BRAC University

Department of Mathematics and Natural Sciences

LECTURE ON

Real Analysis (MAT221)

Monotone Sequences and Subsequences

Monotone Convergence, Bolzano-Weierstrass Theorem

NOVEMBER 02, 2025

CONDUCTED BY

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Monotone Sequences

📖 Monotonically Increasing Sequence

A sequence $\{a_n\}$ is said to be **monotonically increasing** if for all natural numbers n, the terms of the sequence satisfy the inequality

$$a_n \leq a_{n+1}.$$

📖 Monotonically Decreasing Sequence

A sequence $\{a_n\}$ is said to be **monotonically decreasing** if for all natural numbers n, the terms of the sequence satisfy the inequality

$$a_n \geq a_{n+1}.$$

Monotone Convergence Theorem (MCT)

💡 Monotone Convergence Theorem

Every bounded monotone sequence converges.

Specifically,

- If monotonically increasing and bounded above $\implies$ converges to its supremum.

- If monotonically decreasing and bounded below $\implies$ converges to its infimum.

- If monotone but not bounded $\implies$ diverges to either ∞ or $-\infty$.

Thank You!

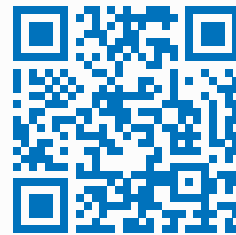We'd love your questions and feedback.

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(Lectures, walkthroughs, and course updates)

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📖 References

[1] Stephen Abbott, *Understanding Analysis*, 2nd Edition, Springer, 2015.

[2] Terence Tao, *Analysis I*, 3rd Edition, Texts and Readings in Mathematics, Hindustan Book Agency, 2016.