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To:
Adriano Tomassini, Chair

Summer course in SMI Perugia: Functional Analysis

Abstract:

One of the aims of Functional Analysis is to develop general tools on linear and/or topological spaces to tackle practical applications in Analysis. This class will be devoted to a study of some selected topics in the field. In the last part, some applications to the variational formulation and resolution of differential equations will be given in the spirit of partial differential equations (which time will not allow to deal with).

Below is a tentative table of content. Depending on the audience and its expectations, some topics will eventually be shortened, others will be more furnished. There will be a strong connection between the lectures and the problems sessions.

Part I: Continuous fonctions

1. Picard's fixed point theorem
2. Stone-Weierstrass and density
3. Ascoli's compactness theorem

Part II: Baire spaces and Convexity

1. Baire's lemma and applications
2. Hahn-Banach's Theorems and applications

Part III: Continuous linear functions

1. Hilbert spaces

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2. Weak topology
3. Fourier Transform

Part IV: Sobolev spaces and applications to elliptic PDEs

1. Dimension 1 and main properties
2. Applications to 1D boundary value problems
3. Higher dimensions and applications (probably no time for this)

Prerequisite:

Topology (especially of metric spaces), Topology of linear normed spaces including projection on convex in Hilbert spaces, Differential Calculus, Integration. Some reminders will be given during the lectures.

References:

Brezis "Functional Analysis: Sobolev spaces and partial differential equations" (Universitext), Rudin "Functional Analysis" (McGraw-Hill).