MACHINE LEARNING/ ARTIFICIAL INTELLIGENCE THE NEXT STEPS

WHERE ARE WE NOW?

Machine learning is programming computers to optimize a performance criterion using example data or past experience.

Learning is used when:

- Human expertise does not exist (navigating on Mars),
- Humans are unable to explain their expertise (speech recognition)
- Solution changes in time (routing on a computer network)
- Solution needs to be adapted to particular cases (user biometrics)

- Learning general models from a data of particular examples
- Data is cheap and abundant (data warehouses, data marts); knowledge is expensive and scarce.
- Example in retail: Customer transactions to consumer behavior
- Build a model that is *a good and useful approximation* to the data.

WHERE ARE WE NOW?

- Retail: Market basket analysis, Customer relationship management (CRM)
- Finance: Credit scoring, fraud detection
- Manufacturing: Optimization, troubleshooting
- Medicine: Medical diagnosis
- Telecommunications: Quality of service optimization
- Bioinformatics: Motifs, alignment
- Web mining: Search engines

Machine Learning: Study of algorithms that improve their performance at some task with experience
Optimize a performance criterion using example data or past experience.
Role of Statistics: Inference from a sample
Role of Computer science: efficient algorithms to solve the optimization problem Representing and evaluating the model for inference

This trend is accelerating
Improved machine learning algorithms
Improved data capture, networking, faster computers
Software too complex to write by hand
New sensors / IOT devices
Demand for self-customization to user, environment

It turns out to be difficult to extract knowledge from human experts→*failure of expert systems in the 1980's*.

APPLICATIONS

Association Analysis
Supervised Learning
Classification
Regression/Prediction
Unsupervised Learning
Reinforcement Learning

SUPERVISED LEARNING

Prediction of future cases: Use the rule to predict the output for future inputs
Knowledge extraction: The rule is easy to understand
Compression: The rule is simpler than the data it explains
Outlier detection: Exceptions that are not covered by the rule, e.g., fraud

UNSUPERVISED LEARNING

Learning “what normally happens”
No output
Clustering: Grouping similar instances
Other applications: Summarization, Association Analysis
Example applications
- Customer segmentation in CRM
- Image compression: Color quantization
- Bioinformatics: Learning motifs

REINFORCEMENT LEARNING

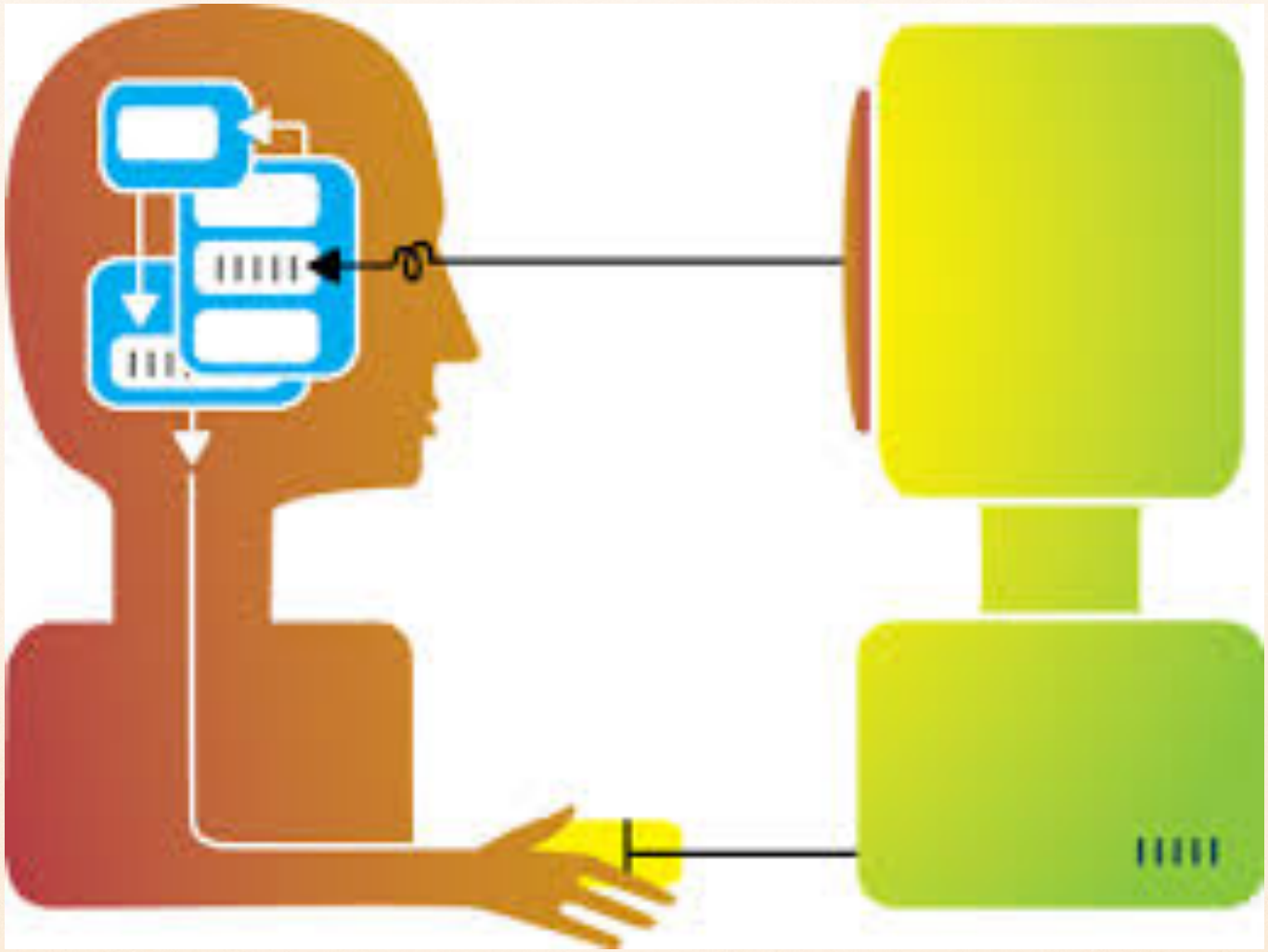
Topics:
- Policies: what actions should an agent take in a particular situation
- Utility estimation: how good is a state (→used by policy)

No supervised output but delayed reward

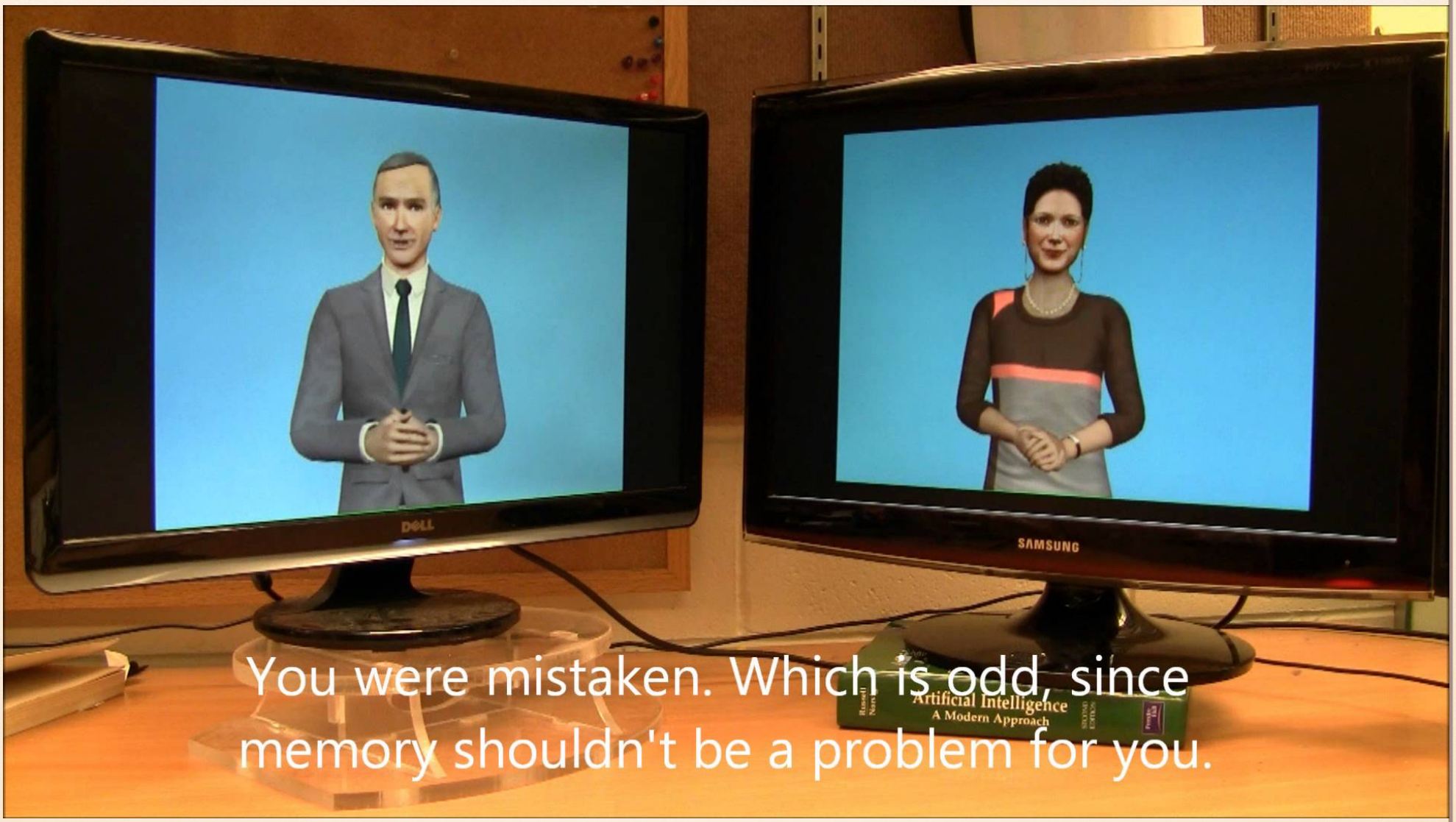
Credit assignment problem (what was responsible for the outcome)

Applications:
- Game playing (Deep Mind!)
- Robot in a maze
- Multiple agents, partial observability, ...

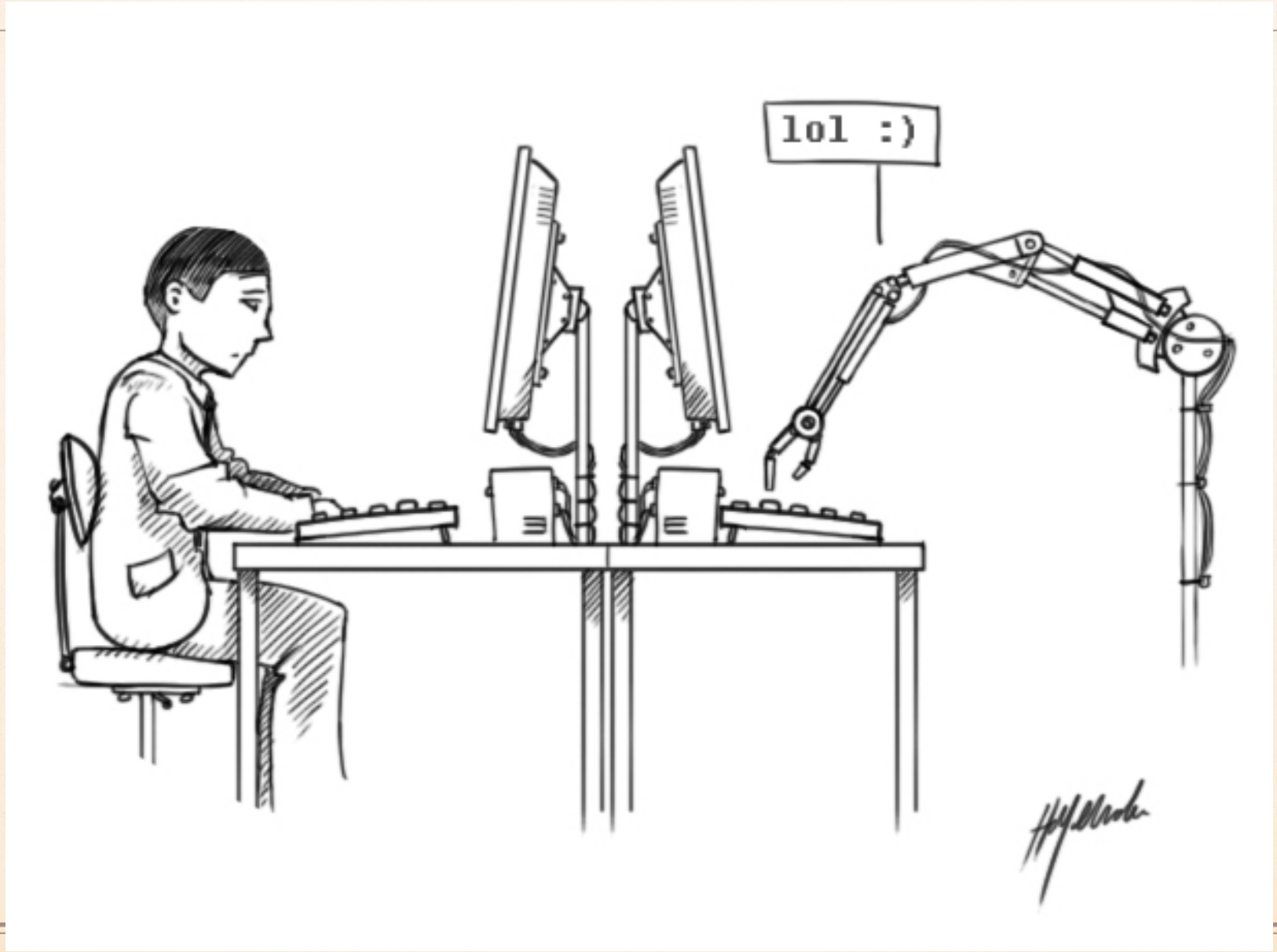
MY RESEARCH



CHATBOTS


DELL
SAMSUNG
Artificial Intelligence
A Modern Approach
You were mistaken. Which is odd, since
memory shouldn't be a problem for you.

A TURING TEST - REDEFINED



WEARABLES


muse

CURRENT PROBLEMS

1. **Churn Prediction**: Churn prediction is one of the most popular use cases for people who want to leverage machine learning. It has a large business value and benefit attached to itself specially in industries like the telecom and banking. Several challenges such as the skewed nature of the data set available and the ability to decide which models to use are going to be under a lot of debate.

2. **Sentiment Analysis** : A lot of decisions these days are being taken on the opinion of others. We buy a product more because it has received a positive opinion and we visit a hotel most likely because it got the best rating online. Sentiment analysis has its own challenges such as how granular can the sentiment be determined, how subjective is the sentiment and so on, and hence sentiment analysis will be a good place to attack machine learning.

3. **Truth and Veracity**: There is a lot said online these days and it is hard to determine what is true and what is fake. We have bots smart enough to publish content like human beings and there are social aspects attached to the ratings of various entities online. I feel machine learning will be leveraged as a big challenge to determine the veracity/truth of information online.

CURRENT PROBLEMS

4. **Recommendations** : There is such a myriad of choices available online that it is becoming even more difficult to choose a book, restaurant or even a simple product. The ability to do smart recommendations based on the user's context and not just based on the preferences of the crowd is going to be a great challenge because it is a great deal to understand the user's context.

5. **Online Advertisement**: There is a lot of work and many start ups around the space of intelligent online advertisements, but to be able to push the right advertisement at the right time in the right way to the user needs a lot of understanding of the when to target a particular customer. Machine learning exhibits a great challenge in this space in my opinion for determining the user's behavior online to push the correct advertisement instantly when the user really needs it.

CURRENT PROBLEMS

6. **News Aggregation**: Plenty of news is being generated around us from various different places about a variety of topics. Yet we all have a constant thirst to consume all the news relevant to us as much as possible. How are we going to aggregate news according to the user's preference? Does his taste vary with time? How do we learn this variation? All this is going to be a challenge for machine learning and it involves a great deal of making sense of news and articles.

7. **Scalability**: Data is constantly expanding in variety, velocity and volumes. Can the traditional machine learning algorithms that were developed a decade back be applied to big data? I feel they will all undergo some kind of refurbishment to be able to operate on data at large scale. Can SVMs train faster? Can it be made parallel? This is going to be a good problem to focus with the rise of big data.

8. **Content Discovery/Search**: There are millions of people around the world on various social networks and within enterprise. How can you discover people who share similar interests as yours and what parameters are you going to consider to measure this similarity? How do we measure similarity and can we quantify this? I feel this is a nice problem for machine learning where we will face the challenge of trying to find the needle in a haystack.

CURRENT PROBLEMS

9. **Intelligent Learning:** For example, it is still difficult to identify a behavior in a video sequence and there has been a lot of research around this space. In my opinion, with the state of art learning algorithms, I feel one of the top problems is to be enable machines to be able to see, hear and recognize like the human brain does. This means a good problem would be to leverage machine learning algorithms to use different modes of learning to achieve a particular task, be it recognition or anything similar.

10. **Machine Learning for Medicine**: There are so many diseases that need our attention and a lot of human time spent in researching for their cure by analyzing a lot of symptoms. Yet, two patients with similar health problems receive different kinds of treatment and eventually different extents of cure. Can we use machine learning to understand how a patient is feeling at a particular moment and appropriate recommend the right treatment for him? I feel this will change how we are going to live and will help doctors discover a lot of new medical methodologies.

LEADING INSTITUTIONS

- MIT
- STANFORD
- CALTECH