



PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

PROF. MADHAVAN MUKUND

Department of Computer Science and Engineering
Chennai Mathematical Institute

INTENDED AUDIENCE : Students in any branch of mathematics/science/engineering, 1st year

PRE-REQUISITES : School level mathematics.

INDUSTRIES APPLICABLE TO : This course should be of value to any company requiring programming skills.

COURSE OUTLINE :

This course is an introduction to programming and problem solving in Python. It does not assume any prior knowledge of programming. Using some motivating examples, the course quickly builds up basic concepts such as conditionals, loops, functions, lists, strings and tuples. It goes on to cover searching and sorting algorithms, dynamic programming and backtracking, as well as topics such as exception handling and using files. As far as data structures are concerned, the course covers Python dictionaries as well as classes and objects for defining user defined datatypes such as linked lists and binary search trees.

ABOUT INSTRUCTOR :

Prof. Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Director. His main research area is formal verification. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals.

He has served as President of both the Indian Association for Research in Computing Science (IARCS) (2011-2017) and the ACM India Council (2016-2018). He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD

COURSE PLAN:**Week 1:**

Informal introduction to programming, algorithms and data structures

Downloading and installing Python

gcd in Python: variables, operations, control flow - assignments, conditionals, loops, functions

Week 2:

Python: types, expressions, strings, lists, tuples

Python memory model: names, mutable and immutable values

List operations: slices etc

Binary search

Inductive function definitions: numerical and structural induction

Elementary inductive sorting: selection and insertion sort

In-place sorting

Week 3:

Basic algorithmic analysis: input size, asymptotic complexity, $O()$ notation

Arrays vs lists

Merge sort

Quicksort

Stable sorting

Week 4:

Dictionaries

More on Python functions: optional arguments, default values

Passing functions as arguments

Higher order functions on lists: map, iter, list comprehension

Week 5:

Exception handling

Basic input/output

Handling files

String processing

Week 6:

Backtracking: N Queens, recording all solutions

Scope in Python: local, global, nonlocal names

Nested functions

Data structures: stack, queue

Heaps

Week 7:

Abstract datatypes

Classes and objects in Python

"Linked" lists: find, insert, delete

Binary search trees: find, insert, delete

Height-balanced binary search trees

Week 8:

Efficient evaluation of recursive definitions: memoization

Dynamic programming: examples

Other programming languages: C and manual memory management

Other programming paradigms: functional programming

LIST OF STUDENTS COMPLETED MOOC

Name of the Department: PHYSICS

B.Sc. PHYSICS (2023-24)

S.No.	Roll No.	Name of the Candidate
1	21PH01	Ajith Kumar E

Dr. T.E. Manjulavalli, M.Sc., M.Phil., Ph.D.,
Assistant Professor and Head
PG & Research Department of Physics
NGM College (Autonomous)
Pollachi - 642 001, Tamil Nadu.

PRINCIPAL
N. G. M. COLLEGE, POLLACHI



Elite

NPTEL Online Certification

(Funded by the MoE, Govt. of India)



This certificate is awarded to

AJITH KUMAR

for successfully completing the course

Programming, Data Structures and Algorithms Using Python

with a consolidated score of **70** %

Online Assignments	25/25	Programming Assignment	25/25	Proctored Exam	20/50
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Total number of candidates certified in this course: **1825**

Prof. Devendra Jalihal

Chairperson,
Centre for Outreach and Digital Education, IITM

Jul-Sep 2022

(8 week course)

Prof. Andrew Thangaraj

NPTEL, Coordinator
IIT Madras



Indian Institute of Technology Madras



Roll No: NPTEL22CS70S23056043

To validate the certificate



No. of credits recommended: 2 or 3