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in mathematics generalized functions are objects extending the notion of functions there is more than one recognized theory for example the theory of distributions generalized functions are especially useful in making discontinuous functions more like smooth functions and describing discrete physical phenomena such as point charges the theory of generalized functions has made great advances has numerous applications and is extensively used in mathematics physics and engineering formally a generalized function is defined as a continuous linear functional on some vector space of sufficiently good test functions generalized functions are defined as continuous linear functionals over a space of infinitely differentiable functions such that all continuous functions have derivatives which are themselves generalized functions the most commonly encountered generalized function is the delta function steps impulses and generalized functions in calculus you learn how to model varying quantities using func tions functions have their limitations though by themselves they are not convenient for modeling some important processes and events especially those involving sudden changes functions is denoted by c c r and its ele ments are called compactly supported smooth functions or simply test functions there are other sets of very good functions with which analogous conclusions are possible e g c functions which decrease faster than ck x k at infinity for all k and analogous es paul garrett 08 introduction to generalized functions distributions january 16 2020 the following very important density assertion gives an explanation of the sense in which distributions are generalized functions they are obtainable as suitable limits of very nice functions generalized functions lectures 3 1 thespaceofgeneralizedfunctionson rn 1 1 motivation oneofthemostbasicandimportantexamplesofageneralized function is the dirac introduction to generalized functions distributions paul garrett garrett math 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most important example of a generalized function that is not a function is the dirac delta writtenjust itisdefinedby 0 6 7 for all 2d where 0 is the origin in rn note again that is forms the space of test functions in the case of the delta function we have z δ x f x dx z dΘ dx f x dx f x Θ x z Θ x df dx dx f x 0 f 0 by a similar computation one can verify that the generalized function xδ x 0 the generalized function p 1 x can be defined generalized functions are the generalization of the classical concept of mathematical function generalized functions are alternatively called distributions because from the physical viewpoint they are introduced and are used to ideally describe the distributions of some physical quantities generalized functions volume 1 properties and operations about this title i m gel fand and g e shilov publication ams chelsea publishing publication year 1964 volume 377 isbns 978 1 4704 2658 3 print 978 1 4704 3122 8 online doi doi org 10 1090 chel 377 view full 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