NEURAL INFORMATION PROCESSING SYSTEMS

SEAL: Structured Energy network As a Loss function

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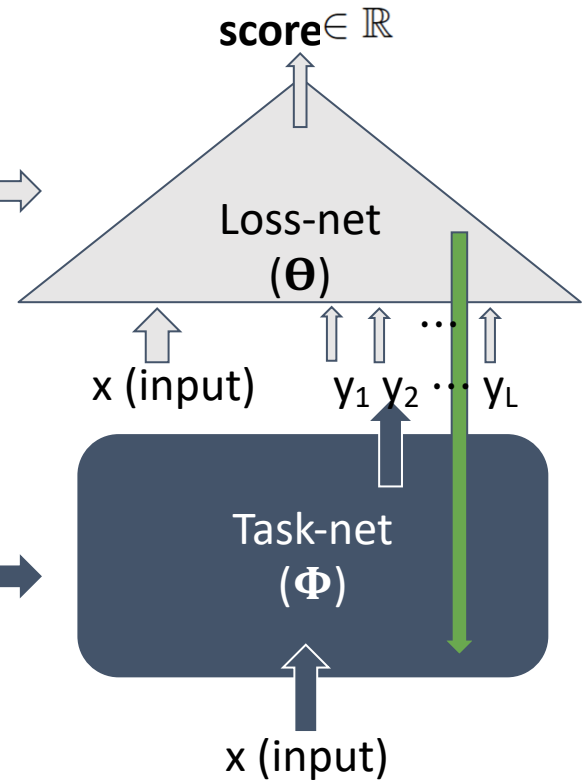
SEAL:
Structured
Energy network
As a
Loss

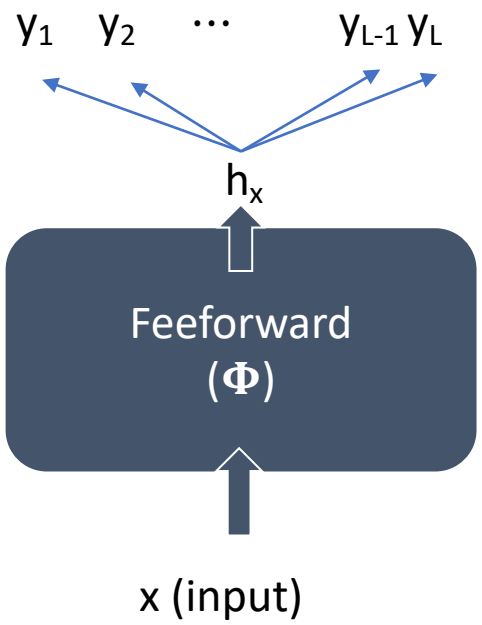
Structured Energy network As a Loss (SEAL)

Trainable loss function

Network used
at inference time.

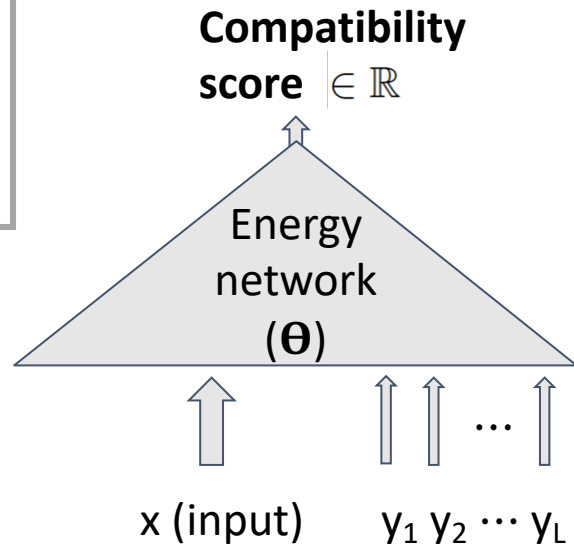


Motivation: Energy network vs. Feedforward



Feedforward model:
Representation of "x" takes care of output dependencies.

Energy-based model:
Captures dependency across multivariate output.



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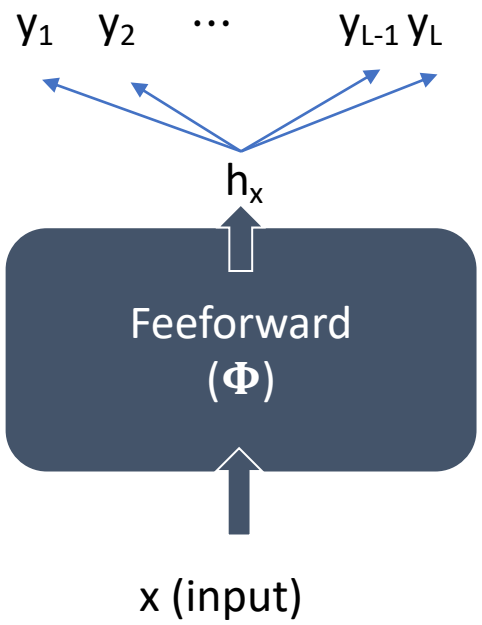
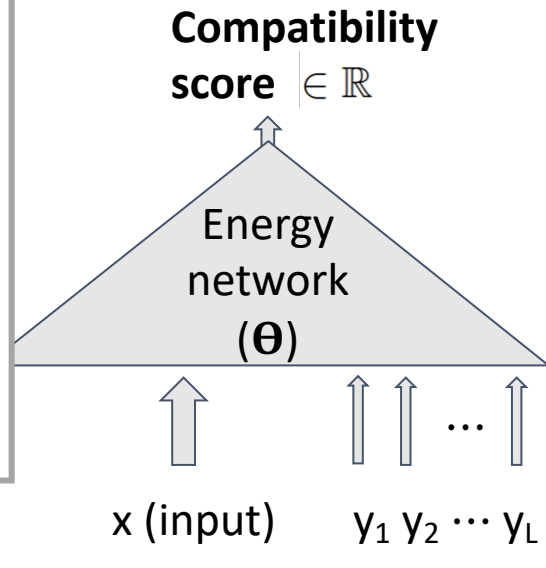


Feedforward model:
Representation of "x" takes care of output dependencies.

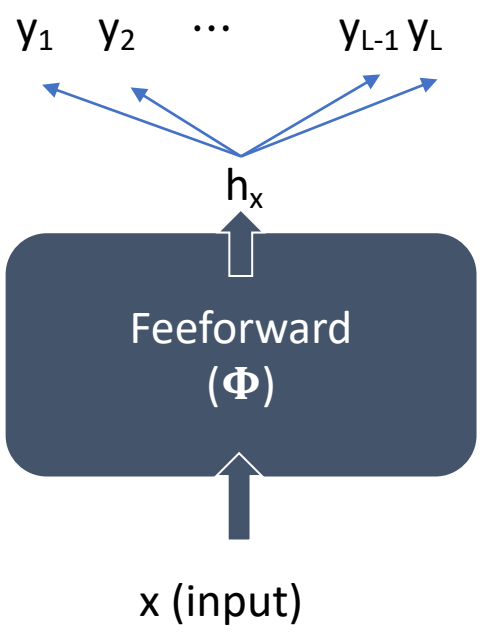
- Light, fast at inference.
- But hard to capture dependencies between labels.

Energy-based model:
Captures dependency across multivariate output

- Captures label dependencies.
- Thus, more accurate.
- Slow, unstable at inference.



Motivation: Energy network vs. Feedforward



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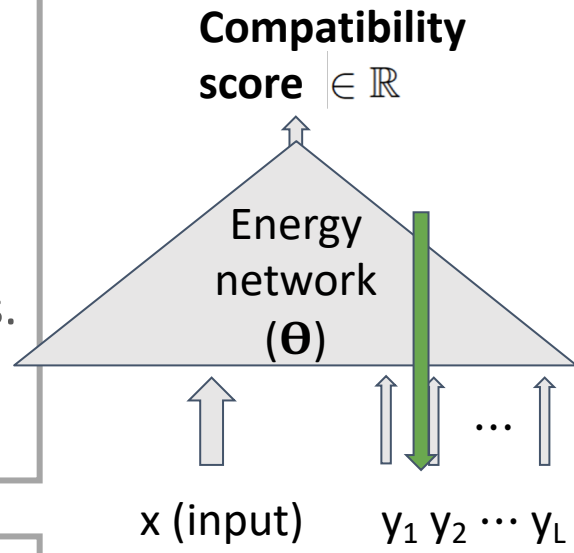
Gradient-Based Inference (GBI)
to search
combinatorial output space.



Structured **E**nergy network **A**s a **L**oss (SEAL)

Loss-net:

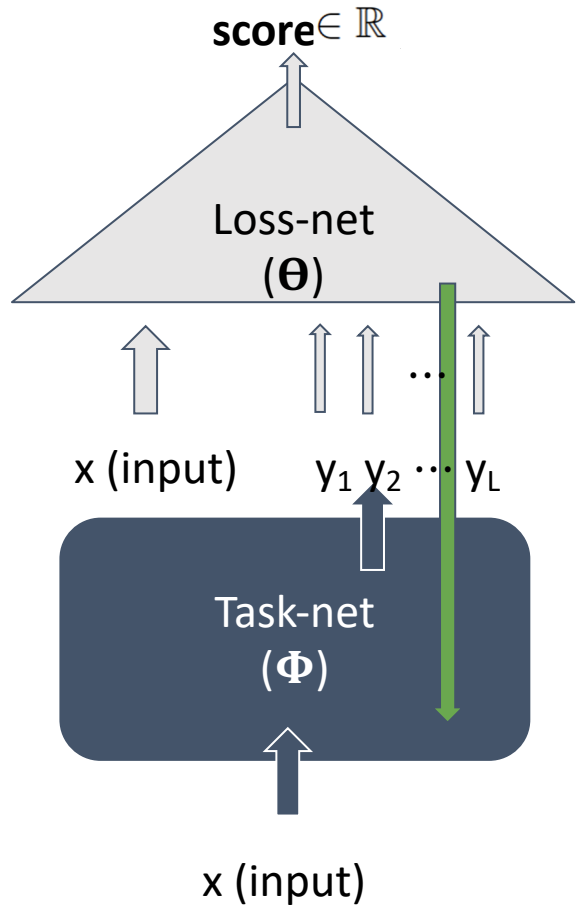
- Structured energy network.

Task-net:

- Fast inference with feedforward.

Two versions:

- SEAL-static
- SEAL-dynamic



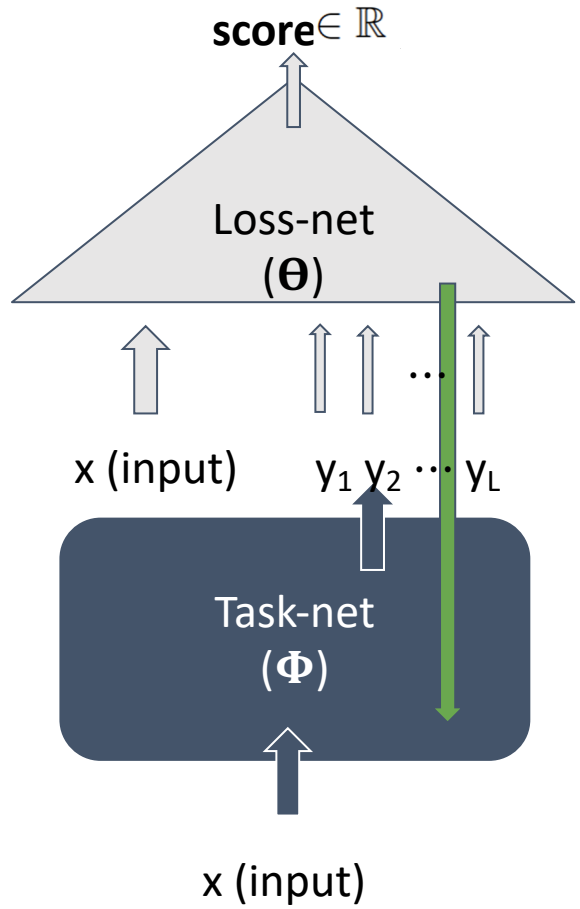
SEAL-static

Loss-net:

- Trained beforehand,
  "fixed" while training task-net.

Task-net:

- Fast inference with feedforward.



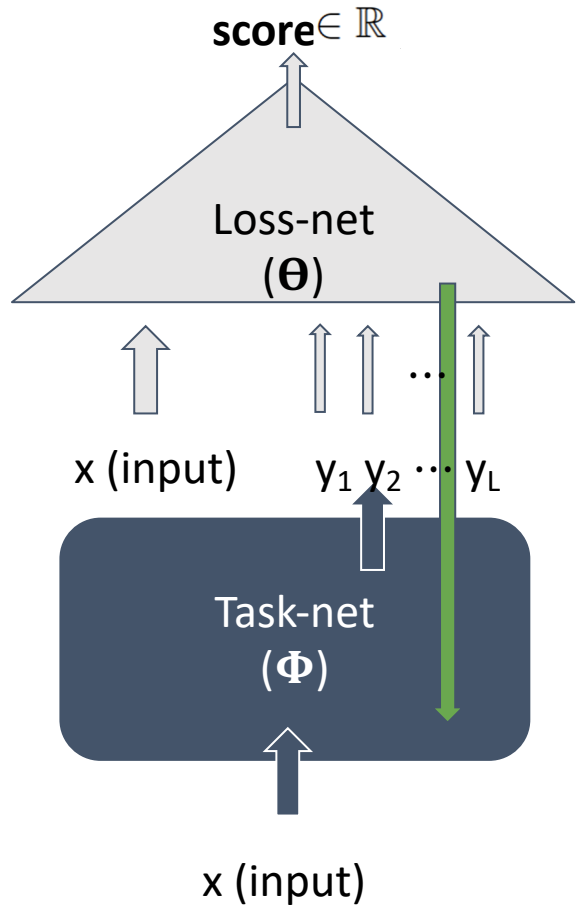
SEAL-dynamic

Loss-net:

- Structured energy network that dynamically adapts to task-net.

Task-net:

- Fast inference with feedforward.

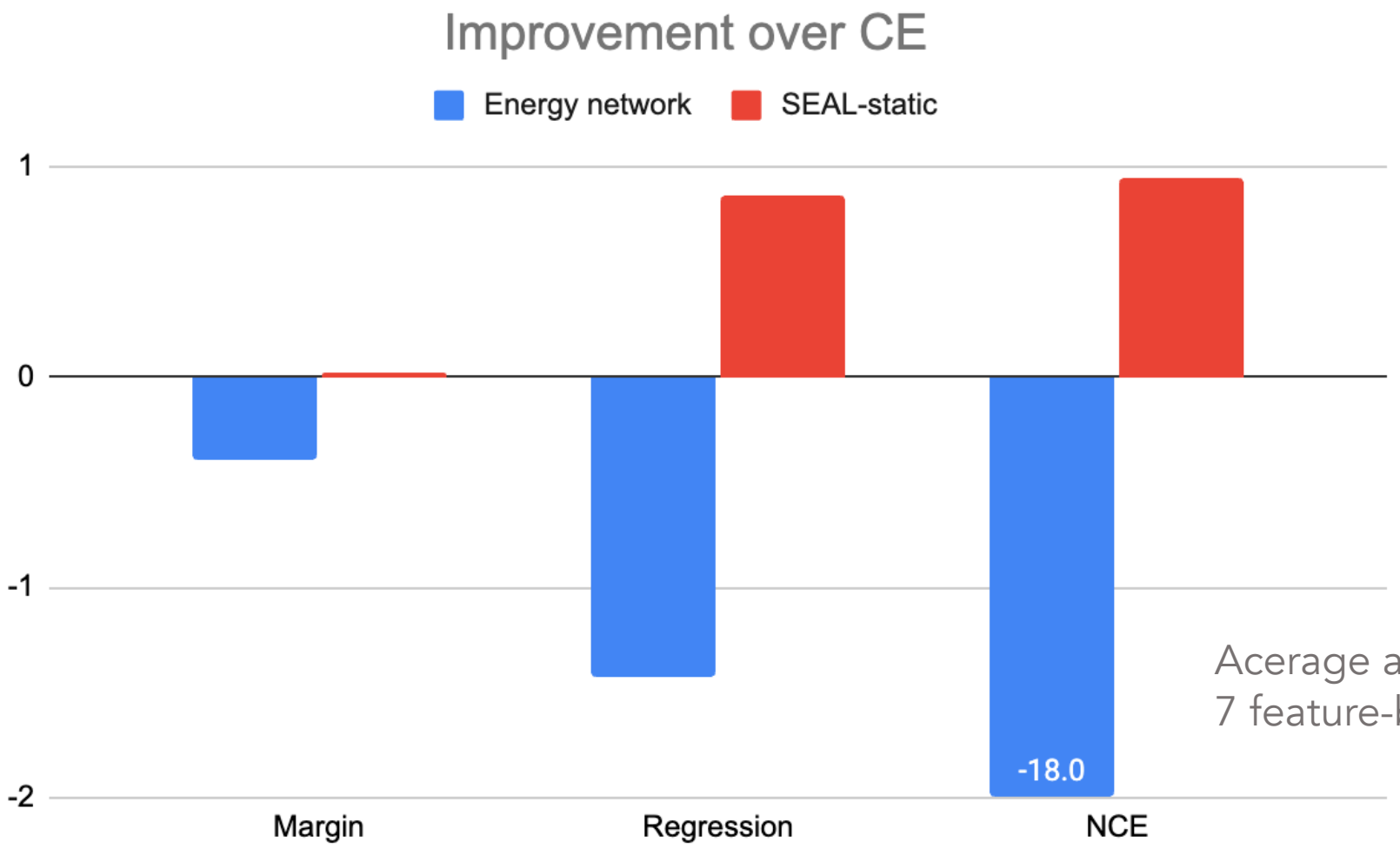


Experiments overview

- Examined three losses for energy netwrok
  - SSVM loss[1]
  - Regression loss[2]
  - Noise-Constrastive Estimation (NCE) ranking loss[3]
- Applications
  - Feature-based MLC
  - Text-based MLC
  - Semantic Role Labeling
  - Binary Image segmentation.

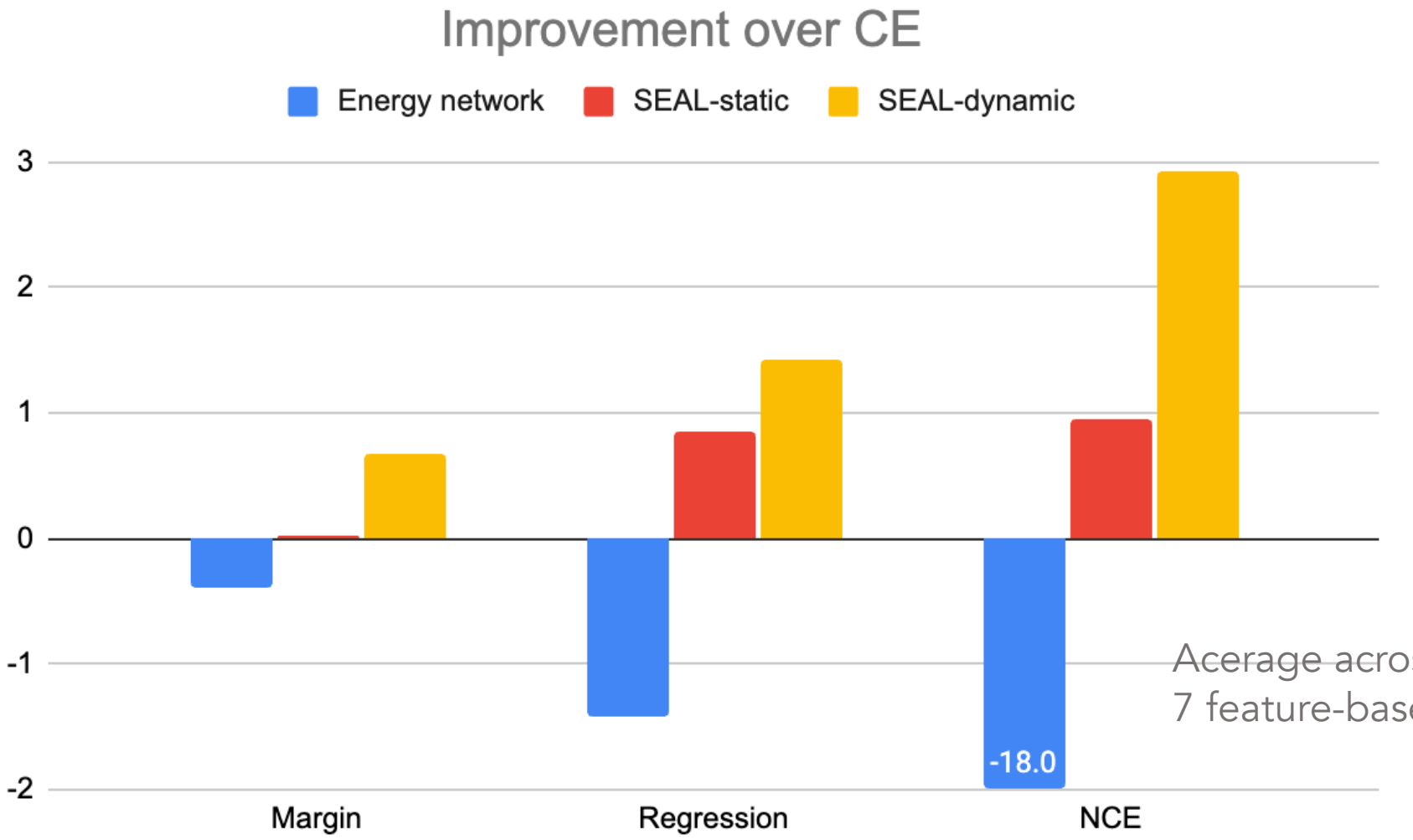
[1] Belanger, D. and McCallum, A. Structured prediction energy networks. *ICML 2016*
[2] Gygli et al., Deep value networks learn to evaluate and iteratively refine structured outputs, *ICML 2017*
[3] Ma, Z. and Collins, M. Noise contrastive estimation and negative sampling for conditional models, EMNLP 2018

Energy network vs. SEAL-static



Acerage across
7 feature-based MLC dataset

SEAL-static vs. SEAL-dynamic



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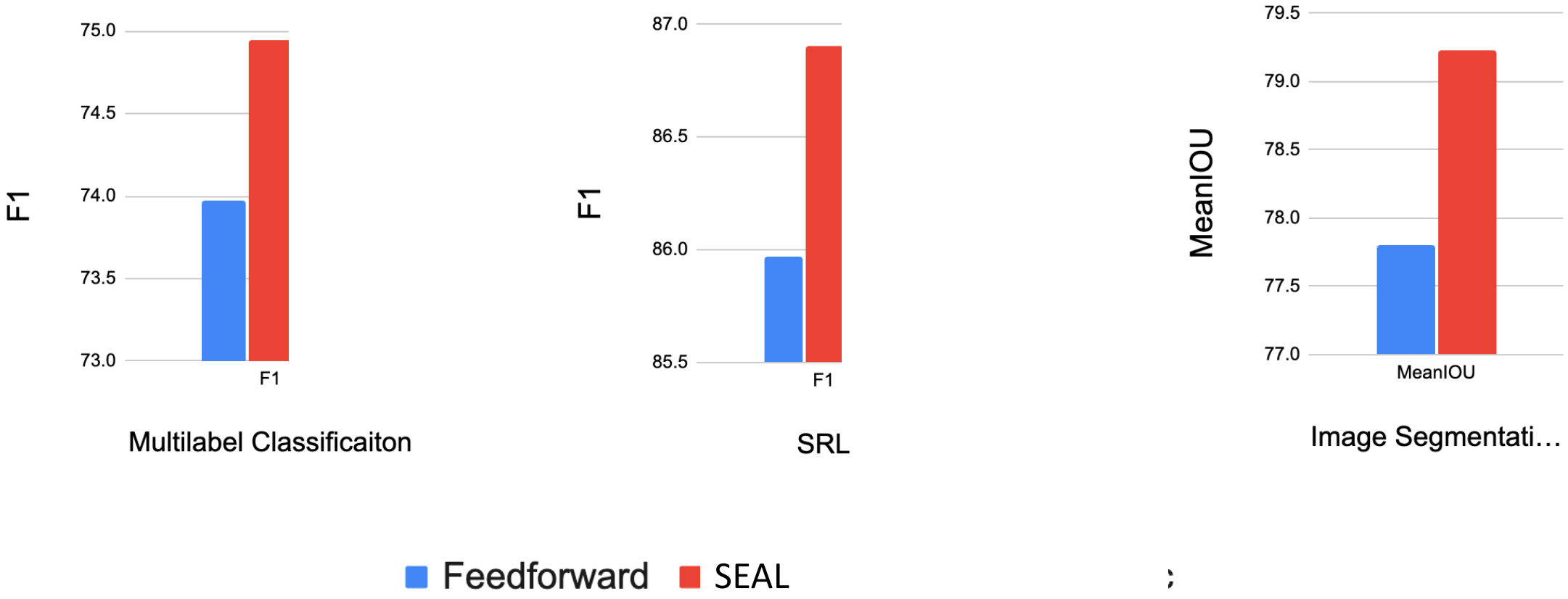
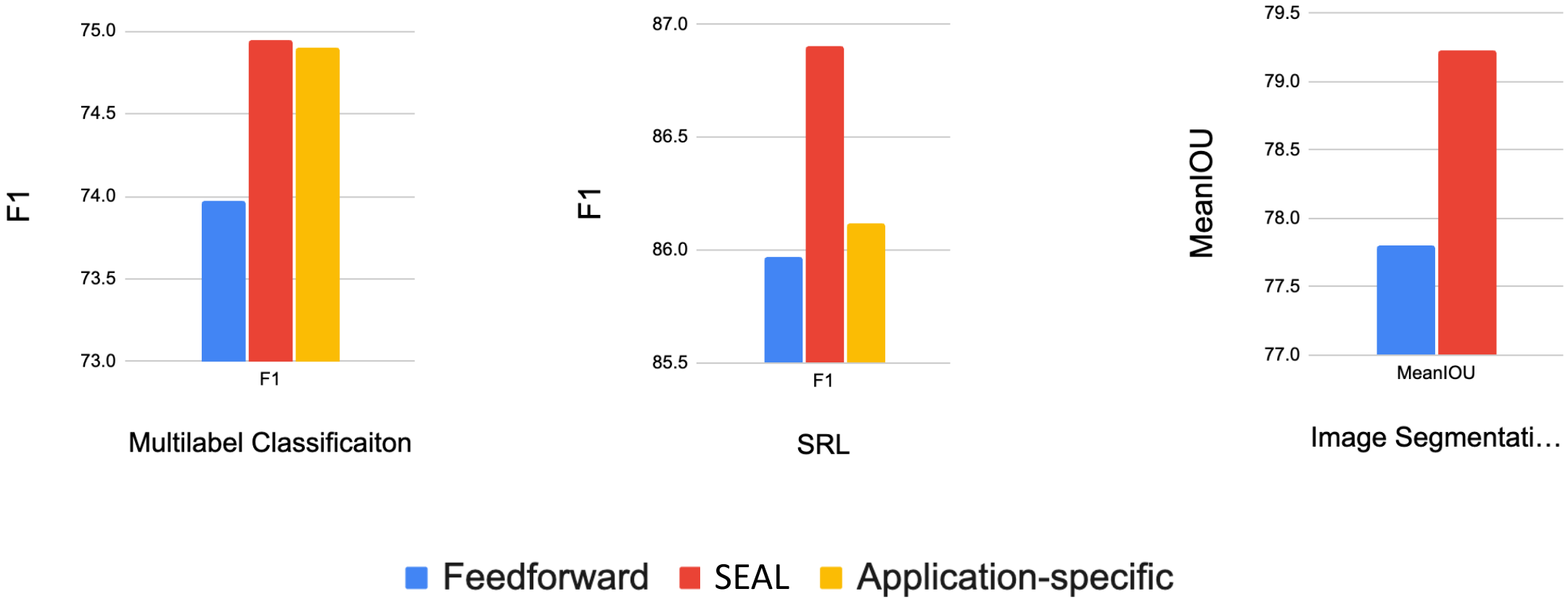
Cross-entropy vs. SEAL

Experiment results



SEAL vs. Application-specific approach

Experiment results



Summary

- SEAL provides
  - better performance than both energy network & feedforward.
  - Faster than energy network, as fast as feedforward.
- Energy network < SEAL-static < SEAL-dynamic

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