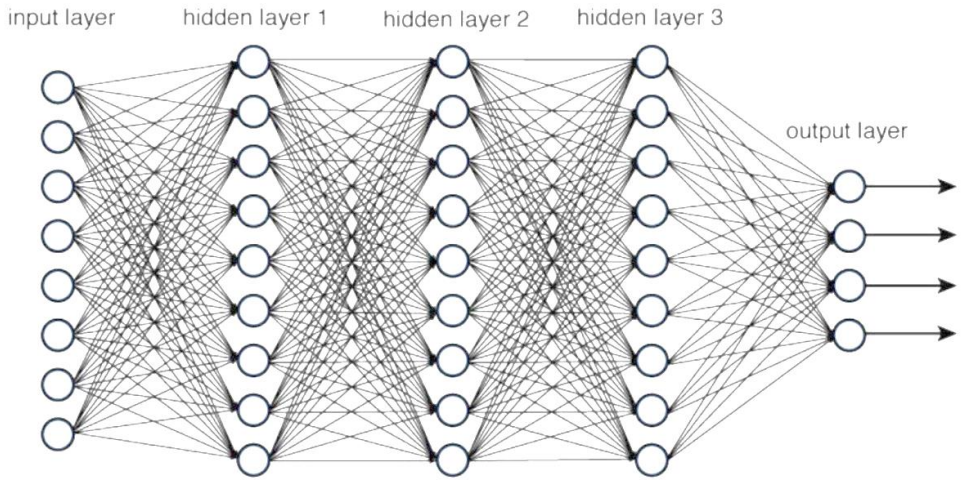
Deep learning:

Knowledge of the domain → Extract features → Use those to classify



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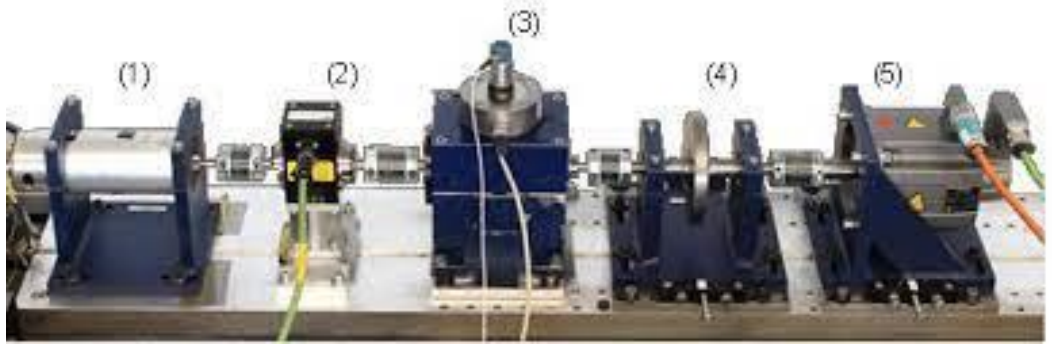
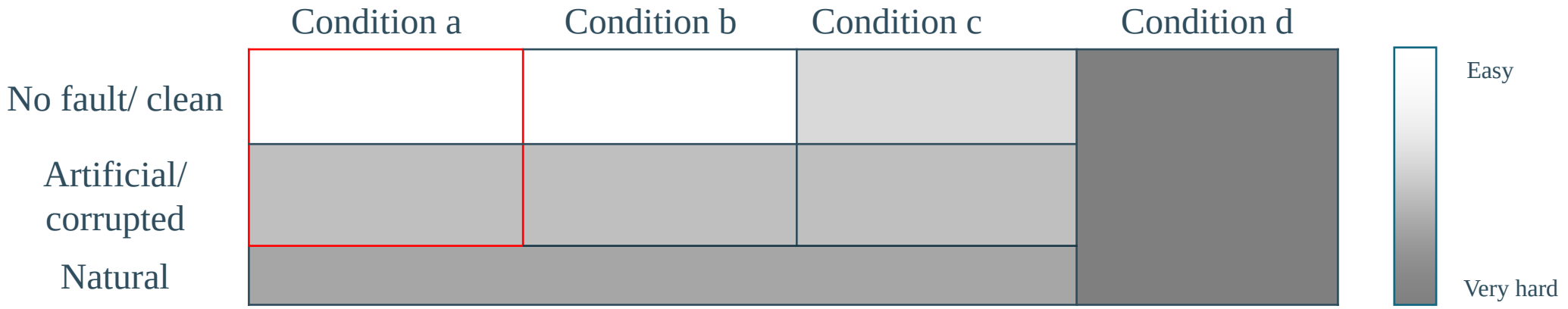
General data availability:





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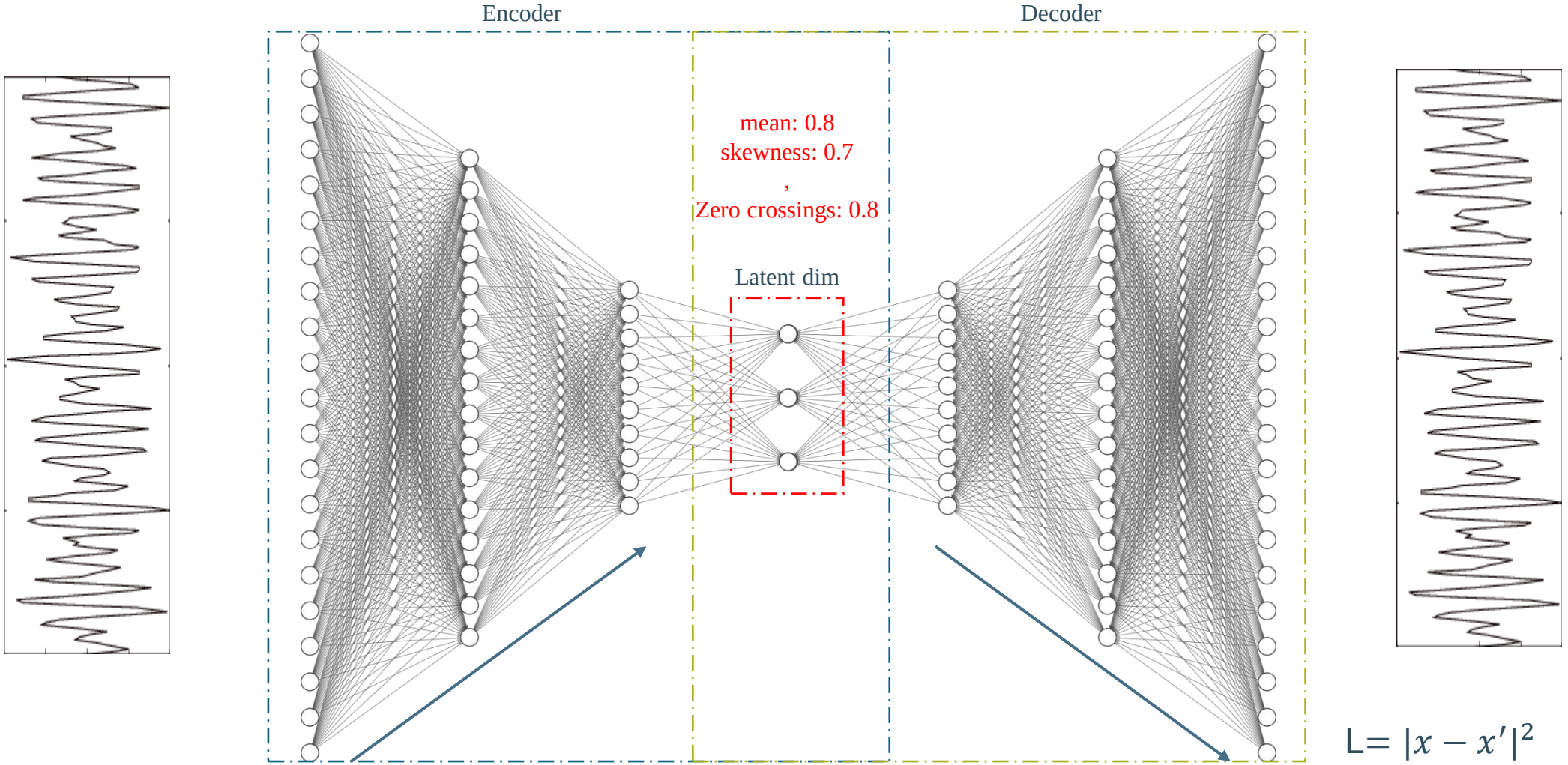
Autoencoder:



$$L = |x - x'|^2$$

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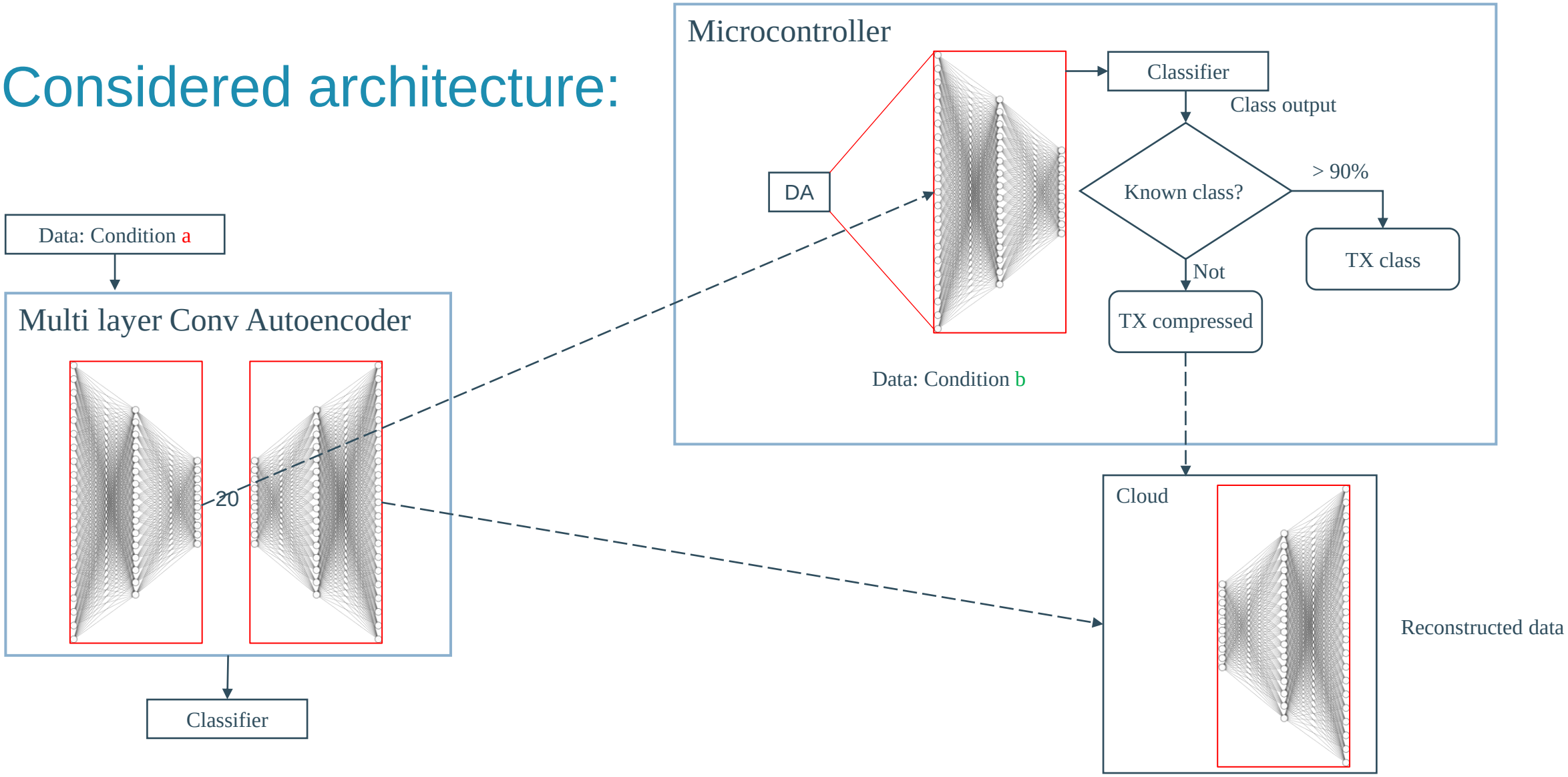
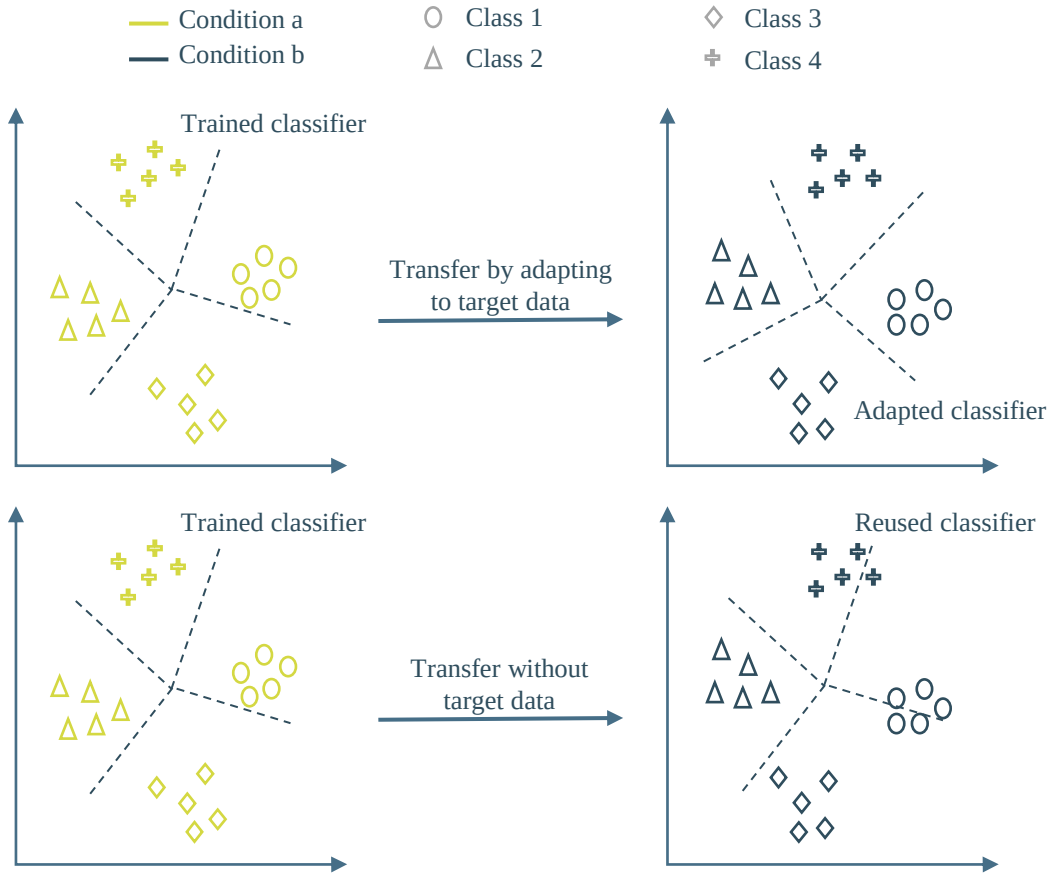
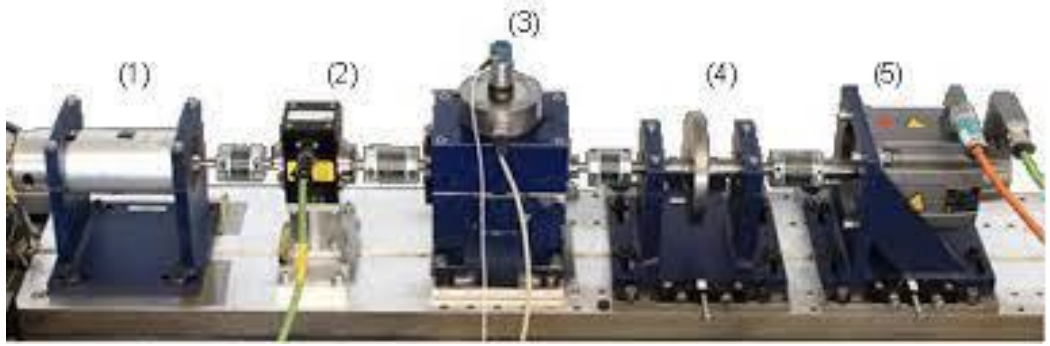
Considered architecture:



Transfer Learning:



Bearing fault datasets:



- CWRU (Vibration data)
  - Conditions: Different loads (4)
  - Classes: Inner race, Outer race, Bearing and no fault
- Paderborn (Vibration data)
  - Conditions: Different axial, radial loads & rotating speeds (4)
  - Classes: Inner race, Outer race, Bearing and no fault (Artificial and natural)

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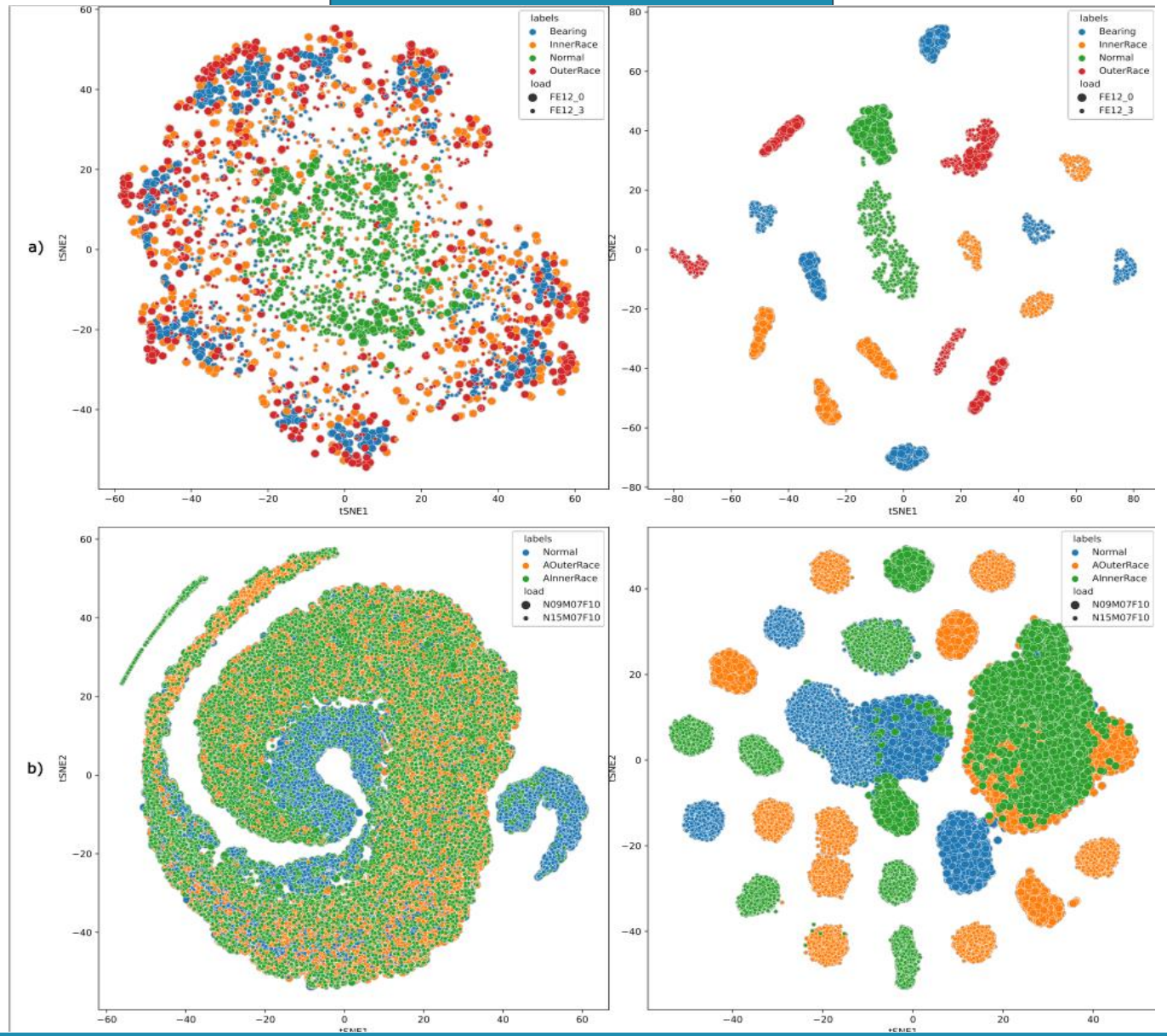
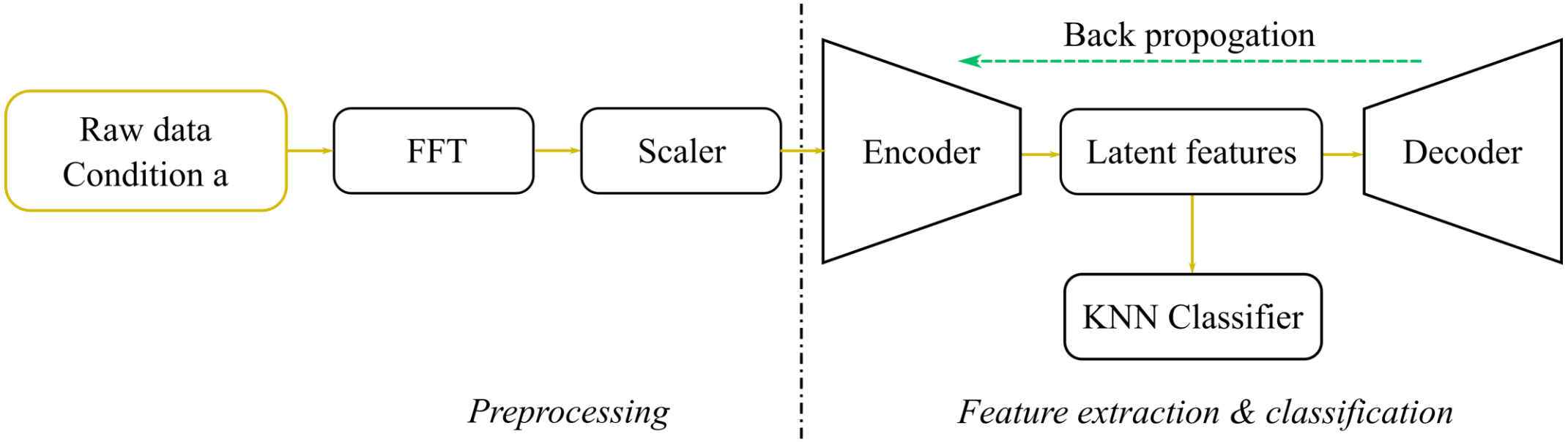
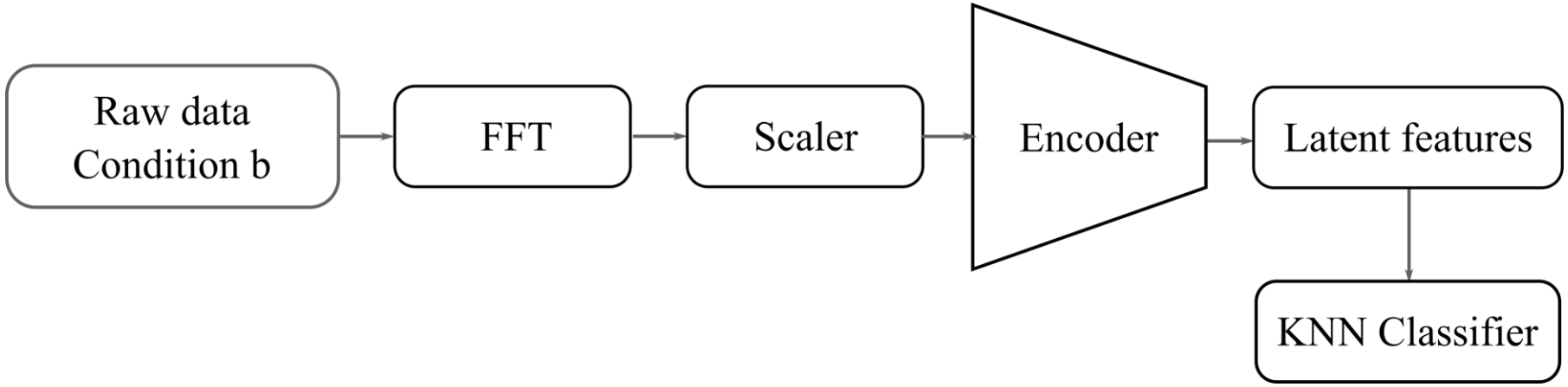

a)
b)
tSNE1
tSNE2
labels
Bearing
InnerRace
Normal
OuterRace
load
FE12_0
FE12_3
labels
Normal
AOuterRace
AInnerRace
load
N09M07F10
N15M07F10

Experimentation: Training



Experimentation: Inference



Results: CWRU dataset

Source only method

Source only method

Transfer Task	SVM	CNN	CNN-MMD	MDDAN	MDIAN	CMD	MLCAE-KNN
C0 → C1	70.70	72.25	81.00	87.15	99.60	-	**100**
C0 → C2	66.45	70.55	79.90	90.60	99.30	95.54	**100**
C0 → C3	63.40	62.45	55.85	91.65	99.10	99.54	**100**
C1 → C0	71.30	87.30	88.95	84.00	99.70	-	**100**
C1 → C2	70.00	89.80	88.70	92.40	99.65	-	**100**
C1 → C3	74.00	74.70	80.50	94.20	99.80	-	**100**
C2 → C0	62.85	60.35	64.65	87.40	97.60	**100**	**99.8**
C2 → C1	61.60	75.50	79.80	91.95	99.45	-	**99.7**
C2 → C3	67.65	84.30	79.95	91.50	99.45	96.9	**100**
C3 → C0	65.30	66.90	75.25	84.25	97.45	**100**	99.9
C3 → C1	65.70	81.15	71.15	87.35	98.60	-	**99.9**
C3 → C2	63.25	74.95	74.85	92.15	99.50	**100**	**100**

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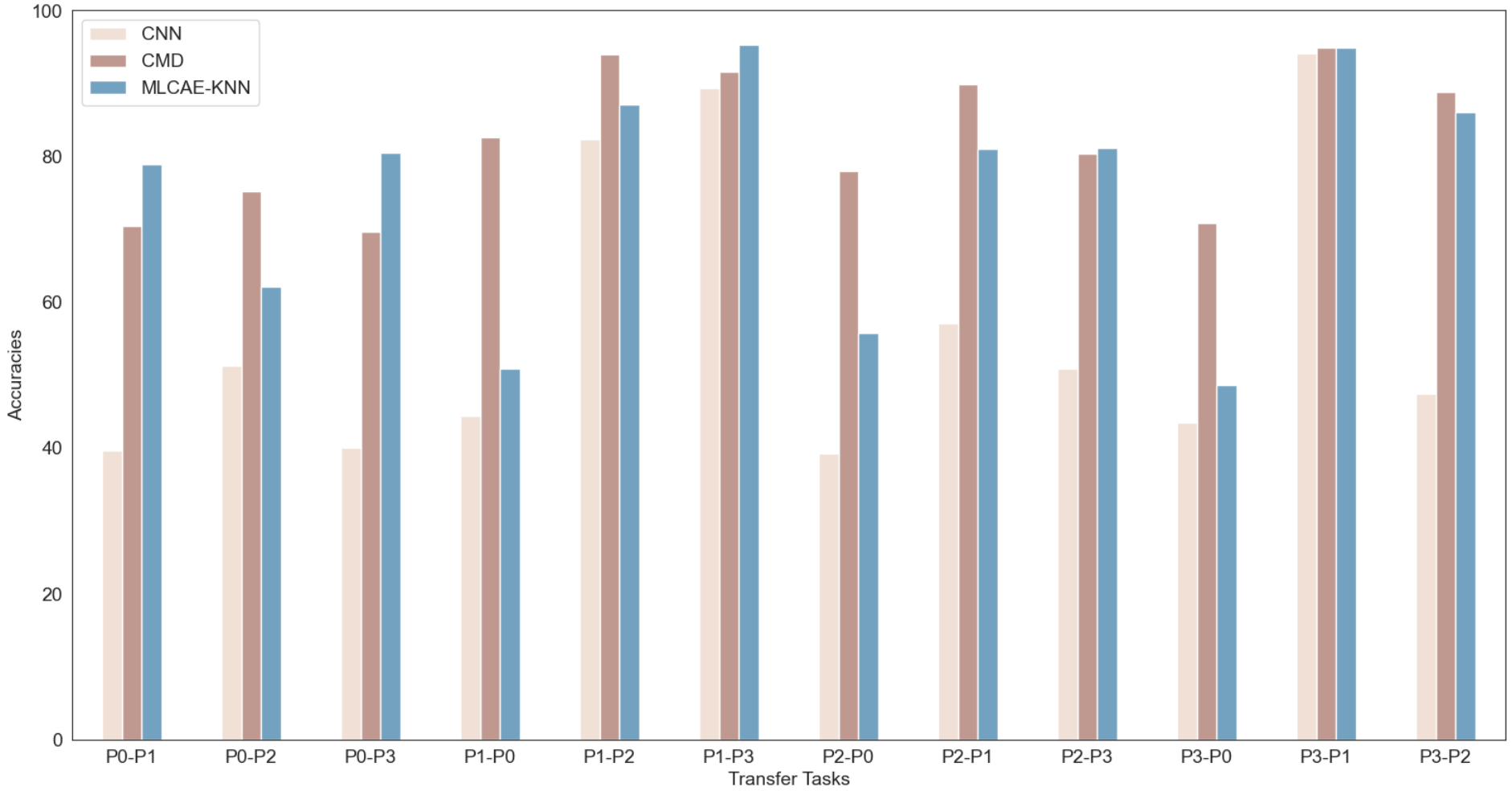
Results: Paderborn dataset



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Results summary:

- Results were promising, especially compared to source only literature
- It was better for many tasks even when compared to TL with adaptation
- Can we consider this to be better than the existing TL methods?

Further work:

- Pseudo labeling and classifier retraining based on **probabilistic KNN**
- This method as co compression and classification algorithm to reduce data bandwidth
- Testing the same on other datasets