Refering to the design of the characteristica universalis, a logical language capable of expressing knowledge about logic, science, and metaphysics:

And so I repeat, what I have often said, that a man who is neither a prophet nor a prince can ever undertake any thing of greater good to mankind or more fitting for divine glory.

— Gottfried Leibnitz
Principles of AI

- Undergraduate Computer Science and Data Science Majors
- Not required for CS but is required for Data
- Course limit is set at 22 but currently has 28 people.
- Only taught in the Spring.
Course Requirements

- To satisfy course requirements, I teach Genetic Algorithms, Neural Nets, and Natural Language Processing topics in a survey format.
- I use ASP to teach the rest of the required topics: knowledge representation, intelligent agents, reasoning, and AI programming.
ASP Text and Resources

- Book: *Knowledge Representation and Reasoning and the Design of Intelligent Agents: The Answer-Set Programming Approach*
- You can find course slides, programs from the book, tips for students, exercises, and other resources for the book at http://pages.suddenlink.net/ykahl/
- Homework: email me at ygkahl@gmail.com and reference this talk.
Other Resources

▶ I supplement with the chapters on Genetic Algorithms and Neural Nets from *The Nature of Code* by Daniel Shiffman, free online at http://natureofcode.com/book, but I don’t put much emphasis on this.

▶ For Neural Nets, I highly recommend three videos from Grant Sanderson of 3Blue1Brown:

  ▶ Introduction to Neural Nets:
    https://www.youtube.com/watch?v=aircAruvnKk&t
  ▶ Gradient Descent:
    https://www.youtube.com/watch?v=IHZwWFHWa-w&t
  ▶ Introduction to Backpropagation:
    https://www.youtube.com/watch?v=Ilg3gGewQ5U&t
Don’t Miss the Forest for the Trees

- In class, students focus heavily on new vocabulary and notation.
- My goal is to keep them focused on ideas represented by this vocabulary and tie them to types of agent reasoning.
- Taken all together, these types of reasoning fit into the agent loop needed for intelligent action in the world.
How Should an Agent Reason?

One suggestion is the ASP way:

1. Satisfy the rules of its program.
2. Not believe in contradictions.
3. Adhere to the “Rationality Principle” which says: “Believe nothing you are not forced to believe.”

This intuition forms the basis for the formal definition of Answer Set.
Defaults

An intelligent agent should:
- Be able to reason with general statements and
- Override its generalizations in favor of exceptions.

This idea is realized via the technical notion of default and various forms of exceptions.
Action Languages

▶ An agent should be able to model the effects of actions. — We can do this with causal laws.

▶ It should be able to know about things that remain unchanged. (The Frame Problem) — Dramatic pause. Students thinking to themselves, “Oh man! That is a problem.” — Guess what? Here’s a solution! We use a default.

▶ An agent should be able to understand effects of indirect actions. (Ramification Problem) — We got that covered too: use state constraints.

▶ An agent must know that there are constraints on actions. — This is done with executability conditions.
Planning and Diagnostics

- Now that you’ve learned to represent some basic laws of the world, we just add this module, and we get planning.
- Things going too slow? Add domain-specific heuristics.
- Now a few more tweaks, and we get diagnostics.
- Notice how each of these things fits into the agent loop.
In Conclusion

▶ I believe tying the technical aspects of ASP to ideas of correct reasoning makes the class more interesting and provides a good framework for learning.

▶ Most people were able to pass the class and many did well.