MAT215: Complex Variables And Laplace Transformations

Emon Hossain[1]

[1]Lecturer
MNS department
Brac University

LECTURE-01

Course Information

- **Course Code:** MAT215
- **Course Title:** Complex Variables And Laplace Transformations
- **Department:** Mathematics and Physical Sciences

Goal of the Course

Introduce the foundations of complex variables and Laplace transformations, with emphasis on their applications and solution methods.

Topics to be Covered

- Introduction to complex variables
- Complex functions and mappings
- Continuity and differentiability in the complex plane
- Analytic functions and Cauchy-Riemann equations
- Complex integration and Cauchy's theorem
- Laplace transformations and their properties
- Inverse Laplace transformations

Materials & References

- Lecture notes provided by the instructor: https://emonhossain.me/teaching/mat215
- Guide to Cultivating Complex Analysis: https://www.jirka.org/ca/ca.pdf (I will borrow most of the theory part from here)
- Complex Variables (2nd Edition): Schaum's Outline Series (You can use this book for practice problems)
- Wanna visualize complex stuff, check https://complex-analysis.com/content/table_of_contents.html + https://github.com/artmenlope/complex-plotting-tools
- Ideas from YOU

Assessments and Policy

- Short quizzes throughout the semester based on class contents only

  These contribute as part of Quiz and Assignment marks
- At least **3 timed graded quiz exams**
- At least **2 assignments**, usually with a **two-week deadline**
- One **midterm** and one **final** (timed exams)

  Each lasts approximately **1:30 to 1:45 hours**

Grading Breakdown

Total: 100 Marks

$$5 + 15(\text{A}) + 20(\text{Q}) + 30(\text{M}) + 30(\text{F}) = 100.$$

A = Assignment

Q = Quiz

M = Midterm

F = Final

How to Succeed in This Course

Attend classes like a regular human, practice problems like a machine, and panic only after trying.

Motivation

You need motivation right?

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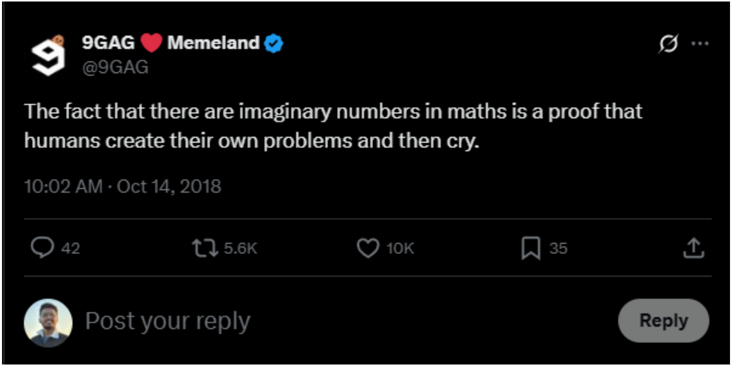
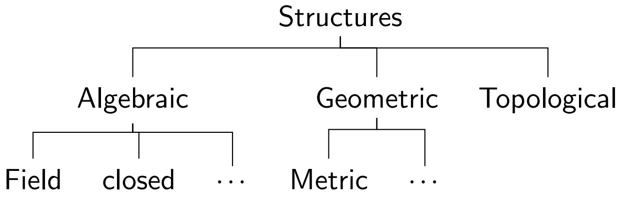


Figure: https://x.com/9gag/status/1051322203533430784

Structures


Structures
Algebraic
Geometric
Topological
Field
closed
· · ·
Metric
· · ·

Nothing to lose, only gain!

$(i) + (-i) > 0 \qquad (i) + (-i) < 0$

Imposter!

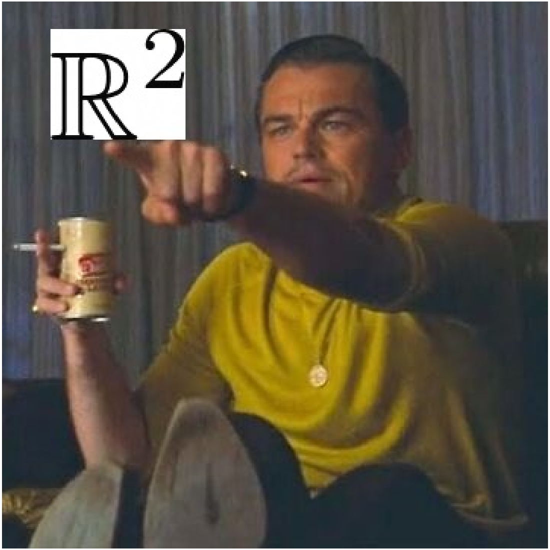


Figure: Imposter

Mate who cancel tours!

Figure: i

https://math.stackexchange.com/q/1760416/803654

Serious, study!

Take $f : \mathbb{R} \to \mathbb{R}$,

$$f(x) = \begin{cases} e^{-\frac{1}{x}}, & x > 0 \\ 0, & x \leq 0 \end{cases}$$

This function is smooth, but this is not analytic (Taylor expandable). Because $f^n = 0$ for every n. So, the Taylor series about 0 gives us

$$f(0) + \sum_{n=1}^{\infty} \frac{f^n(0)}{n!} x^n = 0 \neq f(x)$$

But this is not the case for functions with complex variables. Every smooth function on $\mathbb{C}$ is also analytic.

Continued...

Consider the function,

$$f(x) = \begin{cases} x^2 \sin(1/x), & x \neq 0 \\ 0, & x = 0 \end{cases}$$

This function is once differentiable on $\mathbb{R}$, but the second derivative does not exist. However, for functions with complex variables, if a function is once differentiable, then it is infinitely differentiable.

continued...

The Analytic Miracle: Cauchy's Integral Formula:

$$f(z_0) = \frac{1}{2\pi i} \oint_\gamma \frac{f(z)}{z - z_0}, dz$$

> *This means: to know a function inside a region, it is enough to know it only along the boundary. No other branch of analysis offers this generosity.*

And:

> *Differentiation and integration are no longer enemies — they become two faces of the same formula.*

It's almost as if the function remembers its boundary perfectly.

Fundamental Theorem of Algebra: Every non-constant polynomial has a root in ($\mathbb{C}$).

Good-bye

SCAN ME