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NooJ and Artificial Intelligence: an anthropique approach

Mario Monteleone - Dipartimento di Scienze Politiche e della Comunicazione

Università degli Studi di Salerno (Italy)

mmonteleone@unisa.it

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Topics to cope with

- A (controversial?) definition of Artificial Intelligence (AI)
- Contemporary AI Tools
- Google and AI
- Current limits of AI
- NLP and AI
- Fuzzy Logic, Quantum Computers and the Majorana Fermion
- NooJ Grammars for Fuzzy Logic and AI

A definition of AI - 1

- Set of
  - Theories and techniques used to create machines capable of simulating human intelligence.
  - Concepts and technologies and not a self-contained discipline.
- In France, the CNIL (National Commission for Information Technology and Liberties) defines AI as **"the great myth of our time".**

- Pure AI examples: **Deep Blue** (1997, chess against Kasparov) and **AlphaGo** (2016, against best Go Player in the world)

A definition of AI - 2

- AI is classified in the ***cognitive sciences group***:
  - It calls on ***computational neurobiology*** (neural networks), ***mathematical logic*** and ***computer science***.
  - It is researching problem solving methods with ***high logical or algorithmic complexity***.
  - By extension, in everyday language, it designates devices imitating or replacing humans in certain accomplishment of their cognitive functions.
  - **AI programming differs from conventional programming because it mimics some level of human intelligence, while non-AI programs carry out defined sequences of instructions.**

A definition of AI - 3

- Its purposes and its development have always aroused many interpretations, fantasies or concerns expressed both in science fiction narratives or films and in philosophical essays (i.e. Isaac Asimov in *The Cycle of Robots*).

- Reality still seems to keep AI away from the performance of living people.

Contemporary AI Tools - 1

Basically, they are of three different kinds:

1. **Intelligent personal assistants**, i.e. man-machine interfaces achieving tasks with a slight higher level of automation;

2. **Software routines and Algorithms (basically statistical);**

2. **Hardware components to accelerate computing power** for specific operations (for example, ***image recognition tasks***, ***machine learning*** or ***algorithmic management of complex systems***)

Contemporary AI Tools - 2

AI sofware tools and Machine Learning Algorithms for neural systems/networks management
(https://www.edureka.co/blog/top-12-artificial-intelligence-tools/)

Scikit-learn, Tensorflow, Theano, Caffe, MxNet, Keras, PyTorch, CNTK, DNNs, Auto ML, OpenNN, H20, Google ML Kit

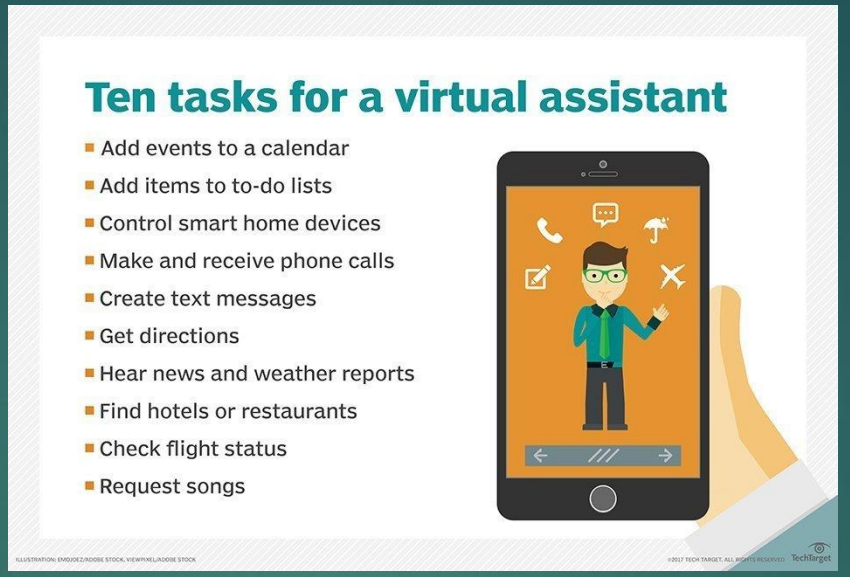
Machine learning (https://expertsystem.com/machine-learning-definition/)

- AI application providing **systems** the ability to **automatically learn and improve from experience without being explicitly programmed**.
- Focuses on the development of computer programs that can **access data and use it learn for themselves**.
- **Enables analysis and observation of massive quantities of data.**
- Looks for **patterns in data and to make better decisions in the future** based on the examples provided.
- Aims at allowing computers to learn automatically and adjust without human intervention or assistance.
- **Classic algorithms of machine learning consider texts as a sequence of keywords.**
- An approach based on semantic analysis mimics the human ability to understand the meaning of a text.
- **Combining machine learning with AI and cognitive technologies** can make it even more effective in processing large volumes of information.

Contemporary AI Tools - 3

- **Machine learning algorithms**
  - **Supervised machine learning algorithms** can apply what has been learned in the past to new data using labeled examples to predict future events.
  - **Unsupervised machine learning algorithms** are used when the information used to train is neither classified nor labeled.
    - Unsupervised learning studies how systems can infer a function to describe a hidden structure from unlabeled data.
      - **The system doesn't figure out the right output**, it explores the data and can **draw inferences** from datasets.
  - **Semi-supervised machine learning algorithms use both labeled and unlabeled data** for training – typically a small amount of labeled data and a large amount of unlabeled data.
  - **Reinforcement machine learning algorithms interact** with its environment by **producing actions and discovers errors or rewards** (trial and error search and delayed reward).

Contemporary AI Tools - 4



(How) Intelligent personal assistants (are defined)

A virtual assistant, also called AI assistant or digital assistant, is an application program that **understands natural language** voice commands and completes tasks for the user. Such tasks, historically performed by a personal assistant or secretary, include **automatic translation**, **taking dictation, reading text or email messages aloud, looking up phone numbers, scheduling, placing phone calls and reminding the end user about appointments.**
Popular virtual assistants currently include **Amazon Alexa, Apple's Siri, Google Assistant and Microsoft's Cortana**.

Contemporary AI Tools - 5

Comparison of notable assistants (https://en.wikipedia.org/wiki/Virtual_assistant)

Intelligent personal assistant	Developer	Free software	Free and open-source hardware	HDMI out	External I/O	IOT	Chromecast integration	Smart phone app	Always on	Unit to unit voice channel	Skill language
Alexa (a.k.a. Echo)	Amazon.com	No	No	No	No	Yes	No	Yes	Yes	?	?
Alice	Yandex	No	N/A	N/A	N/A	Yes	No	Yes	Yes	N/A	?
AliGenie	Alibaba Group	No	No	N/A	N/A	Yes	No	Yes	Yes	N/A	?
Assistant	Speaktoit	No	N/A	N/A	N/A	No	No	Yes	No	N/A	?
Bixby	Samsung Electronics	No	N/A	N/A	N/A	No	No	Yes	N/A	N/A	?
BlackBerry Assistant	BlackBerry Limited	No	N/A	N/A	N/A	No	No	Yes	No	N/A	?
Braina	Brainasoft	No	N/A	N/A	N/A	No	No	Yes	No	N/A	?
Clova	Naver Corporation	No	N/A	N/A	N/A	Yes	No	Yes	Yes	N/A	?
Cortana	Microsoft	No	N/A	N/A	N/A	Yes	No	Yes	Yes	N/A	?
Duer	Baidu[41]										
Evi	Amazon.com True Knowledge	No	N/A	N/A	N/A	No	No	Yes	No	N/A	?
Google Assistant	Google	No	N/A	N/A	N/A	Yes	Yes	Yes	Yes	N/A	C++
Google Now	Google	No	N/A	N/A	N/A	Yes	Yes	Yes	Yes	N/A	?
M (discontinued)[42]	Facebook										
Mycroft[43]	Mycroft AI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Python
SILVIA	Cognitive Code	No	N/A	N/A	N/A	No	No	Yes	No	N/A	?
Siri	Apple Inc.	No	No	N/A	N/A	Yes	No	Yes	Yes	N/A	?
Viv	Samsung Electronics	No	N/A	N/A	N/A	Yes	No	Yes	No	N/A	?
Xiaowei	Tencent										?
Celia	Huawei	No	No	N/A	N/A	Yes	No	Yes	Yes	N/A	?

Contemporary AI Tools - 6

Smartphones

Xiaomi Redmi Note 9s equipped with a **5th Generation AI engine** (wondering how we come to miss the previous 4 generations…)

Contemporary AI Tools - 7

Some considerations on AI intelligent assistants

- From a technical-scientific and functional point of view, there is a still **clear difference between man-machine interfaces** and AI tools.
- Commercial strategies (i.e. the sale of smartphones and associated services), have undone **this difference, with noteworthy cultural issues**.

Contemporary AI Tools - 8

Nvidia A100 chip (released in May, 2020)

- 54 billion transistors (performance of up to five petaflops);
- The output of 600 CPU systems, 25 server racks and 630 kilowatts of power can now be matched using just a single rack and 28 kilowatts of power;

Contemporary AI Tools - 9

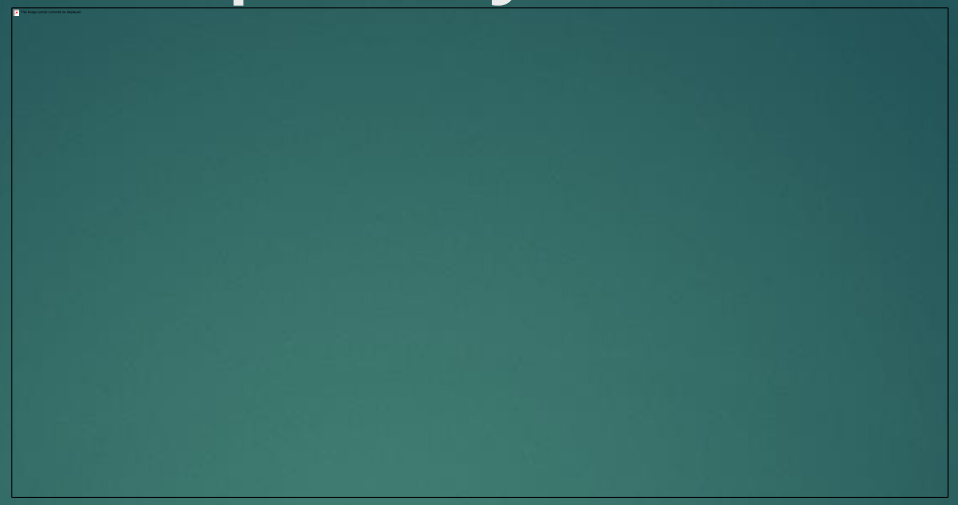


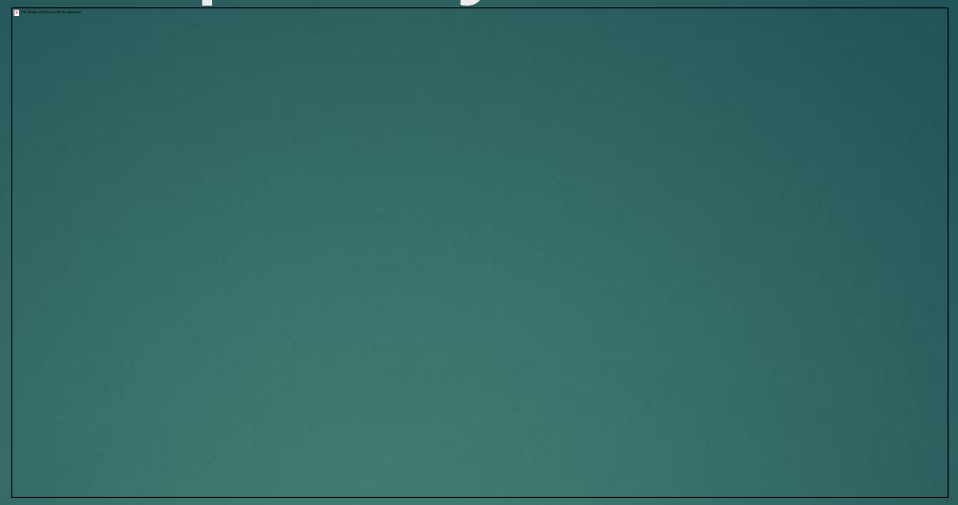
Image recognition tasks/1

https://www-technologyreview-com.cdn.ampproject.org/c/s/www.technologyreview.com/2020/03/04/916701/ai-chip-low-power-image-recognition-nanoseconds/amp/?fbclid=IwAR0Sim6tamwj9gNgYBePogvR-dHsbzfHzjC7UGpRdEFW_uwMChcj934R_wg

A new type of artificial eye, made by combining light-sensing electronics with a neural network on a single tiny chip.

- Computer vision is integral to many applications of AI (driverless cars, industrial robots, smart sensors)
- Most image recognition needs a lot of computing power to work;
- Part of the problem is a **bottleneck at the heart of traditional sensors, which capture a huge amount of visual data, regardless of whether or not it is useful for classifying an image**.

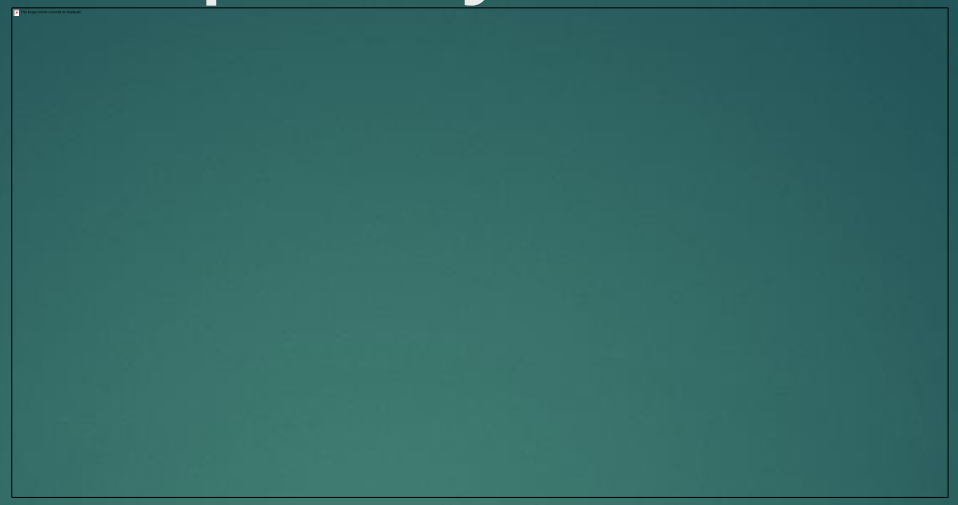
Contemporary AI Tools - 10



AI chip performing image recognition tasks/2

- Chip built out of a sheet of tungsten diselenide, a few atoms thick, etched with light-sensing diodes; then, diodes wired up to form a neural network.
- The material of the chip let the photosensitivity of the diodes—the nodes in the network—to be tweaked externally. So the network can be trained to classify visual information by adjusting the sensitivity of the diodes until it gives the correct responses.
- **In this way, a chip has been trained to recognize stylized, pixelated versions of the letters n, v, and z** *(too poor a result considering the technical efforts made)*.

Contemporary AI Tools - 11



AI chip performing image recognition tasks/3

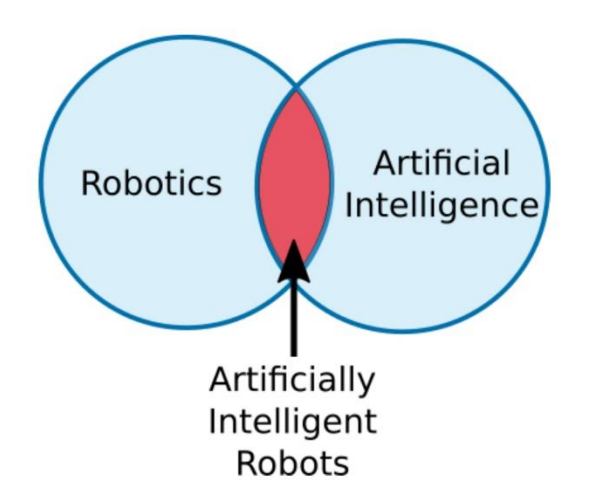
Limited vision

- **The eye consists of only 27 detectors and cannot deal with much more than blocky 3×3 images.**
- Still, small as it is, the chip can perform several standard supervised and unsupervised machine-learning tasks, including classifying and encoding letters.
- The researchers argue that scaling the neural network up to much larger sizes would be straightforward.

AI and Robotics - 1

- Robotics and artificial intelligence are two fields almost entirely separate.
- Robotics is a branch of technology that deals with physical robots.
- Robots:
  - Are programmable machines usually able to carry out a series of actions autonomously, or semi-autonomously.
  - May interact with the physical world via sensors and actuators.
  - May be entirely controlled by a human operator (Telerobots).
- Only a small part of robotics involves artificial intelligence.
- Most industrial robots are non-intelligent.
- Most AI programs are not used to control robots.
- Even when AI is used to control robots, the AI algorithms are only part of the larger robotic system, which also includes sensors, actuators, and non-AI programming

AI and Robotics - 2



- Artificially intelligent robots are controlled by AI programs.
- AI algorithms are necessary to allow the robot to perform more complex tasks.
- Most artificially intelligent robots only use AI in one particular aspect of their operation.
- Examples of artificially intelligent robots.
  - **Warehousing robots** (use a path-finding algorithm to navigate around awarehouse).
  - **Drones** (autonomous navigation to return home when battery is running out).
  - **Self-driving car** (use a combination of AI algorithms to detect and avoid potential hazards on the road).

NLP and AI - 1

Important questions

1. Is NLP seen as crucial for/within AI programs and progress?
2. What scientific and methodological relationship exists between AI and NLP?
3. Are there AI projects and / or functionalities that do make use of structural and transformational linguistics studies, as well as rules-based computational linguistics routines / environments?
4. In the design and actualization of current AI procedures, what weight does human supervision have?

NLP and AI - 2

When it comes to Natural Language…

"NLP/AI systems have yet to live up to their promise in customer service in large part because ***the challenge has been defined as either full automation or failure to automate****. As starting from the outside, trying to 'deflect' as much traffic/call volume as they can and punting to live serve reps when they fail. The result of this has been hundreds of millions of dollars spent on lowering the cost of customer contact – lots of 'claimed success' in terms of deflection rates – and no change in the cost of customer contact or improved customer service. How could this be?*

The very essence of 'conversations' cannot be replicated by a chat bot with a programmable set of rules: If the customer says this – the bot says that and so on. *That's not how any but the most simplistic of conversations go.* ***Conversations are inherently probabilistic – they involve turn taking which includes disambiguation, successive approximation, backing up and starting over, summarization, clarification and so on."***

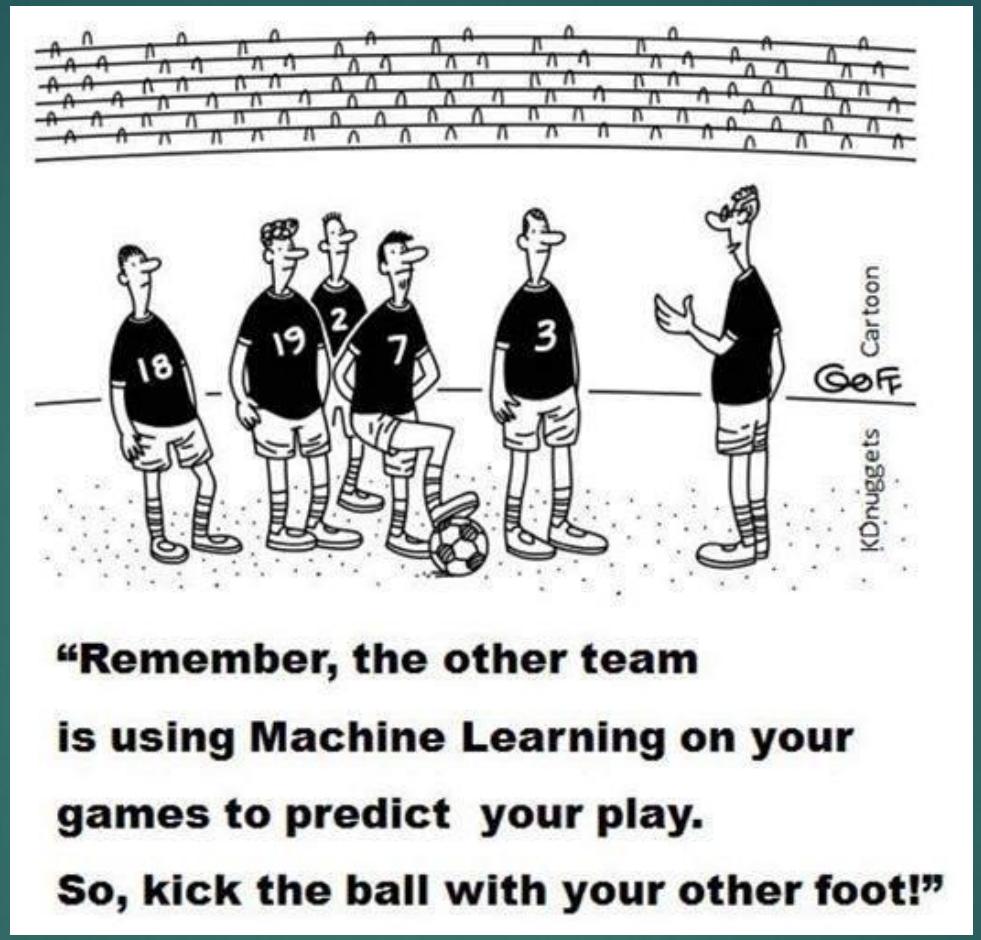
(Martin Ciupa, CXO in Data Technology Co., Team Lead AI/Data Science at American Association for Precision Medicine)

NLP and AI - 3

- As fo its realtionship with rule-based NLP, today AI seems to be nor particularly interested in:

  - **1 – General Linguistics**
  - **2 – Computational Linguistics**
  - **3 – Morph-syntax formalisation methods (rule-based methods, as NooJ and Lexicon-Grammar)**
  - **4 – Formal Semantics**
  - **5 – Natural Language Understanding and Analysis**

Current limits of AI- 1



- ***AI/Machine Learning*** seems to work best within those **small worlds** in which all the possible tasks, links and interactions between all elements are predictable because governed by specific rules (the game of chess, quizzes with non-argumentative answers). With **unpredictable complex systems**, things may get complicated.

Current limits of AI - 2

Procedures that Artificial Intelligence use advantageously:

- **Fuzzy Logics**: a versatile logic where the truth values of variables - instead of being true or false - are reals between 0 and 1.
  - Fuzzy logic therefore tries to go beyond the fixity of binary calculation.
  - In this sense, it extends classic Boolean logic with partial truth values. It consists of taking into account various numerical factors to arrive at a decision that we wish to accept.

Current limits of AI - 3

Tools that AI **might** use advantageously:

- **Quantum Computing and Quantum Computers**
  - **Quantum computing:**
    - the use of quantum-mechanical phenomena such as superposition and entanglement to perform computation.
    - Quantum computers are believed to be able to solve certain computational problems, such as integer factorization (which underlies RSA encryption), substantially faster than classical computers. The study of quantum computing is a subfield of quantum information science.
  - Several models of quantum computing: **quantum circuit model, quantum Turing machine, adiabatic quantum computer, one-way quantum computer, various quantum cellular automata.**
  - **Quantum circuits** (most widely used) are based on the quantum bit, or "qubit", **which can be in a 1 or 0 quantum state, or they can be in a superposition of the 1 and 0 states**.
  - **When qubits are measured the result is always either a 0 or a 1; the probabilities of these two outcomes depend on the quantum state that the qubits were in immediately prior to the measurement.**
  - **Computation is performed by manipulating qubits with quantum logic gates, which are somewhat analogous to classical logic gates.**

Current limits of AI - 4

Baidu

(https://www-zdnet-com.cdn.ampproject.org/c/s/www.zdnet.com/google-amp/article/baidu-releases-quantum-machine-learning-toolkit-on-github/?fbclid=IwAR2j7jp5YPgkdFQ-uw2MtjTRNKdu-0ek4tEgD538FHIfFLku6tbDOvO01YQ)

- Baidu releases **quantum machine learning toolkit** on GitHub, **enabling developers to build and train quantum neural network models**, and includes quantum computing applications.

Current limits of AI - 4

AI, Fuzzy Logic, quantum computers and the "behavior" of a Majorana Fermion

- in Particle Physics, **a Majorana fermion is its own antiparticle.**
  - It is electrically neutral, i.e. **an antiparticle always having a charge opposite to that of its particle**.
  - **It can have null dipole moments, as in the antiparticle such moments are inverted with respect to the direction of the spin**.

Current limits of AI - 6

- No Majorana particles have been found in nature.
- it is theoretically possible to observe it in the form of a quasiparticle, during superconductivity experiments.
- The neutral state of a Majorana Fermion could be "used" in the development of the "reasoning" of Fuzzy Logic:
  - Given a graph - or an automaton - and a series of "IF / THEN" rules, **a node could simultaneously contain a choice and its opposite.**
  - Therefore, **the choice would be made** not based on pre-established parameters for the whole automaton, but **on specific parameters for each individual node**.
  - This would bring **AI "reasoning" very close to that of humans**.

Current limits of AI – 8

The Google Affair

AI and Quantum Computer: Fake News and Problems

- **BERT - Understanding searches better than ever before** (https://www.blog.google/products/search/search-language-understanding-bert/)
- **Google AI Decodes Broken Greek Texts Better than Humans** (https://www.ancient-origins.net/news-history-archaeology/greek-texts-0012762)
- **Google claims to have reached quantum supremacy** (https://www.ft.com/content/b9bb4e54-dbc1-11e9-8f9b-77216ebe1f17)
- **A quantum computing future is unlikely, due to random hardware errors** (https://theconversation.com/a-quantum-computing-future-is-unlikely-due-to-random-hardware-errors-126503?fbclid=IwAR2YbQNuXOkiAkjX01_Dx4qt4AUUh9GkshVyvDwonhK7YFLtravE7xUJpmE)

NooJ and Fuzzy Logic – 1

Questions

1. Could Nooj be a concrete support in AI procedures?

2. What kind of hardware should it use for this purpose?

3. In what kind of Knowledge MAnagement routine should it be embedded for this purpose?

Possible Answers

- Our idea is to imagine a **question answering system** developed with NooJ and based both on the premises of Fuzzy Logic and on the behavior of a Majorana Fermion.

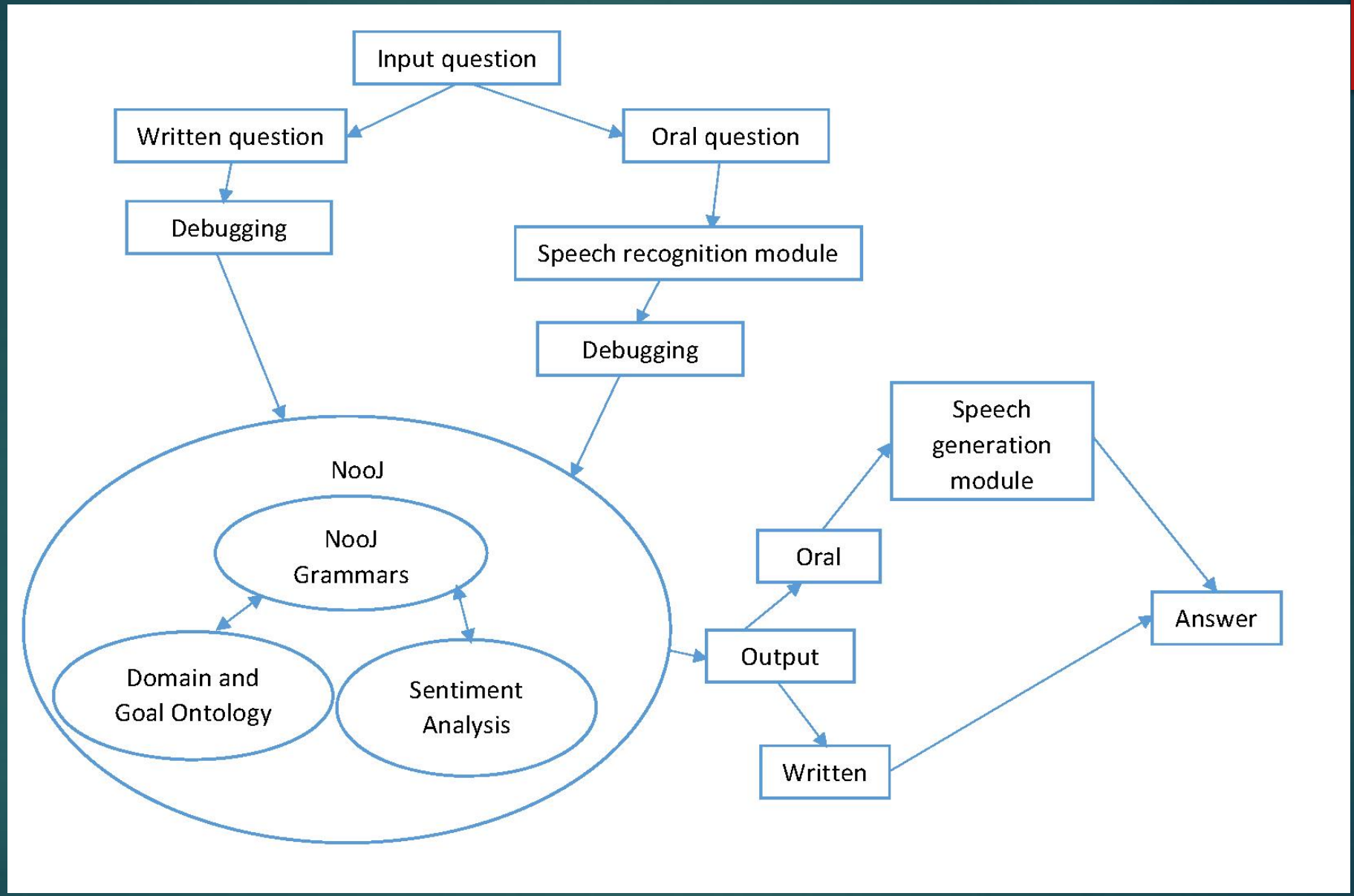
- In addition, **a light sentiment analysis system for responses** was developed.

NooJ and Fuzzy Logic – 2

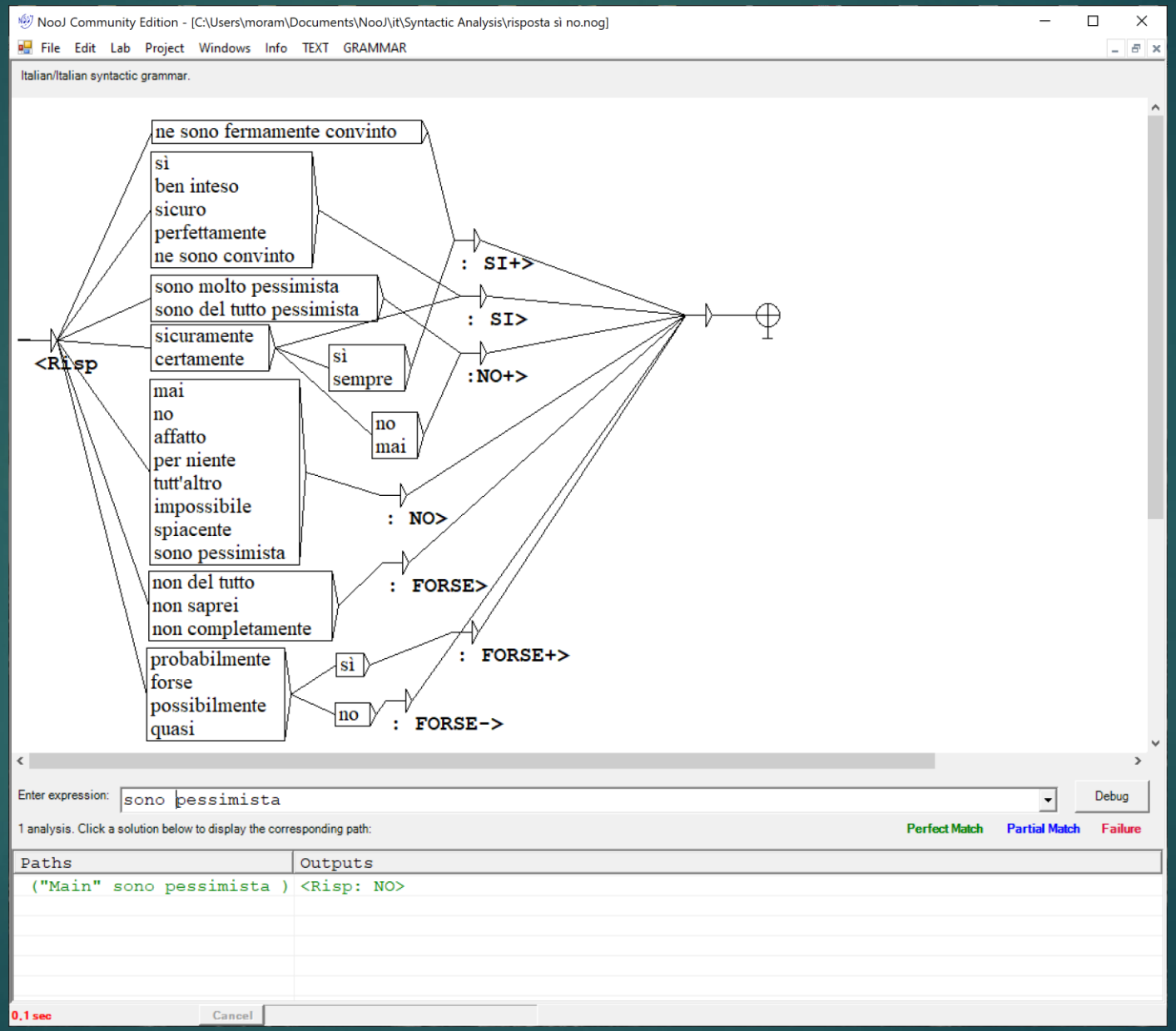
- In our NooJ system, **each grammar and each node can be connected to a specific (domain and/or goal) ontology**, capable of providing detailed and profound choices in terms of subdomains, and facets.

- The system, as it has been imagined, **does not currently need any quantum calculations**, although it could certainly benefit from it.

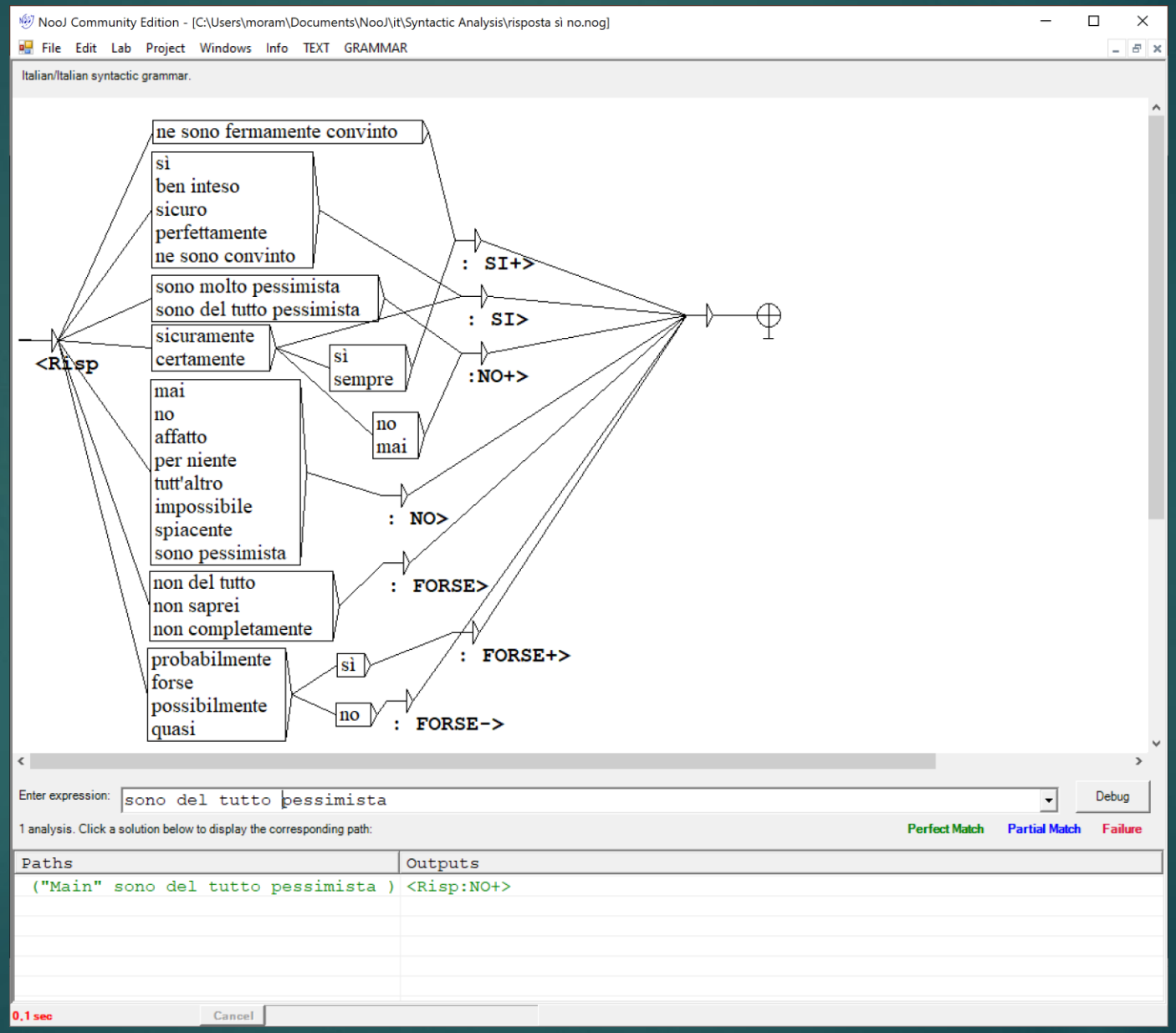
- This indirectly demonstrates that **an IA procedure, embedded in a rule-based NLP environment, can be developed using a classical computing architecture**.


Input question
Written question
Oral question
Debugging
Speech recognition module
Debugging
NooJ
NooJ Grammars
Domain and Goal Ontology
Sentiment Analysis
Output
Oral
Speech generation module
Written
Answer

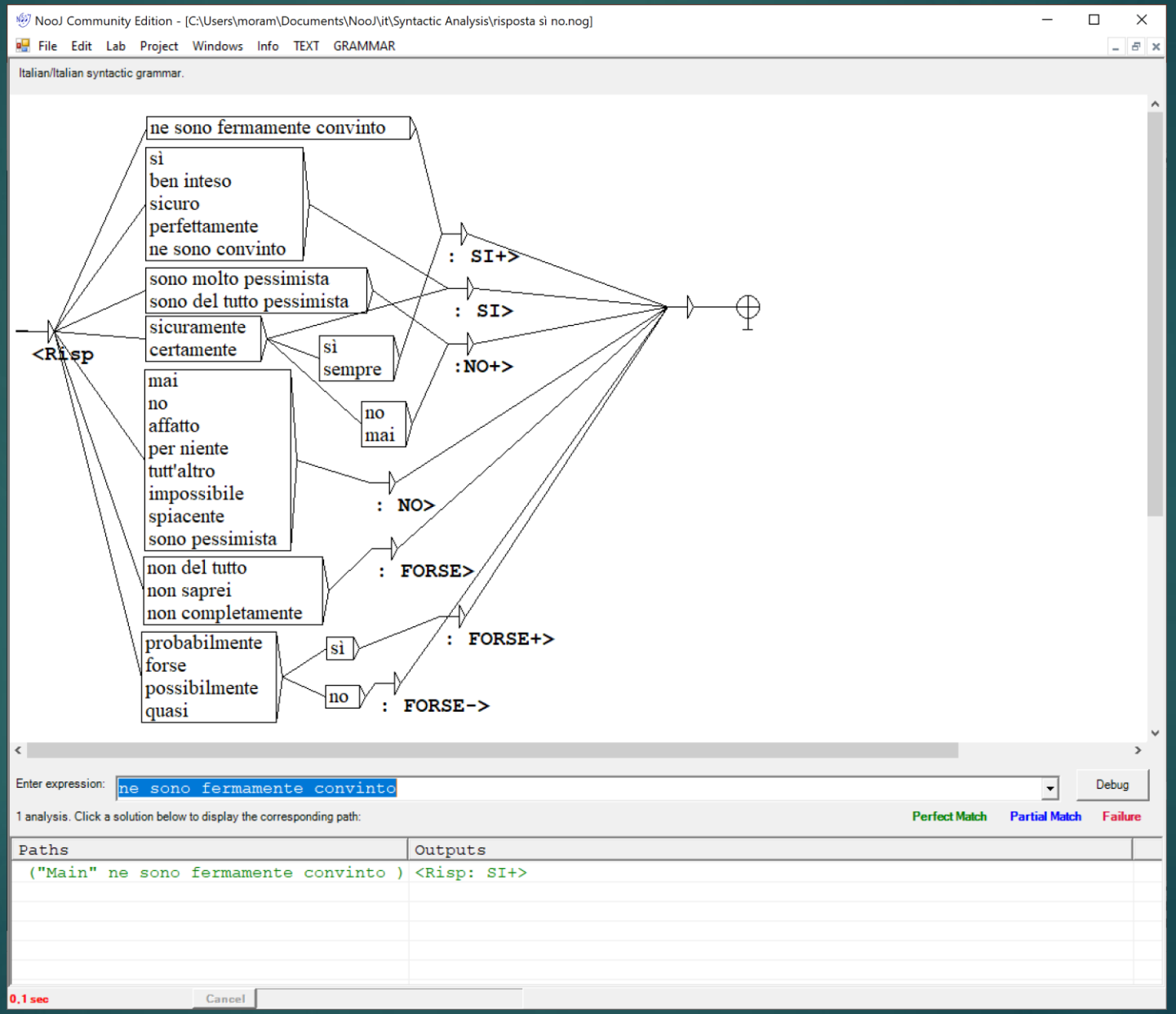
NooJ and Fuzzy Logic – 3



NooJ and Fuzzy Logic – 4



NooJ and Fuzzy Logic – 5



To conclude – Further possible steps

- To complete this grammar, it is necessary to **formalize the syntax of Italian negation** (a very complex but not impossible task).
- Better detailing the *FORSE* (maybe) variables from the point of view of the sentiment analysis, by adding other positive/negative levels (**but we already have 7**).
- Cascading sets of NooJ grammars can be created to **simulate (not casually) a step-by-step human reasoning**. This is what we define an **anthropic approach to Artificial Intelligence**.
- **This grammar, even used on a classic binary calculator, can give answers according to Fuzzy Logic** (when needed, replying *maybe* to our questions).

Hvala na pažnji
Thank you for your attention
Merci de votre attention

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