The architecture of Ibn Sīnā’s logic
(2)

Wilfrid Hodges
SOAS, June 2014

http://wilfridhodges.co.uk/arabic40.pdf

Ibn Sinā’s logic splits down into distinct ‘logics’. Each ‘logic’ has broadly the same components, which it’s convenient to classify as:

1. propositions  qadāyā
2. listing of valid inference forms  ta’did
3. criteria of validity  qawānīn
4. explanation  bayān
5. analysis of arguments  tahālīl

(See part (1) of this talk.)

The ‘logics’ are distinguished by their sentence forms:

- assertoric  mašhūr
- predicative 2D  āmli (narrow time-scope)
- predicative  ‘alā l-sūr (wide time-scope)
- meet-like  muttaṣīl
- difference-like  munfāṣīl

We will discuss the assertoric, 2D and muttaṣīl sentences.

1. Assertoric (mašhūr)

These sentences are virtually the same as Aristotle’s four main quantified forms

(a) Every B is an A.
(e) No B is an A.
(i) Some B is an A.
(o) Not every B is an A.

Ibn Sinā completely accepts Aristotle’s logic of these sentences, and he copies Aristotle’s Prior Analytics i.4–6 closely.
Ibn Sinā is the earliest logician known to have said explicitly that when there are no Bs,

- forms (a) and (i) (the ‘affirmatives’) are false and
- forms (e) and (o) (the ‘negatives’) are true.

Call this the existential assumption.

But Ibn Sinā says this is not his own idea; all earlier logicians—at least the sane ones—assumed it. He is probably right for logicians after 2nd century AD.

---

2. Two-dimensional (2D)

This is my shorthand for the tidiest part of Ibn Sinā’s ‘predicative’ sentences.

The name is from Oscar Mitchell 1883 (more on him below).

Ibn Sinā introduces these sentences in Qiyās (‘Syllogism’) i.3 and in the surviving part of Mašriqiyyūn (‘Easterners’). The account in Mašriqiyyūn is very valuable, repeating what’s in Qiyās without Aristotelian irrelevances.

If anybody here can get a properly edited text of Mašriqiyyūn into print, please do! Logicians will bless you.

---

Ibn Sinā notices (like Mitchell much later) that in assertoric sentences the predicate A often expresses a temporary property:

- Every human breathes in.
- Some people write.
- Zayd is in the house.
- Not every horse is asleep.

So the predicate contains a time reference, often implicit. Ibn Sinā says Aristotle should have noticed this—it matters for logic.

---

So Ibn Sinā introduces several possible ways the time reference can occur in the predicate. Examples:

(a-d) Every B is an A all the time it exists.
(a-ℓ) Every B is an A all the time it’s a B.
(a-m) Every B is an A sometime while it’s a B.
(a-t) Every B is an A sometime while it exists.
(e-d) Every B is throughout its existence not an A.
(i-ℓ) Some B is an A all the time it’s a B.
(o-t) Some B is sometime in its existence not an A.

‘d’, ‘ℓ’ etc. are based on names suggested in Mašriqiyyūn. E.g. d = ḍarūrī, ℓ = lāzīm.
Mitchell reckoned that the subject term $B$ ('human', 'Zayd', 'horse' etc.) doesn't depend on time.

Ibn Sīnā disagrees. The notion 'accident' is irrelevant to logic:

‘Accident’ belongs to the vocabulary of metaphysics, not of logic’ (Ṭaḥliqāt 168.28)

So the fact that subject terms often don't express accidents has no logical significance.
In any case horses die, so there is still a time reference.
But Ibn Sīnā minimises it: $B$ is read as 'sometimes $B$'.

With these 2D sentences, Ibn Sīnā presented for the first time a workable logic of multiple quantification.
Not achieved in the West until 19th century.

He started to develop this logic, partly as a tool for studying Aristotelian modalities.
(Recall he uses ẓarūrī to mean ‘throughout its existence’.)

It was potentially a major breakthrough.
Should we blame Bahmanyār for the fact that it didn’t get much beyond potential?

**Example:** Ibn Sīnā verifies *Barbara* with possibility minor premise and necessity major premise and conclusion.
He does this by translating ‘necessity’ as (d) as above. Thus:

(a-t) Every sometimes-$C$ is sometimes a $B$.
(a-d) Every sometimes-$B$ is always an $A$.
(a-d) Therefore every sometimes-$C$ is always an $A$.
VALID.

(See part (1) of this talk for further facts that he got this way.)

Khūnajī’s counterexample, assuming Zayd could ride horses but in fact rides only donkeys:

Every horse is possibly ridden by Zayd.
Everything ever ridden by Zayd is necessarily a donkey.
Therefore every horse is necessarily a donkey.

*Every sometimes-horse is sometimes ridden by Zayd.*
*Everything sometimes ridden by Zayd is always a donkey.*
*Therefore every sometimes-horse is always a donkey.*
Every sometimes-horse is sometimes ridden by Zayd. Everything sometimes ridden by Zayd is always a donkey. Therefore every sometimes-horse is always a donkey.

VALID, BUT: If the times are actual, first premise is false. If the times are potential, second premise is false.

Khûnajjī’s counterexample depends on reading the modalities in different ways in the two premises. For Ibn Sinā this would be a kind of fallacy of many terms. But logicians from Khûnajjī onwards wanted a logic of two different modalities.

3. Propositional sentences (šartī)

We consider just the muttaṣīl sentences. They come in four forms corresponding to (a), (e), (i) and (o):

(a) kullamā kāna φ fa-ψ.
(e) laysa al-batta idā φ ψ.
(i) qad yakūnu idā kāna φ fa-ψ.
(o) laysa kullamā φ ψ.

where φ, ψ stand for assertoric sentences.

Using these four forms as the (a), (e), (i), (o) sentences, Ibn Sinā gives exactly the same valid syllogisms as for the assertoric sentences, and with exactly the same justifications.

Simplest explanation: The muttaṣīl are a special case of the assertorics. Adopted by some commentators, later Arabic and modern.

‘In the science of meanings, the šartī sentence is a special case of the predicative sentence.’ (Al-Sakkākī, ‘Ilm al-ilmānī 208.3)

So for example we read

- kullamā kāna φ fa-ψ as:
  - There is a time-when-φ-holds, and every such time is a time-when-ψ-holds.

- laysa al-batta idā φ ψ as:
  - No time-when-φ-holds is a time-when-ψ-holds.

The same as Wallis 1702 and Boole 1854 (except that they ignored the existential assumption).
Main problems for this explanation (there are others):

1. Ibn Sinā himself never makes this reduction to assertorics. Instead he treats the muttaṣil sentences as an adaptation of the 2D sentences.

2. Ibn Sinā describes several readings of muttaṣil sentences, but all obeying the same logical rules. This strongly suggests that the different readings come from different choices of parameter within the same formalism.

In one reading (important for reductio ad absurdum), we assume hypotheses that couldn’t ever be true, apparently breaking the existential assumption.

Note how the pieces in a 2D sentence can be rearranged to make other kinds of sentence:

- Every writer sometimes makes a mistake while writing.
- There is a time when everybody writing at that time is making a mistake.
- There is a time when everybody is writing and everybody is making a mistake.

The first is 2D.
The second is what Ibn Sinā calls ‘alā I-sūr.
The third is his qad yakūnu ʿidā kāna ḥ fa-ṣ (a muttaṣil).

In second and third case, so presumably in first case too, Ibn Sinā makes a big distinction between the time quantifier and the other (‘Aristotelian’) quantifier.

For him, the Aristotelian quantifier ranges only over things that actually fit the subject description. Ibn Sinā is very insistent about this, even for modal sentences. He never ampliates to possibles with this quantifier.

But often Ibn Sinā uses ‘times’ that are not actual times.

- He uses ‘times’ when nothing is coloured white, or when all animals are human.
- He uses ‘times’ when a pronoun refers to a certain object.
- He sometimes uses other expressions besides ‘times’: for example ‘situations’ or (once) ‘possible posits’.

These generalised times are important. They must be analysed both logically and metaphysically. The remarks below are very provisional.
(I) We get different applications of logic by using different kinds of ‘time’. (This seems to be the choice of parameter.)

For example literal ‘times’ give temporal or ittifāqī logic, ‘situations’ give logic of necessary entailment or luzūm.

The logical rules are the same in both cases but the application is different.

Recall our discussion of Khūnajī mixing up the applications.

(II) By allowing ‘situations’ where impossible things are true, we can neutralise the existential assumption on (a) sentences.

Ibn Sinā never says this. But I see no other explanation of how he allows impossible assumptions without ever dropping the existential assumption.

In both (I) and (II), Ibn Sinā writes as a logician, not as a metaphysician.

He provides a machinery for solving logical problems, but in his logical writings he says almost nothing about the metaphysical requirements of this machinery.

Many modern logicians take a similar position. But in Ibn Sinā it’s a surprising gap.

No wonder some leading logicians in the Avicennan tradition chose a different path.

References

El-Rouayheb’s edition of Khūnajī Kashf al-asrār (Tehran 2010) gives Khūnajī’s counterexample on page 170, and a good discussion of the issues around muttaṣils in his Introduction at page xxxiii ff.

I may disagree with El-Rouayheb about what the issues were that divide Ibn Sinā from Khūnajī.

My talk ‘The architecture of Ibn Sinā’s logic (1)’ is on the web at http://wilfridhodges.co.uk/arabic38.pdf, with some backup material.