

# DEEP LEARNING WORKSHOP

Dublin City University  
27-28 April 2017



[Slides on GDrive](#)



[@DocXavi](#)

#InsightDL2017

## Spotlight

# One Perceptron to Rule them All: Deep Learning for Multimedia

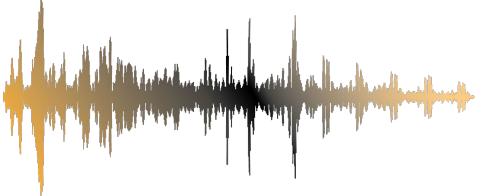


Xavier Giro-i-Nieto

xavier.giro@upc.edu

Associate Professor  
Universitat Politècnica de Catalunya  
Technical University of Catalonia





## Audio



# Sentiment

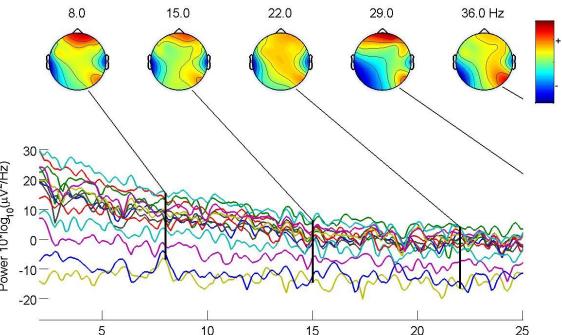
# Text



# Eye gaze



## Vision



EEG



Audio



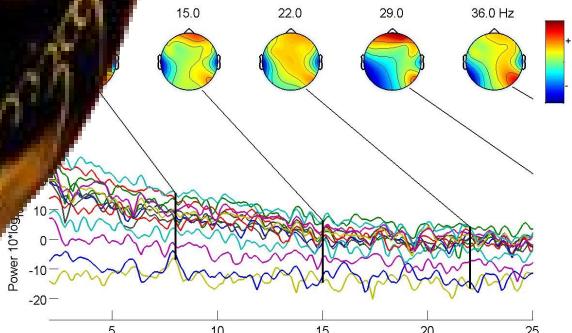
Sentiment

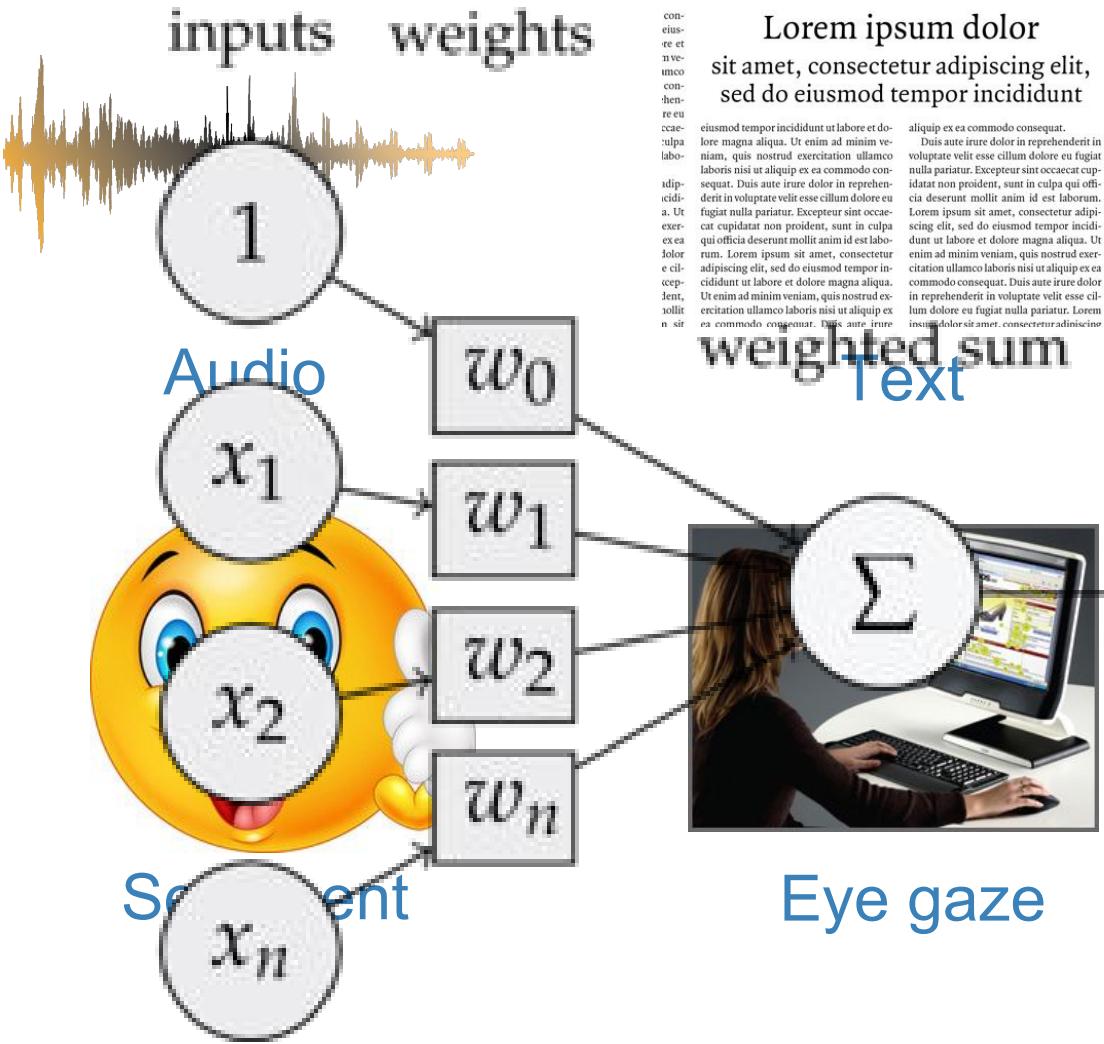


EEG



Image



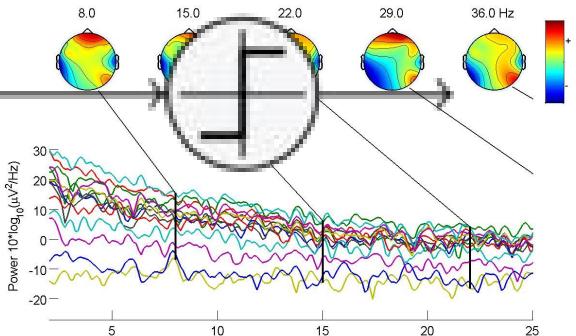


repi  
son  
nifi  
cou  
was  
blar  
whi  
waii  
the  
sint  
in c  
est  
sect  
tem  
na a  
nos  
aliq  
autc  
lupt  
null  
con  
tem  
na a



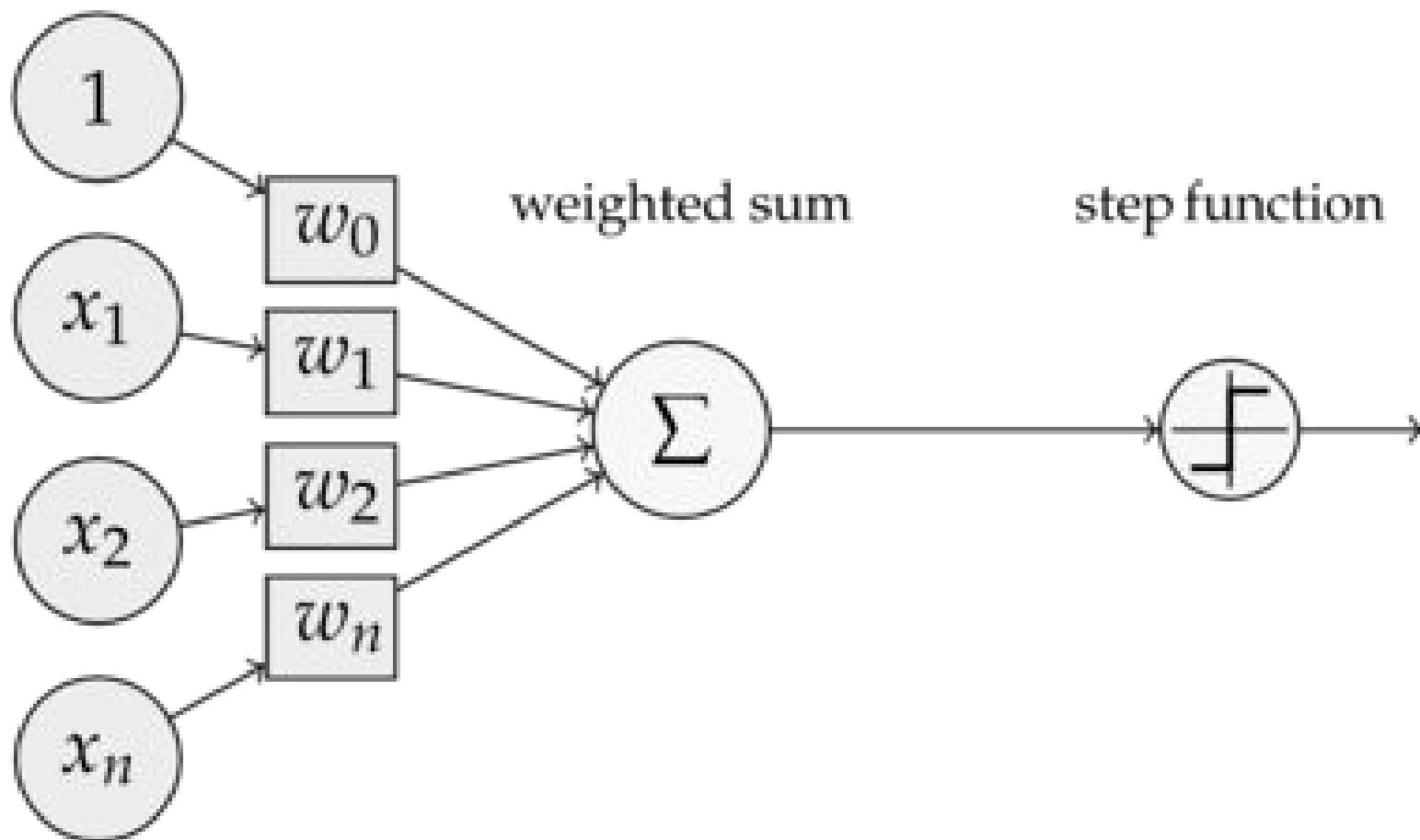
# step function

## Image



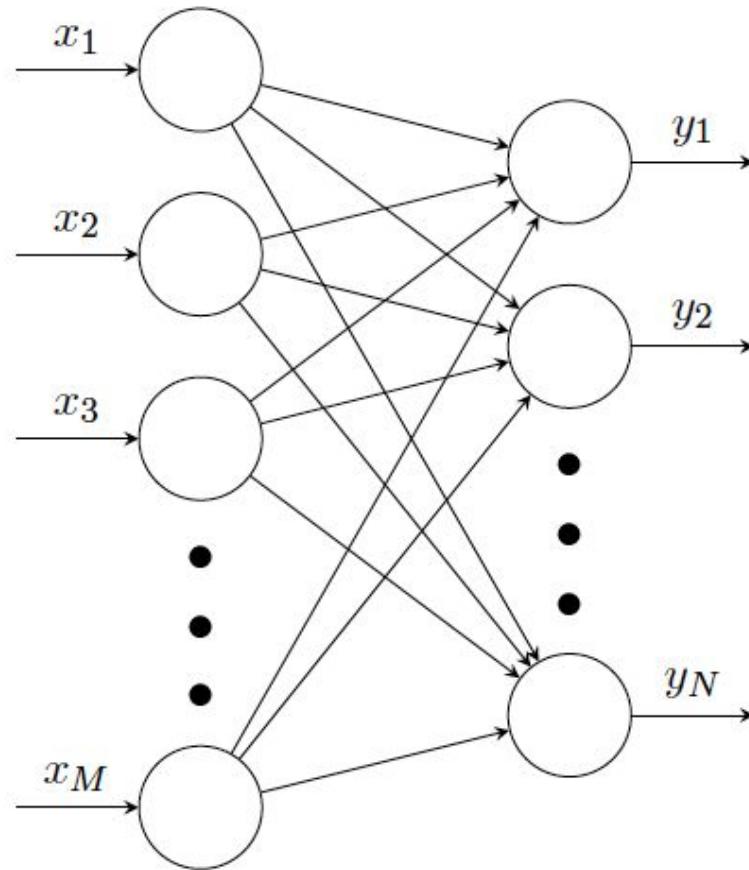
EEG

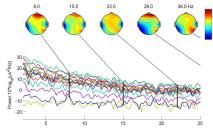
inputs    weights



Input  
layer

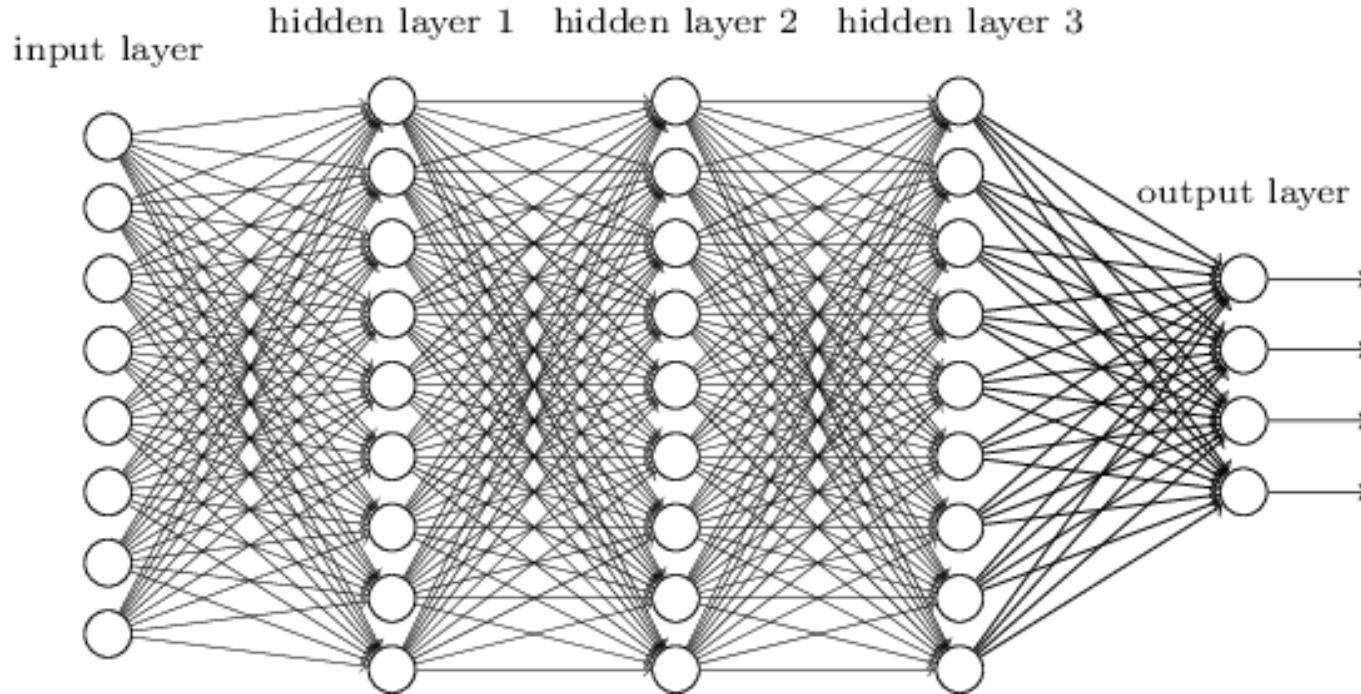
Ouput  
layer

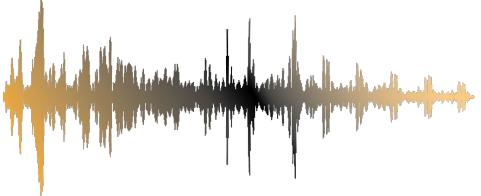




# **LOREM IPSUM DOLOR**

sit amet, consectetur adipiscing elit,  
sed do eiusmod tempor incididunt





## Audio



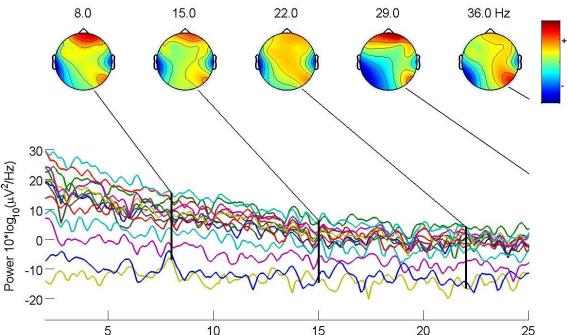
# Sentiment



## Eye gaze

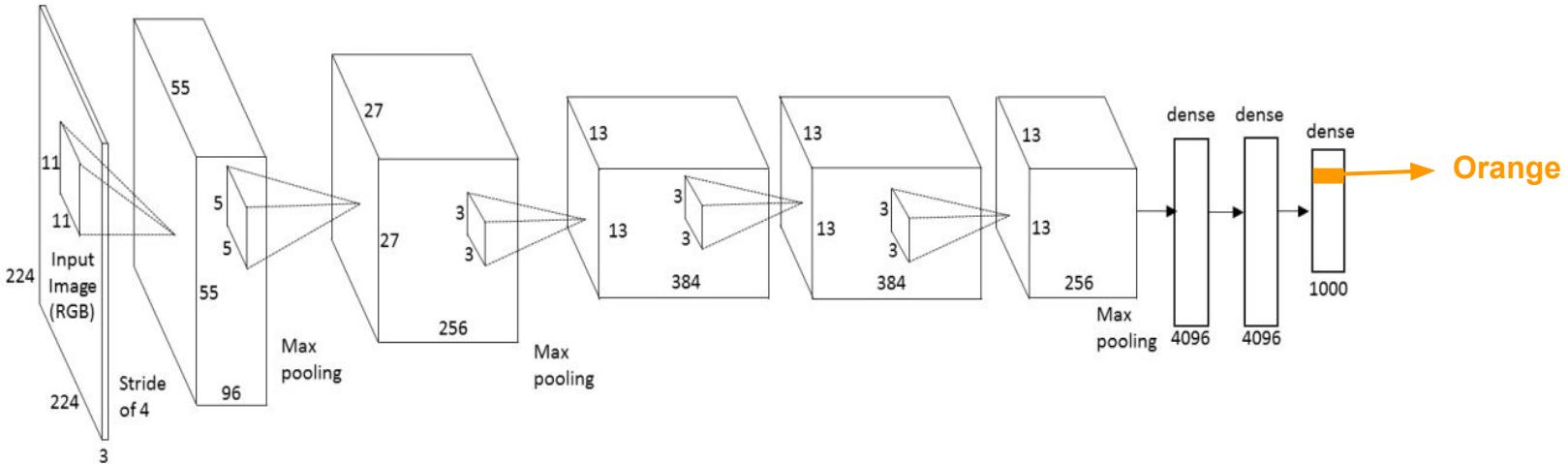
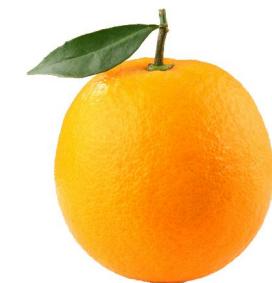


## Visual



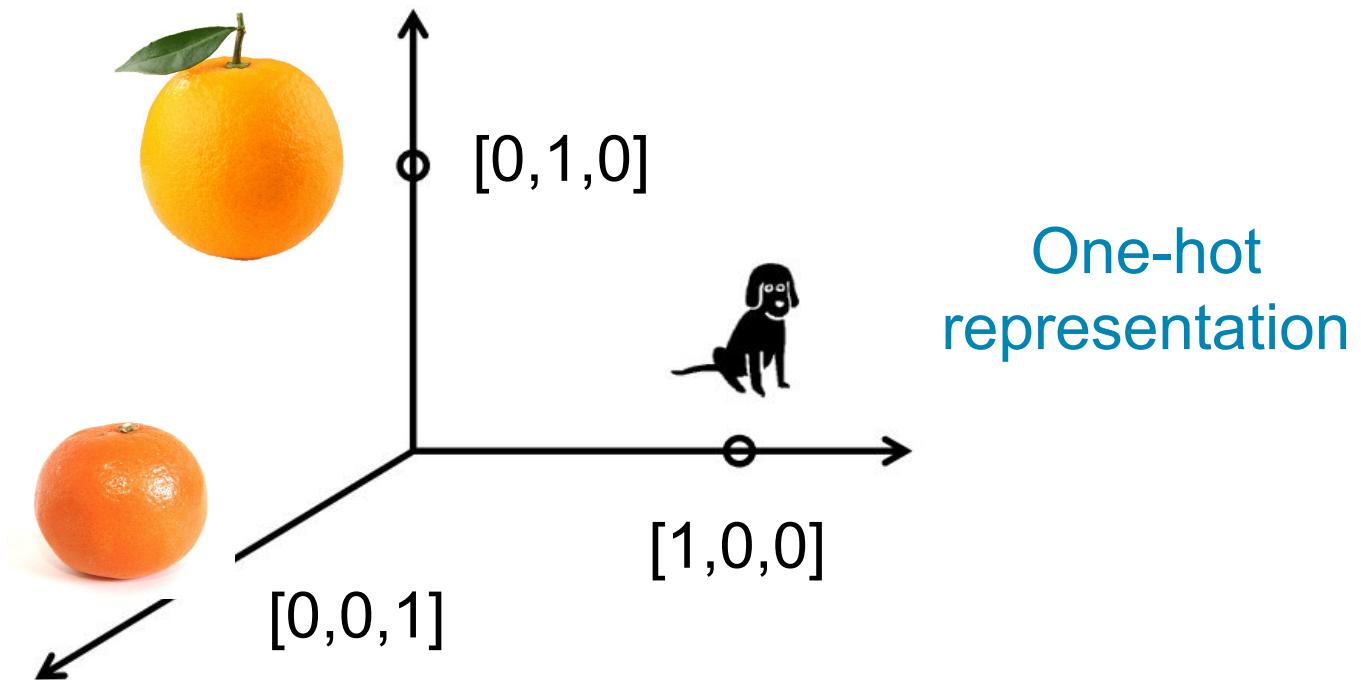
EEG

# Image to Tag

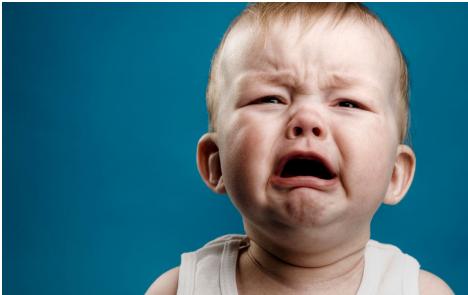


A Krizhevsky, I Sutskever, GE Hinton "[Imagenet classification with deep convolutional neural networks](#)"  
NIPS 2012

# Image to Tag



# Image to Tags: Adjective Noun Pairs



CRYING BABY



SMILING BABY



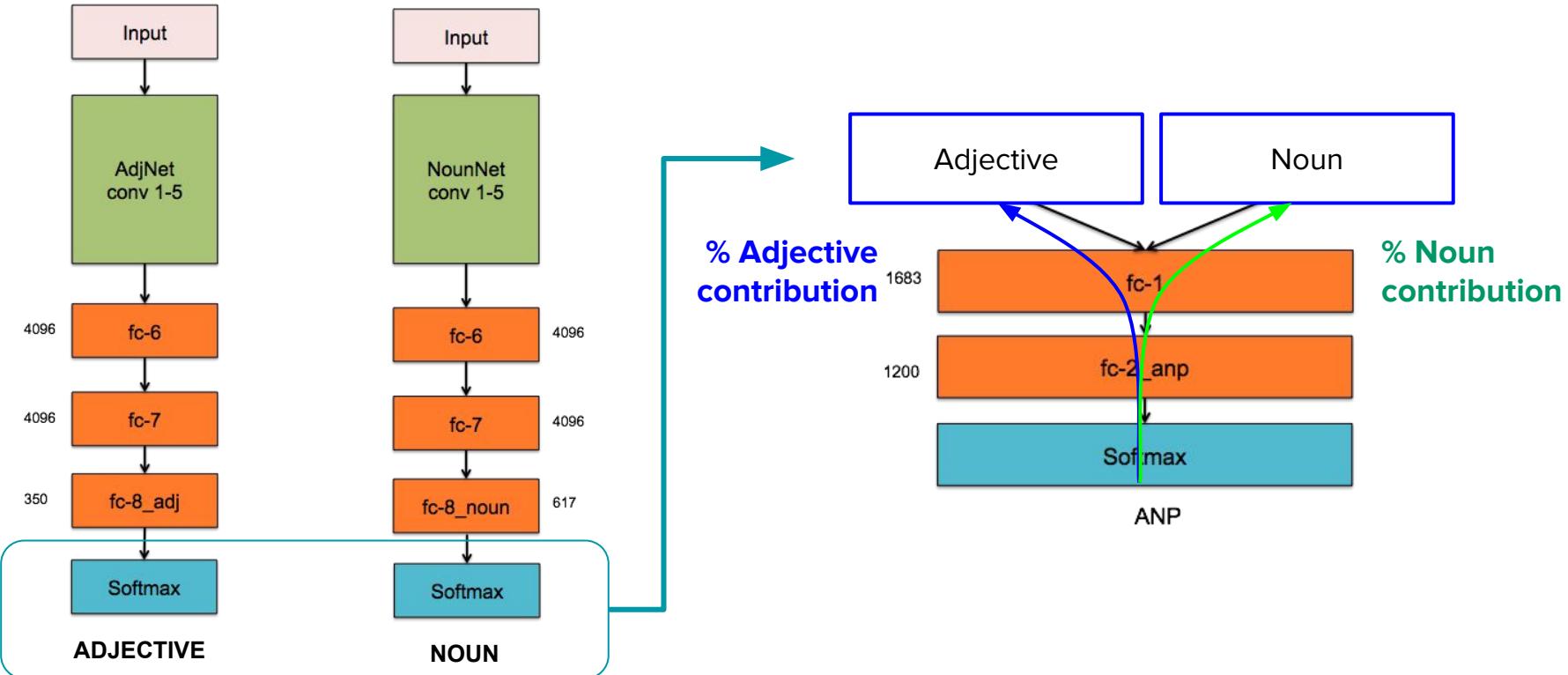
STORMY LANDSCAPE



SUNNY LANDSCAPE

Borth, Damian, Rongrong Ji, Tao Chen, Thomas Breuel, and Shih-Fu Chang. "[Large-scale visual sentiment ontology and detectors using adjective noun pairs.](#)" ACMMM 2013.

# Image to Tags: Adjective Noun Pairs



Delia Fernandez, Alejandro Woodward, Victor Campos, Xavier Giro-i-Nieto, Brendan Jou, Shih-Fu Chang, [“More cat than cute? Interpretable Prediction of Adjective-Noun Pairs”](#).

# Image to Tags: Adjective Noun Pairs

## Interpretation: Adjective vs Noun-oriented predictions

Noun-Oriented



Cute Cat

% of Contribution (top-5)		
	Semantic	Visual
Adjectives	37.17%	30.09%
Nouns	62.82%	69.90%

Adjective-Oriented



Foggy Day

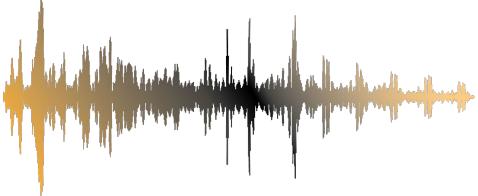
% of Contribution (top-5)		
	Semantic	Visual
Adjective	62.16%	53.42%
Nouns	37.83%	46.57%

# Image to Tags: Adjective Noun Pairs

Interpretation: Contributing Adjectives and Nouns.

			
<b>Happy Dog</b>		<b>Smiling Dog</b>	
<b>top-5 adjectives</b>	<b>top-5 nouns</b>	<b>top-5 adjectives</b>	<b>top-5 nouns</b>
happy smiling friendly playful funny	dog animals pets grass eyes	smiling happy friendly funny playful	dog eyes pets blonde animals

Delia Fernandez, Alejandro Woodward, Victor Campos, Xavier Giro-i-Nieto, Brendan Jou, Shih-Fu Chang, [“More cat than cute? Interpretable Prediction of Adjective-Noun Pairs”](#).



## Audio



# Sentiment

**1** Lorem ipsum dolor

sit amet, consectetur adipiscing elit,  
sed do eiusmod tempor incididunt

# Text (English)



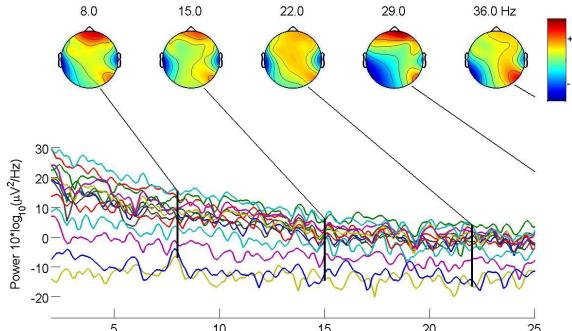
# Eye gaze

Lorem ipsum dolor

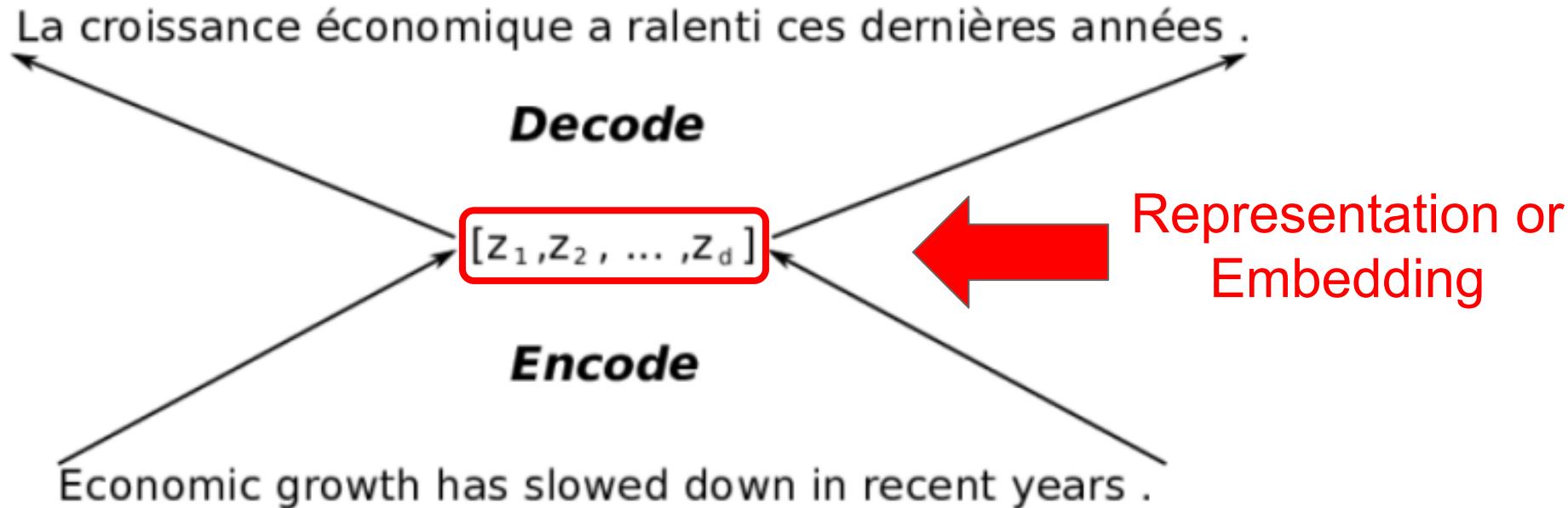
sit amet, consectetur adipiscing elit,  
sed do eiusmod tempor incididunt

etiam in aliis modis. Ut enim ad ipsam rem aliquip ex ea commodo consequatur.

# Text (French)



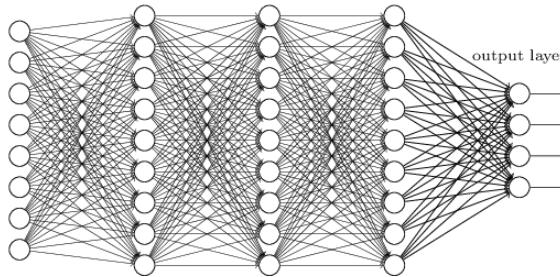
# Neural Machine Translation



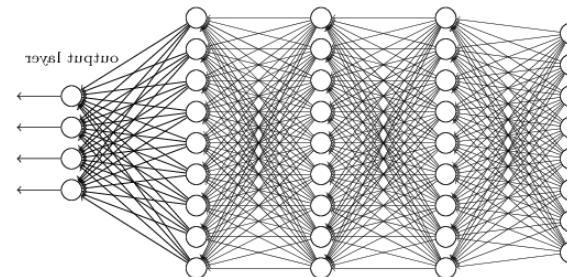
Economic growth has slowed down in recent years .



## Representation or Embedding



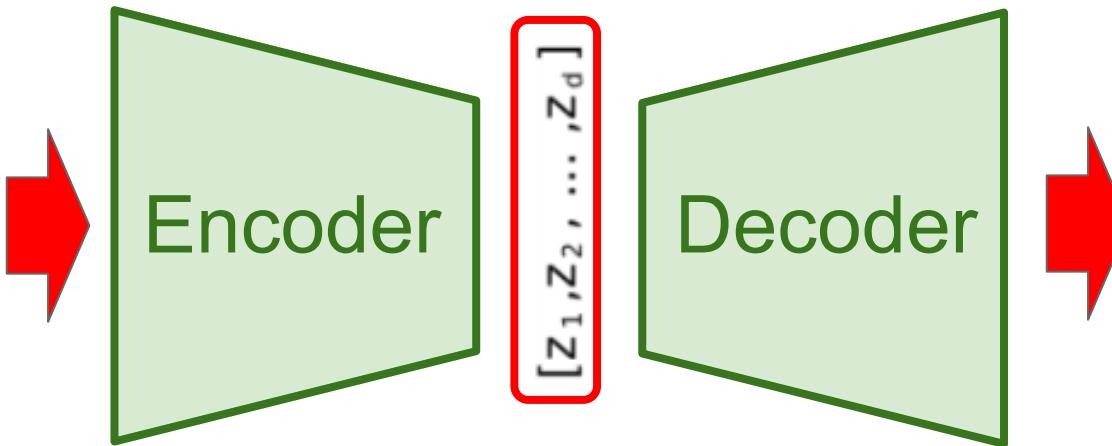
$[z_1, z_2, \dots, z_d]$



La croissance économique a ralenti ces dernières années .

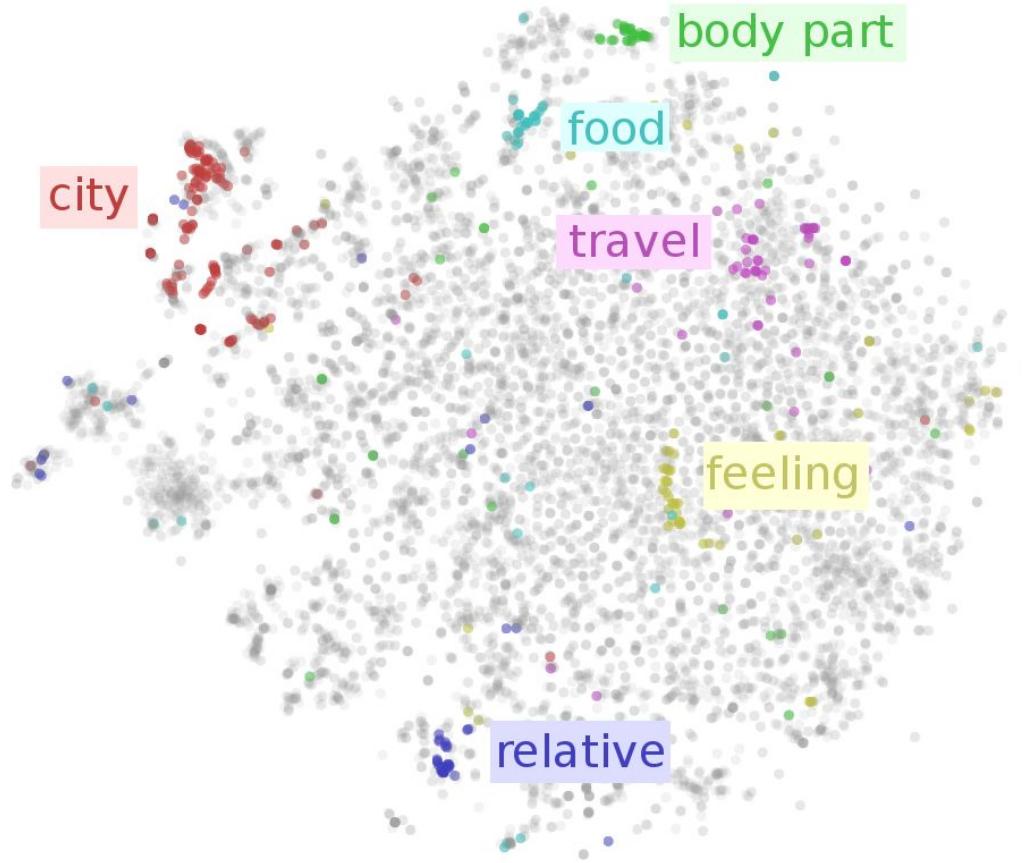
Economic growth has slowed down in recent years .

## Representation or Embedding



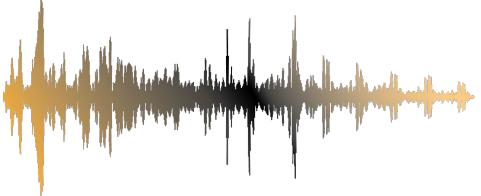
La croissance économique a ralenti ces dernières années .

# Word Embeddings



[Christopher Olah](#)

[Visualizing Representations](#)



## Audio



# Sentiment

# **Lorem ipsum dolor**

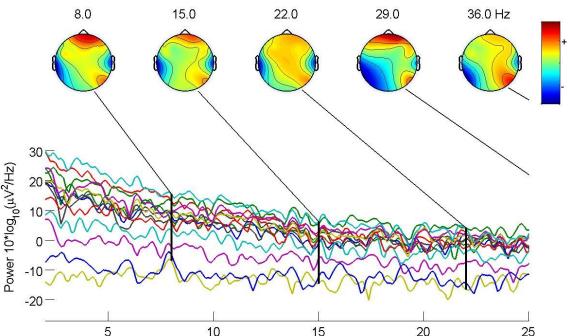
met, consectetur adipiscing elit,  
l do eiusmod tempor incididunt ut



## Eye gaze



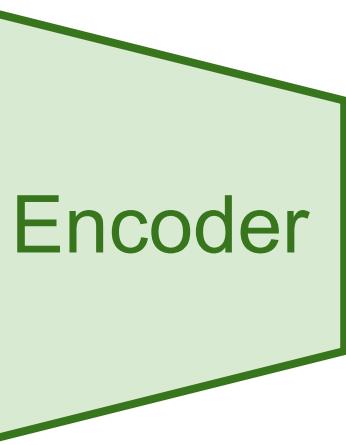
# Visual



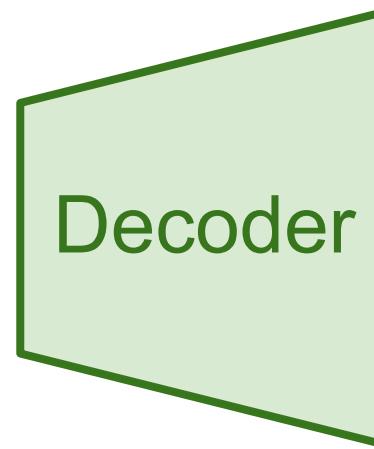
EEG

La croissance économique a ralenti ces dernières années.

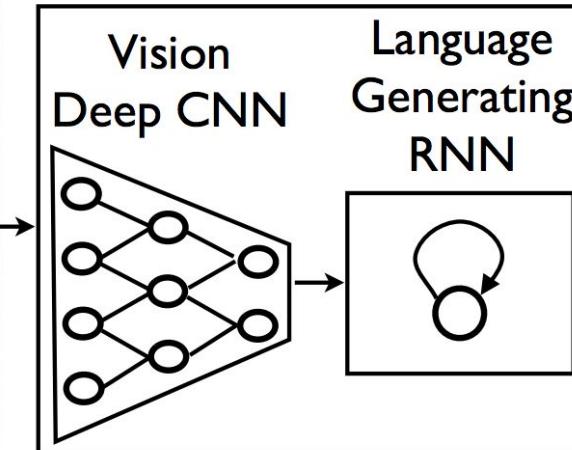
## Representation or Embedding



$[z_1, z_2, \dots, z_d]$



# Captioning: Show & Tell



**A group of people shopping at an outdoor market.**

**There are many vegetables at the fruit stand.**

Vinyals, Oriol, Alexander Toshev, Samy Bengio, and Dumitru Erhan. "[Show and tell: A neural image caption generator.](#)" CVPR 2015.

# Captioning: DeeplImageSent



man in black shirt is playing guitar.



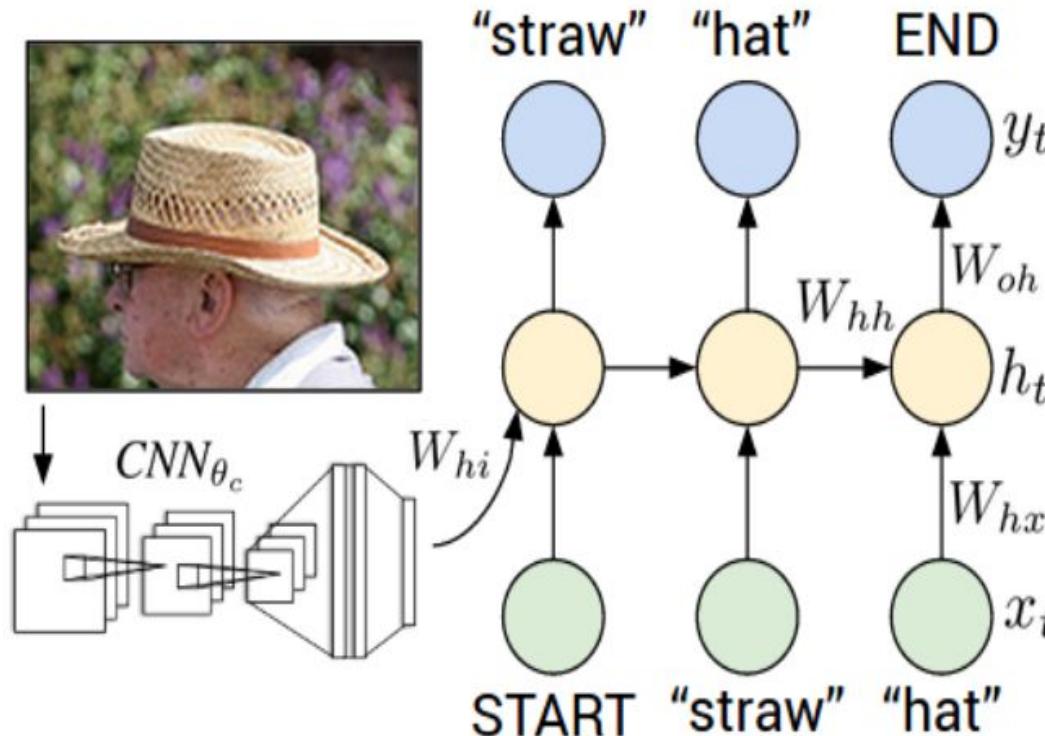
construction worker in orange safety vest is working on road.



two young girls are playing with lego toy.

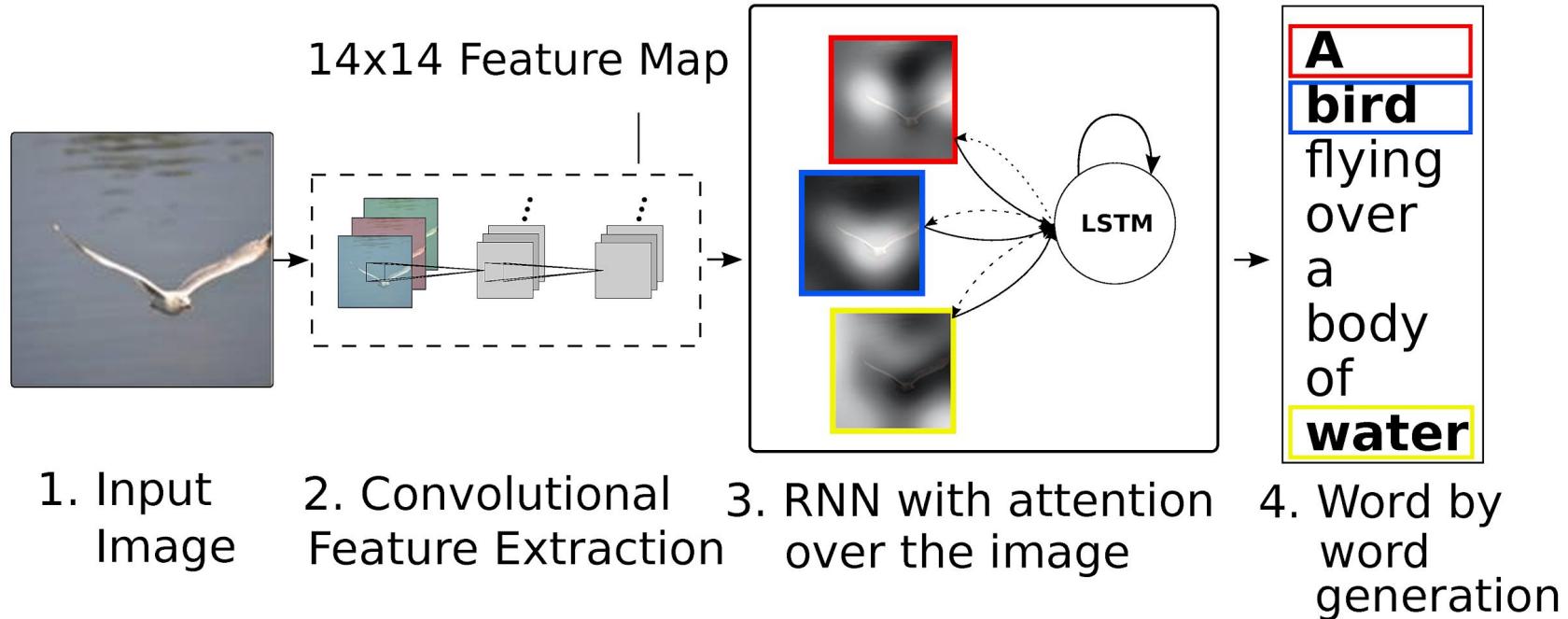
(Slides by Marc Bolaños): Karpathy, Andrej, and Li Fei-Fei. "Deep visual-semantic alignments for generating image descriptions." CVPR 2015

# Captioning: DeeplImageSent



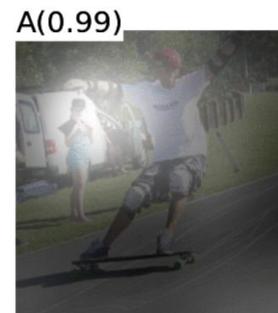
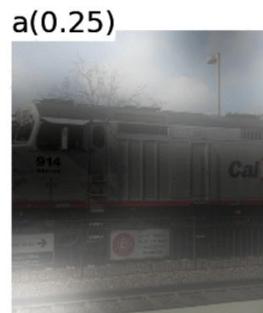
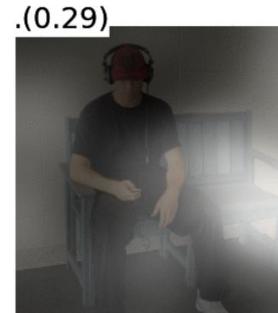
(Slides by Marc Bolaños): Karpathy, Andrej, and Li Fei-Fei. "Deep visual-semantic alignments for generating image descriptions." CVPR 2015

# Captioning: Show, Attend & Tell



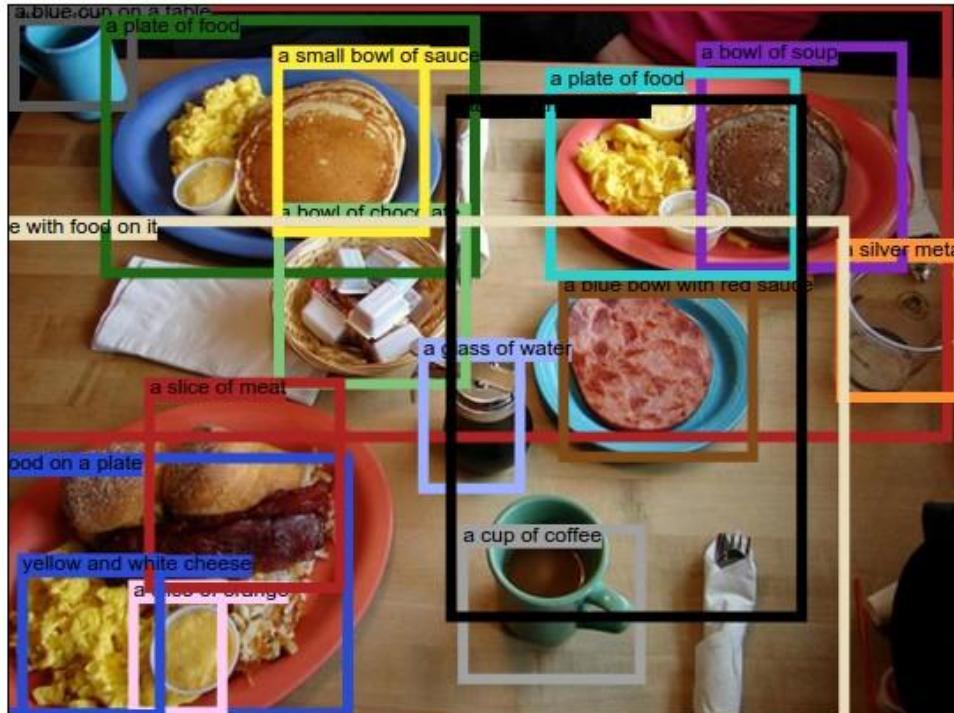
Xu, Kelvin, Jimmy Ba, Ryan Kiros, Kyunghyun Cho, Aaron C. Courville, Ruslan Salakhutdinov, Richard S. Zemel, and Yoshua Bengio. "[Show, Attend and Tell: Neural Image Caption Generation with Visual Attention.](#)" ICML 2015

# Captioning: Show, Attend & Tell



Xu, Kelvin, Jimmy Ba, Ryan Kiros, Kyunghyun Cho, Aaron C. Courville, Ruslan Salakhutdinov, Richard S. Zemel, and Yoshua Bengio. "[Show, Attend and Tell: Neural Image Caption Generation with Visual Attention.](#)" ICML 2015

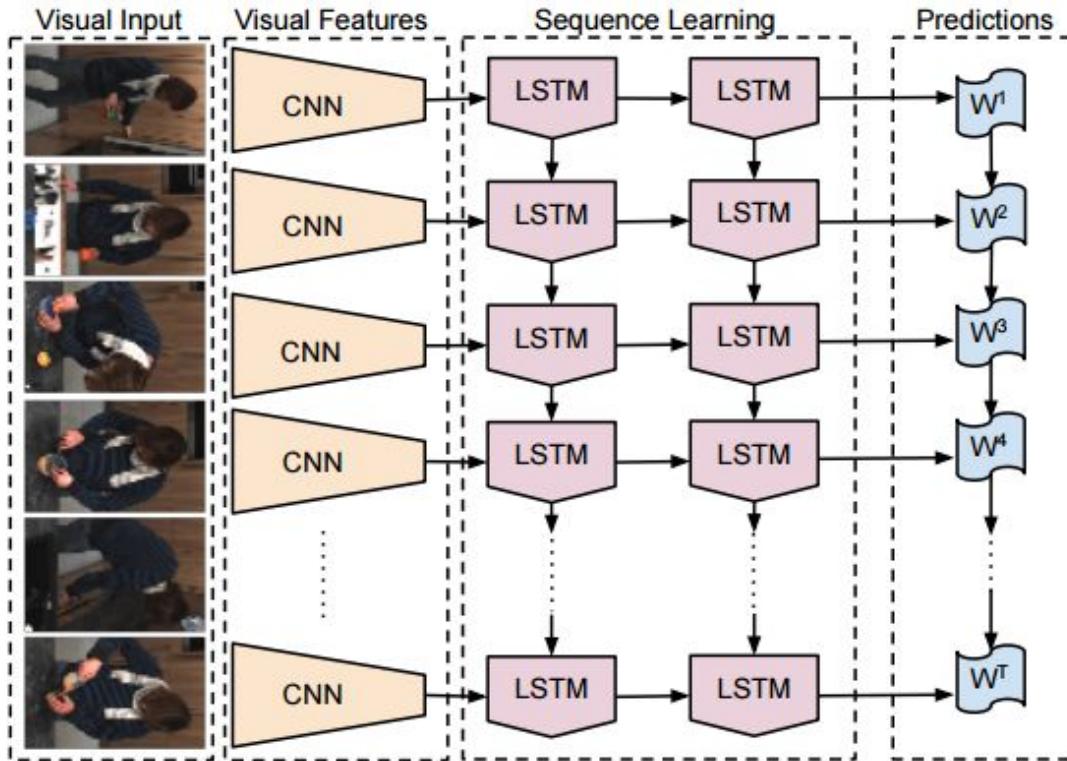
# Captioning (+ Detection): DenseCap



a plate of food. food on a plate. a blue cup on a table. a plate of food. a blue bowl with red sauce. a bowl of soup. a cup of coffee. a bowl of chocolate. a glass of water. a plate of food. a silver metal container. a small bowl of sauce. table with food on it. a slice of orange. a table with food on it. a slice of meat. yellow and white cheese.

Johnson, Justin, Andrej Karpathy, and Li Fei-Fei. "[Densecap: Fully convolutional localization networks for dense captioning.](#)" CVPR 2016

# Captioning for video



Jeffrey Donahue, Lisa Anne Hendricks, Sergio Guadarrama, Marcus Rohrbach, Subhashini Venugopalan, Kate Saenko, Trevor Darrel. [Long-term Recurrent Convolutional Networks for Visual Recognition and Description](#), CVPR 2015. [code](#)

# Visual Question Answering (VQA)

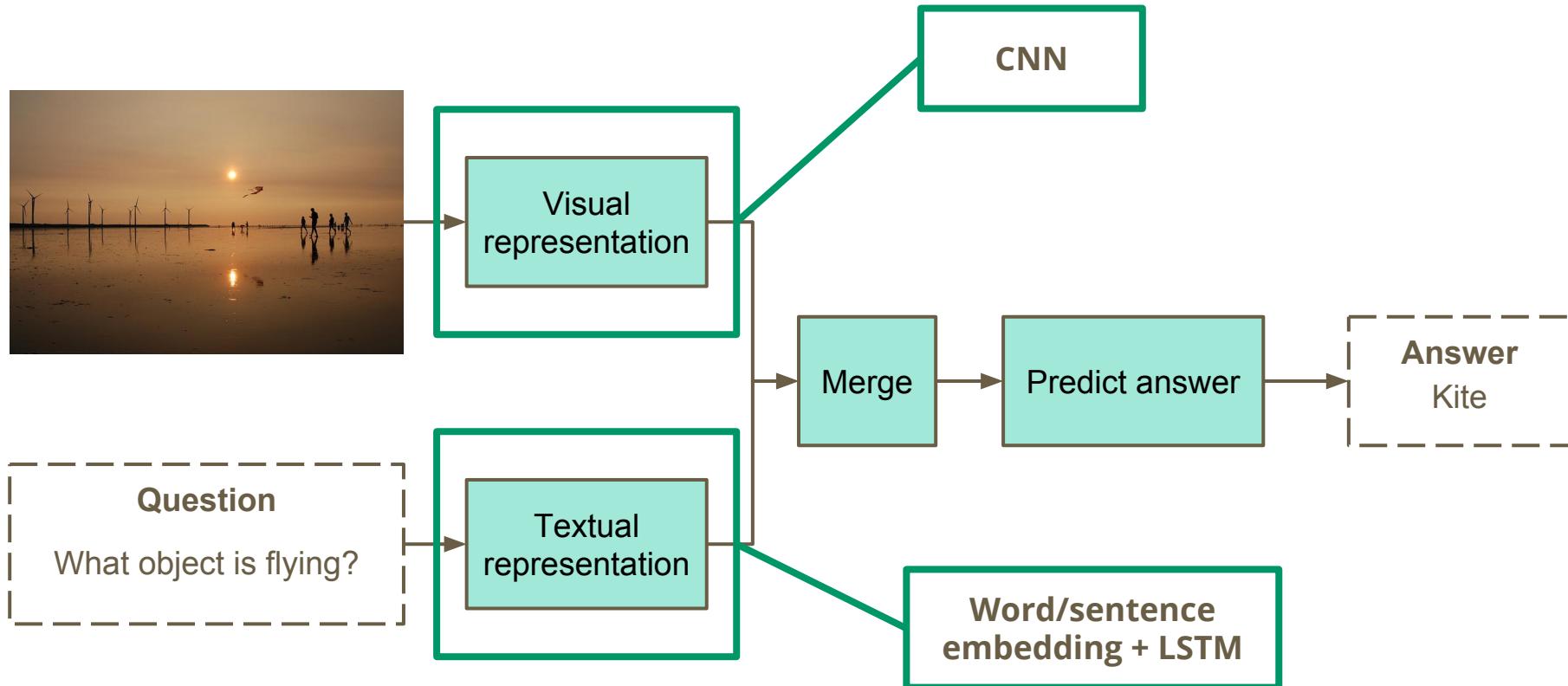


What is the mustache  
made of?

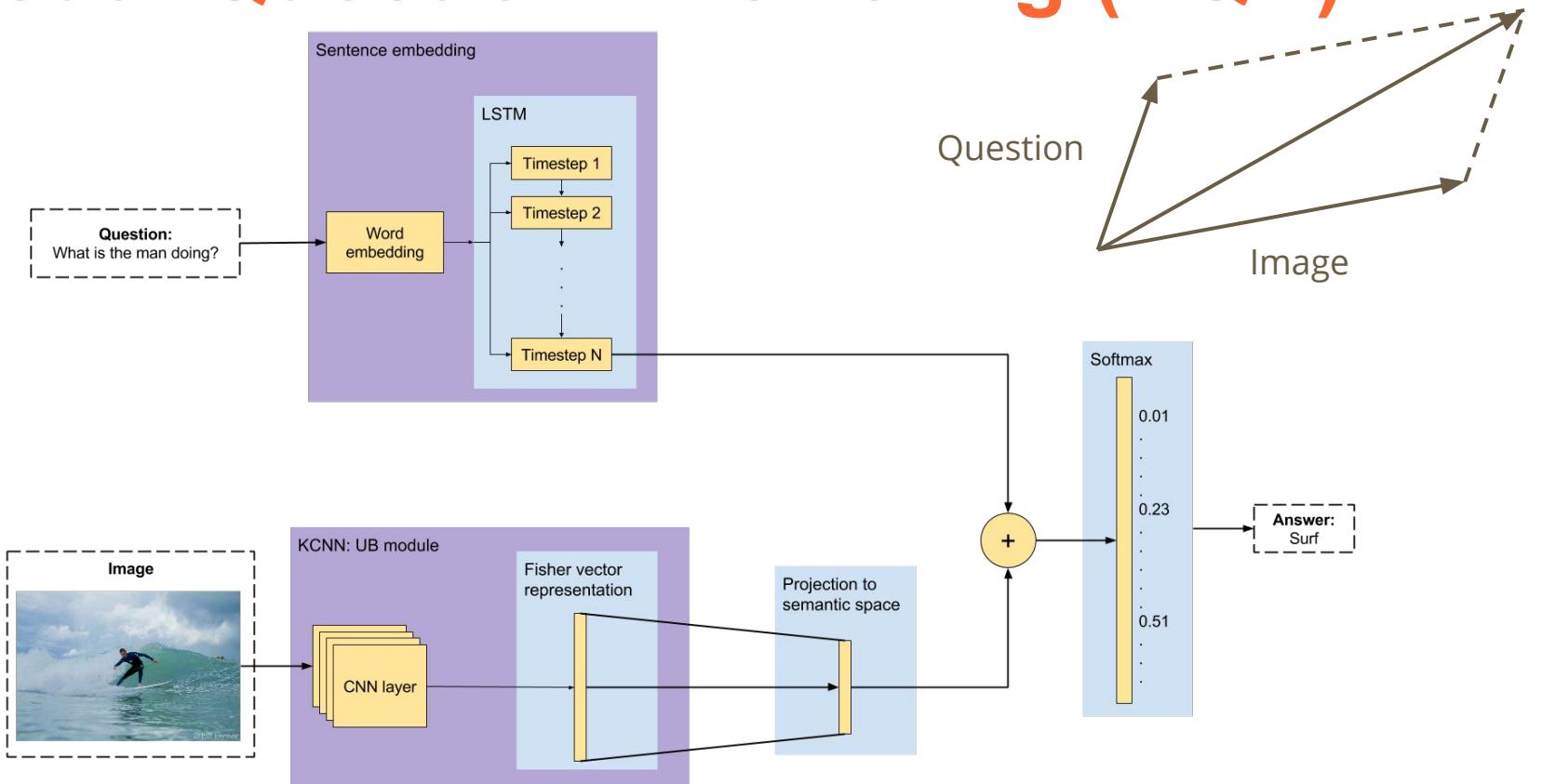
AI System

bananas

# Visual Question Answering (VQA)

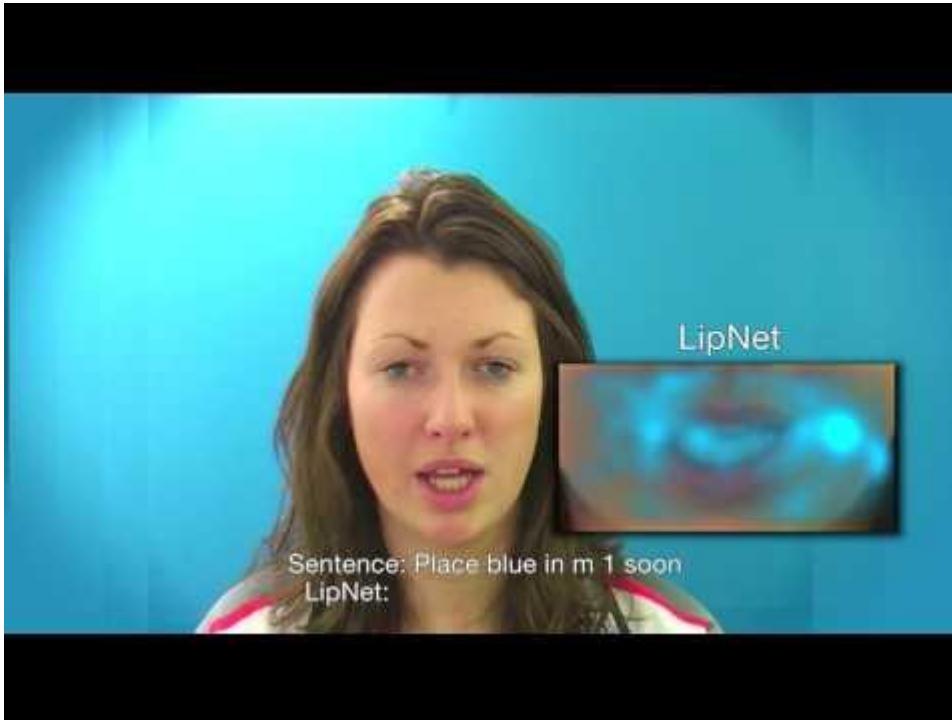


# Visual Question Answering (VQA)



Masuda, Issey, Santiago Pascual de la Puente, and Xavier Giro-i-Nieto. "[Open-Ended Visual Question-Answering](#)." arXiv preprint arXiv:1610.02692 (2016).

# Video to Text: LipNet



Assael, Yannis M., Brendan Shillingford, Shimon Whiteson, and Nando de Freitas. "[LipNet: Sentence-level Lipreading.](#)" *arXiv preprint arXiv:1611.01599* (2016).

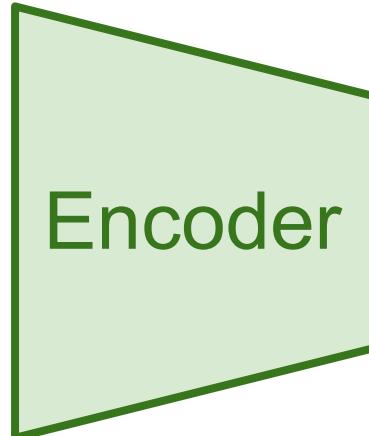
# Video to Text: Watch, Listen, Attend & Spell



Chung, Joon Son, Andrew Senior, Oriol Vinyals, and Andrew Zisserman. "[Lip reading sentences in the wild.](#)" CVPR 2017

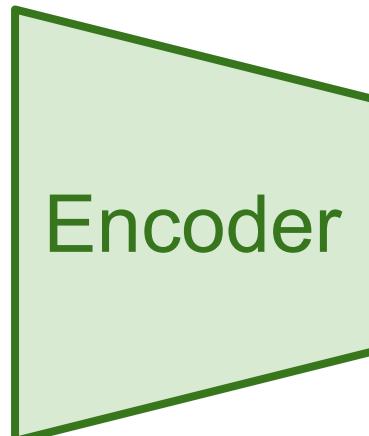
# Joint embeddings

Economic growth has slowed down in recent years .

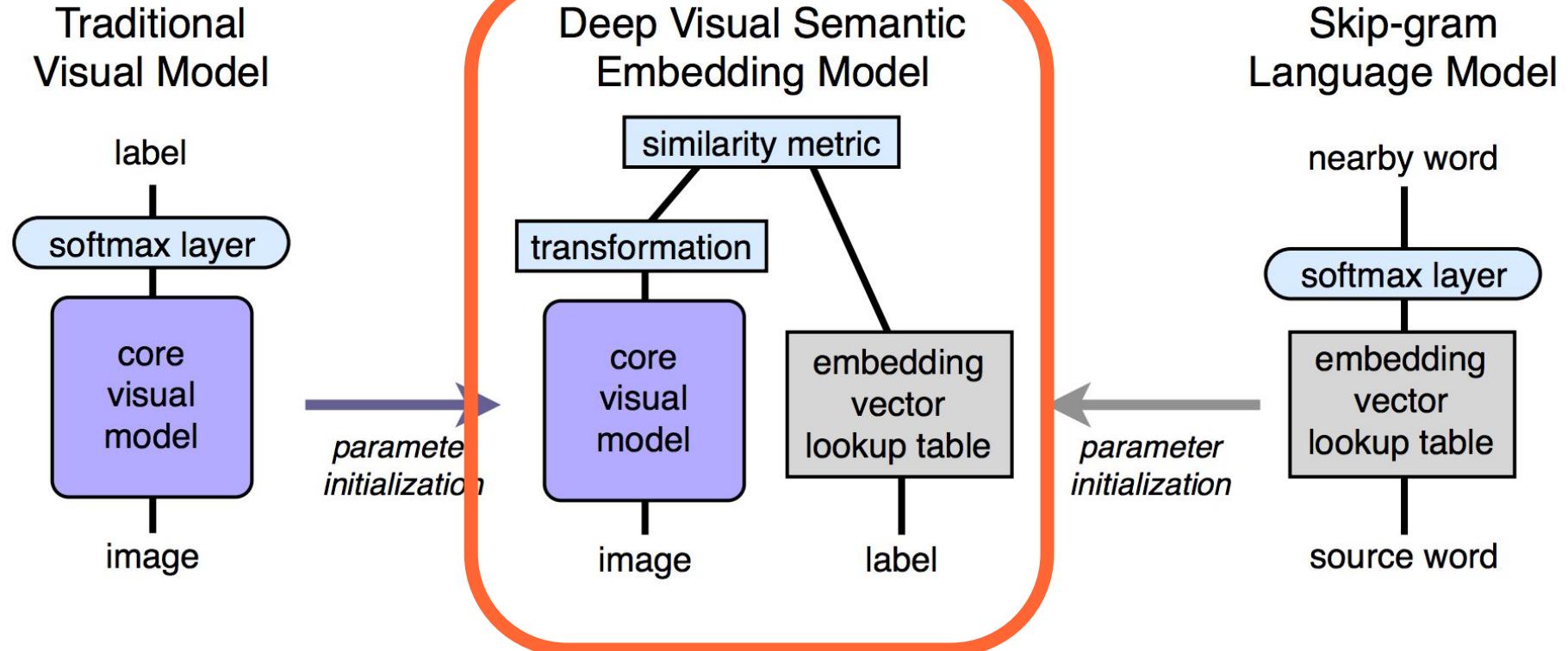


Representation or  
Embedding

$[z_1, z_2, \dots, z_d]$

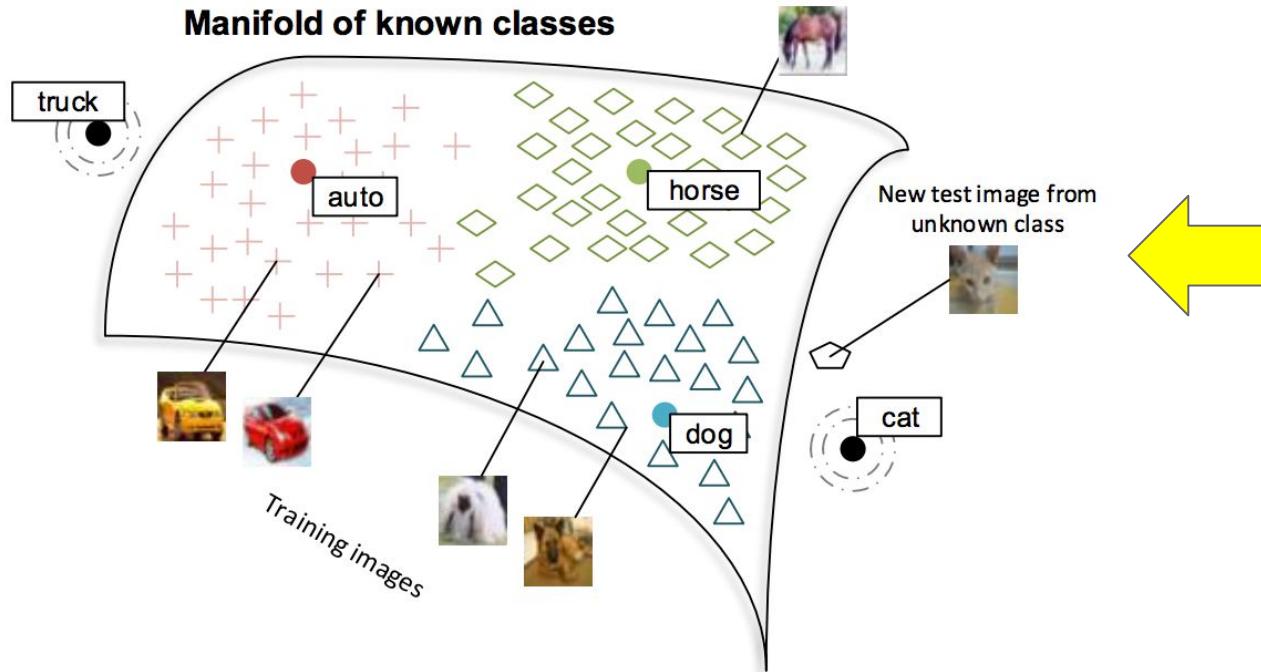


# Joint embeddings



Frome, Andrea, Greg S. Corrado, Jon Shlens, Samy Bengio, Jeff Dean, and Tomas Mikolov. "[Devise: A deep visual-semantic embedding model.](#)" NIPS 2013

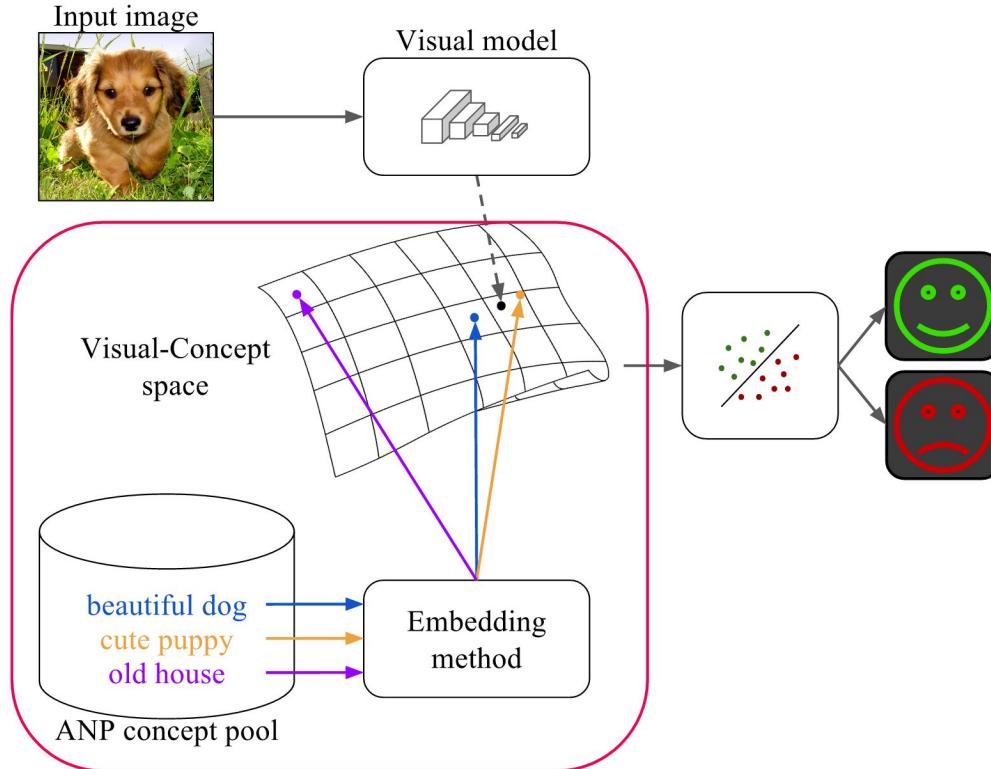
# Joint embeddings



**Zero-shot learning:**  
a class not present in the  
training set of images  
can be predicted

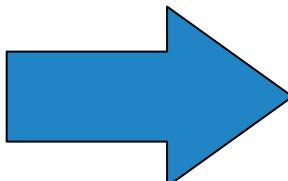
Socher, R., Ganjoo, M., Manning, C. D., & Ng, A., [Zero-shot learning through cross-modal transfer](#).  
NIPS 2013 [\[slides\]](#) [\[code\]](#)

# Joint embeddings



# Joint embeddings

Image and text retrieval with joint embeddings.



## Ingredients

- 3 lbs salmon
- 1 teaspoon cajun seasoning
- 1 tablespoon olive oil

## Cooking Instructions

1. Rinse off salmon and pat dry with paper towel.
2. Drizzle cookie sheet with olive oil.
3. Place salmon (skin side down) on cookie sheet and drizzle more oil on top.
4. Shake Cajun seasoning on salmon to taste.
5. Broil 15-20 minutes or until center of salmon is done.



## Audio



## Sentiment

**Lorum ipsum dolor  
sit amet, consectetur adipiscing elit,  
sed do eiusmod tempor incididunt**

eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure

## Text



## Eye gaze



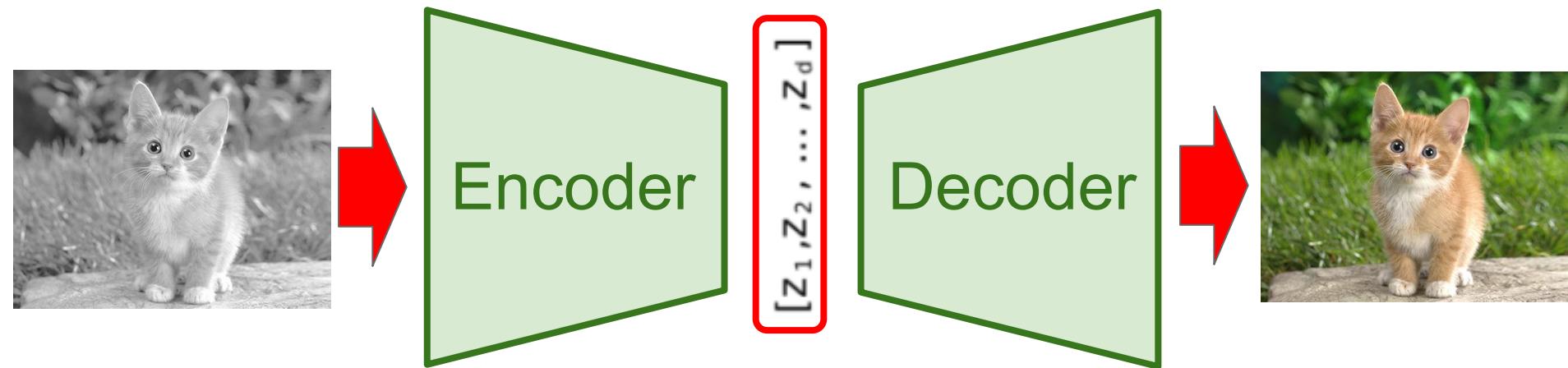
## Visual (in)



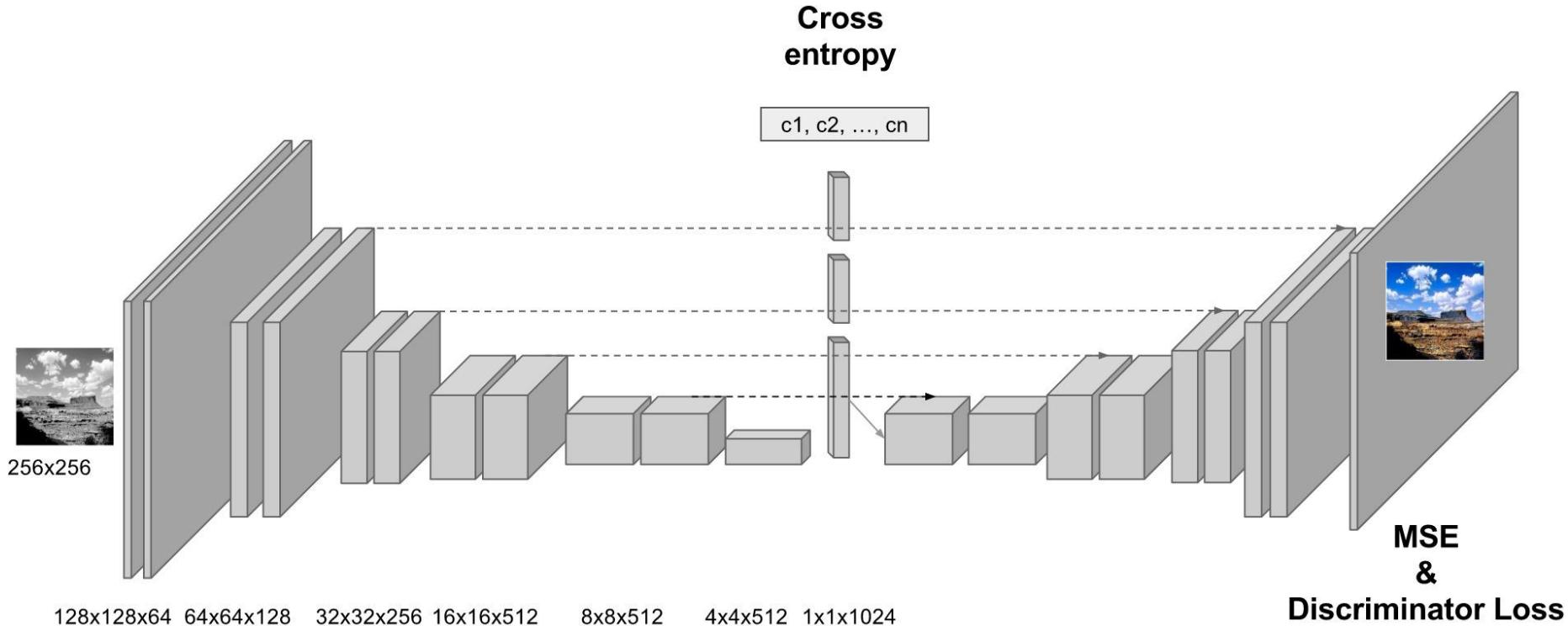
## Visual (out)

# Image to image

Representation or  
Embedding



# Image to image: Colorization



Victor Garcia and Xavier Giro-i-Nieto, “Image Colorization with Conditional Generative Adversarial Networks” (under progress)

# Image to image: Colorization



Victor Garcia and Xavier Giro-i-Nieto, "Image Colorization with Conditional Generative Adversarial Networks" (under progress)

# Image to image #pix2pix

Labels to Street Scene

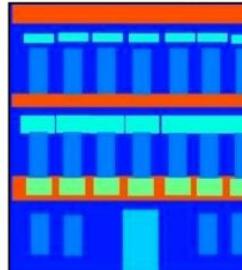


input



output

Labels to Facade



input



output

BW to Color



input

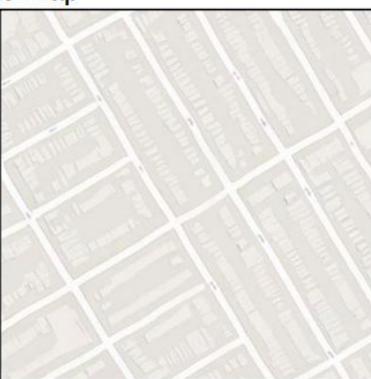


output

Aerial to Map



input



output

Day to Night



input



output

Edges to Photo

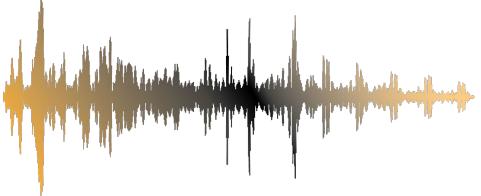


input



output

Isola, Phillip, Jun-Yan Zhu, Tinghui Zhou, and Alexei A. Efros. "[Image-to-image translation with conditional adversarial networks.](#)" arXiv preprint arXiv:1611.07004 (2016).



## Audio



## Sentiment

eiudem tempor incidunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure

Text



## Eye gaze



# Visual (in)

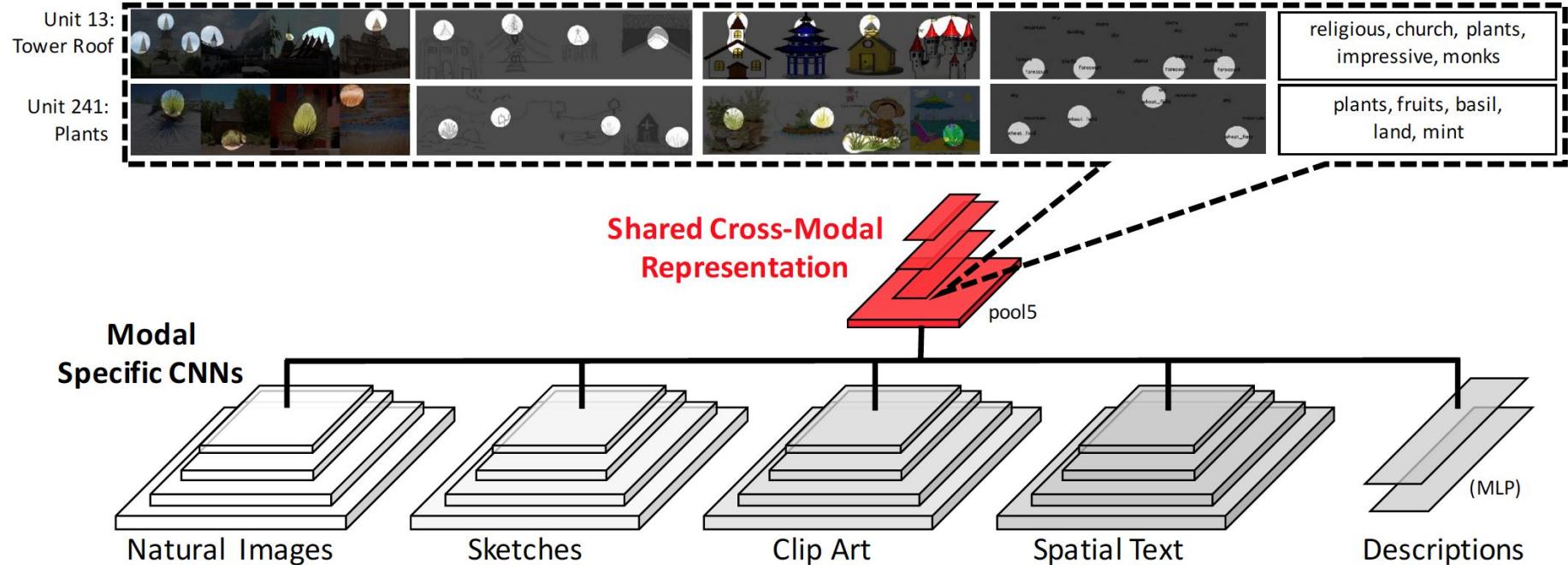


## Visual (out)

# Image to image and text

	Real	Clip art	Sketches	Spatial text	Descriptions
Bedroom					<p>There is a bed with a striped bedspread. Beside this is a nightstand with a drawer. There is also a tall dresser and a chair with a blue cushion. On the dresser is a jewelry box and a clock.</p>
					<p>I am inside a room surrounded by my favorite things. This room is filled with pillows and a comfortable bed. There are stuffed animals everywhere. I have posters on the walls. My jewelry box is on the dresser.</p>
Kindergarten classroom					<p>There are brightly colored wooden tables with little chairs. There is a rug in one corner with ABC blocks on it. There is a bookcase with picture books, a larger teacher's desk and a chalkboard.</p>
					<p>The young students gather in the room at their tables to color. They learn numbers and letters and play games. At nap time they all pull out mats and go to sleep.</p>

# Image to image and text

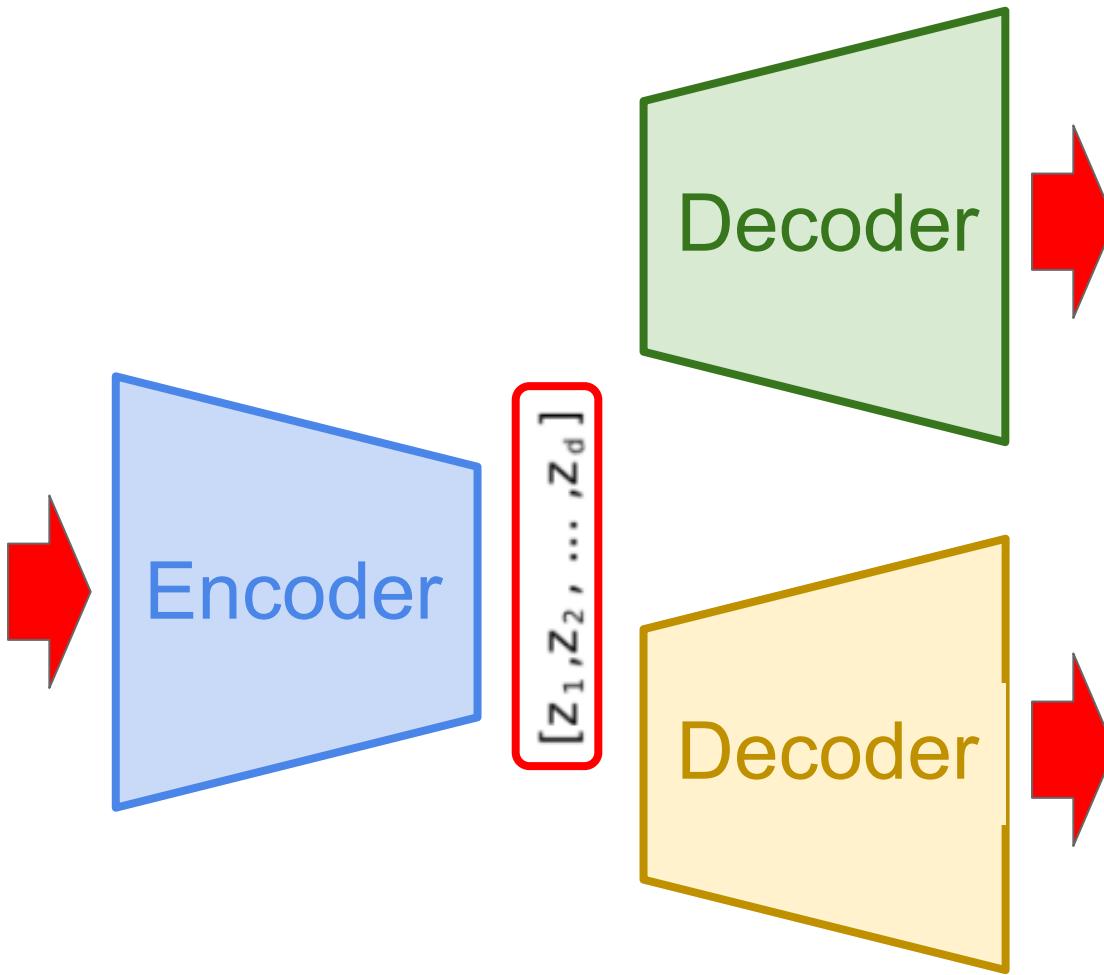


Aytar, Yusuf, Lluis Castrejon, Carl Vondrick, Hamed Pirsiavash, and Antonio Torralba. ["Cross-Modal Scene Networks."](#) arXiv preprint arXiv:1610.09003 (2016).

# Image to image and text

Query	Real	Clip art	Spatial text	Sketches	Descriptions	
			cabinet door wall wall cabinet sink floor	cabinet door wall wall cabinet sink floor		Everything you could need to make dinner, all in one place. Not quite the size of a full kitchen, but everything is there: microwave, refrigerator, and oven.
			sky window building window window	window building sky window window		A very small or compact kitchen. These little kitchens typically have all of the regular equipment found in their larger counterparts such as a refrigerator, stove, and microwave, but they are often smaller than full-sized appliances. The main purpose of these smaller kitchens is to save space.
sky castle wall road			sky castle wall wall road plants	sky castle wall wall plants road		The building appeared grand from the outside, with its turrets and thick stone walls, but inside the stone air was cold and clammy. The few small windows were all that allowed the sunlight to penetrate the cavernous darkness. There were many old rooms to explore in this ancient castle.
			sky snowy_mountain crevasse	sky sky		A large white covered land mass. It is surrounded by clouds at the top. You can see skiers using trails and lift lines on the ground. It is winter and many of the cabins at the base of the land mass are occupied. There is a sign that warns be careful of avalanches.
						Large ice mountain. Usually weather near iceberg is very cold and windy. Huge water bubble sound occurs when the mountain starts melting. Whenever I think of Titanic Ship, I think of Ice mountain that caused it.

Aytar, Yusuf, Lluis Castrejon, Carl Vondrick, Hamed Pirsiavash, and Antonio Torralba. "[Cross-Modal Scene Networks](#)." arXiv preprint arXiv:1610.09003 (2016).

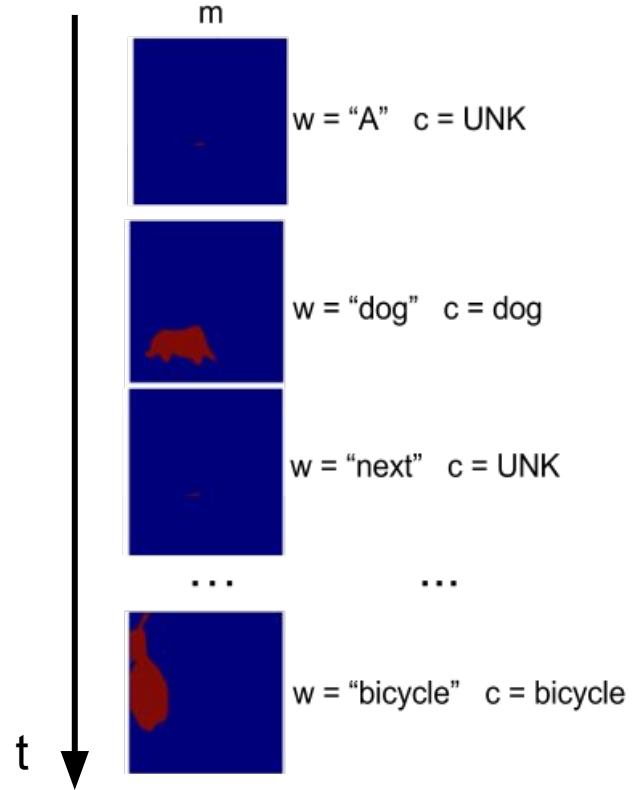
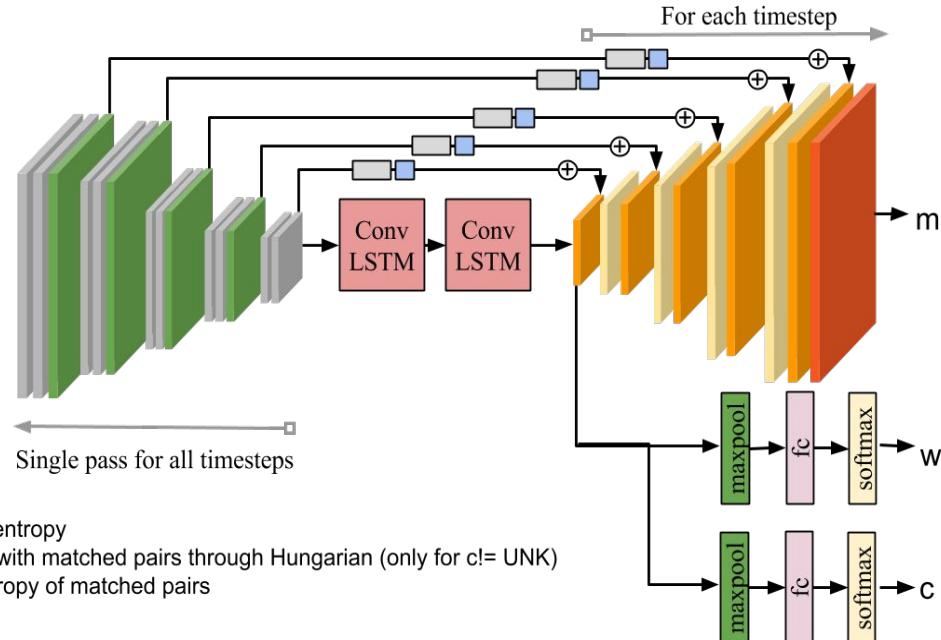


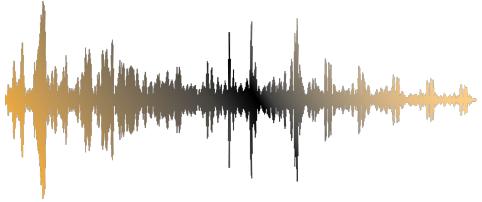
# Image to image, tags & caption (multitask)

deconv  
conv  
feature map  
conv + sigmoid



a dog next to a bicycle





## Audio



## Sentiment

**Lorem ipsum dolor**  
sit amet, consectetur adipiscing elit,  
sed do eiusmod tempor incididunt

eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure

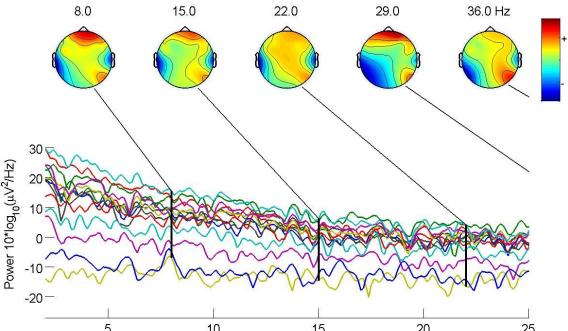
aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Lorem ipsum dolor sit amet, consectetur adipisci



## Visual

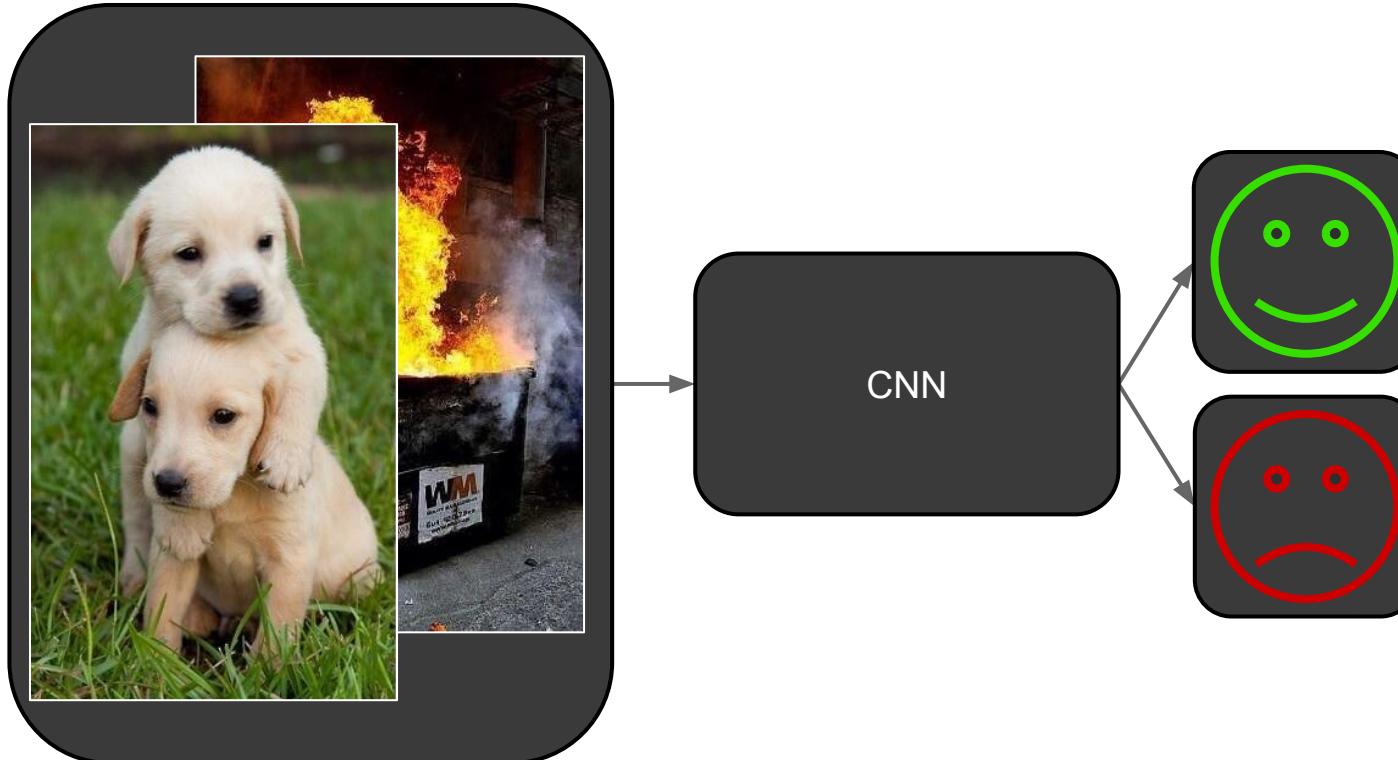


## Eye gaze



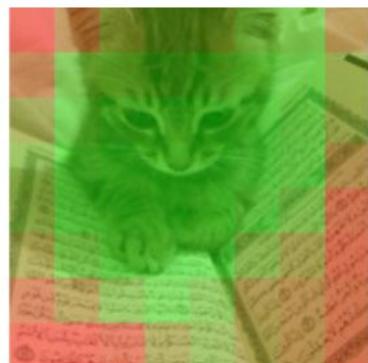
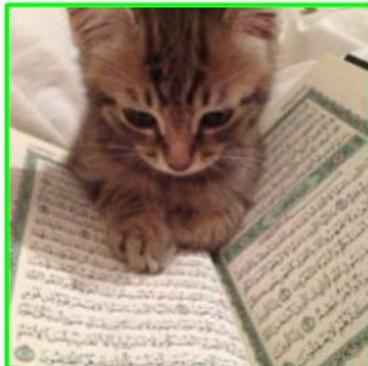
## EEG

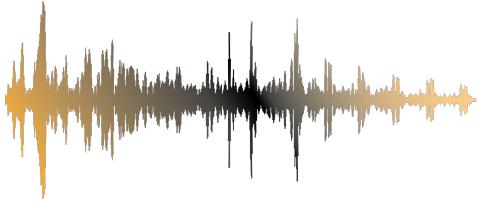
# Image to Sentiment



Campos, Victor, Amaia Salvador, Xavier Giro-i-Nieto, and Brendan Jou. "[Diving deep into sentiment: Understanding fine-tuned cnns for visual sentiment prediction.](#)" In Workshop on Affect & Sentiment in Multimedia, pp. 57-62. ACM, 2015.

# Image to Sentiment





## Audio



## Sentiment

**Lorem ipsum dolor**  
sit amet, consectetur adipiscing elit,  
sed do eiusmod tempor incididunt

eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure

aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure

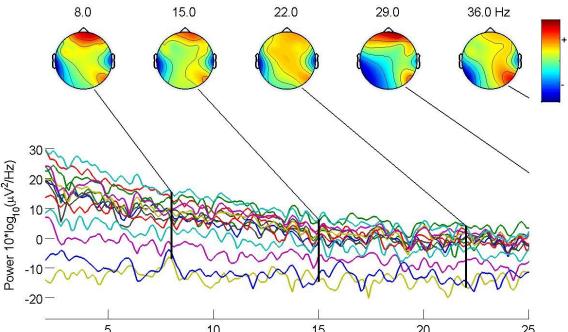
## Text



## Eye gaze

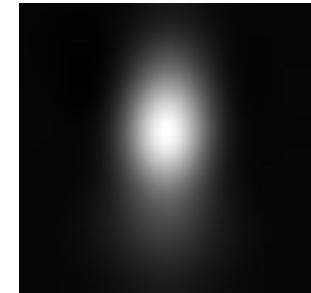
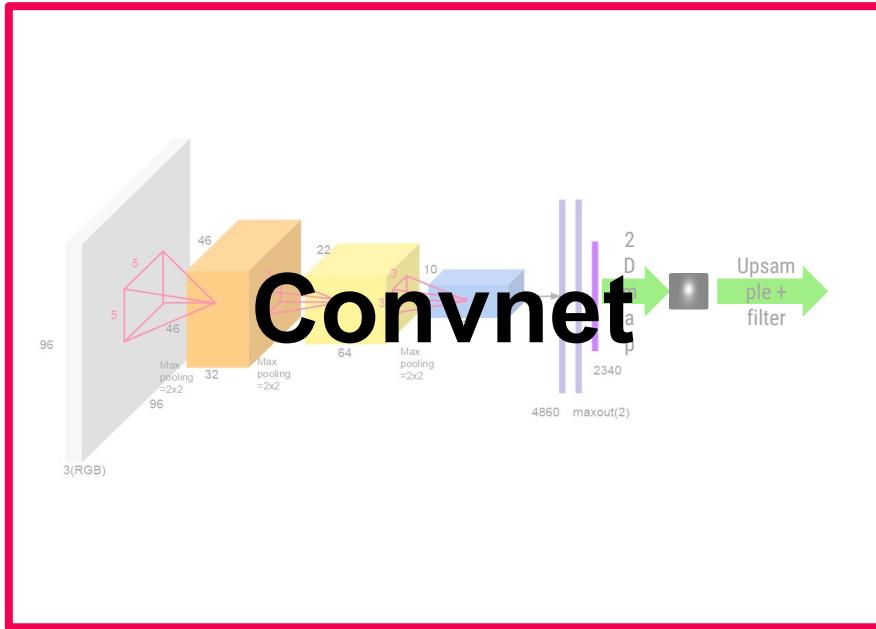
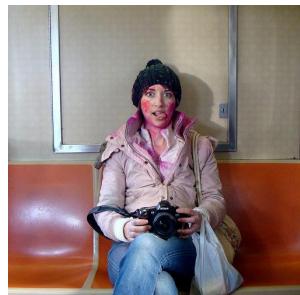


## Visual



## EEG

# Eye Gaze Prediction

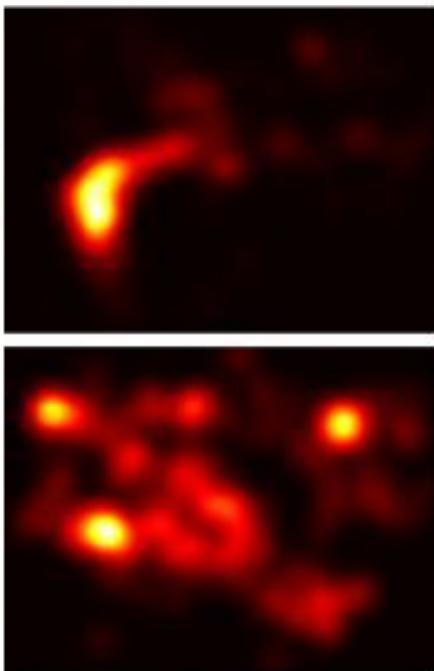


# Prediction

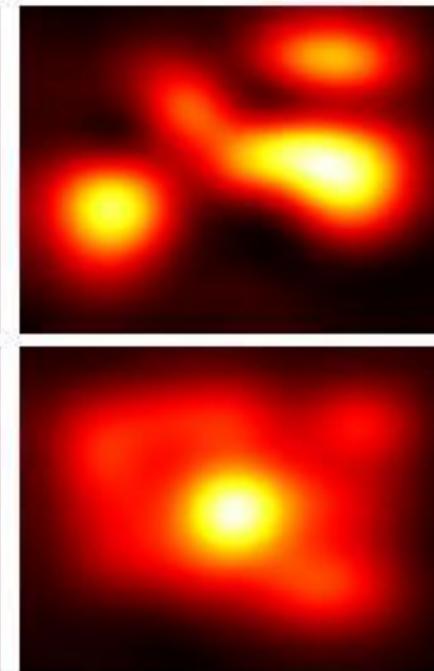
Image



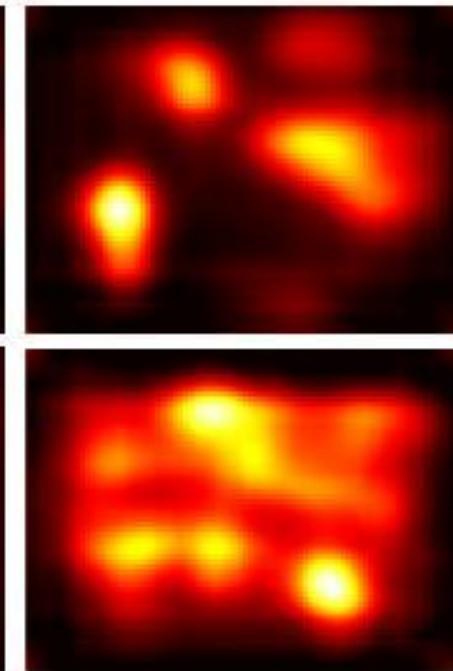
Ground truth



Shallow ConvNet

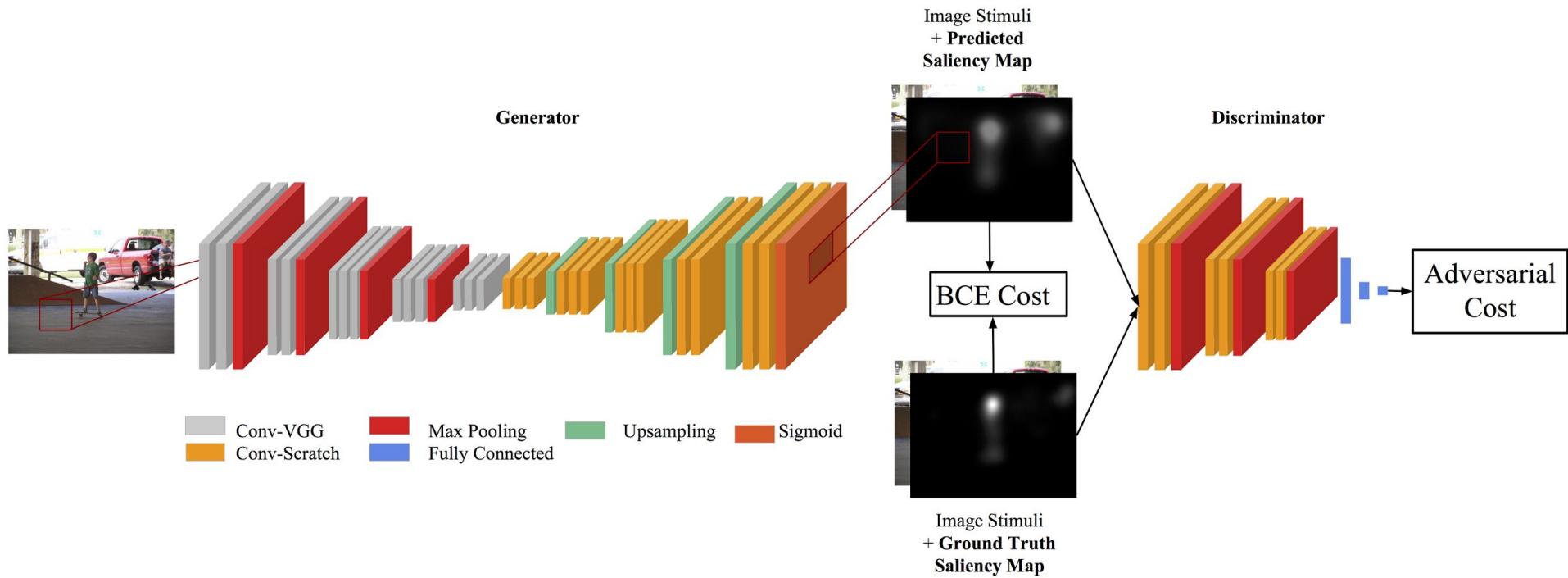


Deep Convnet



Pan, Junting, Elisa Sayrol, Xavier Giro-i-Nieto, Kevin McGuinness, and Noel E. O'Connor.  
["Shallow and deep convolutional networks for saliency prediction."](#) CVPR 2016

# Image to Eye Gaze Prediction

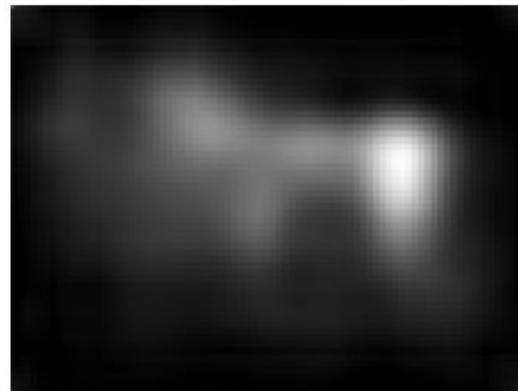


Junting Pan, Cristian Canton, Kevin McGuinness, Noel E. O'Connor, Jordi Torres, Elisa Sayrol and Xavier Giro-i-Nieto. "[SalGAN: Visual Saliency Prediction with Generative Adversarial Networks.](#)" arXiv. 2017.

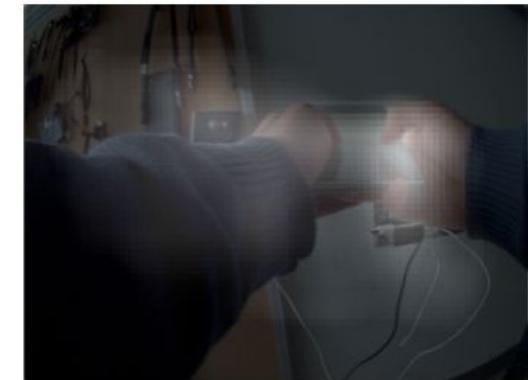
# Image to Eye Gaze Prediction



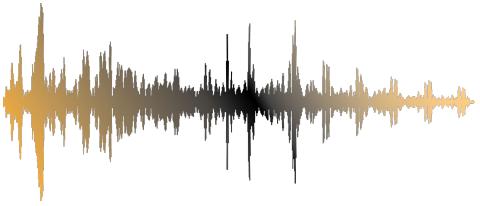
+



=



Reyes, Cristian, Eva Mohedano, Kevin McGuinness, Noel E. O'Connor, and Xavier Giro-i-Nieto. "[Where is my Phone?: Personal Object Retrieval from Egocentric Images.](#)" ACMMM Workshop 2016



## Audio



## Sentiment

**Lorem ipsum dolor**  
sit amet, consectetur adipiscing elit,  
sed do eiusmod tempor incididunt

eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure

aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure

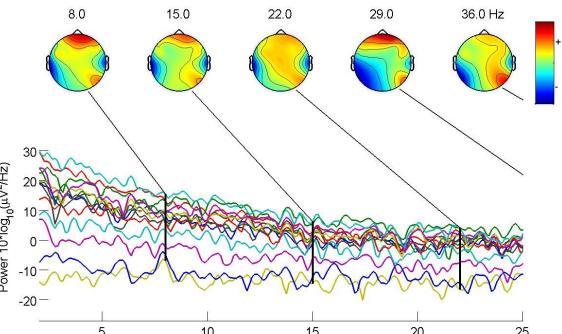
## Text



## Eye gaze



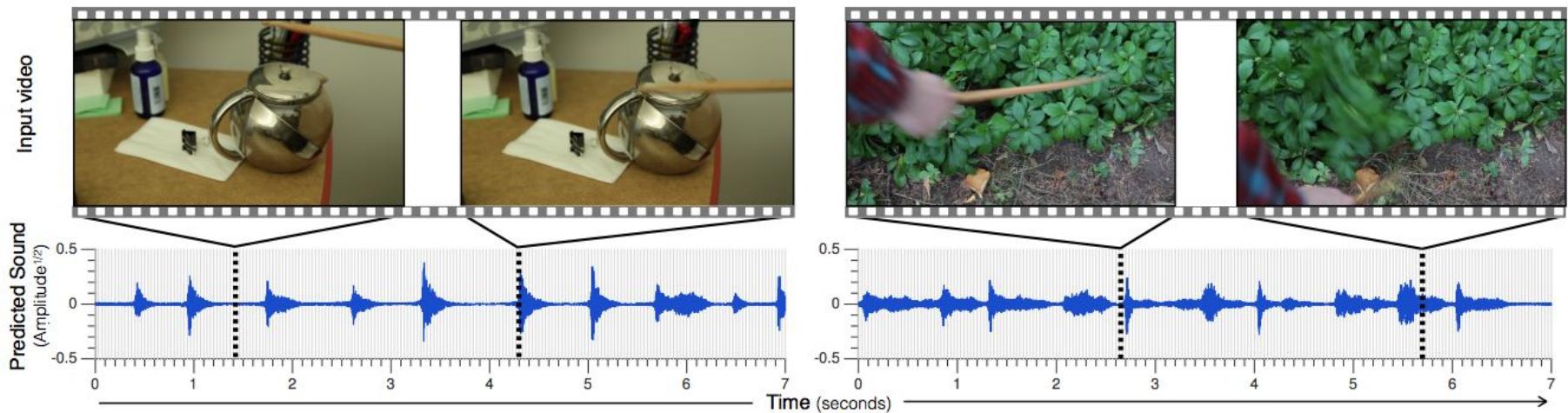
## Vision



## EEG

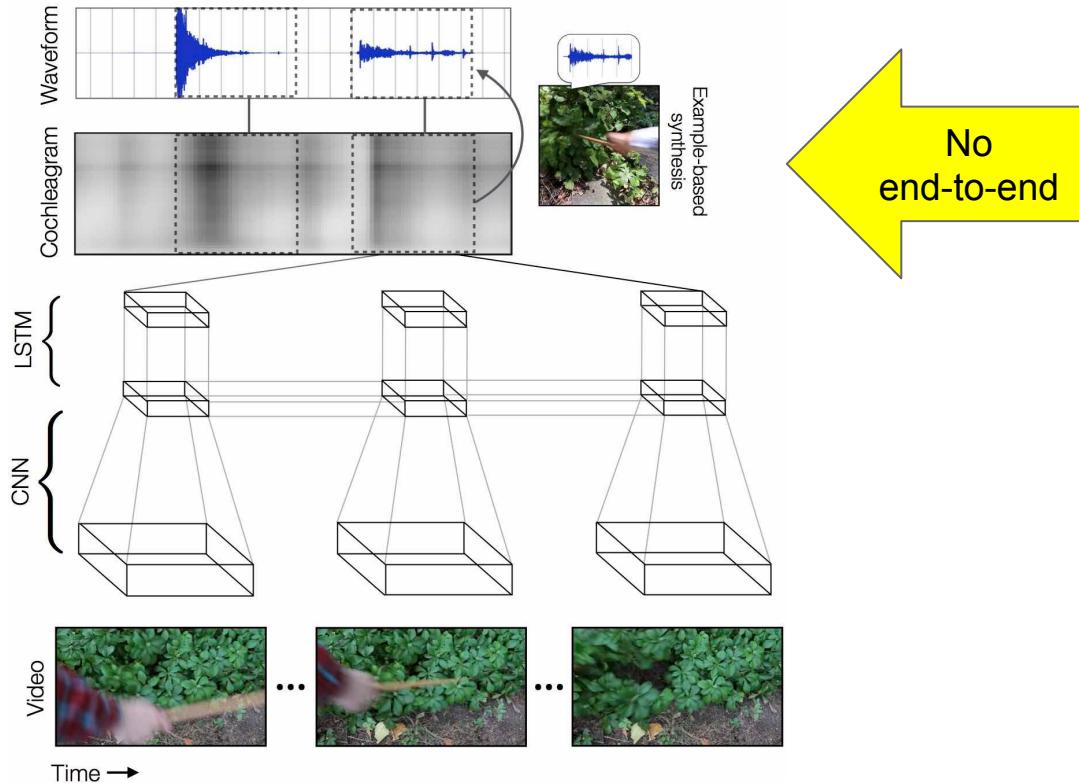
# Video to Audio Representations

Learn synthesized sounds from videos of people hitting objects with a drumstick.



Owens, Andrew, Phillip Isola, Josh McDermott, Antonio Torralba, Edward H. Adelson, and William T. Freeman. "[Visually indicated sounds.](#)" CVPR 2016.

# Video to Audio Representations



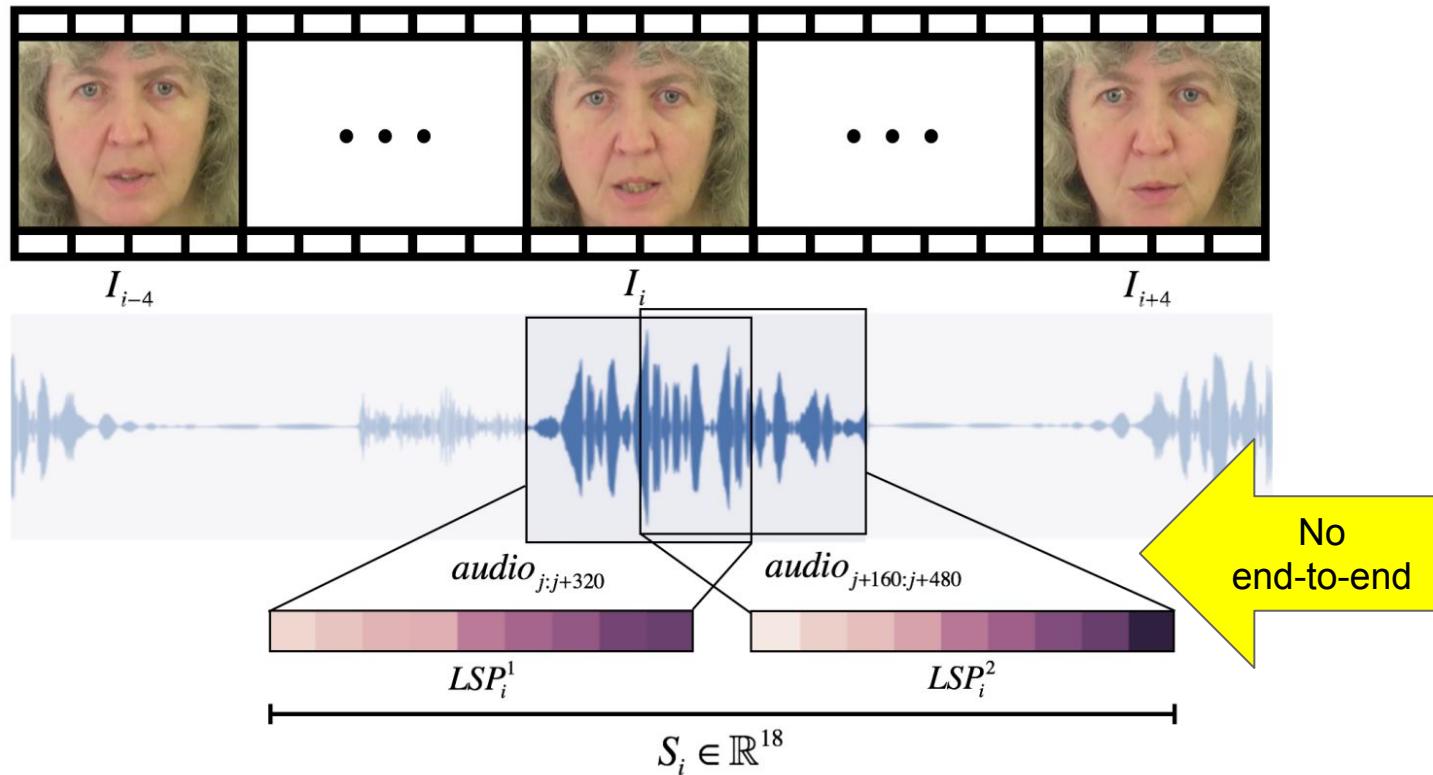
Owens, Andrew, Phillip Isola, Josh McDermott, Antonio Torralba, Edward H. Adelson, and William T. Freeman. "[Visually indicated sounds.](#)" CVPR 2016.

# Video to Audio Representations

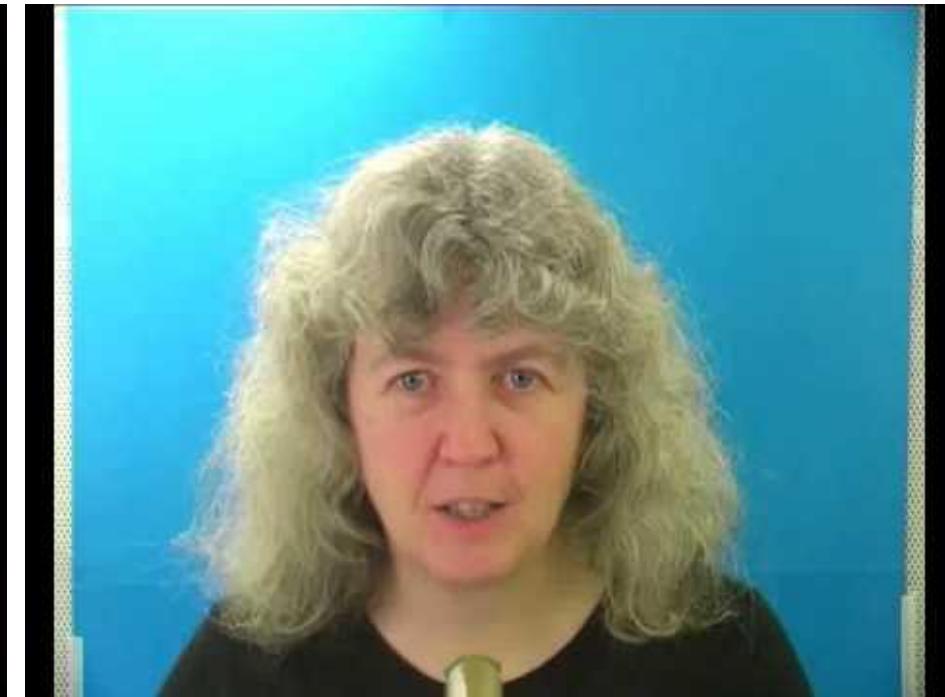


Owens, Andrew, Phillip Isola, Josh McDermott, Antonio Torralba, Edward H. Adelson, and William T. Freeman. "[Visually indicated sounds.](#)" CVPR 2016.

# Video to Audio Representations

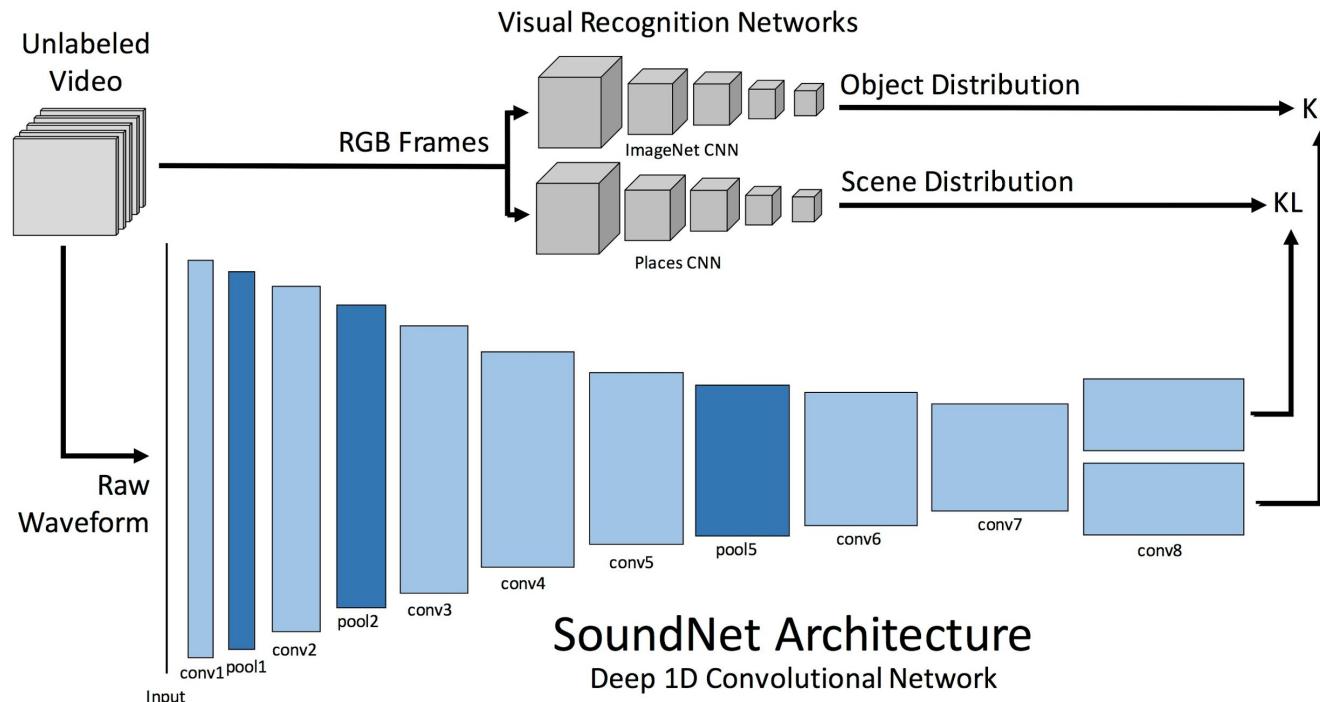


# Video to Audio Representations



# Learn audio representations from video

Object & Scenes recognition in videos by analysing the audio track (only).

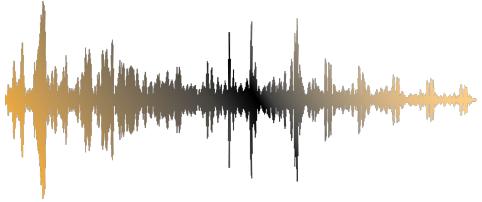


Aytar, Yusuf, Carl Vondrick, and Antonio Torralba. "["Soundnet: Learning sound representations from unlabeled video."](#)" NIPS 2016.

# Learn audio representations from video



Aytar, Yusuf, Carl Vondrick, and Antonio Torralba. "[Soundnet: Learning sound representations from unlabeled video.](#)" NIPS 2016.



## Audio



## Sentiment

**Lorem ipsum dolor**  
sit amet, consectetur adipiscing elit,  
sed do eiusmod tempor incididunt

eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure

aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure

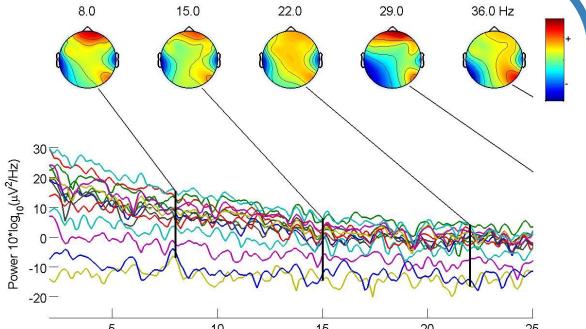


## Vision

## Vision



## Eye gaze



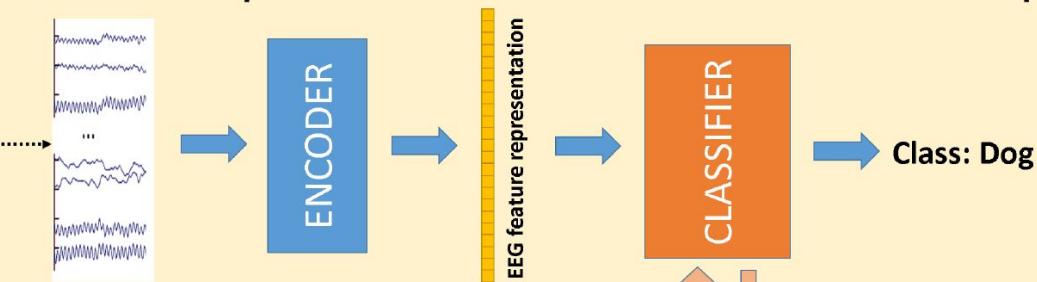
## EEG

## Reading the mind

### Learning feature representation from EEG signals

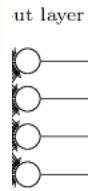
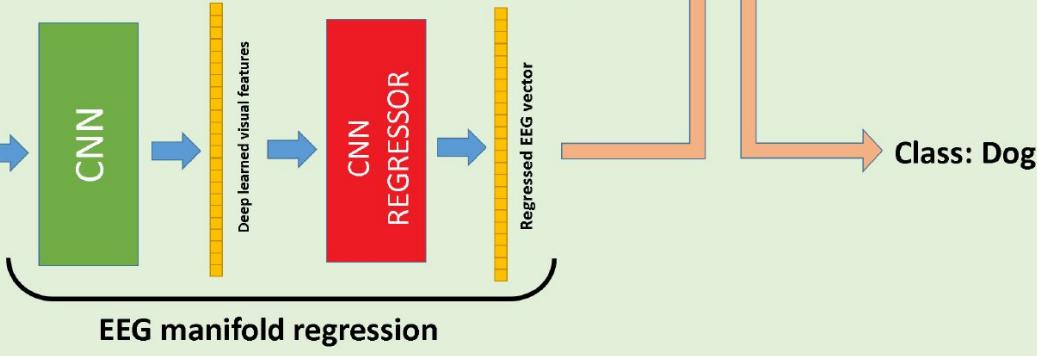


EEG Brain Signals



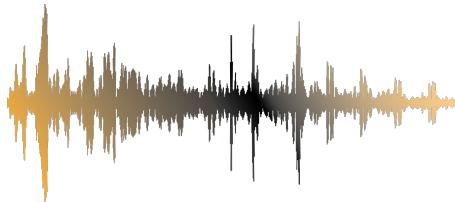
## Transfer human visual capabilities to machines

### EEG features regression for automated image classification



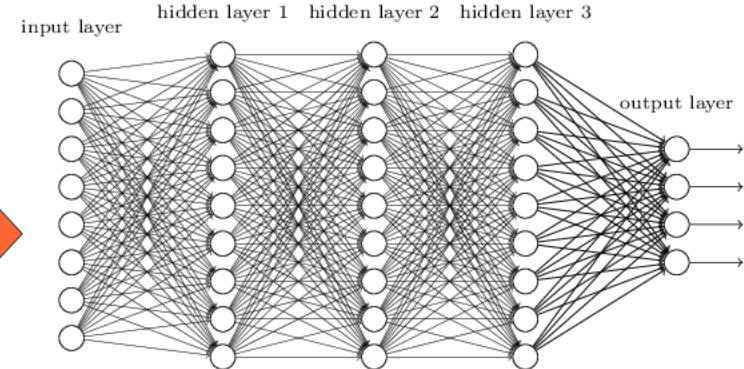
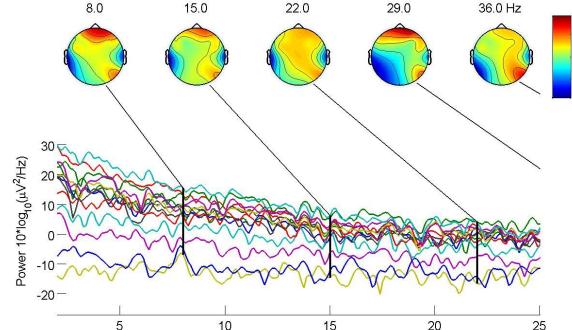
## Lore ipsum dolor

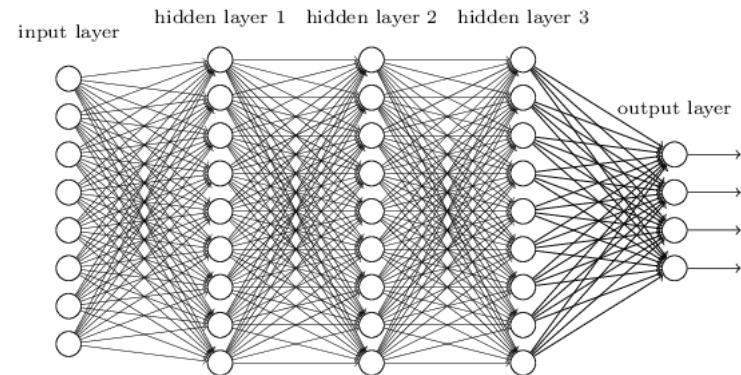
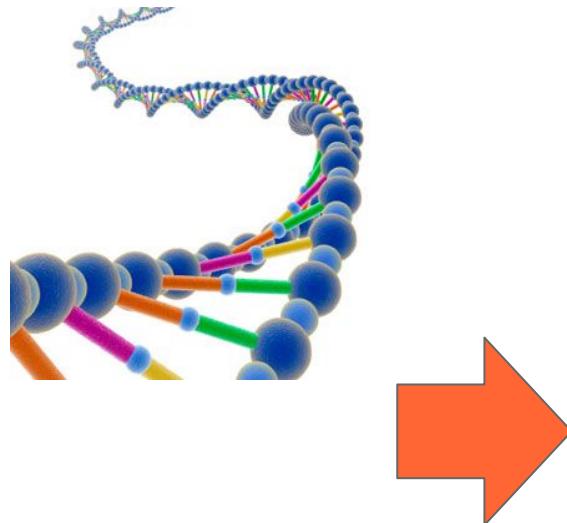
sit amet, consectetur adipiscing elit,  
sed do eiusmod tempor incididunt



eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Lorem ipsum sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.





# DEEP LEARNING FOR COMPUTER VISION

Summer Seminar UPC TelecomBCN, 4 - 8 July 2016



## Instructors



Xavier  
Giró-i Nieto



Elisa  
Sayrol



Amaia  
Salvador



Jordi  
Torres



Eva  
Mohedano

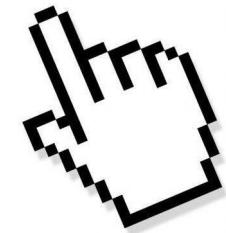


Kevin  
McGuinness

## Organizers



Slides &  
Videos  
Online



Next edition:  
Barcelona (Jun'17)

[\[http://imatge-upc.github.io/telecombcn-2016-dlcv/\]](http://imatge-upc.github.io/telecombcn-2016-dlcv/)

# DEEP LEARNING FOR SPEECH & LANGUAGE

videos will be online

Winter Seminar UPC TelecomBCN, 24 - 31  
January 2017



## Instructors



Antonio  
Bonafonte

J. Adrián Rodríguez  
Fonollosa

Marta  
Ruiz

Javier  
Hernando

Santiago  
Pascual

Elisa  
Sayrol

Xavier  
Giró

## Organizers

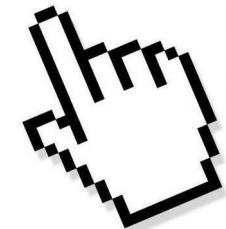


Image Processing Group  
Signal Theory and Communications Department



UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH

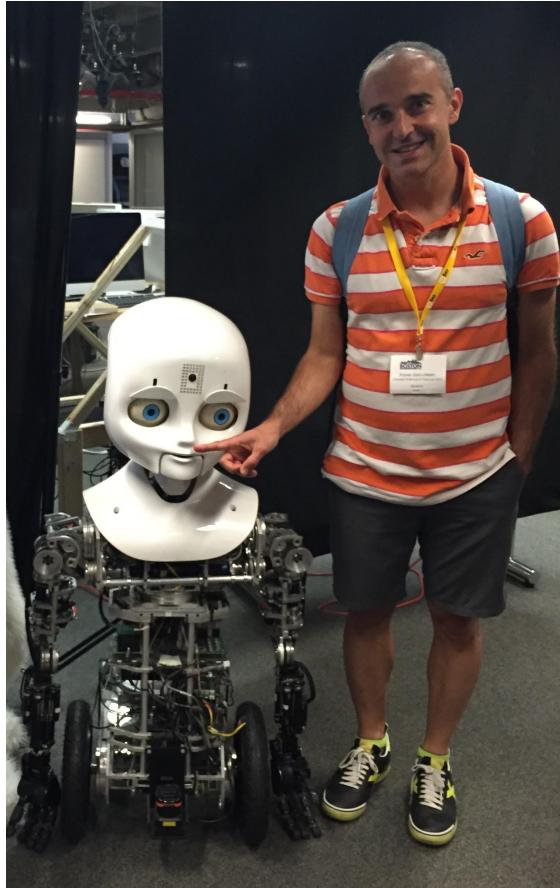
Slides & Videos  
online



Next edition:  
Barcelona  
(January'18)

[\[https://telecombcn-dl.github.io/2017-dls/\]](https://telecombcn-dl.github.io/2017-dls/)

# Thanks ! Q&A ?



#InsightDL2017



@DocXavi



/ProfessorXavi



UNIVERSITAT POLITÈCNICA DE CATALUNYA  
BARCELONATECH

Department of Signal Theory  
and Communications

*Image Processing Group*

<https://imatge.upc.edu/web/people/xavier-giro>