

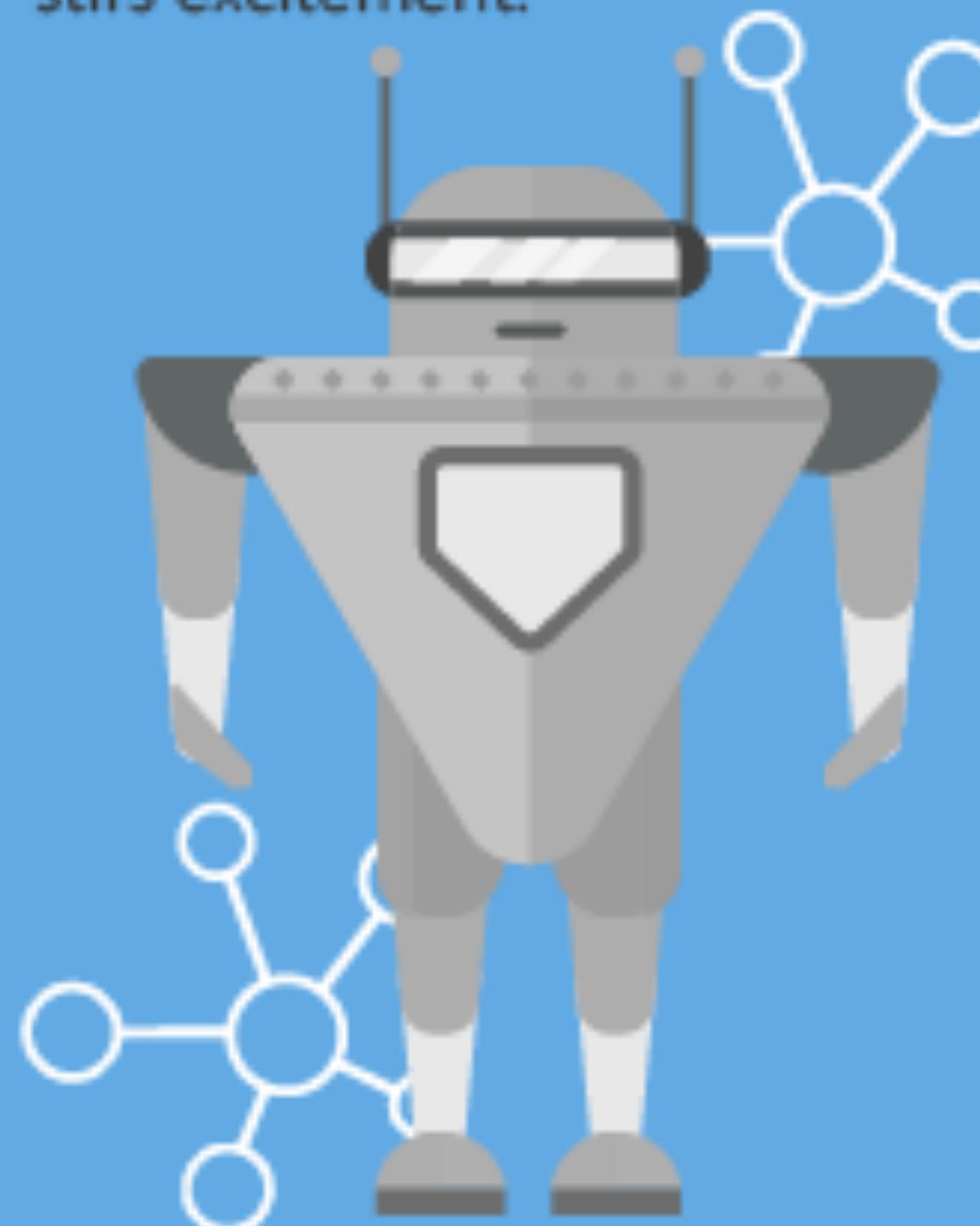
# Machine Learning for Healthcare

Viswanath Sivakumar

Facebook AI Research (FAIR)

# ARTIFICIAL INTELLIGENCE

Early artificial intelligence stirs excitement.



1950's

1960's

1970's

1980's

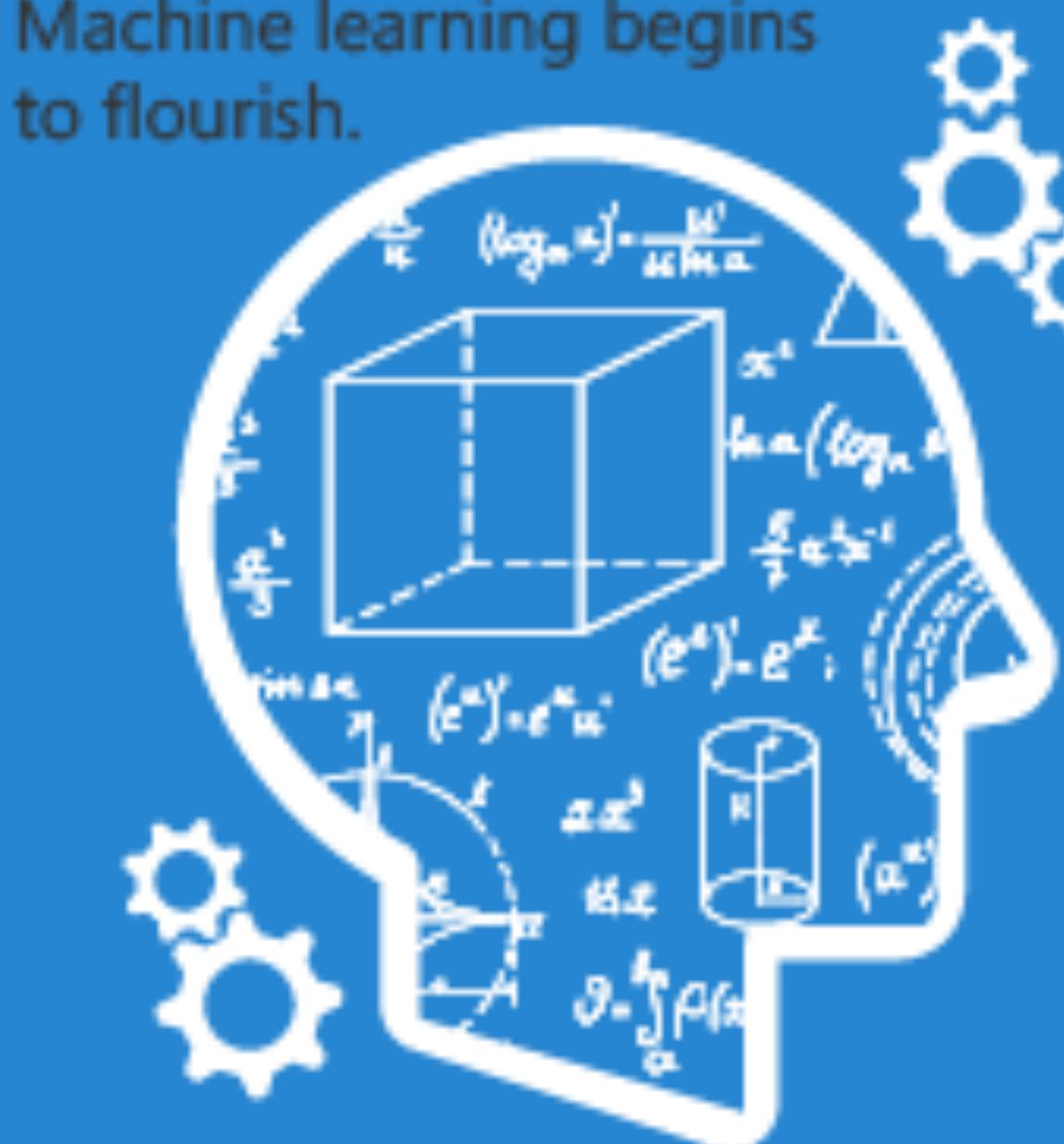
1990's

2000's

2010's

# MACHINE LEARNING

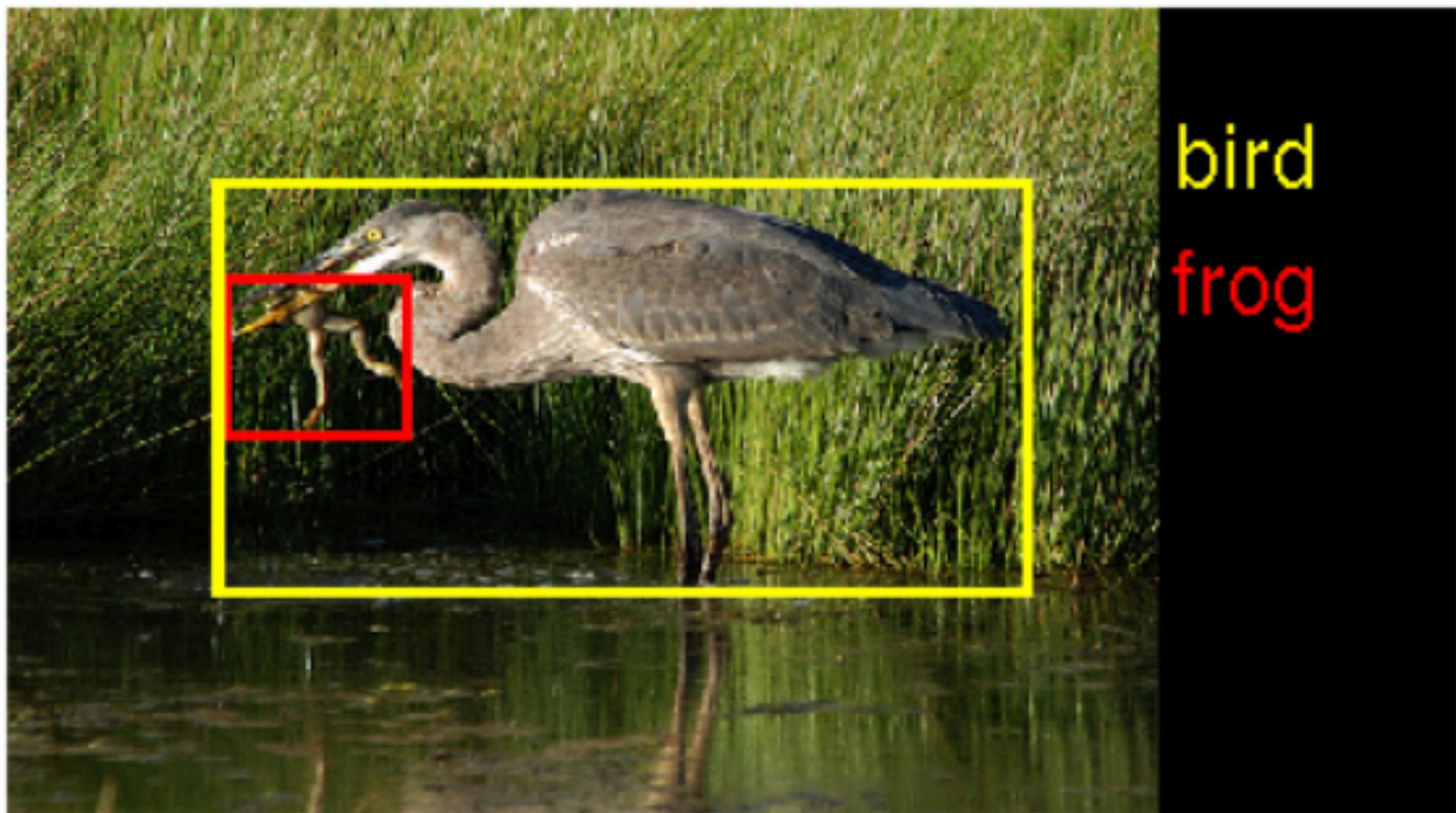
Machine learning begins to flourish.



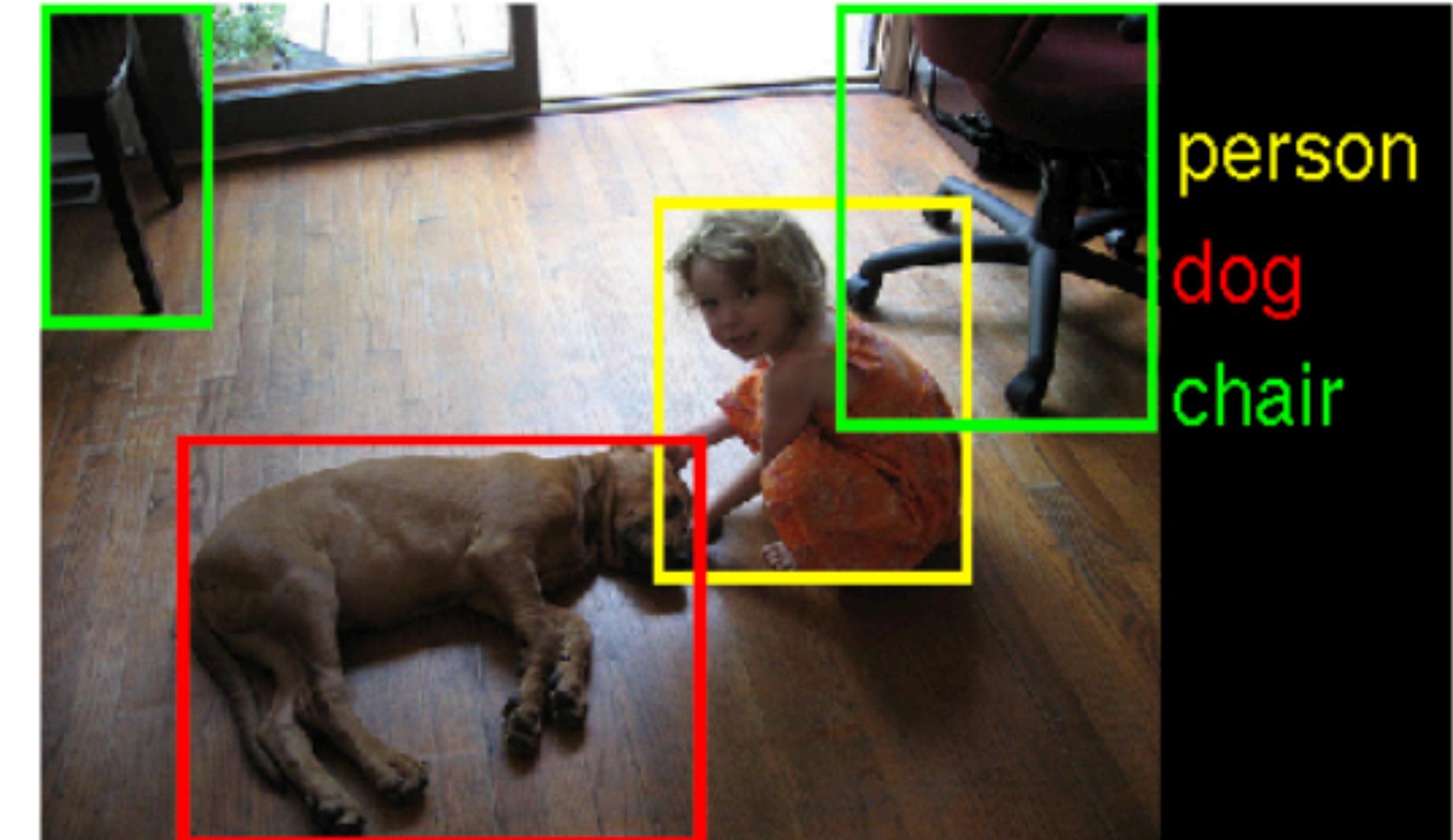
# DEEP LEARNING

Deep learning breakthroughs drive AI boom.





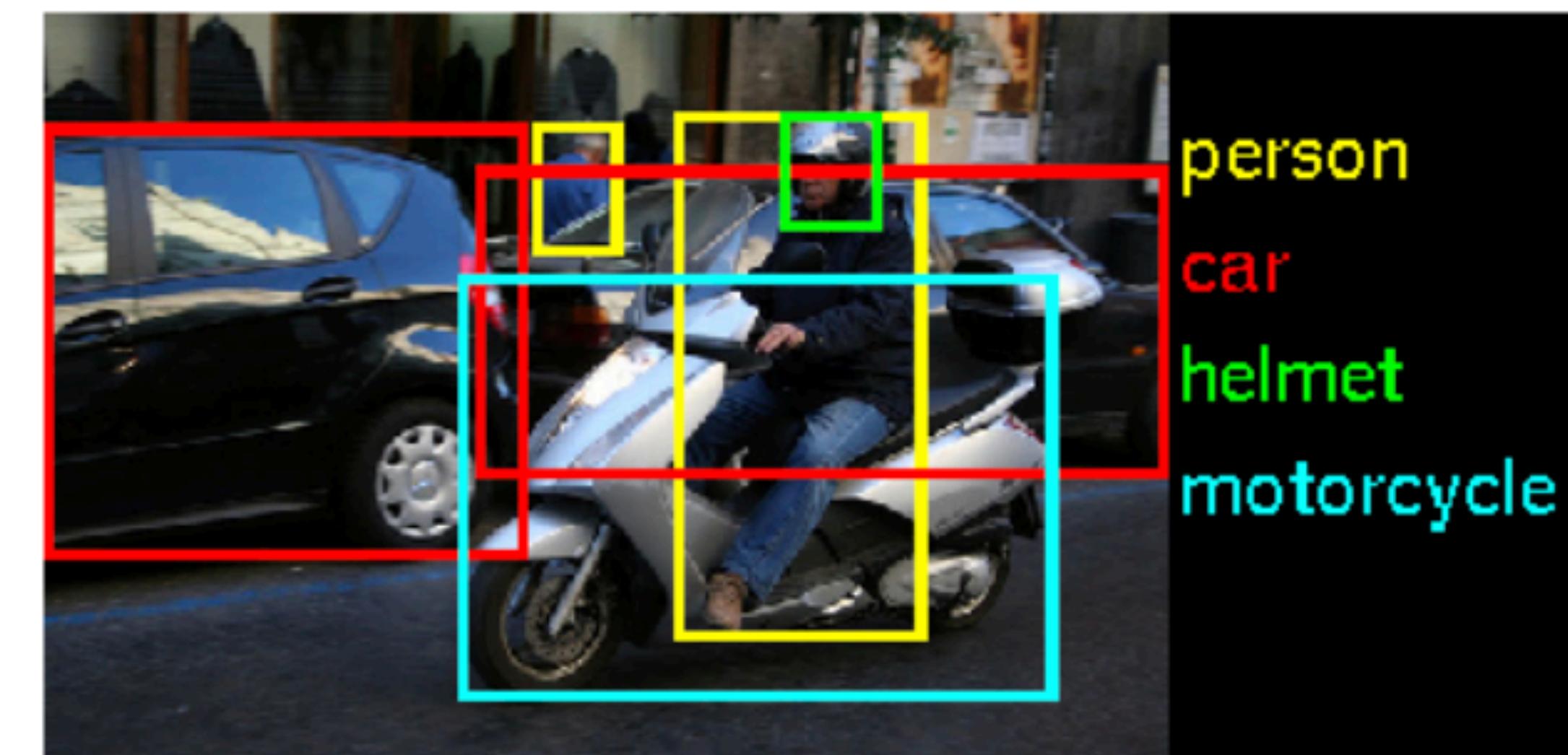
bird  
frog



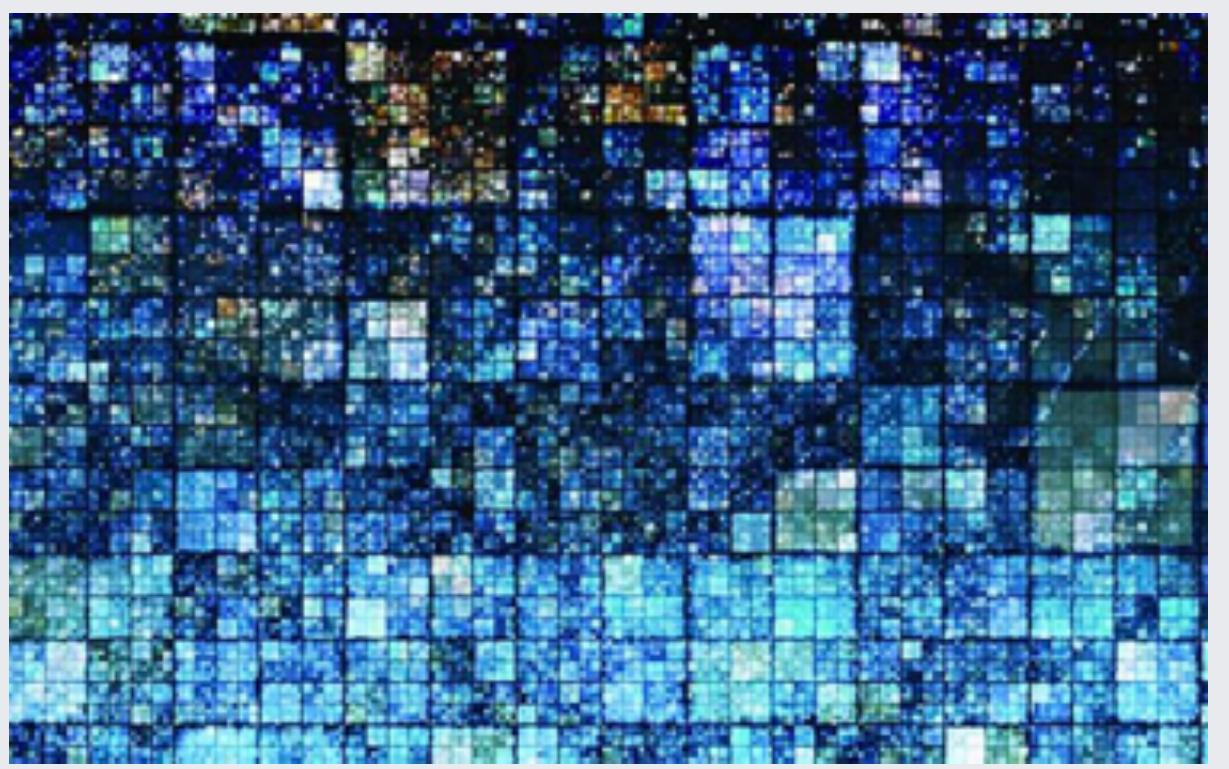
person  
dog  
chair



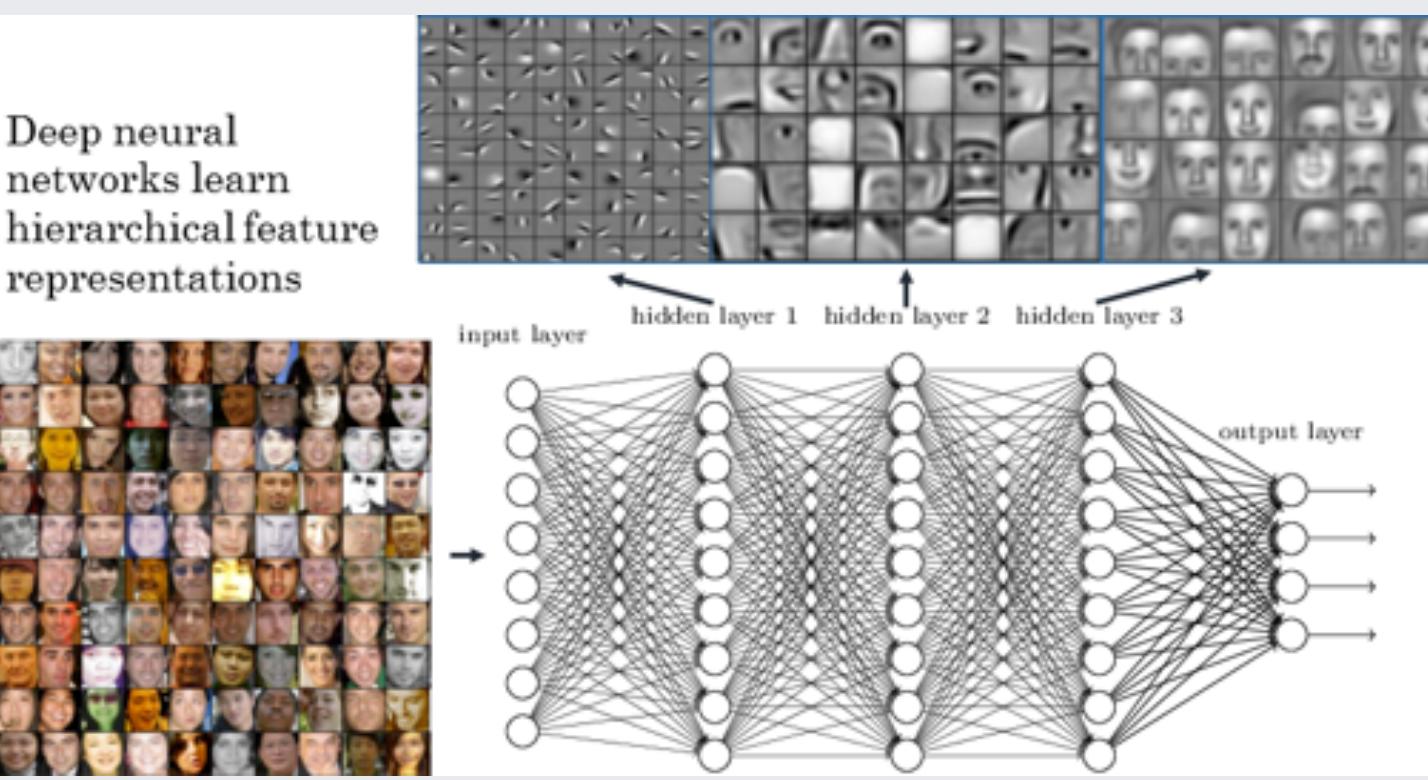
person  
hammer  
flower pot  
power drill



person  
car  
helmet  
motorcycle



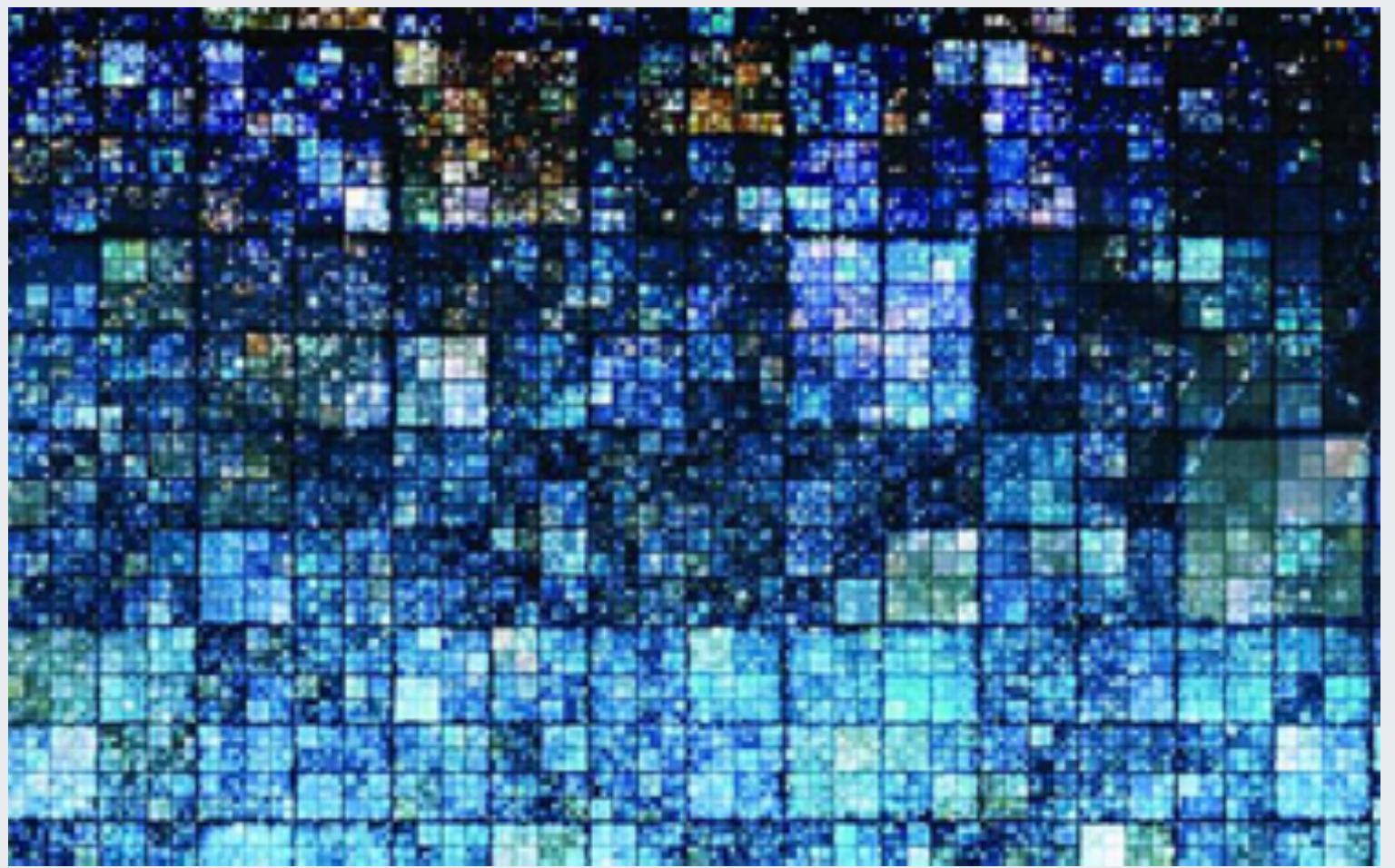
# Data



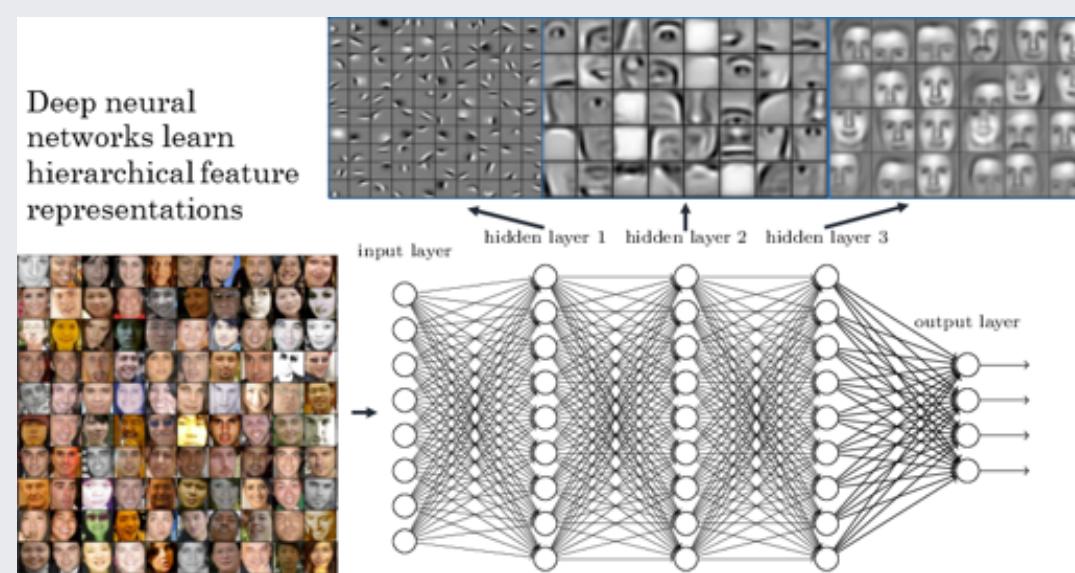
# Algorithm



# Hardware



# Data



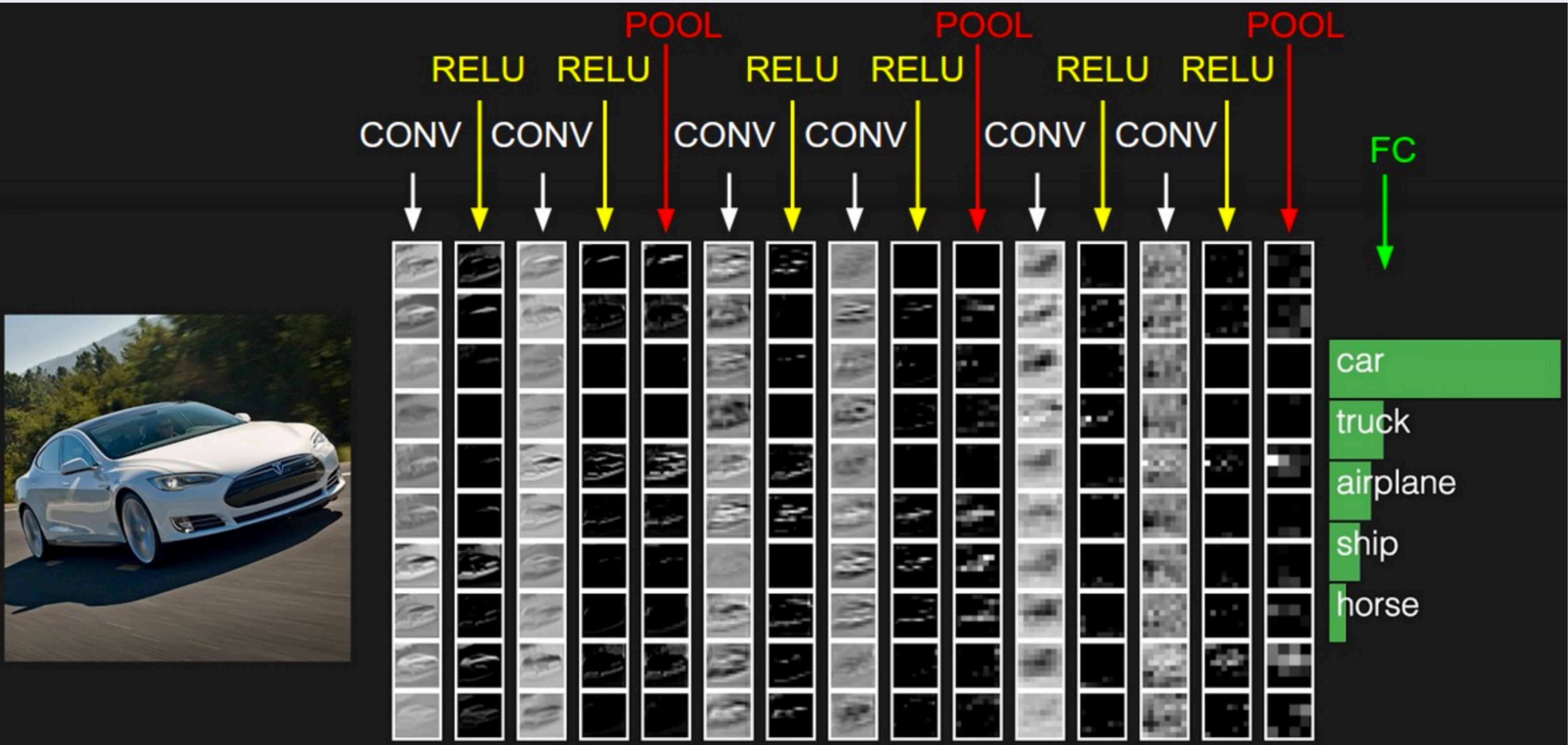
# Algorithm



# Hardware



**1.2M Images  
1000 Categories**





Affenpinscher



Australian Silky Terrier



Australian Terrier



Bichon Frise



Bolognese



Border Terrier



Boston Terrier



Brussels Griffon



Cairn Terrier



Cavalier King Charles Spaniel



Chihuahua



Chinese Crested Dog  
(Hairless)



Chinese Crested Dog  
(Powderpuff)



Chinese Temple Dog



Coton de Tulear



Czech Terrier  
(Cesky Terrier/ Bohemian Terrier)



Dachshund



Dandie Dinmont Terrier



English Toy Spaniel



German Hunting Terrier



Griffon Brabanson



Hairless Dog



Italian Greyhound



Jack Russell Terrier



Japanese Spaniel (Chin)



Japanese Spitz



Lakeland Terrier



Lhasa Apso



Little Lion Dog



Maltese



Manchester Terrier



Miniature Pinscher



Miniature Schnauzer



Norfolk Terrier



Norwich Terrier



Norwegian Lundehund



Papillon



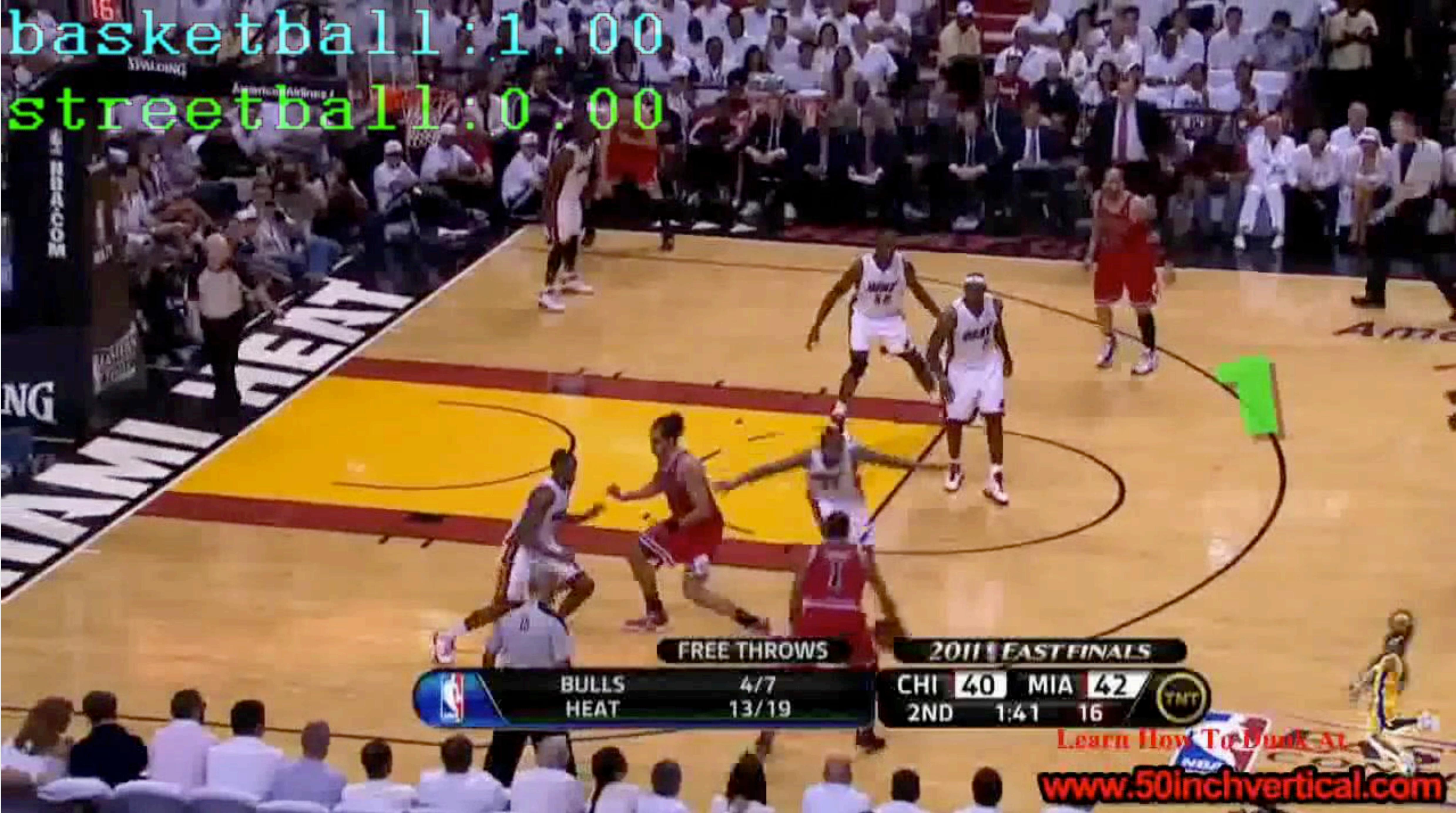
Pekingese



Pomeranian

basketball:1.00

streetball:0.00



FREE THROWS

BULLS  
HEAT

4/7  
13/19

2001 EAST FINALS

CHI 40 MIA 42  
2ND 1:41 16



Learn How To Dunk At

[www.50inchvertical.com](http://www.50inchvertical.com)



# MEDICAL IMAGING MEETS NEURIPS

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December 14th, 2019 - Vancouver Convention Center, Canada

## ML4H: Machine Learning for Health

Workshop at NeurIPS 2019

International Conference on  
Medical Imaging with Deep Learning  
London, 8 - 10 July 2019

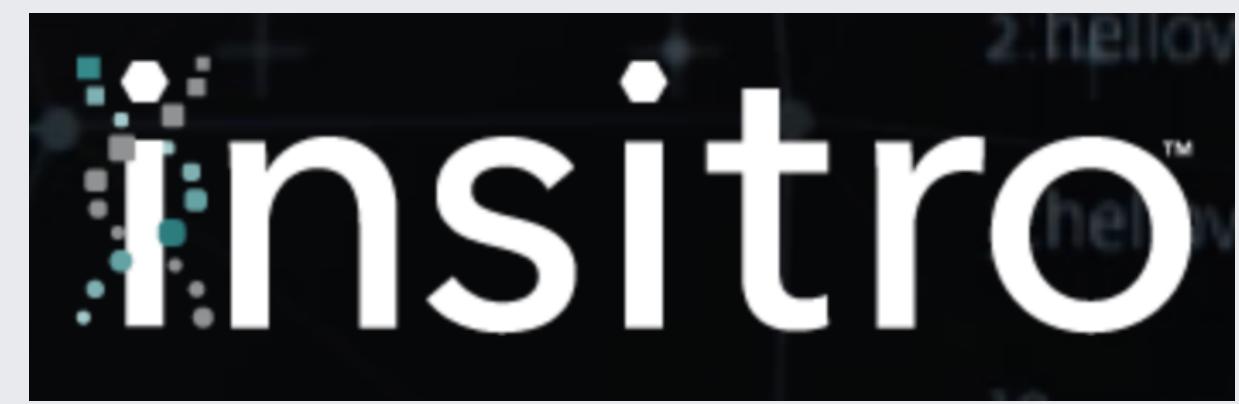
## Fair ML for Health

---

NeurIPS 2019 Workshop, Vancouver Convention Center, Canada

## MACHINE LEARNING FOR HEALTH (ML4H) UNCONFERENCE

May 28-29, 2019; Toronto, ON



BenevolentAI

verily



PathAI

IMAGEN  
Machine Intelligence for Medical Diagnosis

Google<sup>TM</sup>  
health

# MRI



# fastMRI

Accelerating MR Imaging with AI

Facebook AI Research

+

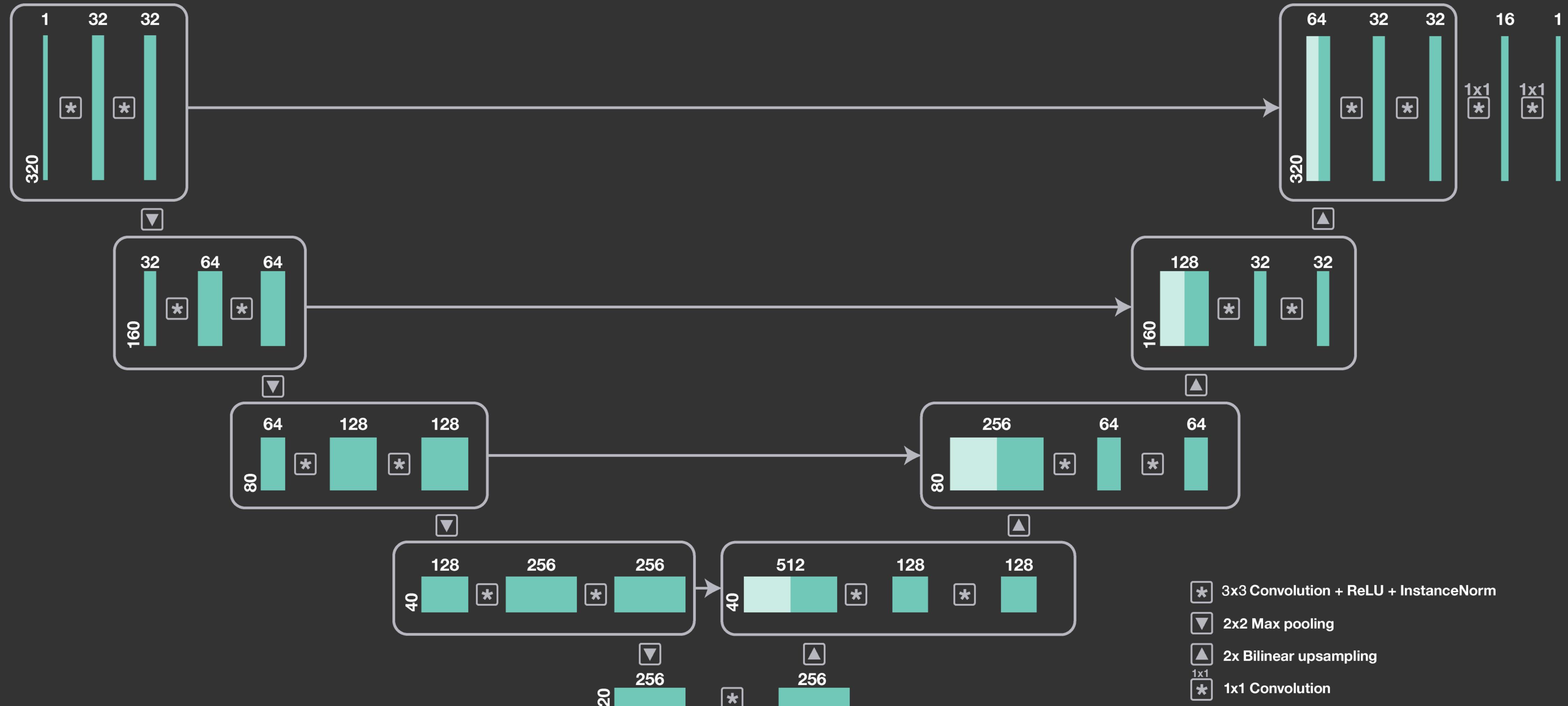
NYU School of Medicine

**Raw Anonymized MRI Data**

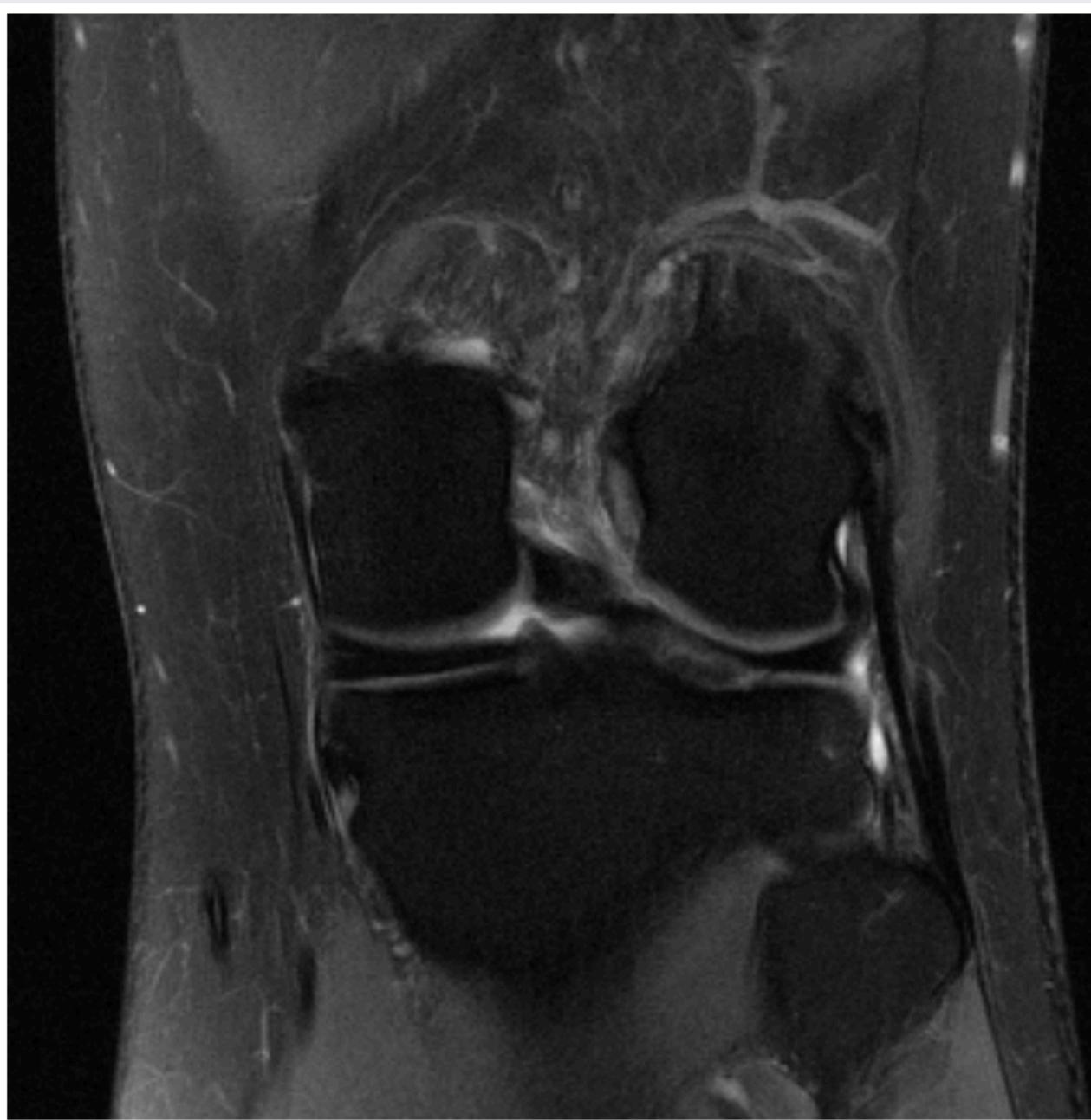
**1,600 Scans**

**57,000 Slices**

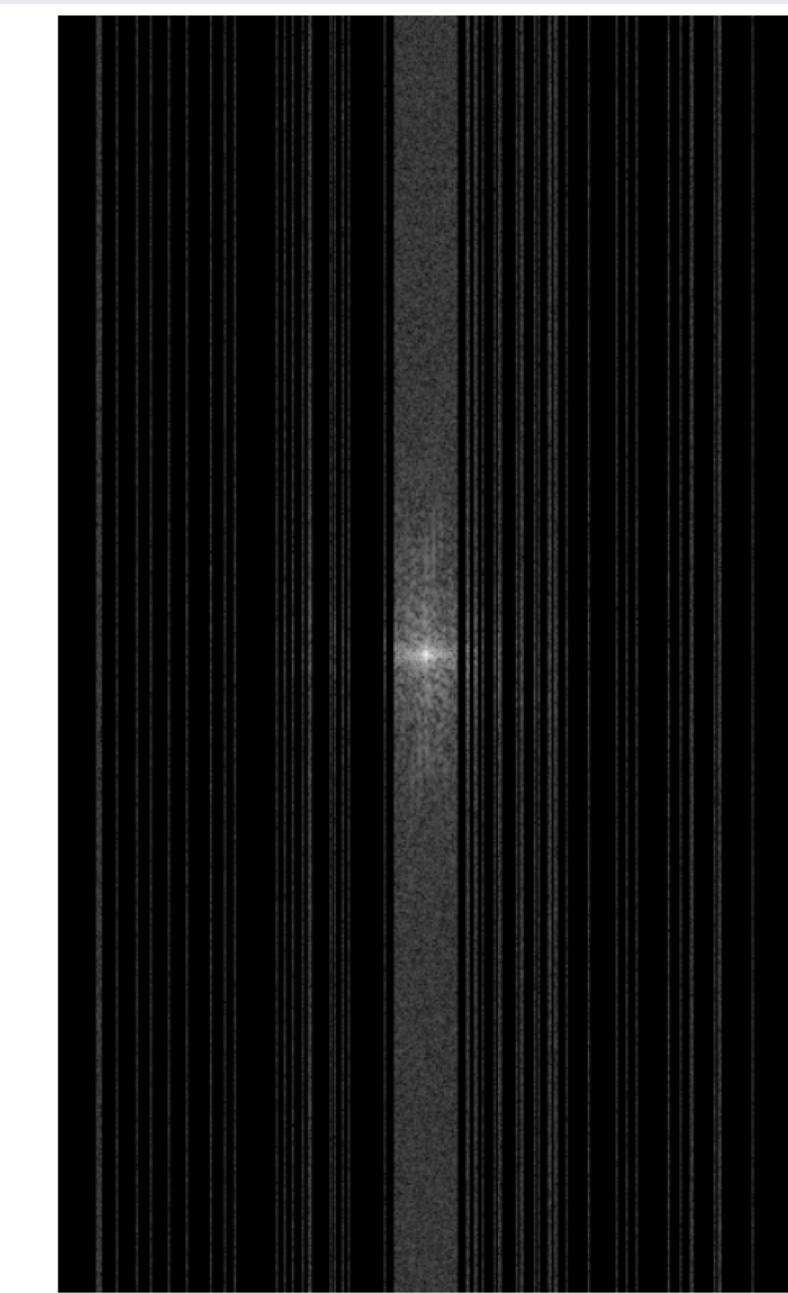
<https://fastmri.org/>



Baseline U-NET Architecture



(a) Cropped and vertically flipped reconstruction from fully sampled k-space data



(b) Rectangular masked k-space



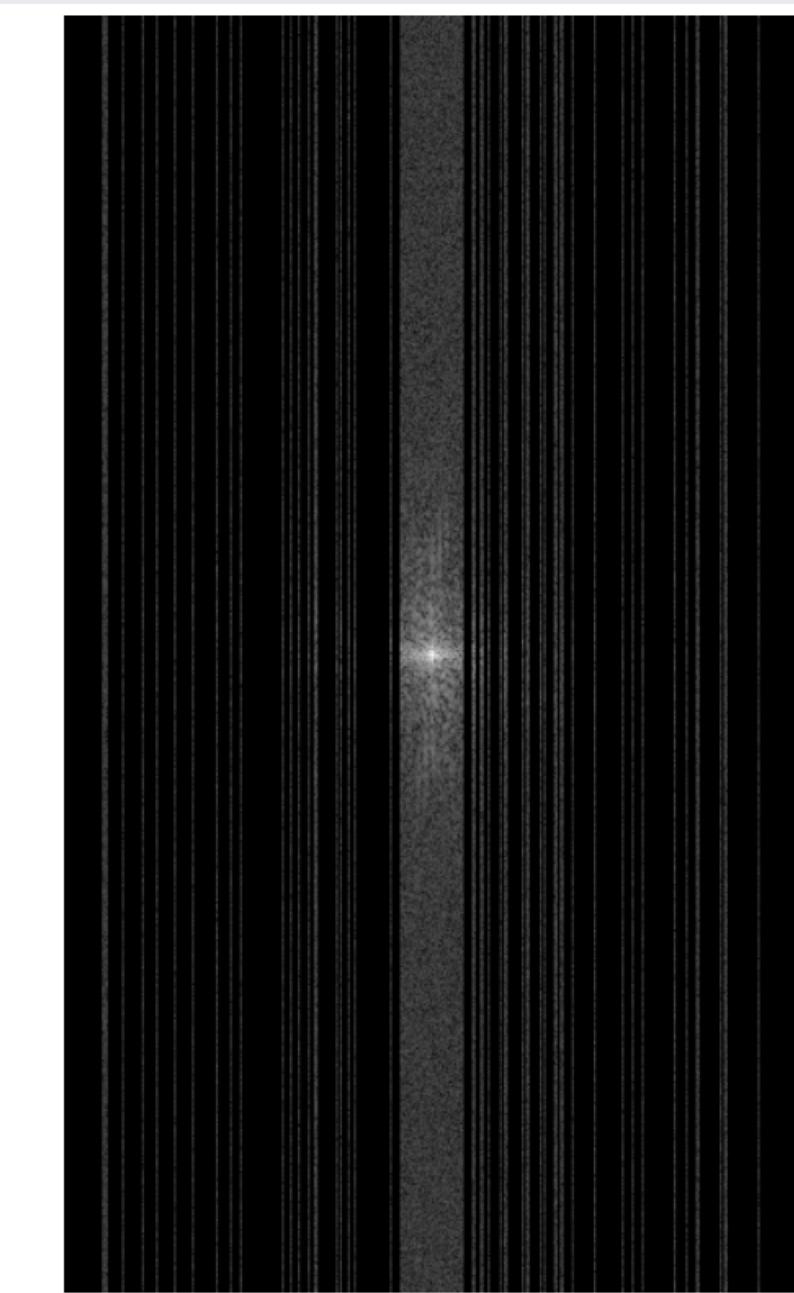
(c) Reconstruction via zero-filled IFFT



(d) Deep-learning baseline UNET reconstruction



(a) Cropped and vertically flipped reconstruction from fully sampled k-space data



(b) Rectangular masked k-space



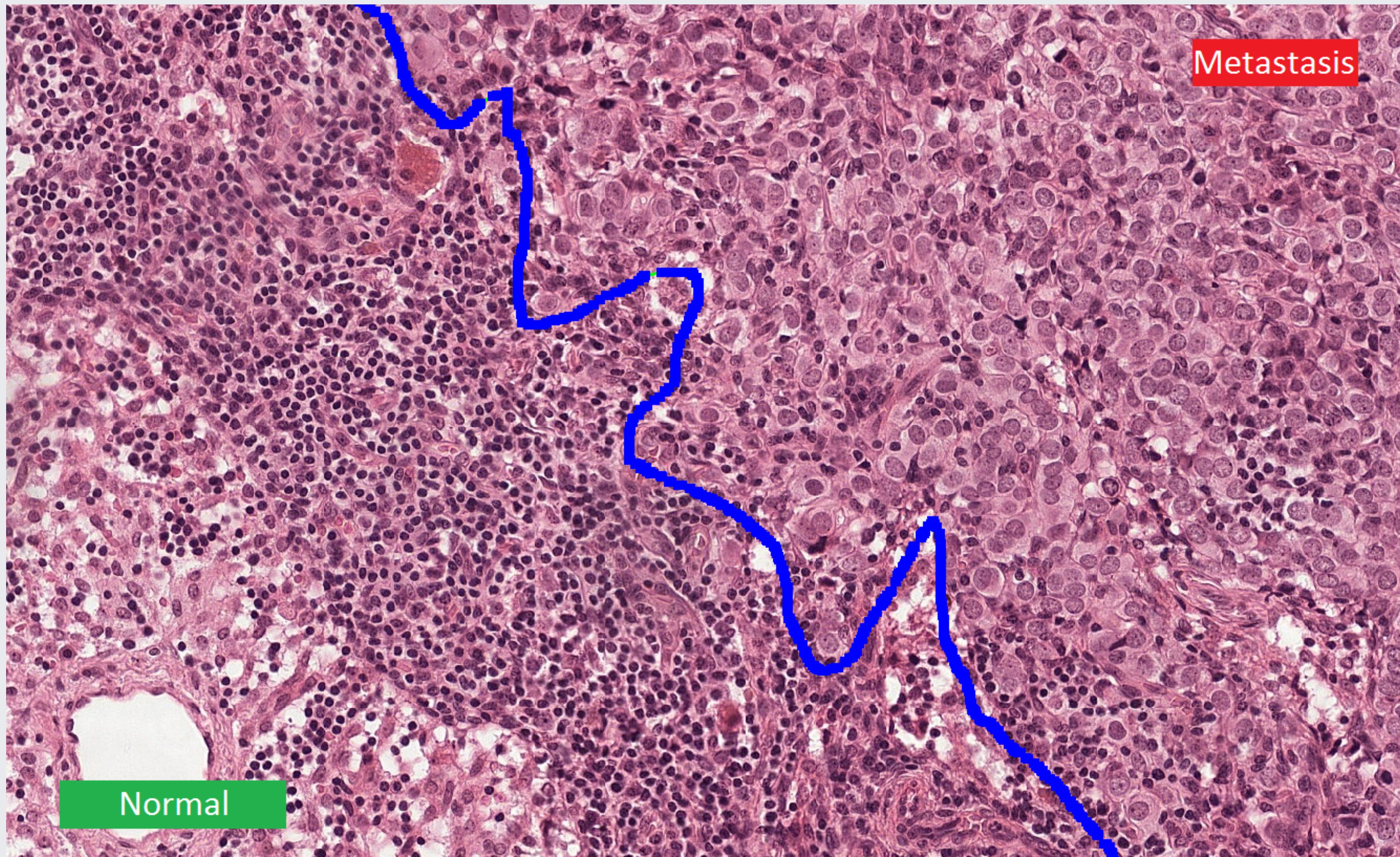
(c) Reconstruction via zero-filled IFFT



(d) Deep-learning baseline UNET reconstruction

**4x and 8x faster!**

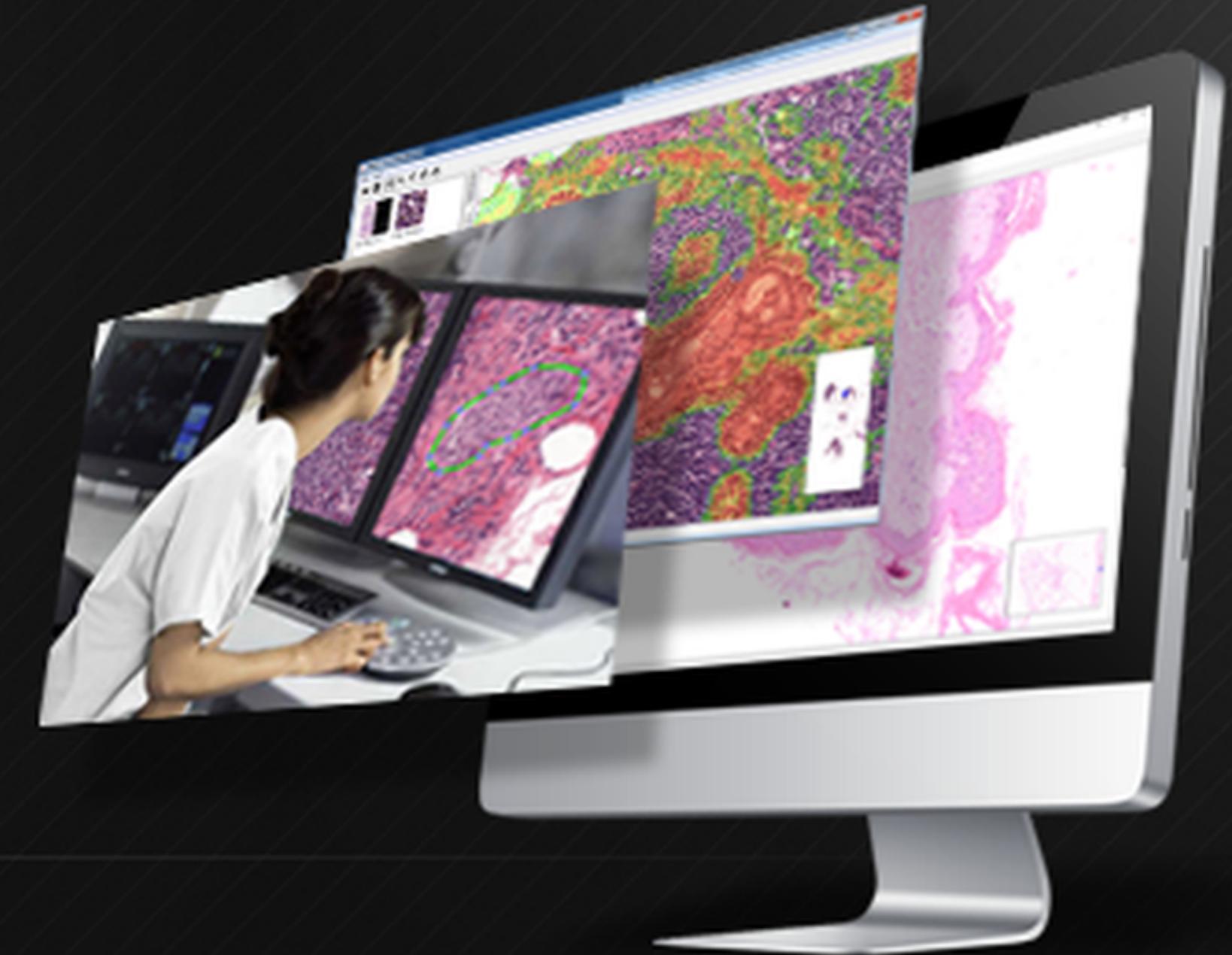
# Pathology





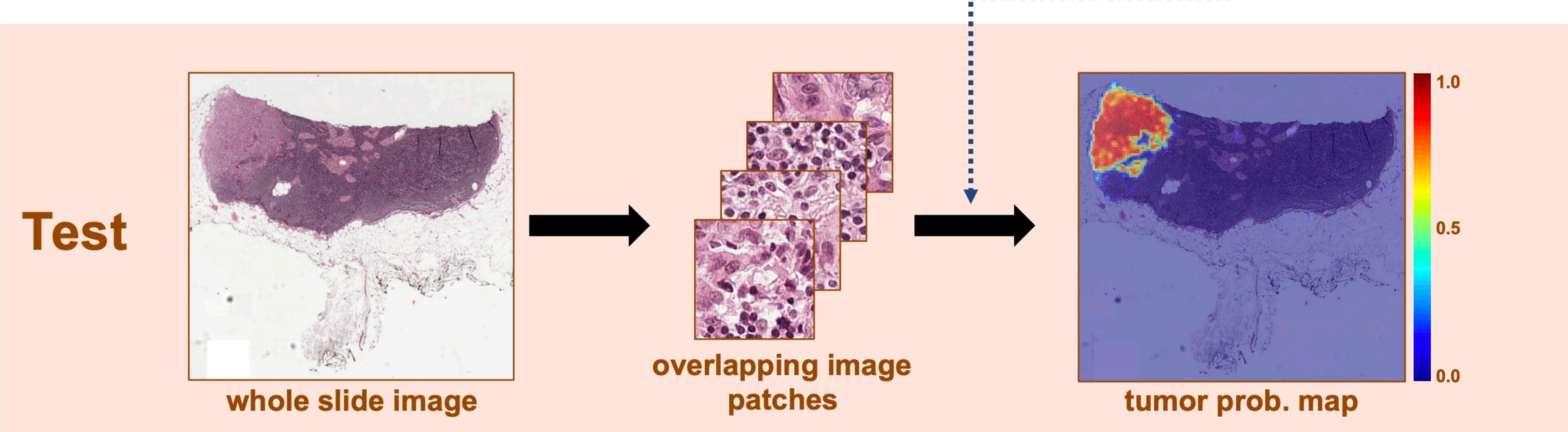
# CAMELYON16

ISBI challenge on cancer metastasis detection in lymph node



**400 whole-slide images sentinel lymph node**

Diagnostic Assessment of Deep Learning Algorithms for Detection of Lymph Node Metastases in Women With Breast Cancer, Ehteshami Bejnordi B et al.



**Pathologist: 3.4% Error Rate**

**Pathologist: 3.4% Error Rate**

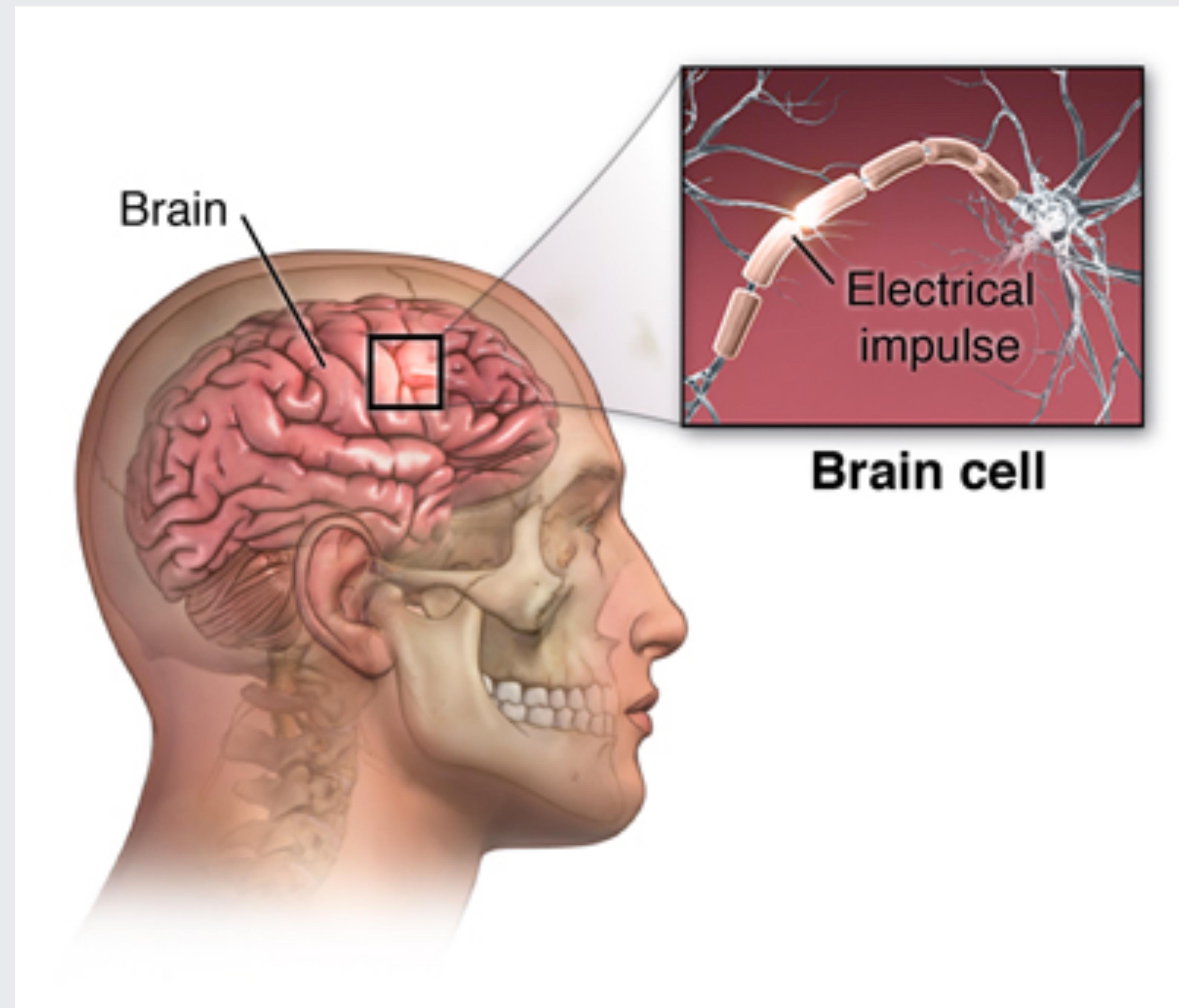
**Machine Learning System: 7.5% Error Rate**

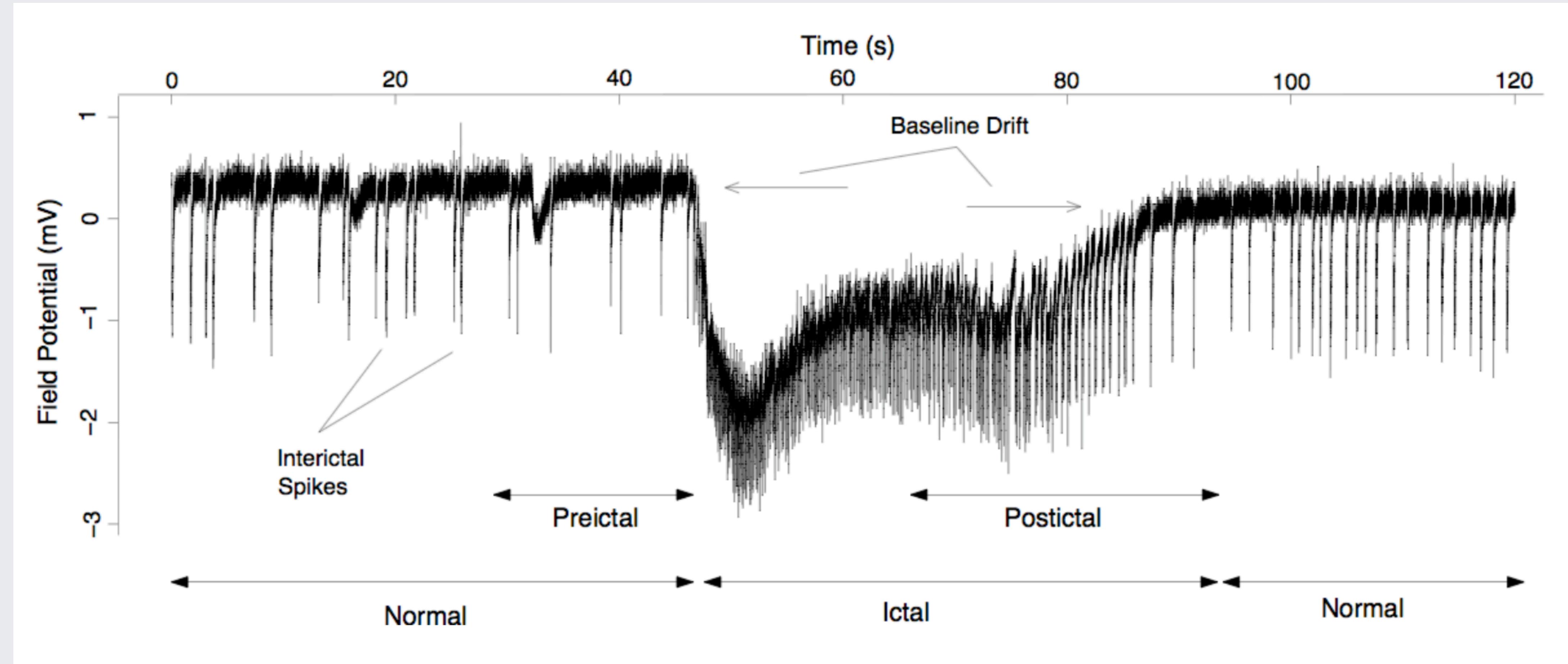
**Pathologist: 3.4% Error Rate**

**Machine Learning System: 7.5% Error Rate**

**Pathologist + Machine Learning: 0.52% Error Rate**

# Epilepsy

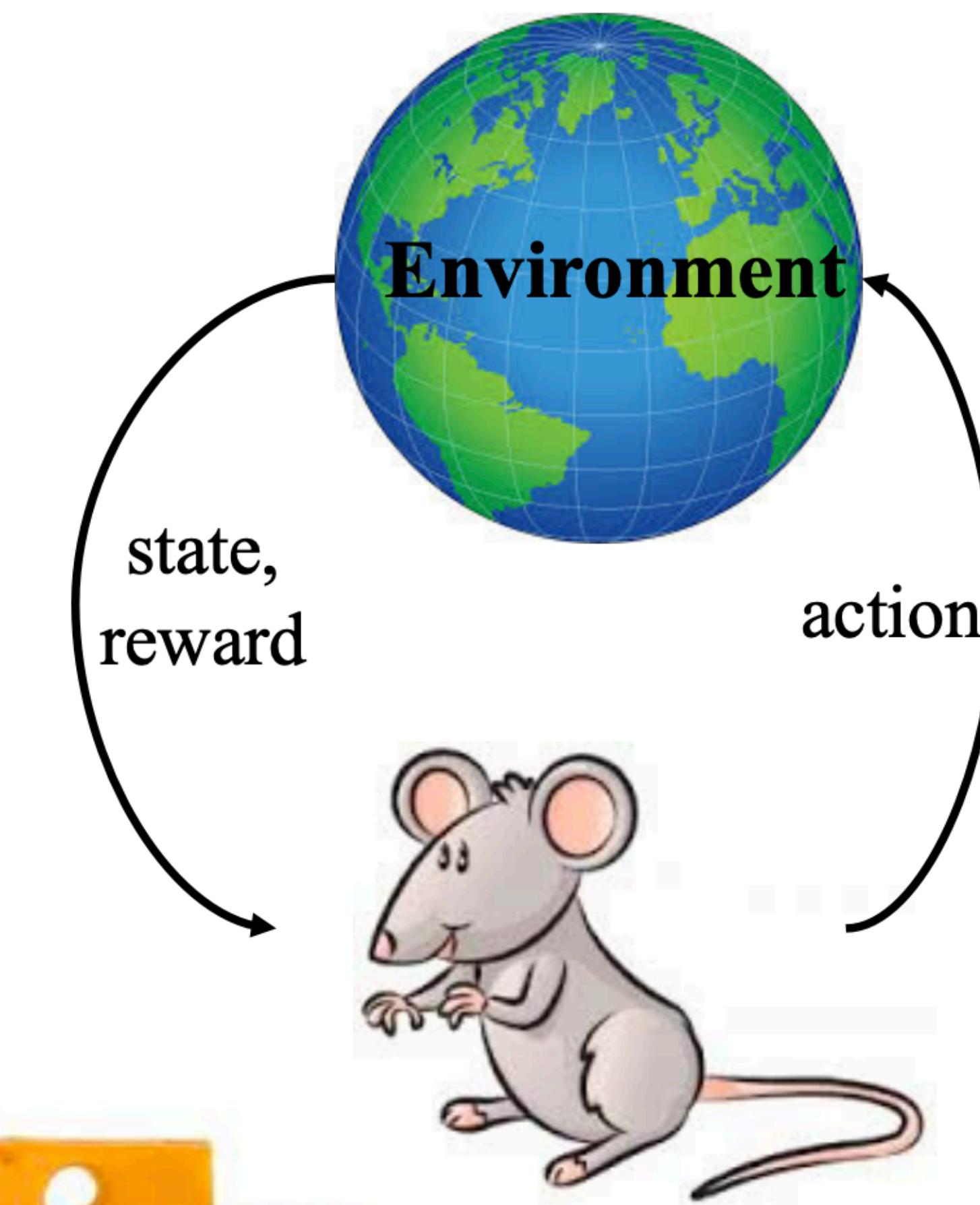
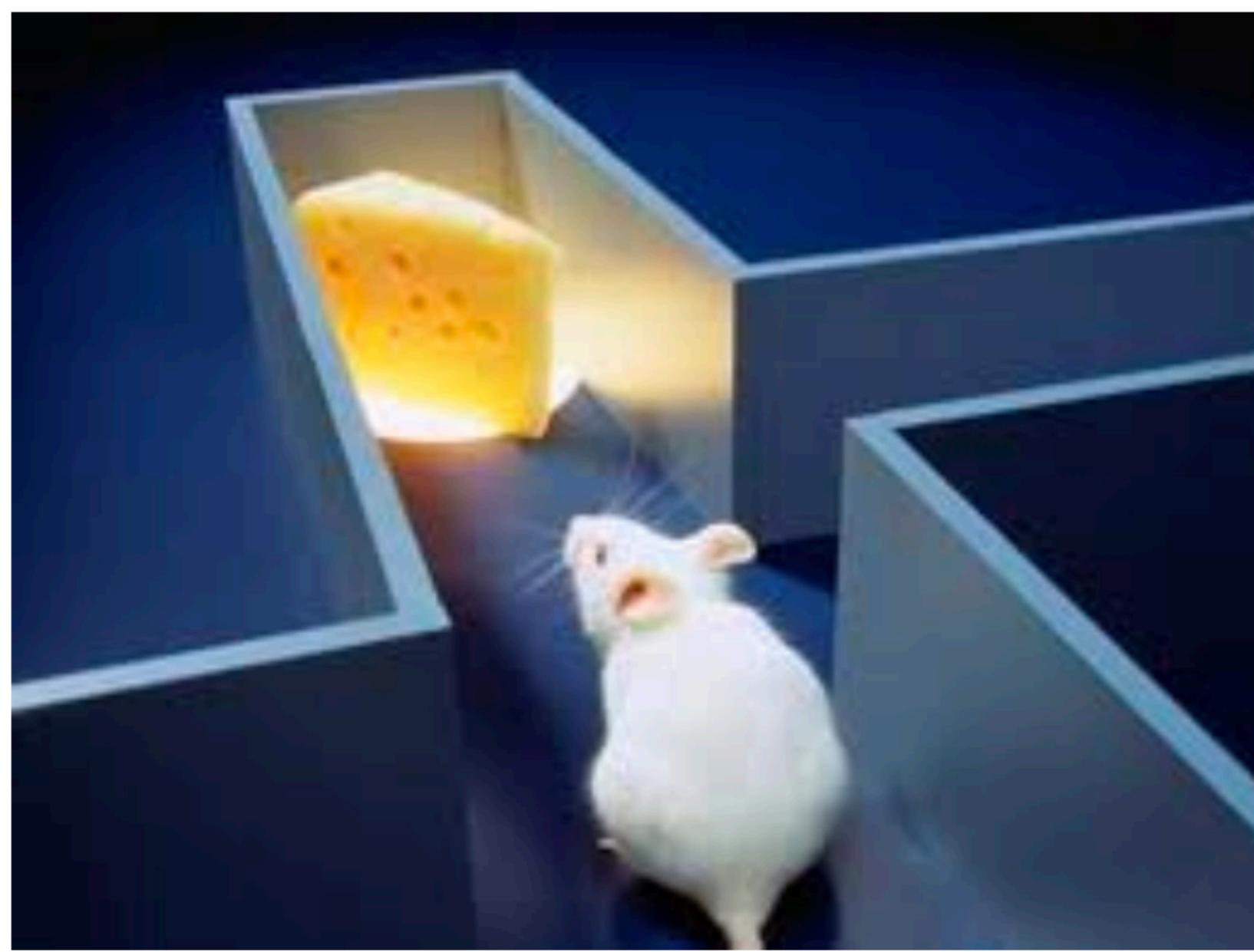




## Anatomy of a seizure (in vitro)

Slide Credit: Joelle Pineau

[http://www.crm.umontreal.ca/2017/MAN2017/pdf/Pineau\\_MAIN\\_2017.pdf](http://www.crm.umontreal.ca/2017/MAN2017/pdf/Pineau_MAIN_2017.pdf)



## Reinforcement Learning

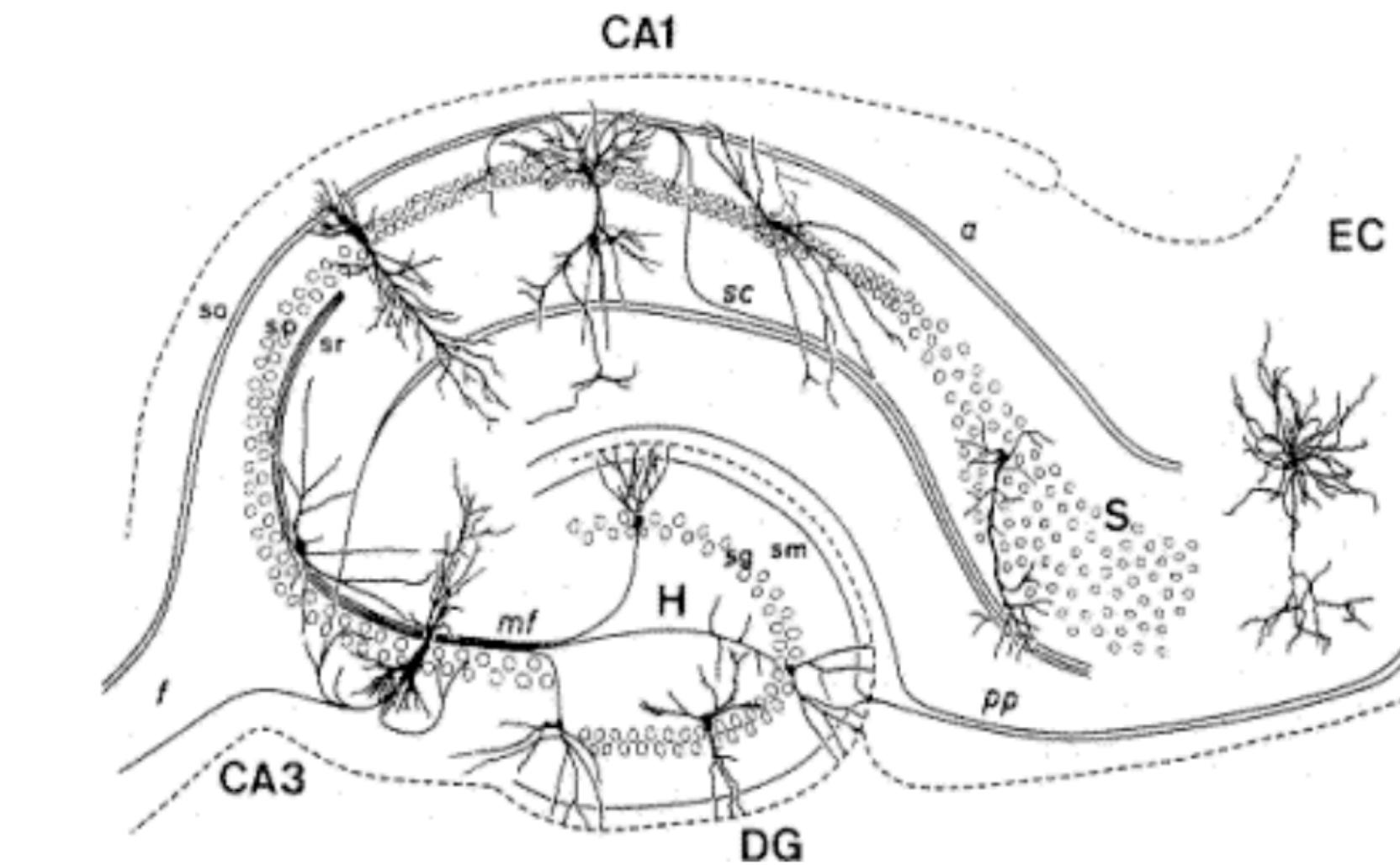
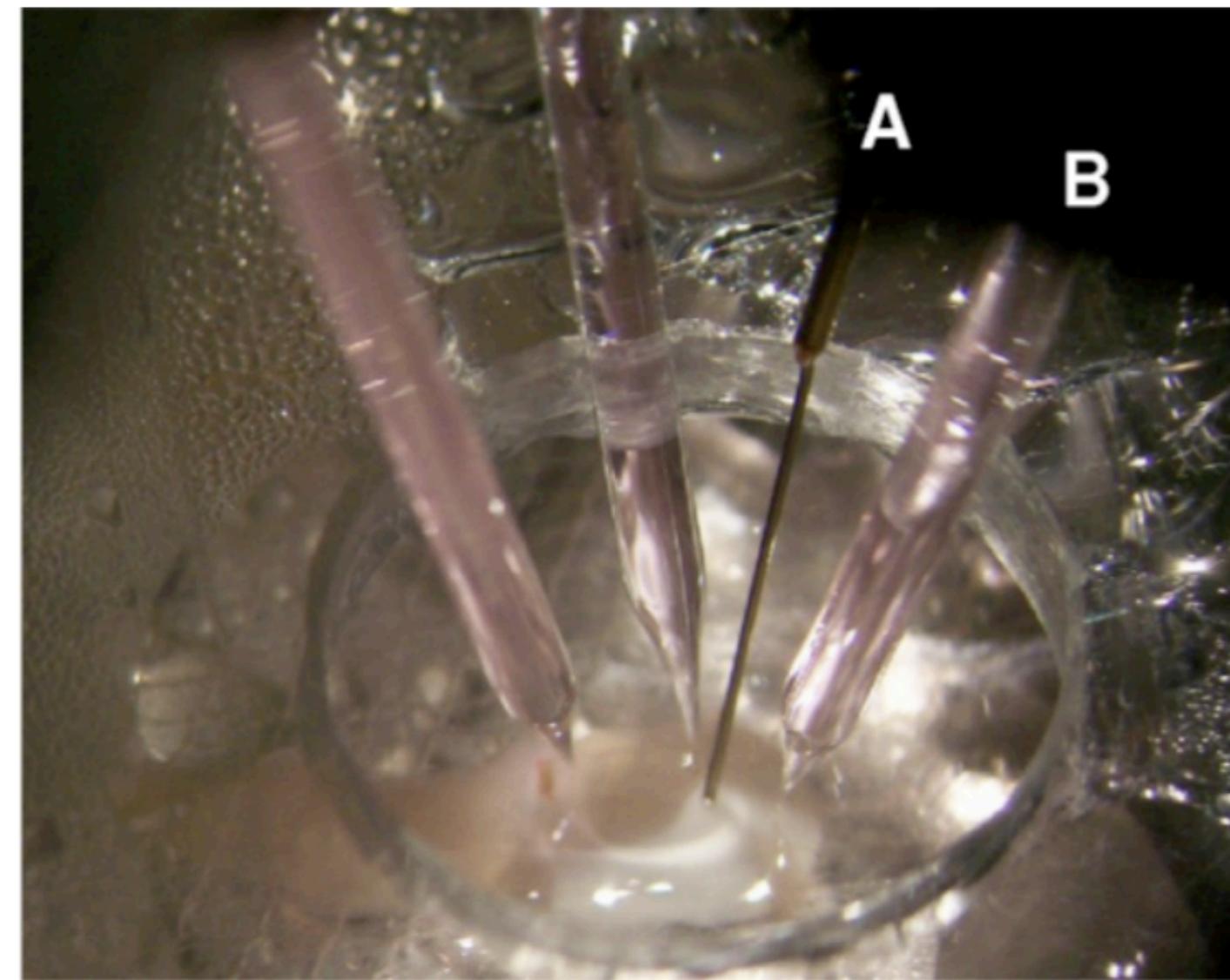
Slide Credit: Joelle Pineau

[http://www.crm.umontreal.ca/2017/MAIN2017/pdf/Pineau\\_MAIN\\_2017.pdf](http://www.crm.umontreal.ca/2017/MAIN2017/pdf/Pineau_MAIN_2017.pdf)

# *In vitro* animal model of epilepsy

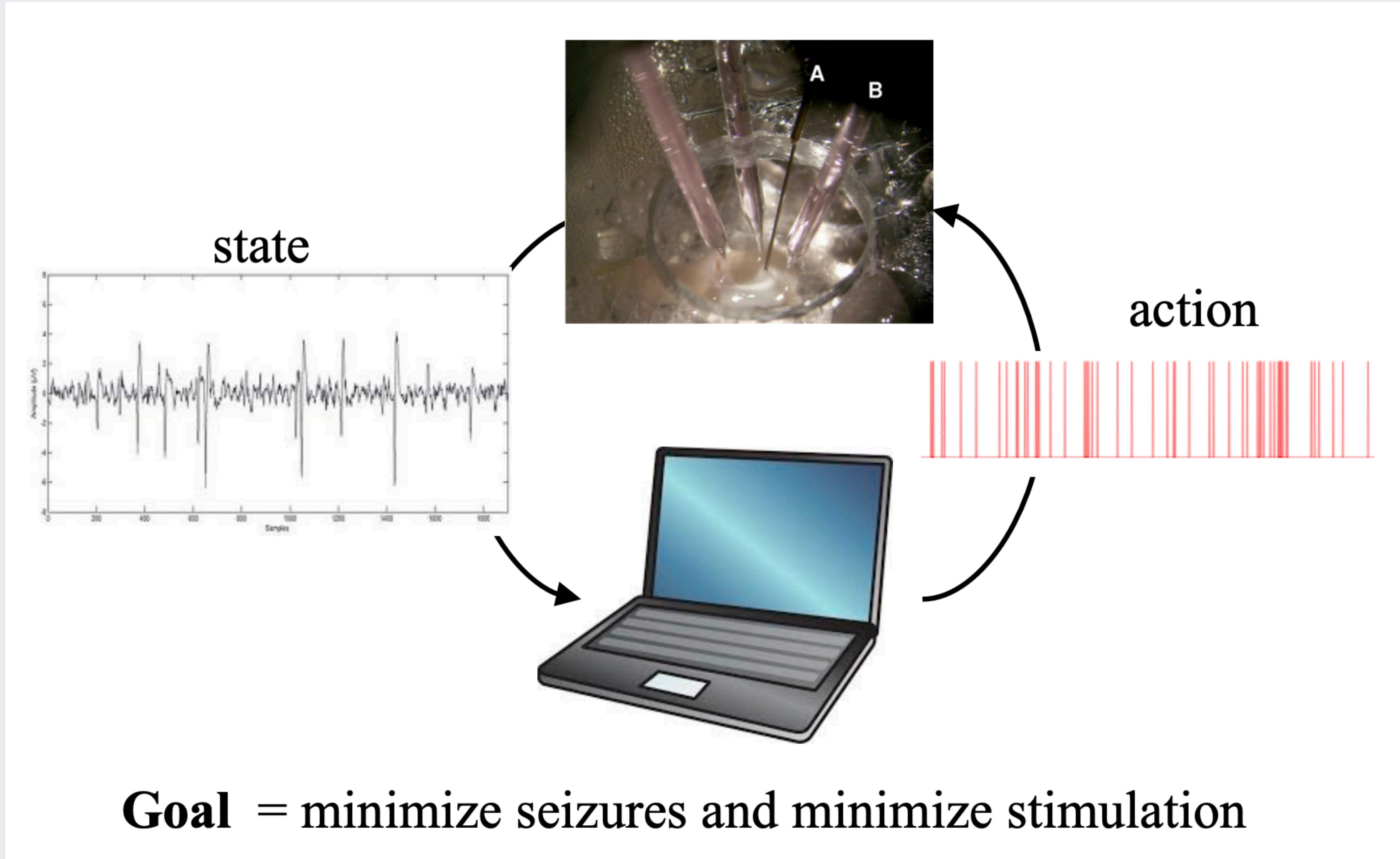


- Rat brain slices (hippocampus + entorhinal cortex) maintained *in vitro*.
  - » Recording in the Entorhinal Cortex (**B**)
  - » Stimulation in the Subiculum (**A**).
- Epileptiform behavior induced by chemical intervention.



Slide Credit: Joelle Pineau

[http://www.crm.umontreal.ca/2017/MAIN2017/pdf/Pineau\\_MAIN\\_2017.pdf](http://www.crm.umontreal.ca/2017/MAIN2017/pdf/Pineau_MAIN_2017.pdf)



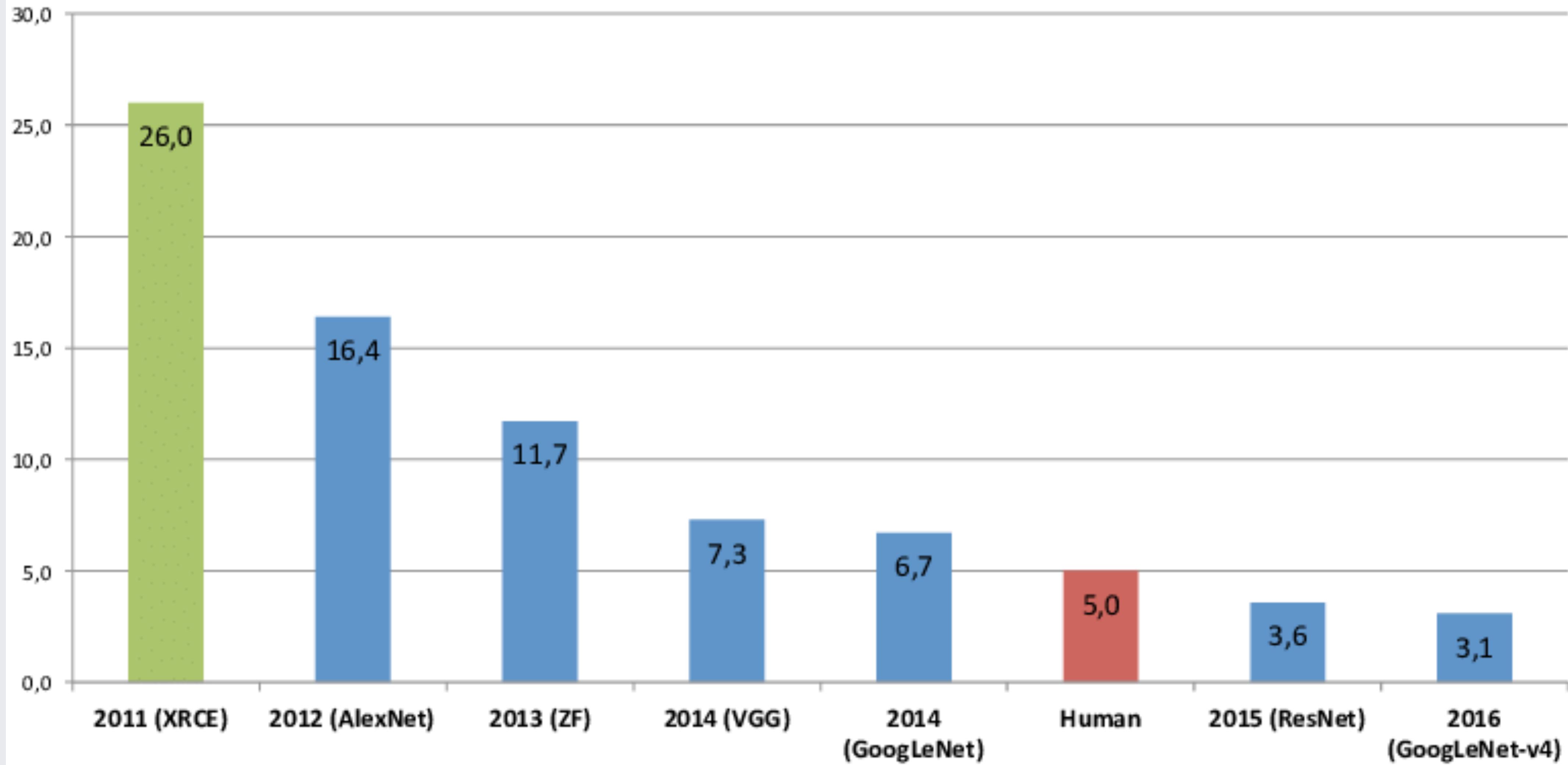
## Adaptive Neurostimulation

Slide Credit: Joelle Pineau

[http://www.crm.umontreal.ca/2017/MAIN2017/pdf/Pineau\\_MAIN\\_2017.pdf](http://www.crm.umontreal.ca/2017/MAIN2017/pdf/Pineau_MAIN_2017.pdf)

# Caveats

## ImageNet Classification Error (Top 5)



## Soap



Country of Origin: Nepal  
Prediction: Food

## Spices



Country of Origin: Philippines  
Prediction: Beer

## Toothpaste



Country of Origin: Burundi  
Prediction: Wood



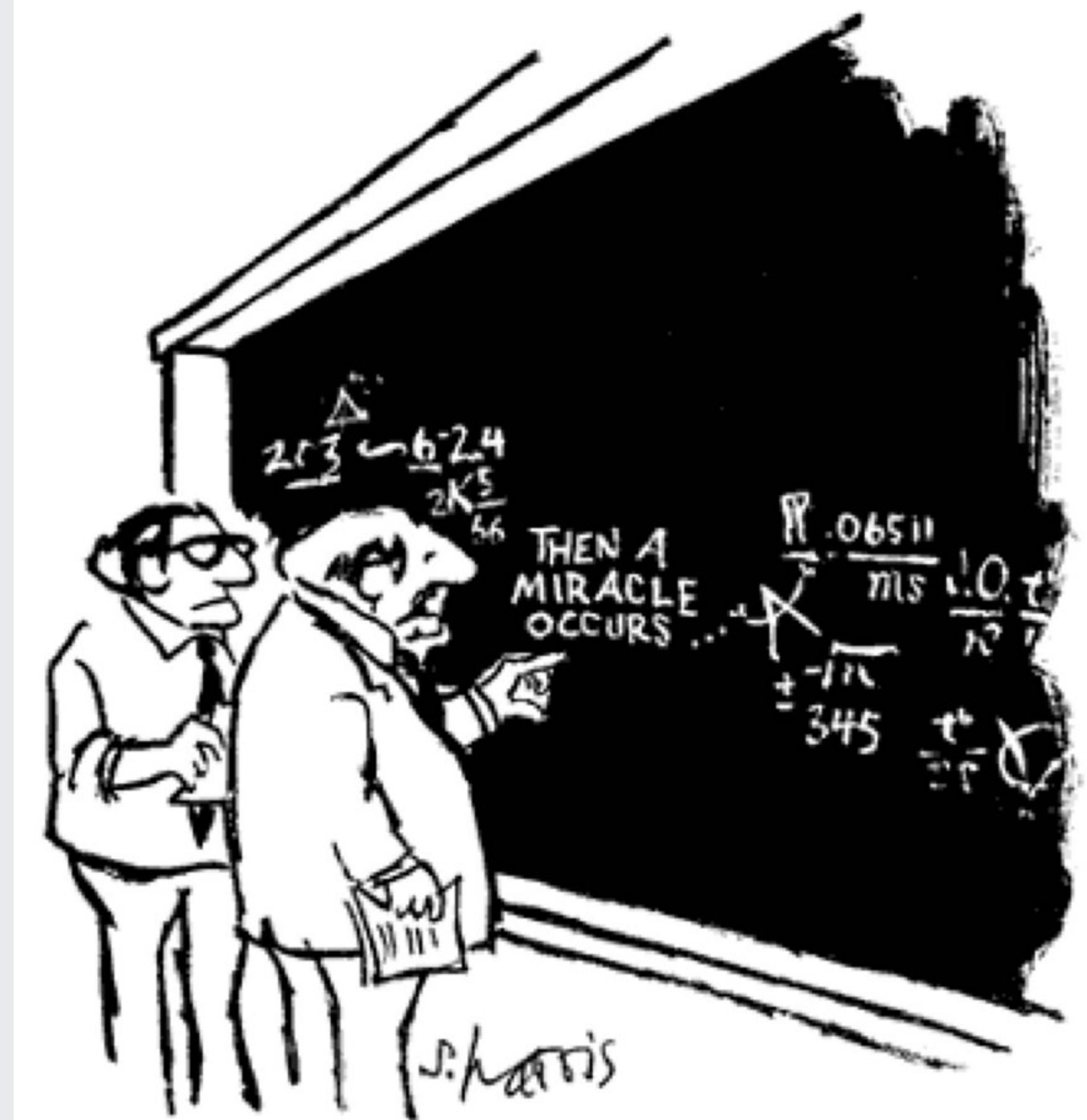
Country of Origin: UK  
Prediction: Toiletry



Country of Origin: USA  
Prediction: Spice



Country of Origin: USA  
Prediction: Toothpaste



"I think you should be more explicit here in step two."

**Computer Vision technology is sufficiently mature**

**Data is key**

**Watch out for biases**

Computer Vision technology is sufficiently mature

Data is key

Watch out for biases

Thank You!