

uCertify

Course Outline

Mathematical Foundations for AI



13 Apr 2026

1. Exercises, Quizzes, Flashcards & Glossary
Number of Questions
2. Expert Instructor-Led Training
3. ADA Compliant & JAWS Compatible Platform
4. State of the Art Educator Tools
5. Award Winning Learning Platform (LMS)
6. Chapter & Lessons

Syllabus

Chapter 1: Introduction

Chapter 2: Vectors and Vector Spaces

Chapter 3: The Geometric Structure of Vector Spaces

Chapter 4: Linear Algebra in Practice

Chapter 5: Linear Transformations

Chapter 6: Matrices and Equations

Chapter 7: Eigenvalues and Eigenvectors

Chapter 8: Matrix Factorizations

Chapter 9: Matrices and Graphs

Chapter 10: Functions

Chapter 11: Numbers, Sequences, and Series

Chapter 12: Topology, Limits, and Continuity

Chapter 13: Differentiation

Chapter 14: Optimization

Chapter 15: Integration

Chapter 16: Multivariable Functions

Chapter 17: Derivatives and Gradients

Chapter 18: Optimization in Multiple Variables

Chapter 19: What is Probability?

Chapter 20: Random Variables and Distributions

Chapter 21: The Expected Value

Chapter 22: Appendix A: It's Just Logic

Chapter 23: Appendix B: The Structure of Mathematics

Chapter 24: Appendix C: Basics of Set Theory

Chapter 25: Appendix D: Complex Numbers

Videos and How To

7. Live labs

Lab Tasks

Here's what you get

1. Exercises

There is no limit to the number of times learners can attempt these. Exercises come with detailed remediation, which ensures that learners are confident on the topic before proceeding.

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EXERCISES

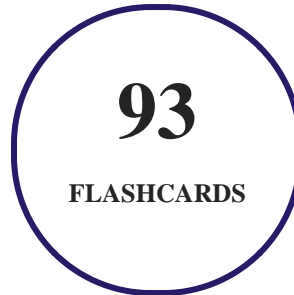
2. Quiz

Quizzes test your knowledge on the topics of the exam when you go through the course material. There is no limit to the number of times you can attempt it.

200
QUIZ

3. flashcards

Flashcards are effective memory-aiding tools that help you learn complex topics easily. The flashcard will help you in memorizing definitions, terminologies, key concepts, and more. There is no limit to the number of times learners can attempt these. Flashcards help master the key concepts.



4. Glossary of terms

uCertify provides detailed explanations of concepts relevant to the course through Glossary. It contains a list of frequently used terminologies along with its detailed explanation. Glossary defines the key terms.



5. Expert Instructor-Led Training

uCertify uses the content from the finest publishers and only the IT industry's finest instructors. They have a minimum of 15 years real-world experience and are subject matter experts in their fields. Unlike a live class, you can study at your own pace. This creates a personal learning experience and gives you all the benefit of hands-on training with the flexibility of doing it around your schedule 24/7.

6. ADA Compliant & JAWS Compatible Platform

uCertify course and labs are ADA (Americans with Disability Act) compliant. It is now more accessible to students with features such as:

- Change the font, size, and color of the content of the course
- Text-to-speech, reads the text into spoken words
- Interactive videos, how-tos videos come with transcripts and voice-over
- Interactive transcripts, each word is clickable. Students can clip a specific part of the video by clicking on a word or a portion of the text.

JAWS (Job Access with Speech) is a computer screen reader program for Microsoft Windows that reads the screen either with a text-to-speech output or by a Refreshable Braille display. Student can easily navigate uCertify course using JAWS shortcut keys.

7. State of the Art Educator Tools

uCertify knows the importance of instructors and provide tools to help them do their job effectively. Instructors are able to clone and customize course. Do ability grouping. Create sections. Design grade scale and grade formula. Create and schedule assessments. Educators can also move a student from self-paced to mentor-guided to instructor-led mode in three clicks.

8. Award Winning Learning Platform (LMS)

uCertify has developed an award winning, highly interactive yet simple to use platform. The SIIA CODiE Awards is the only peer-reviewed program to showcase business and education technology's finest products and services. Since 1986, thousands of products, services and solutions have been recognized for achieving excellence. uCertify has won CODiE awards consecutively for last 7 years:

- **2014**
 1. Best Postsecondary Learning Solution

- **2015**

1. Best Education Solution
2. Best Virtual Learning Solution
3. Best Student Assessment Solution
4. Best Postsecondary Learning Solution
5. Best Career and Workforce Readiness Solution
6. Best Instructional Solution in Other Curriculum Areas
7. Best Corporate Learning/Workforce Development Solution

- **2016**

1. Best Virtual Learning Solution
2. Best Education Cloud-based Solution
3. Best College and Career Readiness Solution
4. Best Corporate / Workforce Learning Solution
5. Best Postsecondary Learning Content Solution
6. Best Postsecondary LMS or Learning Platform
7. Best Learning Relationship Management Solution

- **2017**

1. Best Overall Education Solution
2. Best Student Assessment Solution
3. Best Corporate/Workforce Learning Solution
4. Best Higher Education LMS or Learning Platform

- **2018**

1. Best Higher Education LMS or Learning Platform
2. Best Instructional Solution in Other Curriculum Areas
3. Best Learning Relationship Management Solution

- **2019**

1. Best Virtual Learning Solution
2. Best Content Authoring Development or Curation Solution
3. Best Higher Education Learning Management Solution (LMS)

- 2020
 1. Best College and Career Readiness Solution
 2. Best Cross-Curricular Solution
 3. Best Virtual Learning Solution

9. Chapter & Lessons

uCertify brings these textbooks to life. It is full of interactive activities that keeps the learner engaged. uCertify brings all available learning resources for a topic in one place so that the learner can efficiently learn without going to multiple places. Challenge questions are also embedded in the chapters so learners can attempt those while they are learning about that particular topic. This helps them grasp the concepts better because they can go over it again right away which improves learning.

Learners can do Flashcards, Exercises, Quizzes and Labs related to each chapter. At the end of every lesson, uCertify courses guide the learners on the path they should follow.

Syllabus

Chapter 1: Introduction

- What is this course about?
- How to read this course
- Conventions used
- What this course covers

Chapter 2: Vectors and Vector Spaces

- What is a vector space?

- The basis
- Vectors in practice
- Summary
- Problems

Chapter 3: The Geometric Structure of Vector Spaces

- Norms and distances
- Inner products, angles, and lots of reasons to care about them
- Summary
- Problems

Chapter 4: Linear Algebra in Practice

- Vectors in NumPy
- Matrices, the workhorses of linear algebra
- Summary
- Problems

Chapter 5: Linear Transformations

- What is a linear transformation?

- Change of basis
- Linear transformations in the Euclidean plane
- Determinants, or how linear transformations affect volume
- Summary
- Problems

Chapter 6: Matrices and Equations

- Linear equations
- The LU decomposition
- Determinants in practice
- Summary
- Problems

Chapter 7: Eigenvalues and Eigenvectors

- Eigenvalues of matrices
- Finding eigenvalue-eigenvector pairs
- Eigenvectors, eigenspaces, and their bases
- Summary
- Problems

Chapter 8: Matrix Factorizations

- Special transformations
- Self-adjoint transformations and the spectral decomposition theorem
- The singular value decomposition
- Orthogonal projections
- Computing eigenvalues
- The QR algorithm
- Summary
- Problems

Chapter 9: Matrices and Graphs

- The directed graph of a nonnegative matrix
- Benefits of the graph representation
- The Frobenius normal form
- Summary
- Problems

Chapter 10: Functions

- Functions in theory
- Functions in practice
- Summary
- Problems

Chapter 11: Numbers, Sequences, and Series

- Numbers
- Sequences
- Series
- Summary
- Problems

Chapter 12: Topology, Limits, and Continuity

- Topology
- Limits
- Continuity
- Summary
- Problems

Chapter 13: Differentiation

- Differentiation in theory
- Differentiation in practice
- Summary
- Problems

Chapter 14: Optimization

- Minima, maxima, and derivatives
- The basics of gradient descent
- Why does gradient descent work?
- Summary
- Problems

Chapter 15: Integration

- Integration in theory
- Integration in practice
- Summary
- Problems

Chapter 16: Multivariable Functions

- What is a multivariable function?
- Linear functions in multiple variables
- The curse of dimensionality
- Summary

Chapter 17: Derivatives and Gradients

- Partial and total derivatives
- Derivatives of vector-valued functions
- Summary
- Problems

Chapter 18: Optimization in Multiple Variables

- Multivariable functions in code
- Minima and maxima, revisited
- Gradient descent in its full form
- Summary
- Problems

Chapter 19: What is Probability?

- The language of thinking
- The axioms of probability
- Conditional probability
- Summary
- Problems

Chapter 20: Random Variables and Distributions

- Random variables
- Discrete distributions
- Real-valued distributions
- Density functions
- Summary
- Problems

Chapter 21: The Expected Value

- Discrete random variables
- Continuous random variables

- Properties of the expected value
- Variance
- The law of large numbers
- Information theory
- The Maximum Likelihood Estimation
- Summary
- Problems

Chapter 22: Appendix A: It's Just Logic

- Mathematical logic 101
- Logical connectives
- The propositional calculus
- Variables and predicates
- Existential and universal quantification
- Problems

Chapter 23: Appendix B: The Structure of Mathematics

- What is a definition?
- What is a theorem?

- What is a proof?
- Equivalences
- Proof techniques

Chapter 24: Appendix C: Basics of Set Theory

- What is a set?
- Operations on sets
- The Cartesian product
- The cardinality of sets
- The Russell paradox (optional)

Chapter 25: Appendix D: Complex Numbers

- The definition of complex numbers
- The geometric representation
- The fundamental theorem of algebra
- Why are complex numbers important?

The benefits of live-labs are:

- Exam based practical tasks
- Real equipment, absolutely no simulations
- Access to the latest industry technologies
- Available anytime, anywhere on any device
- Break and Reset functionality
- No hardware costs

Lab Tasks

Vectors and Vector Spaces

- Implementing Tuple and List Operations
- Performing NumPy Array and Vector Operations

The Geometric Structure of Vector Spaces

- Analyzing Vectors and Distances

Linear Algebra in Practice

- Evaluating Vector Norms and Operations
- Applying Matrix Computations Using NumPy
- Representing Images and Text Using Vectors and Matrices

Matrices and Equations

- Solving Linear Equations Using Gaussian Elimination
- Solving Linear Equations Using Determinants and Inverses
- Solving Linear Models in Machine Learning
- Performing LU Decomposition
- Computing the Determinant Using LU Decomposition

Eigenvalues and Eigenvectors

- Finding Eigenvalues and Eigenvectors of Matrices
- Analyzing Matrices Using Characteristic Polynomials
- Visualizing Eigenvectors and Eigenspaces in Linear Algebra

Matrix Factorizations

- Implementing Spectral Decomposition and PCA
- Performing Feature Extraction and Dimensionality Reduction
- Performing Singular Value Decomposition
- Implementing QR Decomposition

Matrices and Graphs

- Reordering Adjacency Matrices Using SCCs

Functions

- Implementing Callable Functions

Numbers, Sequences, and Series

- Visualizing Mathematical Sequences and Approximations
- Visualizing the Harmonic Series

Topology, Limits, and Continuity

- Analyzing Openness, Closedness, and Compactness of Sets

Differentiation

- Applying the Chain Rule

Optimization

- Implementing Gradient Descent for Model Training

Integration

- Approximating Integrals Using the Trapezoidal Rule

Multivariable Functions

- Plotting Multivariable Function Landscapes
- Plotting Linear Mappings and Hyperplanes for ML Models

Derivatives and Gradients

- Evaluating Composite Functions
- Analyzing Gradients, Jacobians, and Hessians in ML Optimization
- Implementing Backpropagation in Neural Networks

Optimization in Multiple Variables

- Training Machine Learning Models with Gradient Descent

What is Probability?

- Simulating Random Outcomes for Probability Learning

Random Variables and Distributions

- Visualizing Discrete Probability Distributions in Machine Learning
- Visualizing Continuous Statistical Distributions

The Expected Value

- Simulating Random Processes for AI Models

Here's what you get

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LIVE LABS

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VIDEO TUTORIALS

01:32

HOURS

You can't stay away! Get

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