

# Taming Discrete Integration via the Boon of Dimensionality

**Jeffrey M. Dudek**

Rice University



**Dror Fried**

The Open University  
of Israel



**Kuldeep S. Meel**

National University  
of Singapore



## Neural Network (Uniform) Robustness

What is the probability that an input sampled **uniformly from all inputs** is adversarial for a given neural network?

## Neural Network (Uniform) Robustness

What is the probability that an input sampled **uniformly from all inputs** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

## Unweighted Projected Model Counting

How many discrete solutions does a set of equations have?

## Neural Network (Uniform) Robustness

What is the probability that an input sampled **uniformly from all inputs** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

## Unweighted Projected Model Counting

How many discrete solutions does a set of equations have?

ApproxMC4



Scales

## Neural Network (Uniform) Robustness

What is the probability that an input sampled **uniformly from all inputs** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

## Unweighted Projected Model Counting

How many discrete solutions does a set of equations have?

ApproxMC4



Scales

## Neural Network (Log-Linear) Robustness

What is the probability that an input sampled **from a log-linear distribution** is adversarial for a given neural network?

## Neural Network (Uniform) Robustness

What is the probability that an input sampled **uniformly from all inputs** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

## Unweighted Projected Model Counting

How many discrete solutions does a set of equations have?

ApproxMC4



Scales

## Neural Network (Log-Linear) Robustness

What is the probability that an input sampled **from a log-linear distribution** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

## Discrete Integration

How many **weighted** discrete solutions does a set of equations have?

## Neural Network (Uniform) Robustness

What is the probability that an input sampled **uniformly from all inputs** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

## Unweighted Projected Model Counting

How many discrete solutions does a set of equations have?

ApproxMC4



Scales

## Neural Network (Log-Linear) Robustness

What is the probability that an input sampled **from a log-linear distribution** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

Probabilistic Inference  
Network Reliability

## Discrete Integration

How many **weighted** discrete solutions does a set of equations have?

GANAK

Dsharp + D2C

WISH



Does not scale

## Neural Network (Uniform) Robustness

What is the probability that an input sampled **uniformly from all inputs** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

## Unweighted Projected Model Counting

How many discrete solutions does a set of equations have?

ApproxMC4



Scales

## Neural Network (Log-Linear) Robustness

What is the probability that an input sampled **from a log-linear distribution** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

Probabilistic Inference  
Network Reliability

## Discrete Integration

How many **weighted** discrete solutions does a set of equations have?

GANAK

Dsharp + D2C

WISH



Does not scale

Our contribution

Add new variables to **exactly** simulate weights



## Neural Network (Uniform) Robustness

What is the probability that an input sampled **uniformly from all inputs** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

## Unweighted Projected Model Counting

How many discrete solutions does a set of equations have?

ApproxMC4



Scales

## Neural Network (Log-Linear) Robustness

What is the probability that an input sampled **from a log-linear distribution** is adversarial for a given neural network?

(Baluta *et. al*, CCS 2019)

Probabilistic Inference  
Network Reliability

## Discrete Integration

How many **weighted** discrete solutions does a set of equations have?

GANAK

Dsharp + D2C

WISH



Does not scale

Our contribution

Add new variables to **exactly** simulate weights