AMECON: Abstract Meta-Concept Features for Text Illustration

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* Both authors contributed equally

Text-illustration System

Textual query: a man cycling on a mountain

Text-illustration system

Most appropriate images:

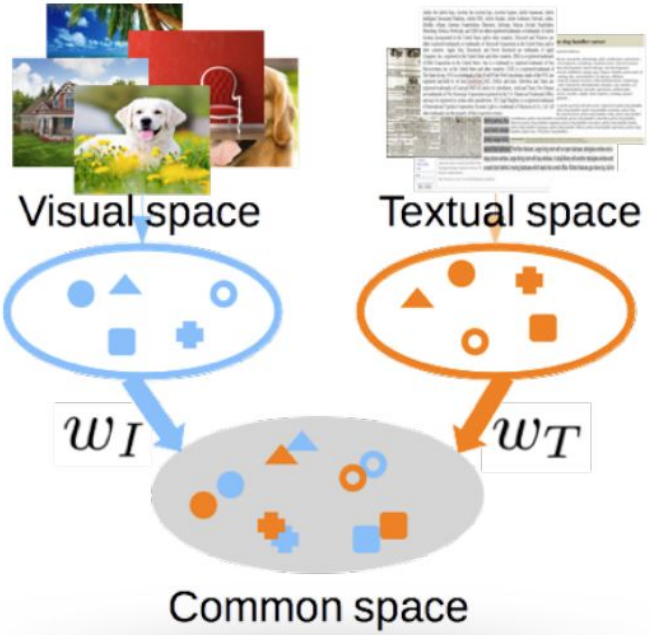



Cross-Modal Retrieval Task

- **Cross-Modal Retrieval task**
  - Given a document in one modality, find (from database) the most relevant documents in another modality
  - Text-illustration
    - Query: sentences
    - Collection: images
- **Hard problem: semantic gap**

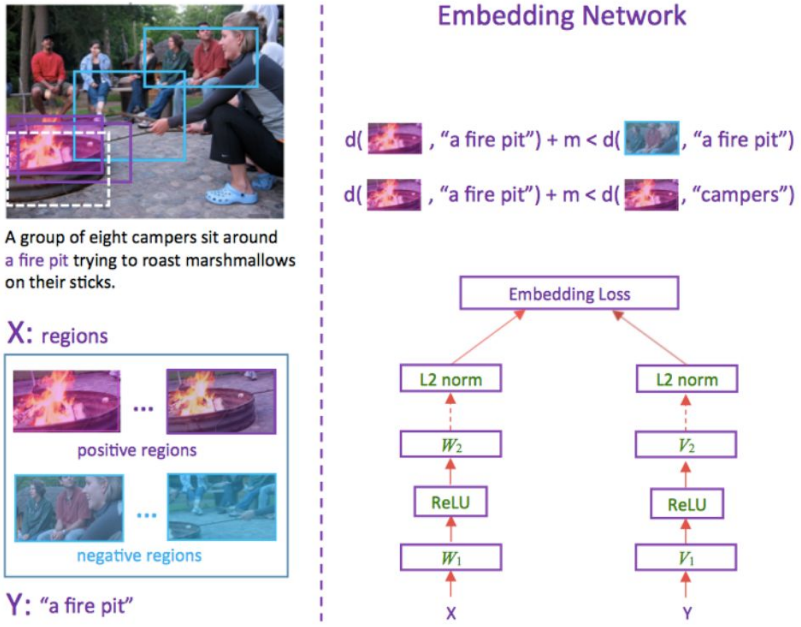
Cross-Modal Retrieval Approach 1

- **Canonical Correlation Analysis**
  - Hardoon et al. Neural Computation 2004
  - Hwang and Grauman, IJCV 2012
  - Costa Pereira et al. TPAMI 2014
  - Tran et al., CVPR 2016
  - etc.



Cross-Modal Retrieval Approach 2

- **Neural Network (NN)**
  - Karpathy and Fei-Fei, NIPS 2014
  - Yan and Mikolajczyk, CVPR 2015
  - Karpathy and Fei-Fei, CVPR 2015
  - Mao et al., ICLR 2015
  - Kiros et al., TACL 2015
  - Wang et al., CVPR 2016
  - etc.



Main Principle of NN Approach

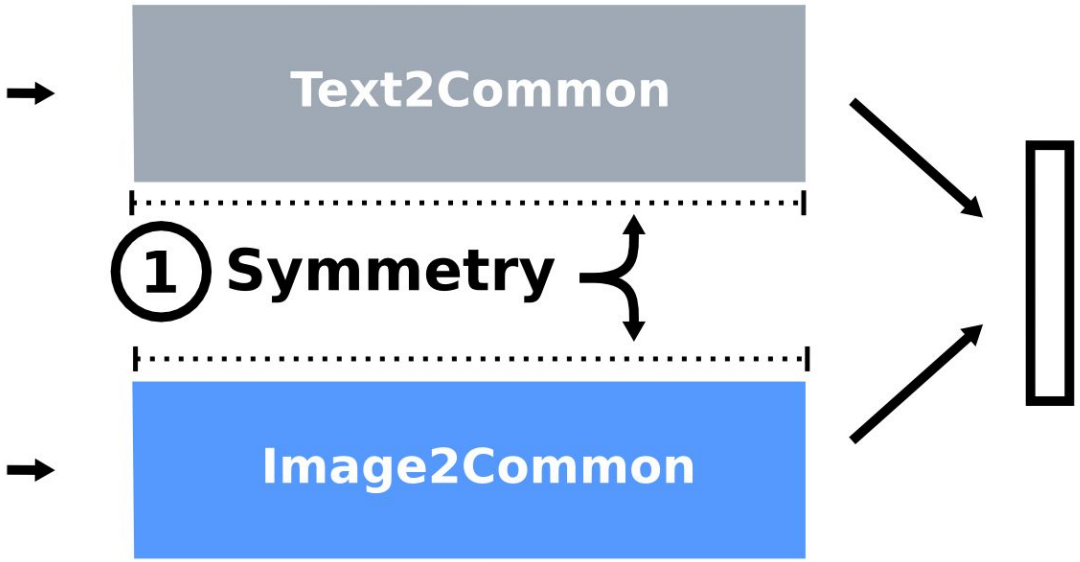
a man is kite-surfing on the water

Text2Common

Image2Common

Main Principle of NN Approach

a man is kite-surfing on the water



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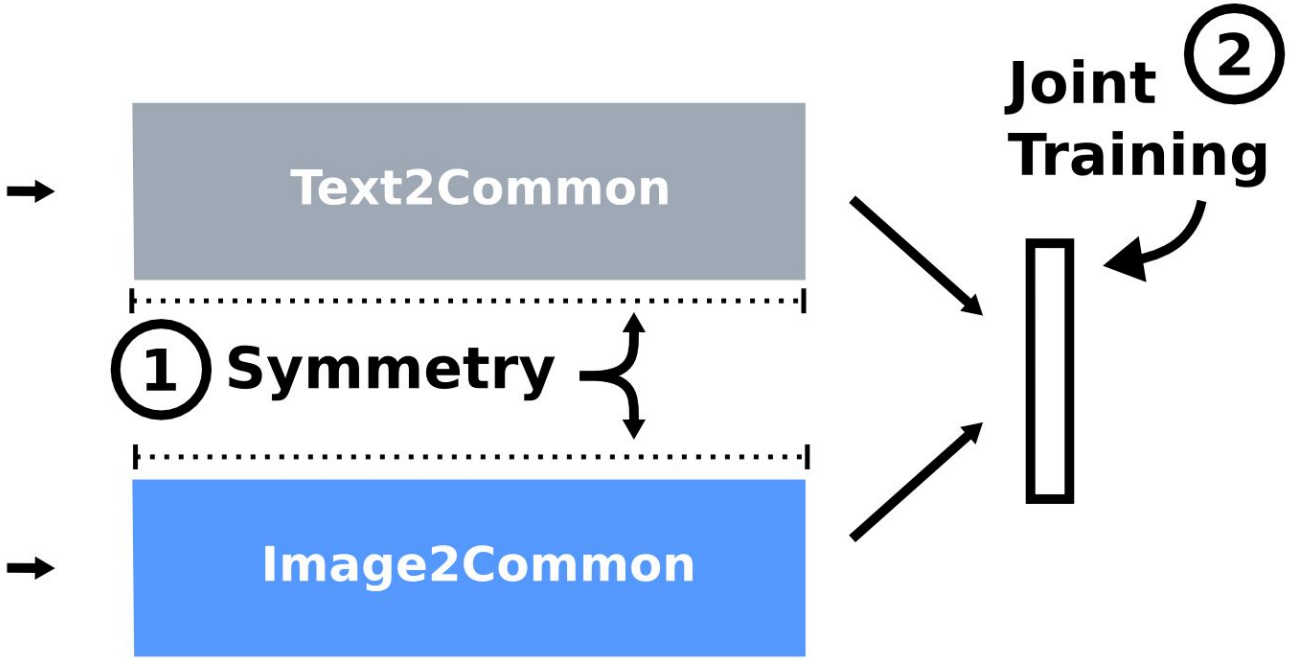
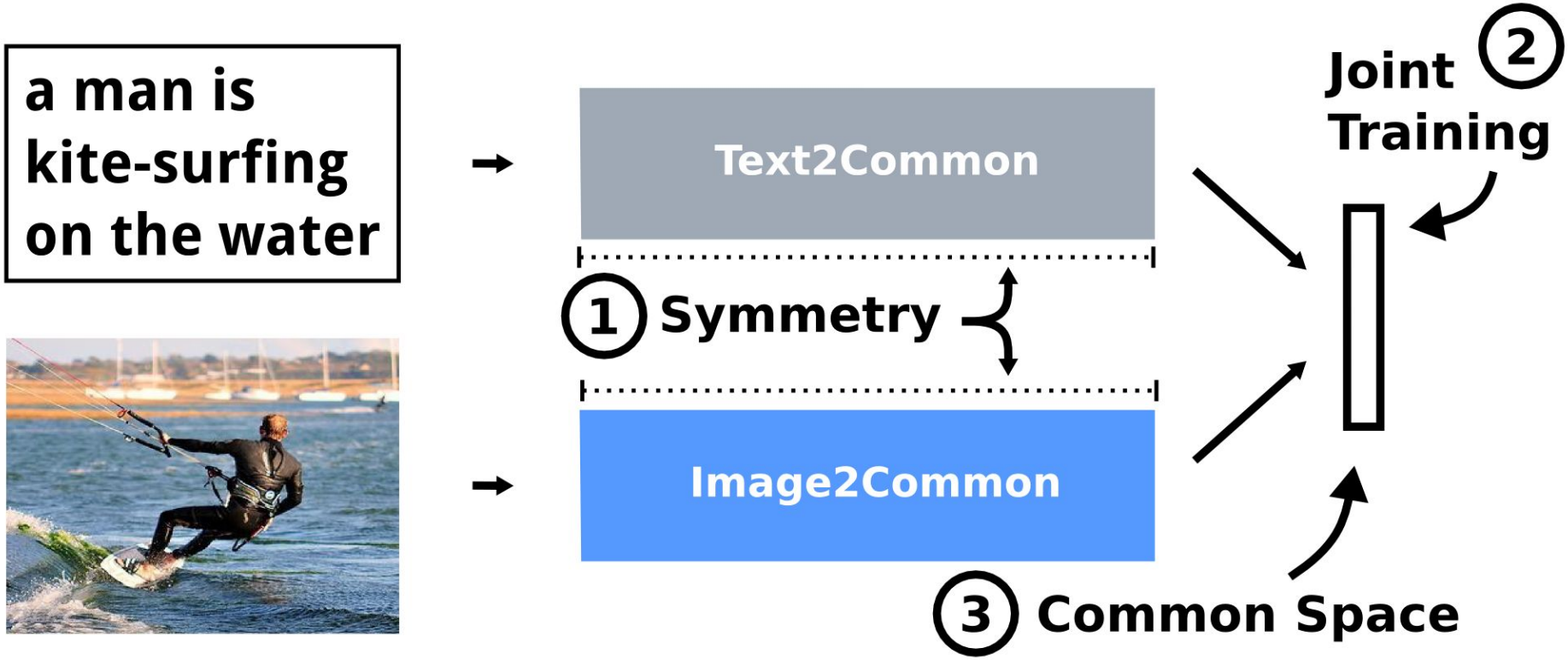
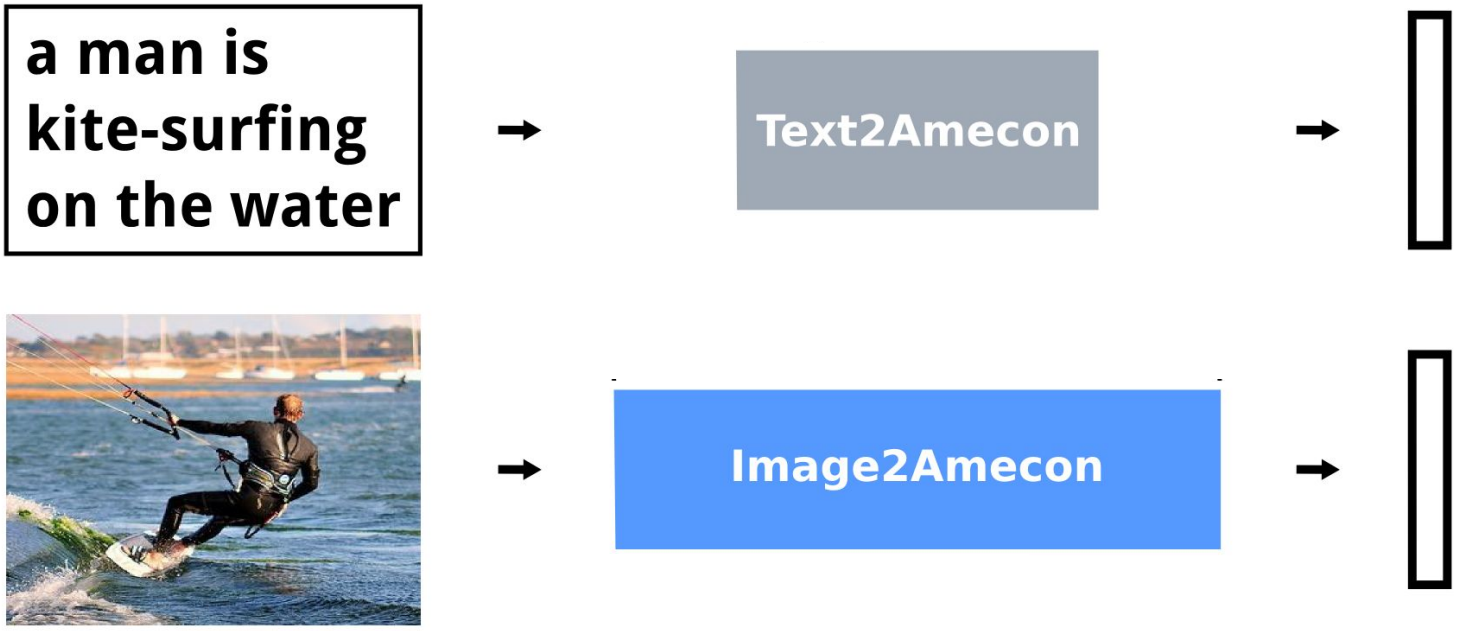


Main Principle of NN Approach



This work: New Approach



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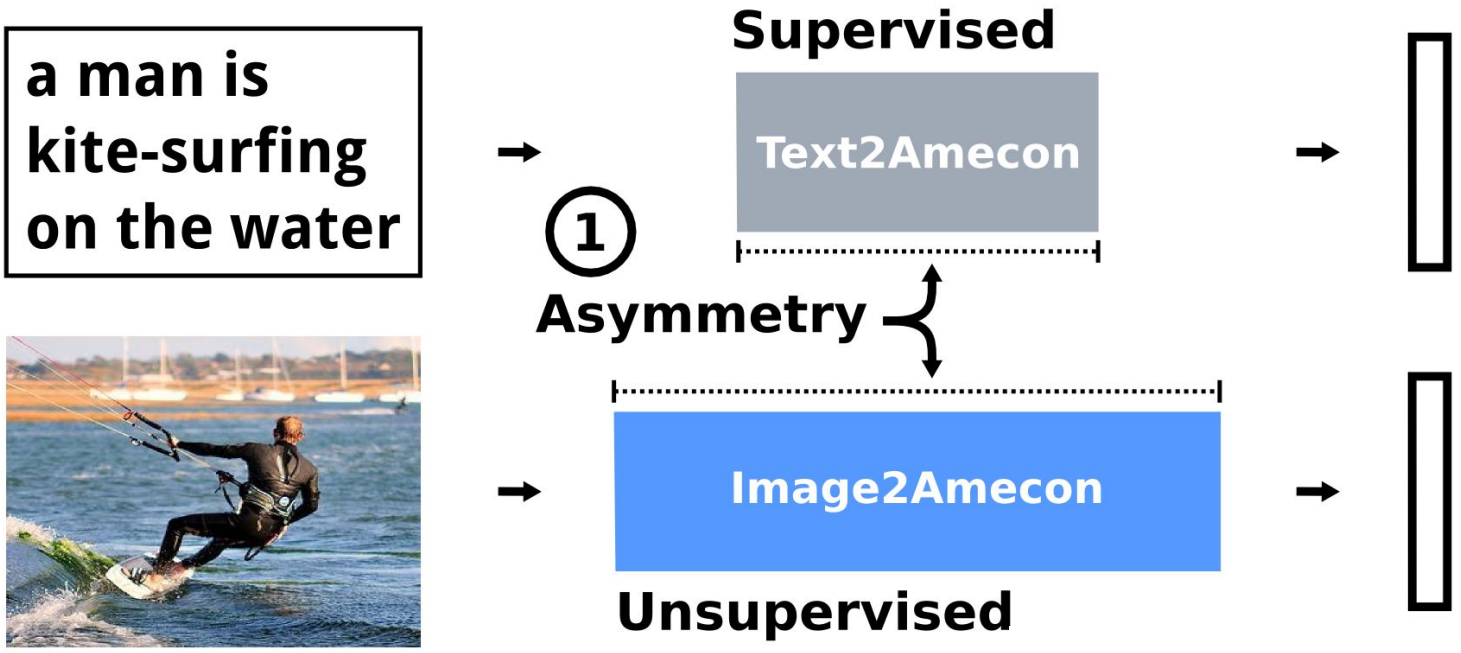

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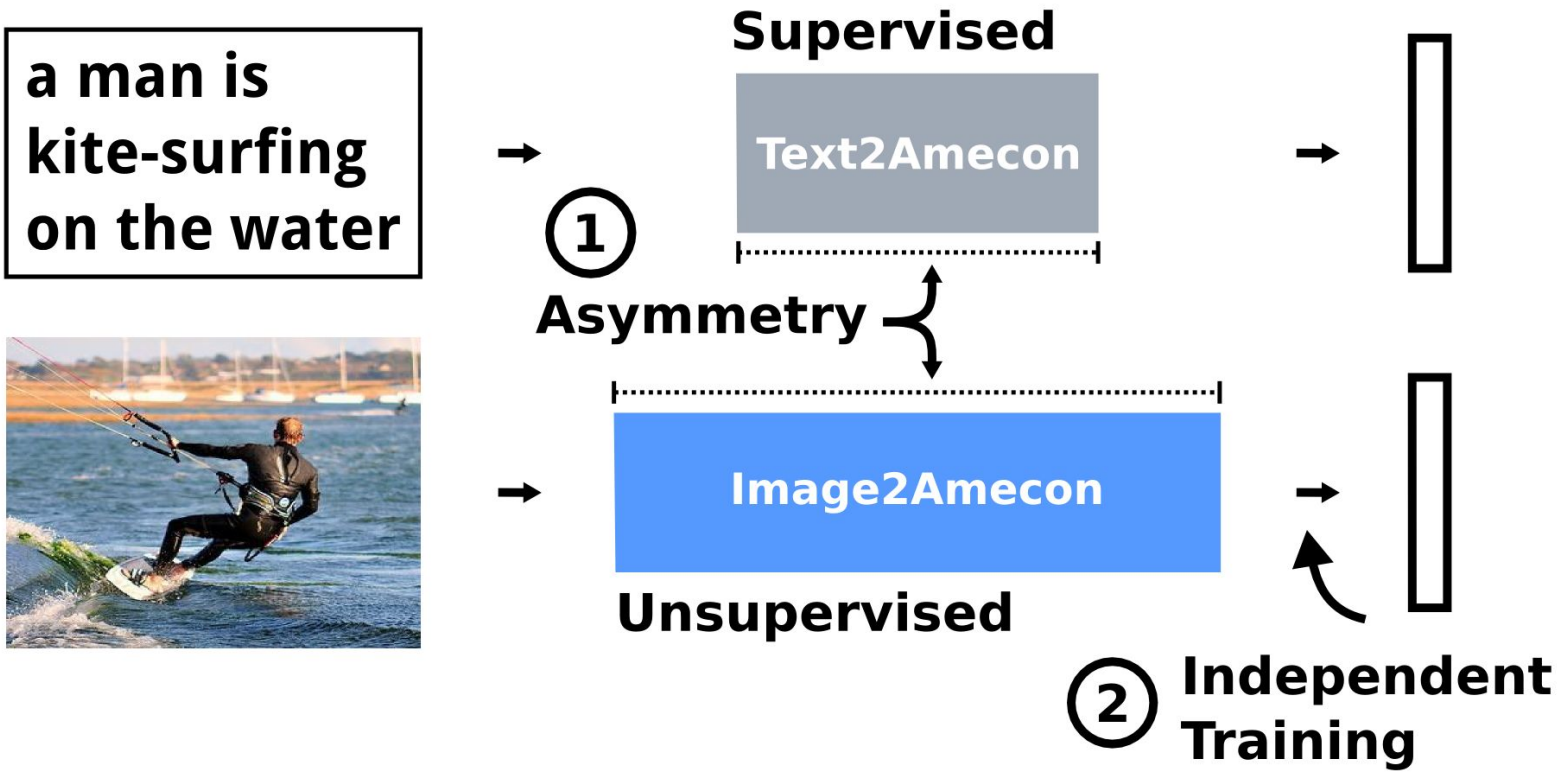

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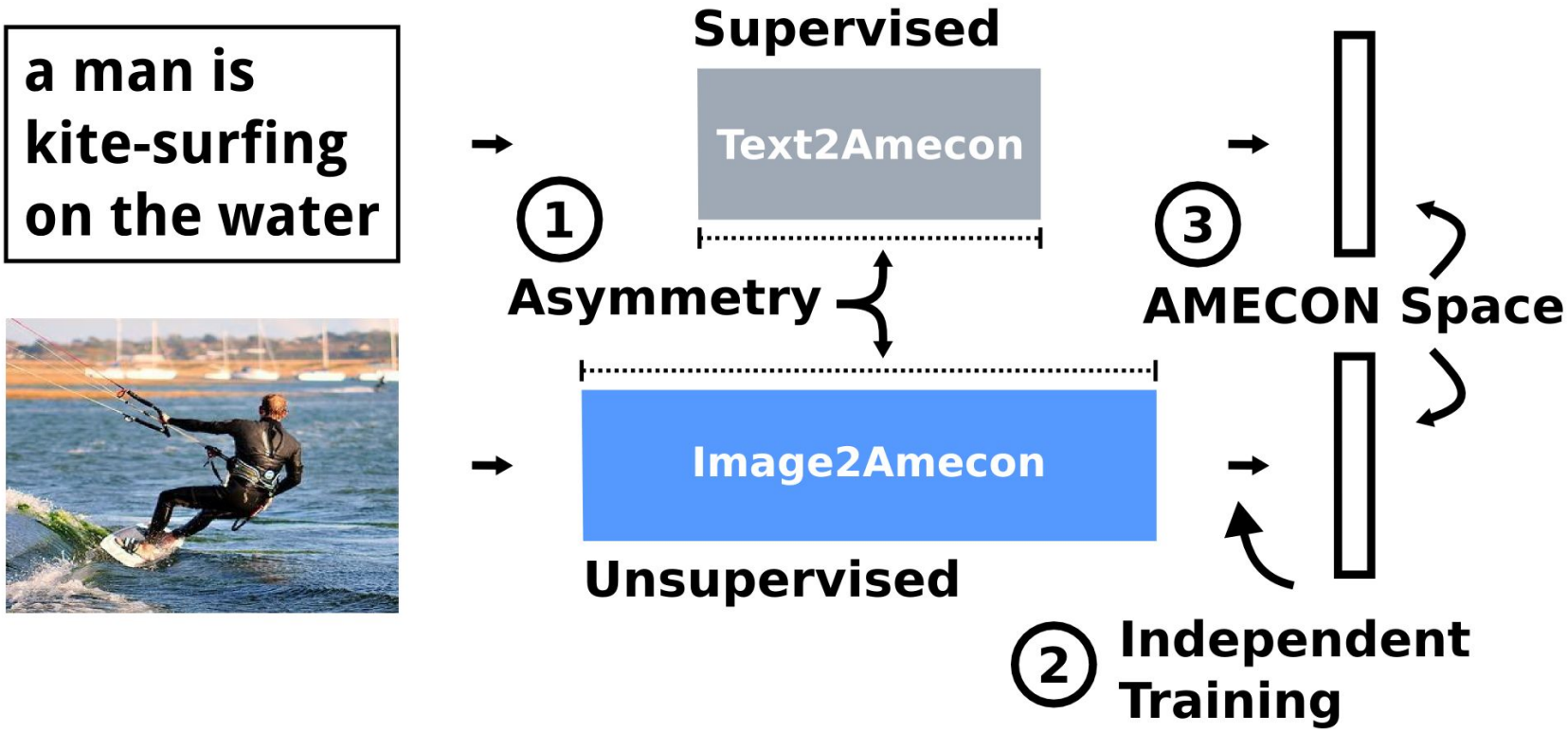

AMECON principle

- **AMECON: Abstract Meta-CONcept**
  - Abstract-concept + Meta-concept

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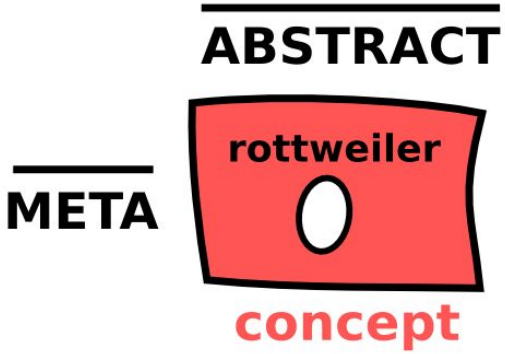

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- **AMECON: Abstract Meta-CONcept**
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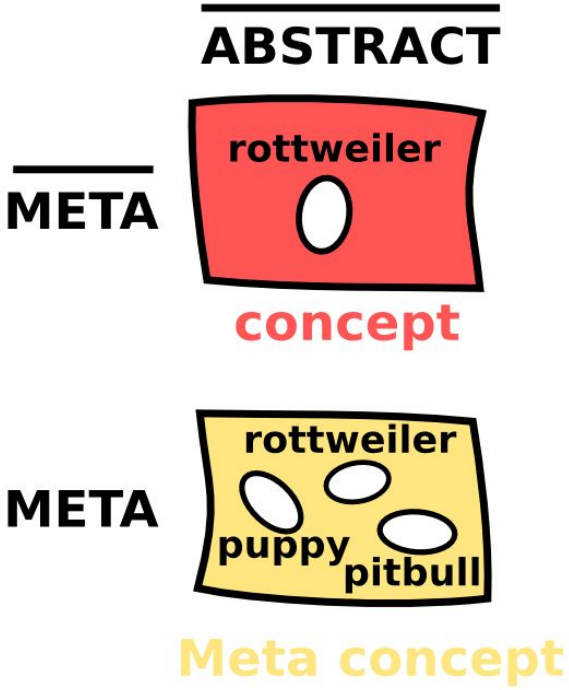

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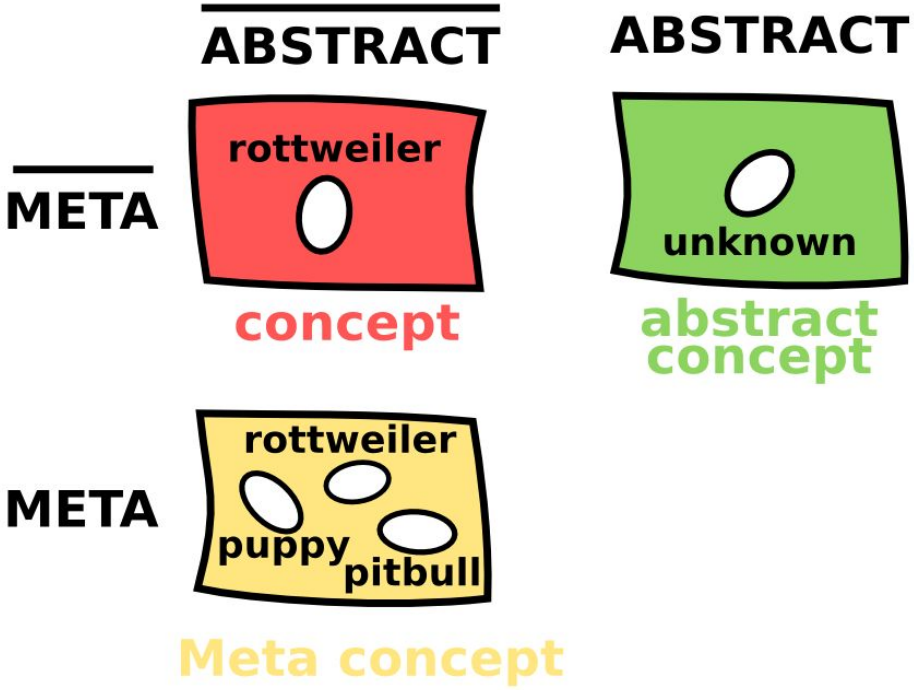

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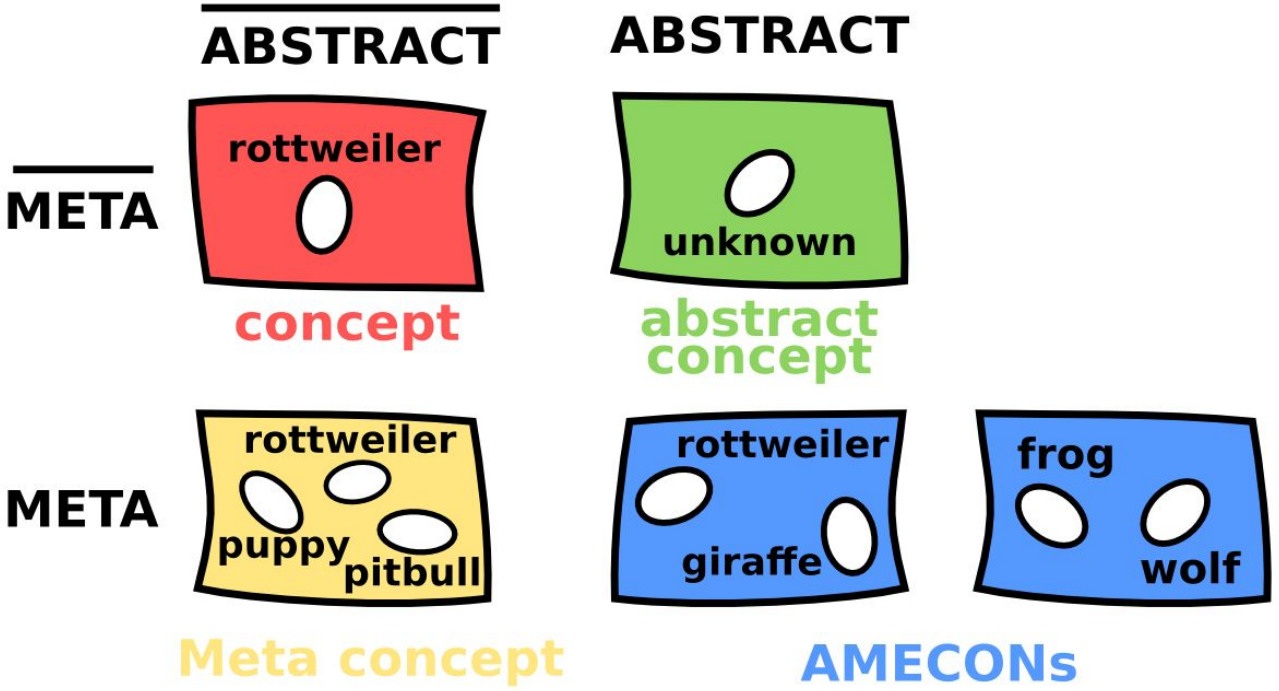
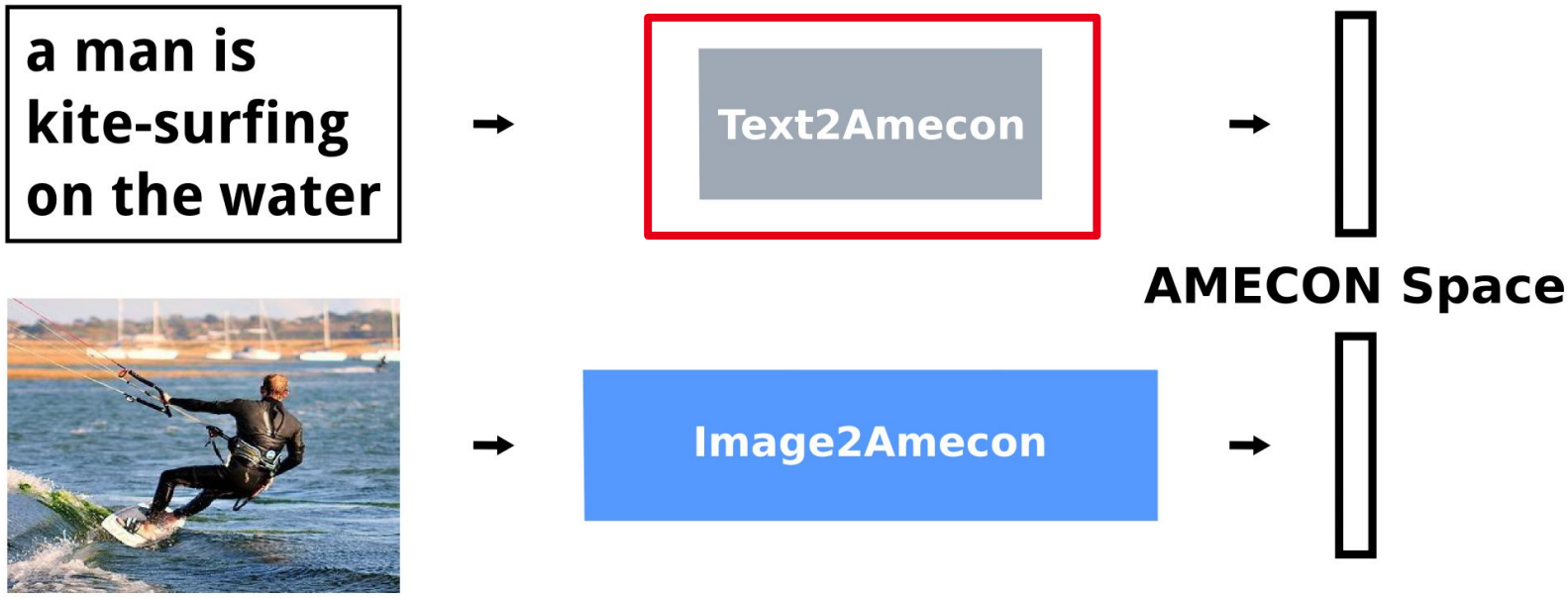
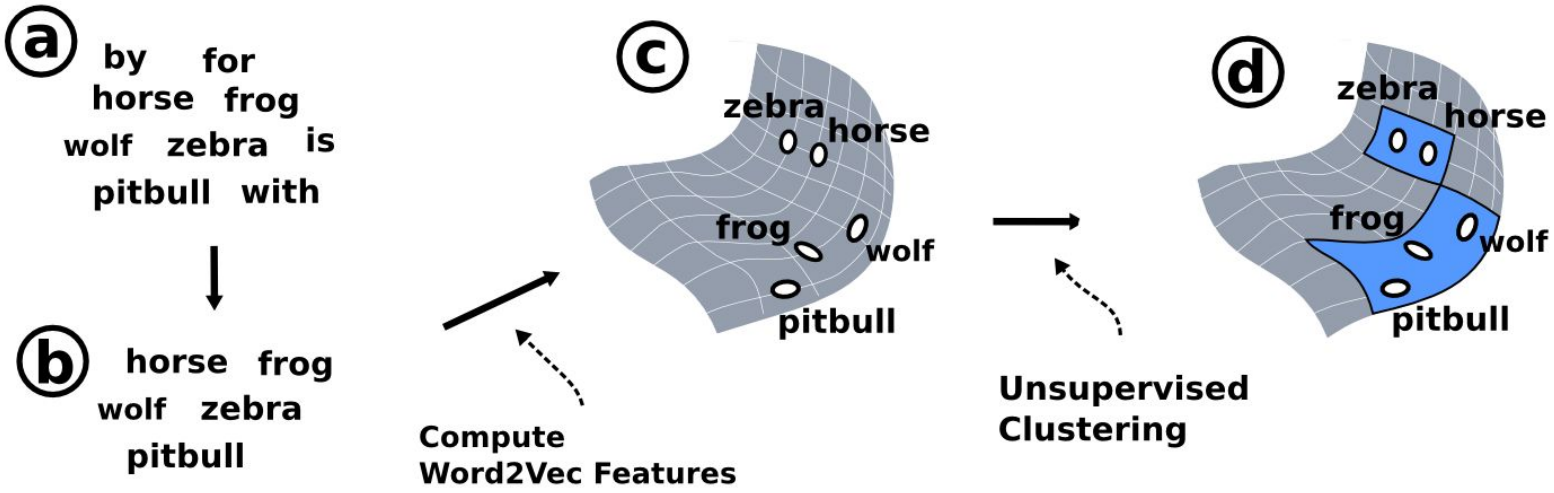


Overview of Our Approach



Learning Text2Amecon block

- **Learning Textual Features**
  a. Select all different words from training-data
  b. Remove stop-words (``is'', ``of'', ``for'', etc.)
  c. Compute word2vec features for each word
  d. Cluster (k-means) the whole set of features



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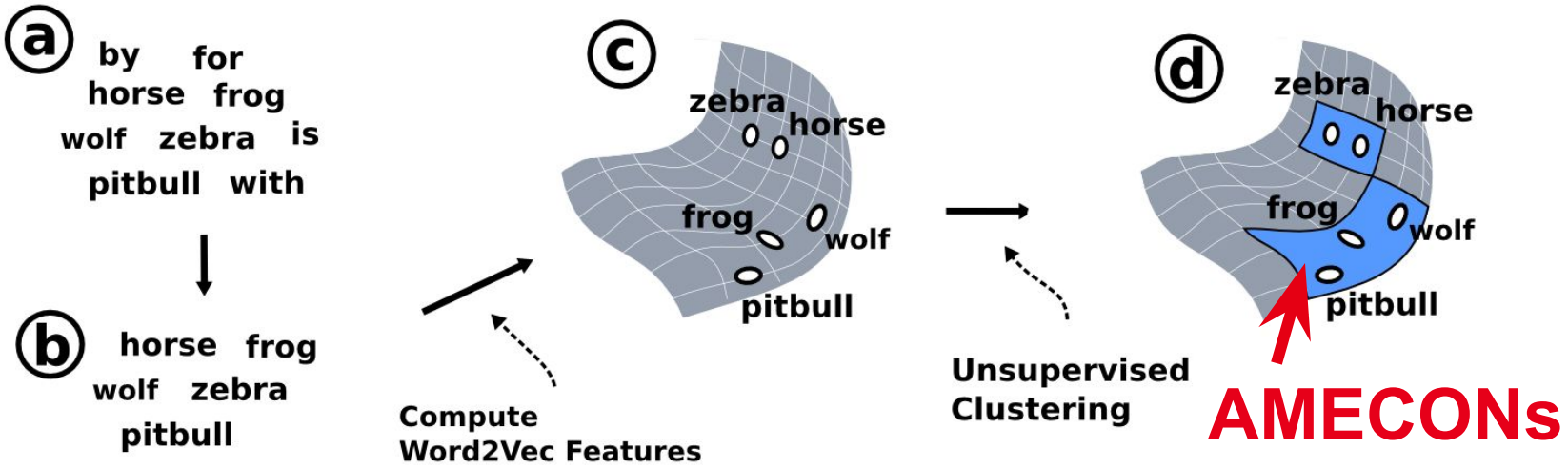
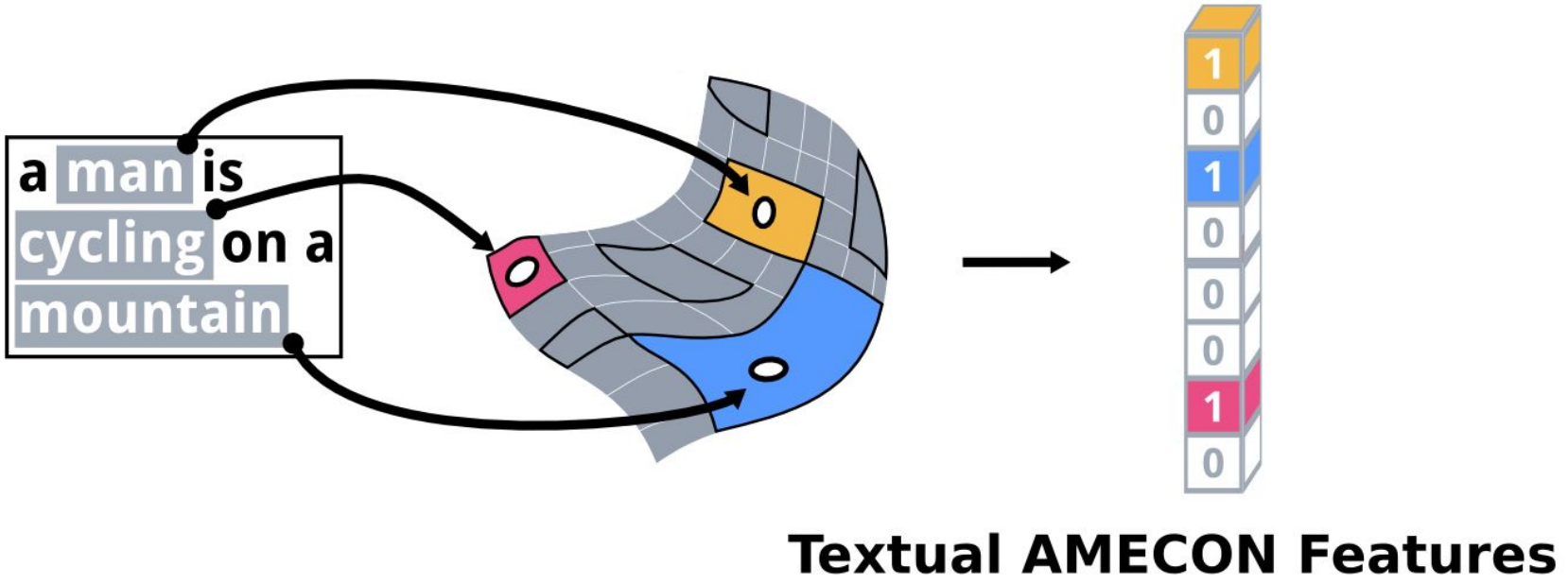


Computing Textual AMECON Features

Test phase



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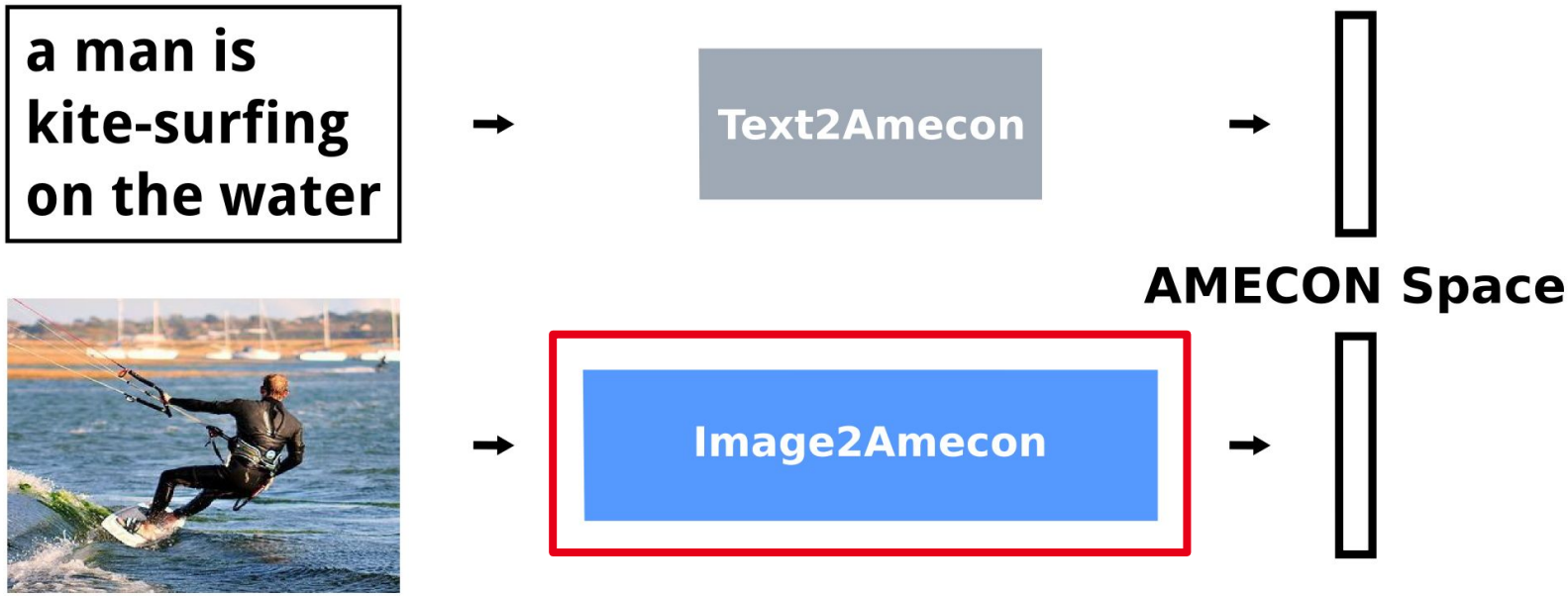

Learning Image2Amecon block

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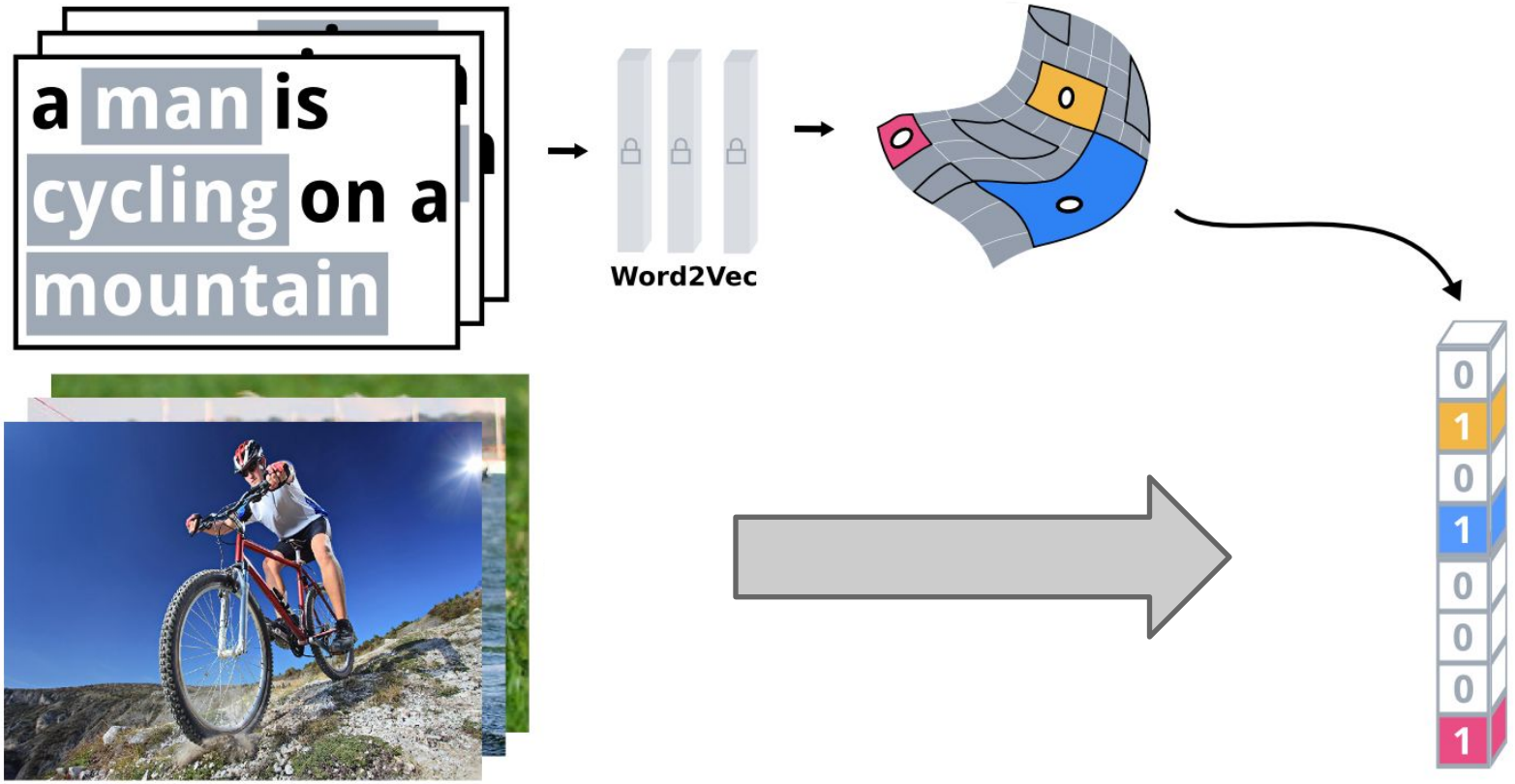

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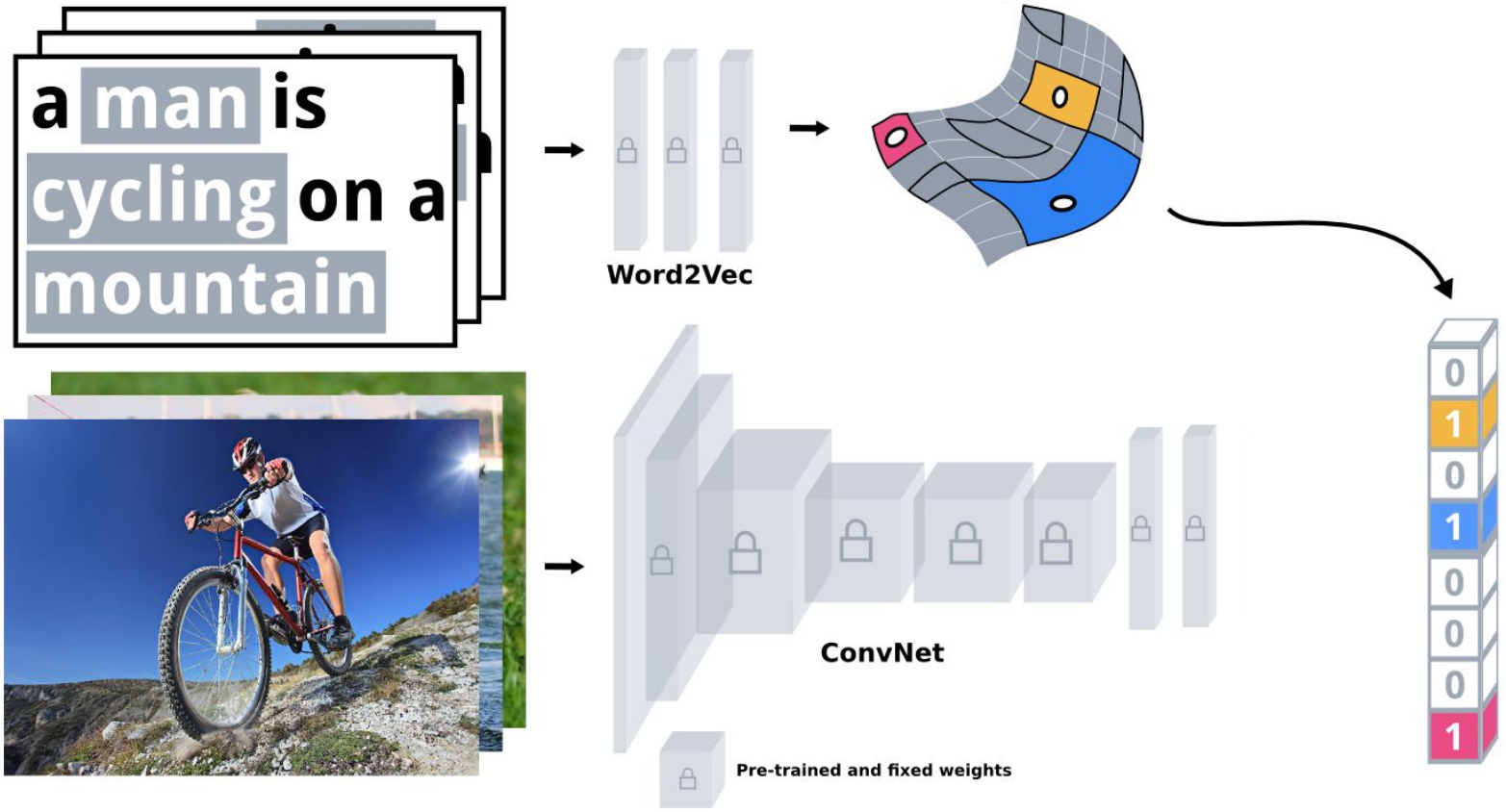

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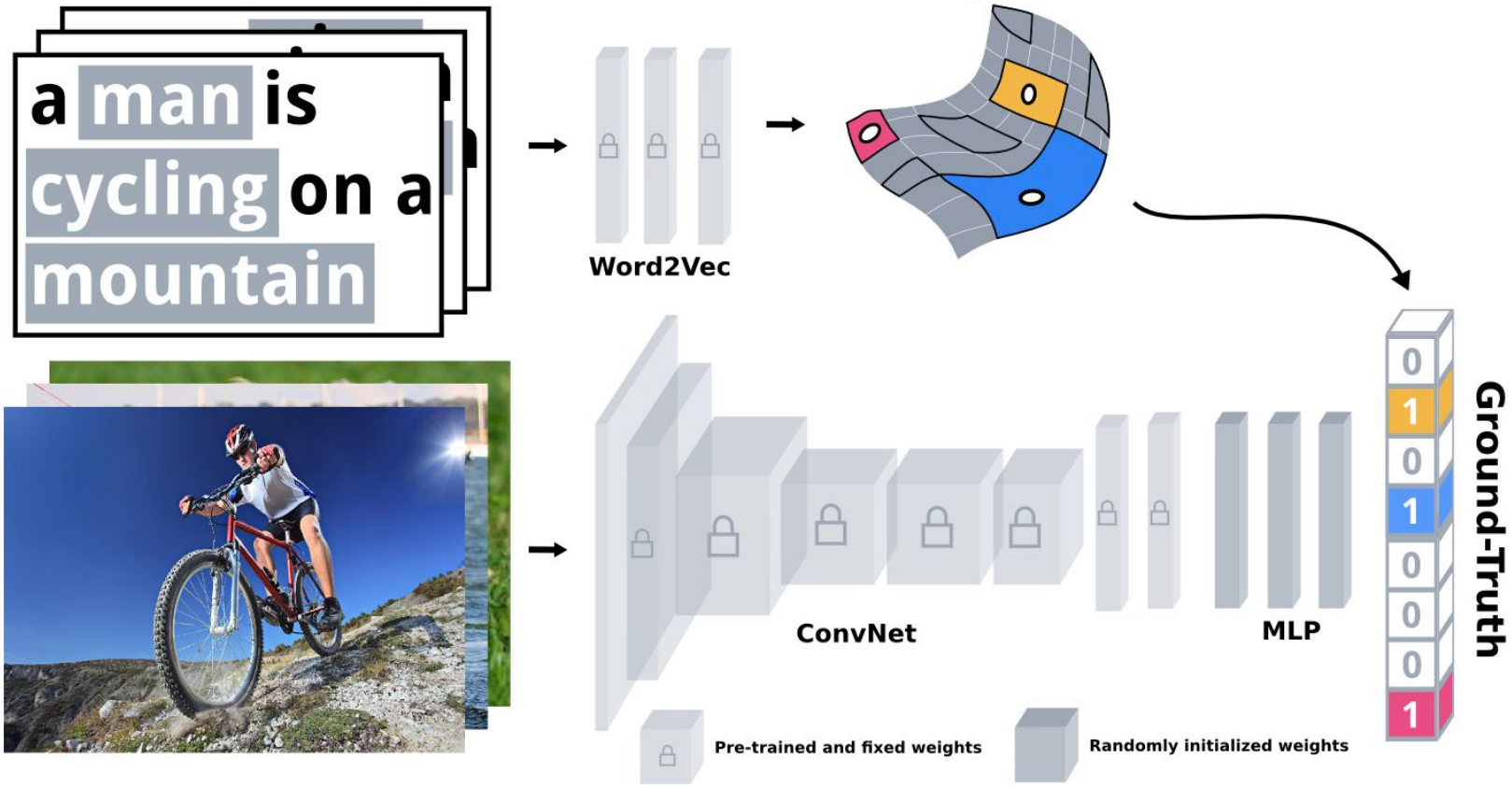

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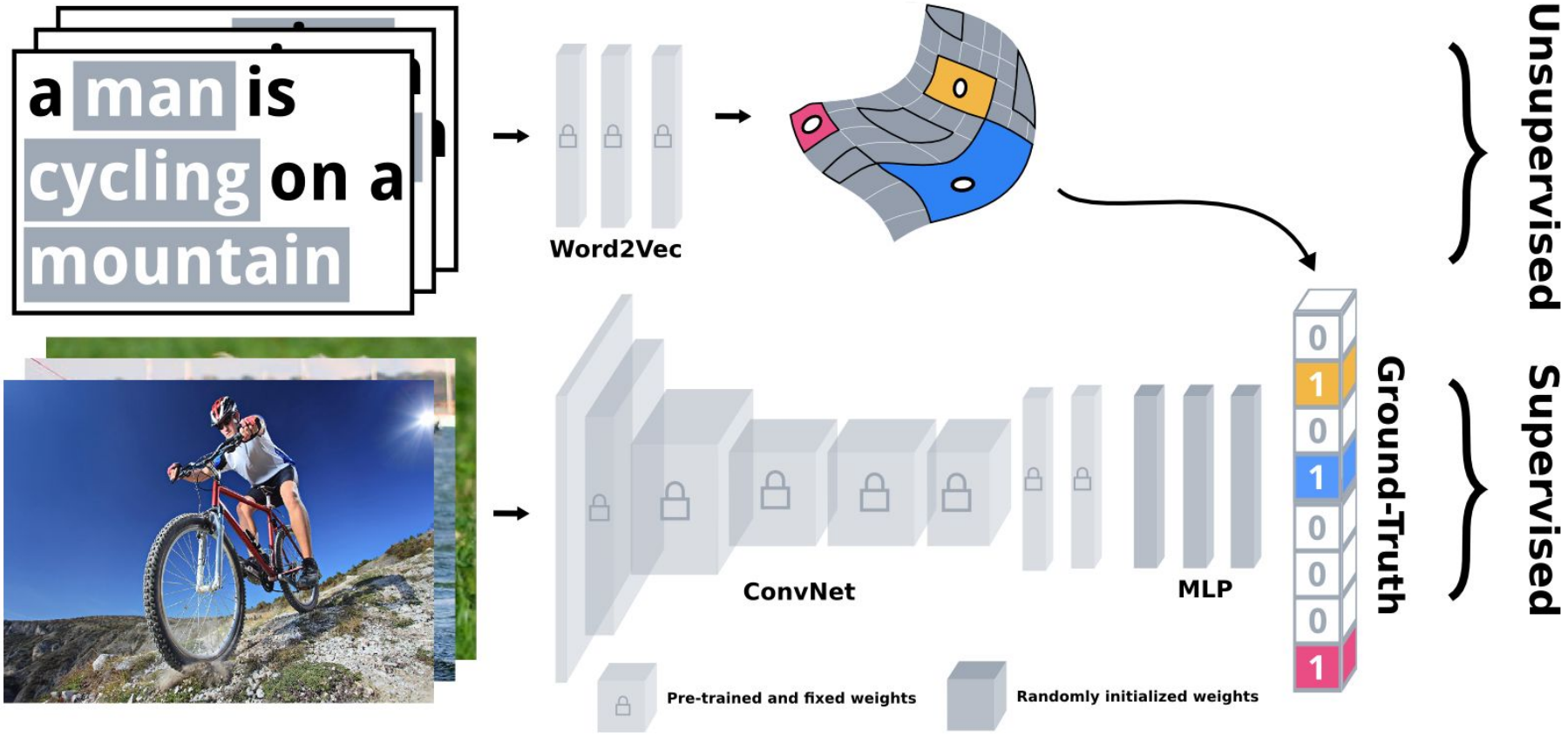
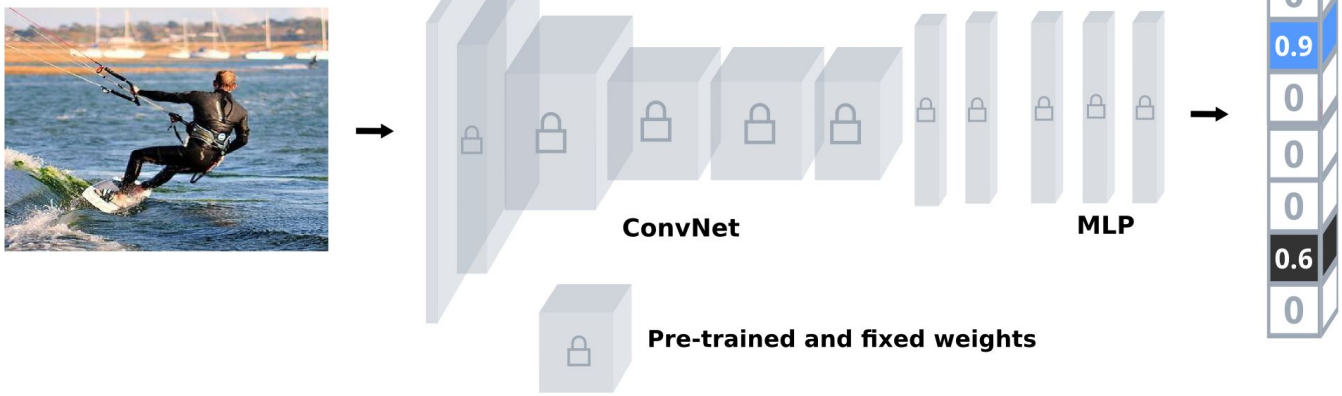


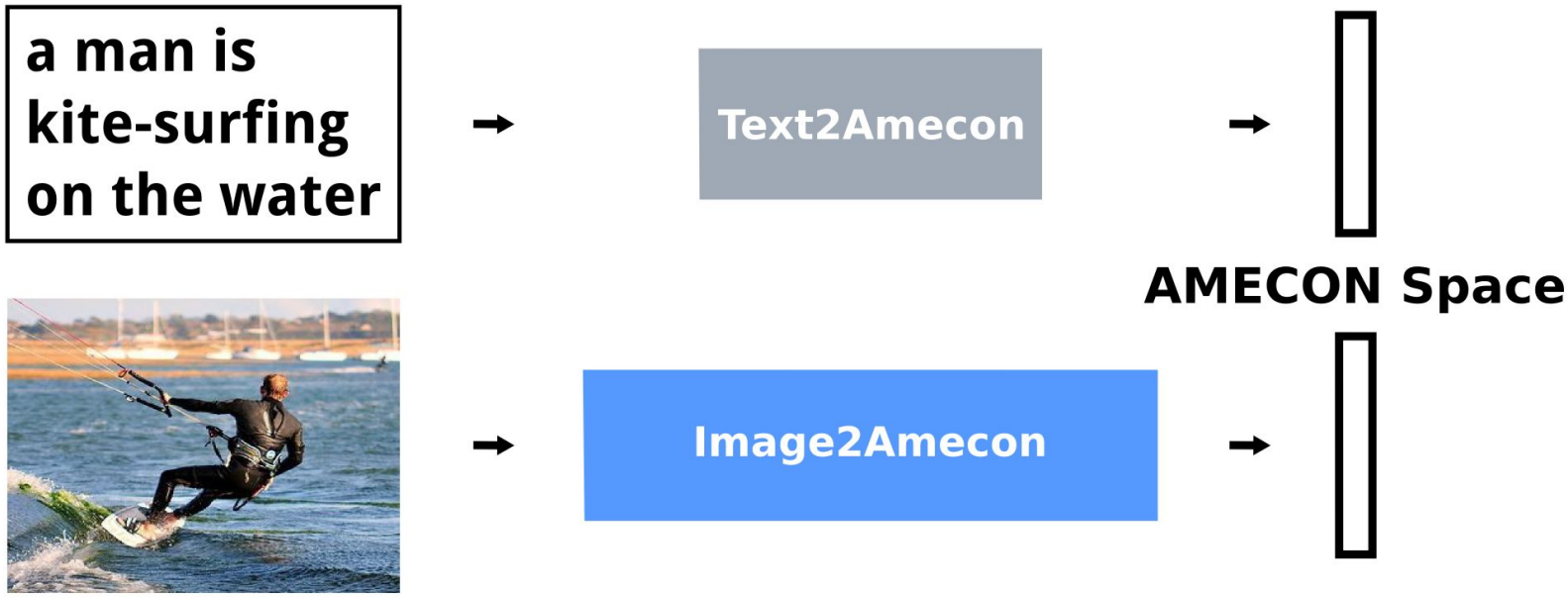
Computing Visual AMECON Features

Test phase



Visual AMECON Features

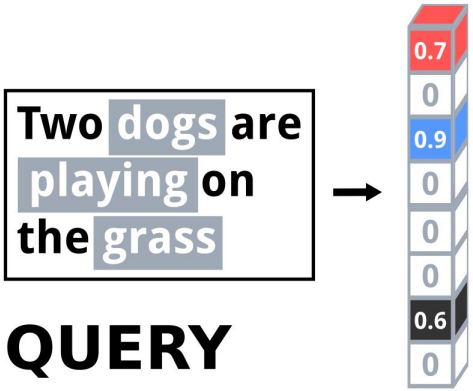
Overview of Our Approach



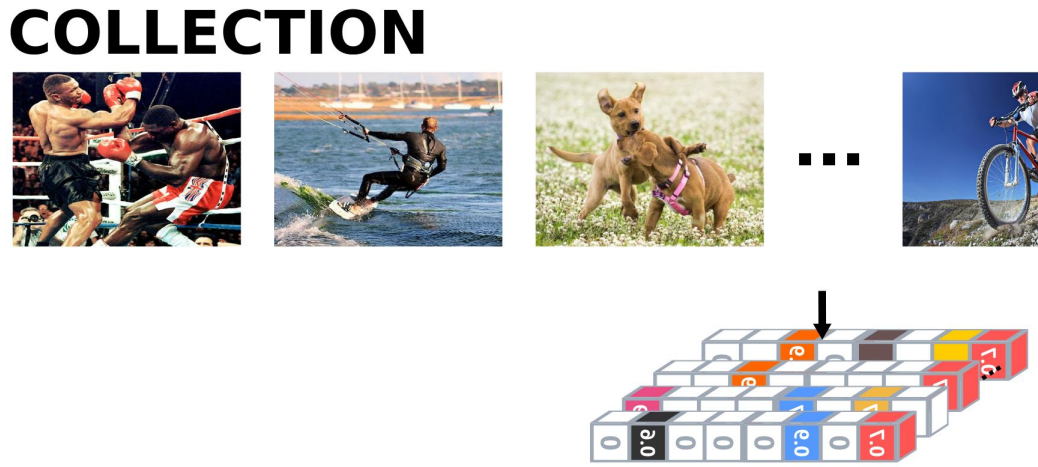
Matching Multi-Modal Data in AMECON Space

- **Matching texts & images in the same AMECON Space**
  - Text and Images directly comparable
  - Perform ANY multi-modal task

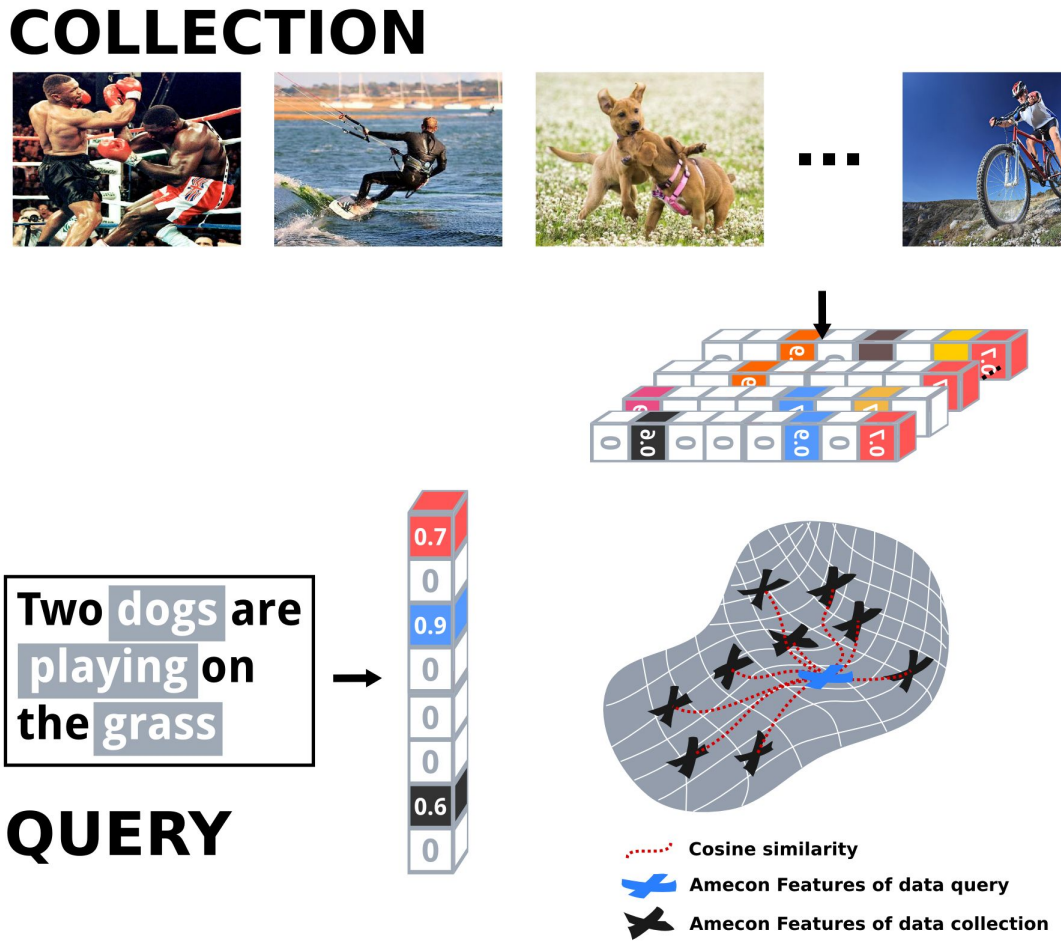
Text-Illustration in AMECON Space



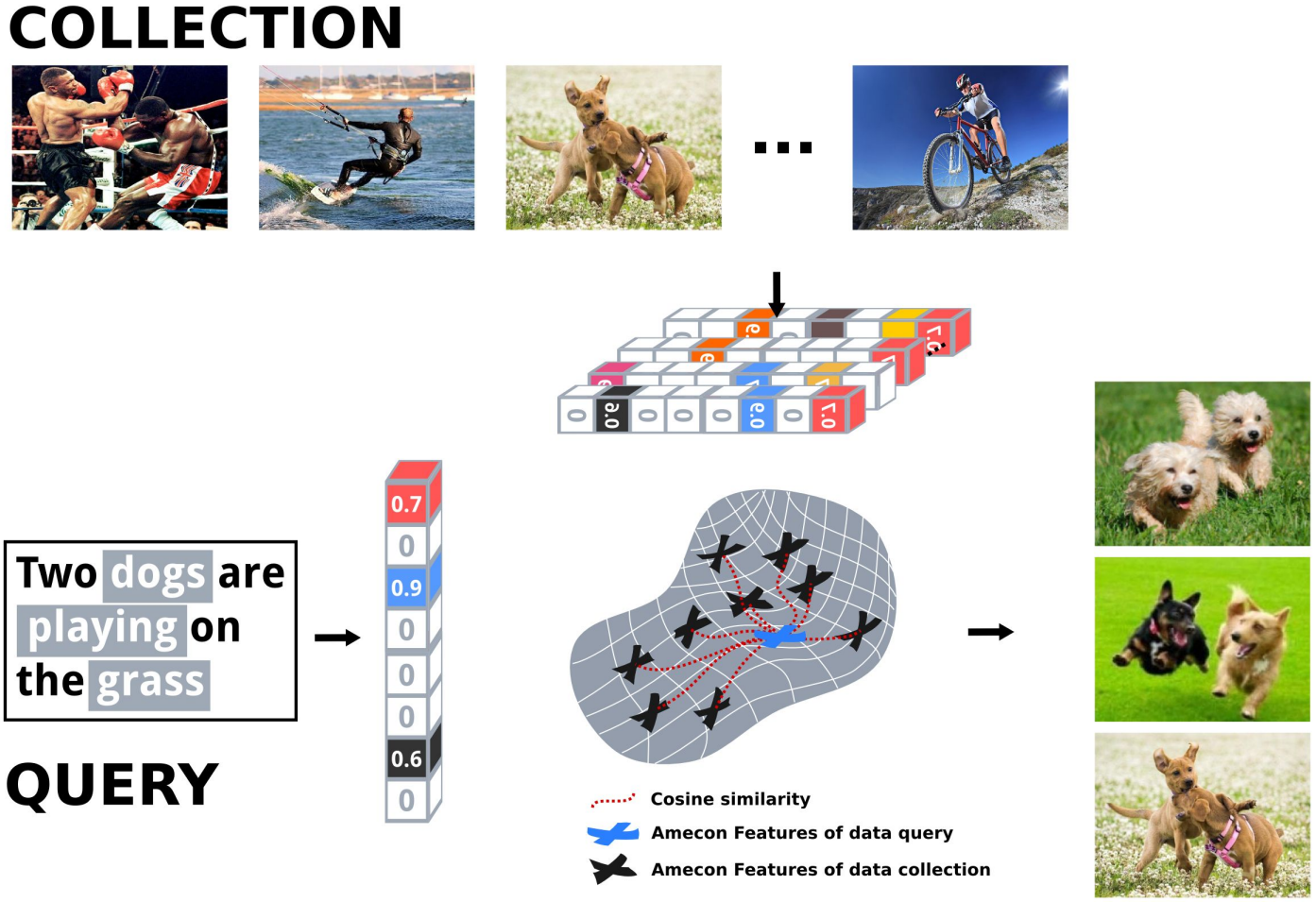
Text-Illustration in AMECON Space



Text-Illustration in AMECON Space



Text-Illustration in AMECON Space



Experimental Protocol

- **Training data**
  - 6,000/30,000 images in Flickr-8k/Flickr-30k
  - Each image associated to 5 captions

- **Testing data** (same for Flickr-8k & 30k)
  - 1000 images and 5000 captions
  - All captions as data-queries
  - All images as data-collection
  - Evaluation metric: Recall@K (K = 1, 5, 10)

Text Illustration Results

Method	Denotation	Flickr-8k			Flickr-30k		
		R@1	R@5	R@10	R@1	R@5	R@10
Karpathy *et al.* [17]	DeFrag						
Kiros *et al.* [18]	MNLM						
Mao *et al.* [21]	m-RNN						
Karpathy *et al.* [16]	BRNN*						
Yan *et al.* [36]	DCCA						
Tran *et al.* [32]	MACC†						
Our Approach	AMECON						

Neural Network-based Approach

CCA-based Approach

Our Approach

Text Illustration Results

Method	Denotation	Flickr-8k			Flickr-30k		
		R@1	R@5	R@10	R@1	R@5	R@10
Karpathy *et al.* [17]	DeFrag	9.7			10.3		
Kiros *et al.* [18]	MNLM	10.4			11.8		
Mao *et al.* [21]	m-RNN	11.5			12.6		
Karpathy *et al.* [16]	BRNN*	11.8			15.2		
Yan *et al.* [36]	DCCA	12.7			12.6		
Tran *et al.* [32]	MACC†	10.2			12.1		
Our Approach	AMECON	**15.9**			**18.3**		

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Text Illustration Results

Method	Denotation	Flickr-8k			Flickr-30k		
		R@1	R@5	R@10	R@1	R@5	R@10
Karpathy *et al.* [17]	DeFrag	9.7	29.6		10.3	31.4	
Kiros *et al.* [18]	MNLM	10.4	31.0		11.8	34.0	
Mao *et al.* [21]	m-RNN	11.5	31.0		12.6	31.2	
Karpathy *et al.* [16]	BRNN*	11.8	32.1		15.2	37.7	
Yan *et al.* [36]	DCCA	12.7	31.2		12.6	31.0	
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Our Approach	AMECON	**15.9**	**37.9**		**18.3**	**41.3**	

Neural Network-based Approach

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Text Illustration Results

Method	Denotation	Flickr-8k			Flickr-30k		
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Karpathy *et al.* [17]	DeFrag	9.7	29.6	42.5	10.3	31.4	44.5
Kiros *et al.* [18]	MNLM	10.4	31.0	43.7	11.8	34.0	46.3
Mao *et al.* [21]	m-RNN	11.5	31.0	42.4	12.6	31.2	41.5
Karpathy *et al.* [16]	BRNN*	11.8	32.1	44.7	15.2	37.7	50.5
Yan *et al.* [36]	DCCA	12.7	31.2	44.1	12.6	31.0	43.0
Tran *et al.* [32]	MACC†	10.2	29.3	41.4	12.4	33.5	46.1
Our Approach	AMECON	**15.9**	**37.9**	**49.5**	**18.3**	**41.3**	**53.5**

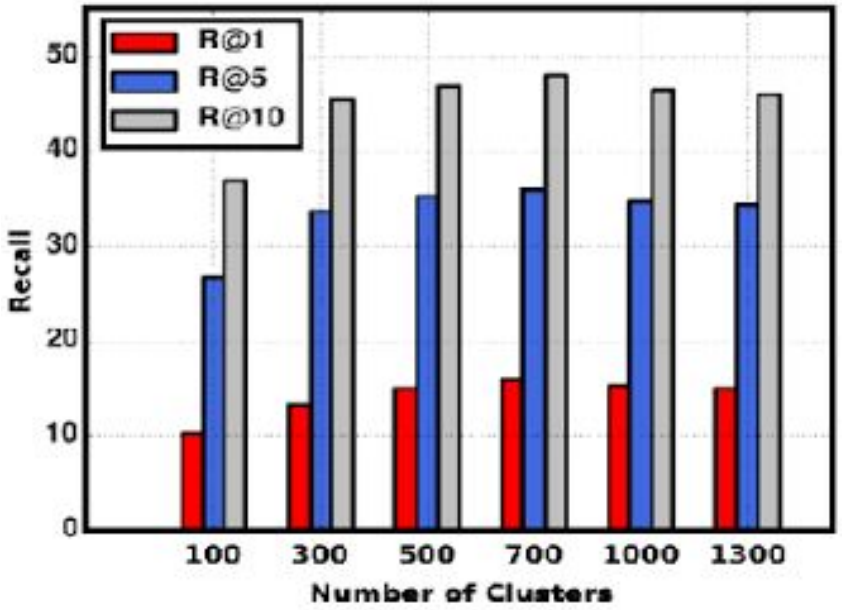
Neural Network-based Approach

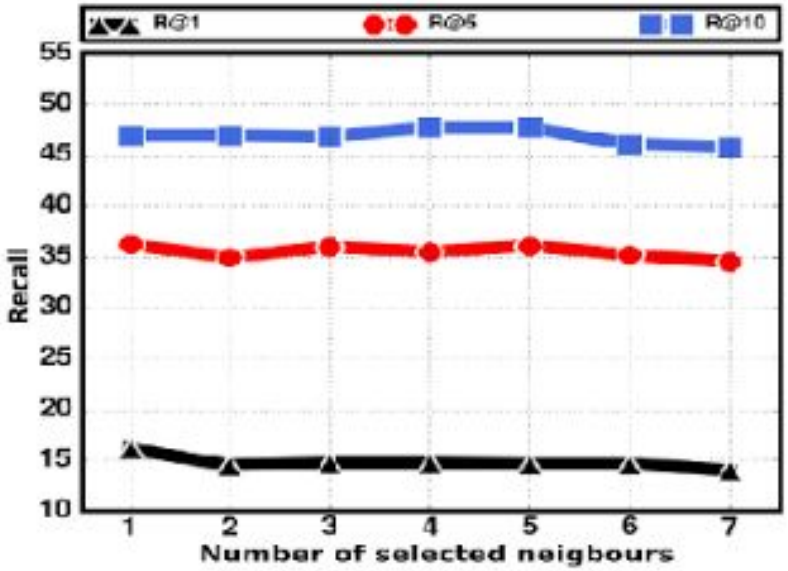
CCA-based Approach

Our Approach

Analysis of Parameters

- Quite robust to the parameters
  - Robust to #selected neighbours
  - Sensitive to #clusters (C) but stable when for a large range of C values





Conclusion

- **Novelty:**
  - Principle of AMECONs
    - Abstract MEta-CONcepts
  - Mixing supervised and unsupervised learning to build a multi-modal space
- **Results on Text-illustration:**
  - +4 points of R@K (avg.) compared to best methods of the literature
- **Future Work:**
  - Image captioning with AMECON-features

Code will be released at:

http://perso.ecp.fr/~tamaazouy/

Thank you (questions ?)

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