

# **INTRODUCTION TO ARTIFICIAL INTELLIGENCE**

**FALL 2019**

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**WEBSITE:**

**<https://www.davidinouye.com/course/ece57000-fall-2019/>**

# SYLLABUS UPDATES

- <https://piazza.com/purdue/fall2019/ece57000>
- Other questions about the syllabus?
- Who already has topic ideas for their project?

# WHAT IS ARTIFICIAL INTELLIGENCE?

- Merriam-Webster Dictionary
  - “a branch of computer science dealing with the **simulation of intelligent behavior** in computers”
- Oxford Dictionary
  - “the theory and development of computer systems able to perform tasks that **normally require human intelligence**, such as visual perception, speech recognition, decision-making, and translation between languages.”

# POSSIBLY A.I. IS A MOVING TARGET

- Are these A.I.?
  - Chess solvers
  - TurboTax
  - Chatbot
- What about these?
  - Speech recognition
  - Face recognition
  - Personalized recommendations
  - Self-driving cars
- “AI is anything that humans can do that computers cannot yet do.”



# A MORE PRAGMATIC DEFINITION

“AI is that which appears in  
academic conferences on AI” \*

\* From slides by Prof. Zico Kolter at CMU:  
<http://www.cs.cmu.edu/~./15780/slides/intro.pdf>)

# NOT “MOVIE” A.I.



*C-3PO and R2D2 in Star Wars.*



*The rogue A.I. HAL9000 from the movie 2001: A Space Odyssey.*



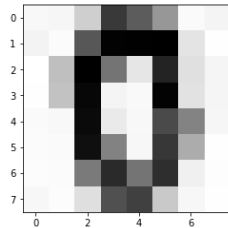
*Skynet from Terminator.*

# COMPUTERS DON'T “THINK” LIKE WE DO

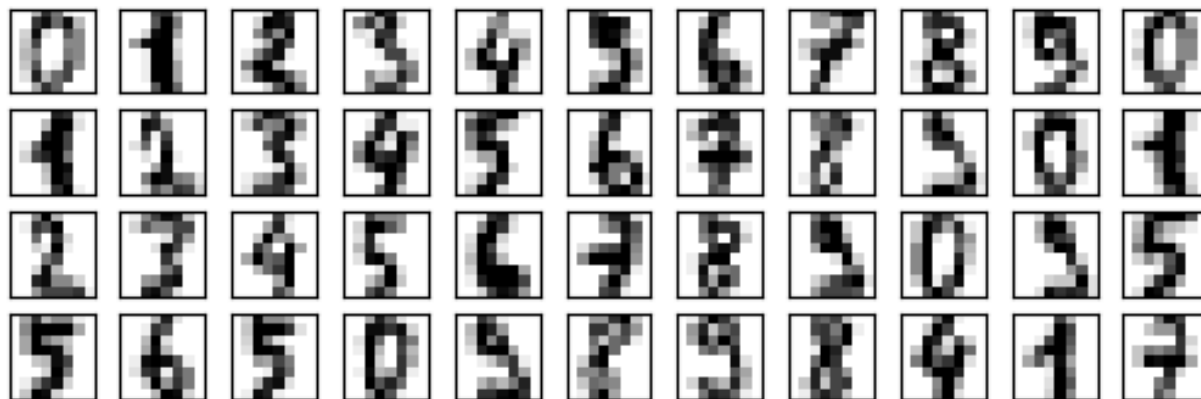
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[6.53e-04 2.53e-04 6.47e-03 1.32e-02 1.02e-02 1.10e-04 6.56e-04 1.38e-04]]
```

A matrix of numbers as the computer “sees”.  
Do you know what this matrix represents?

# COMPUTERS DON'T “THINK” LIKE WE DO



The same matrix of numbers displayed as an image.



Other examples from this dataset.

Do you know what the numbers represent now?

# COMPUTERS DON'T “THINK” LIKE WE DO



$x$

“panda”

57.7% confidence

+ .007 ×



$\text{sign}(\nabla_x J(\theta, x, y))$

“nematode”

8.2% confidence

=



$x +$

$\epsilon \text{sign}(\nabla_x J(\theta, x, y))$

“gibbon”

99.3 % confidence



Real gibbon...

# NOR IS HUMAN IMITATION NECESSARILY THE GOAL

- Consider flight



Imitation



Understanding  
+ Engineering  
(Underlying  
principles)





# **DARPA'S PERSPECTIVE ON AI**

- First wave – Handcrafted Knowledge
- Second wave – Statistical Learning
- Third wave (future) – Contextual Adaptation

Excellent DARPA video (16 min) on AI (content above based on this):

<https://www.youtube.com/watch?v=-O01G3tSYpU>

# 1<sup>ST</sup> WAVE: HANDCRAFTED KNOWLEDGE

- Examples
  - Auto-scheduling systems
  - Chess
  - TurboTax
  - Simple medical diagnosis
- Good at
  - Logical reasoning from rules
- Bad at
  - Perceiving
  - Learning



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**ONE KEY PROBLEM:**  
**(FORMALLY) STATING WHY IS HARD**  
**BUT LABELING IS EASY**

- What is this a photo of?



<https://unsplash.com/search/photos/cute-cat>

- Why is this an image of a cat?
- Can you state a rule for all cats?

# 2<sup>ND</sup> WAVE: STATISTICAL LEARNING

- Examples
  - Voice/face recognition
  - Personalized recommendations
- Good at
  - Perceiving
  - Learning
- Bad at
  - Logical reasoning
  - Robustness

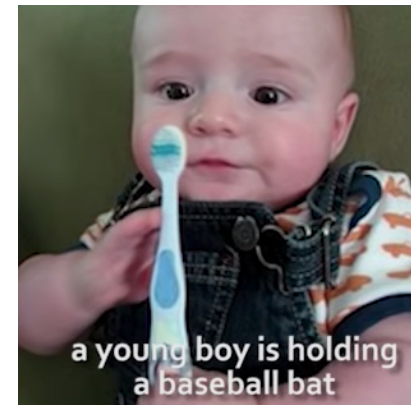
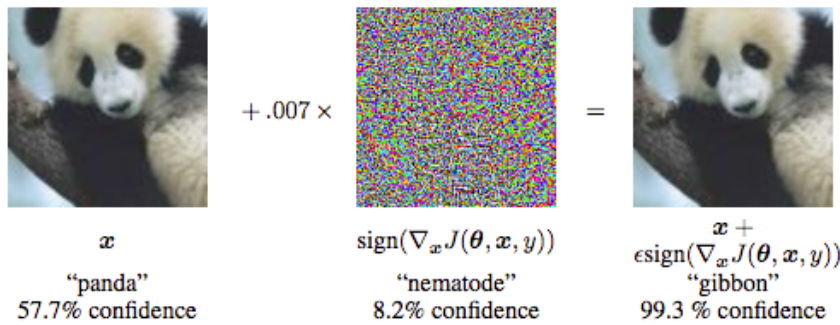


Excellent DARPA video (16 min) on AI (content above based on this):

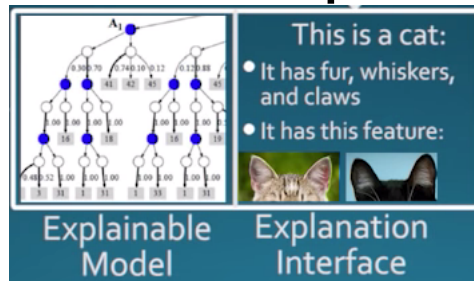
<https://www.youtube.com/watch?v=-O01G3tSYpU>

# KEY PROBLEMS WITH 2<sup>ND</sup> WAVE

- Lack of robustness / fragile systems



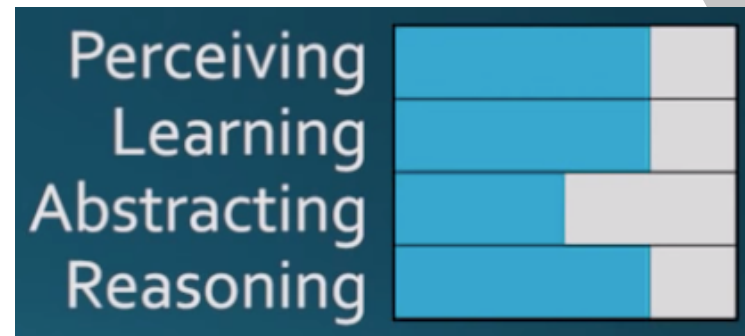
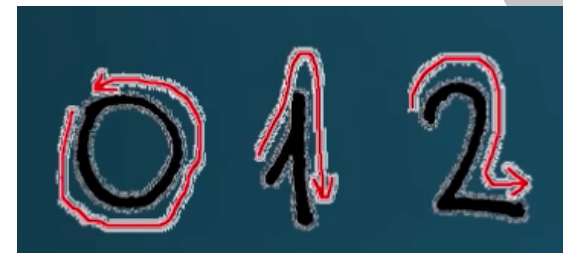
- Lack of explanations



I understand why  
 I understand why not  
 I know when you'll succeed  
 I know when you'll fail  
 I know when to trust you

# 3<sup>RD</sup> WAVE (FUTURE): CONTEXTUAL ADAPTATION

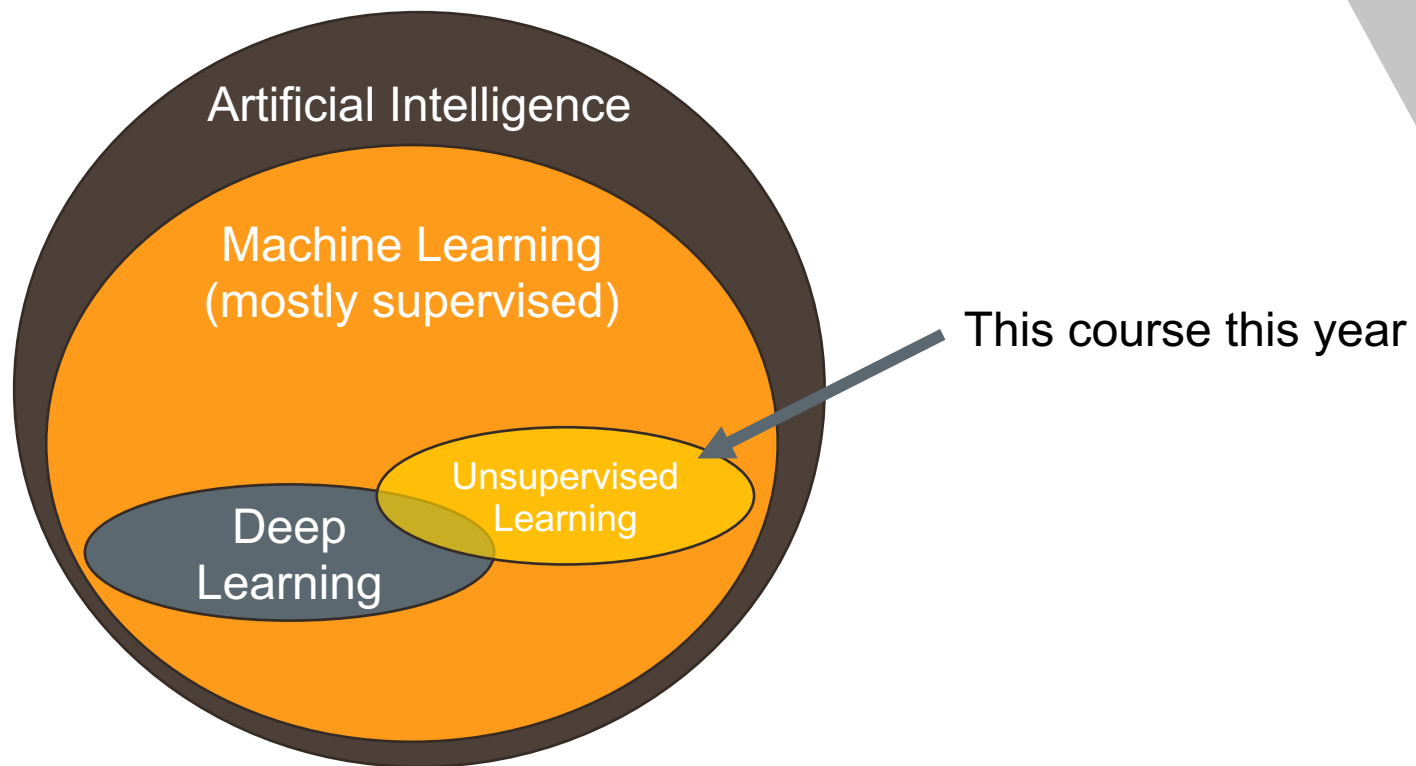
- Combination of previous two waves
- System will construct explanatory models
  - Causation
  - Some abstraction
  - Explainable
- Examples
  - Incorporate handwriting knowledge for recognizing new characters
  - ? - (Maybe you can work on this)
- Good at
  - Perceiving
  - Learning
  - Reasoning
- Slightly better at
  - Abstracting



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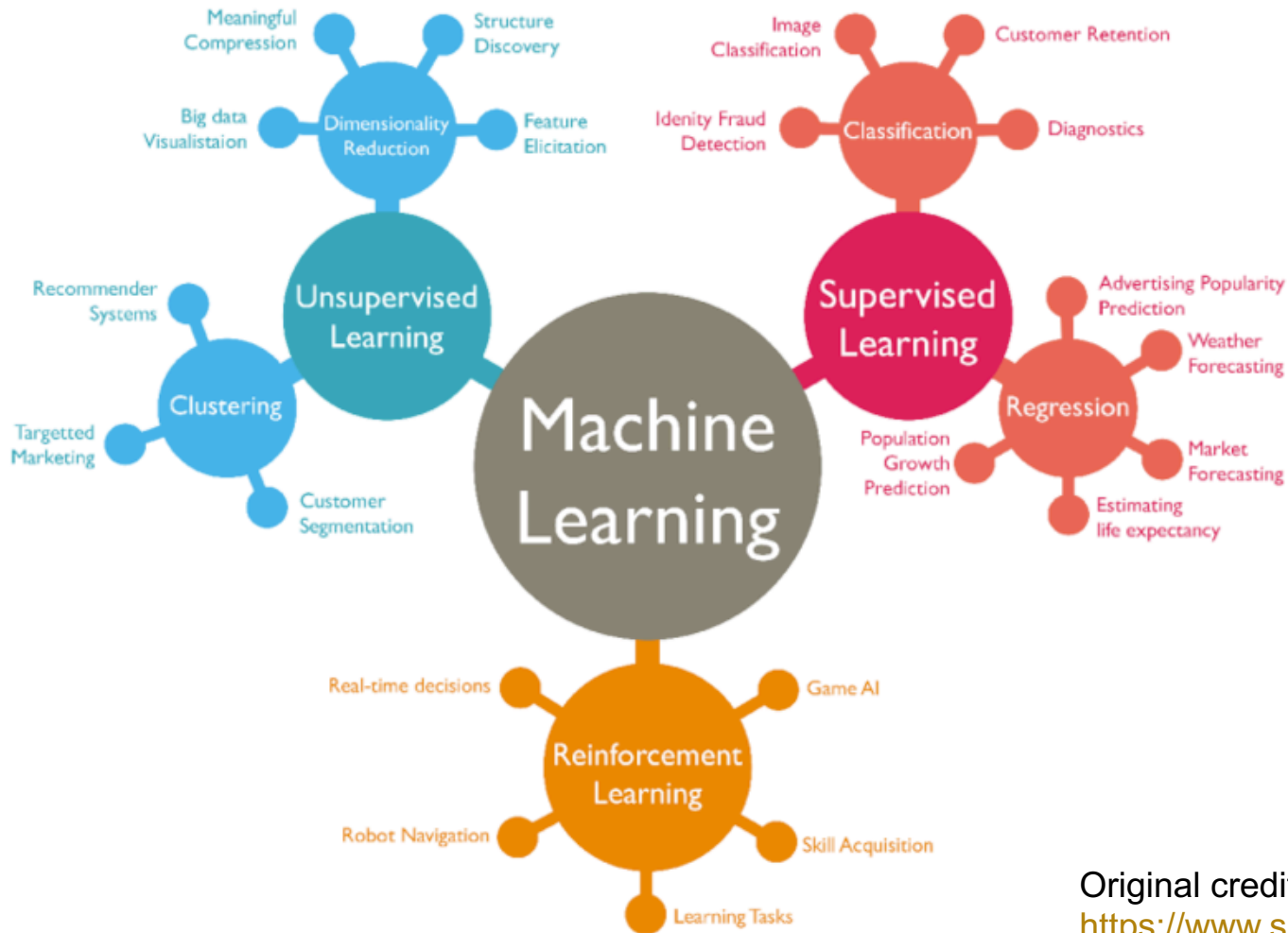
# A.I. IS A VERY BROAD FIELD



# **MACHINE LEARNING IN AI**

- ML itself
  - Models
  - Algorithms
  - Theory
- Or as tool for other AI applications
  - Natural language processing
  - Computer vision
  - Robotics

# INCOMPLETE TAXONOMY OF ML



Original credit unknown, retrieved from <https://www.sharper.ai/taxonomy-ai/>

# **WHY UNSUPERVISED LEARNING?**

- **Labeling data is expensive  
(Supervised)**
- **Gathering raw data is cheap  
(Unsupervised)**
- **Best will probably be a combination**



# **WHY UNSUPERVISED LEARNING? POSSIBLY FOR “COMMON SENSE”**

- ***“The challenge of the next several years is to let machines learn from raw, unlabeled data, such as video or text. This is known as unsupervised learning. AI systems today do not possess “common sense”, which humans and animals acquire by observing the world, acting in it, and understanding the physical constraints of it. Some of us see unsupervised learning as the key towards machines with common sense.”***

***- Yann LeCun, Head of Facebook AI, 2016.***

# QUESTIONS?

**Next lecture:**

**High-Level Overview of AI Topics**