

## Home assignment

The proposed workshop will teach participants about five different types of geometry.

1. Hilbert's synthetic geometry.
2. Birkhoff's axiomatic metric geometry.
3. "Euclidean" geometry.
4. Compass box (empirical) metric geometry
5. The geometry of the sulba sutra.

The reading list for this is put up at <http://ckraju.net/geometry/Reading-list-geometry-rev.pdf>.

The same open directory (<http://ckraju.net/geometry/>) also has (a) the original book by Hilbert on synthetic geometry (<http://ckraju.net/geometry/Hilbert-Foundations-of-Geometry.pdf>), (b) the original paper by Birkhoff on axiomatic metric geometry ([http://ckraju.net/geometry/1932\\_Birkhoff.pdf](http://ckraju.net/geometry/1932_Birkhoff.pdf)), (c) Bertrand Russell's original critique of "Euclidean" geometry (<http://ckraju.net/geometry/Bertrand%20Russell%20on%20Euclid.htm>), and (d) The Manava sulba-sutra, in the original Sanskrit ([http://ckraju.net/geometry/manava\\_shulba\\_sutra.pdf](http://ckraju.net/geometry/manava_shulba_sutra.pdf)). An English translation of a key verse (Manava 10.10) from the book by Sen and Bag is also put up online in the same directory (<http://ckraju.net/geometry/translation-Manava-10.10.pdf>). There is also a detailed critique of geometry in NCERT school texts, class 6-9 in the same directory (<http://ckraju.net/geometry/NCERT%20critique-and-outline-of-alternative.pdf>) which critique will be covered during the workshop.

Please glance through these references, (You are not expected to fully understand these references; it is the purpose of the workshop to help you understand them, and the key differences between these different types of geometry.) But try to answer the following preliminary questions.

1. (a) Is the length of a line segment defined in Hilbert's synthetic geometry? If so, from what axioms?  
(b) Is Hilbert's notion of congruence of triangles the same as the equality of two triangles?
2. Why, in your opinion, is the proof of "Pythagorean" proposition so easy in Birkhoff's geometry, when it requires a whole book in "Euclidean" geometry?
3. (a) Why is the proof of the first proposition of "Euclidean" geometry wrong according to Russell?  
(b) Does this mean that the proof of the "Pythagorean" theorem in "Euclidean" geometry is also wrong?
4. (a) The length of a line segment can be easily measured using a ruler in the compass box. Does this differ from the way the length of a line segment is defined in Birkhoff's metric geometry? If so, how?  
(b) Is the statement in Manava 10.10 equivalent to the "Pythagorean" theorem? If not, what is the difference? (Hint: read the last part of my article "Black thoughts matter: decolonized math, academic censorship, and the "Pythagorean" proposition". *Journal of Black Studies*, 48(3) (2017) pp. 256-278, Available from <http://www.ckraju.net/papers/Manuscript-Black-thoughts-matter-accepted-version.pdf>.)
5. (a) Which of the above geometries are included in your school texts? which are excluded? Why?  
(b) Does the school text explain the difference between the various types of geometry that are included? Are they all mutually compatible?