(Biased) Overview of A.I. Topics

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Wednesday, August 25, 2021
High-Level Categorization of AI Topics

1. Artificial Intelligence (other than topics below)


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

![Prisoner's Dilemma Diagram]

- Real-world
  - Google Ads bidding
  - Connections to “Generative Adversarial Networks”
AI: Human + AI

- Crowdsourcing
  - “Stop spam, read books”

- Human-robot interactions

AI: Knowledge representation and reasoning

▸ Knowledge graphs

- Spock played characterIn Leonard Nimoy
- Science Fiction genre Star Trek
- Star Wars starredIn Alec Guinness
- Obi-Wan Kenobi characterIn played

▸ 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

Dataset

Classes with many samples Classes with few samples

Classifier

Labeled Data → Machine Learning Model → Pool of Unlabeled Data

Label for Difficult Point

Point That is Difficult for Machine

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

https://blog.cloudera.com/a-guide-to-learning-with-limited-labeled-data/
ML: AutoML / Meta-learning

https://cloud.google.com/automl-tables/?hl=vi
ML: Generative/Probabilistic Models

- Density estimation
- Graphical Models

The Student Network

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Positive Exp. SQR

Negative Exp. SQR

Positive Poisson SQR

Negative Poisson SQR
ML: Topic Models

ML: Generative Adversarial Networks (GAN)

- Generative Adversarial Networks (GAN)
  
  ![Image of generated images](http://papers.nips.cc/paper/5423-generative-adversarial-nets.pdf)

- Image to image translation via GANs
  
  ![Image of image translation](http://openaccess.thecvf.com/content_cvpr_2017/papers/Isola_Image-To-Image_Translation_With.CVPR.2017_paper.pdf)
ML: Invertible networks

- Invertible Flows

- Deep Density Destructors


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?”
ML: Domain Generalization

- Distribution shifts in the real-world

<table>
<thead>
<tr>
<th>Dataset</th>
<th>iWildCam</th>
<th>Camelyon17</th>
<th>RxRx1</th>
<th>OGB-MolPCBA</th>
<th>GlobalWheat</th>
<th>CivilComments</th>
<th>FMoW</th>
<th>PovertyMap</th>
<th>Amazon</th>
<th>Py150</th>
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<tbody>
<tr>
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<td>camera</td>
<td>tissue</td>
<td>slide</td>
<td>cell image</td>
<td>molecular</td>
<td>graph</td>
<td>image</td>
<td>comment</td>
<td>satellite image</td>
<td>product review</td>
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<tr>
<td>Prediction (y)</td>
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<td>species</td>
<td>tumor</td>
<td>perturbed</td>
<td>gene</td>
<td>bioassays</td>
<td>wheat</td>
<td>head bbox</td>
<td>toxicity</td>
<td>land use</td>
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<td>scaffold</td>
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<td>time</td>
<td>demographic</td>
<td>time, region</td>
<td>country</td>
<td>rural-urban</td>
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<td>523,846</td>
<td>19,669</td>
<td>539,502</td>
<td>150,000</td>
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- How can you train models so that they work in new unseen test domains?

3. Computer Vision (Based on CVPR sessions)

- Classic tasks

- 3D Multiview / Depth estimation

- Synthesis
CV: Classic Tasks

▸ Recognition

▸ 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

CV: Image / Video Generation (Synthesis)

- Style transfer


- Sketch to draw

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."

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

<table>
<thead>
<tr>
<th>Country</th>
<th>Population</th>
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</thead>
<tbody>
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<td>China</td>
<td>1,388,232,693</td>
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<tr>
<td>India</td>
<td>1,342,512,706</td>
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<tr>
<td>Unites States</td>
<td>326,474,013</td>
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<tr>
<td>Indonesia</td>
<td>263,510,146</td>
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<tr>
<td>Brasil</td>
<td>174,315,386</td>
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### 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


[https://www.ontotext.com/knowledgehub/fundamentals/information-extraction/](https://www.ontotext.com/knowledgehub/fundamentals/information-extraction/)
NLP: Dialogue Systems / Question Answering

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