Re: help with a basic differentiability and derivative function

Source: http://sci.tech−archive.net/Archive/sci.math.num−analysis/2005−12/msg00303.html

- *From*: "David L. Wilson" <dwilson314@xxxxxxxxxxxx>

- *Date*: Tue, 20 Dec 2005 23:25:31 −0500

I am replying to my own post to add an additional final paragraph to further
clarify.

"David L. Wilson" <dwilson314@xxxxxxxxxxxx> wrote in message
news:Y6Gdna_kruMIWTXenZ2dnUVZ_sOdnZ2d@xxxxxxxxxxxxxxx
>
> "David Wilkinson" <david@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx> wrote in message
> news:do92n6$p1r$1@xxxxxxxxxxxxxxxxxxxxxx
>> David L. Wilson wrote:
>>> "David Wilkinson" <david@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx> wrote in message
>>> news:do8f40pjb1@xxxxxxxxxxxxxxxxxxxxxx
>>>
>>>>disanalysis wrote:
>>>>
>>>>>very basic problem...can anyone help me with the proof?
>>>>>
>>>>>f(x) = x^2−3x+8 if x>1
>>>>>f(x) = 2x^2+x+3 if x=<1
>>>>>
>>>>>using epsilon−delta property can you prove that f(x) is differentiable
>>>>>at all points except x=1
>>>>>and that it is not differentiable at 1?
>>>>>
>>>>>thanx
>>>>>
>>>>
>>>>At x = 1 f(x) = 6 from both expressions.
>>>>
>>>>for x > 1, df(x)/dx = 2x−3 −> −1 as x −> 1 from the first expression,
>>>>and
>>>>
>>>>For x <= 1, df(x)/dx = 4x+1 = 5 at x=1.
>>>>
>>>>So the first derivative of f(x) is discontinuous at just above x = 1.
>>>>But, at x = 1 it is differentiable from the second expression which
>>>>holds up to and including x = 1.
>>>
>>>

>>> Wrong. The derivative does NOT exit at x=1 because the limit defininingx
>>> the derivative at that point does not exist as the limit defining the
>>> derivative at x=1 from the left is not equal to the limit defining the
>>> derivative at x=1 from the right. Or were you intentionally giving him
>>> a wrong answer on this obvious homework problem.
>>>
>>> Graphically, there is a sharp turn at x=1, hence, the derivative does
>>> not exist at the point (1, 6) although the function is continuous there.
>> Right. Since the second expression holds up to x = 1 the derivative is
>> defined by it at x = 1. The first expression only holds for x > 1 so the
>> derivative is different for x > 1, not at x = 1.
>
> NO NO NO
> The derivative at a point is defined as a limit (the usual definition in a
> calculus text). That limit exists if and only if that limit from the
> right and that limit from the left are the same. In this case, that limit
> from the left is 5 and that limit from the right is −1 so the limit that
> defines the derivative at x=1 does not exist. However, one can say at
> x=1, the left derivative is 5 and the right derivative is −1.
>
> The fact that one of his equations defines the function for x<=1 does not
> allow one to use it alone to define the derivative at x=1−−−−Your sentence
> "Since the second expression holds up to x = 1 the derivative is defined
> by it at x = 1." is terribly wrong.

To look at it another way...Change the definition of the function to
f(x) = x^2−3x+8 if x=>1 (I moved the equal to here.)
f(x) = 2x^2+x+3 if x<1
This is the same function. Each x has the same f(x) value. But by your argument the derivative at x=1 is now −1 instead of 5−−−but it is the same function. Something must be wrong (namely the derivative at x=1 actually does not exist).

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- ***Follow−Ups***:
  - ♦ ***Re: help with a basic differentiability and derivative function***
    - ◊ *From:* David Wilkinson

- ***References***:
  - ♦ ***help with a basic differentiability and derivative function***
    - ◊ *From:* disanalysis
  - ♦ ***Re: help with a basic differentiability and derivative function***
    - ◊ *From:* David Wilkinson
  - ♦ ***Re: help with a basic differentiability and derivative function***
    - ◊ *From:* David L. Wilson
  - ♦ ***Re: help with a basic differentiability and derivative function***
    - ◊ *From:* David Wilkinson

- ***Re: help with a basic differentiability and derivative function***
  - *From:* David L. Wilson

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