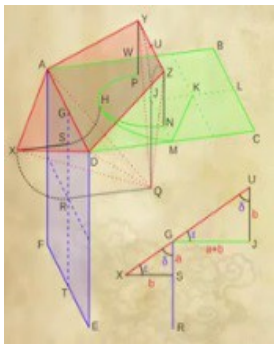
These handouts are for personal educational use only: do not copy, cite, or distribute.

3.6 Scientific reasoning and inductive logic

Now we'll take a look how **logic** in the West relates to **science** (here in 3.6) and **psychology** (in 3.7 & 3.8) and how the central dynamic there differs significantly from what went on in classical Chinese philosophy.

(Caveat: Western philosophy has a broad and rich set of alternatives to this dynamic; in these few lectures we're only trying to paint a rough picture of the general differences in emphasis between the two traditions.)



We saw (in 3.5) that the Western metaphor of **law** is not only connected to the concept of **authority** but also has a **logical** role to play. We need **laws** as **premises** in order to get *any* kind of **reasoning** going, including scientific reasoning.

So the question for the West becomes: **Where do we get these laws from?**

The solution: We look for laws that are **self-evident** in the light of **reason**. In classical Greek times, scientific reasoning was understood on the model of **Euclidean geometry**, which begins with axioms that are supposedly self-evident (e.g., "All right angles are equal") and uses logic to go from these axioms to all the other truths about space and shape.

Logic and God

the West

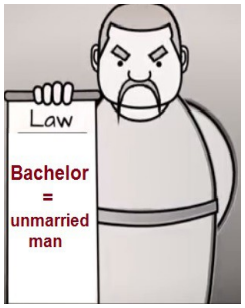
Such a model tied up the beginnings of Western philosophy in a very neat package with God. What was most important about God for philosophy was that God is a **reasoner**: he created the world on the basis of **self-evident truths of reason**. And human beings, since they are made in the image of God, are therefore also capable of coming to know these self-evident by making use of their capacity for reason.

Mozi

Compare Mozi, whose talk of 天 **tiān** (heaven) never presents 天 **tiān** as a **reasoner**. 天 **tiān** may have desires (e.g., for man's benefit) but is not a thinker who constructs the universe out of laws or first principles.

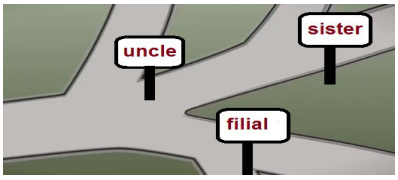
Logic and language

the West



Language in the West gets linked to logic and law through **definitions** (again, following the Euclidean model). Definitions provide us with **law-like statements** whose truth is **self-evident** to anyone who understands the use of the word in language. For example, if you know the definition of the word "bachelor", then you know without further demonstration the "law" that *all bachelors are unmarried*. In our earlier model of a map of concepts, you know how to get from bachelor to unmarried.

classical China



In classical China, the meaning of a word has to do with **traditions** and **paths** of use. Words mark regular way things happen. They work in the context of a **social dao** for which they serve as signposts. The idea is that understanding the meaning of a word helps a person know **when to do what** – for example, when it is appropriate to use the word "goh goh" (older brother) to address a sibling, when to use. "mui mui" (little sister) and so on.

Inductive Logic

Eventually we come to the period when people started to doubt these self-evident truths and we get to the period of modern science, where the focus shifts to what we call **inductive logic**. Rather than going from the **general** (e.g., a universal law) to the **particular**, the stereotype of inductive logic is from the **particular** to the **general**. You learn about particular things and from that construct some kind of universal hypothesis—your conclusion. For example:

Classical inductive argument

Premise 1: The first card off the deck is a heart.
Premise 2: The second card off the deck is a heart.
Premise 3: The third card off the deck is a heart.

Conclusion: All the cards in the deck are hearts.

In contrast with **deductive** arguments, the truth of whose premises must *guarantee* the truth of the conclusion (see lecture 3.4), a good **inductive** argument, the truth of the premises does not *guarantees* the truth of the conclusion – the truth of the premises must merely make the conclusion *more probable*.

Note the obvious weakness of the inductive argument above. What if it was just chance that the first three cards were hearts? Or what if someone arranged the deck by suit with all the hearts on the top? We can improve on the method (as we do in the social sciences today) by **randomizing** (e.g., instead of picking the first three cards, we could pick randomly within the deck). But it is still a very slow, imperfect way of finding out laws.

~~~~~~~~~~~~~~

Modern science is the strongest form of inductive argument. It makes use of **deductive reasoning** *within* its **inductive structure**.

For example, suppose our universal hypothesis is Boyle's Law ("Gas pressure is inversely proportional to volume"). Science adds experiment which uses **deduction**.

To see if Boyle's law is true, we devise an experiment where we can use deduction to formulate a precise experimental outcome. We then carry out the experiment to see if our prediction turns out to be **true** or **false**. The important addition is using **deductive reasoning** to come up with the prediction as follows.

Premise 1: The law to be tested *(Boyle's Law: "Gas pressure is inversely proportional to volume.")*

Premise 2: Additional facts or laws relied upon in the experimental set-up.
(e.g., *"The volume of gas has been increased to 24dm^3."*)

Premise 3: Additional facts or laws relied upon in the experimental set-up.
(e.g., *"The temperature has remained at 25 degrees C."*)

Premise 4: Additional facts or laws……
Premise 5: Additional facts or laws……

Conclusion: The prediction *(e.g., "The pressure of the gas will decrease to 30 Pa."*)

With the mathematics,the above set of sentences in blue forms a *deductive* argument. If the conclusion of the argument (the prediction) turns out to be *false*, then at least one premise is false. We say the experiment **disconfirms** Boyle's Law. Note that we don't say it proves the law *false*, because the law is only one of the premises. Conversely, if the prediction turns out to be *true*, we say it **confirms** the law**:** our experiment *tends to* show we can use the law deductively to predict things. It makes the reliability of Boyle's Law (the **constancy** of its natural *dào*) **more probable**, This is scientific *induction* applied to Boyle's Law.
~~~~~~~~~~~~~~