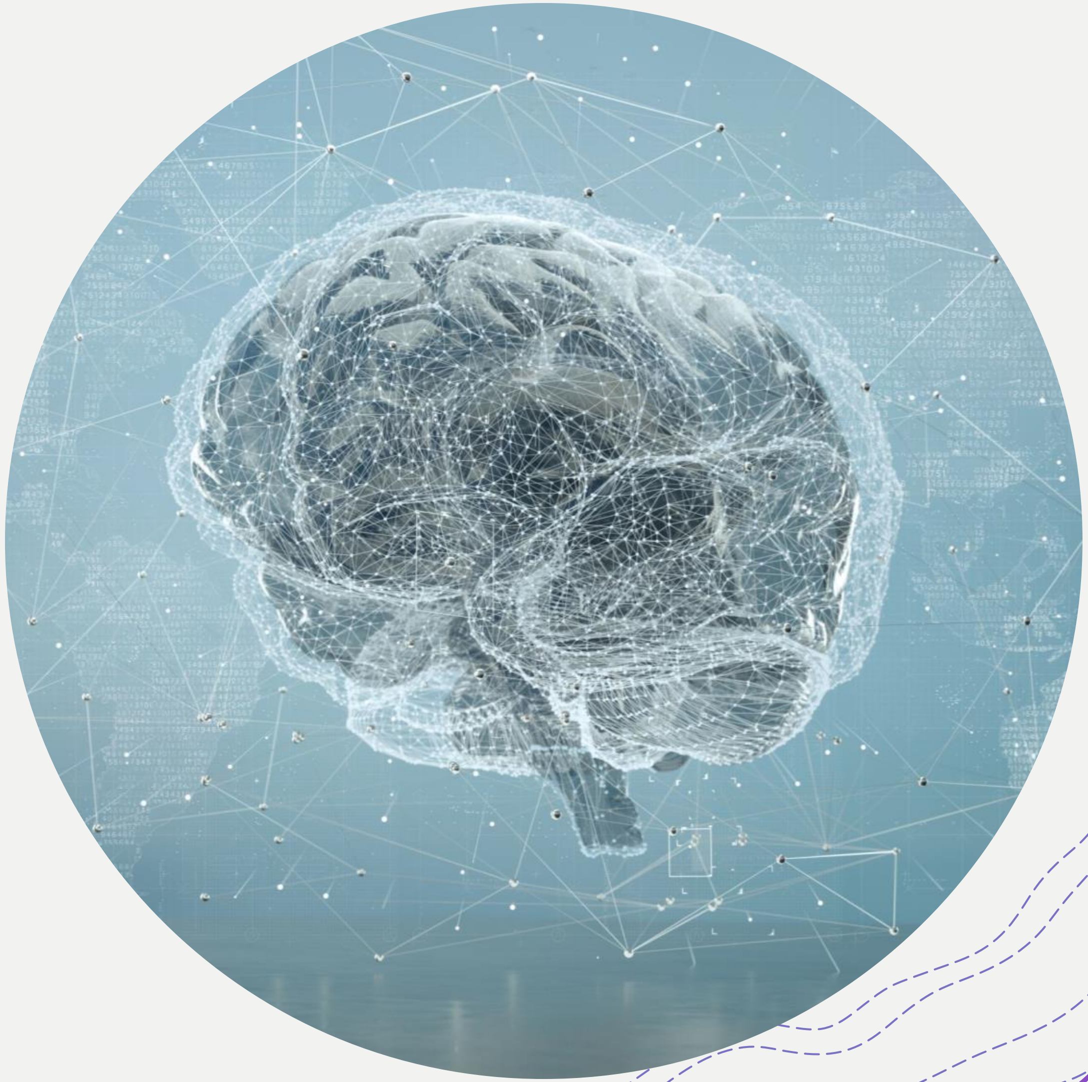
Intelligent Minds and Machines

PSYC 3043

Week 7: Perception and Action + Project



today's agenda

+ upcoming discussion schedule
+ project discussion + rubrics
+ perception and action

Week	Date	Weekly Module	Agenda / Key question	Discussion Type	Leader 1	Leader 2
7	Thursday, October 17, 2024	W7: Perception and Action	Robots and perceptual machines	Prof	Prof	
8	Tuesday, October 22, 2024	W8: Emotional learning	How do we learn emotions?	Group	Emely	Haley
8	Thursday, October 24, 2024	W8: Emotional learning	Can machines learn emotions?	Solo	May	
9	Tuesday, October 29, 2024	W9: Theory of Mind	How do we infer other's mental states?	Group	Ocean	Rachel
9	Thursday, October 31, 2024	W9: Theory of Mind	Do machines have theory of mind?	Solo	Emely	
10	Tuesday, November 5, 2024	W10: Consciousness & sentience	How do we test for consciousness?	Group	Jennifer	May
10	Thursday, November 7, 2024	W10: Consciousness & sentience	Are plants and machines conscious?	Solo	Rachel	
11	Tuesday, November 12, 2024	W11: Memories, Dreams, and Plans	Mental time travel	Prof	Prof	
11	Thursday, November 14, 2024	W11: Memories, Dreams, and Plans	Dreams and memory consolidation	Solo	Haley	
12	Tuesday, November 19, 2024	W12 Project Discussion Day	Project Discussion Day	Prof	Prof	
12	Thursday, November 21, 2024	Psychonomics Conference	NO CLASS	No class	No class	
13	Tuesday, November 26, 2024	THANKSGIVING BREAK!!!	NO CLASS	No class	No class	
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+ review discussion feedback BEFORE you come to meeting
+ Oct 22: guest drop-in (Prof. Claire Harrigan, Geology)
+ soon: QALMRI feedback + Language Board + class participation feedback
+ also soon: mid semester survey

project discussion

6	Sunday, October 13, 2024	**W6 Assignment (Project Milestone #2: QALMRI/SPARK) Due**
7	Tuesday, October 15, 2024	W7: Perception and Action
7	Thursday, October 17, 2024	W7 continued…
7	Sunday, October 20, 2024	**W7 Assignment (Reflection) Due**
8	Tuesday, October 22, 2024	W8: Emotional learning
8	Thursday, October 24, 2024	W8 continued…
8	Sunday, October 27, 2024	**W8 Assignment (Project Milestone #3: Project Plan) Due**

Points

Component	Points	Learning goal
Weekly annotations	10	Evaluate, Produce
Reflections	20	Evaluate, Produce
Class participation	10	Produce, Reflect
Leading discussions	20	Evaluate, Produce, Reflect
Final project	40	Evaluate, Produce
Extra credit	5	Reflect
Total	105	

Class participation (10 points)

Students are encouraged to participate during class by responding to and reflecting on the course content, as well as engaging with other students via activities and group work. Your attendance will also count for some part of your class participation.

Overall, here is a breakdown of how class participation will be assessed:

Component	Points
In-class participation and/or attending office hours	4.5
Peer review for project draft	5
Attendance (attending 90% of classes)	0.5
	10

Milestone	Points
Questions of interest	2.5
QALMRI + SPARK for research articles	10
Project plan/outline	5
First draft	2.5
Final submission	20
Total	40

Extra credit (5 points)

There will be some opportunities to earn extra credit during the semester. These opportunities are described below:

1. Complete class surveys (2 points) : There will be 3 surveys during the semester to gather your reflections and suggestions to improve the course. With the exception of the pre-class survey (which is mandatory), all other surveys will be anonymous, and you will be able to earn 1 point for each survey you complete.
2. Win Discussion Dynamo (1 point): Each time you lead discussion in class, I will provide you feedback on the same. The two students who receive the highest overall discussion score during the semester for leading great discussions will earn 1 extra credit each.
3. Win Team Player (1 point) : Throughout the course, I will also evaluate who stood out as a team player during class discussions and activities, by observing how you participate in groups and consider your peers' perspectives. The student who receives the overall highest score at the end of the semester will earn 1 extra credit.
4. Win Memer of the Semester (1 point) : Each week, you will have the opportunity to submit a meme via

next milestone #3 (project plan: 5 points)

- identify a critical question (broad + specific)
- think about how your question connects to at least ONE of the learning goals #1 and #2

1. Evaluate scientific approaches to defining, understanding, and building intelligences [Department Goal #4]
2. Reflect on your own and other's perspectives on the cultural and ethical issues surrounding the study of intelligence [Department Goal #3]

- think about your original critique: you need to go beyond summarizing articles
- come up with a plan + format

Project Outline Rubric

Criteria	Ratings	Pts
Central thesis/question Project outline clearly motivates (why is this topic important?) and states the central question/thesis (what is the central question the project attempts to answer) and sets the reader up for what is coming up next (how will you answer the question you have posed?).	This area will be used by the assessor to leave comments related to this criterion.	10 pts
Learning Goals The outline clearly describes how the critical question aligns to the learning goals for this class	This area will be used by the assessor to leave comments related to this criterion.	10 pts
Plan for next steps + format Outline clearly describes what's next and lays out a specific timeline for how those plans will be executed, for both the actual project research AND the format that the project will take	This area will be used by the assessor to leave comments related to this criterion.	10 pts
		Total Points: 30

First Draft Rubric

Criteria	Ratings	Pts
Central thesis/question Project clearly motivates (why is this topic important?) and states the central question/thesis (what is the central question the project attempts to answer) in some form (will vary depending on format)	This area will be used by the assessor to leave comments related to this criterion.	10 pts
Critical thinking The analysis is well-motivated and clearly examines a specific question, through the use of specific materials, outcomes, and tests. It is clear that a scientific approach has been taken towards creating the final project and an annotated references list describes how scholarly work has been references and used to create the project.	This area will be used by the assessor to leave comments related to this criterion.	10 pts
Organization, visualization, & flow Clear organization and natural “flow” to the project. Scholarly ideas are referenced correctly and follow logical conclusions/arguments. The project is engaging, in writing and/or visual form.	This area will be used by the assessor to leave comments related to this criterion.	10 pts
		Total Points: 30

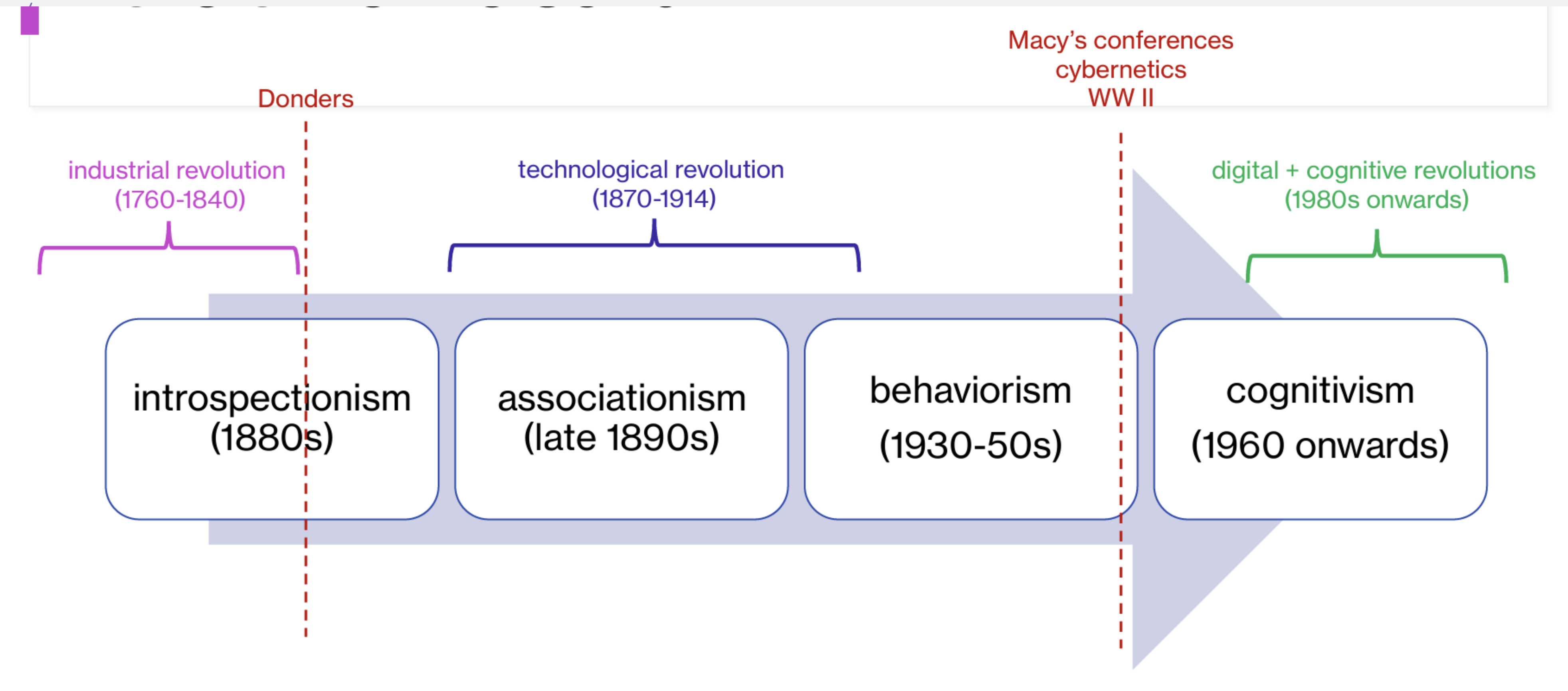
format checklist

+ fill out and then come back and discuss questions and thoughts

perception and action: agenda

+ embodiment article review
+ terminology review
+ podcast & prof. chown debrief
+ vision paper

history of cognition



Searle (1999) Chinese room argument / also Harnad (1990)

Imagine a native English speaker who knows no Chinese locked in a room full of boxes of Chinese symbols (a data base) together with a book of instructions for manipulating the symbols (the program). Imagine that people outside the room send in other Chinese symbols which, unknown to the person in the room, are questions in Chinese (the input). And imagine that by following the instructions in the program the man in the room is able to pass out Chinese symbols which are correct answers to the questions (the output). The program enables the person in the room to pass the Turing Test for understanding Chinese but he does not understand a word of Chinese.

Matheson & Barsalou

Heath E. Matheson
Professor
Memorial University of Newfoundland

Lawrence Barsalou
Professor
University of Glasgow

- **replacement**: discard all mental representations, everything is "in the moment"
- **constitution**: environment scaffolds cognition (e.g., grocery list)
- **influence**: body ⇔ cognition
- **conceptualization**: cognition is supported by real or imagined simulations

such as Hebbian associative learning, or by the weight adjustments that occur in distributive, connectionist networks (e.g. McClelland & Rumelhard, 1985). For instance, in encountering a hammer repeatedly, neural ensembles that respond to different features in each of the modalities (the general shape in visual modality, the sounds it makes in the auditory modality, the way it is held in the motor modality, etc.) are reliably co-activated. The regularities in these co-occurrences serve to establish strong, functional, associations between the different types of features, distributed across the brain. These associative relationships between the features define the distributed network that represents the concept of a hammer (Martin, 2007; also see Barsalou, 1999; Pulvermuller and Fadiga,

A pre-registered, multi-lab non-replication of the action-sentence compatibility effect (ACE)

Richard D. Morey[1] · Michael P. Kaschak[2] · Antonio M. Díez-Álamo[3,4] · Arthur M. Glenberg[3,4] · Rolf A. Zwaan[5] · Daniël Lakens[6] · Agustín Ibáñez[7,8,9,10,11] · Adolfo García[7,8,9,12,13] · Claudia Gianelli[14,15] · John L. Jones[2] · Julie Madden[16] · Florencia Alifano[7] · Benjamin Bergen[17] · Nicholas G. Bloxsom[18] · Daniel N. Bub[19] · Zhenguang G. Cai[20,21] · Christopher R. Chartier[18] · Anjan Chatterjee[22] · Erin Conwell[23] · Susan Wagner Cook[24] · Joshua D. Davis[17] · Ellen R. K. Evers[25] · Sandrine Girard[26] · Derek Harter[27] · Franziska Hartung[22] · Eduar Herrera[28] · Falk Huettig[29,30] · Stacey Humphries[22] · Marie Juanchich[31] · Katharina Kühne[14] · Shulan Lu[27] · Tom Lynes[21] · Michael E. J. Masson[19] · Markus Ostarek[29] · Sebastiaan Pessers[32] · Rebecca Reglin[14] · Sara Steegen[32] · Erik D. Thiessen[26] · Laura E. Thomas[23] · Sean Trott[17] · Joachim Vandekerckhove[33] · Wolf Vanpaemel[32] · Maria Vlachou[32] · Kristina Williams[27] · Noam Ziv-Crispel[34]

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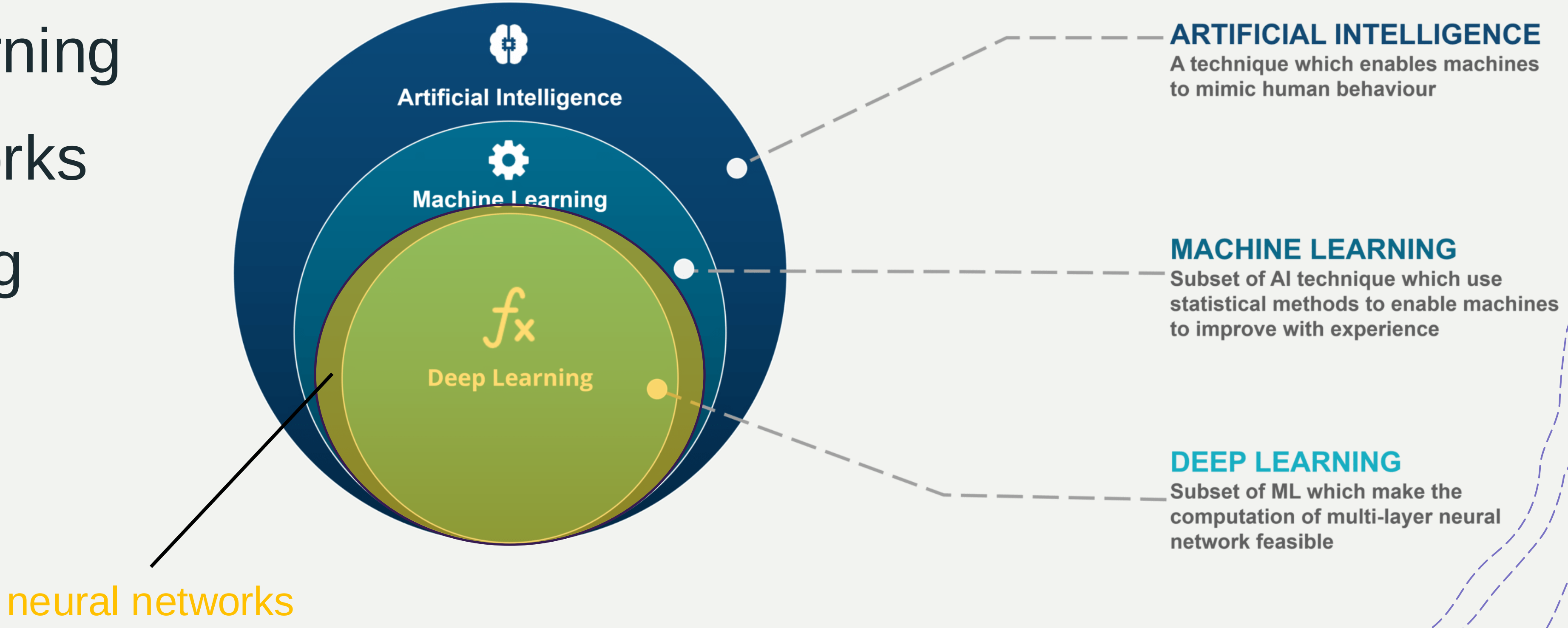
Abstract

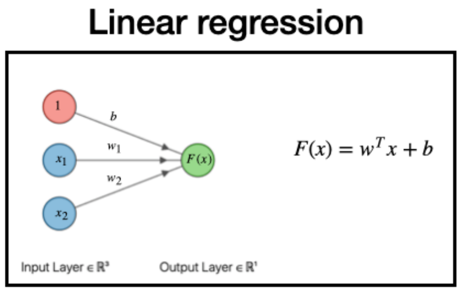
The Action-sentence Compatibility Effect (ACE) is a well-known demonstration of the role of motor activity in the comprehension of language. Participants are asked to make sensibility judgments on sentences by producing movements toward the body or away from the body. The ACE is the finding that movements are faster when the direction of the movement (e.g., *toward*) matches the direction of the action in the to-be-judged sentence (e.g., *Art gave you the pen* describes action toward you). We report on a pre-registered, multi-lab replication of one version of the ACE. The results show that none of the 18 labs involved in the study observed a reliable ACE, and that the meta-analytic estimate of the size of the ACE was essentially zero.

terminology

+ machine learning
+ neural networks
+ deep learning



from regression to neural networks...



https://joshuagoings.com/2020/05/05/neural-network/

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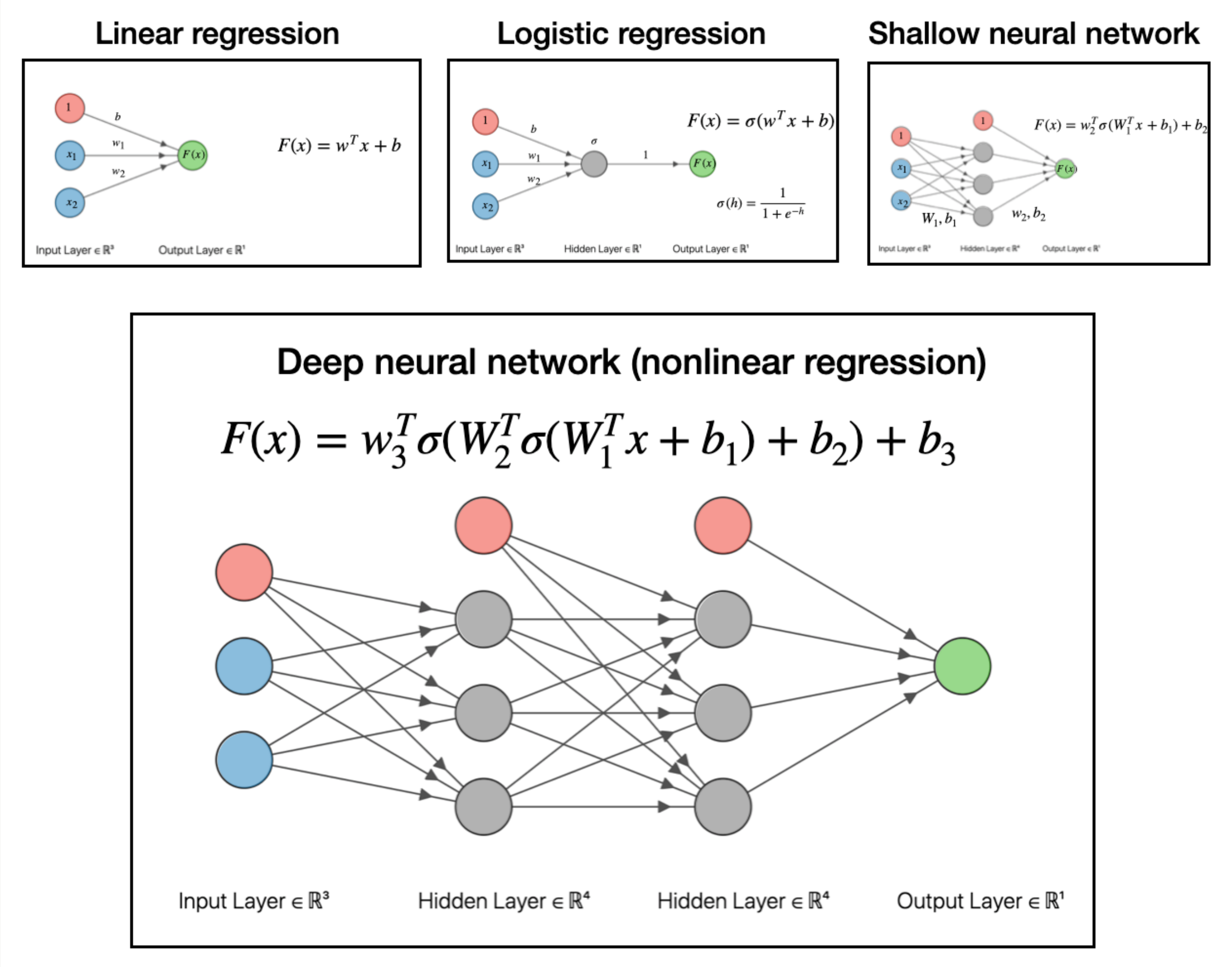


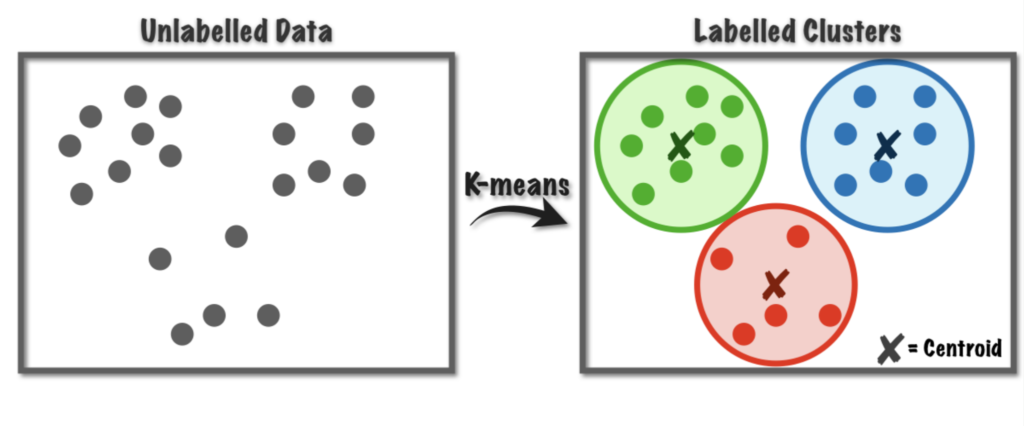
https://joshuagoings.com/2020/05/05/neural-network/

how to teach something to a machine?

- unsupervised (unlabeled data)
  - clustering approaches (e.g., k-means, hierarchical)
  - factor analysis / principal components analysis / dimensionality reduction
- semi-supervised (ordered/structured data)
  - speech/text models
- supervised learning (labeled data, e.g., images)
- reinforcement learning
  - reward-based, can be combined with predictive (neural network) models

unsupervised learning

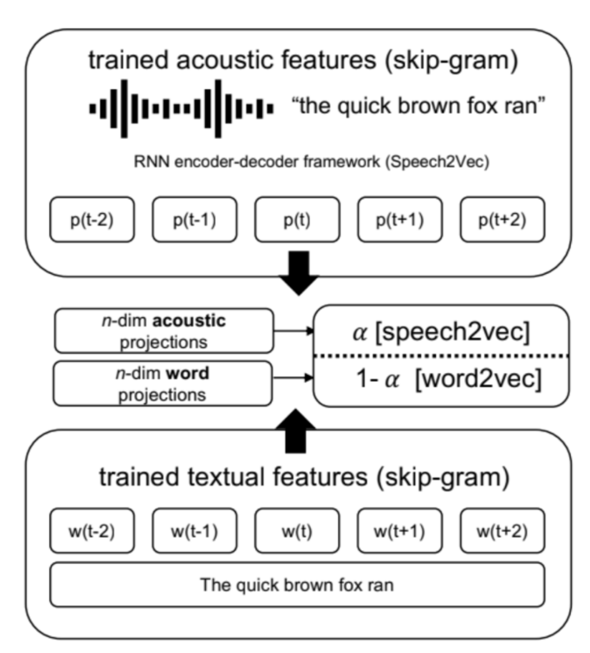
+ given a completely unlabeled set of data points, find some meaningful clusters
+ examples
  + customer segments (teens, adults)
  + anomaly detection (bots)
  + recommender engines (Netflix)

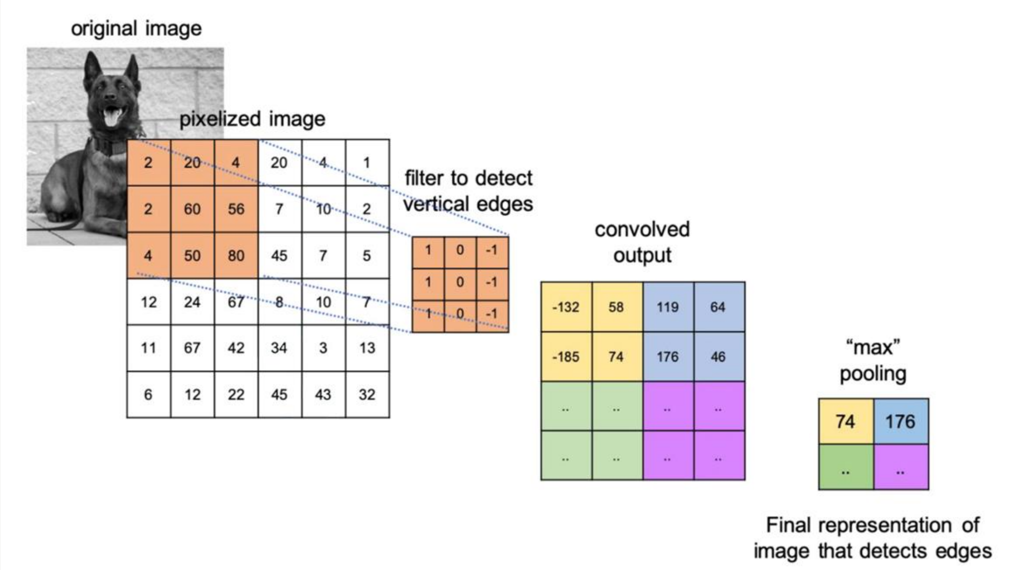


$$\arg\min_{\mathbf{S}} \sum_{i=1}^{k} \frac{1}{|S_i|} \sum_{\mathbf{x},\mathbf{y}\in S_i} \|\mathbf{x}-\mathbf{y}\|^2$$

multimodal learning

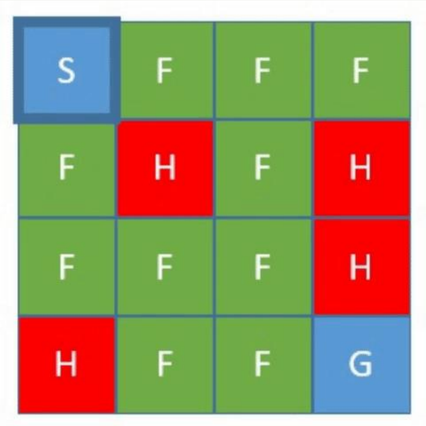
+ convert everything into a numeric representation
+ learn associations between those representations via some type of “machine learning” algorithm to perform task(s)
+ “convolutional” networks
+ multimodal networks





reinforcement learning

- learning through rewards
- components:
  - s: states (rooms 1, 2, 3 , etc.)
  - a: actions (1, 2, 3, etc.)
  - R: rewards (for walkable path)
    - 1 to 2 : +1
    - 2 to 6: -1 or 0
  - Q (s, a): quality of a particular action via Bellman equation
- ***deep*** RL: for more complex setups, can use a neural network to predict different Q-values and learn from prediction error



1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

$$Q(s,a) = R(s,a) + \gamma \sum_{s'} \left(P\left(s,a,s'\right) \max_{a'} Q\left(s',a'\right) \right)$$

$$Q(s_t,a_t) \leftarrow (1-\alpha) \cdot \underbrace{Q(s_t,a_t)}_{\text{old value}} + \underbrace{\alpha}_{\text{learning rate}} \cdot \overbrace{\left(\underbrace{r_t}_{\text{reward}} + \underbrace{\gamma}_{\text{discount factor}} \cdot \underbrace{\max_a Q(s_{t+1},a)}_{\text{estimate of optimal future value}} \right)}^{\text{learned value}}$$

https://www.baeldung.com/cs/reinforcement-learning-neural-network

https://blog.floydhub.com/an-introduction-to-q-learning-reinforcement-learning/

questions

- Haley: Would the robots in robotcup use DNNs as tools or am I misunderstanding this purpose? If they would not- why not? Are there certain machines that can only handle DNNs?

key themes / Prof. Chown visit

- ethics and goals (Jennifer, Haley and Rachel)
- reward for a machine? (May, Emely, and Ocean)

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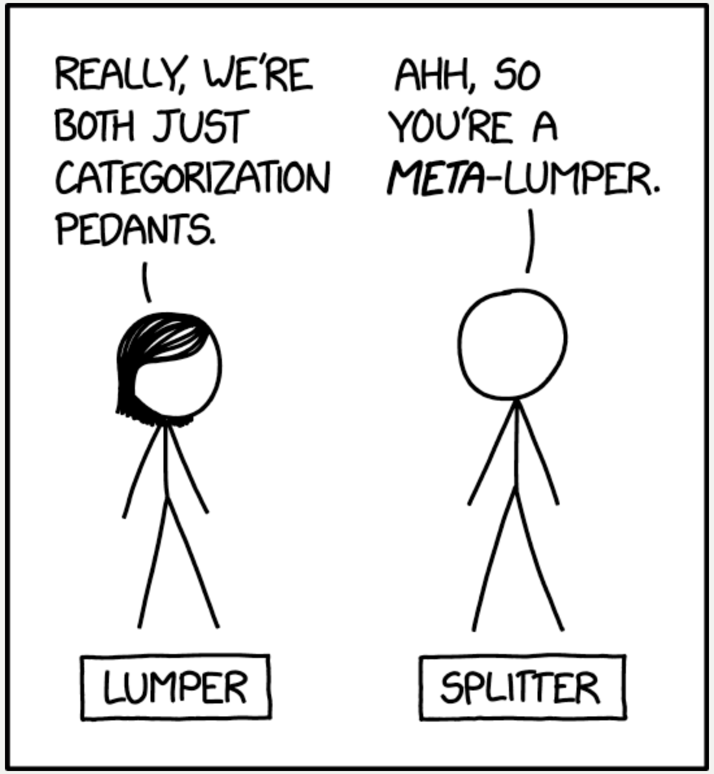

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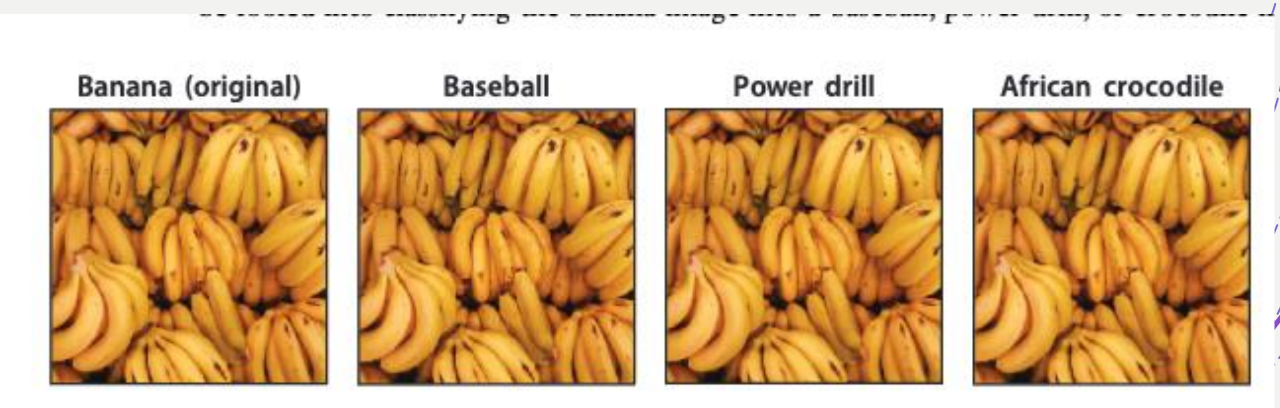
vision as a test case

+ benchmarks
+ “adversarial” attacks
+ working with limited data, using inductive biases and structured architectures and processes

Felix A. Wichmann
Professor, Eberhard Karls Universität Tübingen

Robert Geirhos
Research Scientist, Google DeepMind



broader ideas

- "how much is really necessary to make it more like humans instead of more like animals/non-humans?" – Emely
- "how did we create something that we do not understand and cannot apply to ourselves?" – May

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