$$\int_{\Omega} \{\mathbf{u}_t \cdot \boldsymbol{\phi} + \mathbf{u} \cdot \nabla \mathbf{u} \cdot \boldsymbol{\phi} + \nabla \mathbf{u} : \nabla \boldsymbol{\phi} - \mathbf{f} \cdot \boldsymbol{\phi}\}\, dx\, dt = 0 \quad \text{for all} \quad \boldsymbol{\phi} \in L^2(0, T; J_1(\Omega)).$$

$$\int_0^T \int_{\Omega} \{\mathbf{u}_t \cdot \boldsymbol{\phi} + \mathbf{u} \cdot \nabla \mathbf{u} \cdot \boldsymbol{\phi} + \nabla \mathbf{u} : \nabla \boldsymbol{\phi} - \mathbf{f} \cdot \boldsymbol{\phi}\}\, dx\, dt = 0$$

From classical to weak derivatives

$$\text{for all} \quad \boldsymbol{\phi} \in L^2(0, T; J_1(\Omega)).$$

Magdalena Czubak

We learn very quickly the definition of the derivative in Calculus. Then if a function is differentiable, we learn it is necessarily continuous. So we know not to ask if a function is differentiable if it is not continuous. But what if we would like to persist, and still find a way to differentiate functions that are not continuous? In this talk, we show how to define a derivative for functions that might not be differentiable in the classical sense, and give some reasons why one would like to do so.

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Math Club
University of Colorado Boulder