Question Answering and Lifelong Learning

Programme: Intelligent Systems

Guillermo Echegoyen

Advisors:

Anselmo Peñas

Alvaro Rodrigo

Who am I

Background

- Software Engineering BSc
- Artificial Intelligence MSc

Where to find me

- Resumé
- Google Scholar

Currently

- International project LIHLITH-KIQA (PI: Anselmo Peñas). Question Answering that evolve over time.
- First year PhD in Lifelong Learning Question Answering.

Table of contents

Introduction

Lifelong Learning

Framework to study how to enable systems to evolve over time, integrating new knowledge with previous one and adapting to new tasks.

Can be applied to multiple learning paradigms and techniques:

- Reinforcement Learning
- Transfer Learning
- Knowledge acquisition

Question Answering

Systems that automatically answer questions posed by humans in a natural language

Focus

- Based on Knowledge Graphs
- Based on other resources: Set of documents, search engines

Applications

- Question Answering Systems are everywhere, from personal assistants to chatbots and IT ticket management.

Most QA systems:

- Work under a closed world assumption, ranking plausible answers
- Learn only during training, becoming stale over time
- Fail to sustain performance in production environments

We focus on Lifelong Learning Question Answering systems, that:

- Evolve over time
- Integrate new knowledge with previous one
- Adapt to new tasks

Research Plan

Objectives

- Develop QA systems sustainable in production environments
- Study methods to detect knowledge gaps in QA systems
- Find strategies to fill these gaps
- Enable QA systems to evolve over time
- Enable QA systems to adapt to new tasks.

Research Questions

- Can we measure QA systems confidence on its knowledge?
- Can QA systems adapt to new tasks?
- How to detect unanswerable questions given the available knowledge?
- How to incorporate new knowledge with previous one?
- How machines and humans performance differ?

Goal: Study the state-of-the-art

- Related to Knowledge Graphs:
  Guillermo Echegoyen, Álvaro Rodrigo, Anselmo Peñas (2019). **Benchmarking Entity Linking for Question Answering over Knowledge Graphs**. Sociedad Española de Procesamiento de Lenguaje Natural (PLN). Volume 63, pages 121-128. ISSN: 19897553, 11355948. DOI: 10.26342/2019-63-13. [2]

Outcomes

- 6 Entity Linking evaluation datasets.
- EL has a higher impact over QA systems than usually though.

Goal: Study the state-of-the-art

- Related to NLP and Dialogue Systems:
  Jan Deriu, Alvaro Rodrigo, Arantxa Otegi, Guillermo Echegoyen, Sophie Rosset, Eneko Agirre, Mark Cieliebak (2020). **Survey on evaluation methods for dialogue systems**. Artificial Intelligence Review. DOI: 10.1007/s10462-020-09866-x. [1]

Outcomes

- Trend towards end-to-end, more cryptic systems, based on large amounts of data.
- Trend towards less human involvement regarding evaluation.

Goal: Study the state-of-the-art

- Related to Lifelong Learning (WIP):
  Guillermo Echegoyen, Álvaro Rodrigo, Anselmo Peñas.
  Study of a Lifelong Learning Scenario for Question Answering

Outcomes

- Transfer learning between different extractive QA datasets works.
- Catastrophic forgetting is a big concern.

Goal: Study the problem statement

- Position papers (shared task proposal):
  Anselmo Peñas, Mathilde Veron, Camille Pradel, Arantxa Otegi, Guillermo Echegoyen and Alvaro Rodrigo (2019). **Continuous Learning for Question Answering. Dialogue Systems and Lifelong Learning**. Increasing Naturalness and Flexibility in Spoken Dialogue Interaction: 10th International Workshop on Spoken Dialogue Systems, Lecture Notes in Electrical Engineering, Springer. ISSN: 1876-1100 [4]

Outcomes

- Task: Determine mappings from utterances to a KG and means to enrich the KG.

Goal: Study the problem statement

- Position papers (LL Evaluation collection):
  Mathilde Veron, Anselmo Peñas, Guillermo Echegoyen, Somnath Banerjee, Sahar Ghannay, and Sophie Rosset (2020). **A Cooking Knowledge Graph and Benchmark for Question Answering Evaluation in Lifelong Learning scenarios**. Natural Language in the Database and Information Systems (NLDB), Lecture Notes in Computer Science, Springer 2020. Volume 12089, pags. 94-101. ISSN: 0302-9743 [5]

Outputs

- Cooking Domain Knowledge graph
- Cooking Domain Question Answering dataset

Goal: Transfer Learning between tasks and languages

- Lifelong Learning and transfer learning:
  Guillermo Echegoyen, Álvaro Rodrigo, Anselmo Peñas (en prensa). **Cross-lingual Training for Multiple-Choice Question Answering**. Sociedad Española de Procesamiento de Lenguaje Natural (PLN). Accepted in March 2020, Volume 64, September. ISSN: 1989-7553. [3]

Outputs

- Exams dataset: Difficulty affects human and machines in a similar way.
- QA systems can be transferred to different tasks with acceptable performance, even in different languages.

Assessing a lack of knowledge is key

- Propose method to address unanswerable Questions
- Propose method to incorporate new knowledge
- Craft evaluation collections for the task

Transfer Learning between languages & tasks

- Cross-lingual models
- Multiple Reading Comprehension datasets

QA System capable of:

- Learning new tasks without forgetting previous ones
- Assessing what it doesn't know and trigger learning procedures
- Integrating new knowledge with previous one
- Adapting to new tasks

Insights

Experimentation is hard

- Money for value
- Interpretability is not always clear
- Catastrophic forgetting is hard to overcome
- We are far from real world QA systems
- Ideal laboratory settings are far from real world use cases

Trend towards Deep Learning

- Large code base
- Programming GPUs/TPUs
- Experiments are costly
- Cloud computing
- Models are not interpretable
- Research grows exponentially

Thank you!

Questions?

Guillermo Echegoyen

Advisors:

Anselmo Peñas

Alvaro Rodrigo

References i

J. Deriu, Rodrigo, Alvaro, Otegi, Arantxa, Echegoyen, Guillermo, Rosset, Sophie, E. Agirre, and M. Cieliebak. **Survey on evaluation methods for dialogue systems.** *Artificial Intelligence Review*, 2020.

G. Echegoyen, Á. Rodrigo, and A. Peñas. **Benchmarking Entity Linking for Question Answering over Knowledge Graphs.** *Procesamiento del lenguaje natural*, (63):121–128, 2019.

References ii


G. Echegoyen, Á. Rodrigo, and A. Peñas.
Cross-lingual Training for Multiple-Choice Question Answering.
Procesamiento del lenguaje natural, 64, 2019.


A. Peñas, M. Veron, C. Pradel, A. Otegi, G. Echegoyen, and A. Rodrigo.
Continuous learning for question answering.
In *Tenth International Workshop on Spoken Dialogue Systems Technology (IWSDS)*, 2019.


M. Veron, A. Peñas, G. Echegoyen, S. Banerjee, S. Ghannay, and S. Rosset.
A Cooking Knowledge Graph and Benchmark for Question Answering Evaluation in Lifelong Learning Scenarios.
In E. Métais, F. Meziane, H. Horacek, and P. Cimiano, editors, *Natural Language Processing and Information Systems - 25th International Conference on Applications of Natural Language to Information Systems, {NLDB} 2020, Saarbrücken, Germany, June 24-26, 2020, Proceedings*, volume 12089 of *Lecture Notes in Computer Science*, pages 94–101. Springer, 2020.