

(Biased) Overview of A.I. Topics

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Thursday, August 22, 2019

High-Level Categorization of AI Topics

1. Artificial Intelligence (other than topics below)
2. Machine Learning (& Deep Learning)
3. Computer Vision
4. Natural Language Processing

1. Artificial Intelligence (Based on [AAAI topic list](#))

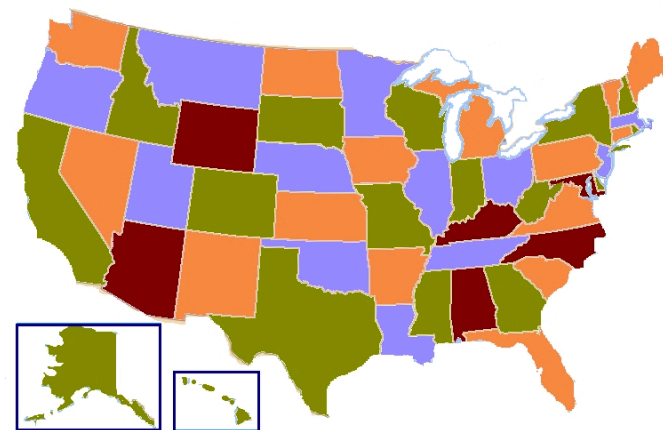
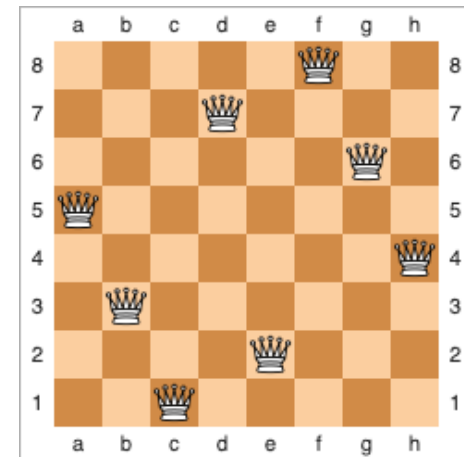
- ▶ Cognitive modeling and systems
- ▶ Constraint Satisfaction/ Optimization
- ▶ Game theory
- ▶ Human + AI
- ▶ Knowledge representation and reasoning
- ▶ Robotics

AI: Cognitive Modeling

- ▶ Models of human/animal cognition
- ▶ Based on psychological theory and experiments
- ▶ 2 Goals
 - ▶ AI -> Cognitive Science: Understand/test underlying cognitive mechanisms by computational modeling
 - ▶ Cognitive Science -> AI: Improve computational methods via insights from cognitive science

AI: Constraint Satisfaction / Heuristic Optimization

- ▶ Eight queens puzzle
- ▶ Map coloring problem
- ▶ Real-world
 - ▶ Resource allocation
 - ▶ Scheduling



AI: Game Theory

► Prisoner's dilemma

THE PRISONER'S DILEMMA

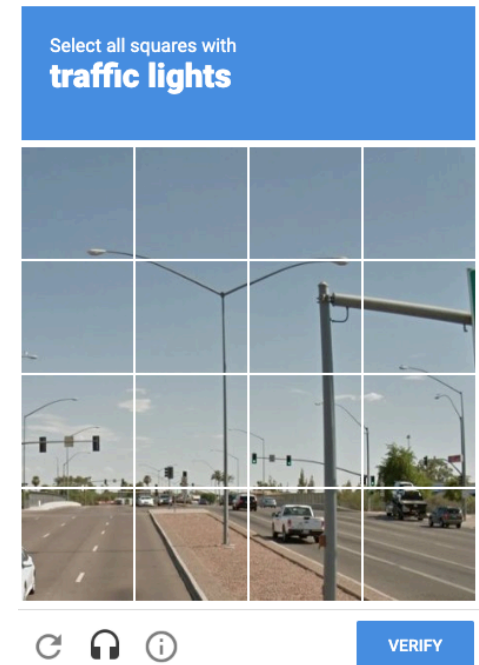
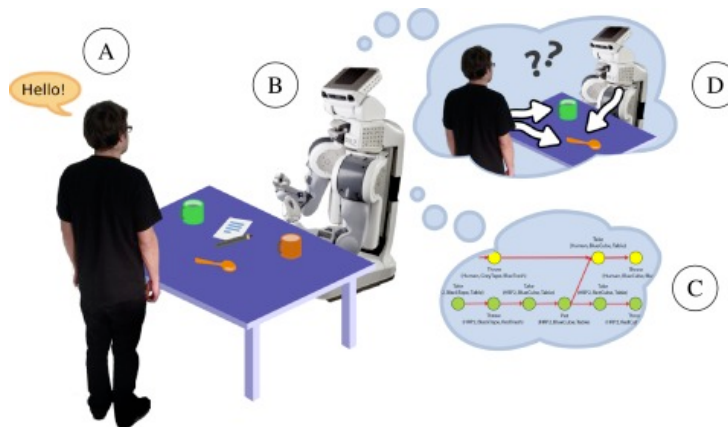
		B stays silent (cooperates)	B betrays A (defects)
A stays silent (cooperates)	Both serve 1 year	A serves 3 years, B goes free	
A betrays B (defects)	A goes free, B serves 3 years	Both serve 2 years	

► Real-world

- Google Ads bidding
- Connections to “Generative Adversarial Networks”

AI: Human + AI

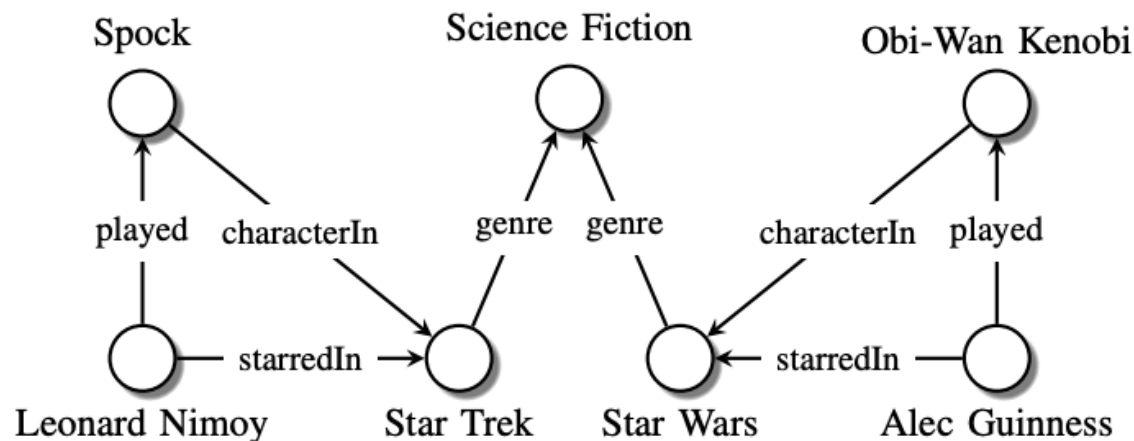
- ▶ Crowdsourcing
 - ▶ “Stop spam, read books”
- ▶ Human-robot interactions



<https://www.sciencedirect.com/science/article/pii/S0004370216300790>

AI: Knowledge representation and reasoning

► Knowledge graphs



<https://arxiv.org/pdf/1503.00759.pdf>

► Inferences in knowledge graphs

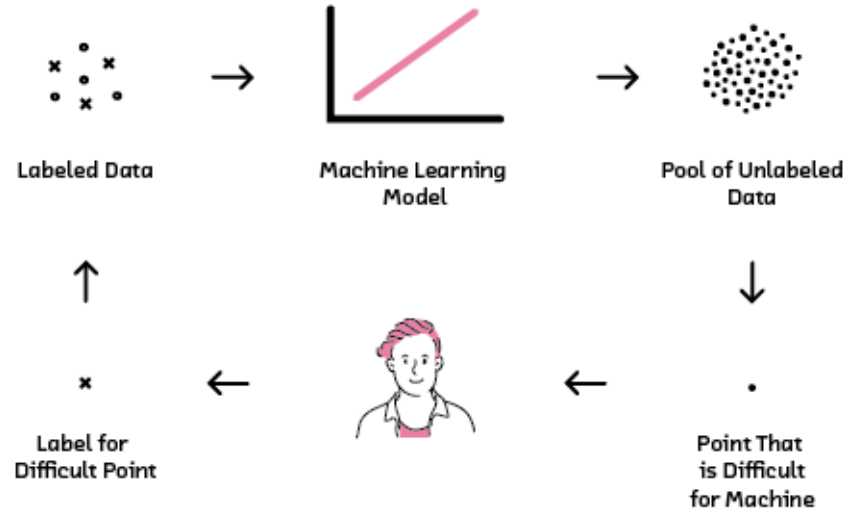
- Did Alec Guinness ever play a Science Fiction character?

2. Machine Learning (based on [NeurIPS Topics](#))

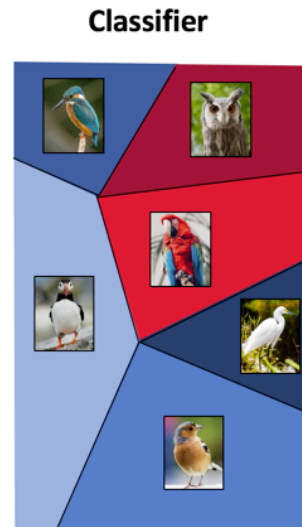
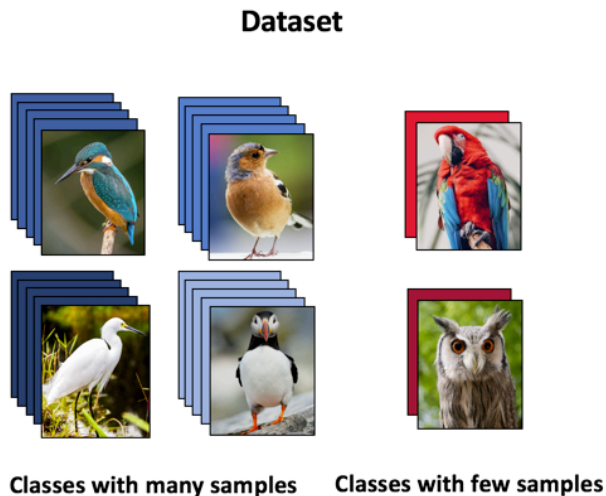
- ▶ Learning with limited labels
- ▶ Generative / probabilistic models
- ▶ Reinforcement learning
- ▶ Explainable AI

ML: Learning with limited labels

► Active learning



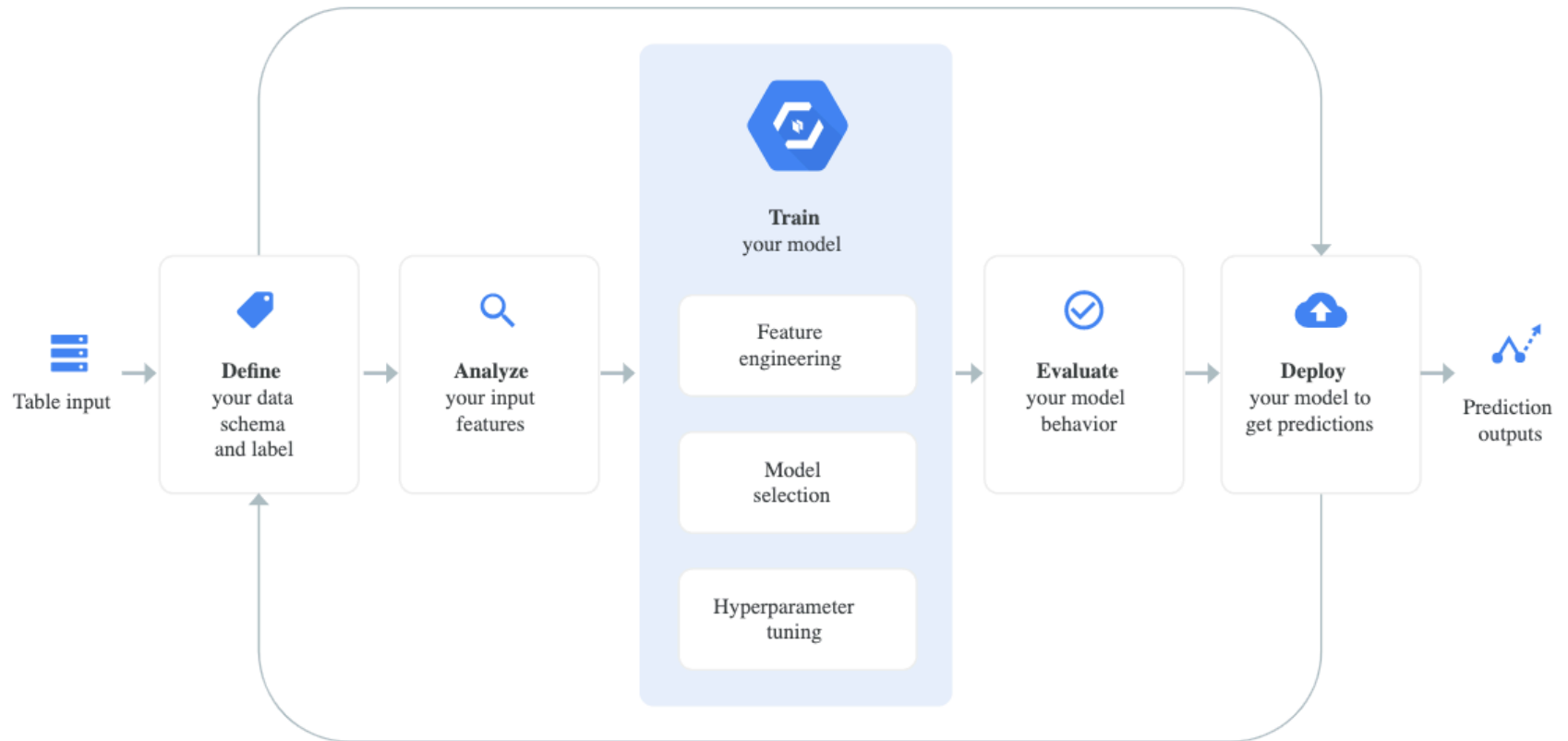
► Few-Shot Learning



<https://blog.cloudera.com/a-guide-to-learning-with-limited-labeled-data/>

<https://medium.com/sap-machine-learning-research/deep-few-shot-learning-a1caa289f18>

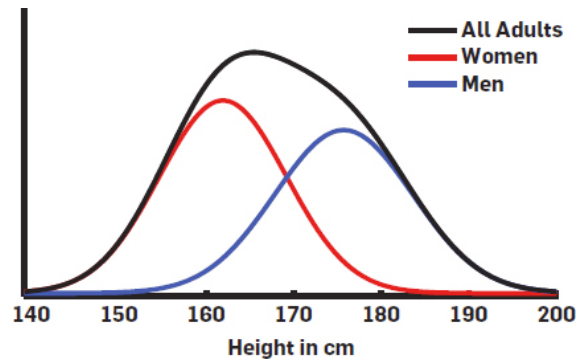
ML: AutoML / Meta-learning



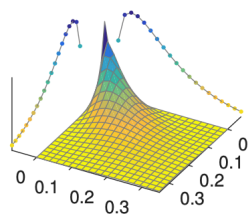
<https://cloud.google.com/automl-tables/?hl=vi>

ML: Generative/Probabilistic Models

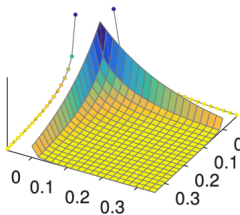
► Density estimation / Graphical Models



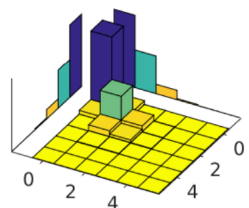
Positive Exp. SQR



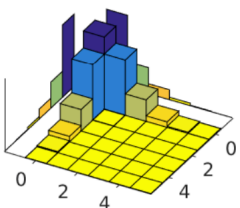
Negative Exp. SQR



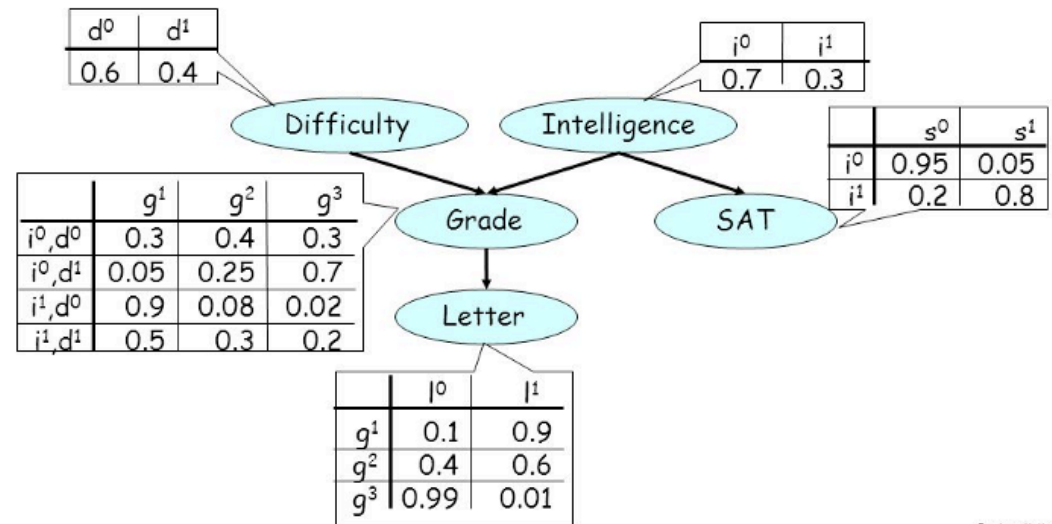
Positive Poisson SQR



Negative Poisson SQR

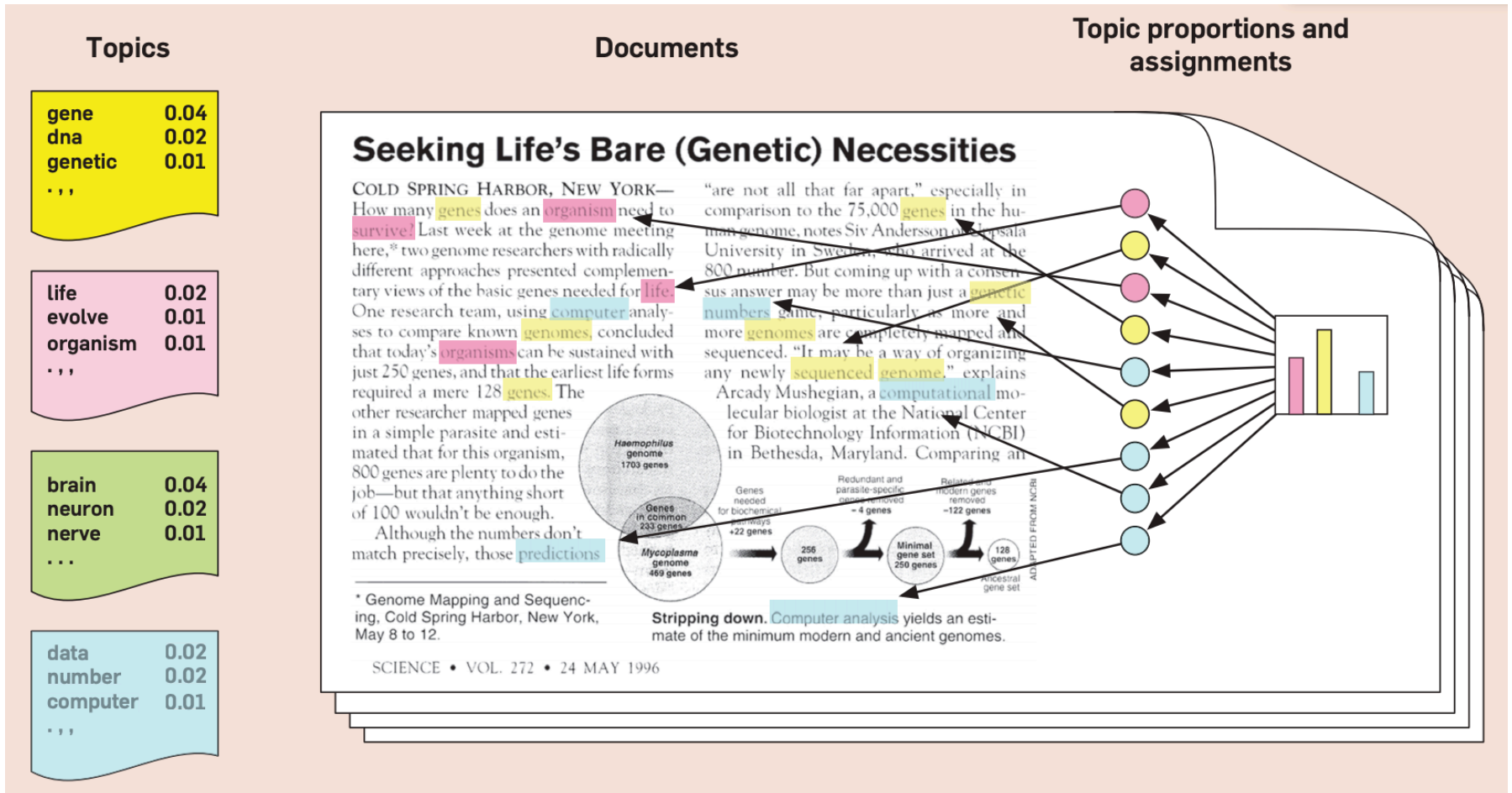


The Student Network



Daphne Koller

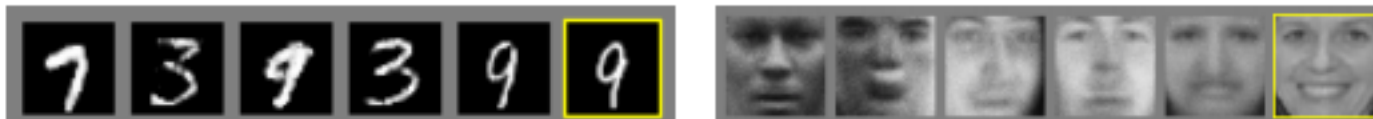
ML: Topic Models



<http://www.cs.columbia.edu/~blei/papers/Blei2012.pdf>

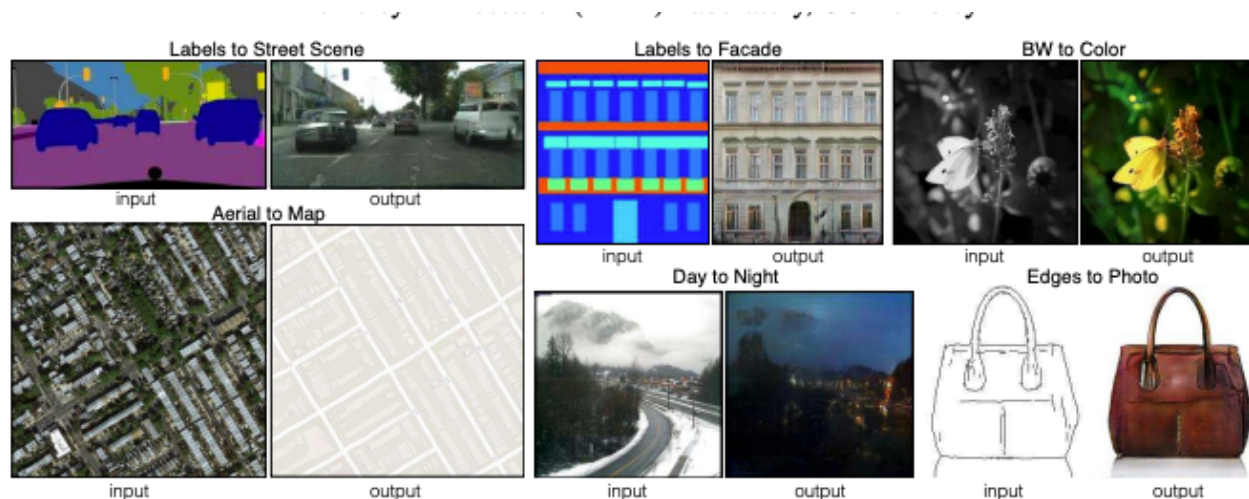
ML: Generative Adversarial Networks (GAN)

► Generative Adversarial Networks (GAN)



<http://papers.nips.cc/paper/5423-generative-adversarial-nets.pdf>

► Image to image translation via GANs



http://openaccess.thecvf.com/content_cvpr_2017/papers/Isola_Image-To-Image_Translation_With_CVPR_2017_paper.pdf

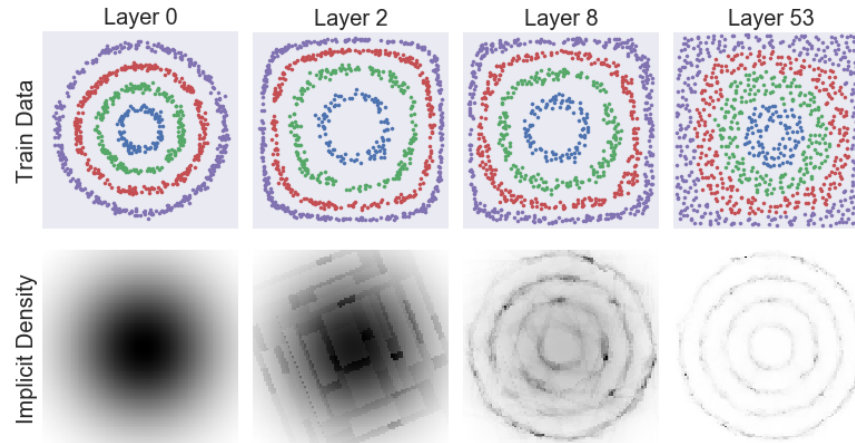
ML: Invertible networks

► Invertible Flows



<https://papers.nips.cc/paper/8224-glow-generative-flow-with-invertible-1x1-convolutions.pdf>

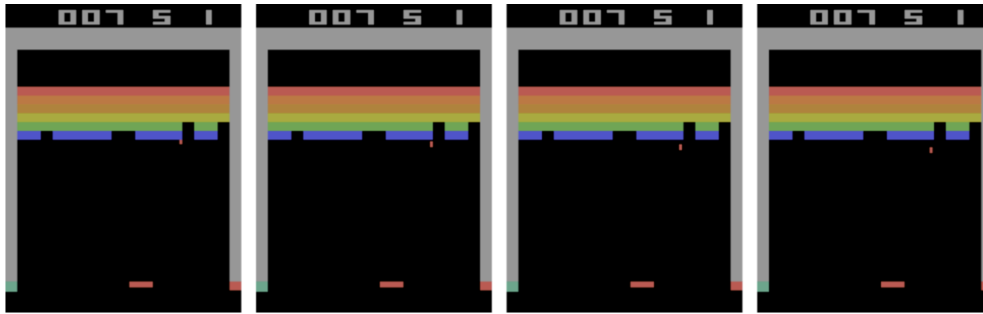
► Deep Density Destructors



<https://www.davidinouye.com/publication/inouye-2018-deep/inouye-2018-deep.pdf>

ML: Reinforcement Learning

- ▶ Game playing



- ▶ Bandit algorithms (simpler form of RL)
 - ▶ Which Google search result should I show?

ML: Explainable AI

Why model
explanations?
Accuracy is
insufficient for
many applications



Loan approval: “Could the model make a catastrophic mistake?”



Self-driving cars: “Does the model obey common sense intuitions?”



Bail decisions: “Is the model biased because of historical discrimination?”



Healthcare: “Does the model agree with doctor’s knowledge?”



Military strategy: “How will the model perform in adversarial settings?”

3. Computer Vision (Based on CVPR sessions)

- ▶ Classic tasks
- ▶ 3D Multiview / Depth estimation
- ▶ Synthesis

CV: Classic Tasks

► Recognition



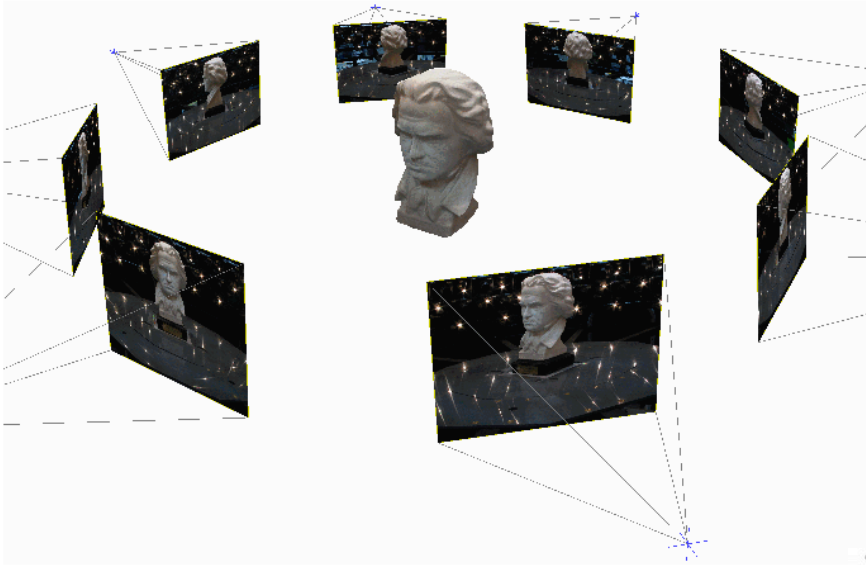
<http://www.cs.toronto.edu/~fritz/absps/imagenet.pdf>

► Segmentation

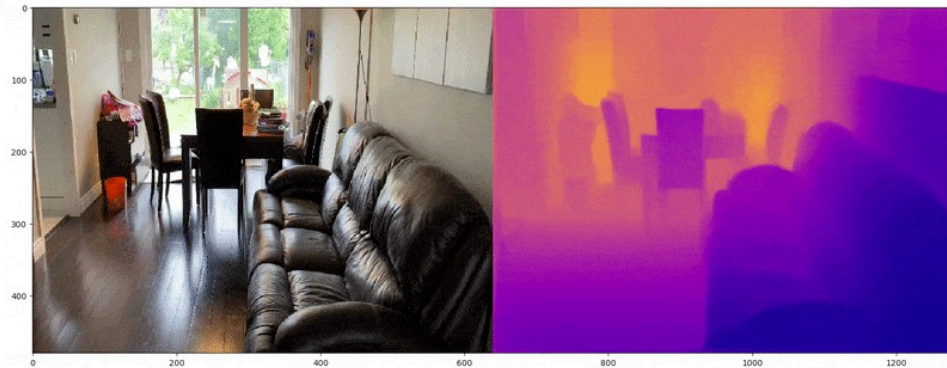


<http://vladlen.info/publications/feature-space-optimization-for-semantic-video-segmentation/>

CV: 3D Multiview / Depth estimation



<https://vision.in.tum.de/research/image-based-3d-reconstruction/multiviewreconstruction>



<https://towardsdatascience.com/depth-estimation-on-camera-images-using-densenets-ac454caa893>

CV: Image / Video Generation (Synthesis)

► Style transfer

https://www.cv-foundation.org/openaccess/content_cvpr_2016/papers/Gatys_Image_Style_Transfer_CVPR_2016_paper.pdf



► Sketch to draw

<https://techcrunch.com/2019/03/18/nvidia-ai-turns-sketches-into-photorealistic-landscapes-in-seconds/>



4. Natural Language Processing (based on [ACL 2019 Call for Papers \(CFP\)](#))

- ▶ Tagging and Parsing
- ▶ Information Extraction and Text Mining
- ▶ Dialogue Systems / Question Answering
- ▶ Applications
 - ▶ Summarization
 - ▶ Sentiment Analysis
 - ▶ Machine Translation

NLP: Ambiguity is huge challenge in NLP

Lexical Ambiguity

The presence of two or more possible meanings within a single word.



"I saw her duck."

Syntactic Ambiguity

The presence of two or more possible meanings within a single sentence or sequence of words.

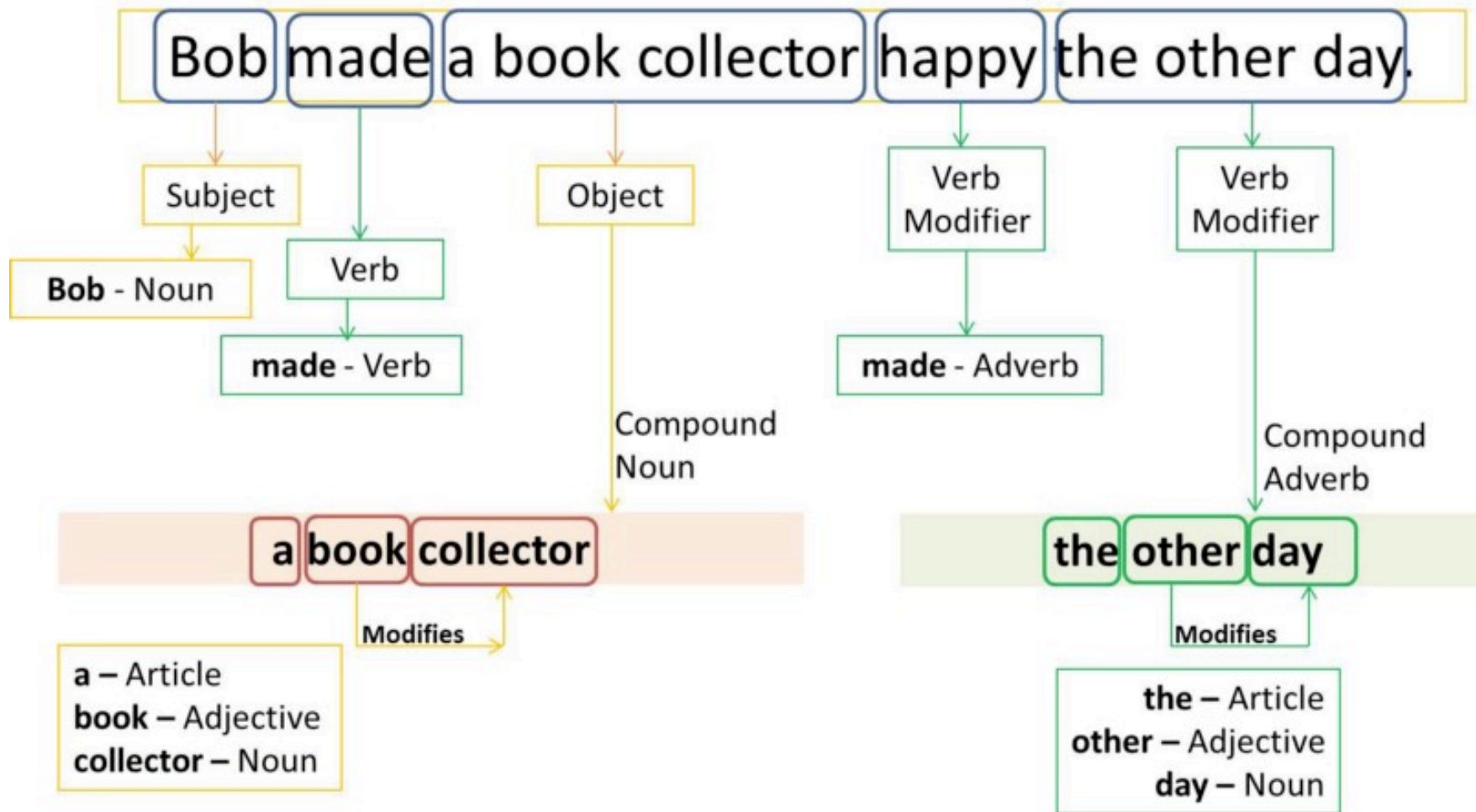


"The chicken is ready to eat."

ThoughtCo.

<https://www.thoughtco.com/ambiguity-language-1692388>

NLP: Tagging and Parsing



NLP: Information Extraction and Text Mining

Text in

Brazil ranks number 5 in the list of countries by population.

The term **"Ibu Negara"** (Lady/Mother of the State) is used for **wife** of the President of Indonesia.

Game of Thrones is an adaptation of A Song of Ice and Fire, George R. R. Martin's series of fantasy novels. It ranks **fourth** among the **IMDB Top Rated TV Shows**

Data out

THE COUNTRIES WITH THE LARGEST POPULATION

China	1	1,388,232,693
India	2	1,342,512,706
Unites States	3	326,474,013
Indonesia	4	263,510,146
Brasil	5	174,315,386

THE COUNTRY'S' FIRST LADIES

Brigitte Macron

- Spouse: Emmanuel Macron, President of France (2017 -)

Melania Trump

- Spouse: Donald J. Trump, U.S. President (2017-)

Iriana Widodo

- Spouse: Joko Widodo, **President of Indonesia** (2014 -)

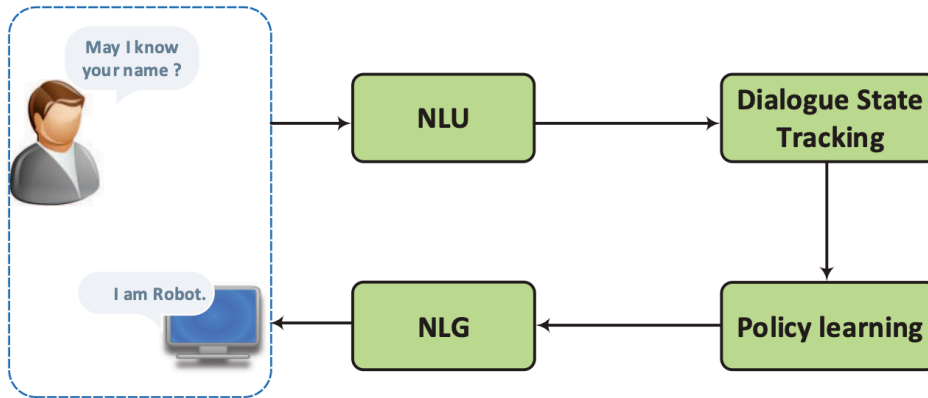
- Also known as: **"Ibu Negara"** (Lady/Mother of the State)

IMDB TOP RATED TV SHOWS

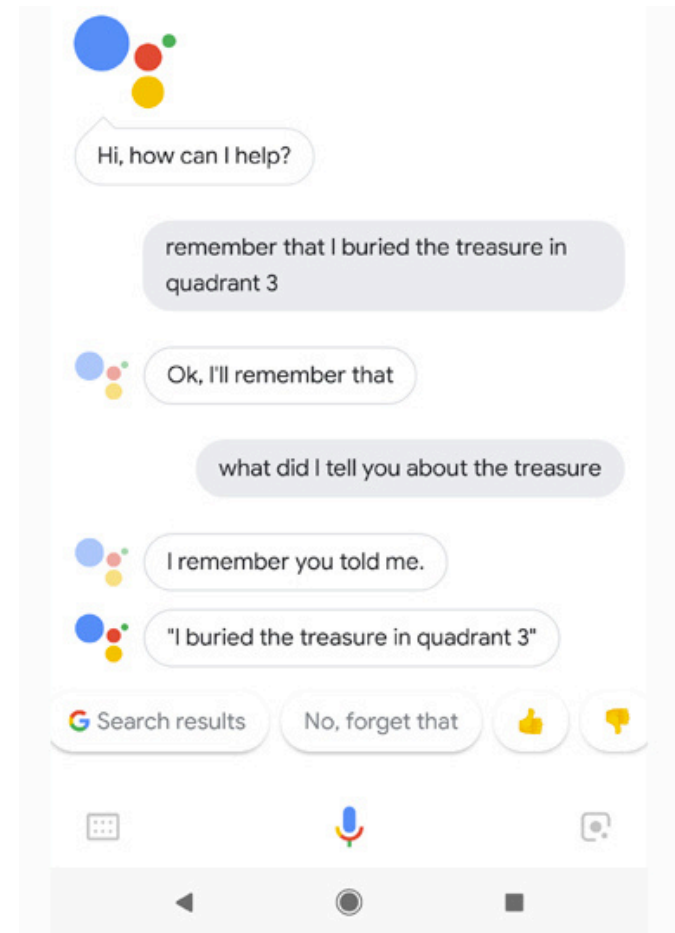
- 1 Planet Earth II (2016) 9.6.
- 2 Band of Brothers (2001) 9.5.
- 3 Planet Earth (2006) 9.5.
- 4 **Game of Thrones** (2011) 9.4.
- 5 Breaking Bad (2008) 9.4.

<https://www.ontotext.com/knowledgehub/fundamentals/information-extraction/>

NLP: Dialogue Systems / Question Answering



<https://arxiv.org/pdf/1711.01731.pdf>



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