What is AI?

Dave Touretzky

Carnegie Mellon University

Artificial Intelligence is a **collection of techniques** that allow **computers** to do things that, when people do them, are considered evidence of **intelligence**.

We Use AI-Powered Technologies Every Day

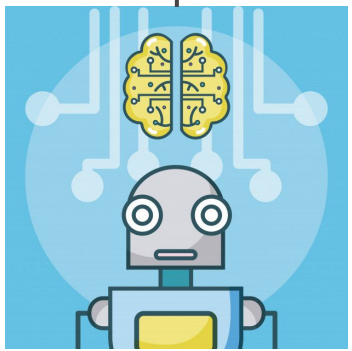
- Speech recognition
  - Home assistants: “Alexa, please dim the lights.”
  - Automated video subtitles; automated transcription services (otter.ai, sonix.ai)
- Computer vision
  - Use your face to unlock your iPhone; play with Snapchat and Tiktok filters
  - Self-driving cars: Tesla autopilot; automated lane departure warnings; emergency braking
- Language understanding
  - Google search: “What does an alligator weigh?” “What’s the second largest city in Honduras?”
  - Google Translate: automatic translation among any of 100+ languages; translate menus
- Recommender systems
  - Netflix→movies; Amazon→products; Facebook→news stories; Google→ads
- Robotics
  - Roombas clean up; Kiva robots automate warehouses; drones follow you

AI Poses Challenges for Society

- Many types of work will become more highly automated.
  - Some people will **lose their jobs** -- including white collar jobs.
  - People will find that their **jobs have changed**; new skills are needed.
  - New **jobs will be created** around AI, robotics, and machine learning.
- Automated decision making systems can be opaque and biased.
- AI is powering the surveillance state:
  - Ubiquitous face recognition: loss of privacy
  - Automated monitoring of phone calls and social media
- Deep fakes: seeing is no longer believing; hard to know what to trust

AI is a Branch of Computer Science

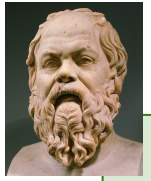
- Algorithms and complexity theory
- **Artificial intelligence**
- Computer systems (i.e., hardware)
- Databases
- Graphics
- Human-computer interaction
- Networking
- Operating Systems
- Programming Languages
- Security
- Software Engineering



AI's Relationships with Other Disciplines

Statistics
Bayesian inference, regression

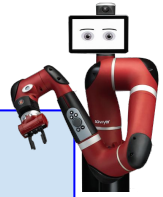
Operations Research
planning, optimization



Philosophy
logic, ontology, theory of mind, consciousness

Artificial Intelligence

Cognitive Science
perception, memory, learning, reasoning



Robotics
artificial intelligence + mechanical engineering + electrical engineering

AI4K12.org

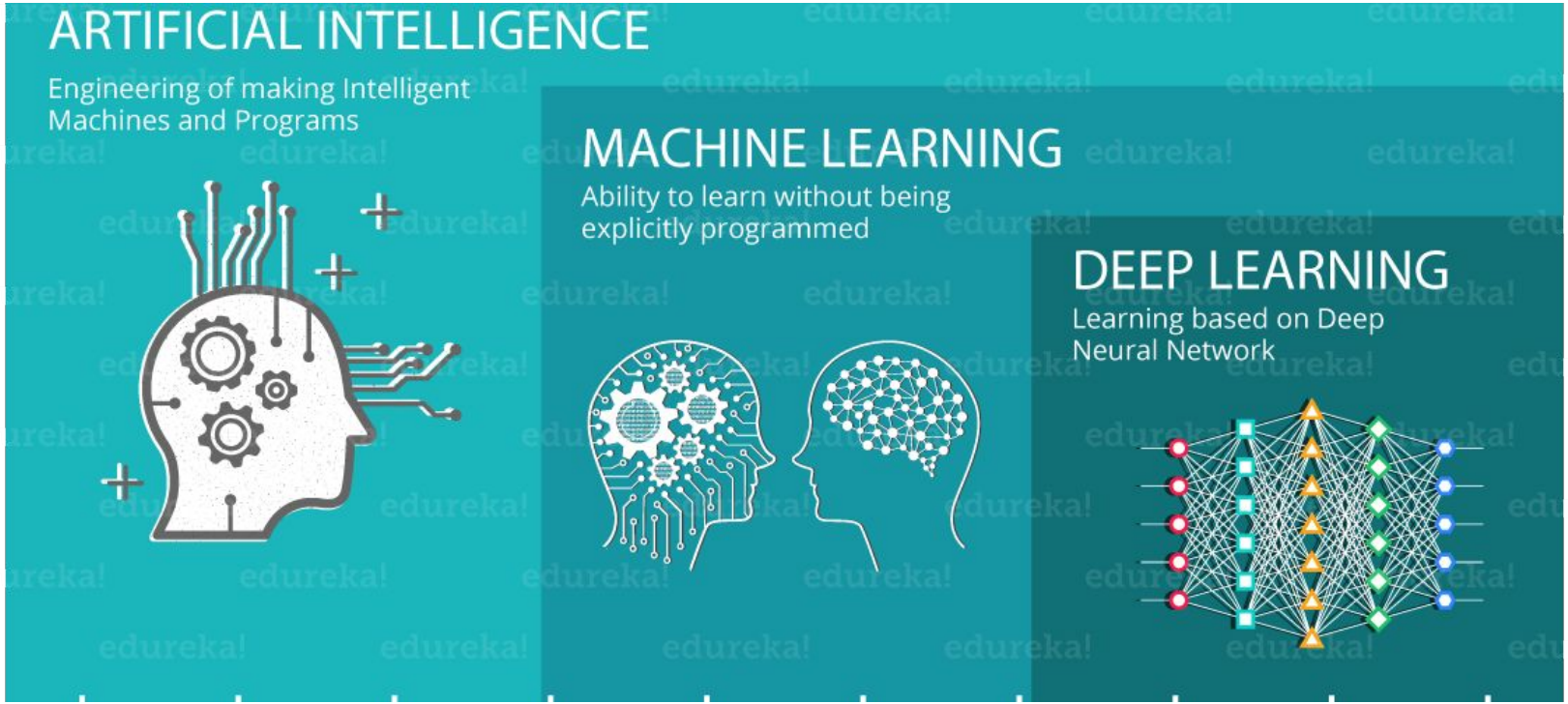
Specialties Within AI

- Computer vision
- Game playing (chess, go, poker, etc.)
- Knowledge representation
- **Machine learning**
- Machine translation
- Natural language understanding
- Neural networks
- Optimization
- Planning
- Search
- Speech recognition
- Theorem proving / automated reasoning

These are topics that would be covered in a university-level AI course.

Each topic might itself be a course in a graduate-level AI program.

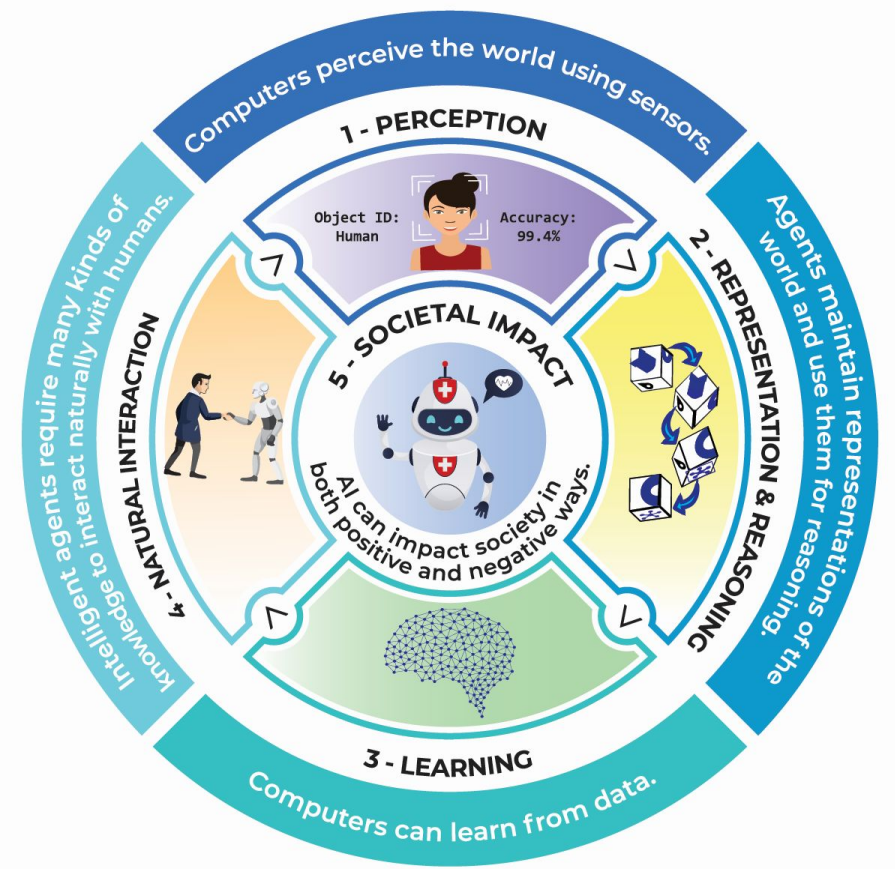
AI and Machine Learning



1950s 1980s 2010s

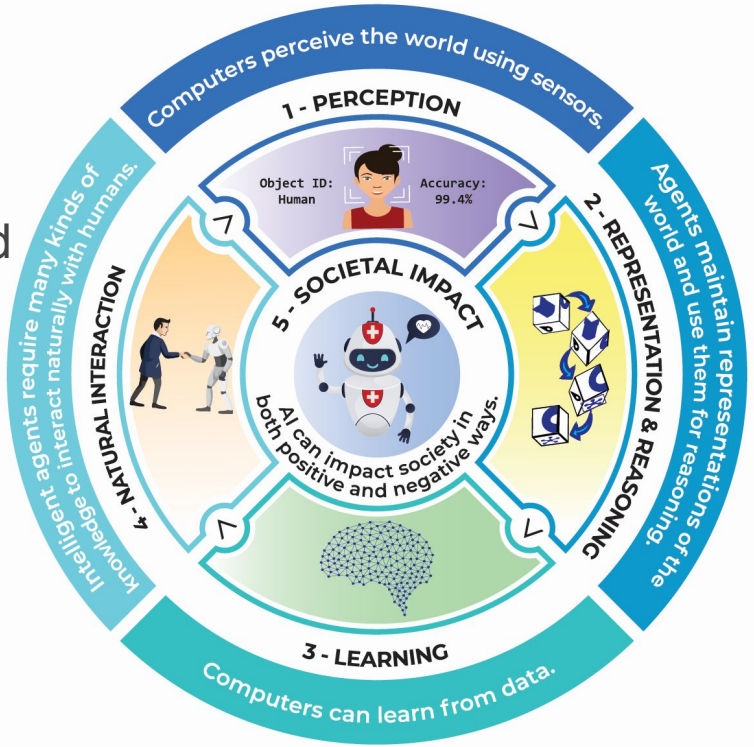
Five Big Ideas in AI

- Organizing framework for the K-12 guidelines.
- 5 big ideas are enough to cover the richness of the field, but small enough to be manageable by teachers.
- CSTA experience shows 5 is a good number.
- Not necessarily the way AI practitioners view their field, but appropriate for the needs of the K-12 audience.



Five Big Ideas in AI

1. **Perception:** Computers perceive the world using sensors.
2. **Representation and reasoning:** Agents maintain representations of the world and use them for reasoning.
3. **Learning:** Computers can learn from data.
4. **Natural interaction:** Intelligent agents require many kinds of information to interact naturally with humans.
5. **Societal impact:** AI can impact society in both positive and negative ways.



AI4K12.org

Weak vs. Strong AI (or Narrow vs. Broad AI)

Weak AI is what we have now:

- Specialized algorithms for solving hard but narrowly-defined problems.
- When IBM's Deep Blue beat chess grandmaster Garry Kasparov in 1996-97, it had no idea who Kasparov was, or what a grandmaster was, or even what physical chess pieces look like.
- Google cannot tell you if an alligator weighs more than an ostrich.

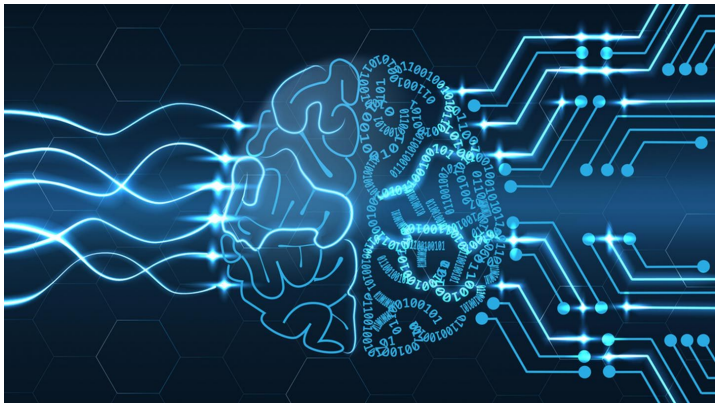
Strong AI or AGI (Artificial General Intelligence) is what we hope to achieve:

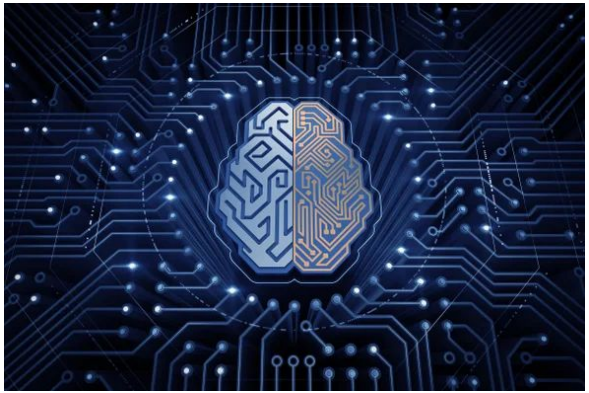
- General reasoning abilities with human-like breadth and flexibility
- Self-awareness, consciousness
- This is what is needed to create Commander Data or C3PO or Terminator
- Sadly, we have no idea how to achieve this

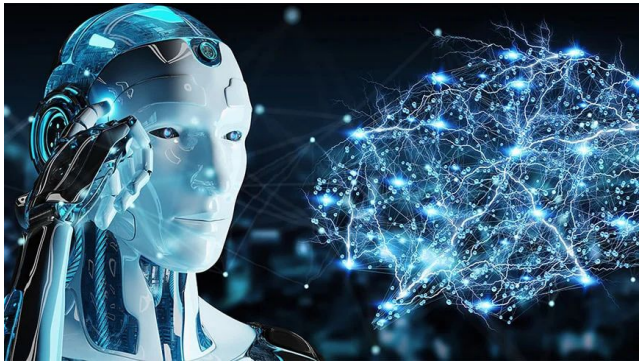
Hype vs. Reality

“Google, What Does AI Look Like?”

AI is Blue and Has Brains and Wires and Cyborgs







What AI Really Looks Like: Algorithms + Data Structures

```python
import tensorflow as tf

x = tf.placeholder(tf.float32)
W = tf.Variable(0 , dtype = tf.float32)
b = tf.Variable(0 , dtype = tf.float32)
y_ = tf.placeholder(tf.float32)

y = W * x + b

lost = tf.reduce_mean(tf.square(y_ - y))

optimizer = tf.train.GradientDescentOptimizer(0.01)
train_step = optimizer.minimize(lost)

sess = tf.Session()
init = tf.global_variables_initializer()
sess.run(init)

tf.summary.scalar('lost' , lost)
merged = tf.summary.merge_all()
writer = tf.summary.FileWriter("./logs", graph=tf.get_default_graph())

steps = 1000
for i in range(steps):
    xs = 1
    ys = 3
    feed = { x: xs, y_: ys }
    sess.run(train_step , feed_dict=feed)
    xs = 2
    ys = 5
    feed = { x: xs, y_: ys }

    _ , rs = sess.run([train_step , merged] , feed_dict=feed)
    writer.add_summary(rs, i)

print("W: %f" % sess.run(W))
print("b: %f" % sess.run(b))
```

the function of the code is

linear recurrence

$y = 2x + 1$

calculate the lost

record the lost

update