Lecture I

Tols of argumentation that we can use and apply in a large range of conversations.
How to reason correctly? Logic was an organòn, a method to think for Aristotle and ancient greeks.
Science is the context where correct reasoning is of essence.
Logical positivists regarded scientific logic to be the highest form of logic. In the Vienna Manifesto, they said: “The scientific world conception is marked by the application of a certain method, logical analysis”.
Learning about scientific reasoning (namely, its “logic”) will give us an opportunity will give us the opportunity to evaluate a discipline for its own credentials/values.
It’s not the only what is scientific is worth of be considered!
We will see different traditions of logical reasoning.
Three topics:
- Scientific methods
- Scientific explanations
- Natural and social kinds

Scientific method: following a method has always been a characteristic of every discipline (just think about religion). Science is able to tell us how world is like, how it works, in a way more accountable, shared and justified (not an act of faith).
There are different descriptions of how this method looks like, depending on history or personal perspectives. All these methods have been put forward by using difference logic inference.
Science progresses on the form of a universal form, it must be sharable and replicable.
Some of the forms are, for example:
- Deduction/demonstration: Aristotle (this was regarded as the best method from the following generations of philosophers).
- Induction: Experimentalists, Bacon, Hume (he criticized induction, critics, solutions. Induction has lots of problems that many philosophers discussed. We all live by embracing the rule of induction, because we know from the past to the future.
- Falsification/hypothetico-deductivism (Popper and criticism): actually, it is a logical format of deduction, a new deduction suggested by Popper. Popper’s logic will be criticized by future philosophers, which argued that, for example, history would be a better tool than logic (sometimes a bit too rigid) to analyze reality.

We will insist that logic is an important tool in philosophic science, but not the only one, and we need to make room for different kind of logic we will be facing from time to time.

We expect science to be able to explain for how world works. We don’t want our expectations to be only reasonable, but even reliable.

About scientific explanation, we’ll see:
- The deductive-nomological model (Hempel)
- Inference to the best explanation/abduction (Pierce, Lipton)

To describe what an explanation is, this are the two main methods.

For what regards the third topic, we don’t want science only science to tell us how world function, but we want it to show us the various categories science it is talking about:
- Categorizing the world
- Necessary properties
- Modalities (necessary/possible)
- Essentialism
- Social kind
- Natural and social ontologies

Hence we want to know the properties belonging to the natural phenomena, in order to understand them.
Model logic is precisely that kind of logic that is not about what is true or false (Aristotelian logic), but what is necessary and what is possible.

We'll start by discussing logical science in order to arrive to the topic of the ontology/content of science.
"Understanding philosophy of science" by James Ladyman will be the book from which the teacher will take some extracts.

What is logic? The word logic comes from the greek logos. Logic is the study of correct reasoning/arguments. To be able to reason/"construct arguments" correctly, we must have and follow some principles. Logic studies these principles. Logic, in some sense, in not an empirical, but a normative discipline. It does't describe how we reason or what are the empirical facts that bring us to reason in a certain way, but it tells as how we ought to reason if we want to reason correctly.
There are two consequences of logic being a normative discipline:
- Logic may primarily have to do with the form of our reason/arguments: x is y, y is z, hence x is z. It's more important how we arrive from an idea to another, rather than their content.
- Principles and rules don't depend on changing circumstances: If a then a; this is a necessary inference. For something to be true, it must be true independently by its circumstances.

In Aristotle, the term logic doesn't appear as such, he uses analytics. This is because logic in Aristotle primarily refers to the analysis of reasoning to a particular logical form, which is the syllogism.
In prior analytics, Aristotle analysis what he consider to be the focus/aspect of logic, the syllogism, namely the deductive reasoning. This is the first time in history logic is analyzed as a subject. He distinguishes between what is possible and what is not (?).
In posterior analytics he deals with demonstration, namely to devise a means that can guide us to understand how science works and applies its knowledge. Science is demonstrative to Aristotle. Science starts from axioms and from these we can analyze the different domain of science.
He built the architecture of scientific knowledge.

What is a syllogism? All men (M) are mortal (P) (major premise); Socrates (S) is a man (M) (minor premise); Socrates (S) is mortal (P) (conclusion). Men is the medium term (we can find it in the major or. minor premise, but never in the conclusion); Mortal is the predicate (major term or extreme); Socrates is the subject (minor term or extreme).
The major premise connects the major term (mortal) and the medium term (men). Namely MP, hence SM, therefore SP.
S is P: subject-copula-predicate. In a syllogism we find propositions/statements, because in these we propose/state something: we do not ask, we do not command, we just affirm/predicate something.
What is the "something" that enters these sentences? The predicate.
Categorial/categorial logic: sentences that predicate things about classes of objects (categories), or objects that belong to those classes.
What I say with my syllogistic derivation is to affirm that something is true or wrong. This is a type of **binary logic**. Its propositions only admit two possibilities. It's either true or false that something is x.
Propositions in Aristotle can only take four forms:
- Universal (all men are mortal), can be both affirmative or negative.
- Particular (Socrates is mortal), can be both affirmative or negative.

There is a limit that you can say something about something else, there is a limit to the number of ways you can predicate something.
In a syllogism, there are certain rules that are used to correlate these idea.
One of these rules is called inference, namely a process of reasoning that correlates one type of sentence (premise) with another type of sentence (conclusion) on the basis of a series of rules (rules of deduction, or logical derivation).

Rules of logical derivation (there are 8 of them): in a syllogism there can be only three terms (major, minor and conclusion); the medium term can never be present in the conclusion…
There are 3 principles:
- Identity: given A, A si A
- Non-contradiction: it is not possible that "A is x" and "A is not X"
- Excluded middle: a sentence can be true or false, there are no other solutions in this kind of logic (like in truth table).

By relying on rules and principles, we are able to build what we call valid inferences, allowing us to distinguish between valid inference and an invalid one (fallacy).
A valid reasoning does not necessarily affirm the truth of something, it just guarantees that a certain correlation of sentences is correct only by virtue of its inferential form.
For example, if a man is an amphibian, he can live under water: correct reasoning but false conclusion. On the other hand, if a man is an amphibian, he cannot live under water: wrong reasoning but true conclusion. What is true and what is valid doesn't amount to the same thing.
Hence, **the form of the inference is the basic, most important thing**.
Syllogistic logic can lead to true scientific logic.

For this reason, in posteriors analytics Aristotle focuses on application.
The rules of syllogism allow Aristotle to us to arrive to a valid conclusion, hence it allows us to access the scientific knowledge.
Doxa (opinion) VS Epistè (knowledge).
The type of logic we use in science is to provide scientific inquiry with a formal tool an organon, a method, to guarantee the validity of every scientific argument we build.

Aristotle conceives the various sciences (biology, physics…) as deductive structures. These deductive structures on the model of syllogisms, move from my premises and draw to the conclusions. In a scientific demonstration, we proceed from a premise to a conclusion via rules of inference (deductive reasoning). If the premises are true, then the conclusion are true as well. Hence, the validity of a conclusion depends on the validity of its premisses.
There are different sciences, each of them dealing with different subjects/topics, but the architecture behind it is the same, and geometry is its structure model to proceed.
Geometrical style demonstration are an exempla of clarity.
Descartes is famous for having spelled out that our mind works in this way and that a good method must use this rules, rules that are certain, easy and that everyone can use to assess that something is correct.
Aristotle didm't have in mind a kind of unification of all sciences, didn't want to unite them, because there is one fundamental science.
Each science is autonomous because it is defined by its objects/facts, but logic is the architecture behind them.
Syllogisms: not all of them can be correct. When we apply our 8 rules and 3 (?), we can rule out the fallacies and hence have only correct syllogisms.

Aristotelian logic is a very powerful tool, but for some things not powerful enough.
There is a notorious limitation: how can I assert the truth of the premises? The syllogistic machinery cannot verify this on its own.
Hence, in order to make this machinery work, we must assume our premisses are given, but this means the premises themselves cannot be themselves demonstrated.
In science, we cannot assume the truth of the premises.
How did Aristotle handle this? In a demonstration, these premises are called "first principles": they can be used to demonstrate but they are themselves non-demonstrable.
Human being are rational (natural first principle); Planets are celestial bodies near the earth (astronomic first principle); Men are biped (anatomical first principle): if we don't understand these statements, how can we trust them?
If we are only able to demonstrate what we understand, then we leave out many things.
It becomes quite obvious to ask: what kind of knowledge can we acquire with these first principles, and what knowledge can be brought about.
Aristotle answered that ——> we'll answer to this next lesson.