Simple tasks, grand challenges: defining an evaluation roadmap for general AI

Marco Baroni
Tomas Mikolov, Rahma Chaabouni, Allan Jabri,
Germán Kruszewski, Armand Joulin, Klemen Simonic
Progress in machine learning

Image credit: Aphex34
Progress in machine learning

Mnih et al. 2015
Progress in machine learning

Silver et al. 2016

#RAAIS2017
Progress in machine learning: Commonalities

- Model trained to accomplish a single task
- Long training phase
- Direct error signal
The machine we'd want

- Hi Machine, today my blood test results should be available at the clinic, can you help me picking them up?
- Sure, how can I do that?
- Search the number of St. George Clinic, call them, and ask them for their hours. Then, call me a cab for the earliest time at which they're open.
The machine we get

- **Q:** Google, can you pick up my blood test results?
- **A:** Things your doctor won't tell you about your blood test results
- **A:** Can cancers be picked up in blood tests?
- **A:** A typical blood test would show pregnancy, right?
Desideratum #1: Flexibility, fast adaptation to new tasks

• Hi Machine, today my blood test results should be available at the clinic, can you help me picking them up?
• Sure, how can I do that?
• Search the number of St. George Clinic, call them, and ask them for their hours. Then, call me a cab for the earliest time at which they're open.
Desideratum #2: Ability to communicate and learn through natural language

• Hi Machine, today my blood test results should be available at the clinic, can you help me picking them up?

• Sure, how can I do that?

• Search the number of St. George Clinic, call them, and ask them for their hours. Then, call me a cab for the earliest time at which they're open.
Desideratum #3: Learn from light error signals

- Hi Alice, I have booked the cab for 2.30pm.
- Great, thank you!
Learning in the wild?

https://www.flickr.com/photos/torek/3452468522

#RAAIS2017
Learning in the wild?

Chloroplasts' main role is to conduct photosynthesis, where the photosynthetic pigment chlorophyll captures the energy from sunlight and converts it and stores it in the energy-storage molecules ATP and NADPH while freeing oxygen from water. They then use the ATP and NADPH to make organic molecules from carbon dioxide in a process known as the Calvin cycle. Chloroplasts carry out a number of other functions, including fatty acid synthesis, much amino acid synthesis, and the immune response in plants. The number of chloroplasts per cell varies from 1 in algae up to 100 in plants like Arabidopsis and wheat.

What is the process of turning CO2 into organic molecules called?

https://rajpurkar.github.io/SQuAD-explorer/
The CommAI approach: Simple tasks, big challenges

E: concatenate A and K.
L: djksjdkjf.
E: wrong, you should have said AK.

E: reverse KRM.
L: MRK.
E: right. [+1 reward]

E: reverse concatenate K and XYK.
L: KYXK.
E: right. [+1 reward]

E: reverse BRGJ.
L: JGRB.
E: right.
"Simple"?

- **E:** dpodbubufobuf!B!boe!L/
- **L:** eklkelkg/
- **E:** xspoh-!zpv!tipvme!ibwf!tbje!BL/

- **E:** sfwfstf!LSN/
- **L:** NSL/
- **E:** sjhiu/ [+1 reward]

- **E:** sfwfstf!CSHK/
- **L:** KHSC/
- **E:** sjhiu/

#RAAIS2017
"Simple"?

TASK 1

TASK 1 again

#RAAIS2017
Open research problems #1: Compositionality

**E:** concatenate A and K.
**E:** reverse KRM.
**E:** reverse concatenate K and XYK.

- Once a model solved $\text{concatenate}(X,Y)$ and $\text{reverse}(X)$, $\text{reverse}(\text{concatenate}(X,Y))$ should be easy
- Store task solutions in long-term memory
- Learn to access and process previously learned solutions
Open research problems #2: Learning through communication

• Learning from explicit instruction:
  E: BAP...PAB; FGJH...HJGF; BERR...RREB.
  E: reverse BAP.

• Linguistic feedback:
  L: fkljfd.
  E: wrong; you should have said XYKOUU.

• Interaction:
  E: concatenate OUU and XYK.
  L: can you give an example?
Open research problems #3: Diminishing reward, light error signals

E: reverse BRGJ.
L: JGRB.
E: right.

- Reward should be at best sparse (e.g., given only on task completion)
- Extract error signal from verbal feedback
- Discover useful patterns without explicit supervision/reward (e.g., discover task delimiters, learn to parse input signal into "functions" and "arguments")
CommAI-env

https://github.com/facebookresearch/CommAI-env
https://www.facebook.com/groups/1329249007088140/

• A general open-source environment supporting text-/sequence-based interactive scenarios
• A growing community:
  • FB Users group with >250 users
  • >1000 stars on github

```python
from learners.base import BaseLearner

class MySmartLearner(BaseLearner):
    def reward(self, reward):
        # record receiving a reward

    def next(self, input_bit):
        # figure out what should be
        # the next bit to be spoken
        return next_bit

    _how many property does pineapple have in mary's basket? 
    input: three. 
```
The GoodAI General AI Challenge

Based on CommAI, currently running with about 400 participants from 55 countries

https://www.general-ai-challenge.org

https://youtu.be/O63JMJn24fs

#RAAIS2017
The CommAI initiative

https://research.fb.com/projects/commai/

• The CommAI visiting researcher call
  • https://research.fb.com/programs/post-docs-and-sabbaticals/#CommAI_Visiting_Researcher_Program

• PhD fellowship call coming soon!