SHARING

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DEPARTMENT OF MATHEMATICS

THE UNIVERSITY OF HONG KONG

JUPAS, HKU

HKU WEBSITE

2022-2023 Programs

- 6846 Bachelor of Science in Marketing Analytics and Technology (Business School)

- 6262 Bachelor of Engineering in Data Science and Engineering (Faculty of Engineering)

- 6470 Bachelor of Science in Bioinformatics (Faculty of Medicine)

- 6858 Bachelor of Science and Bachelor of Laws (Faculty of Science)

JUPAS, HKU
HKU WEBSITE

2022-2023 Programs

- 6846 Bachelor of Science in Marketing Analytics and Technology (Business School)

[1.5 x ENG + 1.25 x MATH + 1.25 x M1/M2 + Best 3 Subjects + 0.2 x 7th Best] [39 37 32]

[1.5 x ENG + 1.5 x Math + Best 3 Subjects + 0.2 x 6th Best Subject] <2023-2024>

- 6262 Bachelor of Engineering in Data Science and Engineering (Faculty of Engineering)

[ENG + MATH + Best 3 Subjects (including M1/M2)] [30 28 28]

[ENG + MATH + Best 3 Subjects (including M1/M2)] <2023-2024>

Conversion: 5**=8.5, 5*=7, 5=5, 4=4, 3=3, 2=2, 1=1

JUPAS, HKU
HKU WEBSITE

2022-2023 Programs

- 6470 Bachelor of Science in Bioinformatics (Faculty of Medicine)

[Best 6 Subjects] [39 38 37]

[Best 6 Subjects] <2023-2024>

- 6858 Bachelor of Science and Bachelor of Laws (Faculty of Science)

[2 x ENG + 2 x MATH/M1/M2 + 2 x Best Science Subject + Best 3 Subjects] [60 67 54]

[2 x ENG + 2 x MATH/M1/M2 + 2 x Best Science Subject + Best 3 Subjects] <2023-2024>

Conversion: 5**=8.5, 5*=7, 5=5, 4=4, 3=3, 2=2, 1=1

JUPAS, HKU

(HTTPS://WWW.JUPAS.EDU.HK/EN/PAGE/DETAIL/3667/)

Other Programs	6781 Bachelor of Business Administration in Accounting Data Analytics (Business School)	6884 Bachelor of Science in Quantitative Finance (Business School)	6248 Bachelor of Arts and Sciences in Financial Technology (Faculty of Engineering)
6925 Bachelor of Engineering in Biomedical Engineering (Faculty of Engineering)	6937 Global Engineering and Business Programme (Faculty of Engineering)	6951 Bachelor of Engineering in Engineering Science (Faculty of Engineering)	6963 Bachelor of Engineering (Faculty of Engineering)

JUPAS, HKU

(HTTPS://WWW.JUPAS.EDU.HK/EN/PAGE/DETAIL/3667/)

Other Programs

6224 Bachelor of Arts and Sciences in Applied Artificial Intelligence (Faculty of Science)

6688 Science Master Class (Faculty of Science)

6729 Bachelor of Science in Actuarial Science (Faculty of Science)

6901 Bachelor of Science (Faculty of Science)

JUPAS, HKU
6884 BACHELOR OF SCIENCE IN QUANTITATIVE FINANCE (BUSINESS SCHOOL)

- 1.5 x ENG + 1.25 x MATH + 1.25 x M1/M2 + Best 3 Subjects + 0.2 x 7th Best Subject

- (2022-2023) [1.5 x ENG + 1.25 x MATH + 1.25 x M1/M2 + Best 3 Subjects + 0.2 x 7th Best] [50 48 47]

- (2021-2022) [1.5 x ENG + 1.25 x MATH + 1.25 x M1/M2 + Best 3 Subjects] [52 49 48]

- (2020-2021) [Best 6] [41 38 38]

- (2019-2020) [Best 6] [41 39 38]

Conversion: 5**=8.5, 5*=7, 5=5, 4=4, 3=3, 2=2, 1=1

JUPAS, HKU
6248 BACHELOR OF ARTS AND SCIENCES IN FINANCIAL TECHNOLOGY
(FACULTY OF ENGINEERING)

- [ENG + MATH + Best 4 Subjects (including M1/M2)]

- (2022-2023) [ENG + MATH + Best 4 Subjects (including M1/M2)] [37 36 35]

- (2021-2022) [ENG + MATH + Best 4 Subjects (including M1/M2)] [38 36 35]

- (2020-2021) [ENG + MATH + Best 4 Subjects (including M1/M2)] [39 36 35]

- (2019-2020) [Best 6] [38 36 35]

Conversion: 5**=8.5, 5*=7, 5=5, 4=4, 3=3, 2=2, 1=1

JUPAS, HKU
6224 BACHELOR OF ARTS AND SCIENCES IN APPLIED ARTIFICIAL INTELLIGENCE (FACULTY OF SCIENCE)

- [2 x ENG + 2 x MATH + 2 x M1/M2 + Best 2 Subjects]

- (2022-2023) [2 x ENG + 2 x MATH + 2 x M1/M2 + Best 2 Subjects (weighting 5)] [59 55 51]

- (2021-2022) [2 x ENG + 2 x MATH + 2 x M1/M2 + Best 3 Subjects (weighting 3)] [72 68 63]

- (2020-2021) [Best 6 Subjects] [39 36 35]

- (2019-2020) [Best 6 Subjects] [38 36 35]

JUPAS, HKU
6729 BACHELOR OF SCIENCES IN ACTUARIAL SCIENCE (FACULTY OF SCIENCE)

- [1.2 x ENG + 1.2 x MATH + 1.2 x M1/M2 + Best 2 Subjects]

- (2022-2023) [1.2 x ENG + 1.2 x MATH + 1.2 x M1/M2 + Best 2 Subjects] [34 31 30]

- (2021-2022) [2 x ENG + 2 x MATH + 2 x M1/M2 + Best 3 Subjects] [54 51 48]

- (2020-2021) [Best 6 Subjects] [33 32 30]

- (2019-2020) [Best 6 Subjects] [36 33 32]

JUPAS, HKU
6688 SCIENCE MASTER CLASS (FACULTY OF SCIENCE)

- [ENG + MATH + Best 2 in M1/M2 and Sci Subjects + Best Subject]

- (2022-2023) [ENG + MATH + M1/M2 + Best 2 Science Subjects] [34 32 31]

- (2021-2022) [2 x ENG + 2 x MATH + 2 x M1/M2 + 2 x Best 2 Science Subjects + Best Subject (weighting 4)] [82 73 71]

JUPAS, HKU 6688 SCIENCE MASTER CLASS (FACULTY OF SCIENCE)

- The double degree elite Programme

- caters specifically to the needs of science-inclined students and incubates the next generation of scientists

- allows students to learn from the best minds and be inspired by Science Masters (renowned scientists), enhancing their scholastic potential in science

- equips students to translate scientific knowledge into practical applications with far- and wide-reaching impacts

JUPAS, HKU 6688 SCIENCE MASTER CLASS (FACULTY OF SCIENCE)

- Fast-track for completing 2 degrees at accelerated pace: a BSc plus a Master of Research

- Learning from Science Masters– Grand Masters through special tutorials and Masters as academic advisers

- Catering the needs of elite students

- disciplinary-based intensive study for research-aspired students

- ample opportunities available in our flagship Young Scientist Scheme (YSS) including Summer Research Fellowship, Overseas Research Fellowship, Exchange Study and be considered for the Cambridge-track for Natural Sciences disciplines

- Research postgraduate courses and research projects to enhance the students' frontier scientific knowledge and research skills

STUDY MATHEMATICS

CURRICULUM
QUANTITATIVE FINANCE

- ACCT1101 Introduction to financial accounting, ECON1210 Introductory microeconomics, ECON1220 Introductory macroeconomics, FINA1310 Corporate finance

- MATH1013 University mathematics II

- MATH2014 Multivariable calculus and linear algebra

- COMP1117 Computer programming

- ECON2280 Introductory econometrics, FINA2320 Investments and portfolio analysis, FINA2322 Derivatives

- STAT2601 Probability and statistics I

- FINA3350 Mathematical finance

- FINA3351 Spreadsheet financial modelling

CURRICULUM
QUANTITATIVE FINANCE

- COMP2119 Introduction to data structures and algorithms, FINA2390 Financial programming and databases

- FINA3322 Credit risk, FINA3323 Fixed income securities, FINA3325 Alternative investments, FINA3353 Regulatory, operational and valuation issues in finance institutions

- ECON3225 Big data economics, ECON3283 Economic forecasting, STAT4601 Time series analysis, MATH3405 Differential equations, MATH3603 Probability theory, STAT3603 Stochastic processes, FINA4341 Quantitative risk management, FINA4350 Text analytics and natural language processing in finance and fintech, FINA4359 Big data analytics applied toward quantitative finance, IIMT3601 Database management, STAT2602 Probability and statistics I, FINA4354 Financial engineering

CURRICULUM
DATA SCIENCE AND ENGINEERING

- Engineering Core Courses

- ENGG1320   Engineers in the modern world

- ENGG1330   Computer programming I

- ENGG1340   Computer programming II

- MATH1013   University mathematics II

CURRICULUM
DATA SCIENCE AND ENGINEERING

- Discipline Core Courses

- COMP2119   Introduction to data structure and algorithms

- COMP2501   Introduction to data science and engineering

- MATH2014   Multivariable calculus and linear algebra

- STAT2601   Probability and statistics I

- STAT2602   Probability and statistics II

CURRICULUM
DATA SCIENCE AND ENGINEERING

- Discipline Core (Advanced) Courses

- COMP3278   Introduction to database management systems

- COMP3314   Machine learning

- LLAWxxxx   Law and ethics in data science

CURRICULUM
DATA SCIENCE AND ENGINEERING

Discipline Elective Courses

COMP3270	Artificial intelligence
COMP3317	Computer vision
COMP3323	Advanced database systems/Big data and data mining
COMP3340	Applied deep learning
COMP3353	Bioinformatics
COMP3355	Cyber security
COMP3361	Natural language processing
COMP3362	Hands-on AI: experimentation and applications
COMP3407	Scientific computing

Curriculum
Data Science and Engineering

Discipline Elective Courses

COMP3513   Big data systems

COMP3516   Data analytics for IoT

COMP3520   Special topics in data science

COMP3521   Visualization for data analytics

STAT3600 Linear statistical analysis

STAT3612 Statistical machine learning

STAT3621 Statistical data analysis

STAT4601 Time-series analysis

STAT4602 Multivariate data analysis

CURRICULUM
APPLIED AI

1. Introductory Level Disciplinary Core Courses

APAI1001 Artificial intelligence: foundation, philosophy and ethics

COMP1117 Computer programming

COMP2119 Introduction to data structures and algorithms

COMP2120 Computer organization

MATH1013 University mathematics II

MATH2014 Multivariable calculus and linear algebra

STAT2601 Probability and statistics I

STAT2602 Probability and statistics II

CURRICULUM
APPLIED AI

- 2. Advanced Level Disciplinary Core Courses

- COMP3340   Applied deep learning

- MATH3904   Introduction to optimization

- STAT3612   Statistical machine learning

- 3. Concentration (Disciplinary Electives)

- Concentration: AI Technology, Concentration: AI in Business and Finance, Concentration: AI in Smart City, Concentration: AI in Neurocognitive Science

CURRICULUM
APPLIED AI

- Concentration: AI Technology

- COMP3271   Computer graphics

- COMP3356   Robotics

- APAI3010   Image processing and computer vision

- APAI4011   Natural language processing

- APAI4012   High-performance computing

- APAI4099   Special topics of applied AI

CURRICULUM
APPLIED AI

- Concentration: AI in Business and Finance

- COMP3320   Electronic commerce technology

- MATH3901   Operations research 1

- MATH3906   Financial calculus

- STAT3613   Marketing analytics

- STAT4601   Time-series analysis

- APAI4099   Special topics of applied AI

CURRICULUM
APPLIED AI

- Concentration: AI in Medicine

- STAT3655   Survival analysis

- STAT4610   Bayesian learning

- APAI3021   Modern biostatistics

- APAI4022   Omics data analysis

- APAI4023   Medical image analysis

- APAI4099   Special topics of applied AI

CURRICULUM
APPLIED AI

- Concentration: AI in Smart City

- URBS1003   Theories and Global Trends in Urban Development

- URBS1005   Urban Problems, Interventions and Design Thinking

- GEOG2090   Introduction to geographic information systems

- GEOG3202   GIS in environmental studies

- GEOG3420   Transport and society

- APAI4099   Special topics of applied AI

CURRICULUM
APPLIED AI

- Concentration: AI in Neurocognitive Science

- PSYC1001   Introduction to psychology

- PSYC2051   Perception

- PSYC2066   Foundations of cognitive science

- APAI4099   Special topics of applied AI

BACHELOR OF SCIENCE
MAJOR IN MATHEMATICS

- Disciplinary Core Courses

- MATH1013   University mathematics II

- MATH2012   Fundamental concepts of mathematics

- MATH2101   Linear algebra I

- MATH2102   Linear algebra II

- MATH2211   Multivariable calculus

- MATH2241   Introduction to mathematical analysis

BACHELOR OF SCIENCE MAJOR IN MATHEMATICS

- Disciplinary Core Course
- MATH3301   Algebra I
- MATH3401   Analysis I
- MATH3403   Functions of a complex variable
- MATH3405   Differential equations
- MATH3600   Discrete mathematics
- MATH3603   Probability theory
- MATH3904   Introduction to optimization
- MATH4404   Functional analysis
- MATH4406   Introduction to partial differential equations …

MATH 2241 Introduction to Mathematical Analysis

Teacher: Michael Ng
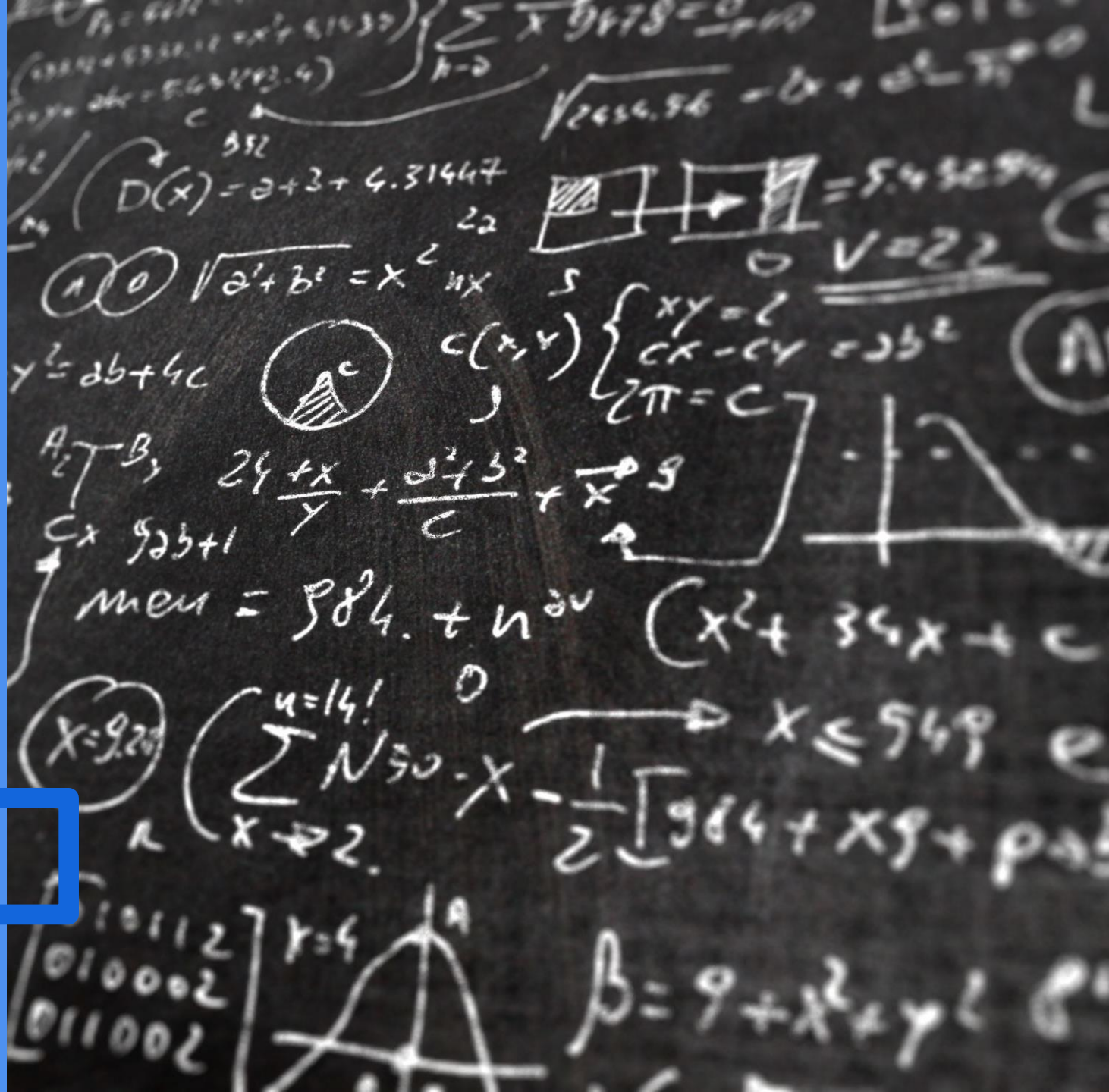
Outline of Topics

+ The Real Numbers: The field axioms, the order axioms, supremum and infimum, the completeness axiom and its consequences, the Archimedean property, density of rational numbers

+ Sequences and Series: Limits of sequences, properties of convergent sequences, monotone sequences and Cauchy sequences, subsequences, Bolzano-Weierstrass theorem, series, tests of convergence for series

+ Continuity: Limits of functions, continuous functions and their properties, the extreme value theorem, the intermediate value theorem, uniform continuity

+ Differentiation: Differentiability, properties of differentiable functions, the mean value theorem, Taylor's theorem and its applications

+ Integration: The Riemann integral, construction of the Riemann integral using Darboux sums and Riemann sums, the fundamental theorem of calculus

Definition 4.2. *Let* $f : A \to \mathbb{R}$ *be a function, where* $A \subseteq \mathbb{R}$. *Let* c *be a limit point of* A. *We say that* f *tends to a real number* L *as* x *tends to* c *if*
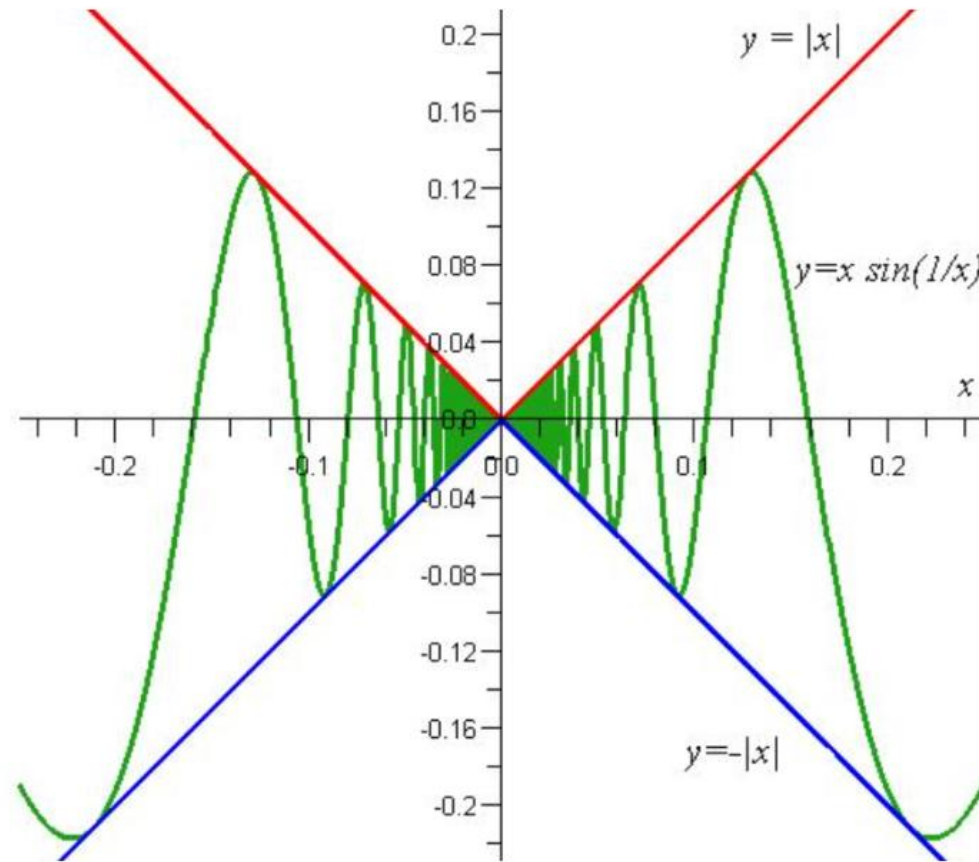
$$\forall \epsilon > 0, \exists \delta > 0 \text{ such that } \forall x \in A, \text{ if } 0 < |x - c| < \delta, \text{ then } |f(x) - L| < \epsilon.$$

In symbols we write

$$\lim_{x \to c} f(x) = L, \text{ or } f(x) \to L \text{ as } x \to c.$$

(ii) Let $f : \mathbb{R} \setminus \{0\} \to \mathbb{R}$ be defined by $f(x) = x \sin \frac{1}{x}$. Note that f is not defined at 0 but 0 is a limit point of its domain. Use the ϵ-δ definition of the limit to prove that

$$\lim_{x \to 0} f(x) = \lim_{x \to 0} x \sin \frac{1}{x} = 0.$$

4.3   Continuous Functions

We will first give the definition of a function being continuous at a point. Intuitively, to say that f is continuous at a point means that the graph of f does not have a break at that point.

Definition 4.7. *Let $f : A \to \mathbb{R}$ be a function, where $A \subseteq \mathbb{R}$, and let $c \in A$. We say that f is continuous at c if*

$$\forall \epsilon > 0, \exists \delta > 0 \text{ such that } \forall x \in A, \text{ if } |x - c| < \delta, \text{ then } |f(x) - f(c)| < \epsilon.$$

If f fails to be continuous at c, then we say that f is discontinuous at c. If f is continuous at every point in a set $B \subseteq A$, the we say that f is continuous on B.

Mathematical definitions, theorems, proofs and exercises

Understand and learn the framework for the study in mathematical analysis

Theorems → important mathematical properties and we can use them for analysis in other mathematical courses

Proofs → understand such important mathematical properties and learn the ``proof'' (logical) techniques

Exercises → to re-visit the properties and results

Theorem 5.5. *(Chain Rule) Let $f : (a, b) \to \mathbb{R}$ and $g : (c, d) \to \mathbb{R}$ be functions. Suppose that $f((a, b)) \subseteq (c, d)$. Suppose further that f is differentiable at $x_0 \in (a, b)$, and that g is differentiable at $f(x_0) \in (c, d)$. Then the composite function $g \circ f : (a, b) \to \mathbb{R}$ is differentiable at x_0 with derivative*

$$(g \circ f)'(x_0) = g'(f(x_0))f'(x_0).$$

THANK YOU VERY MUCH !