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4.11

Moderator: helmut [Moderator Control Panel]

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Author	Message

oula-khouzam **Post subject:** 4.11 **Posted:** Wed, 22 Apr 2020 02:32

offline
Member

Joined: Tue, 31 Mar 2020 17:23
Posts: 22

From BW and using 2.24
let x_n be a sequence where $a \leq x_n \leq b$ then $\exists x_{nk}$ such that x_{nk} converges to x, where x $\in$ [a,b]

so by def:
$\forall \epsilon > 0, \exists N_1 \in \aleph \; s.t. \; for \; all \; k \geq N_1 :$
$|x_{nk} - x| < \epsilon$ let $\epsilon \; be \; \delta/2$ ...... @

Now since the question is saying that f is a continues function on [a,b], so for x $\in$ [a,b] we can write:
For all ε > 0 there is a δ > 0 such that for all $|x_n - x|$< δ, let $\delta \; be \; \delta$ /2 ....@
$x_n \in$ [a,b] => $|f(x_n) - f(x)| < \epsilon$

let us add the @+@ then we can have :
$|x_n - x| + |x - x_{nk}| < \delta/2 + \delta/2$ => $|x_n - x_{nk}| < \delta$

from the def. of continuity => $|f(x_n) - f(x_{nk})| < \epsilon$
so f is uniform continuity on [a,b]

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oula-khouzam **Post subject:** Re: 4-11 **Posted:** Wed, 22 Apr 2020 08:44

offline
Member

Joined: Tue, 31 Mar 2020 17:23
Posts: 22

From BW and using 2.24
let x_n be a sequence where a $\leq x_n \leq$b then $\exists x_{nk}$ such that x_{nk} converges to x, where x $\in$ [a,b]

so by def:
$\forall \epsilon > 0, \exists N \in \aleph \; s.t. \; for \; all \; k \geq N:$

$|x_{nk} - x| < \epsilon$ let ϵ be $\delta/2$ ...... @

Now since the question is saying that f is a continues function on [a,b], so for x ∈[a,b] we can write:
For all ε > 0 there is a δ > 0 such that for all $|x_n - x| < \delta$, let δ be $\delta/2$ ....@
$x_n \in [a,b] => |f(x_n) - f(x)| < \epsilon$

let n $\geq$ N => if we add the @+@ then we can have :
$|x_n - x| + |x - x_{nk}| < \delta/2 + \delta/2 => |x_n - x_{nk}| < \delta$

from the def. of continuity => $|f(x_n) - f(x_{nk})| < \epsilon$
so f is uniform continuity on [a,b]

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helmut

online

Site Admin

Joined: Sat, 26 Apr 2003 15:14
Posts: 2278
Location: El Paso TX (USA)

Post subject: Re: 4.11 **Posted:** Thu, 07 May 2020 14:06

Not a valid proof yet. Looks to me like you only check with one particular x.

The greater danger for most of us lies not in setting our aim too high and falling short; but in setting our aim too low, and achieving our mark. - Michelangelo Buonarroti

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helmut

online

Site Admin

Joined: Sat, 26 Apr 2003 15:14
Posts: 2278
Location: El Paso TX (USA)

Post subject: Re: 4.11 **Posted:** Thu, 07 May 2020 22:25

Here is an outline of a proof:

Suppose to the contrary that f is **not** uniformly continuous on [a,b]. Then there is an $\varepsilon > 0$ such that for every $\delta > 0$ one can find $x, y \in [a,b]$ such that $|x - y| < \delta$, yet $|f(x) - f(y)| \geq \varepsilon$.

This means setting $\delta = 1/n$, we can find two sequences (x_n), (y_n) in [a,b], such that $|x_n - y_n| < 1/n$, yet $|f(x_n) - f(y_n)| \geq \varepsilon$.

By BW, (x_n) has a converging subsequence (x'_n), with some limit $x_0 \in [a,b]$ (cp. 2.24).

The corresponding subsequence (y'_n) of (y_n), again by BW, has a further subsequence (y''_n) that is convergent. Check that its limit must be x_0.

Note that the corresponding subsequence (x''_n) of (x_n) also converges to x_0.

Finally check that this implies that f is **not** continuous at x_0.

The greater danger for most of us lies not in setting our aim too high and falling short; but in setting our aim too low, and achieving our mark. - Michelangelo Buonarroti

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