AI Applications: Present and Future, Hype and Reality

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What is artificial intelligence?

Terminology…

- Intelligence has many aspects:
  - Natural language processing (NLP)
  - Machine learning (ML)
  - Computer vision (CV)
  - Automated reasoning (AR)

- Artificial general intelligence (AGI)
- Applied AI
- Data science

Source: twitter.com/computertales/status/912177367702843392

Why are people so excited about AI nowadays?

COCOQA 5078
How many leftover donuts is the red bicycle holding?
Ground truth: three

Deep learning

Deep learning has enabled a wave of progress, especially in vision and in combined language and vision.

Also, deep learning has yielded better accuracy in many predictive tasks, such as forecasting.

Source: http://www.cs.toronto.edu/~mren/imageqa/

So, what is deep learning?

Deep learning (DL) is the current generation of neural networks

- Neural networks were invented in the 1950s, with great advances in the 1980s, and then again in the 2010s.
- Inspired (loosely!) by neuroscience.
- DL takes advantage of modern computational power.
- Traditional statistical methods are too simple for massive data, or for text, image, and video data.

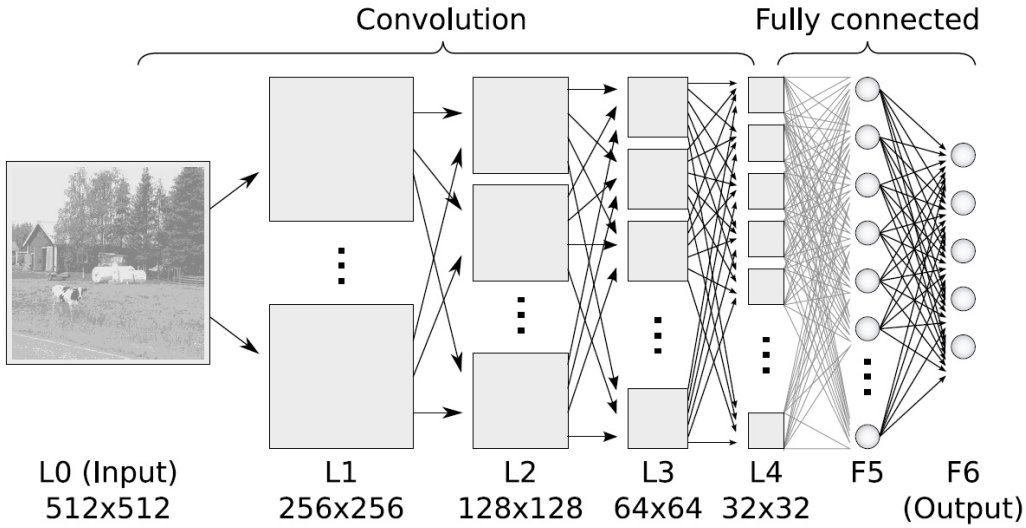


Image source: https://www.ais.uni-bonn.de/deep_learning/

Deep learning applied to forecasting

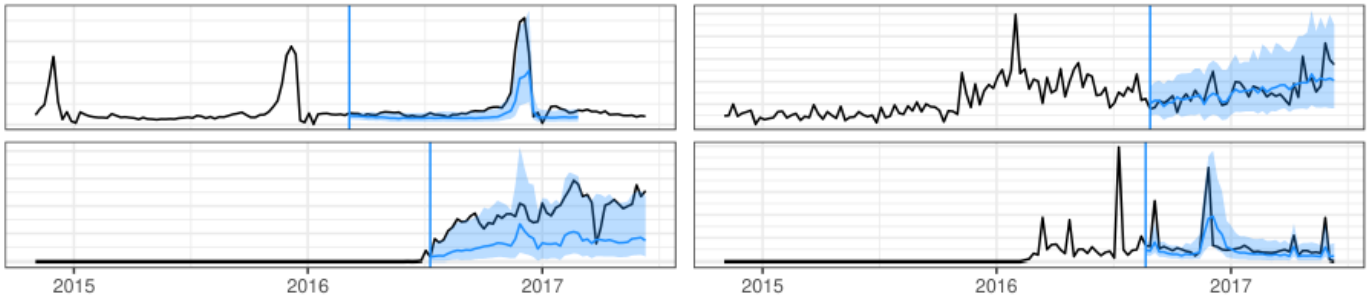
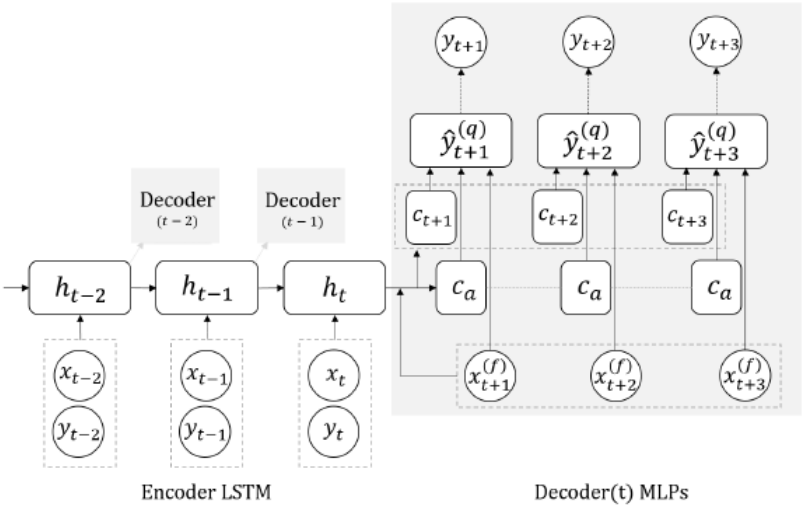


Figure 3: MQ-RNN Forecasts for four example products.



Source: https://arxiv.org/pdf/1711.11053.pdf

Deep versus shallow understanding

Now and foreseeably, artificial intelligence (AI) methods can achieve shallow understanding, but not deep understanding.

■What is understanding?	Practically, understanding is the ability to answer questions of many different types correctly.
■What is **shallow** understanding?	The ability to answer a limited range of questions that are similar to each other.
■What is **deep** understanding?	Understanding that is multilayered, and involves broad context, and uses broad knowledge.

Etymology: The Latin verb **intelligere** means to understand, with the root meaning “to select between.”

Deep understanding

Is the answer really three? Maybe it is three and a half? Or three and two pieces?

Deep understanding combines language and vision and knowledge and personal experience.

Here, deep understanding requires reasoning about occlusion, about gravity, about social conventions, and more.

COCOQA 5078

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Ground truth: three

Consequences of shallow understanding

Many applications remain impossible

- Example: Interviewing candidates for a job

Most applications remain brittle

- Examples: Face recognition, street sign recognition, question answering:

Q: Alexa, how high is Mount Everest?	A: " … 29,029 feet …"
Q: Alexa, where is **it** located?	A: "I couldn't find that one, but I'm working on adding more local businesses."

AI systems need excessive quantities of training examples

- Consider the regional meaning of **wicked** as in "It's wicked cold outside." A human needs only one example, and some thinking, to know when and when not to use this idiom.

Is deep understanding really needed?

Yes, for "AI-complete" tasks.

Example: True autonomous driving is AI-complete.

- To be fully self-driving, a car needs to understand symbolic human gestures.

Source: https://www.express.co.uk/news/nature/665681/man-stops-traffic-duck-ducklings-cross-road-animal-lover-John-Ridley-Cheltenham

So, when are current AI methods useful?

ML methods can solve problems that cannot be programmed directly

- In many applications, mistakes due to brittleness can be tolerated
- In other scenarios, mistakes are rare because the environment is not adversarial

AI methods can be super-human in speed, throughput, repeatability, comprehensiveness

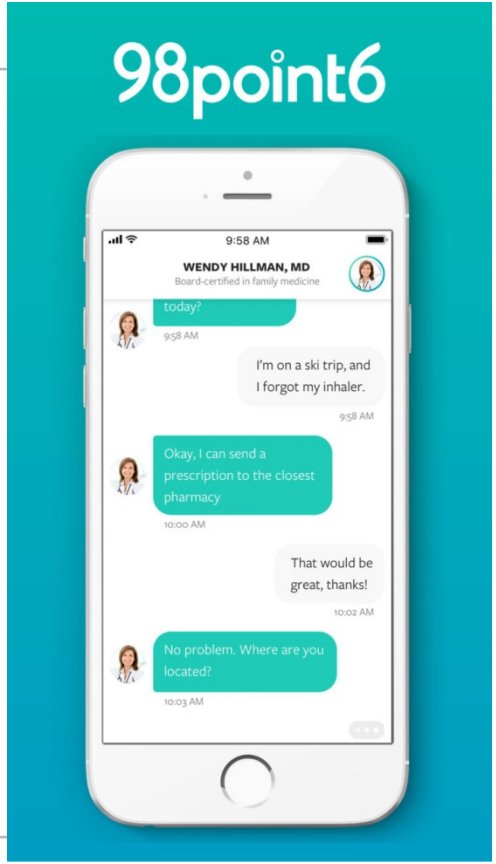
- A human-machine partnership (such as a search engine!) can outperform either alone

Example: Higher convenience and productivity in medicine

How can we make healthcare visits more convenient for patients, and more efficient for doctors?

- Step 1: The patient describes his/her symptoms in free text.
- Step 2: Based on this text, the app uses ML to select follow-up questions from a bank of standard questions.
- Step 3: The patient answers the questions.
- Step 4: The physician reads all the answers, then meets the patient.
- Step 5: The physician asks for more information as needed.
- Step 6: The physician makes decisions: medicine, advice, referrals.

Deep understanding is not necessary!



Source: https://www.geekwire.com/2018/98point6-launches-virtual-clinic-app-solve-americas-primary-care-crisis-ai/

Present and future, hype and reality

Do use the latest AI methods to discover patterns in data

- Analyze multiple types of data simultaneously
- Expect super-human performance along some dimensions, but not in deep understanding
- Look for systems that use the complementary strengths of software and of humans

Do not expect genuine artificial intelligence in the foreseeable future

- But don’t be confident that genuine AI is impossible
- We can’t predict when, but there will be more breakthroughs in research in the future