

[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 2 Simplicial Complexes and Q-analysis**

**Homework to be completed by 23:00 CET on Sunday 13th July**

[1] (a) Give an example of a simplex which, on removal of any of its vertices, loses it Gestalt property. Do not give an example already in the Lesson 2 text.

(b) How many *p*-dimension faces does a *q*-simplex have, 0 ≤ *p* < *q*. Illustrate the application of your formula for the faces of a 3-simplex.

[2] (a) Let you be *R*-related to an interest in *I* = {gaming, pubs, cars, sport, fashion, painting, history, literature, gardening, cooking, nature, science}if you like it. What is your ‘interest simplex’, *σ*(you), with vertices those interests that you like?

Notes: ‘gaming’ means playing games that can include gambling, *e.g.* roulette, poker, blackjack; ‘pubs’ includes bars; ‘painting’ includes making your own paintings or an interest in the painting of others; history includes the artifacts and geo-politics of ancient or more modern times; cooking means doing it your self; nature means active engagement with nature; science includes and branch of science including mathematics.

(b) Complete this table

|  |  |  |
| --- | --- | --- |
| person | *σ* (you) ∩ *σ* (person) | | *σ* (you) ∩ *σ* (person) | |
| Pete |  |  |
| Sam |  |  |
| Sue |  |  |
| Jane |  |  |
| Tim |  |  |

Where *σ* (you) ∩ *σ* (person) is the shared face and and | *σ* (you) ∩ *σ* (person) |is the number of shared vertices. Which person(s) is most highly connected to you? What is your eccentricity?

[3] Let *P’* = {Pete, Sam, Sue, Jane, Tim, you}. Give a Q-analysis of *FP’*( *I*, *R*).

[4] Give two examples of a Galois prism from the analysis of Escher’s Sky and Water drawing in the Lesson 2 text. Your examples should share at most one vertex – say what it is.

[5] In a multiple-choice quiz, would you expect good and bad students to be more or less highly connected? Explain your answer.