

Applied programming and numerical analysis

Lecture 1: Introduction and Programming of Python

Abstract

- Introduction
- Python
- Let's get started.

Homepage (T2SCHOLA) :

<https://t2schola.titech.ac.jp/course/view.php?id=9753>

(It is necessary to login to Titech Portal.)

1 Introduction

1.1 Purpose of this lecture

Department of Transdisciplinary Science and Engineering

- Problems has become more complex.
 - Increase of resource consumption and emissions
⇒ **Global environmental problems**
 - **Power of human beings has become strong comparing to nature in the earth.**
 - If the power is weak, only a city or a culture will go to ruin. Such cases actually happened.
 - Because the power is stronger, human beings as well as other lives cannot survive.
- To solve such problems, international corporation and regulation are necessary.
- However, it is very difficult to solve such problems
 - Some groups of researchers say “No problem”. (Even in our institute).
 - Solving the problems is postponed because it is not clear.
(Untoward facts are neglected.)
 - **The Clash of Civilizations**

Engineering Transformation is necessary.

- **Department of General Medicine Primary Care**

- When we go to a hospital, it is sometimes difficult to decide to which department we should go.
- Patients do not concern about the department even surgery and internal medicine. What we need is only that the disease is cured.
- However, now our destiny will be changed by the firstly selected department, surgery or internal medicine.
- Furthermore, in case of a hospital of Japanese university, the first and second departments of internal medicine does not use the same curing procedure for the same disease.

- **Science and Engineering have be reconsidered**
 ⇒ **Transdisciplinary Science and Engineering**
 - Consider not from chemical, machine, electronic, information, environmental engineerings but from the problem that should be solved.
 - Engineers tend to depend on their specialty.
 - Specialties such as civil and electrical engineerings have been split historically.
 - However, they may not be optimum.
 - There are many Overlaps.
 - Of course, an individual progress is important.
 (Robot, Hybrid car, solar power generation, HDTV)
 - **However, can they solve such huge problems?**

Transdisciplinary Science and Engineering

- **By getting over walls between countries or disciplines, it contributes to welfare of human beings.**

Programming and numerical analysis

- If we compare engineerings to functions in a man, computer is brain.
- That is very important to enhance intellectual activities of men.
- A Computer is not only in PC or a super computer but also in a smart phone, a camera, a car, a remote controller, etc.
- To make a thing, a design is necessary.
- The design should be evaluated to make a proper thing.
- If you make a real thing for the evaluation, it takes much cost or is sometimes dangerous.
- They should be virtually evaluated at first.
- For a complex thing, an analytic solution is not enough so that numerical analysis is necessary.
- Numerical analysis is used not only in chemical mechanical, electrical, computer, environmental and civil engineering but also in economics and

Programming and numerical analysis is a very **fundamental** subject in Transdisciplinary Science and Engineering.

1.2 Text book

1.3 Schedule (Yamashita)

1. Guidance and introduction to Python (Yamashita) 12/9
Programming of Python: Variables, expression, and control (Yamashita)
2. Programming of Python: Class (Yamashita) 12/16
Practice: Sorting (Yamashita)
3. Programming of Python: Array (Yamashita) 12/23
Practice: Matrix calculation (Yamashita)
Practice: Statistical calculation (Yamashita) 1/6
4. Practice: Discrete Fourier transform
Practice: Image processing

2 Introduction to Python

- Conceived in the late 1980s.
- Implemented in 1998.
- Python 2 was released in 2000.
- Python 3 was released in 2008.
(We will use Python 3.4.)
- Python is a high-level programming language.
 - Low-level: similar to codes which CPUs execute directly.
Examples: Machine language and Assembly language of which statement has almost one-to-one mapping to statement of the machine language.
 - High-level: easy to understand by humans
Examples: FORTRAN, Java, and C++
- Python is general.
 - Targeted to an application domain.
Examples: MATLAB for matrix calculation and R for statistical calculation.
 - General
Examples: C, C++, Java, and Ruby Examples: FORTRAN, Java, and C++

- Python works by Interpreter.
 - Interpreter: Execute a line by a line of a source program.
Example: JavaScript, PHP, and Ruby.
 - Compiler: A source program is converted to a program in machine language and the latter is executed in a computer.
Example: C, C++, and FORTRAN

2.1 Preparation for programming

- We use “Google colaboratory” to execute a python program.
- Please make a account for Google and login in Google Chrome web browser.

2.2 Let's get started

- Download ‘Lec01S.ipynb’ from
- Access to Google drive.
- Click ‘New’.
- Select ‘More’.
- If you cannot see ‘Colaboratory’:
 - Click ‘Connect more apps’.
 - Select ‘Colaboratory’.
 - Click ‘Install’.
 - Click ‘Continue’.
 - Choose your account.
 - Click ‘OK’.
 - Click ‘Done’.
 - Close a window to install apps.

- Click 'New'.
- Select 'Colaboratory', then, a file Untitled0.ipynb is opened (This file is not used)).
- Click menu 'File', and select 'upload a notebook'.
- Drag 'Lec01S.ipynb' in the file explore to the place for upload.
- Return to Google drive and select folder 'Colab Notebooks'.
- Click 'New'.
- Select 'Folder', make a new folder with APN. (Of course, you can use another name. But explanation is done as the name is 'APN'.)
- Move 'Lec01S.ipynb' into folder 'APN'.
- Click folder 'APN' to change the current folder to 'APN'.
- Return to 'Lec01S.ipynb'