ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

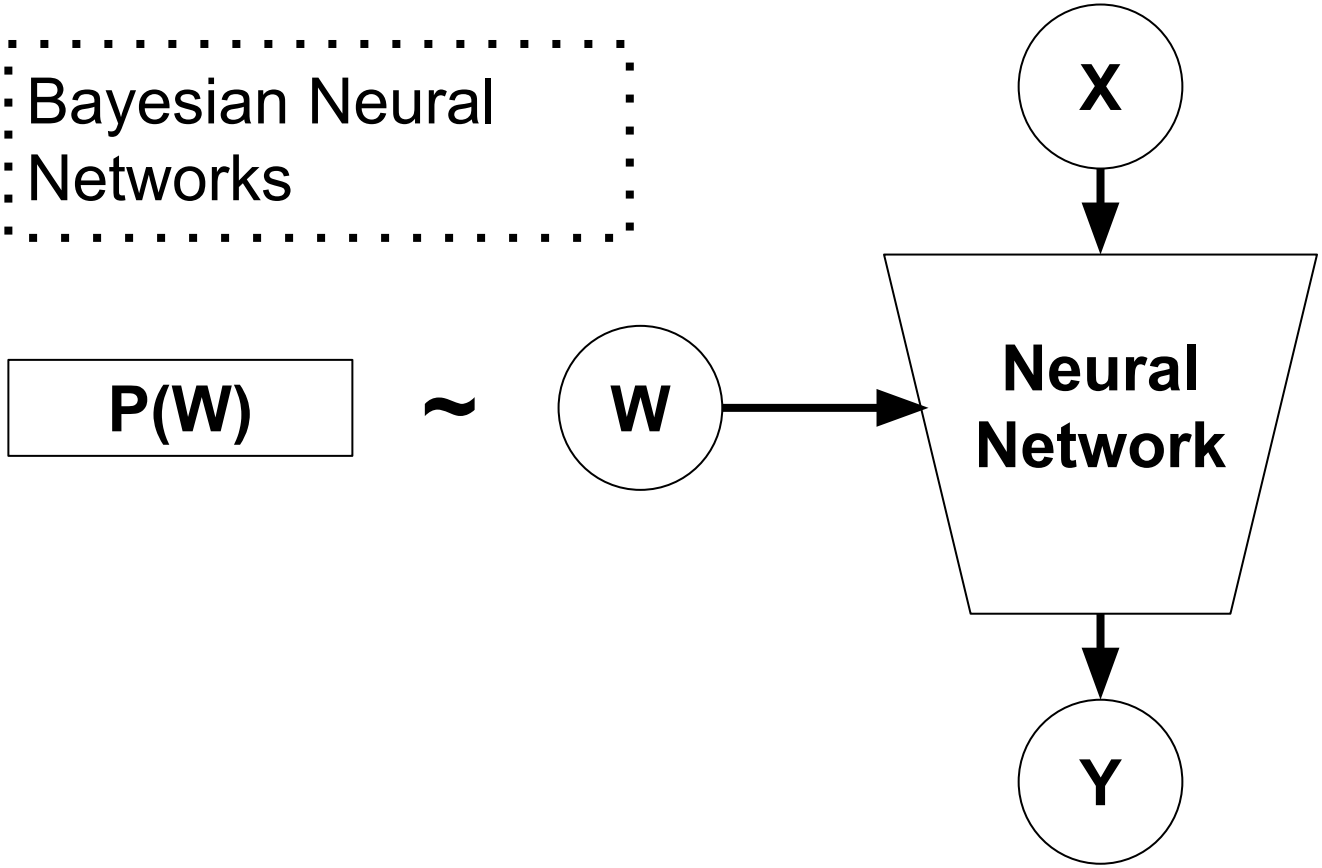
CVL Computer Vision Lab

On the Practicality of Deterministic Epistemic Uncertainty

Janis Postels* [1], Mattia Segu* [1,2], Tao Sun [1], Luca Daniel Sieber [1], Luc Van Gool [1], Fisher Yu [1], Federico Tombari [3,4]

[1] ETH Zurich [2] MPI Informatics [3] Technical University Munich [4] Google

Deterministic Uncertainty Methods (DUMs)



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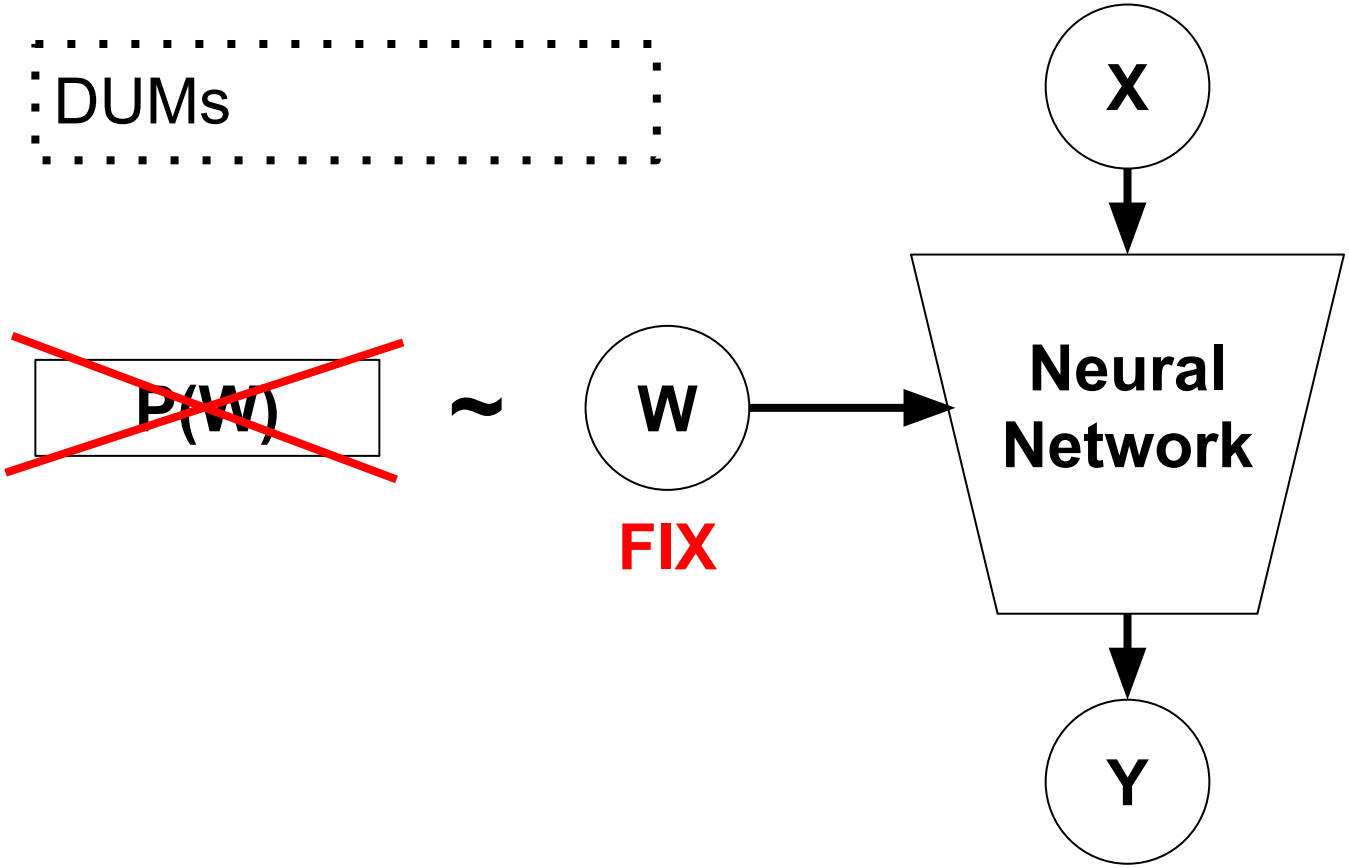
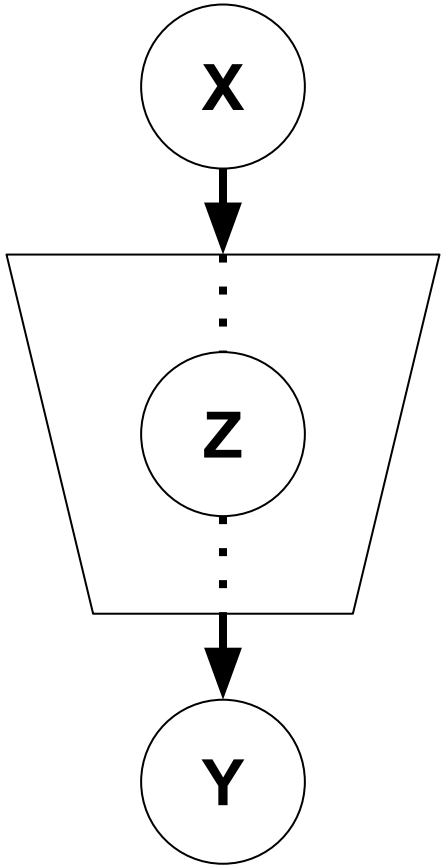
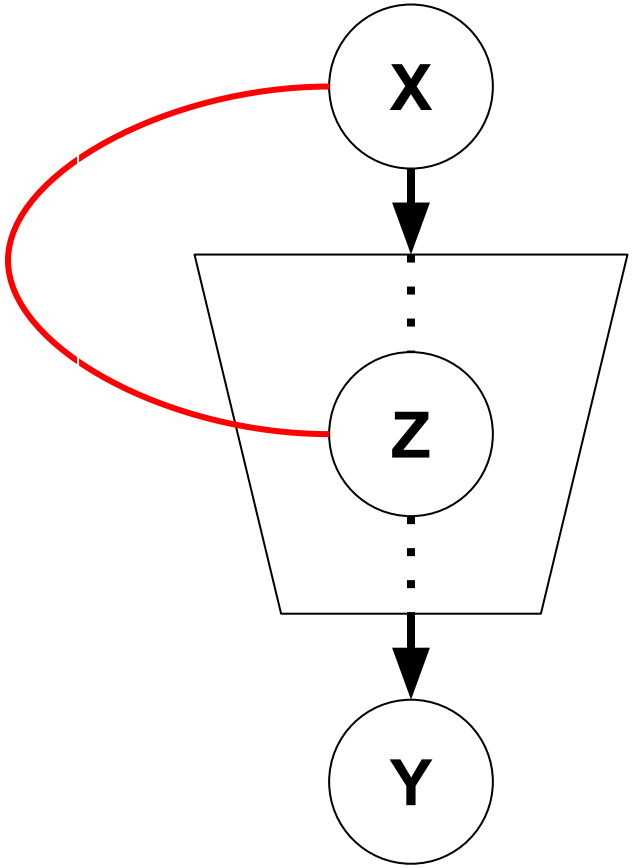


How to Regularize DUMs?



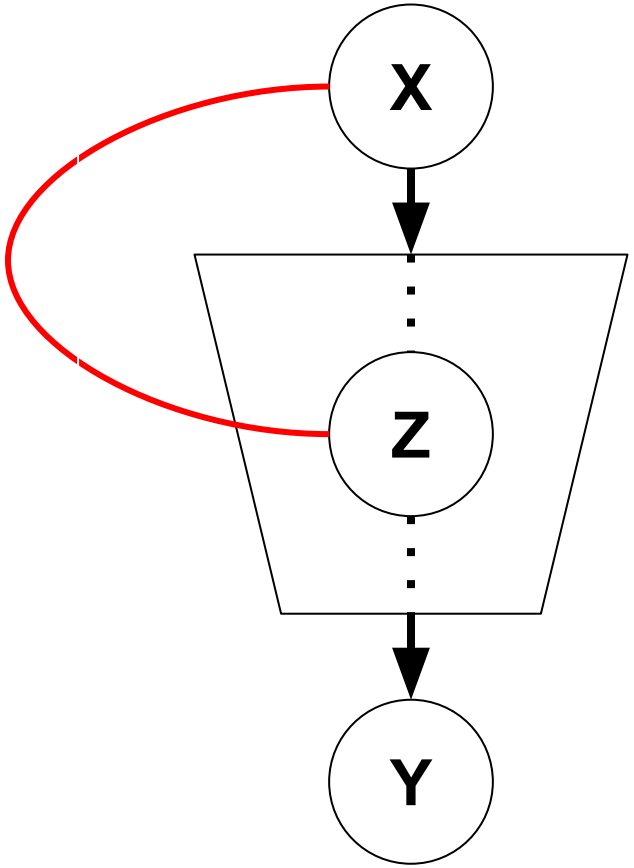
How to Regularize DUMs?

Distance-aware Representations
|Z1 - Z2| ~ |X1 - X2|

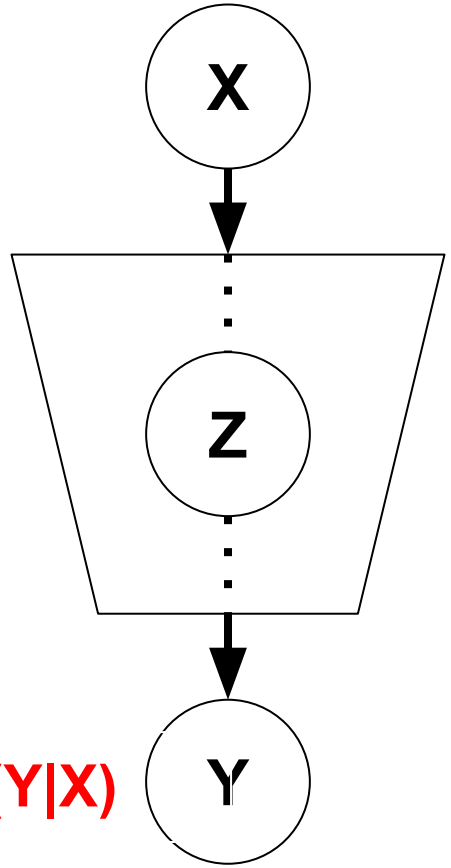


How to Regularize DUMs?

Informative Representations
max MI(X, Z)



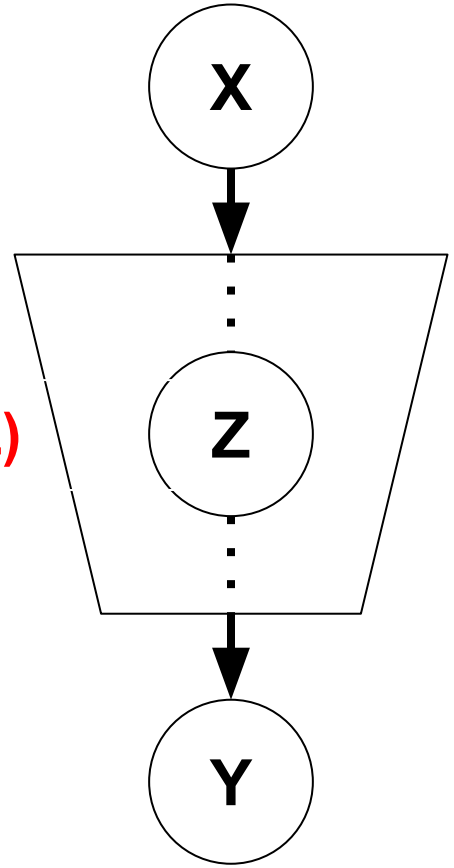
How Do DUMs Estimate Uncertainty?



Discriminative P(Y|X)

How Do DUMs Estimate Uncertainty?

Generative P(Z)



Desired Properties of an Epistemic Uncertainty Estimate

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Out-of-Distribution Detection

- Residing far away from the training data distribution
- Random model performance

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Out-of-Distribution Detection

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Calibration

- Model can generalize close to training data distribution
- Epistemic uncertainty should contain information about expected model performance

Research Questions regarding DUMs

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Do DUMs scale to realistic vision tasks?

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Is the epistemic uncertainty from DUMs well calibrated?

Measuring the Calibration of DUMs

ECE / Brier Score not applicable

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Property of well-calibrated uncertainty:
Can order samples according to predictive quality

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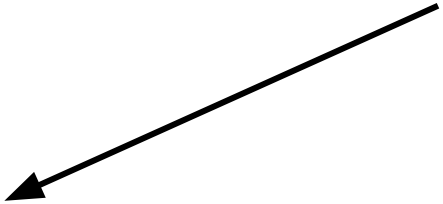

AUROC

Measuring the Calibration of DUMs

ECE / Brier Score not applicable

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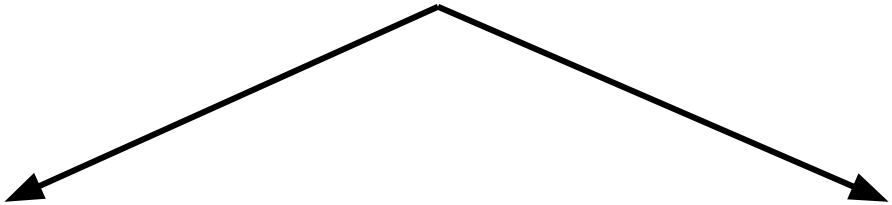

AUROC

rAULC
(Relative Area Under the Lift Curve)

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ECE / Brier Score not applicable

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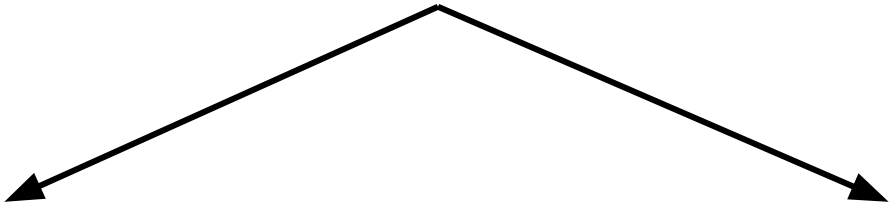

AUROC

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➢ Measures improvement over randomly ordered samples

Datasets & Distributional Shifts

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Image classification:

- CIFAR10/100-C

Datasets & Distributional Shifts

Image classification:

- CIFAR10/100-C

Semantic Segmentation:

- CITYSCAPES-C
- CARLA-C
  - Uses SHIFT [1] toolkit for data collection in CARLA

[1] Sun & Segu et al. SHIFT: A Synthetic Driving Dataset for Continuous Multi-Task Domain Adaptation. CVPR 2022

Summary

DUMs scale to realistic vision tasks

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DUMs scale to realistic vision tasks

Epistemic uncertainty from DUMs is not well calibrated

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DUMs scale to realistic vision tasks

Epistemic uncertainty from DUMs is not well calibrated

Distance sensitivity does not correlate well with calibration or OOD detection

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Thanks for Your Attention!

Tue Jul 19 06:30 PM -- 08:30 PM
@ Hall E #506

Paper: