

[4th Ph.D. summer School on “Mathematical Modeling of Complex Systems”, Cultural Foundation “Kritiki Estia”, Athens](https://nlsconf.physics.uoc.gr/)

**An Introduction to Hypernetworks**

**Lesson 4 Hypernetworks**

**Homework to be submitted by 23:00 Thursday 7th July 2014**

[1] Let { D, O, G } and { G, O, D } be hypergraph edges.

(i) What is { D, O, G } ∩ { G, O, D }?

(ii) Why is this problematic?

(iii) How do simplices overcome the problem that { D, O, G } = { G, O, D }?

(iv) Let H be a hypergraph with edges E and vertices V. What is the Galois hypergraph of H?

[2] (a) Give examples not in the Lesson 4 slides of

1. a 1-dimensional simplex
2. a 2-dimensional simplex
3. a 3-dimensional simplex.

(b) The common name for the geometric realisations of a 1-simplex is ‘a line’. What are the common names for the geometric realisations of the 2 simplex and 3-simplex.

(c) Suggest a name for the geometric realisation of a 4-simplex.

[3] Referring to the Lesson 4 slides:

(a) what is a p-dimensional hypersimplex?

(b) give an example of a Gestalt that can be represented by a hypersimplex.

(c) Give an example from the Lesson slides of the same set of objects being assembled to make two different objects with different Gestalt.

[4] Referring to the Lesson 4 slides:

(a) What is the intermediate word problem?

(b) Why is it relevant to complex systems science?

(c) Briefly, how does this relate to ‘ontology’.

[5] Referring to the Lesson 4 slides:

1. Give an example of an AND aggregation.
2. Give an example of an OR aggregation.