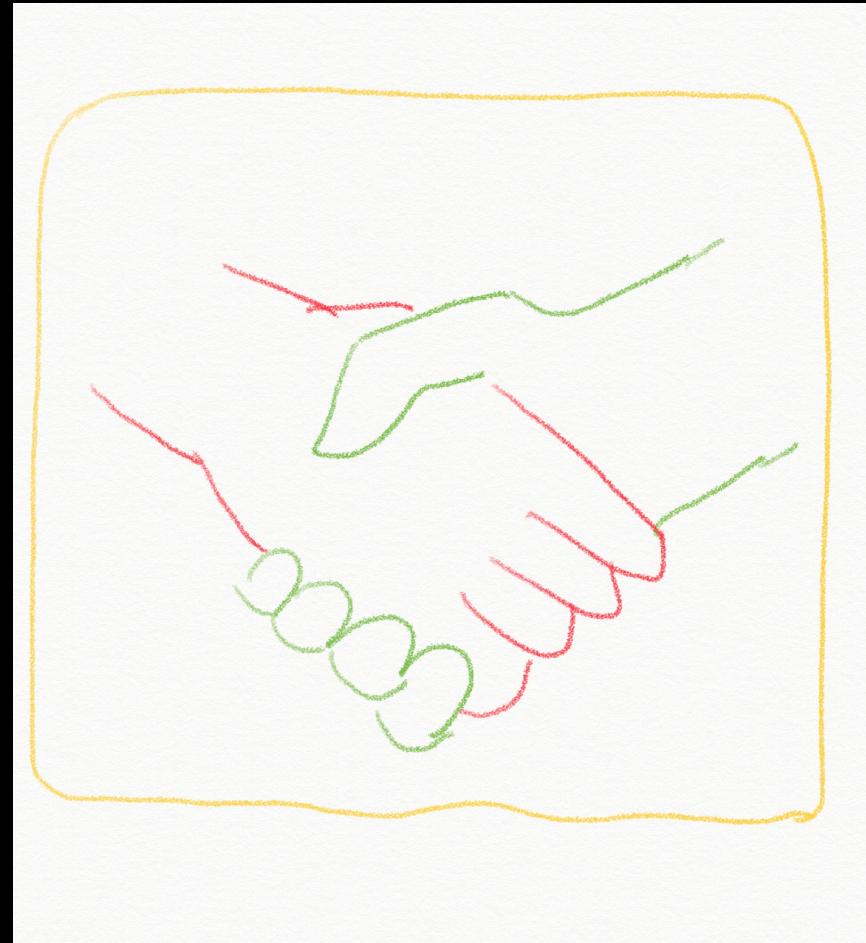


# Intelligence and Machine Learning

Jin Guo  
SOCS McGill University

# What is Intelligence?

Draw a sketch to illustrate your understanding of Intelligence.



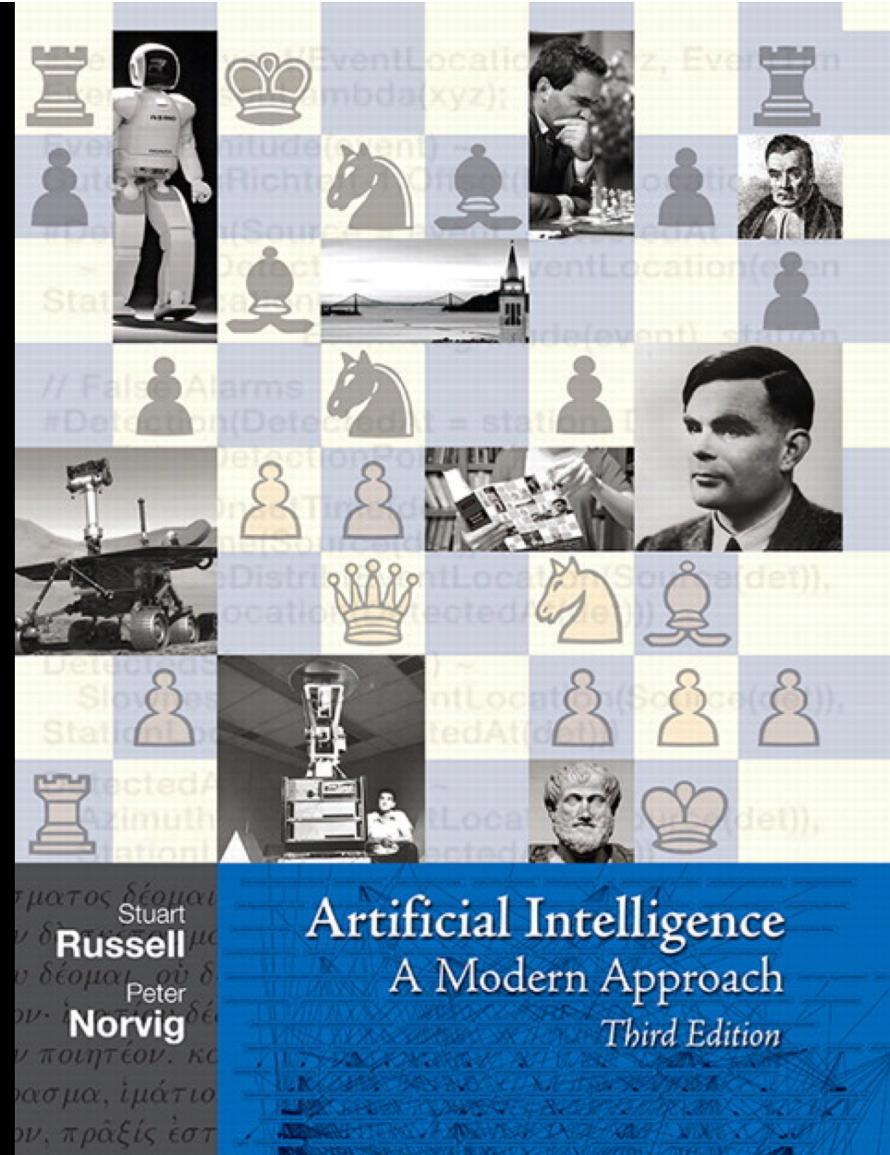
# Does your “intelligence” mean

- Think like people?
- Act like people?
- Think/Behave rationally?
- or        *1.7 Einsteins, 2 Maxwells, 5 Faradays and .3 Manhattan Projects?*

# AI in the Textbook

Study the problem of building agents that can maximize the expected utility given certain constraints.

Perceive and Act



**Artificial Intelligence**  
A Modern Approach  
*Third Edition*

Stuart  
**Russell**  
Peter  
**Norvig**

# Perceive and Act

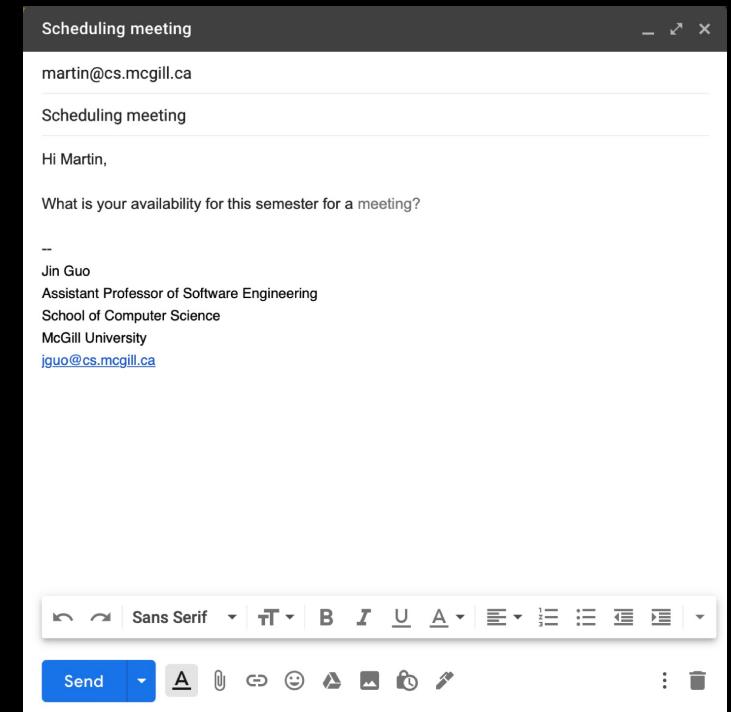


Image from : <https://www.bloomberg.com/news/articles/2019-12-05/waymo-s-autonomous-taxi-service-tops-100-000-rides>

# Considerations

- Nature of the environment
- The observations and actions that connect the agent to the environment
- Agents' objective

# AI in the News

SCIENCE

## Optimism as Artificial Intelligence Reunite

Researchers who in the 1960s tackled a field separately are coming together again.

By John Markoff

PRINT EDITION

December 8, 2009, Page D4

TECHNOLOGY

## Google's Computing Power Refines Translation Tool

The company's network pushes the limits of translation technology and has become a favored source for millions.

By Miguel Helft

PRINT EDITION Google Can Now Say No to "Raw Fish Shoes," in 52 Languages | March 9, 2010, Page A1

TECHNOLOGY

## Bringing Data Mining Into the Mainstream

A leading data-mining expert explains what will be needed to bring the field into the mainstream of business.

By Steve Lohr

# AI in the News

PERSONAL TECH

## Amazon Echo, a.k.a. Alexa, Is a Personal Aide in Need of Schooling

The Amazon Echo is an artificially intelligent personal assistant answering to the could one day be

By Farhad Manjoo

PRINT EDITION [Ama  
Schooling | June 2](#)



TECHNOLOGY

## A Facebook Project to Beam Data From Drones Is a Step Closer to Flight

The company said its unmanned aerial vehicle, intended to bring Internet access to remote areas, is ready for tests in the upper atmosphere, most likely in the United States.

By Vinod Goel and Quentin Hardy

PRINT EDITION [A Facebook Project to Beam Data From Drones Is a Step Closer to Flight | July 31, 2015, Page B3](#)



# AI in the News

OPINION

## How Do You Know a Human Wrote This?

Machines are gaining the ability to write, and they are getting terrifyingly good at it.

By Farhad Manjoo

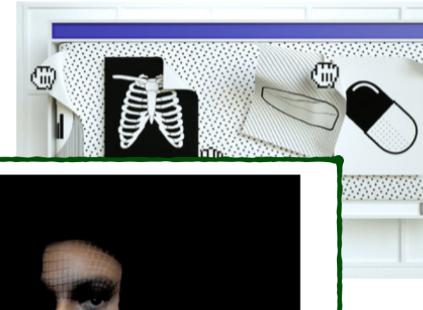
PRINT EDITION

July 30, 2020, Page 1

TECHNOLOGY

## How A.I. Steered Doctors Toward a Possible Coronavirus Treatment

Dear Reader



TECHNOLOGY

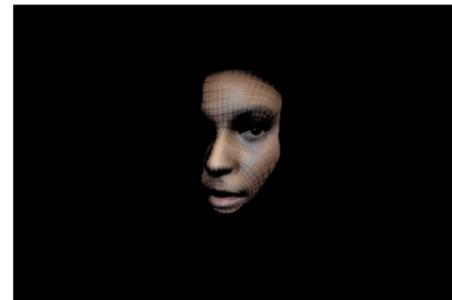
## A Case for Banning Facial Recognition

A Google research scientist explains why she thinks the police shouldn't use facial recognition software.

By Shira Ovide

PRINT EDITION

June 10, 2020



# AI in the Research Frontier

Latent Variable Modelling with Hyperbolic Normalizing Flows

*Avishek Joey Bose, Ariella Smofsky, Renjie Liao, Prakash Panangaden, William L. Hamilton*

Laplacian Change Point Detection for Dynamic Graphs

*Shenyang Huang, Yasmeen Hitti, Guillaume Rabusseau, Reihaneh Rabbany*

Algorithmic Improvements for Deep Reinforcement Learning Applied to Interactive Fiction.

*Vishal Jain, William Fedus, Hugo Larochelle, Doina Precup, Marc G Bellemare*

A Cross-Domain Transferable Neural Coherence Model

*Peng Xu, Hamidreza Saghir, Jin Sung Kang, Teng Long, Avishek Joey Bose, Yanshuai Cao, Jackie Chi Kit Cheung*

How To Evaluate Your Dialogue System: Probe Tasks as an Alternative for Token-level Evaluation Metrics

*Prasanna Parthasarathi, Joelle Pineau, Sarath Chandar*

Building reproducible, reusable, and robust machine learning software

*Joelle Pineau*

# Machine Learning

- Constructing and/or learning the parameters of a specified model given existing data
  - Supervised
    - Known: Input instances, corresponding labels
    - Predict: labels using unseen instances*
  - Unsupervised
    - Known: Input instances
    - Recognize input structure, Generate data*
  - Reinforcement Learning

# Supervised Learning

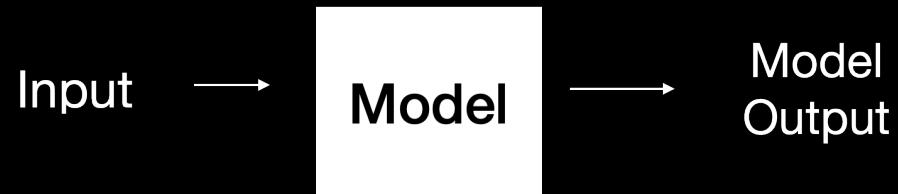


Input					Output
ID	Temperature	Cough	Sore throat	Headache	Flu
Features					
1	37	Yes	No	No	No
2	39	No	Yes	No	No
3	39.2	Yes	No	Yes	Yes

# Training the model

$$activation_w(x) = \sum_{i=1} w_i \cdot f_i(x)$$

Linear classifier



Input					Output
ID	Temperature	Cough	Sore throat	Headache	Flu
Features					
1	37	Yes	No	No	No
2	39	No	Yes	No	No
3	39.2	Yes	No	Yes	Yes

# Loss Function

- A Quantitative measure of loss when the output label is different from the label assigned by the classifier
- Use to calculate empirical risk of the classifier with respect to the training data

Input					Output
ID	Temperature	Cough	Sore throat	Headache	Flu
Features					
1	37	Yes	No	No	No
2	39	No	Yes	No	No
3	39.2	Yes	No	Yes	Yes

# Training the model

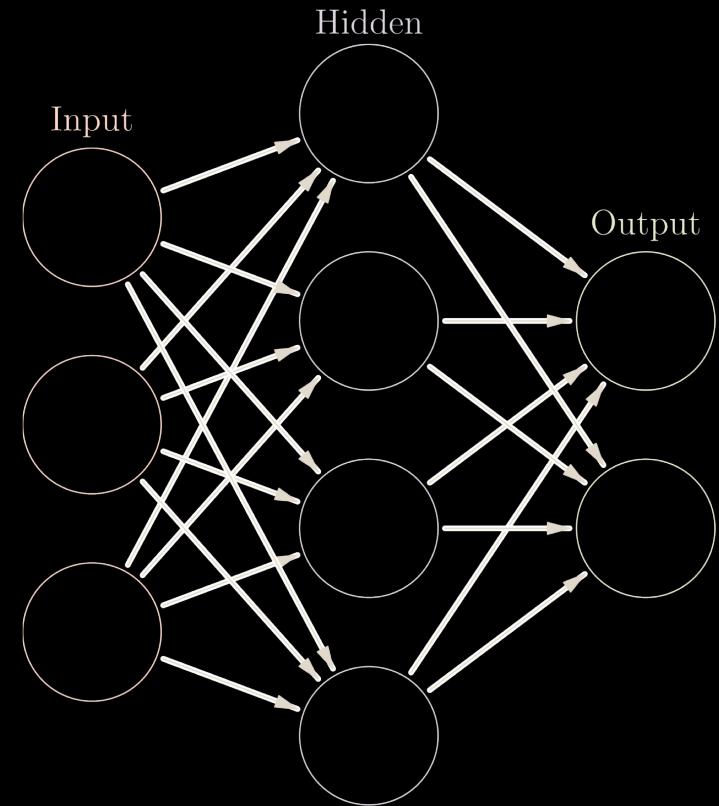
$$activation_w(x) = \sum_{i=1} w_i \cdot f_i(x)$$

Linear classifier

$$z = \sum_{i=1} w_i \cdot f_i(x)$$

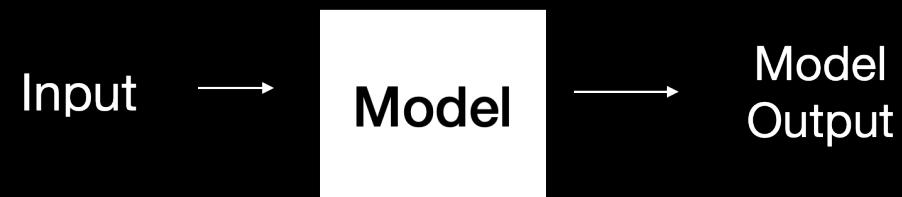
Probabilistic decisions

$$\sigma(z) = 1/(1 + e^{-z})$$



<http://playground.tensorflow.org/>

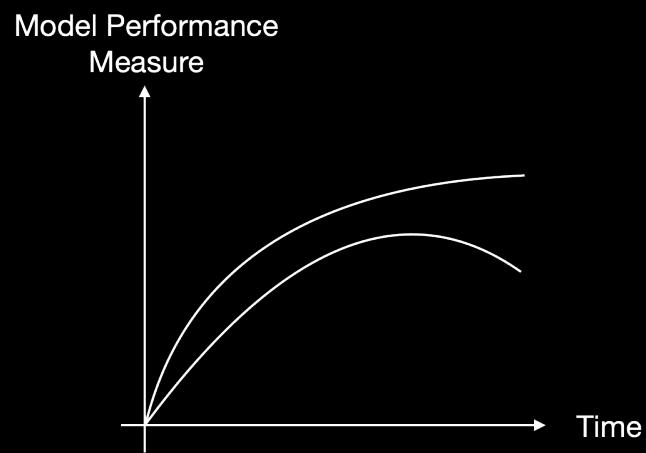
# How good is the trained model?



Input					Output
ID	Temperature	Cough	Sore throat	Headache	Flu
Features					
1	37	Yes	No	No	No
2	39	No	Yes	No	No
3	39.2	Yes	No	Yes	Yes

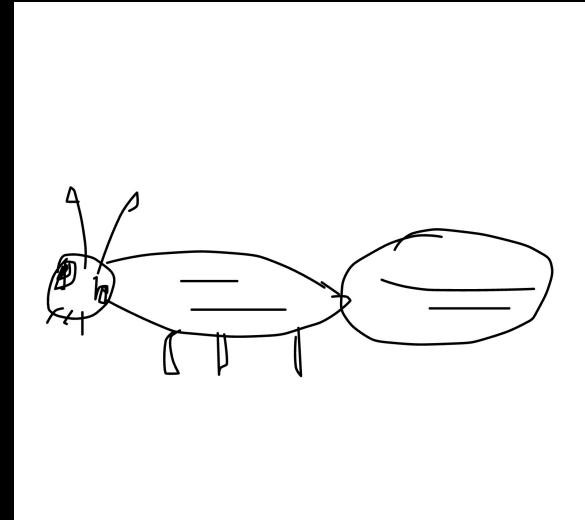
# Model Validation

- Training data
- Validation data (dev, hold-out)
- Test data (consider as final)



# Data Preparation

Example: Human Sketch Recognition



Eitz, M., Hays, J. and Alexa, M., 2012. How do humans sketch objects?. ACM Transactions on graphics (TOG), 31(4), pp.1-10.  
<http://cybertron.cg.tu-berlin.de/eitz/projects/classifysketch/>

# Data Preparation

## Example: Email Spam Detection

**Miguel Sanchez**

✉ Junk - Exchange   August 21, 2020 at 12:01 PM

Business Relationship.

To: jin.guo@mcgill.ca,

Reply-To: msanchez1@163.com

---

Hello,

I have a proposal that would be beneficial to you. Kindly get back to me.  
Miguel Sanchez.

Next Tuesday:

Model Selection, Evaluation and  
Documentation