Data Science Salon Miami November 2018 Workshop Presentation Notes

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Outline

Opening

- Mission statement.
  - Primary:
    - To introduce, teach, and illustrate the making of goal oriented conversational agents using context free grammars and finite state machines .
  - Secondary:
    - To speed up the coming of the next AI winter .
- The GitHub repository.

What we are going to do?

- ▶ What kind of conversational agents we consider here?
  - ▶ For machine learning workflows.
  - ▶ For super-user or end-user interfacing of software components.
  - ▶ Hence (most, but not all) of the conversational agents that are shallow or not conversational much.
    - ▶ Shallow: one or two states at most.
  - ▶ But yes, this can be used for "deeper meaning" conversational agents.
- ▶ Other uses:
  - ▶ for brainstorming;
  - ▶ for project management;
  - ▶ for Domain Specific Languages (DSL's).

Who am I?

Education

- MSc Computer Science (Data Bases)
- MSc Mathematics (Abstract Algebra)
- PhD Applied Mathematics (Large Scale Air-Pollution Simulations)

General point of view on AI

- Siding with the Weak AI.
- See the related blog post and panel video from the Data Science Salon Miami February 2018.
  - TowardData Science post link

The companies I have made conversational agents for

- Panasonic Automotive Systems America
  - *butler in the car*
- Entefy
  - *universal communicator*
- Clearsense LLC
  - *diabetics management, patient critical conditions predictions*
- Christy Health Inc
  - *patient critical conditions prediction, data transformations*
- AITO Consulting LLC
  - *accounting data handling and cash flow prediction*
- QiO Technologies
  - *predictions and recommendations in Industry 4.0*

GitHub project for the workshow and installations required

- ▶ The GitHub project:
  - ▶ `https://github.com/antononcube/`
    `ConversationalAgents/tree/master/Projects/`
    `DataScienceSalon-Miami-Nov-2018-Workshop`
  - ▶ Or just find it in:
    - ▶ `https:`
      `//github.com/antononcube/ConversationalAgents/`
- ▶ While I am talking you can (try to) install the software tools listed in that repository.
  - ▶ Rakudo (for Perl6.)
    - ▶ Up to you; better use the online tool:
      `https://glot.io/new/perl6` .
  - ▶ Atom editor (for Perl6 and Python.)
    - ▶ Install the corresponding packages too.
  - ▶ R and RStudio (for R.)
  - ▶ Mathematica (used, but not needed.)
  - ▶ ANTLR (listed, but not needed.)
    - ▶ *I would rather use Perl6 at this point.*

Managing expectations

- You are not going to learn how to make a complete, say, Alexa skill in 2 hours.
  - Or 20 it this is the first time you see this kind of expositions.
- In this workshop we only sketch making of complete Alexa skills or Google Home apps/skills.
  - Note that there are a lot of other conversational platforms.
- What are you going to see is a particular type of conversational agent making based on grammars and finite state machines.
- Because of what Amazon, Apple, Google, Nuance, and others developments of speech-to-text recognition frameworks we are taking for granted to be easily able to hook-up with a certain speech-to-text module (or two, or five.)
  - Same for text-to-speech.
- Note that there are a plenty of dialog system design paradigms / approaches.
- I have a script for only 40 min, the rest of the workshop is unscripted.
  - What we are going to do would depend on:
    - what kind of background the audience has, and
    - what kind of agents the audience wants to design.

Opening examples

Didactic

- ☒ Phone Dialogs Conversational Agent.
- ☐ Love food
  - Simple we are going to download it, use it, and extend it 5-10 min from now.

Eliza run example

Shock and awe examples (I hope. . .)

- ☒ Regression workflows
  - QRMon main workflow example.
  - Note the three-four regression methods presented:
    - quantile regression;
    - linear regression;
    - neural nets regression.
- ☐ Classification workflows.
  - ClCon main workflow.
  - Rapid creation of classification workflows.

Complex Conversational Agent example

- ▶ Diabetes management: Glukoza.
- ▶ Note the complex nature of the design.
- ▶ Two perspectives are accommodated:
  - ▶ "simple" end user, and
  - ▶ physician / researcher.

The big picture

- In this workshop we concentrate on first ~~four~~ six steps in the following workflow.
- The main workflow simplified:
  1. Get and brainstorm on an automation idea.
  2. Gather or come-up with dialogs.
  3. Make suitable grammars / DSL's.
  4. Come up with finite states and transition between them.
  5. Program parser(s).
  6. Program interpreter(s).
  7. Refine with initial feedback.
  8. Decide when to stop.
- The use of monadic DSL's big picture.

Introduction to EBNF

- Context free grammars.
    - A set of production rules.
    - You will know it when you see it.
    - Comes from Noam Chomsky's formal grammars hierarchy.
- Extended Backus-Naur Form.

Introduction to parser programming

- This is not that important to follow.
- Actual parser programming in R.
- Should we do it *also* in Perl6? (comming up next. . .)
  - I think yes.
- Contrasting the two approaches.
  - Functional parsers vs
  - Declarative rules.

Introduction to parser generation

- Here we use the declarative rules.
- Languages
  - Perl6
  - Python
  - Mathematica
  - sorry, no R.
- Grammar inclusions and reuse.

Interpretation

- What if you parsing tree is also code?
  - Lisp, Mathematica
- What if parsing tree traversal is baked-in into the language?
  - Perl6, Scala
- Alternatively, you can get code that traverse the tree.
  - ANTLR

Grammar making exercises

Love food grammar

- Add more food items and check can you parse sentences with them.
- Add new verbs.
- Add new commands. E.g.
  - Where to find the best ...?
- What other actions to hook-up?
  - (Instead of just gain calories.)

dplyr natural language command

- What other commands to add?
- What other functionalities to program for the existing commands?

Break

Deciding what conversational agent to design

- ► Natural language commands for dplyr.
- ► Will they kill me?
  - ► I have a half-baked interactive demo dashboard.
- ► Regression workflows.
  - ► Fully developed.
- ► Job search.
- ► Movie search and recommendations.
- ► Construction and training of neural networks.

Gather dialogs

- ► How are we going to gather the dialogs?
  - ► By typing in?
  - ► By a public Slack channel?
    - ► datasciencesalon.slack.com #conversational-agents
  - ► By email: antononcube@gmail.com

Making Morphological Analysis tables

- Morphological Analysis is used for problem solving.
- Consider:
    - multi-dimensional, non-quantified complex problems.
    - open-ended problems,
    - wicked problems.
- Dealing with seemingly non-reducible complexity.
- Made by Fritz Zwicky for star classification, etc.

Describe and program grammars

- ☐ Perl6
  - It is very likely I would use Perl6.
- ☐ Python
- ☐ Mathematica

Generation of parsers

- ☐ Perl6
- ☐ Python
- ☐ Mathematica

Conclusion

Why keep learning about this?

Where to go next?

References

1. Anton Antonov, Creating and programming domain specific languages, (2016), MathematicaForPrediction at WordPress.