Collective Intelligence as a Source for Machine Learning Self-Supervision

Saulo Pedro and Estevam Hruschka Jr.

Federal University of São Carlos

April, 2012

Main objectives of this work: Show that the wisdom of crowds could be used to bring intelligent systems closer to users by using their opinion as part of the knowledge acquisition/validation allowing self-supervision.

To achieve that they are also going to:

- Show how to take advantage from web communities.
- Introduce new concepts in Question Answering.

Introduction
Motivation

- Machine Learning systems depend on a source of information to learn from
- Increased use of the Internet in recent years
- Social media holds information that could become knowledge
- Popularity of web communities

Introduction
Case

How they drove to achieve objectives:

- ▶ Use NELL's RL algorithm as a Machine Learning source
- ▶ Query Yahoo! Answers users about the validity of RL rules
- ▶ Use the answers to enhance NELL's knowledge

Method

How could we take information from a machine and use it to query human users? They defined the Reversed Macro QA.

Micro QA: A single question is given, and the QA system returns a natural sentence as an answer.

Macro QA: The input is a set of questions. The QA system gets the general idea embedded in the questions and the output is a simple answer (e.g. yes, no).

Reversed QA: The questions are proposed by the computational system which receives a set of answers from human users.

In a **Reversed Macro QA** task, The system receives a set of answers to a specific question, and must base its "answer understanding" on on the redundancy of the main ideas identified in the answers.

Method
Usual Questions

Why NELL?

- ▶ It aims to learn as human do.
- ▶ It has a KB freely available on the web.

Why not Mechanical Turk?

- ▶ It is not a part of human behavior.

Why Yahoo! Answers?

- ▶ Very popular in the web community.
- ▶ It has an API that makes communication easier.

Method
SS-Crowd

Based on the Macro Reversed QA approach, they proposed a self-supervisor agent based on the wisdom of crowds, namely **SS-Crowd**.

The agent has the following automatic capabilities:

- ▶ Take rules from NELL's Machine Learning.
- ▶ Converting the rules into human understandable questions.
- ▶ Ask the question in Yahoo! Answers.
- ▶ Retrieve the answers from users.
- ▶ Identify the users opinion and combine them into a single opinion.
- ▶ Discard invalid rules and feedback the valid rules to NELL as correct knowledge.

Method

Rule extracted from NELL's RL:
athleteplaysforteam(x,y):-athletehascoach(x,z), coachesteam(z,y)
Rule converted into question: Is it true that If an athlete X has coach Z and coach Z coaches team Y, then athlete X plays for team Y?.
If the system receives a set of 5 answers like:

1. no.
2. no not always.
3. no it is not always true BYE
4. No, not unless you postulate that coach z coaches team y exclusively
5. athletes run jump etc they dont play for any team

The system discards answers 4 and 5 because they are too complicated to get the user opinion. We lost these contributions.

Method

To enhance the advantage taken from web communities, they introduce Reversed Human Computer Interaction.

What happens in Human Computer Interaction?

- ▶ Investigate interaction between users and computers, securing user satisfaction.

Considerations to implement Reversed Macro QA:

- ▶ Questions should be easily interpreted by humans.
- ▶ Encourage simple answers.

When we raise concerns about how to ask a question to better machine comprehension of answers, we are actually investigating the Reverse Human Computer Interaction.

What happens in Reversed Human Computer Interaction?

- ▶ Secure machine capability of getting help from humans in an easy and comprehensible way.

With attention to the **Reversed Human Computer Interaction**, the SS-Crowd algorithm also converts rules into Yes/No questions.

The advantages of Yes/No questions are:

- Avoid long answers.
- Answers are easy to be interpreted by a machine.

Simple approach: (please answer yes or no) If an athlete X has coach Z and coach Z coaches team Y, then athlete X plays for team Y?.

Experiments
Applying Reversed Macro QA

How they evaluated their work:

- ▶ SS-Crowd took the 10% of rules from RL that most affect NELL's knowledge.
- ▶ They compared the validity of the rules from Yahoo! Answers view and NELL developers view.

They evaluated the answers from two points of view:

Micro Reversed QA: All answers to a question are considered individually.

Macro Reversed QA: All answers to a question are combined into one single answer.

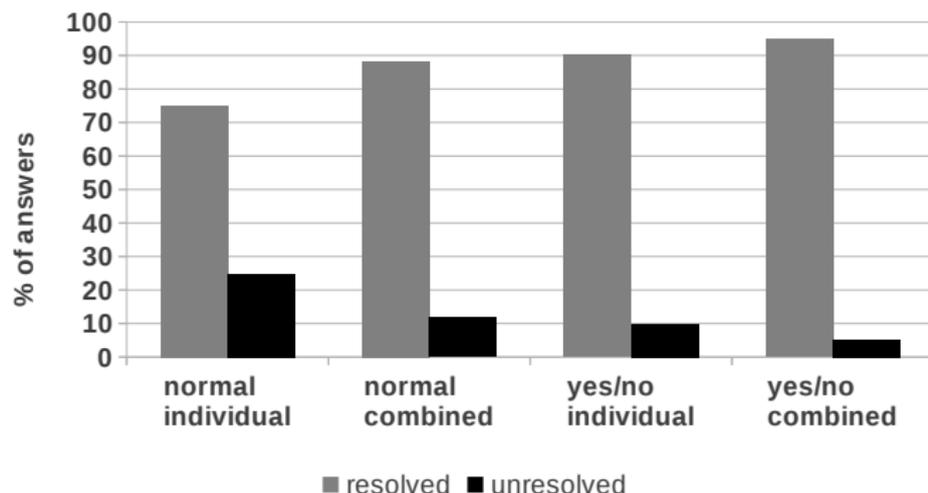# Experiments
Yes/No Questions Advantages

Figure: Applying Macro Reversed QA and asking Yes/No Questions

Experiments

Rule extracted from Rule Learner:
teamplayssport(x, hockey) :- teamplaysinleague(x, nhl)

This rule represents the belief that a team that plays in league
NHL, plays the sport hockey. Although it might seem obvious,
users pointed that NHL could refer to New Hampshire Lacrosse,
and the rule would not be true for all values of X.

From examples like this, they could infer that:

- Web users judgment is very restrictive.
- The scope of NELL's knowledge is smaller than the Web users
  knowledge.

Results

Inferences

Question Type	Precision	Recall	Accuracy	F-Measure
Regular Individual	0.85	0.51	0.61	0.64
Regular Combined	0.61	0.79	0.54	0.69
Yes/No Individual	0.81	0.57	0.66	0.67
Yes/No Combined	0.71	0.71	0.60	0.71
Best Answers	0.86	0.39	0.59	0.54

Table: Comparison of SS-Crowd results and NELL developers

Conclusion

Through this work the authors presented:

- The possibilities to count on collective intelligence to improve Machine Learning tasks.
- Web communities as a way to provide self-revision and self-supervision to learning systems.
- Encourage interaction with human users that is interesting to systems that learns continuously.

Conclusion
Future Work

They next steps are:

- Deepen the studies in web communities collaboration to Machine Learning.

- Improve the opinion analysis of answers.

- Explore other web communities.

Acknowledgements

Thanks

Questions

In case of any questions, please send a note to:

Saulo Pedro - saulods.pedro@gmail.com
Estevam Hruschka Jr. - estevam.hruschka@gmail.com