Fundamentals of Deep Learning

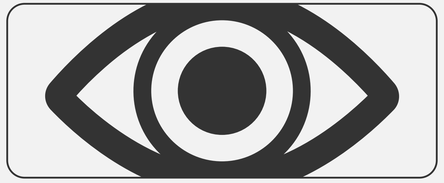
Part 6: Advanced Architectures

Agenda

- Part 1: An Introduction to Deep Learning
- Part 2: How a Neural Network Trains
- Part 3: Convolutional Neural Networks
- Part 4: Data Augmentation and Deployment
- Part 5: Pre-Trained Models
- Part 6: Advanced Architectures

Moving Forward

Fields of AI

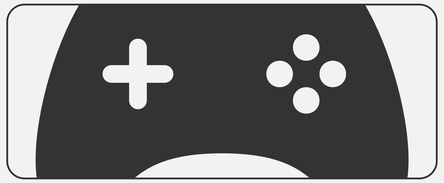


Computer Vision

- Optometry

Natural Language Processing

- Linguistics



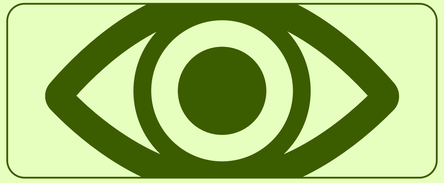
Reinforcement Learning

- Game Theory
- Psychology

Anomaly Detection

- Security
- Medicine

Fields of AI



Computer Vision

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Natural Language Processing

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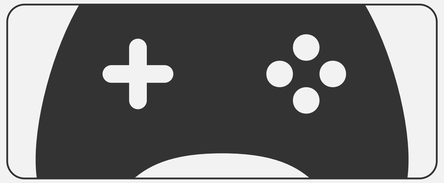

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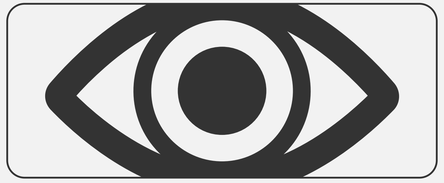
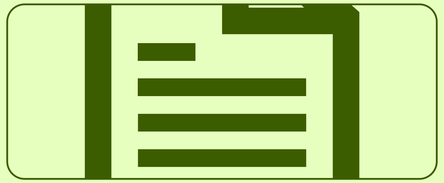


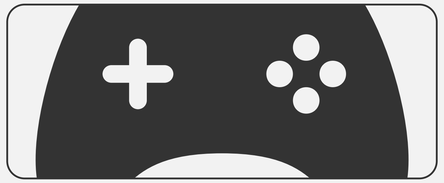
Computer Vision

- Optometry



Natural Language Processing

- Linguistics



Reinforcement Learning

- Game Theory
- Psychology

Anomaly Detection

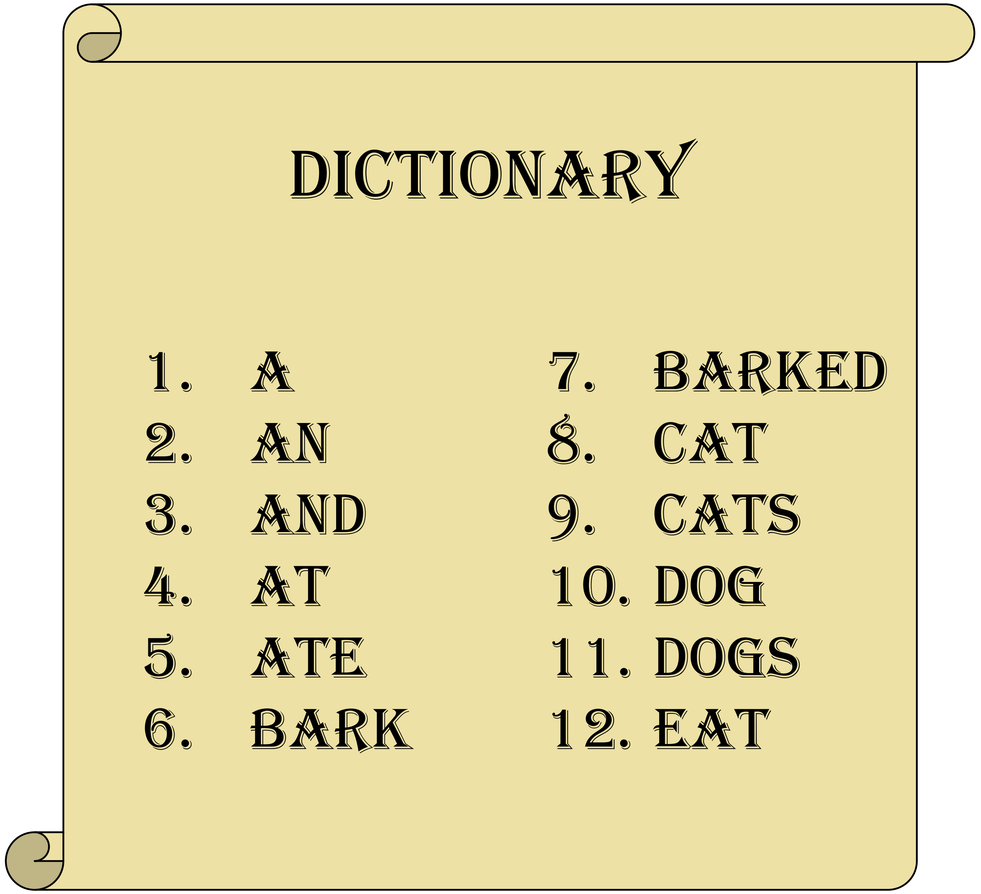
- Security
- Medicine

Natural Language Processing

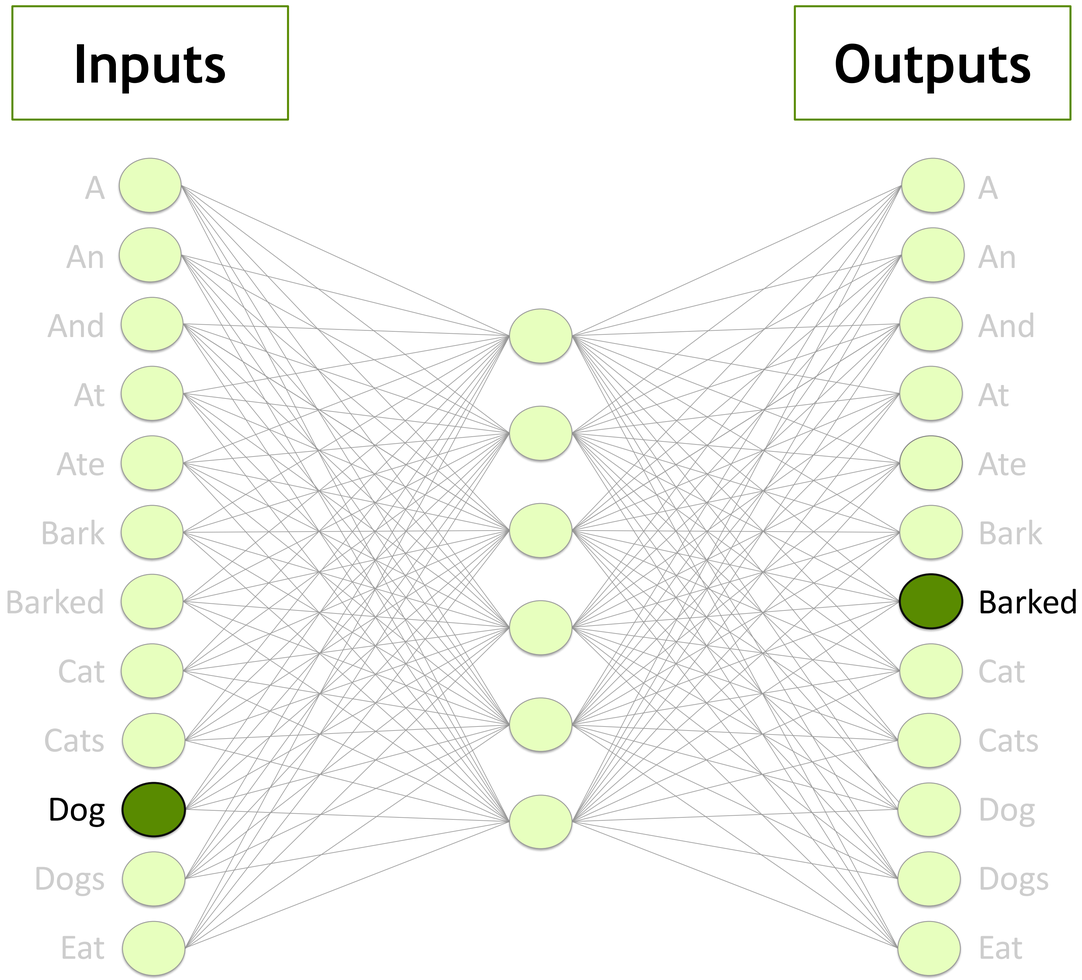
From Words to Numbers

“A dog barked at a cat.”

[1, 10, 7, 4, 1, 8]



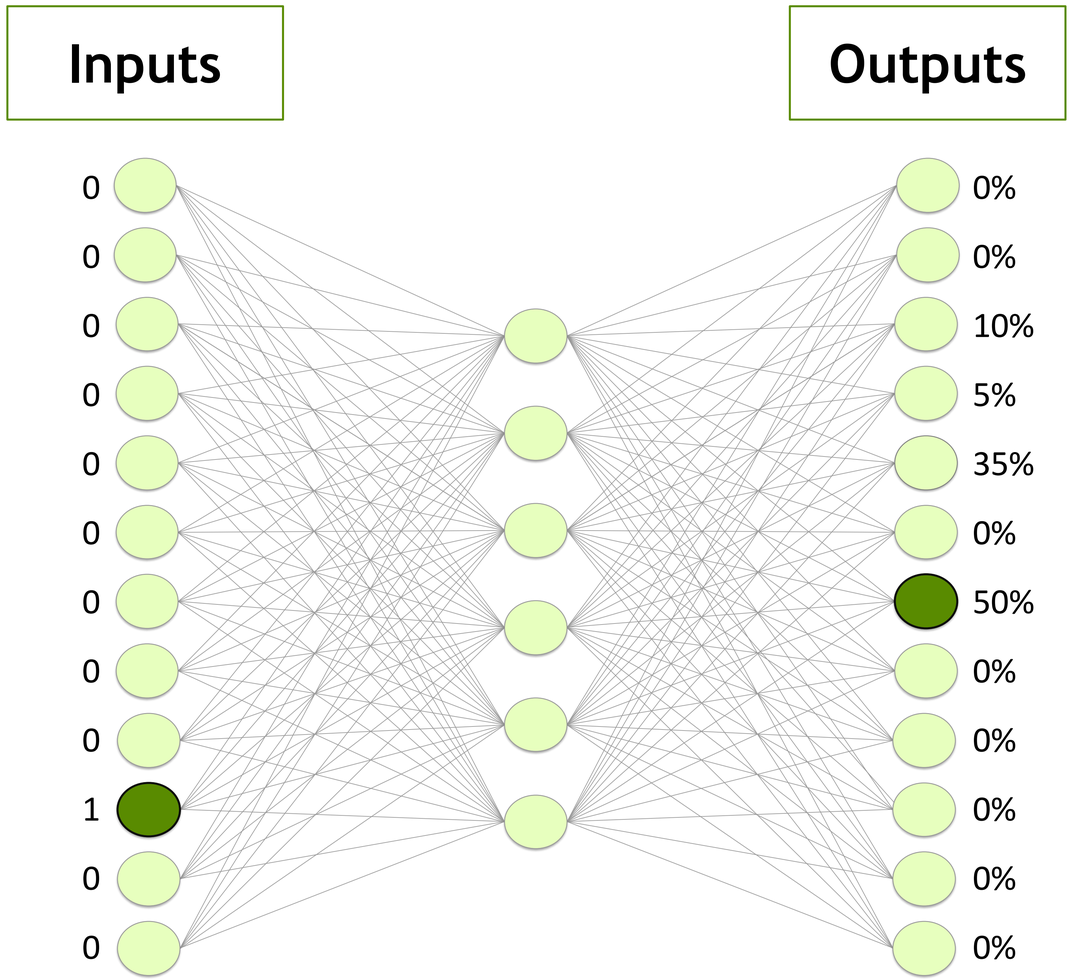
From Words to Numbers

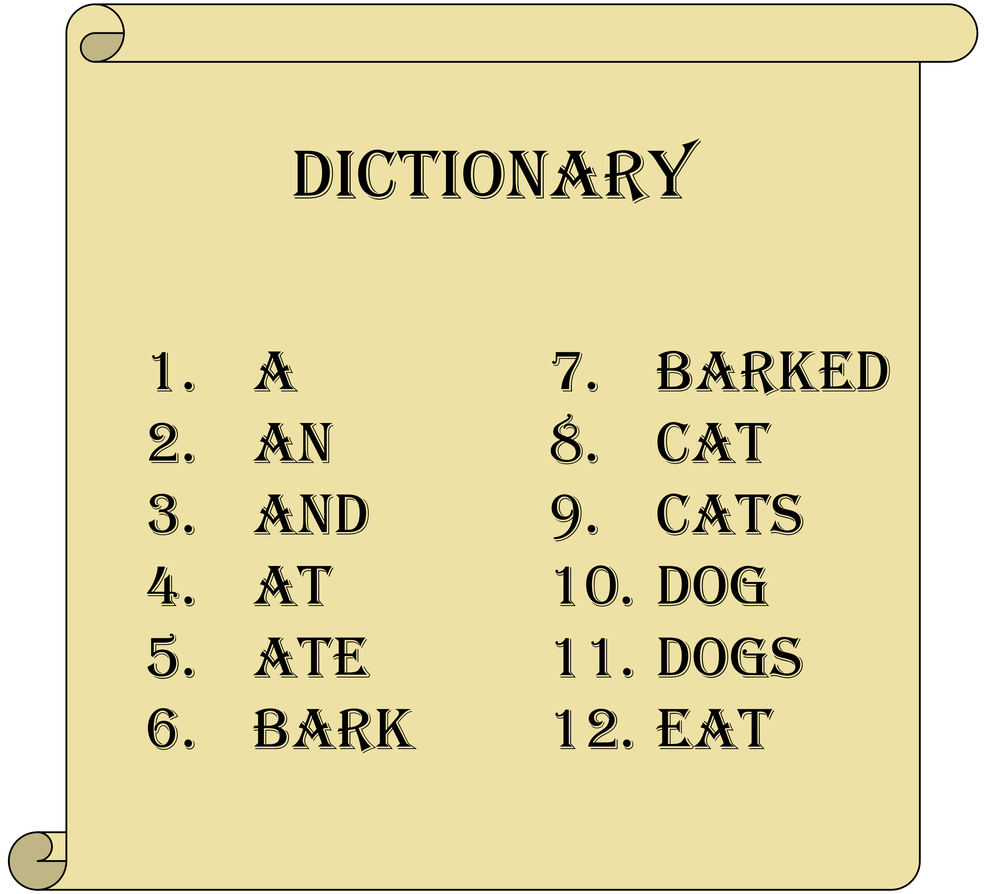


DICTIONARY

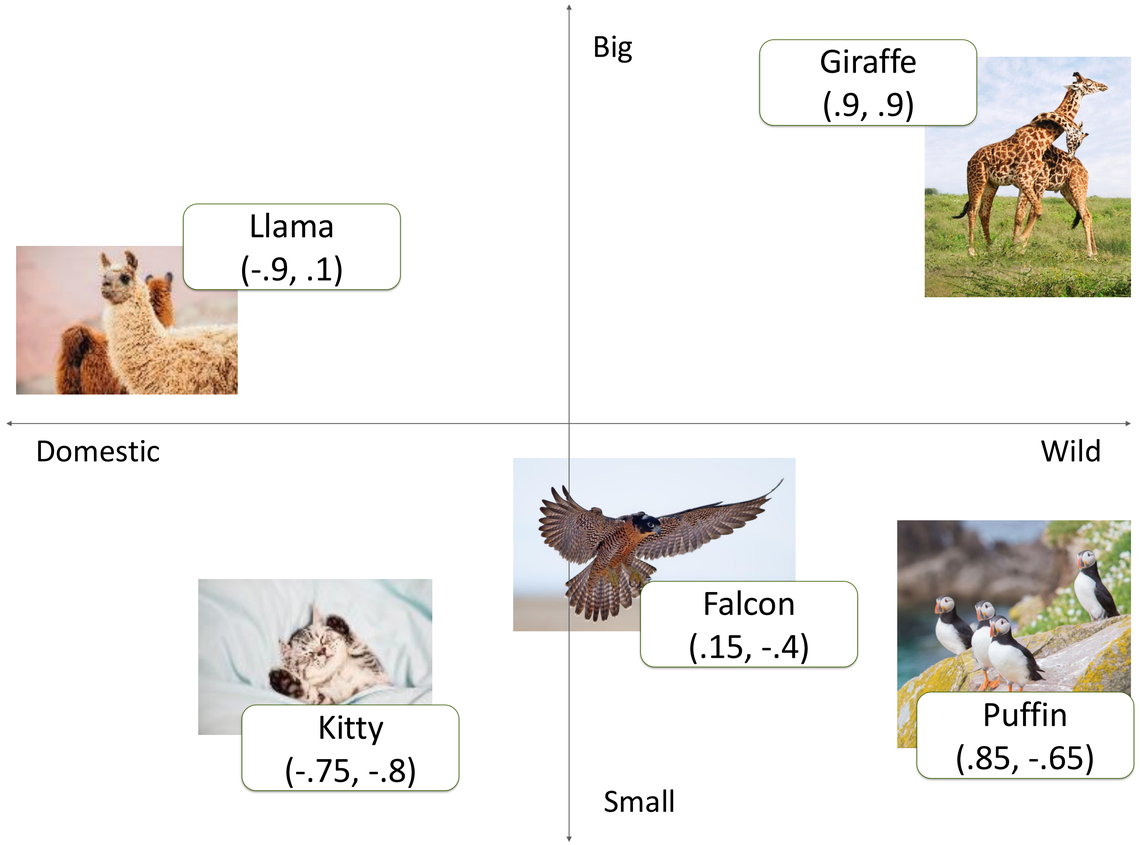
1. A
2. AN
3. AND
4. AT
5. ATE
6. BARK
7. BARKED
8. CAT
9. CATS
10. DOG
11. DOGS
12. EAT

From Words to Numbers





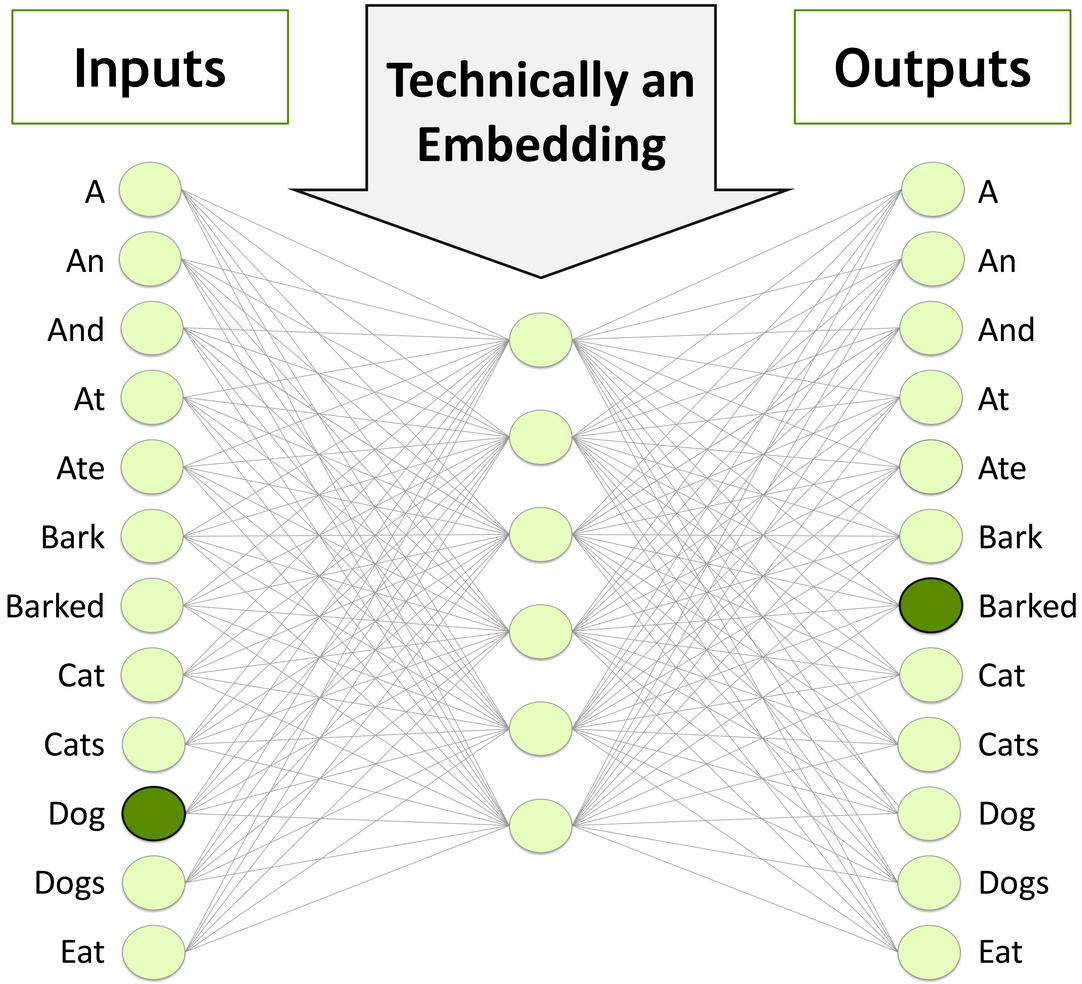
From Words to Numbers



BIGGER DICTIONARY

1.	A	33.	BARKED	65.	EATEN
2.	AN	34.	CAT	66.	A
3.	AND	35.	CATS	67.	AN
4.	AT	36.	DOG	68.	AND
5.	ATE	37.	DOGS	69.	AT
6.	BARK	38.	EAT	70.	ATE
7.	BARKED	39.	EATEN	71.	BARK
8.	CAT	40.	A	72.	BARKED
9.	CATS	41.	AN	73.	CAT
10.	DOG	42.	AND	74.	CATS
11.	DOGS	43.	AT	75.	DOG
12.	EAT	44.	ATE	76.	DOGS
13.	EATEN	45.	BARK	77.	EAT
14.	A	46.	BARKED	78.	EATEN
15.	AN	47.	CAT	79.	...
16.	AND	48.	CATS	80.	...
17.	AT	49.	DOG	81.	...
18.	ATE	50.	DOGS	82.	...
19.	BARK	51.	EAT		
20.	BARKED	52.	EATEN		
21.	CAT	53.	A		
22.	CATS	54.	AN		
23.	DOG	55.	AND		
24.	DOGS	56.	AT		
25.	EAT	57.	ATE		
26.	EATEN	58.	BARK		
27.	A	59.	BARKED		
28.	AN	60.	CAT		
29.	AND	61.	CATS		
30.	AT	62.	DOG		
31.	ATE	63.	DOGS		
32.	BARK	64.	EAT		

From Words to Numbers



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14.	A	46.	BARKED	78.	EATEN
15.	AN	47.	CAT	79.	...
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23.	DOG	55.	AND		
24.	DOGS	56.	AT		
25.	EAT	57.	ATE		
26.	EATEN	58.	BARK		
27.	A	59.	BARKED		
28.	AN	60.	CAT		
29.	AND	61.	CATS		
30.	AT	62.	DOG		
31.	ATE	63.	DOGS		
32.	BARK	64.	EAT		

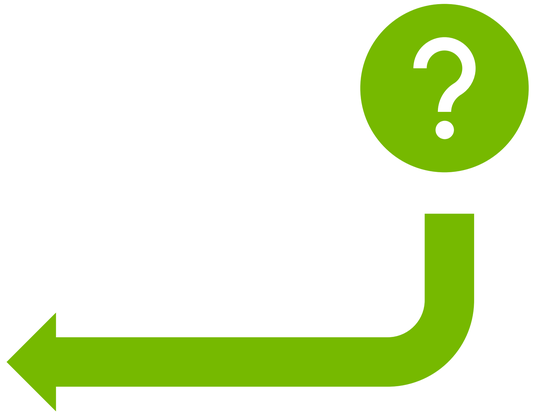
Attention

Sentence Prediction

I am the very model of a modern Major-Gineral,
I've information vegetable, animal, and mineral,

...

I'm very good at integral and differential calculus;
I know the scientific names of beings animalculous:
In short, in matters vegetable, animal, and mineral,
I am the very model of a m



~ Major-General Stanley

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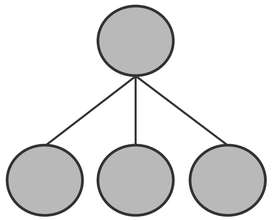
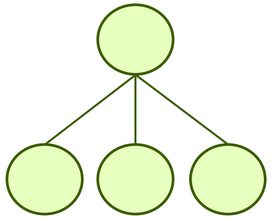




I
am
the
very
model

5 x 3

Q

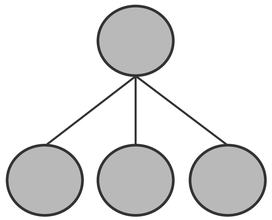
Query

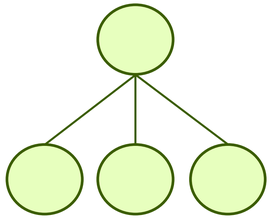
5 x 3

K

Key

Attention





I						
am						
the						
very						
model						

5 x 3

Q

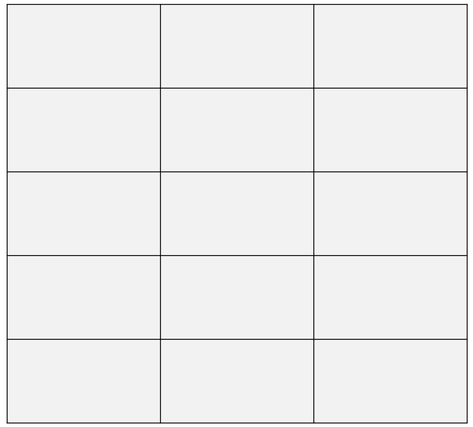
Query

5 x 3

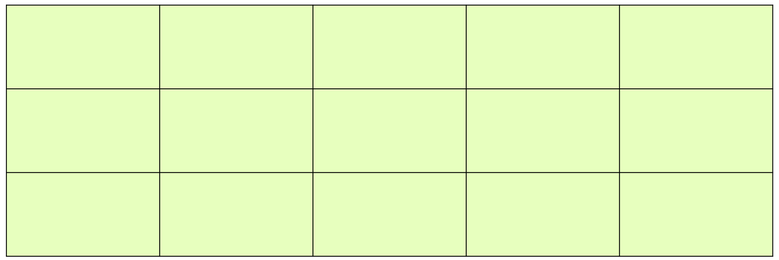
K

Key

Attention

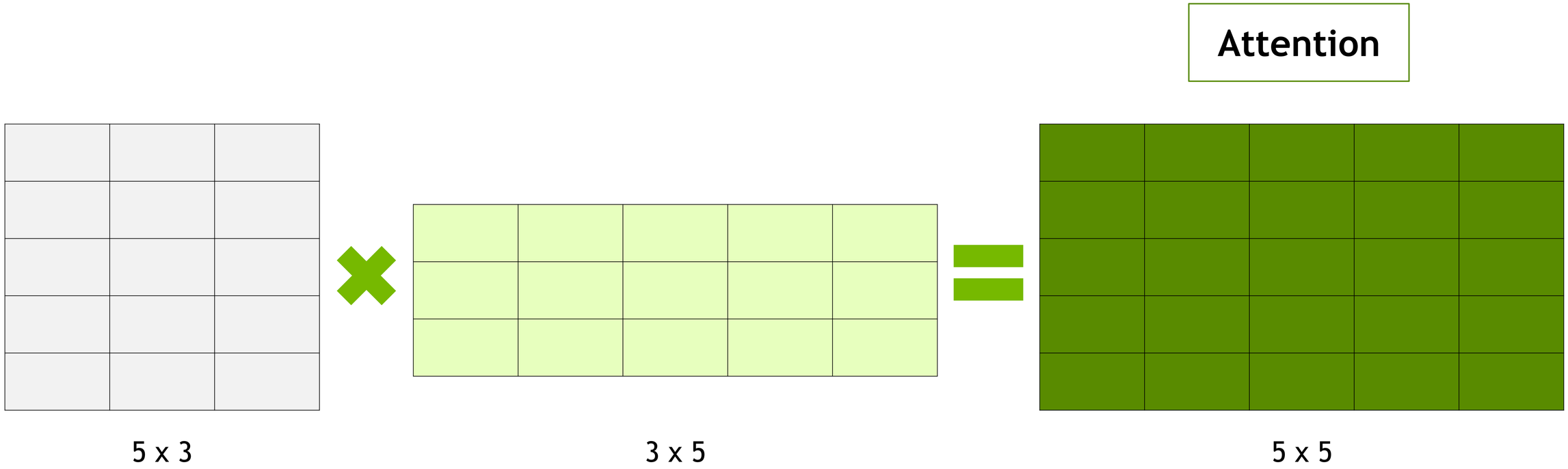


5 x 3

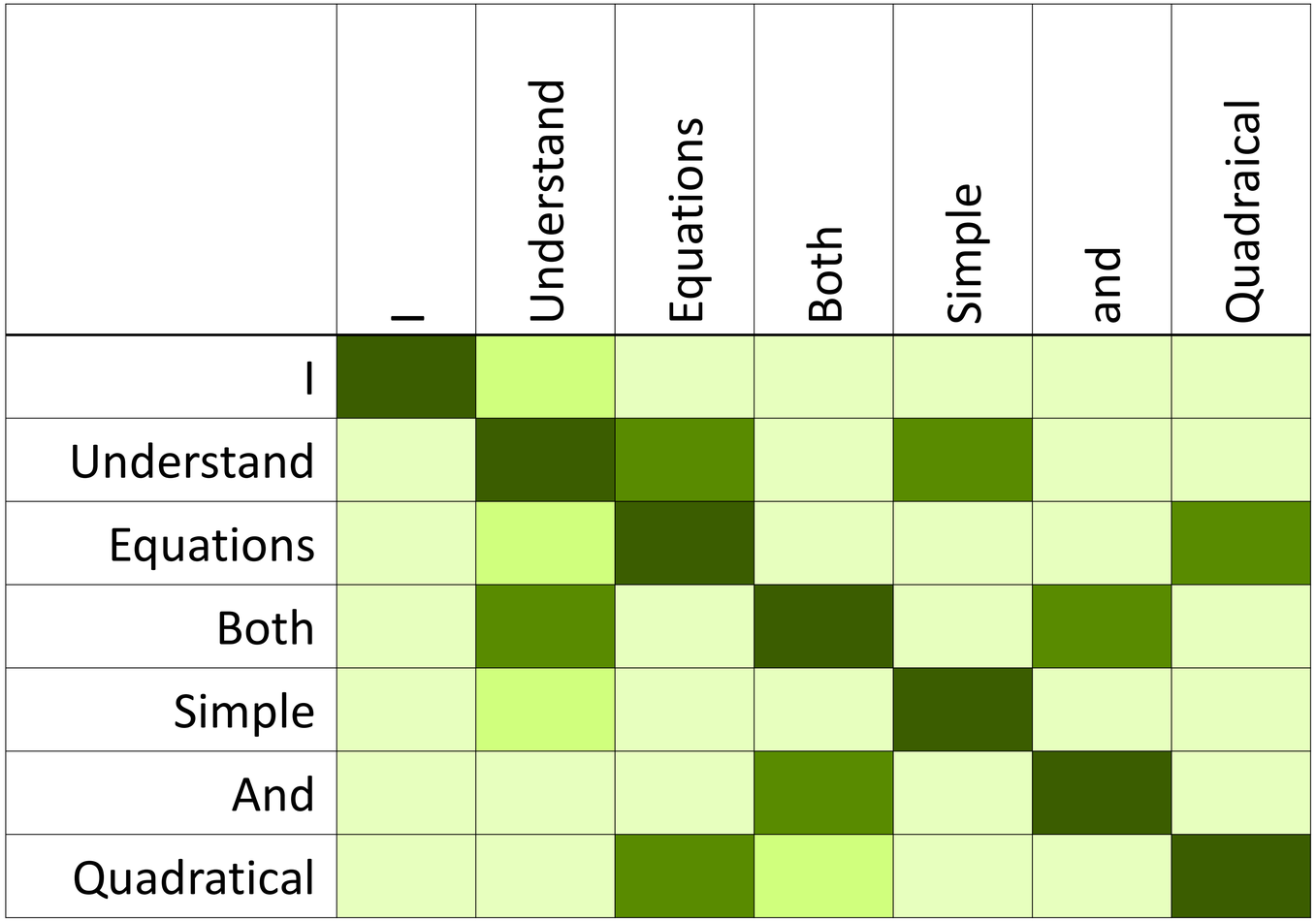


3 x 5

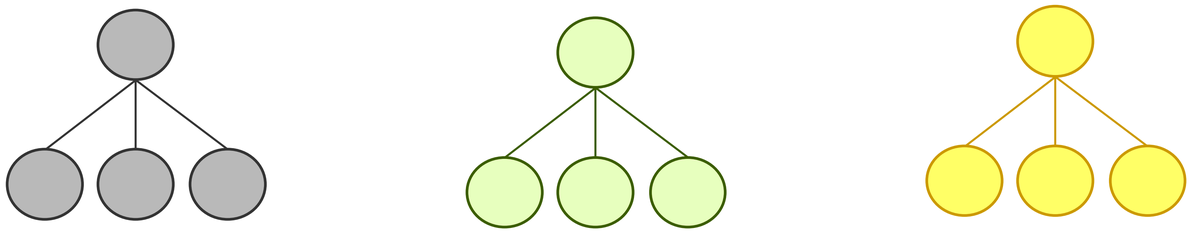
Attention



Attention


I
Understand
Equations
Both
Simple
and
Quadraical
I
Understand
Equations
Both
Simple
And
Quadratical

Attention



I									
am									
the									
very									
model									

5 x 3

Q

Query

5 x 3

K

Key

5 x 3

V

Value

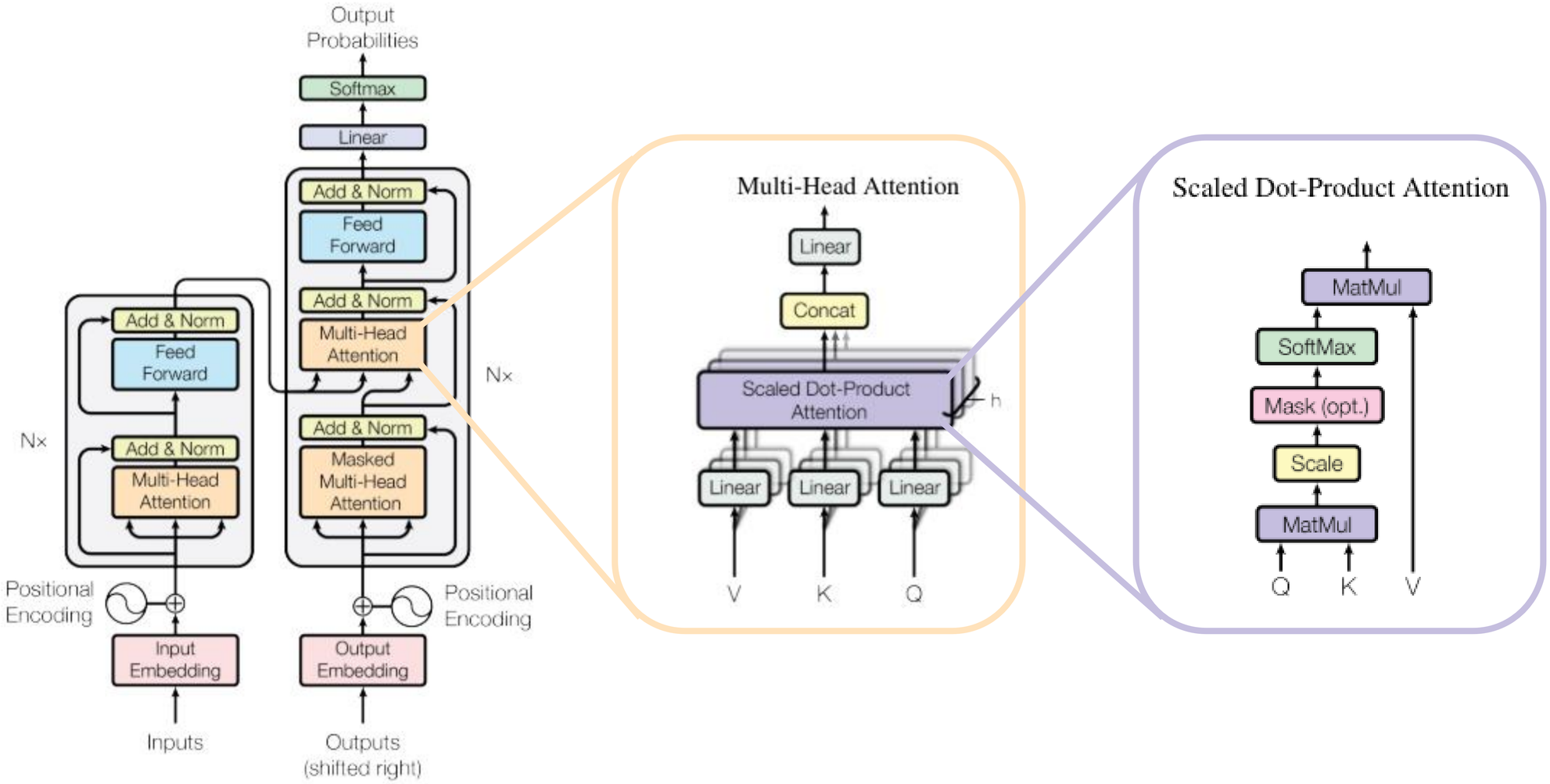
Attention

$$Z = softmax\left(\frac{Q \times K^T}{\sqrt{d_k}}\right)V$$

I												
am												
the												
very												
model												

5 x 3	5 x 3	5 x 3	5 x 3
Q	K	V	Z
Query	Key	Value	Attention Score

Transformers



BERT

BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding

Jacob Devlin **Ming-Wei Chang** **Kenton Lee** **Kristina Toutanova**
Google AI Language
{jacobdevlin,mingweichang,kentonl,kristout}@google.com

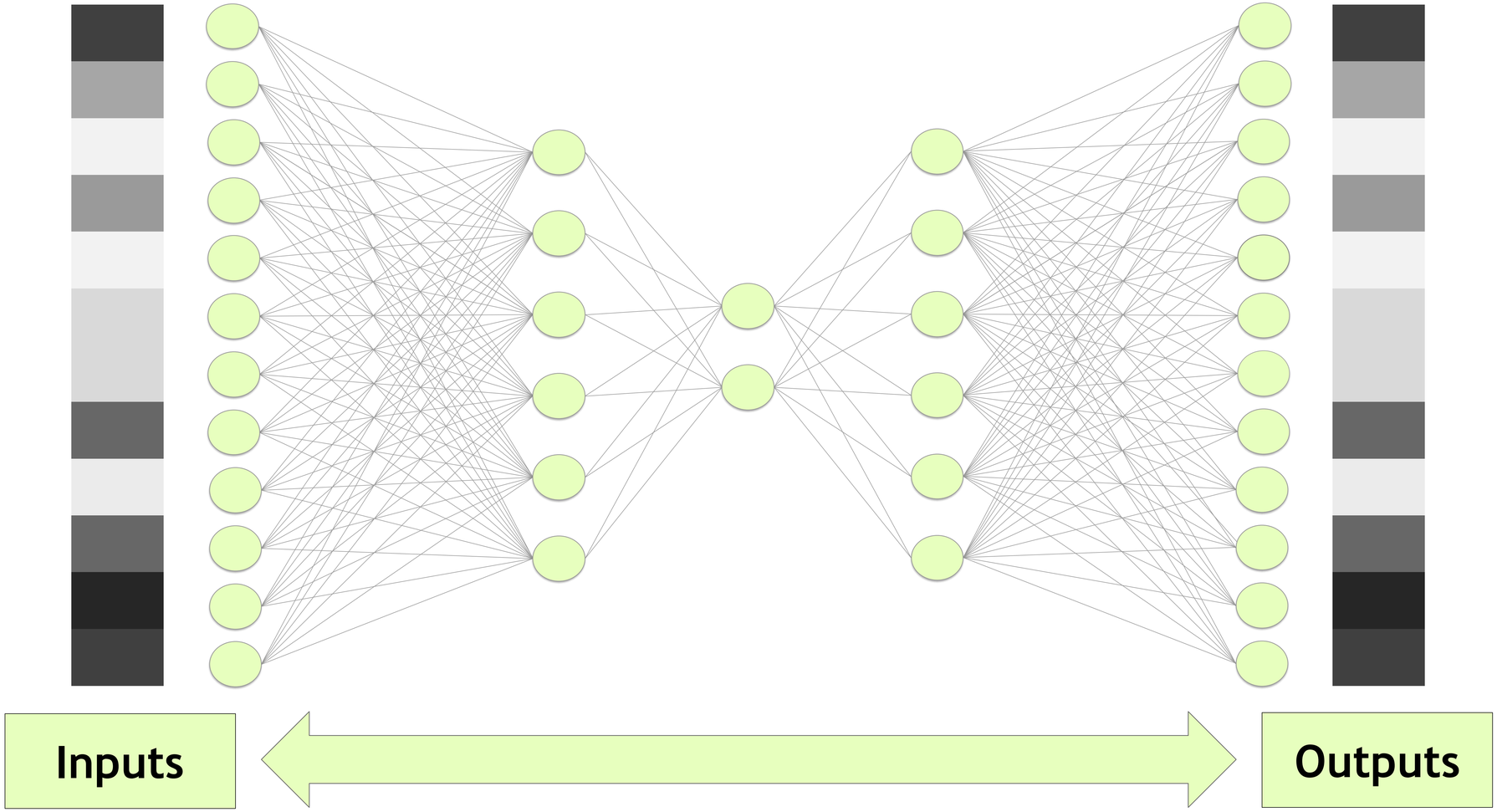
Abstract

We introduce a new language representation model called **BERT**, which stands for **B**idirectional **E**ncoder **R**epresentations from

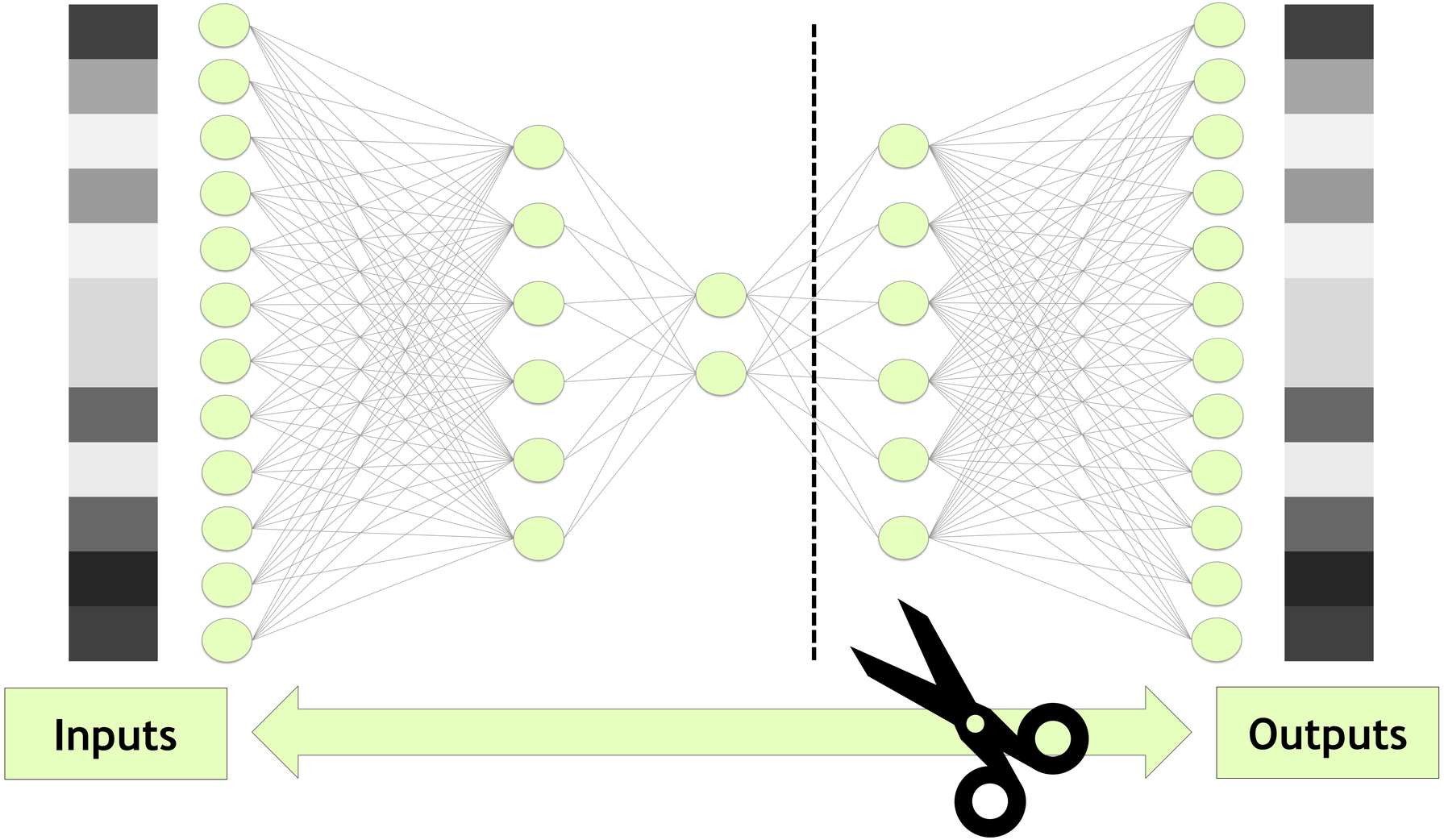
There are two existing strategies for applying pre-trained language representations to downstream tasks: *feature-based* and *fine-tuning*. The feature-based approach, such as ELMo (Peters

Other Architectures

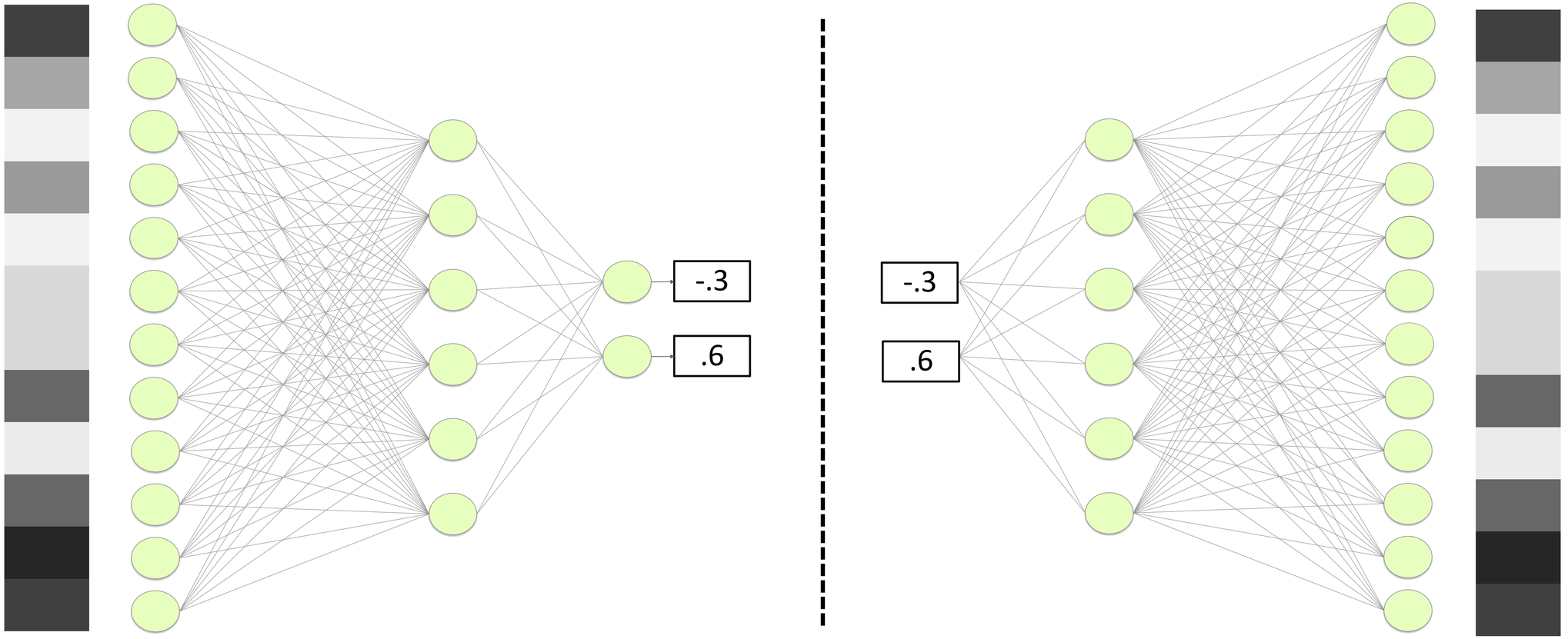
Autoencoders



Autoencoders



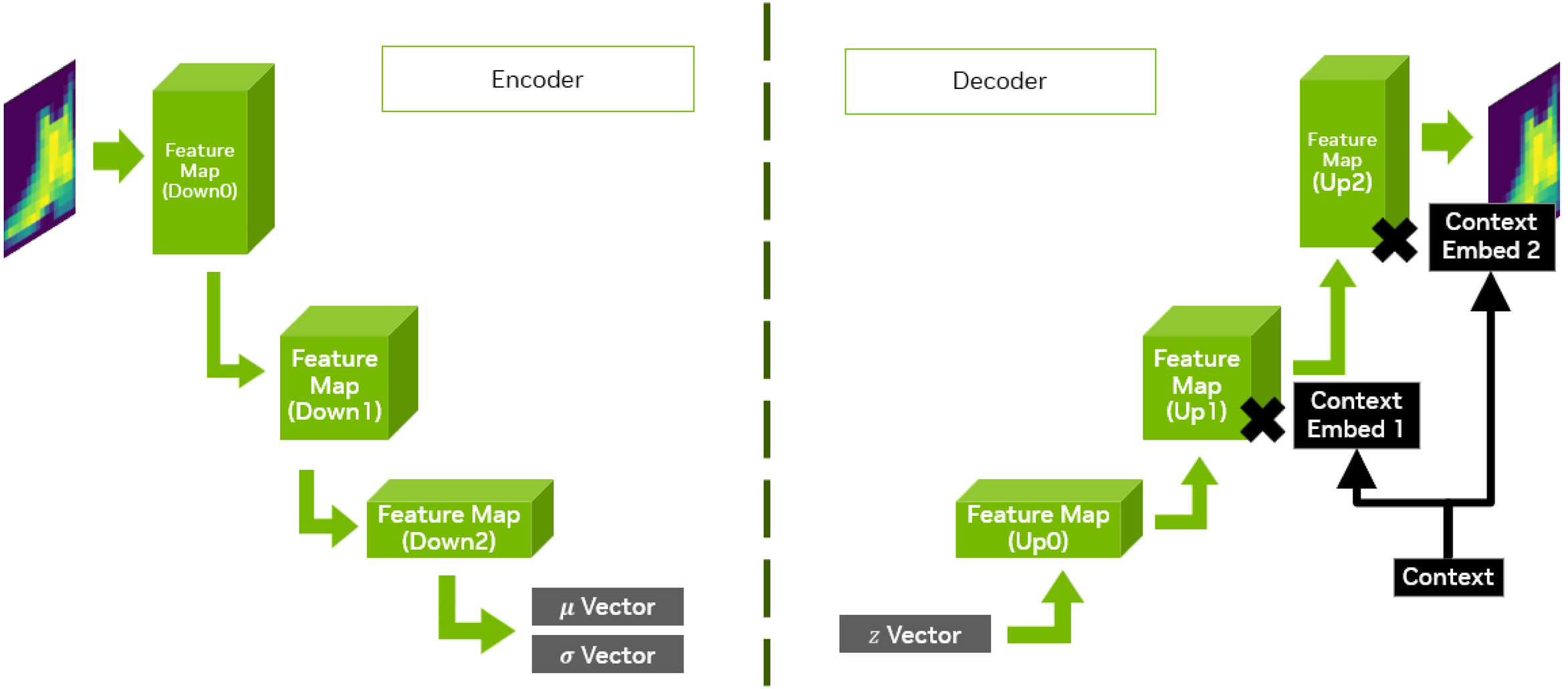
Autoencoders



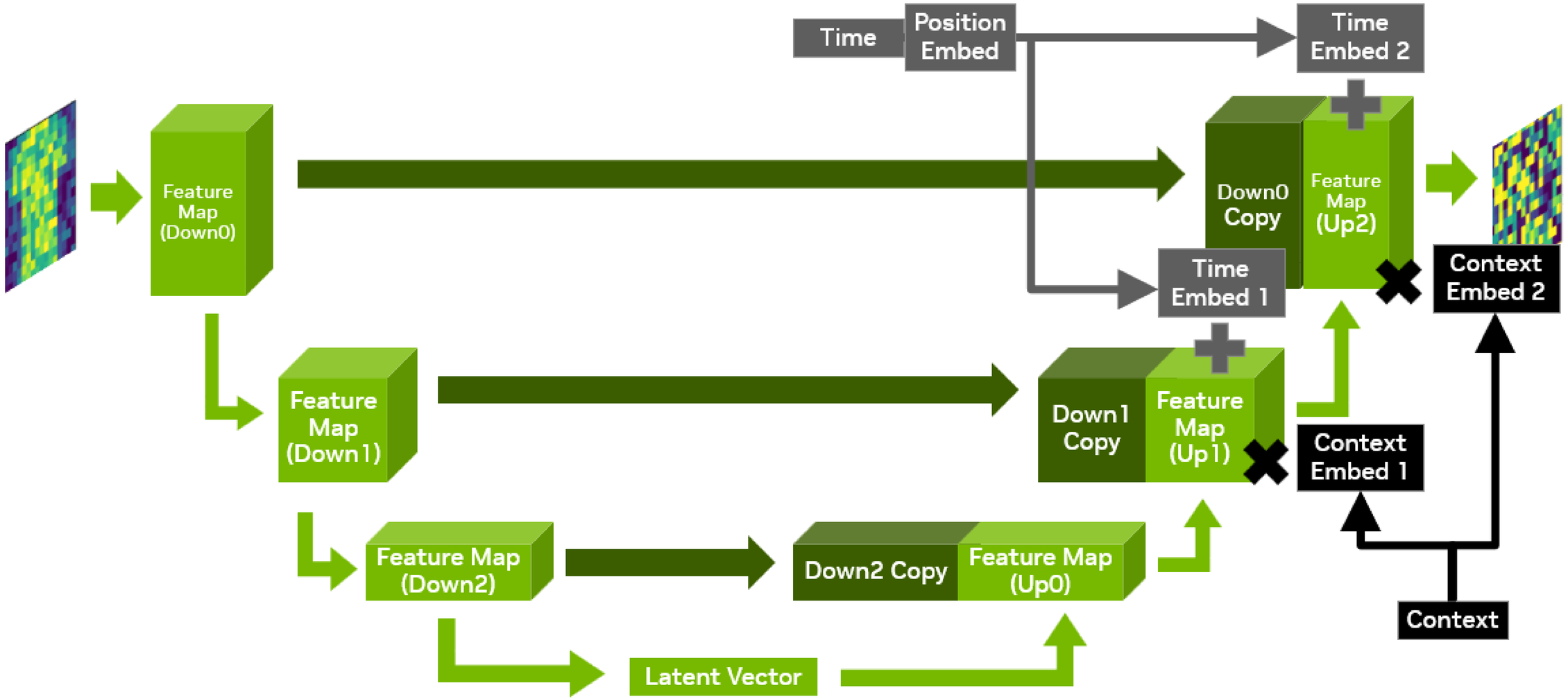
Encoder

Decoder

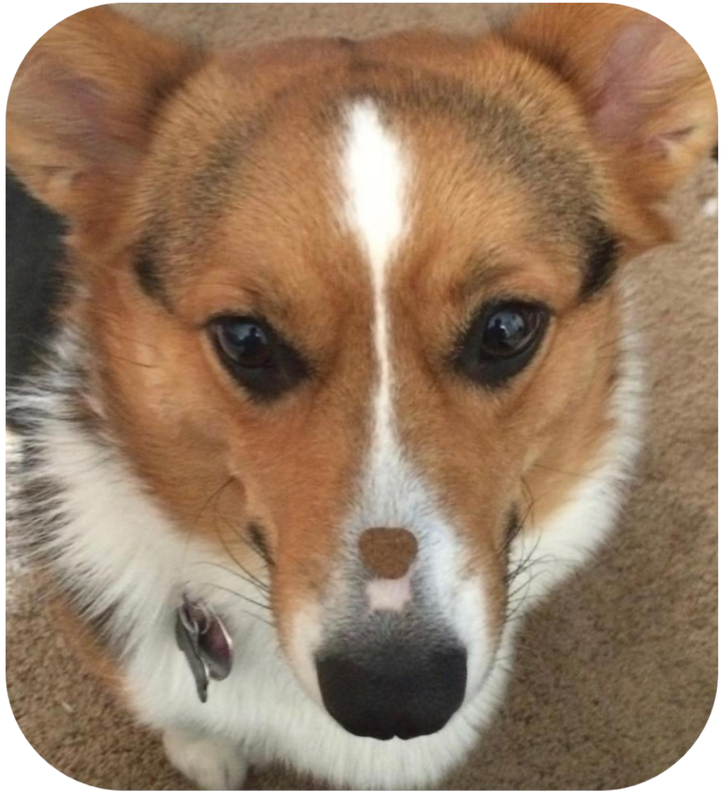
Variational Autoencoder

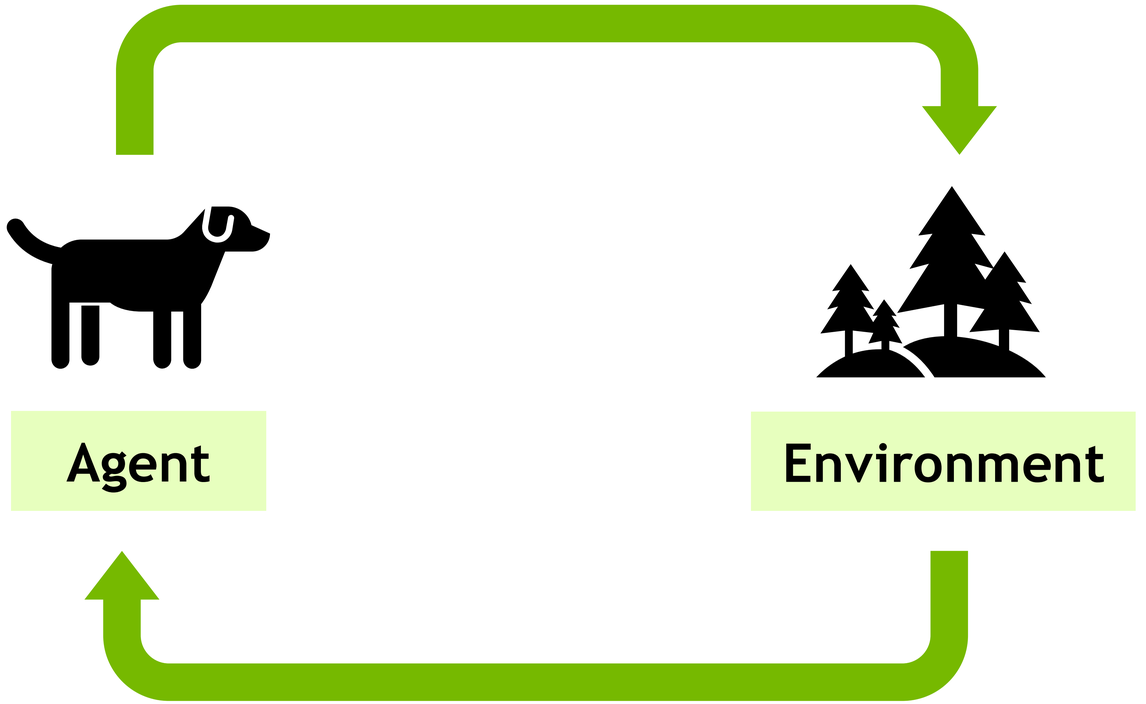


Diffusion Models



Reinforcement Learning





Next Steps

ENABLING PORTABILITY WITH NGC CONTAINERS

Extensive

- Diverse range of workloads and industry specific use cases

Optimized

- DL containers updated monthly
- Packed with latest features and superior performance

Secure & Reliable

- Scanned for vulnerabilities and crypto
- Tested on workstations, servers, & cloud instances

Scalable

- Supports multi-GPU & multi-node systems

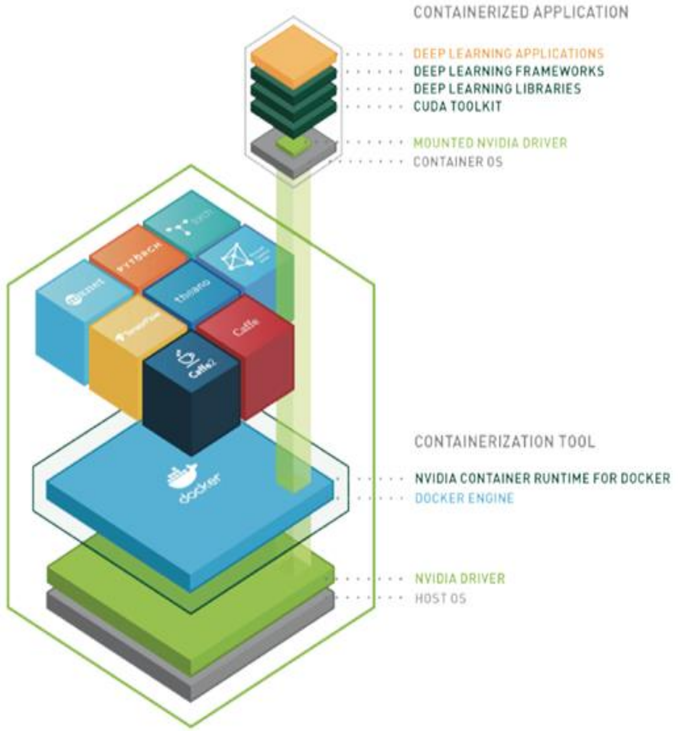
Designed for Enterprise & HPC

- Supports Docker, Singularity & other runtimes

Run Anywhere

- Bare metal, VMs, Kubernetes
- x86, ARM, POWER
- Multi-cloud, on-prem, hybrid, edge

NGC Deep Learning Containers



CONVERSATIONAL AI — Riva

HEALTHCARE — CLARA

SMART CITIES — DEEPSTREAM & SMART PARKING

TELECOM — AERIAL

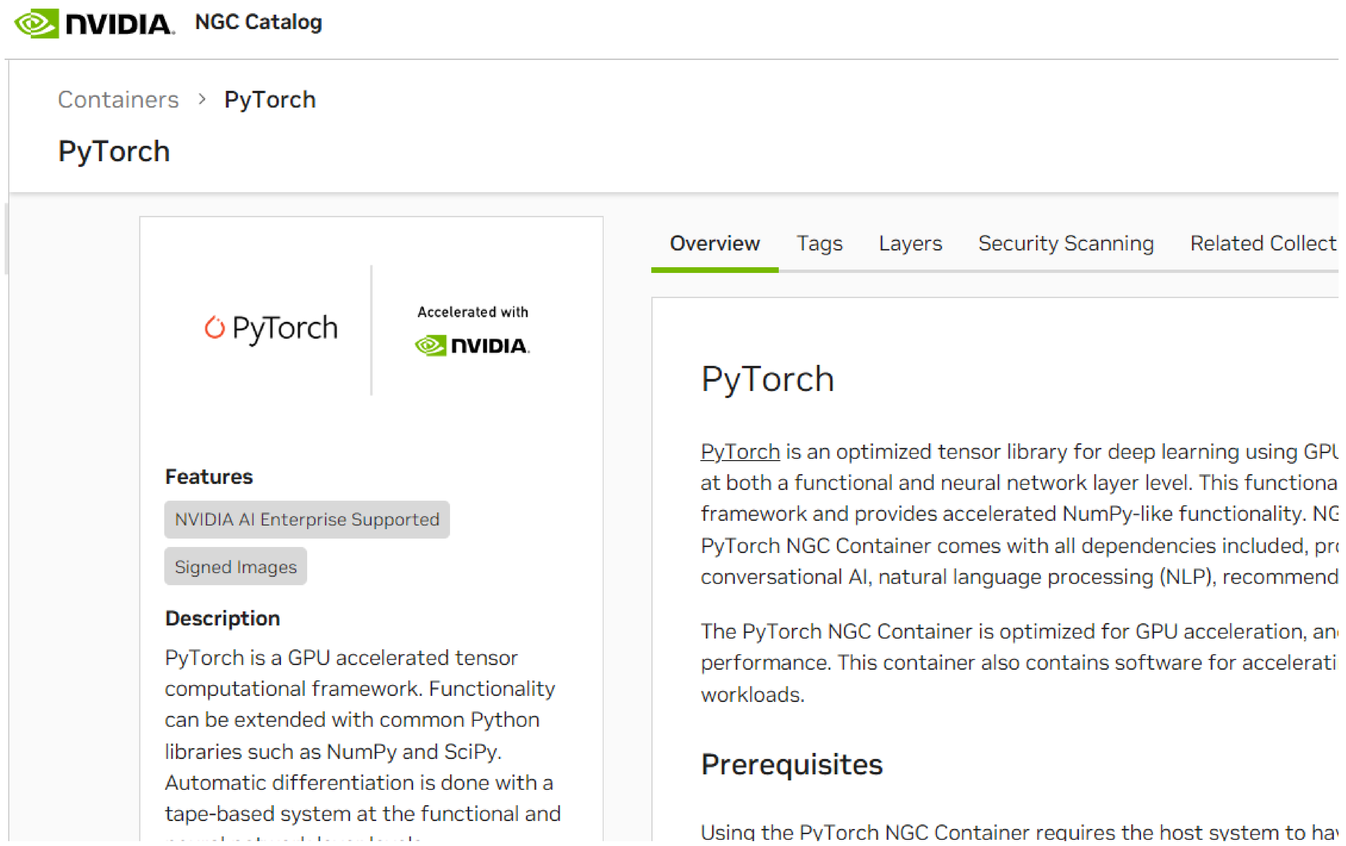
AUTONOMOUS DRIVING — DRIVE

ROBOTICS — ISAAC

HPC — HPC SDK

Learn more about NGC Containers

Next Steps for This Class



Step 1 Sign up for NGC

https://docs.nvidia.com/dgx/ngc-registry-for-dgx-user-guide/index.html

Step 2 Visit NGC Catalog

https://catalog.ngc.nvidia.com/orgs/nvidia/containers/pytorch

Step 3 Pull and Run Container

Visit localhost:8888 to check out a JupyterLab environment

Closing Thoughts

Copying Rocket Science

Let’s get Started!