

Python for Accounting Applications

Introduction to Python for Accounting Applications

1121PAA01

ACC2, NTPU (U2004) (Fall 2024)

Wed 6, 7, 8, (14:10-17:00) (9:10-12:00) (B3F10)

aws
educate | Cloud
Ambassador
2020 Cohort



Min-Yuh Day, Ph.D,
Professor

Institute of Information Management, National Taipei University

<https://web.ntpu.edu.tw/~myday>





國立臺北大學
National Taipei University



Min-Yuh Day, Ph.D.



Cloud
Ambassador

2020 Cohort



2020 Cohort



Accredited
Educator



Solutions
Architect
Associate



Cloud
Practitioner

Professor, Information Management, NTPU

Visiting Scholar, IIS, Academia Sinica

Ph.D., Information Management, NTU

Director, Intelligent Financial Innovation Technology, IFIT Lab, IM, NTPU

Director, Fintech and Green Finance Research Center, NTPU

Division Director, Sustainable Development, Sustainability Office, NTPU

**Artificial Intelligence, Financial Technology, Big Data Analytics,
Data Mining and Text Mining, Electronic Commerce**



國立臺北大學
National Taipei University



Course Syllabus

National Taipei University

Academic Year 113, 1st Semester (Fall 2024)

- **Course Title: Python for Accounting Applications**
- **Instructor: Min-Yuh Day**
- **Course Class: ACC2, NTPU (3 Credits, Elective)**
- **Details**
 - **EMI Course**
(3 Credits, Elective, One Semester) (U2004)
- **Time & Place: Wed. 6, 7, 8, 14:10-17:00(B3F17)**
- **Google Meet: <https://meet.google.com/ofh-iosa-ehd>**



Course Objectives

- 1. Understand the fundamental concepts of Python for Accounting Applications.**
- 2. Equip with Hands-on practices of Python for Accounting Applications.**

Course Outline

- This course introduces the **fundamental concepts** and **hands-on practices** of **Python for Accounting Applications**.
- **Topics include**
 1. Introduction to Python for Accounting Applications,
 2. Python Programming and Data Science,
 3. Foundations of Python Programming,
 4. Data Structures,
 5. Control Logic and Loops,
 6. Functions and Modules,
 7. Files and Exception Handling,
 8. Data Analytics and Visualization with Python,
 9. Obtaining Data From the Web with Python,
 10. Statistical Analysis with Python,
 11. Machine Learning with Python,
 12. Text Analytics with Generative AI and Python,
 13. Applications of Accounting Data Analytics with Python, and
 14. Applications of ESG Data Analytics with Python.

Syllabus

Week Date Subject/Topics

1 2024/09/11 Introduction to Python for Accounting Applications

2 2024/09/18 Python Programming and Data Science

3 2024/09/25 Foundations of Python Programming

4 2024/10/02 Data Structures

5 2024/10/09 Control Logic and Loops

6 2024/10/16 Functions and Modules; Files and Exception Handling

7 2024/10/23 Data Analytics and Visualization with Python

8 2024/10/30 Midterm Project Report

Syllabus

Week Date Subject/Topics

9 2024/11/06 Self-Learning

10 2024/11/13 Obtaining Data From the Web with Python

11 2024/11/20 Statistical Analysis with Python

12 2024/11/27 Machine Learning with Python

13 2024/12/04 Text Analytics with Generative AI and Python

14 2024/12/11 Applications of Accounting Data Analytics with Python

15 2024/12/18 Applications of ESG Data Analytics with Python

16 2024/12/25 Final Project Report

Teaching Methods and Activities

- **Lecture**
- **Discussion**
- **Practicum**

Evaluation Methods

- **Individual Presentation 30 %**
- **Group Presentation 30 %**
- **Case Report 20 %**
- **Class Participation 10 %**
- **Assignment 10 %**

Required Texts

- **Allen B. Downey (2016), Think Python: How to Think Like a Computer Scientist, 2nd Edition, O'Reilly Media**

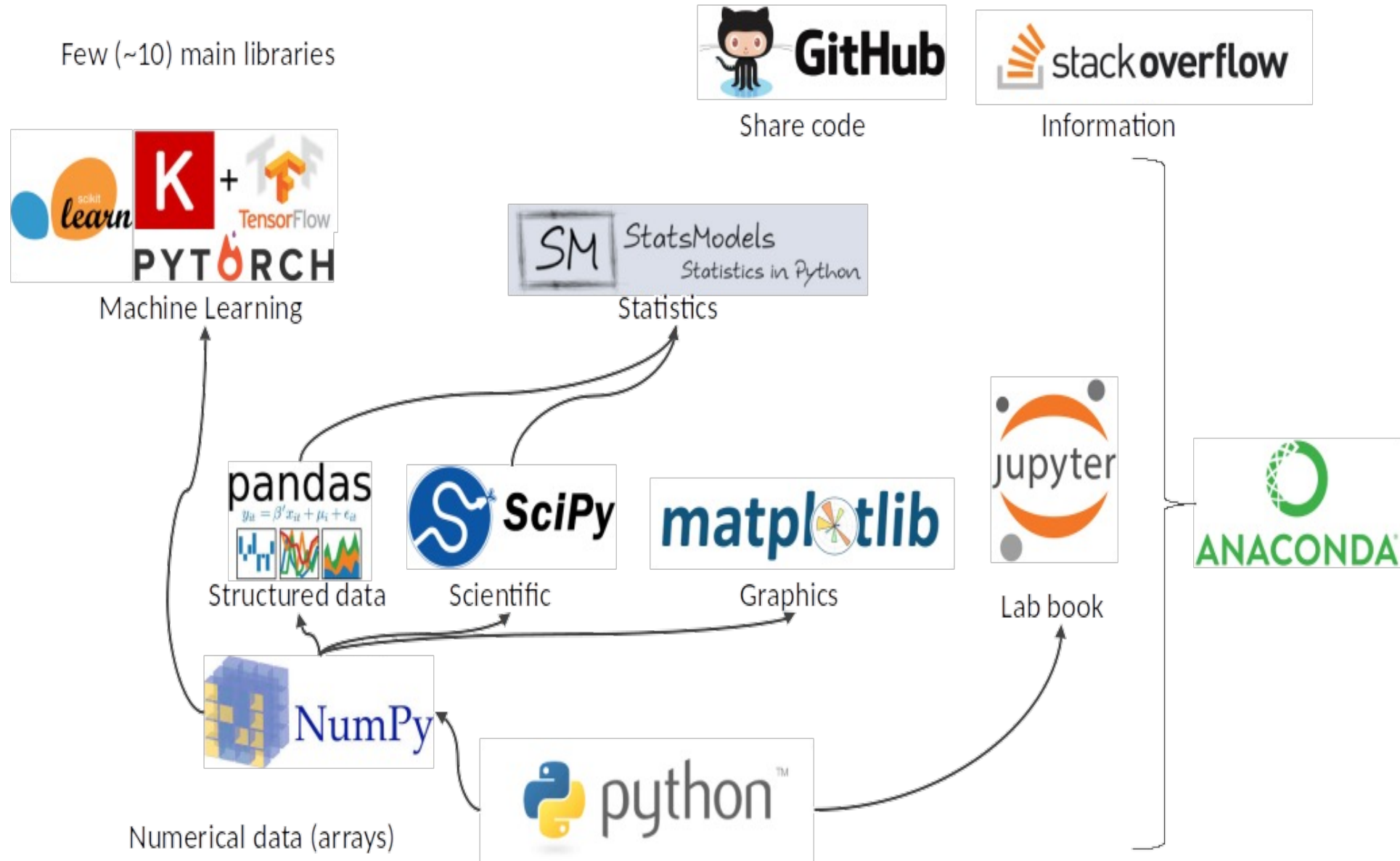
Reference Books

1. **Frederick Kaefer and Paul Kaefer (2020), Introduction to Python Programming for Business and Social Science Applications, SAGE Publications**
2. **Abdullah Karasan (2021), Machine Learning for Financial Risk Management with Python: Algorithms for Modeling Risk, O'Reilly Media**
3. **Vic Anand, Khrystyna Bochkay, and Roman Chychyla (2020), Using Python for Text Analysis in Accounting Research, Now Publishers**
4. **Aurélien Géron (2022), Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd Edition, O'Reilly Media.**
5. **Yves Hilpisch (2018), Python for Finance: Mastering Data-Driven Finance, 2nd Edition, O'Reilly Media.**
6. **Yves Hilpisch (2020), Artificial Intelligence in Finance: A Python-Based Guide, O'Reilly Media.**
7. **Numa Dhamani and Maggie Engler (2024), Introduction to Generative AI, Manning**
8. **Denis Rothman (2024), Transformers for Natural Language Processing and Computer Vision - Third Edition: Explore Generative AI and Large Language Models with Hugging Face, ChatGPT, GPT-4V, and DALL-E 3, 3rd ed. Edition, Packt Publishing**
9. **Ben Auffarth (2023), Generative AI with LangChain: Build large language model (LLM) apps with Python, ChatGPT and other LLMs, Packt Publishing.**

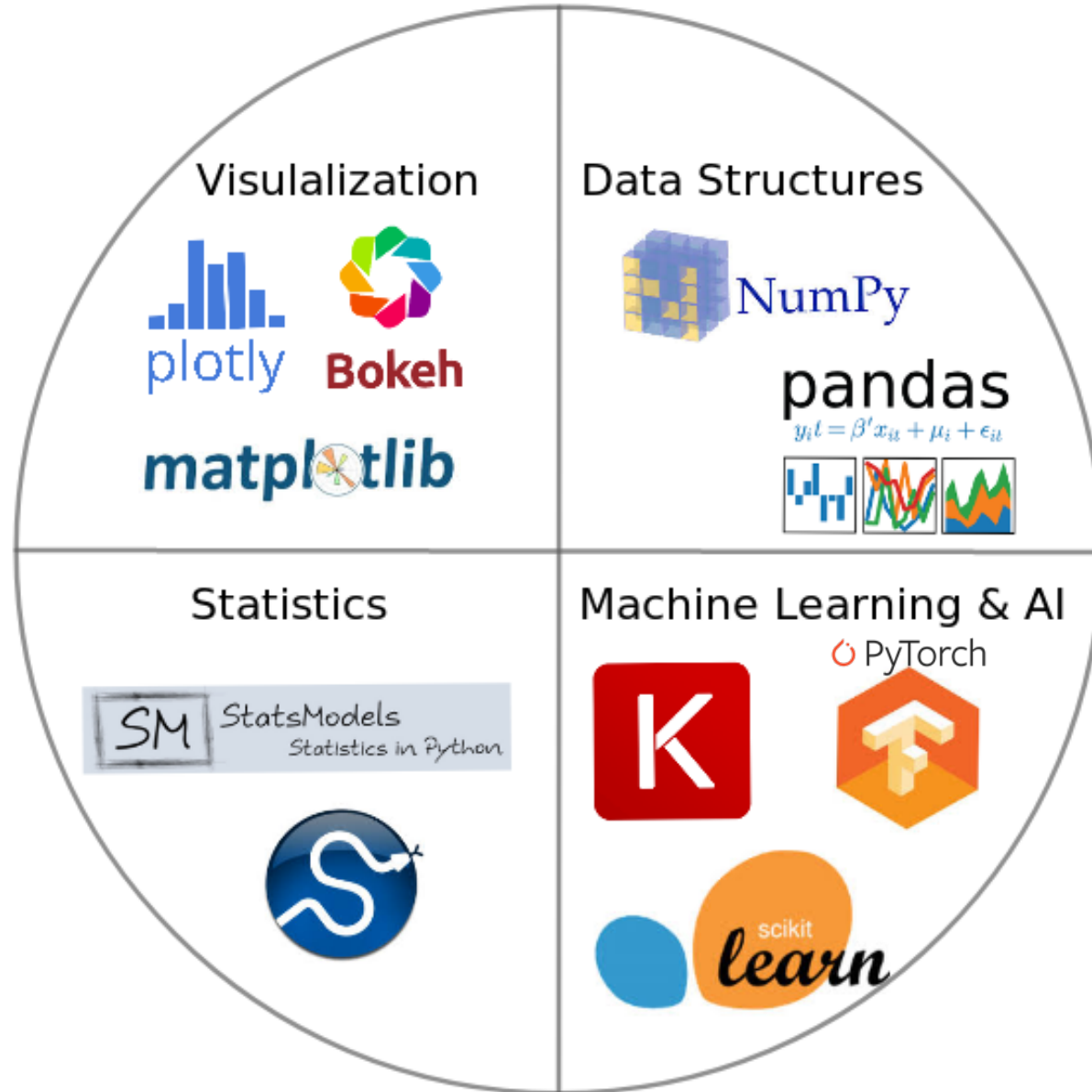
Other References

- Python, <https://www.python.org/>
- GRI (Global Report Initiative):
<https://www.globalreporting.org/>
- CDP (Carbon Disclosure Project):
<https://www.cdp.net/>
- SASB (Sustainability Accounting Standards Board):
<https://sasb.org/>
- ISSB (International Sustainability Standards Board):
<https://www.ifrs.org/groups/international-sustainability-standards-board/>
- TCFD (Task Force on Climate-related Financial Disclosures):
<https://www.fsb-tcfd.org/>

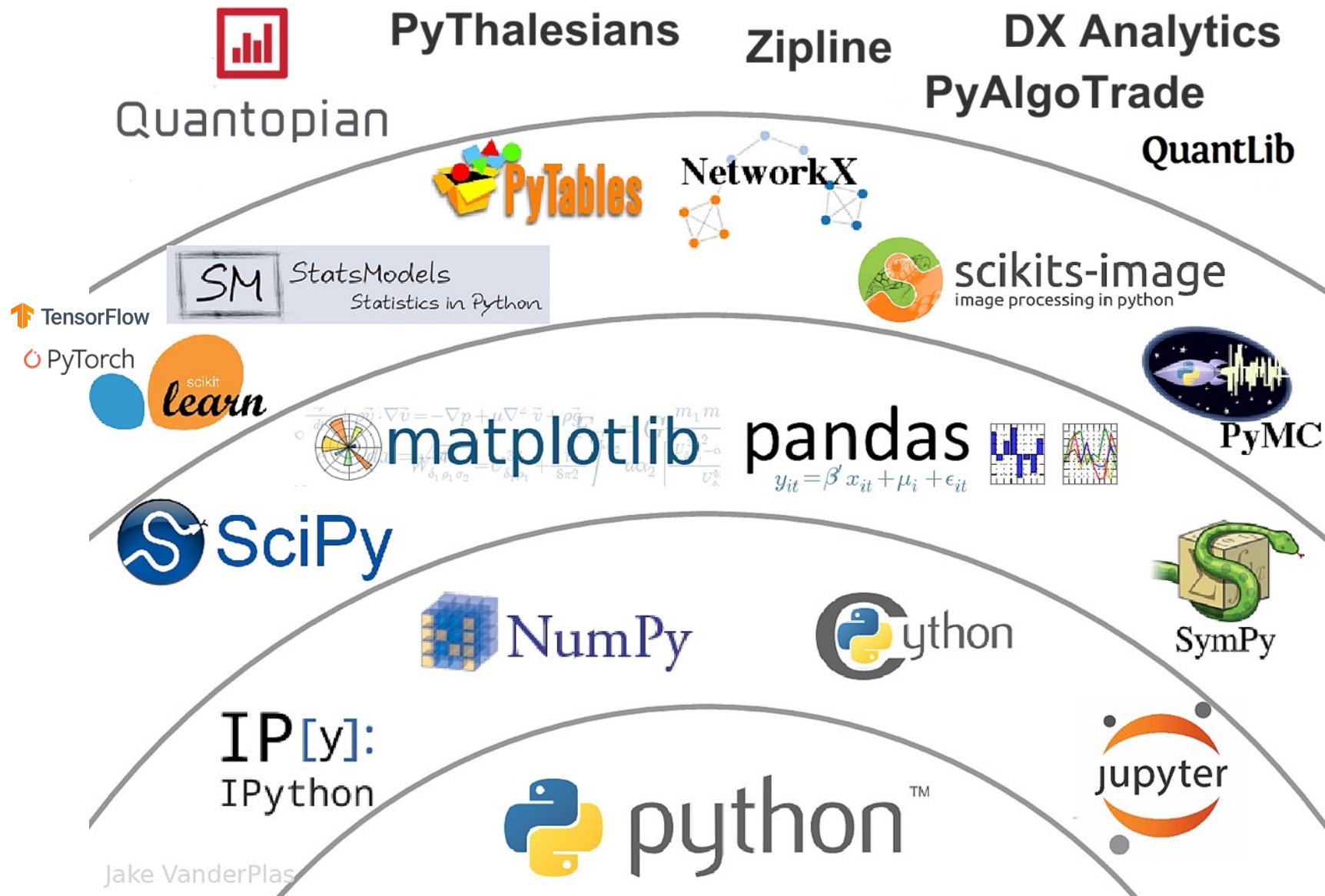
Python Ecosystem for Data Science



Python Ecosystem for Data Science



The Quant Finance PyData Stack

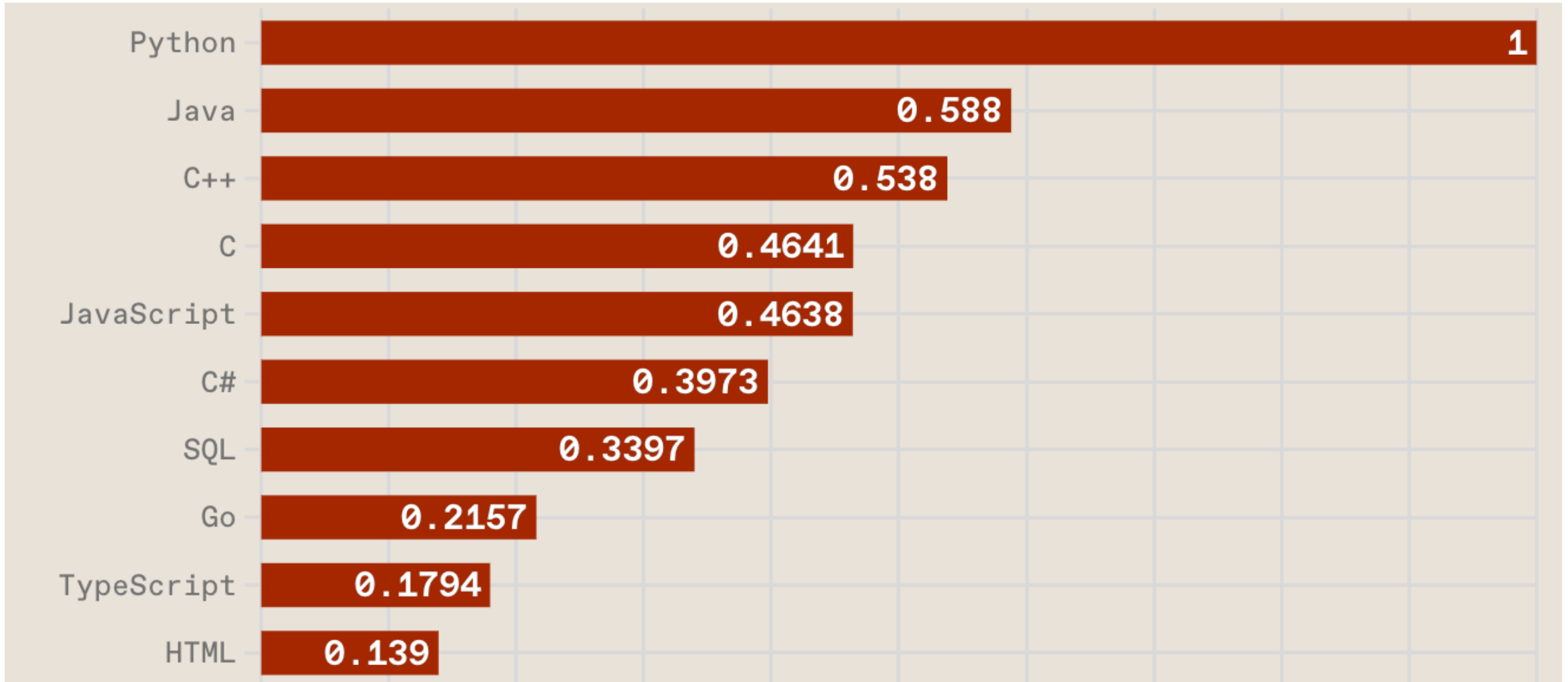




Python

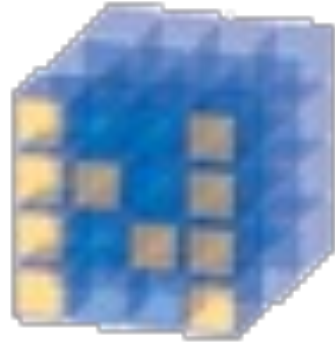
Programming

Top Programming Languages



Python is an
interpreted,
object-oriented,
high-level
programming language
with
dynamic semantics.

NumPy



NumPy

Base

N-dimensional array

package

Python

matplotlib

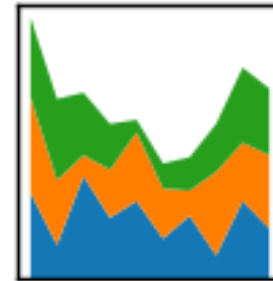
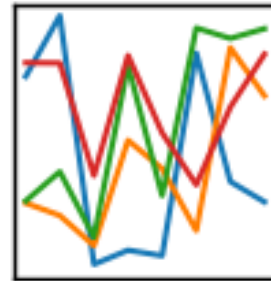
matplotlib

The logo for Matplotlib, which is a circular plot with a white background and a light gray grid. It features several colored wedges (orange, yellow, green, and blue) radiating from the center, resembling a pie chart or a polar plot.

Python Pandas

pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$



- Python Tutorial
- Python HOME**
- Python Intro
- Python Get Started
- Python Syntax
- Python Comments
- Python Variables
- Python Data Types
- Python Numbers
- Python Casting
- Python Strings
- Python Booleans
- Python Operators
- Python Lists
- Python Tuples
- Python Sets
- Python Dictionaries
- Python If...Else
- Python While Loops
- Python For Loops
- Python Functions

Python Tutorial

[← Home](#)

[Next >](#)

Learn Python

Python is a popular programming language.

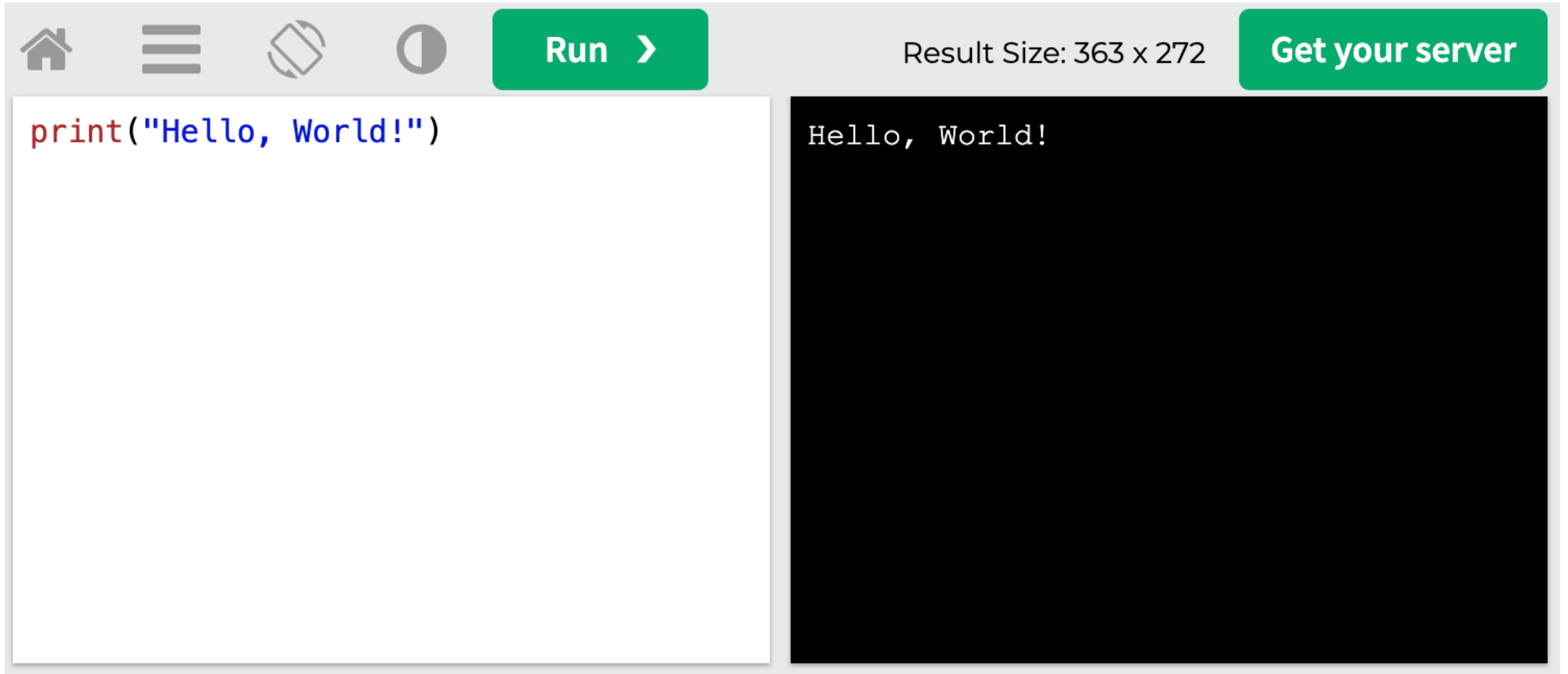
Python can be used on a server to create web applications.

[Start learning Python now »](#)

Learning by Examples

With our "Try it Yourself" editor, you can edit Python code and view the result.

W3Schools Python: Try Python

A screenshot of the W3Schools Python Try Python interface. The interface has a light gray header with navigation icons (home, menu, refresh, moon) and a green 'Run >' button. To the right of the 'Run' button, it says 'Result Size: 363 x 272' and a green 'Get your server' button. The main area is split into two panels: a white code editor on the left containing the Python code `print("Hello, World!")` and a black terminal window on the right displaying the output 'Hello, World!'.

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Welcome

Welcome to the LearnPython.org interactive Python tutorial.

Whether you are an experienced programmer or not, this website is intended for everyone who wishes to learn the Python programming language.

You are welcome to join our group on [Facebook](#) for questions, discussions and updates.

After you complete the tutorials, you can get certified at [LearnX](#) and add your certification to your LinkedIn profile.

Just click on the chapter you wish to begin from, and follow the instructions. Good luck!

<https://www.learnpython.org/>

Google's Python Class

Google for Education > Python

Search

English



Filter

Overview

Python Set Up

Python Intro

Strings

Lists

Sorting

Dicts and Files

Regular Expressions

Utilities

Lecture Videos

1.1 Introduction, strings [↗](#)

1.2 Lists and sorting [↗](#)

1.3 Dicts and files [↗](#)

2.1 Regular expr [↗](#)

2.2 Utilities [↗](#)

2.3 Utilities urllib [↗](#)

2.4 Conclusions [↗](#)

Python Exercises



Home > Products > Google for Education > Python

Was this helpful? [👍](#) [🗨️](#)

Google's Python Class [📄](#)

Welcome to Google's Python Class -- this is a free class for people with a little bit of programming experience who want to learn Python. The class includes written materials, lecture videos, and lots of code exercises to practice Python coding. These materials are used within Google to introduce Python to people who have just a little programming experience. The first exercises work on basic Python concepts like strings and lists, building up to the later exercises which are full programs dealing with text files, processes, and http connections. The class is geared for people who have a little bit of programming experience in some language, enough to know what a "variable" or "if statement" is. Beyond that, you do not need to be an expert programmer to use this material.

To get started, the Python sections are linked at the left -- [Python Set Up](#) to get Python installed on your machine, [Python Introduction](#) for an introduction to the language, and then [Python Strings](#) starts the coding material, leading to the first exercise. The end of each written section includes a link to the code exercise for that section's material. The lecture videos parallel the written materials, introducing Python, then strings, then first exercises, and so on. At Google, all this material makes up an intensive 2-day class, so the videos are organized as the day-1 and day-2 sections.

This material was created by [Nick Parlante](#) working in the engEDU group at Google. Special thanks for the help from my Google colleagues John Cox, Steve Glassman, Piotr Kaminski, and Antoine Picard. And finally thanks to Google and my director Maggie Johnson for the enlightened generosity to put these materials out on the internet for free under the [Creative Commons Attribution 2.5](#) license -- share and enjoy!

<https://developers.google.com/edu/python>

Google Colab

Table of contents

- Getting Started
- Highlighted Features
 - TensorFlow execution
- GitHub
- Visualization
- Forms
- Examples
- Local runtime support

SECTION

Welcome to Colaboratory!

Colaboratory is a free Jupyter notebook environment that requires no setup and runs entirely in the cloud. See our [FAQ](#) for more info.

Getting Started

- [Overview of Colaboratory](#)
- [Loading and saving data: Local files, Drive, Sheets, Google Cloud Storage](#)
- [Importing libraries and installing dependencies](#)
- [Using Google Cloud BigQuery](#)
- [Forms, Charts, Markdown, & Widgets](#)
- [TensorFlow with GPU](#)
- [Machine Learning Crash Course: Intro to Pandas & First Steps with TensorFlow](#)

Highlighted Features

Seedbank

Looking for Colab notebooks to learn from? Check out [Seedbank](#), a place to discover interactive machine learning examples.

TensorFlow execution

Colaboratory allows you to execute TensorFlow code in your browser with a single click. The example below adds two matrices.

$$\begin{bmatrix} 1. & 1. & 1. \end{bmatrix} + \begin{bmatrix} 1. & 2. & 3. \end{bmatrix} = \begin{bmatrix} 2. & 3. & 4. \end{bmatrix}$$

Connect Google Colab in Google Drive

The image shows a browser window with the Google Drive interface. The address bar displays 'https://drive.google.com/drive/u/2/my-drive'. The main navigation bar includes the Drive logo, a search bar, and utility icons. On the left, a sidebar lists navigation options: 'New', 'My Drive', 'Computers', 'Shared with me', 'Recent', 'Starred', 'Trash', 'Backups', and 'Storage'. The 'New' button is highlighted with a red dashed border. A dropdown menu is open from 'New', listing options: 'New folder...', 'Upload files...', 'Upload folder...', 'Google Docs', 'Google Sheets', 'Google Slides', and 'More'. The 'More' option is also highlighted with a red dashed border. A second dropdown menu is open from 'More', listing: 'Google Forms', 'Google Drawings', 'Google My Maps', 'Google Sites', and 'Connect more apps'. The 'Connect more apps' option is highlighted with a red dashed border. The main content area shows 'Quick Access' and a 'Files' section with a 'Name' column header.

Google Colab

The screenshot shows the Google Drive web interface. A dialog box titled "Connect apps to Drive" is open, displaying a search for "colab". The search results are as follows:

App Name	User Count
ZIP Extractor	307,585 users
Lumin PDF - Beautiful PDF Editor	289,310 users
CloudConvert	373,161 users
Sejda	2,131,600 users
DocHub - Edit and Sign PDF Docu...	2,131,600 users
Google Forms	4,803,614 users

Google Colab

The image shows a browser window with a Google Drive page. A modal dialog titled "Connect apps to Drive" is open in the center. The dialog has a search bar at the top with the text "colab" entered. Below the search bar, a search result for "Colaboratory" is displayed. The result includes the Colaboratory logo (two yellow circles), the name "Colaboratory", the URL "https://colab.research.google.com", a description: "A data analysis tool that combines code, output, and descriptive text into one collaborative document.", and a rating of five stars with "(195)" reviews. A blue button with a white plus sign and the text "+ CONNECT" is positioned to the right of the app details. The entire search result card is enclosed in a red dashed rectangular border. The background shows the Google Drive interface with a sidebar on the left containing navigation options like "My Drive", "Computers", "Shared with me", "Recent", "Starred", "Trash", "Backups", and "Storage".

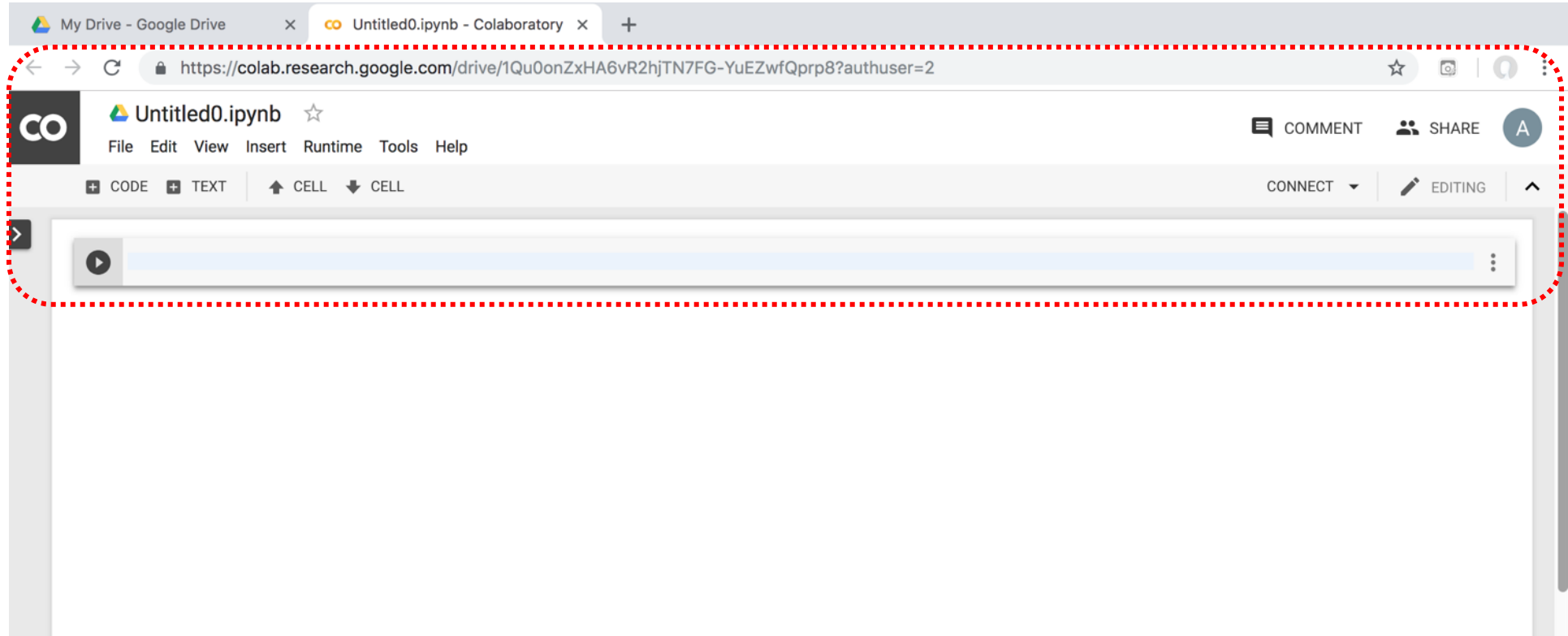
Connect Colaboratory to Google Drive

The screenshot shows the Google Drive web interface. A dialog box titled "Connect apps to Drive" is open, displaying a search for "colab". A confirmation message from Colaboratory is centered in the dialog, stating "Colaboratory was connected to Google Drive." and "Make Colaboratory the default app for files it can open" with a checked checkbox. An "OK" button is visible at the bottom right of the message. The background shows the Drive sidebar with categories like "My Drive", "Computers", "Shared with me", "Recent", "Starred", "Trash", "Backups", and "Storage". The storage status indicates "0 bytes of 15 GB used" with an "UPGRADE STORAGE" link. The top navigation bar includes the Drive logo, search bar, and various utility icons.

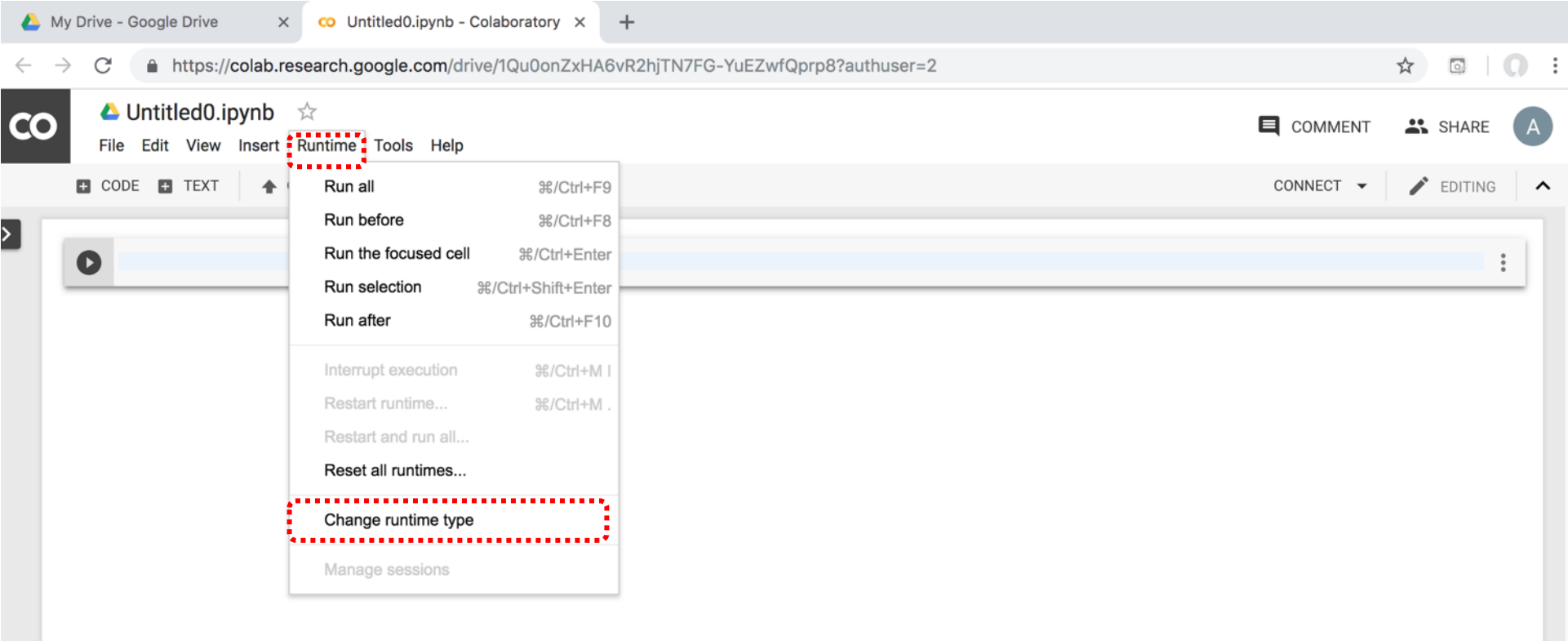
Google Colab

The image shows a browser window with the Google Drive interface. The address bar displays 'https://drive.google.com/drive/u/2/my-drive'. The main navigation bar includes the Drive logo, a search bar, and utility icons. On the left, a sidebar contains navigation options like 'New', 'My Drive', 'Computers', 'Shared with me', 'Recent', 'Starred', 'Trash', 'Backups', and 'Storage'. The 'New' button is highlighted with a red dashed box, and its dropdown menu is open. Within this menu, the 'More' option is also highlighted with a red dashed box. A secondary dropdown menu is visible, listing various Google services: Google Forms, Google Drawings, Google My Maps, Google Sites, Colaboratory (highlighted with a red dashed box), and Connect more apps. The background shows a file list with a 'Name' column header and a scroll bar.

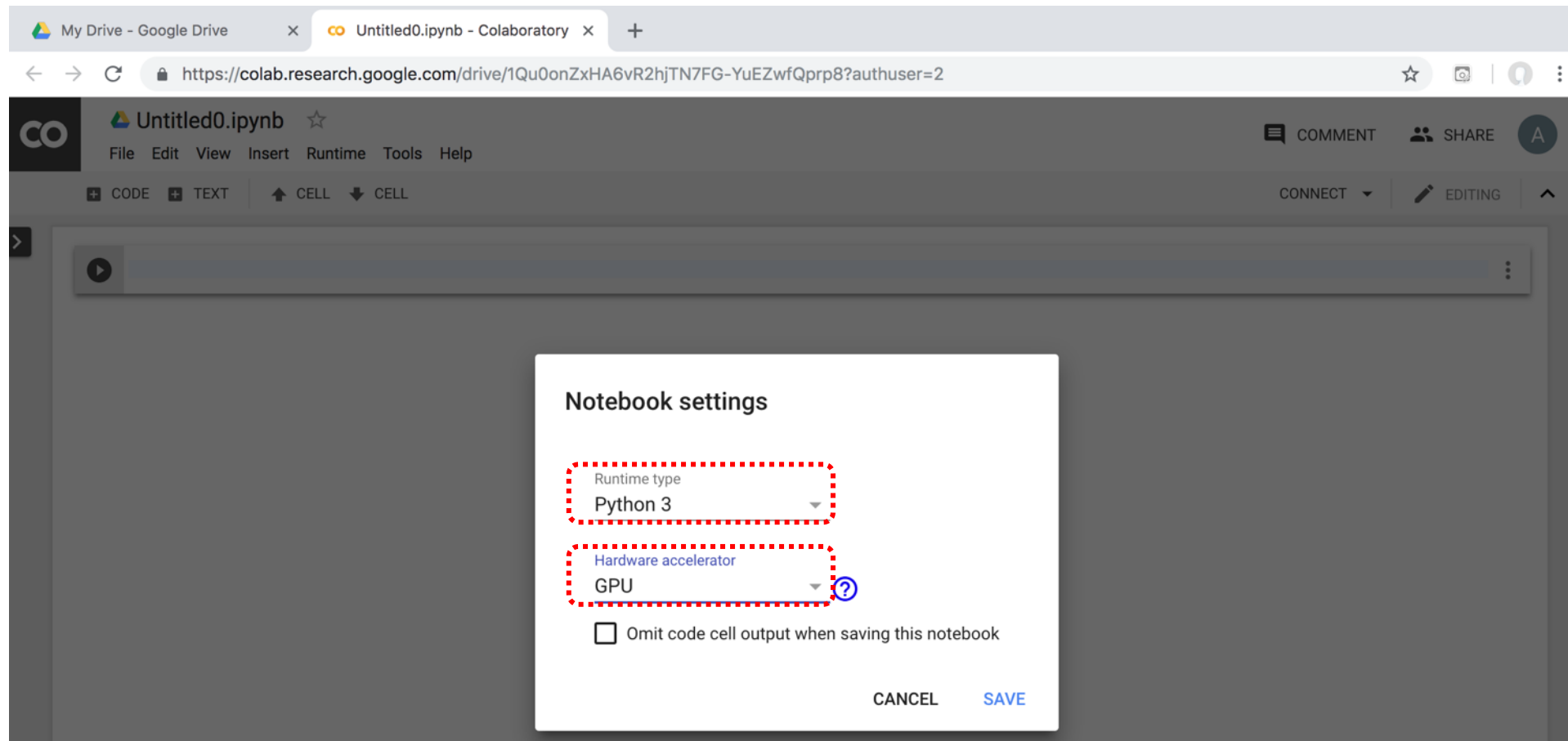
Google Colab



Google Colab



Run Jupyter Notebook Python3 GPU Google Colab



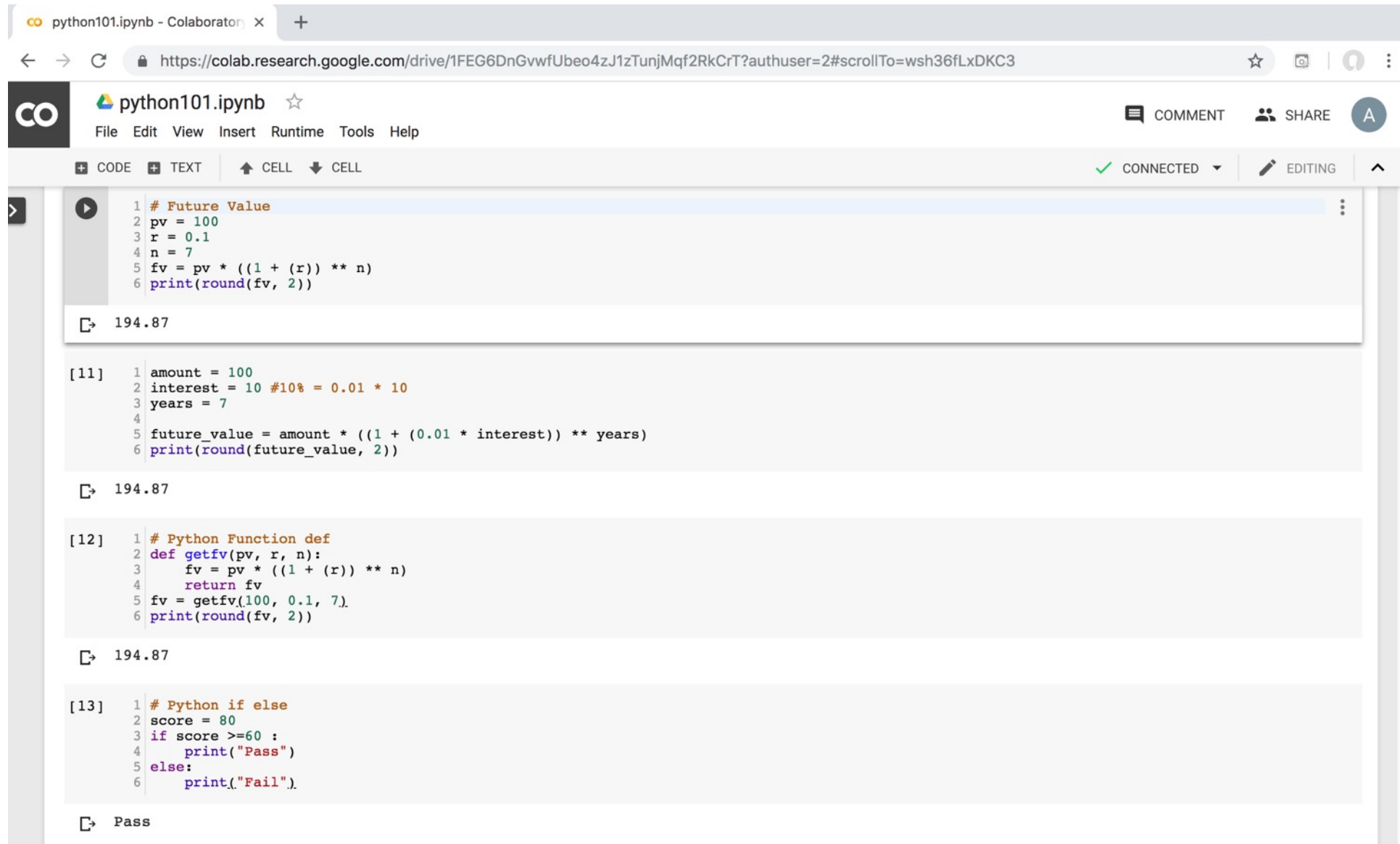
Google Colab Python Hello World

```
print('Hello World')
```



Python in Google Colab (Python101)

<https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT>



The screenshot shows a Google Colab notebook titled "python101.ipynb". The interface includes a top navigation bar with "File", "Edit", "View", "Insert", "Runtime", "Tools", and "Help" menus. On the right, there are "COMMENT", "SHARE", and a user profile icon. Below the navigation bar, the notebook is in "EDITING" mode, and the status is "CONNECTED".

The notebook contains four code cells:

- Cell 1:** A code cell with the following Python code:

```
1 # Future Value
2 pv = 100
3 r = 0.1
4 n = 7
5 fv = pv * ((1 + (r)) ** n)
6 print(round(fv, 2))
```

The output is "194.87".
- Cell [11]:** A code cell with the following Python code:

```
1 amount = 100
2 interest = 10 #10% = 0.01 * 10
3 years = 7
4
5 future_value = amount * ((1 + (0.01 * interest)) ** years)
6 print(round(future_value, 2))
```

The output is "194.87".
- Cell [12]:** A code cell with the following Python code:

```
1 # Python Function def
2 def getfv(pv, r, n):
3     fv = pv * ((1 + (r)) ** n)
4     return fv
5 fv = getfv(100, 0.1, 7)
6 print(round(fv, 2))
```

The output is "194.87".
- Cell [13]:** A code cell with the following Python code:

```
1 # Python if else
2 score = 80
3 if score >=60 :
4     print("Pass")
5 else:
6     print("Fail").
```

The output is "Pass".

<https://tinyurl.com/aintpupython101>



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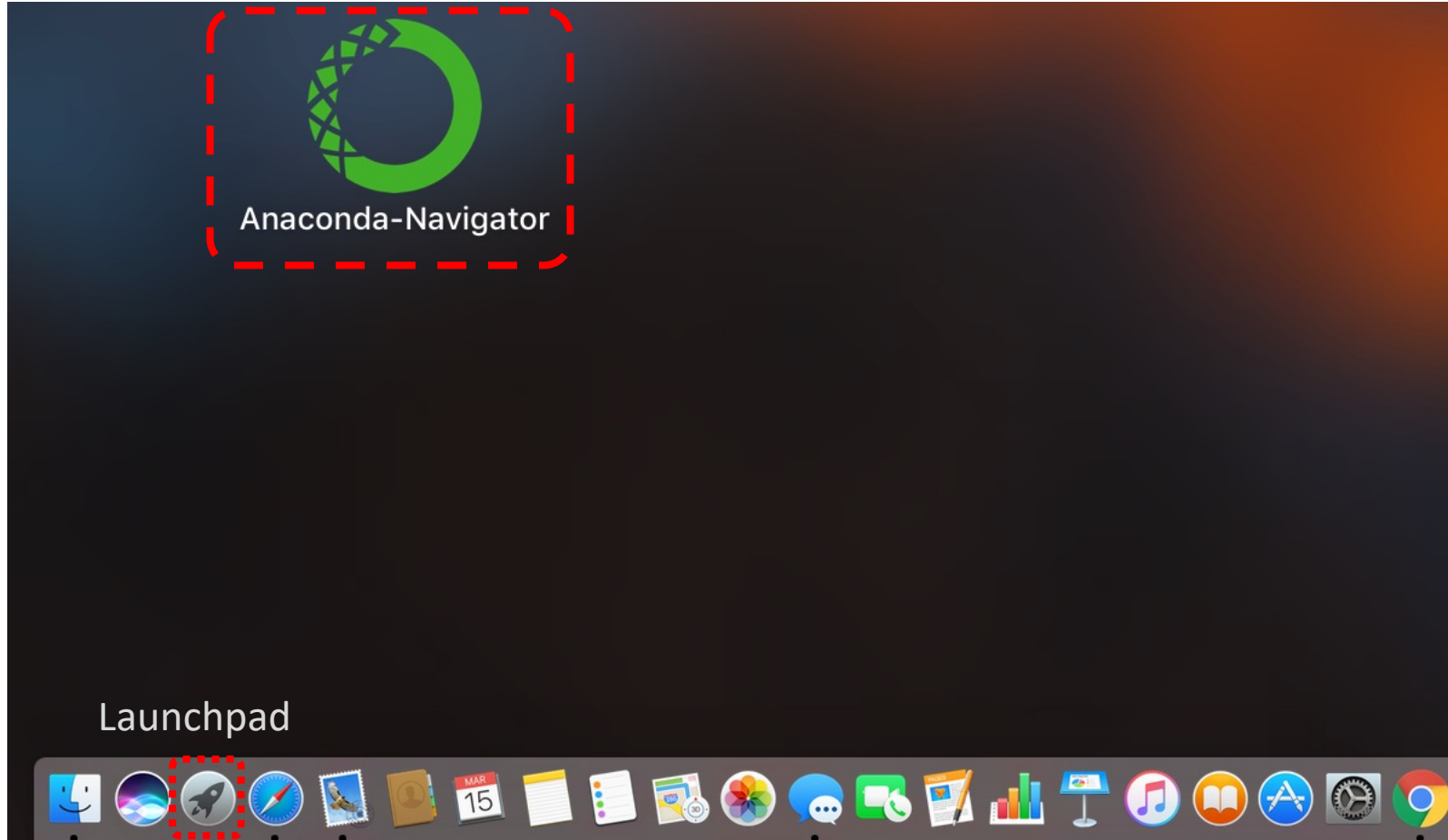
<https://www.anaconda.com/download>



Python

HelloWorld

Anaconda-Navigator



Anaconda Navigator

The screenshot displays the Anaconda Navigator desktop application. At the top, the title bar reads "Anaconda Navigator". Below it, the application header features the "ANACONDA NAVIGATOR" logo on the left and a "Sign in to Anaconda Cloud" button on the right. A left-hand sidebar contains navigation options: "Home", "Environments", "Learning", and "Community". At the bottom of the sidebar are links for "Documentation", "Developer Blog", and "Feedback", along with social media icons for Twitter, YouTube, and GitHub.

The main content area is titled "Applications on" and shows a dropdown menu set to "base (root)" and a "Channels" button. A "Refresh" button is located in the top right of this section. The applications are arranged in a grid:

- jupyterlab** (0.31.5): An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture. [Launch]
- jupyter notebook** (5.4.0): Web-based, interactive computing notebook environment. Edit and run human-readable docs while describing the data analysis. [Launch]
- qtconsole** (4.3.1): PyQt GUI that supports inline figures, proper multiline editing with syntax highlighting, graphical calltips, and more. [Launch]
- spyder** (3.2.6): Scientific PYTHON Development Environment. Powerful Python IDE with advanced editing, interactive testing, debugging and introspection features. [Launch]
- vscode** (1.22.2): Streamlined code editor with support for development operations like debugging, task running and version control. [Launch]
- glueviz** (0.12.4): Multidimensional data visualization across files. Explore relationships within and among related datasets. [Install]

The "jupyter notebook" application card is highlighted with a red dashed border, and its "Launch" button is enclosed in a solid red box.

Jupyter Notebook

The screenshot shows a web browser window with the Jupyter Notebook interface. The browser's address bar displays the URL `localhost:8888/tree/Documents/Data/BDA`. The Jupyter logo and a "Logout" button are visible in the top left and right corners, respectively. Below the navigation tabs ("Files", "Running", "Clusters"), there is a prompt "Select items to perform actions on them." followed by "Upload", "New", and "Refresh" buttons. A file browser table is shown with a red dashed border around its main content area. The table header includes a selection column with a checkbox and the number "0", a breadcrumb path `/ Documents / Data / BDA`, and two columns: "Name" with a downward arrow and "Last Modified". The table body contains a single row with a folder icon and the text `..` in the "Name" column, and `seconds ago` in the "Last Modified" column. Below the table, a message states "The notebook list is empty."

<input type="checkbox"/> 0	<code>/ Documents / Data / BDA</code>	Name ↓	Last Modified
	<code>..</code>		seconds ago

The notebook list is empty.

Jupyter Notebook

New Python 3

The screenshot shows a web browser window with the Jupyter Notebook interface. The browser's address bar displays `localhost:8888/tree/Documents/Data/BDA`. The Jupyter logo and a 'Logout' button are visible at the top. Below the navigation tabs ('Files', 'Running', 'Clusters'), there is a prompt: 'Select items to perform actions on them.' To the right of this prompt are buttons for 'Upload', 'New', and a refresh icon. The 'New' button is highlighted with a red circle. A dropdown menu is open, showing options under 'Notebook:' and 'Other:'. The 'Python 3' option under 'Notebook:' is highlighted with a red rectangle. Other options include 'Text File', 'Folder', and 'Terminal'. The file browser below shows the path `/ Documents / Data / BDA` and a message: 'The notebook list is empty.'

print("hello, world")

The screenshot shows a web browser window with two tabs: 'Home' and 'HelloWorld'. The address bar shows the URL `localhost:8888/notebooks/Documents/Data/BDA/HelloWorld.ipynb`. The page title is 'jupyter HelloWorld (autosaved)'. The top navigation bar includes 'File', 'Edit', 'View', 'Insert', 'Cell', 'Kernel', 'Widgets', and 'Help'. The 'Run' button in the toolbar is highlighted with a red box. Below the toolbar, a code cell is shown with the input `In [1]: print("hello, world")` and the output `hello, world`. The code cell is also highlighted with a red box. Below the code cell, there is an empty input field labeled `In []:`.



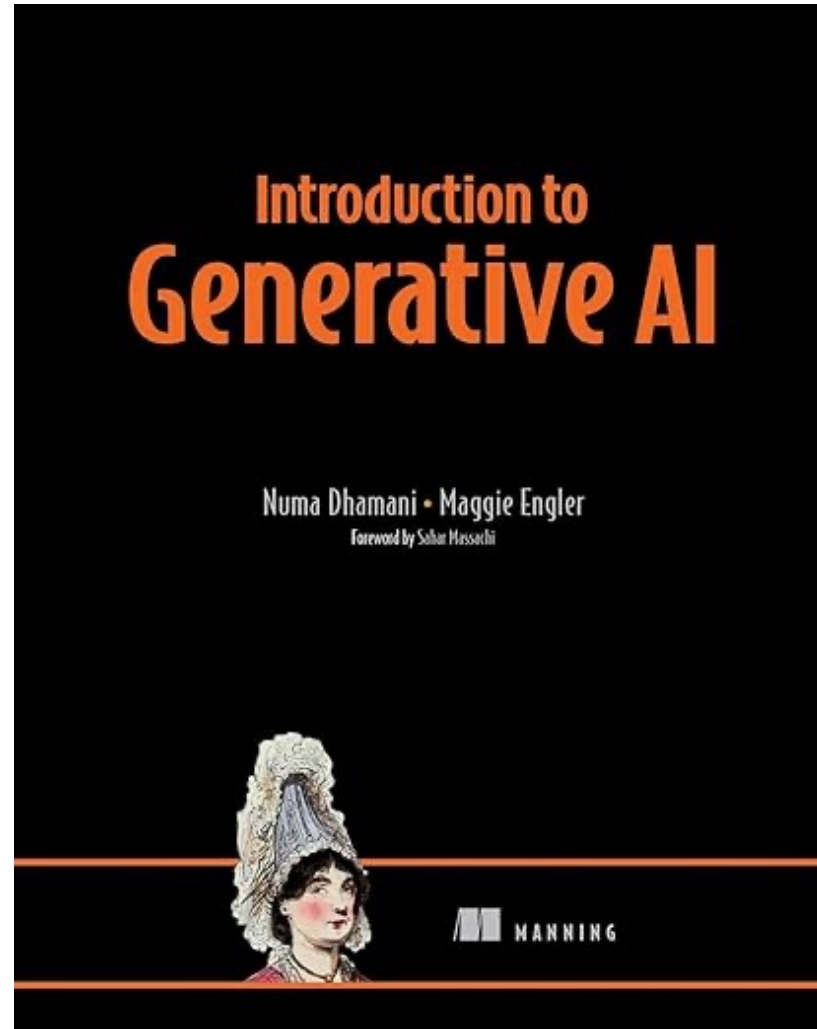
Python

Programming

Foundations of Python Programming

- **Python Syntax**
 - **Python Comments**
- **Python Variables**
- **Python Data Types**
 - **Python Numbers**
 - **Python Casting**
 - **Python Strings**
- **Python Operators**
- **Python Booleans**

Numa Dhamani and Maggie Engler (2024),
Introduction to Generative AI,
Manning

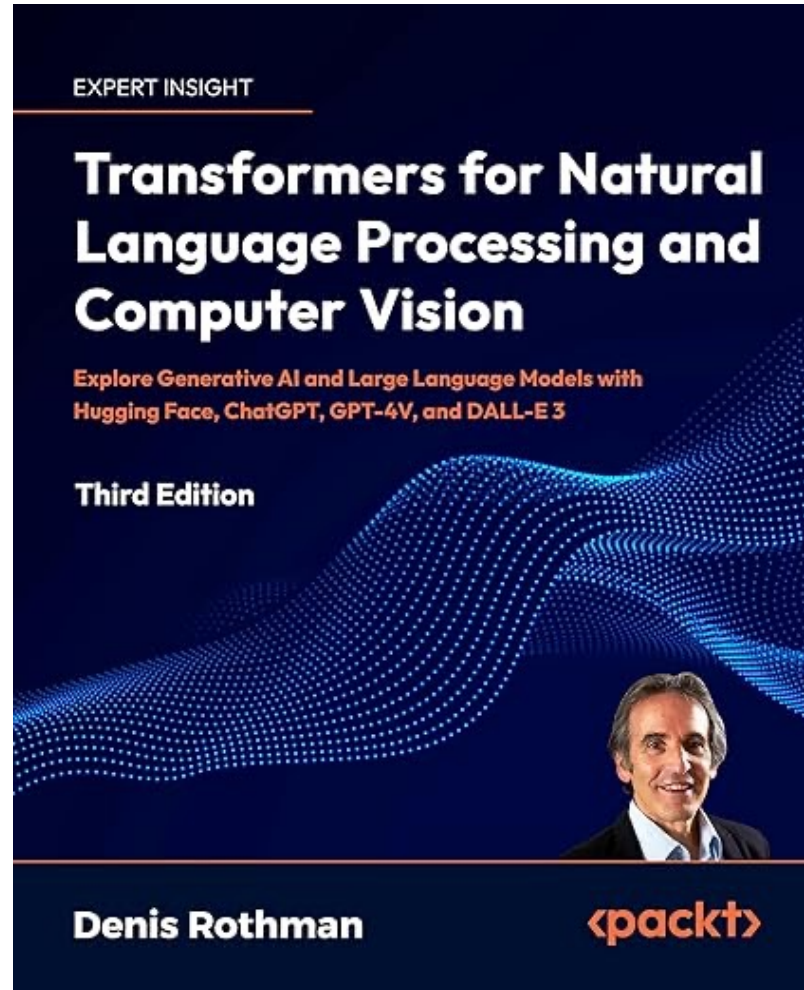


Source: Numa Dhamani and Maggie Engler (2024), Introduction to Generative AI, Manning
<https://www.amazon.com/Introduction-Generative-AI-Numa-Dhamani/dp/1633437191/>

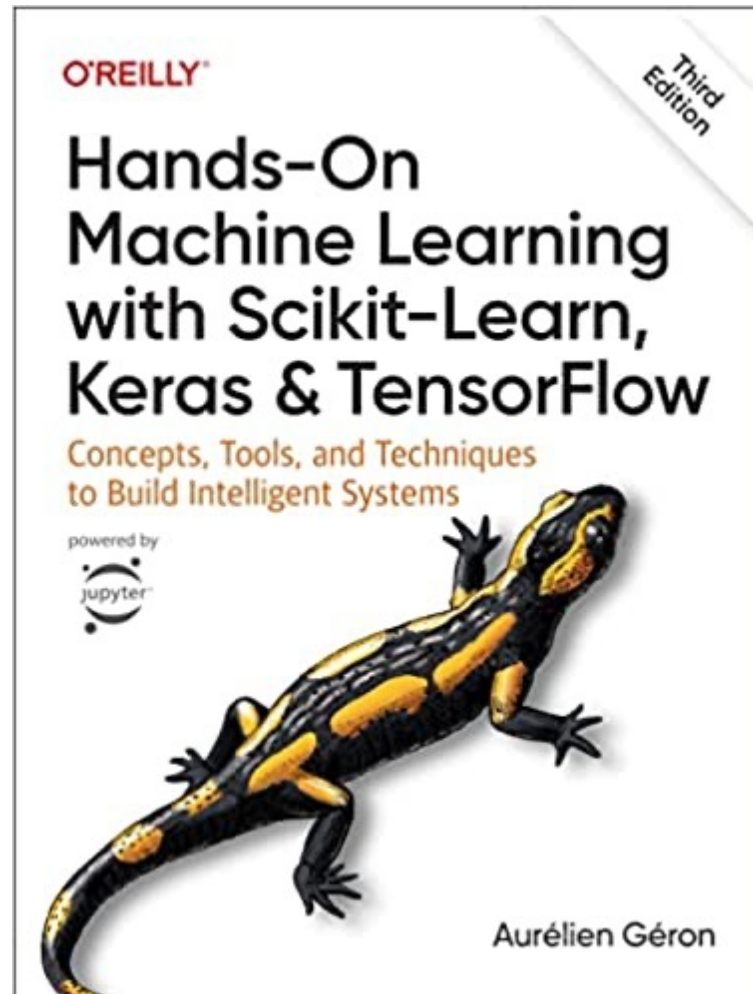
Denis Rothman (2024),

Transformers for Natural Language Processing and Computer Vision:

Explore Generative AI and Large Language Models with Hugging Face, ChatGPT, GPT-4V, and DALL-E 3,
3rd Edition, Packt Publishing



Aurélien Géron (2022),
Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow:
Concepts, Tools, and Techniques to Build Intelligent Systems,
3rd Edition, O'Reilly Media.



SASB (Sustainability Accounting Standards Board)

IFRS Foundation

Other Resources: [The ISSB](#) [Integrated Reporting Framework](#)



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An aerial photograph showing a winding river through a lush green landscape. The left side of the river is a well-maintained golf course with distinct mowed patterns. The right side is a dense forest with some trees showing autumnal colors. A road or path crosses the river.

**SASB Standards: Your
pathway to ISSB**

[Learn more](#)

<https://sasb.org/>

ISSB (International Sustainability Standards Board)



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Home > International Sustainability Standards Board

International Sustainability Standards Board

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About the International Sustainability Standards Board

The Trustees of the IFRS Foundation announced the formation of the International Sustainability Standards Board (ISSB) on 3 November 2021 at COP26 in Glasgow, following strong market demand for its establishment. The ISSB is developing—in the public interest—standards that will result in a high-quality, comprehensive global baseline of sustainability disclosures focused on the needs of investors and the financial markets.

Sustainability factors are becoming a mainstream part of investment decision-making. There are increasing calls for companies to provide high-quality, globally comparable information on sustainability-related risks and opportunities, as indicated by feedback from many consultations with market

Related information

[Sustainability FAQs](#)

[General Sustainability-related Disclosures project](#)

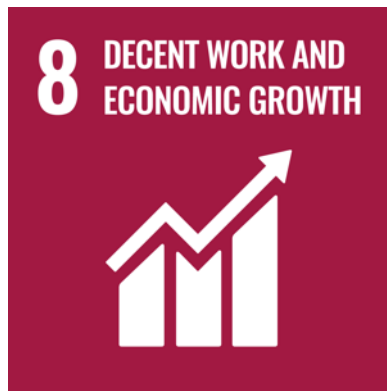
[Climate-related Disclosures project](#)

[Consolidated organisations](#)

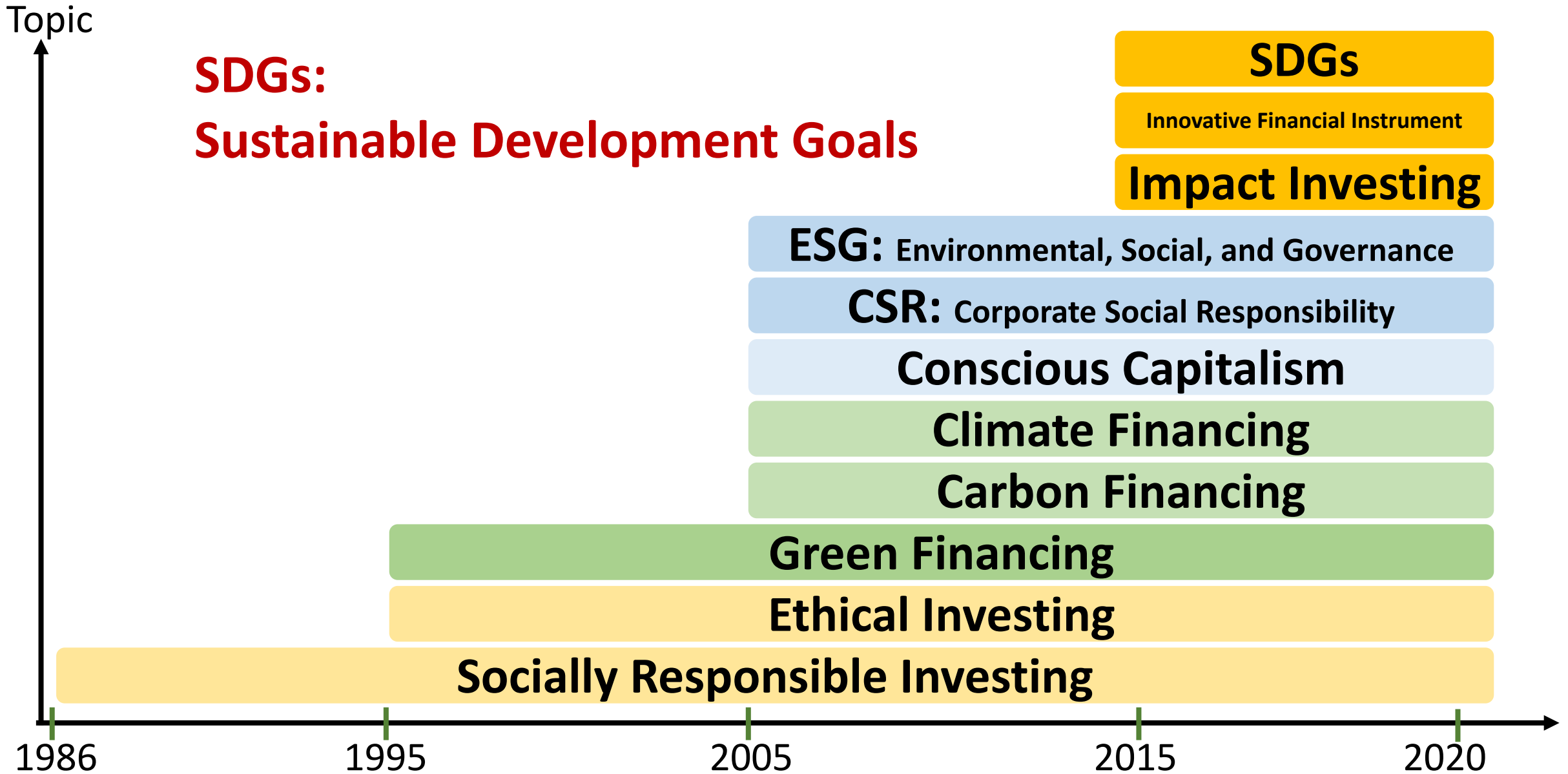
<https://www.ifrs.org/groups/international-sustainability-standards-board/>

Sustainability and ESG Data Analytics

Sustainable Development Goals (SDGs)



Evolution of Sustainable Finance Research



Source: Kumar, S., Sharma, D., Rao, S., Lim, W. M., & Mangla, S. K. (2022). Past, present, and future of sustainable finance: Insights from big data analytics through machine learning of scholarly research. *Annals of Operations Research*, 1-44.

Green Finance and Sustainable Finance

AI for Environmental, Social, and Governance (AI4ESG)

AI for Social Good (AI4SG)

Sustainability

SDGs

CSR

ESG

Sustainable Development Goals (SDGs) and 5P

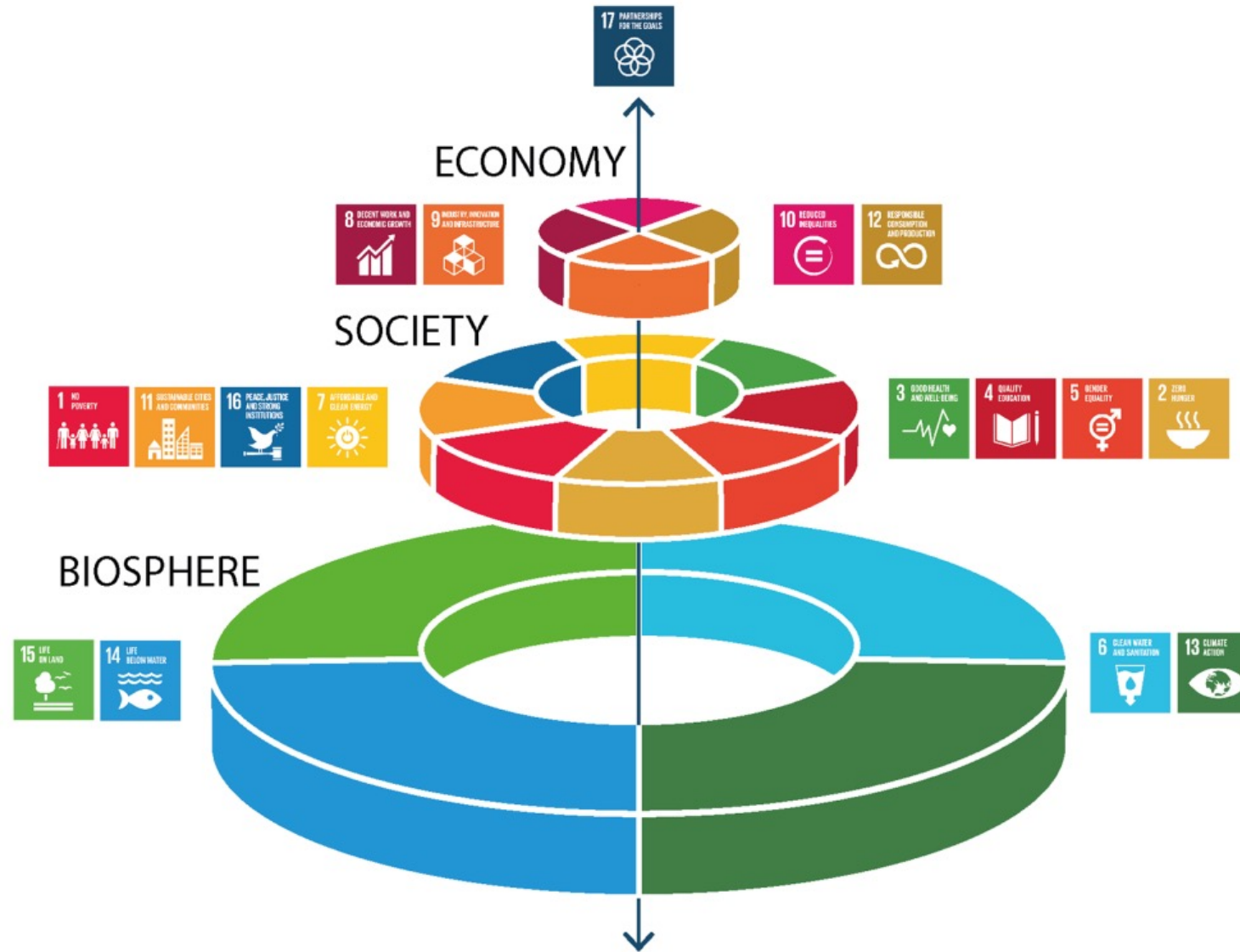
Partnership

Peace

Prosperity

People

Planet



ESG to 17 SDGs

ENVIRONMENT



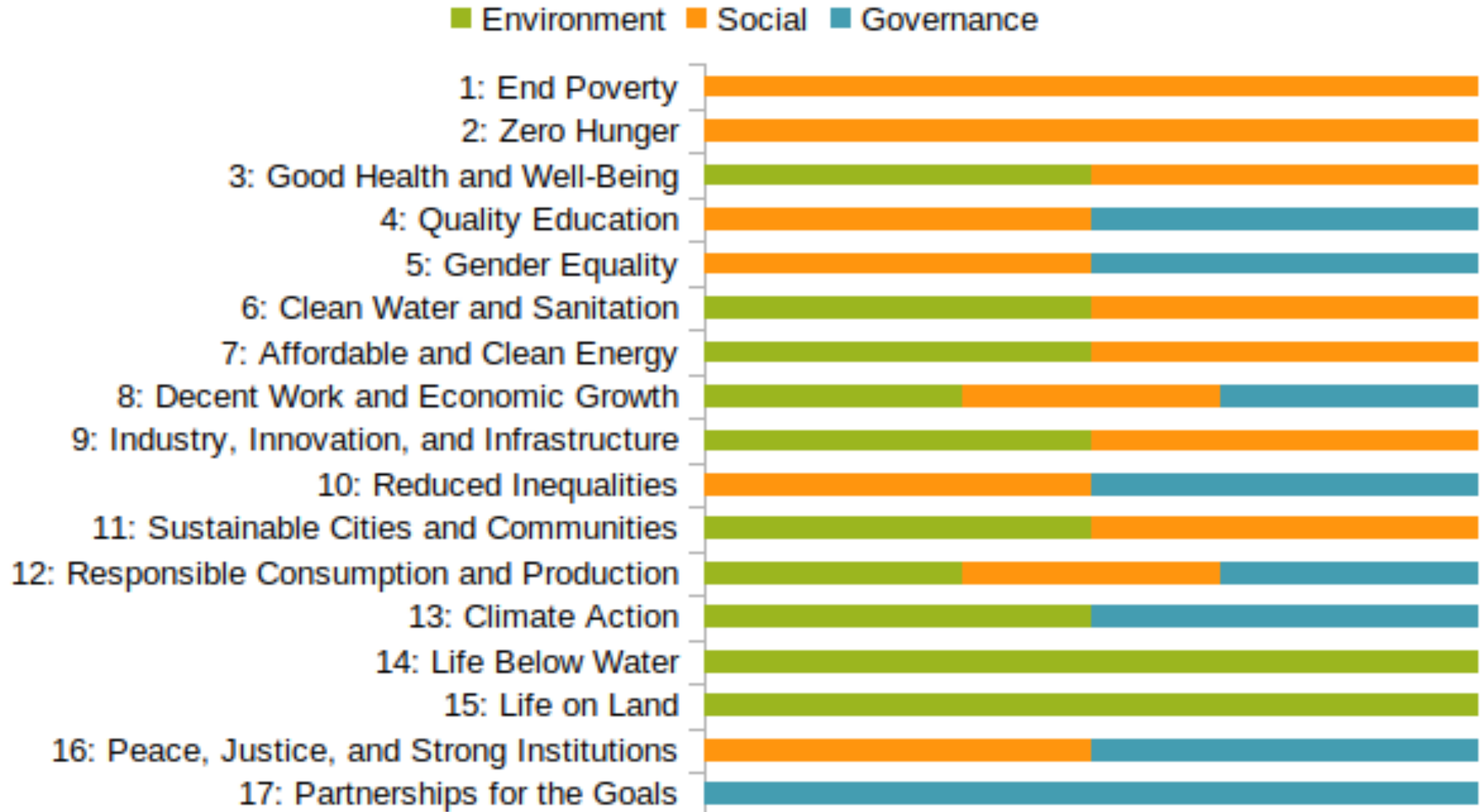
SOCIAL



GOVERNANCE

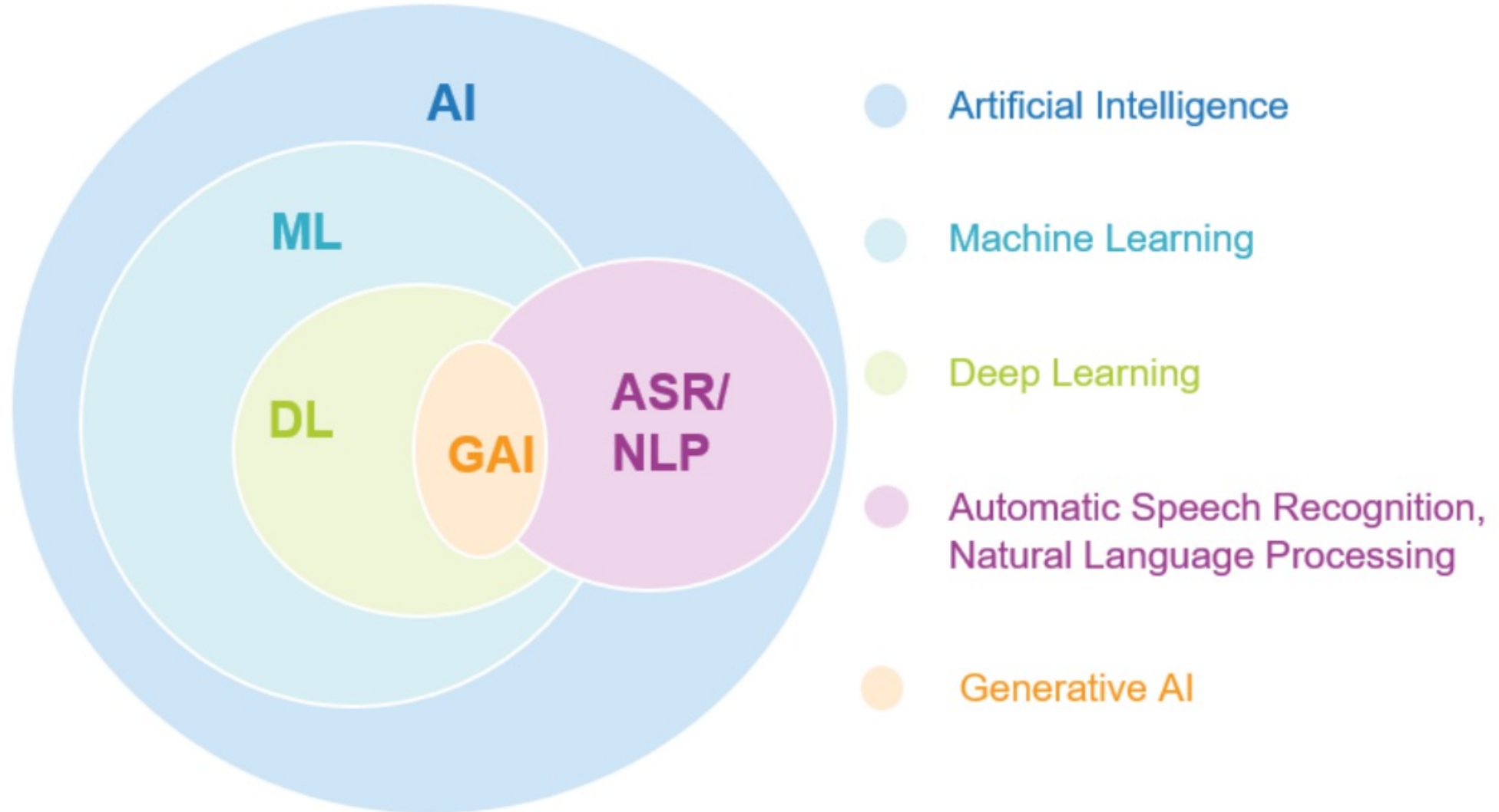


ESG to 17 SDGs

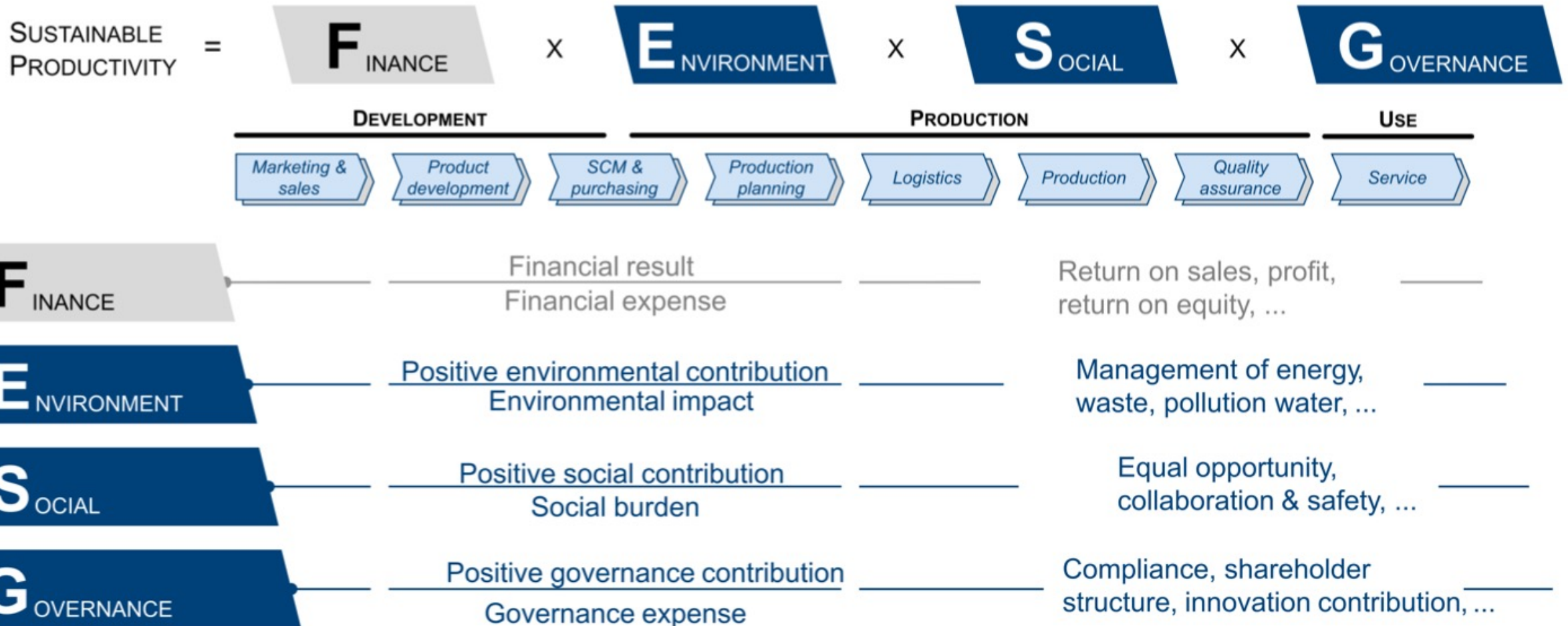


Generative AI for ESG Applications

AI, ML, DL, Generative AI

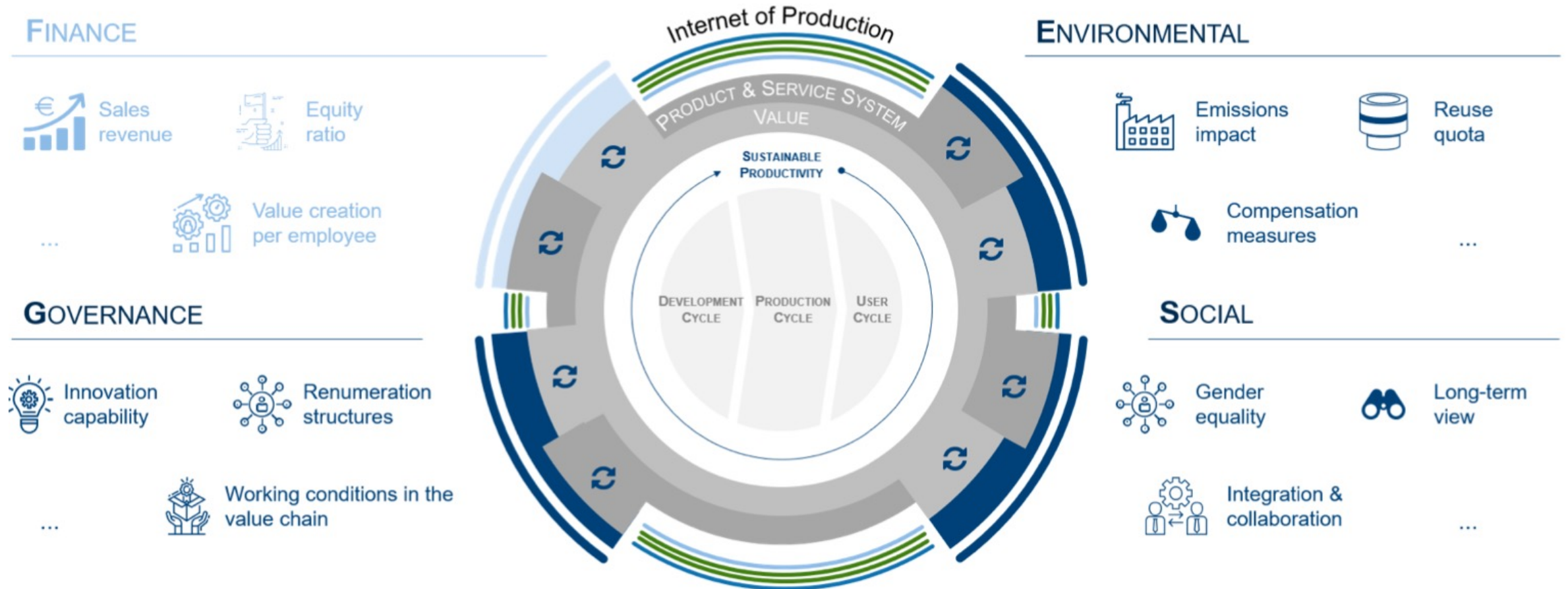


Sustainable Productivity: Finance ESG



Sustainable Resilient Manufacturing

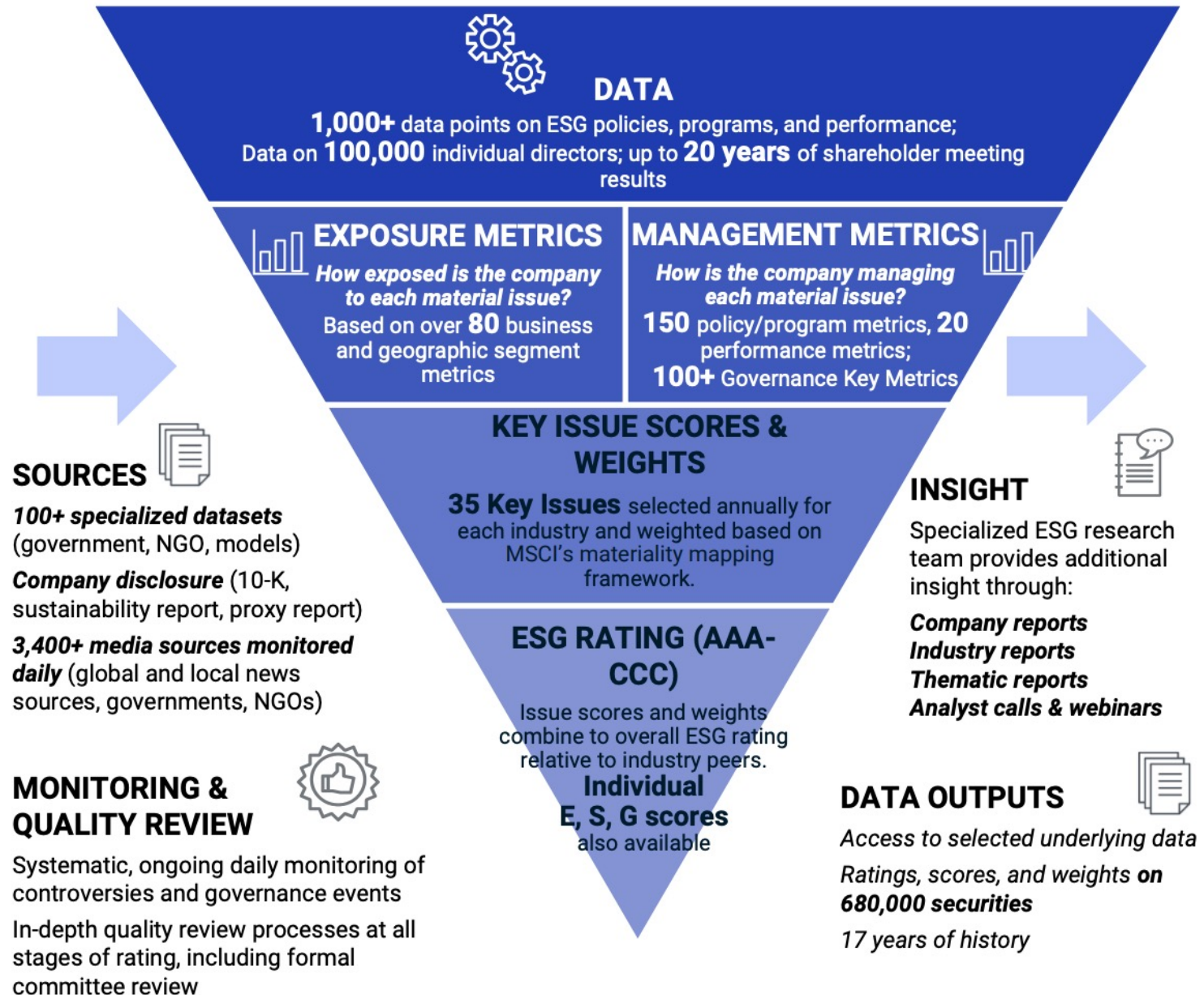
ESG



ESG Indexes

- **MSCI ESG Index**
- **Dow Jones Sustainability Indices (DJSI)**
- **FTSE ESG Index**

MSCI ESG Rating Framework

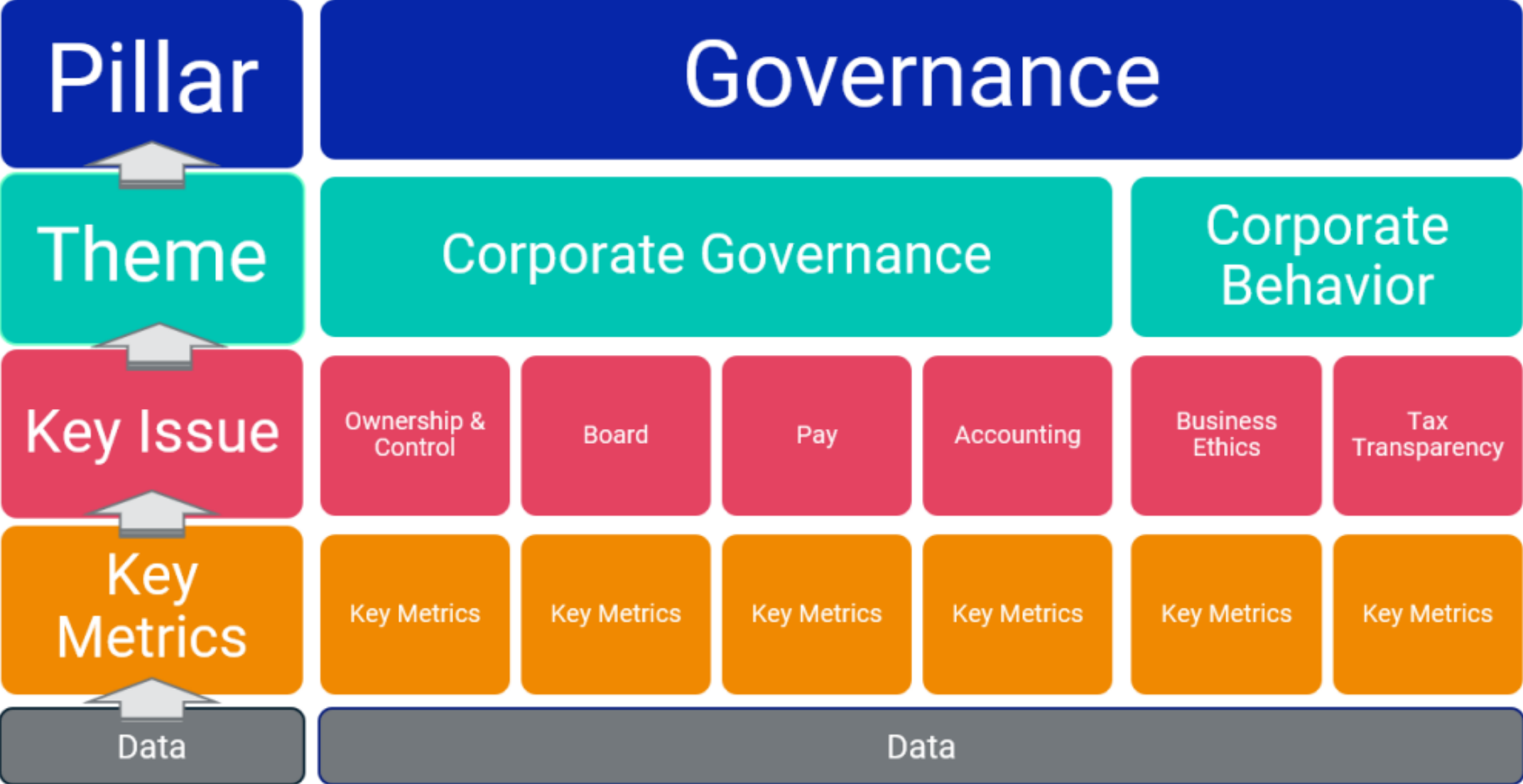


MSCI ESG Key Issue Hierarchy

3 Pillars	10 Themes	35 ESG Key Issues	
Environment	Climate Change	Carbon Emissions Product Carbon Footprint	Financing Environmental Impact Climate Change Vulnerability
	Natural Capital	Water Stress Biodiversity & Land Use	Raw Material Sourcing
	Pollution & Waste	Toxic Emissions & Waste Packaging Material & Waste	Electronic Waste
	Environmental Opportunities	Opportunities in Clean Tech Opportunities in Green Building	Opportunities in Renewable Energy
Social	Human Capital	Labor Management Health & Safety	Human Capital Development Supply Chain Labor Standards
	Product Liability	Product Safety & Quality Chemical Safety Consumer Financial Protection	Privacy & Data Security Responsible Investment Health & Demographic Risk
	Stakeholder Opposition	Controversial Sourcing Community Relations	
	Social Opportunities	Access to Communications Access to Finance	Access to Health Care Opportunities in Nutrition & Health
Governance	Corporate Governance	Ownership & Control Board	Pay Accounting
	Corporate Behavior	Business Ethics Tax Transparency	

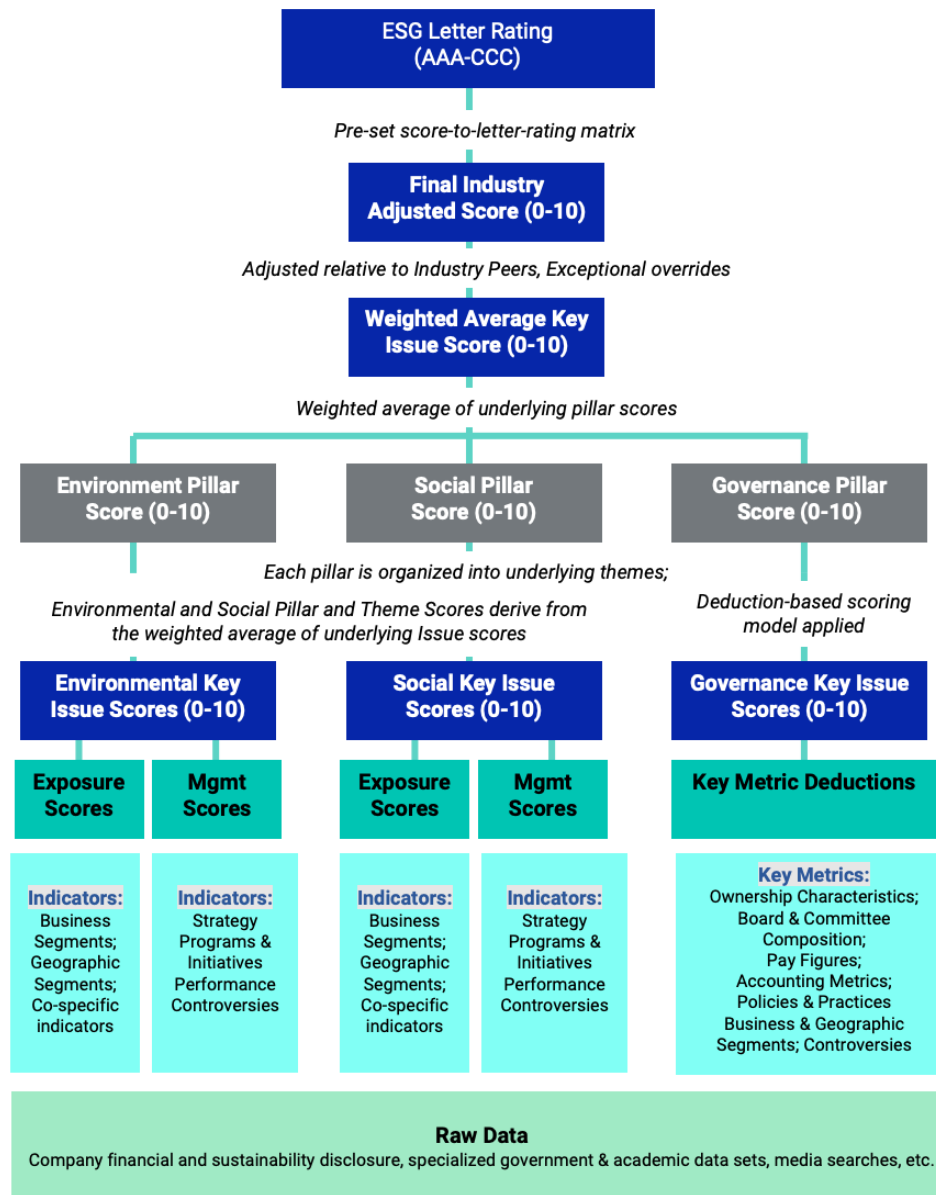
MSCI Governance Model Structure

Deductions from Key Metrics flow up through each level to the overall Pillar score calculation



Source: <https://www.msci.com/documents/1296102/21901542/ESG-Ratings-Methodology-Exec-Summary.pdf>

MSCI Hierarchy of ESG Scores

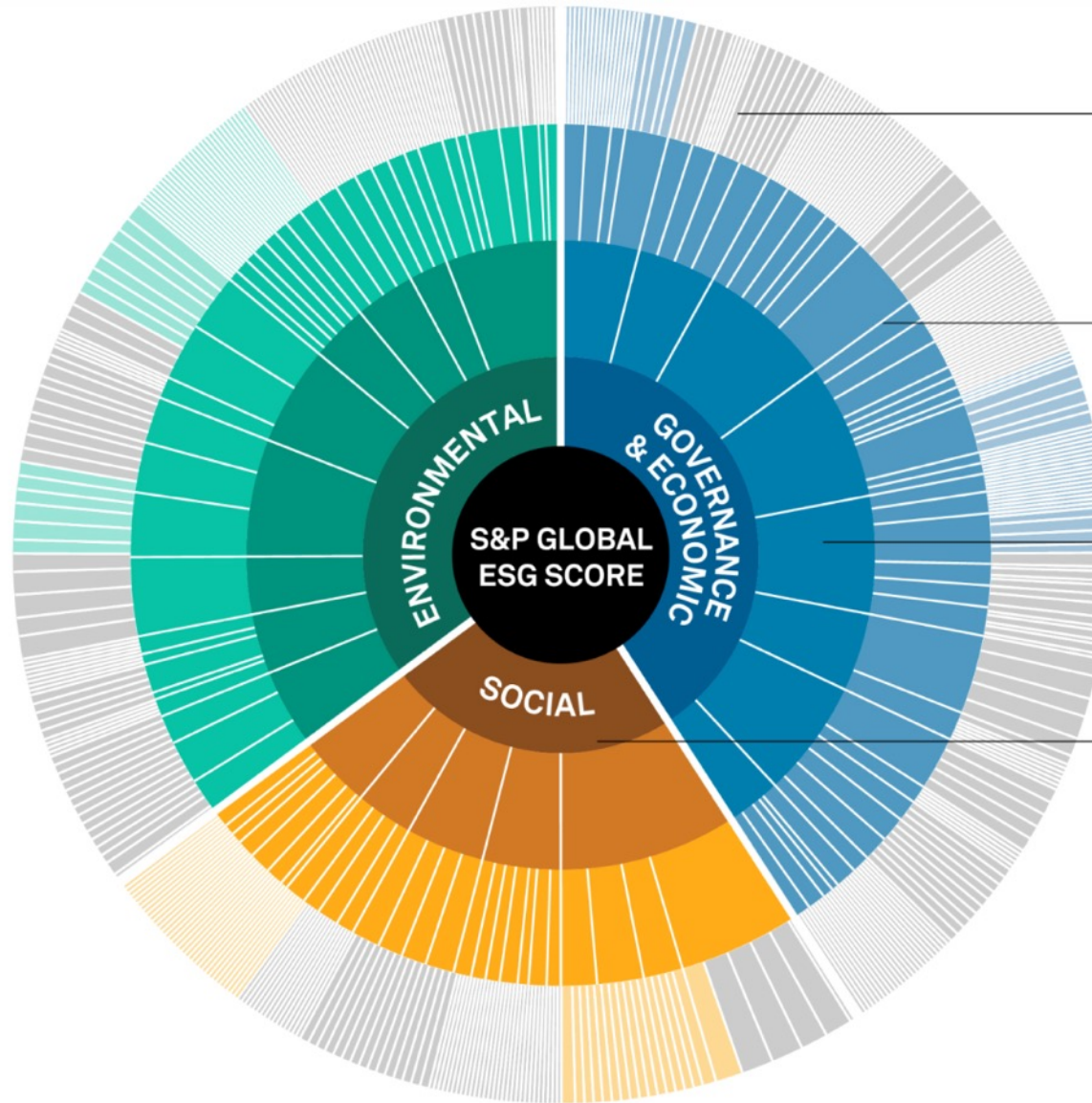


DJSI S&P Global ESG Score

8,000
Companies

90%
Global market capitalization

340,000+
Current Research Universe and Active Securities



Approx.
1,000
Datapoints

Assessed values, text, checkboxes, documents
Sources: Web-based questionnaire and company documents

130+
Questions

Weighted data point scores
Up to 50% industry-specific

Ave.
30+
Criteria scores

Weighted question scores
61 industry specific approaches, with tailored questions, criteria and related weightings

3
Dimension scores

Weighted criteria scores
Adjusted for corporate ESG controversies where applicable

1

S&P Global ESG Score

Sum of weighted dimension scores

FTSE Russell ESG Ratings



Sustainalytics

ESG Risk Ratings

Analyst-based
approach

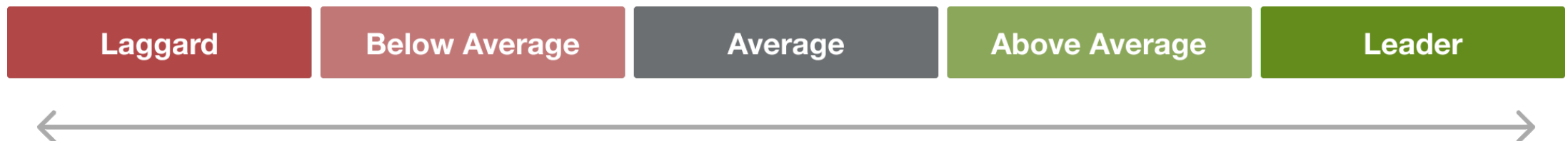
Sustainalytics' ESG Risk Ratings measure a company's exposure to industry-specific material ESG risks and how well a company is managing those risks.

Negligible	Low	Medium	High	Severe
0 - 10	10 - 20	20 - 30	30 - 40	40+

Truvalue ESG Ranks

Machine-based
approach

- **Truvalue Labs** applies **AI** to analyze over **100,000 sources** and uncover **ESG risks** and opportunities hidden in **unstructured text**.
- The ESG Ranks data service produces an overall company rank based on industry percentile leveraging the **26 ESG categories** defined by the **Sustainability Accounting Standards Board (SASB)**.
- The data feed covers **20,000+** companies with more than **13 years** of history.



Analyst-driven vs. AI-driven ESG

Analyst-driven ESG research

Derives ratings in a structured data model

Sustainalytics



Analyst role at the end of the process allows subjectivity to color results

AI-driven ESG research

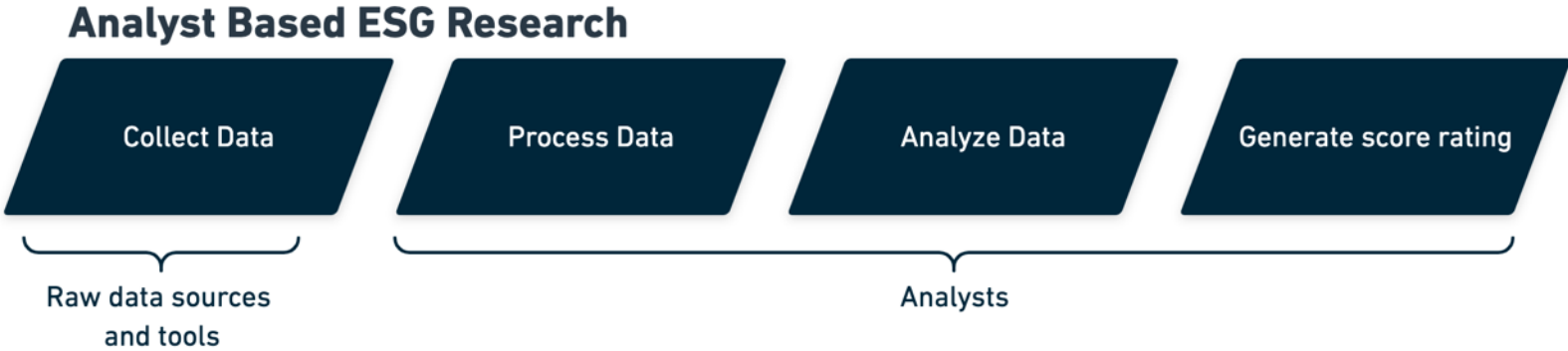
Derives signals from unstructured data

Truvalue Labs

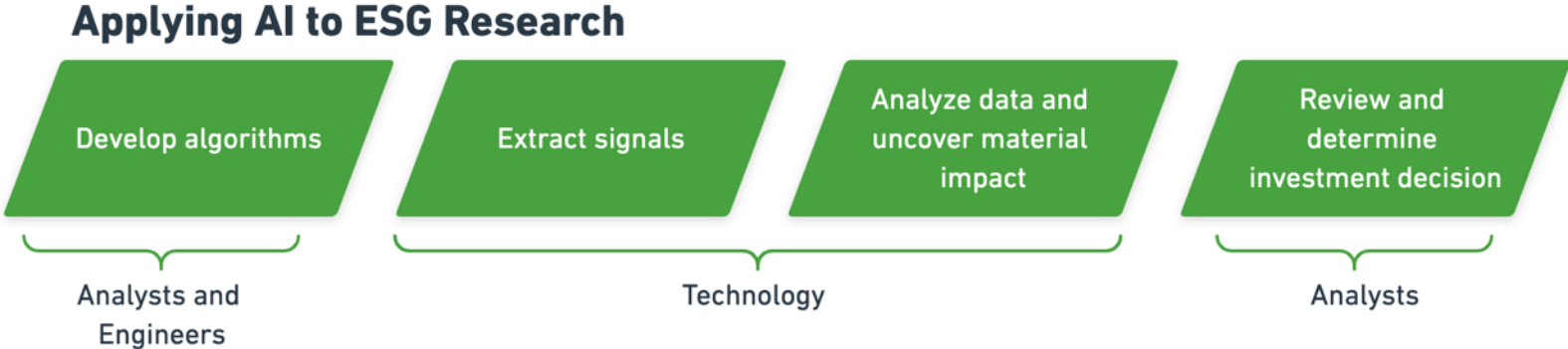


Analyst expertise at the beginning of the process produces consistent results

Analyst based ESG Research

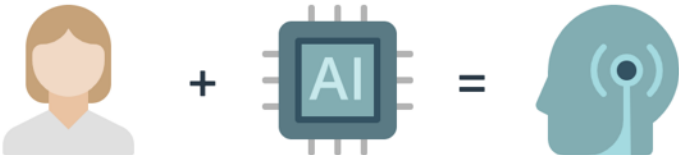


AI based ESG Research



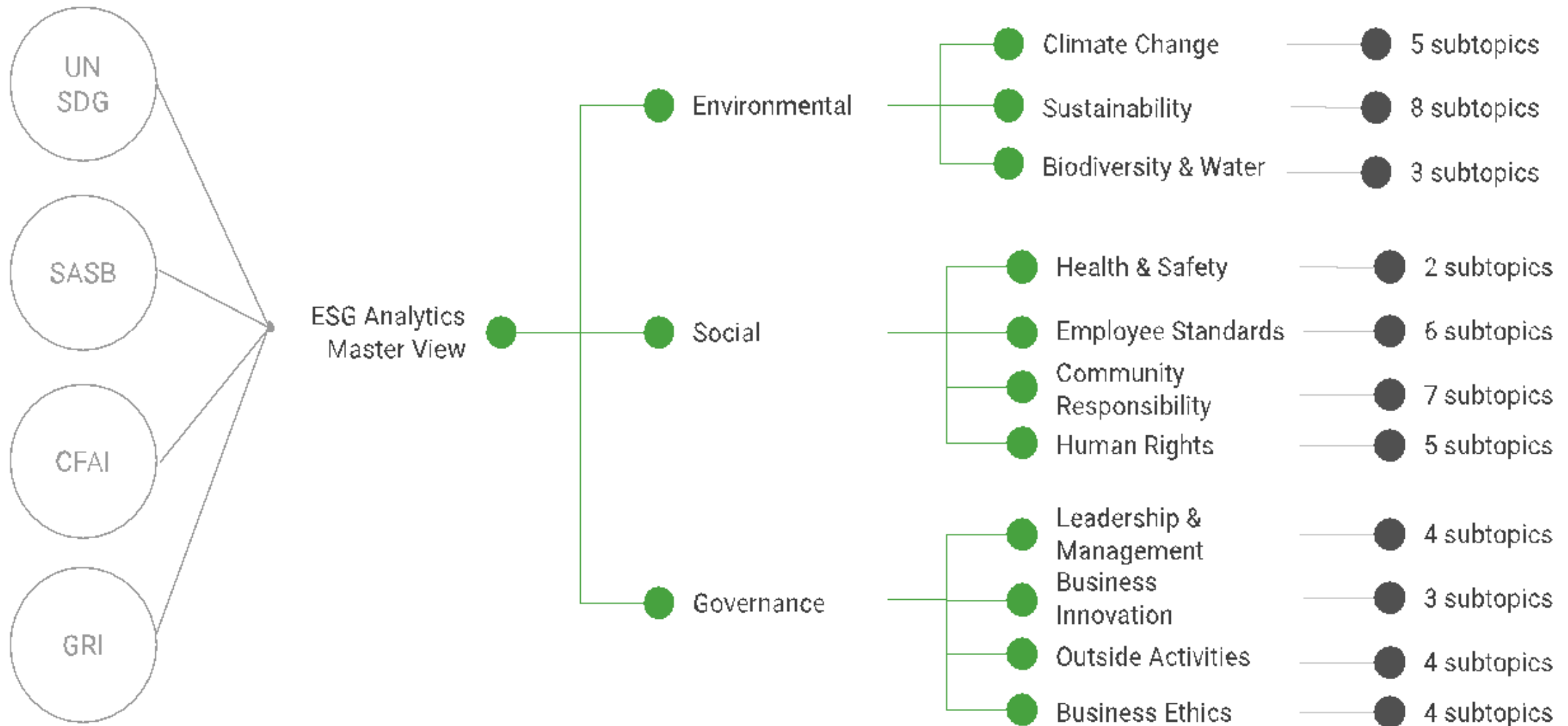
It would take an analyst over 5 years to do what our AI can in 1 week

Combining analysts with AI creates gives you the full picture



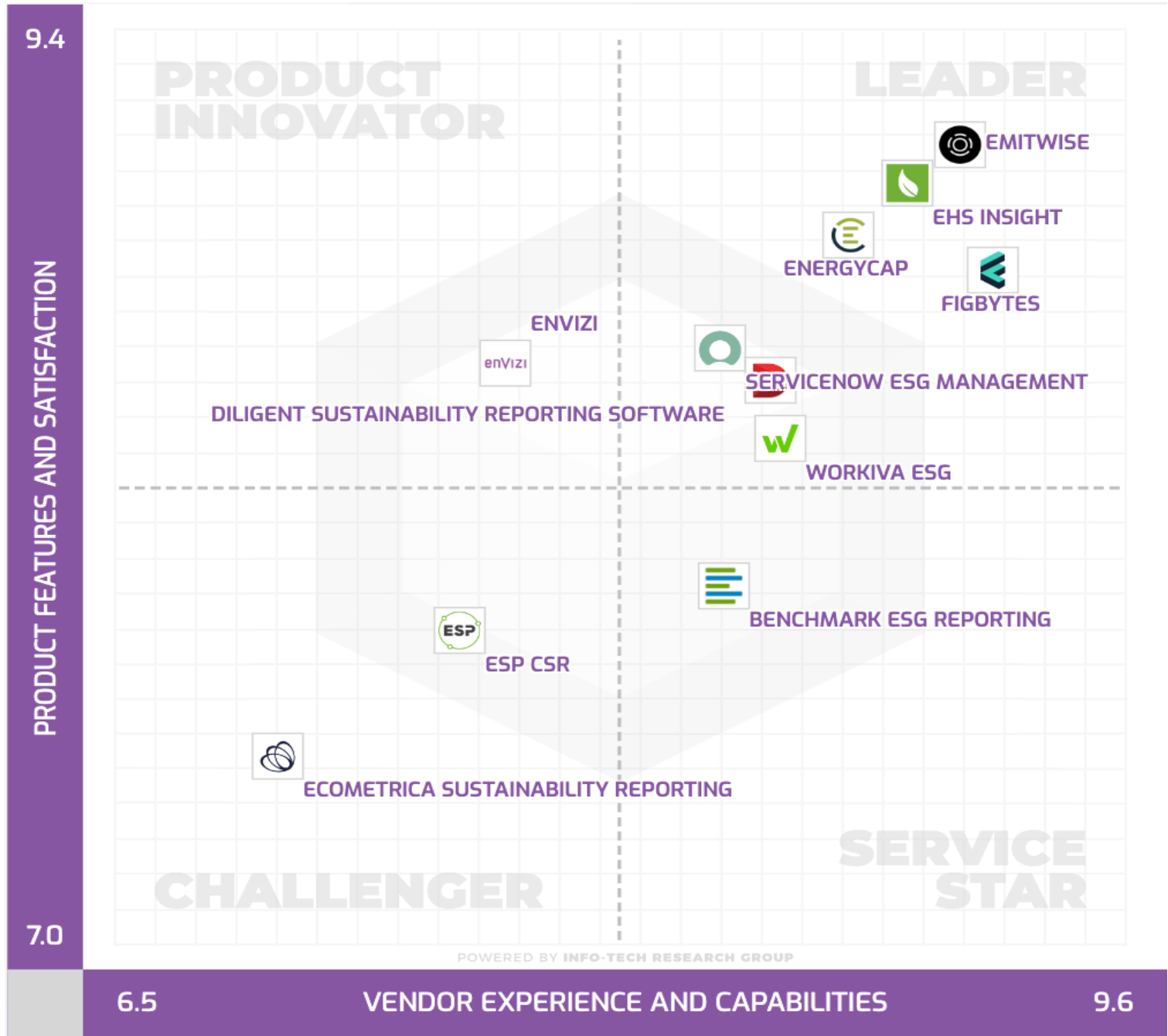
ESG ANALYTICS
Invest where it matters.

ESG Analytics: NLP Taxonomy



Top ESG Reporting Software

Environmental, Social and Governance (ESG) Reporting software or Sustainability software helps organizations manage their operational data, evaluate their impact on the environment and provide reporting to perform audits.



ESG Reporting Software: Workiva ESG

- Workiva is a cloud native platform that simplifies the complexities of reporting and compliance.
- Workiva ESG is the end-to-end platform that allows you to integrate financial data, nonfinancial data, and XBRL.
- Workiva, the platform that streamlines your entire ESG process.
- Automate data collection, utilize frameworks, and directly connect to all your ESG reports. in meaningful glossy reports, accurate survey responses, and regulatory filings with integrated XBRL tagging.

8.4

COMPOSITE
SCORE

8.7

CX SCORE

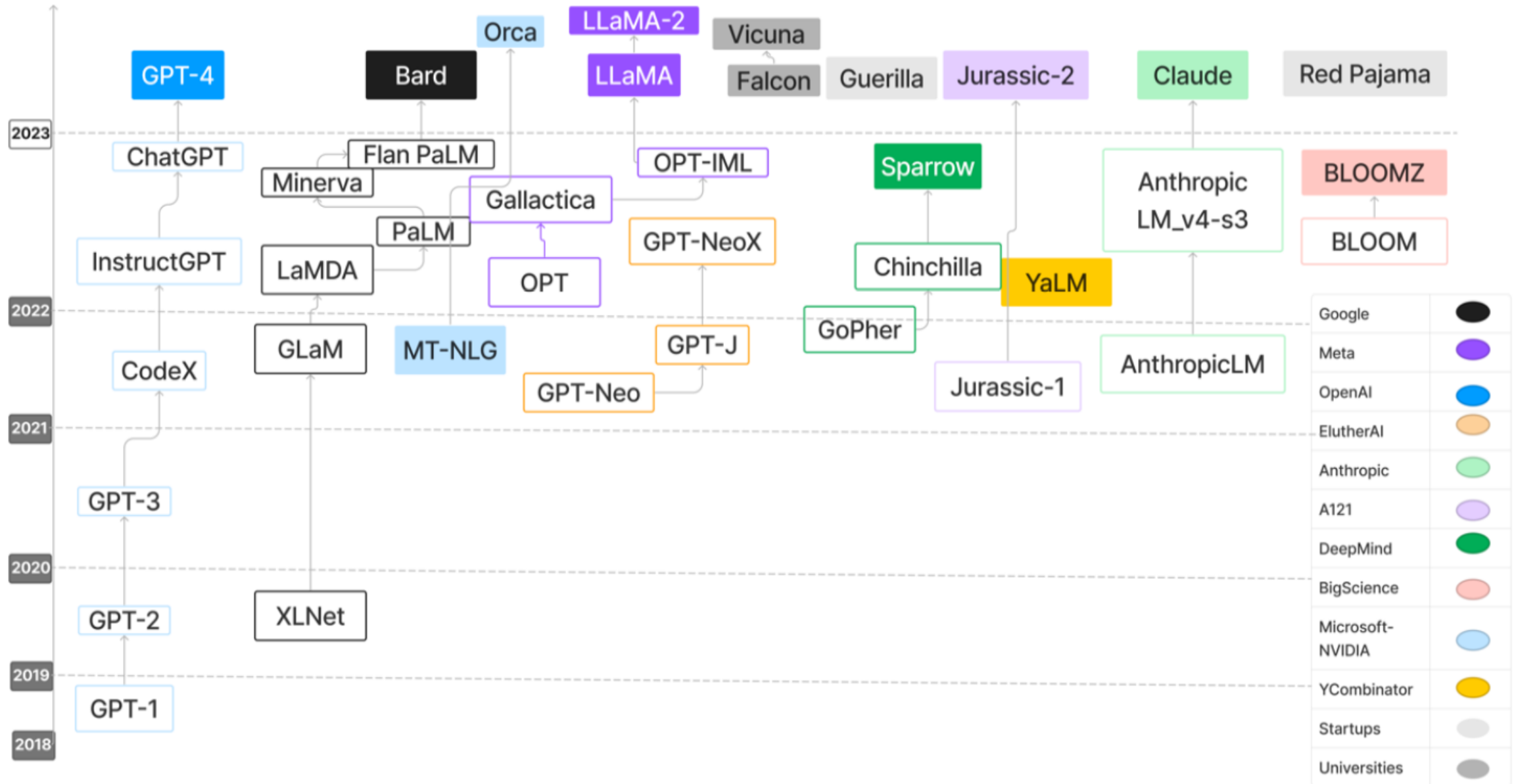
+92

EMOTIONAL
FOOTPRINT

89%

LIKELINESS TO
RECOMMEND

Large Language Models (LLMs)



Four Paradigms in NLP (LM)

Paradigm	Engineering	Task Relation
a. Fully Supervised Learning (Non-Neural Network)	Feature (e.g. word identity, part-of-speech, sentence length)	
b. Fully Supervised Learning (Neural Network)	Architecture (e.g. convolutional, recurrent, self-attentional)	
Transfer Learning: Pre-training, Fine-Tuning (FT)		
c. Pre-train, Fine-tune	Objective (e.g. masked language modeling, next sentence prediction)	
GAI: Pre-train, Prompt, and Predict (Prompting)		
d. Pre-train, Prompt, Predict	Prompt (e.g. cloze, prefix)	

Generative AI

**Text, Image, Video, Audio
Applications**

Comparison of Generative AI and Traditional AI

Feature	Generative AI	Traditional AI
Output type	New content	Classification/Prediction
Creativity	High	Low
Interactivity	Usually more natural	Limited

Generative AI

- **Generative AI: The Art of Creation**
- **Definition: AI systems capable of creating new content**
- **Characteristics: Creativity, interactivity**

Popular Generative AI

- **OpenAI ChatGPT (GPT-4o, GPT-4)**
- **Claude.ai (Claude 3.5)**
- **Google Gemini**
- **Chat.LMSys.org**
- **Perplexity.ai**
- **ChatPDF**
- **Stable Diffusion**
- **Video: D-ID, Synthesia**
- **Audio: Speechify**

OpenAI ChatGPT (GPT-4o, GPT-4)

ChatGPT 4o ▾

Model ⓘ

- ✦ GPT-4o
Newest and most advanced model ✓
- ✦ GPT-4
Advanced model for complex tasks
- ⚡ GPT-3.5
Great for everyday tasks

🔄 Temporary chat



Morning routine
for productivity

Study vocabulary

Experience
Seoul like a local

Superhero
shark story

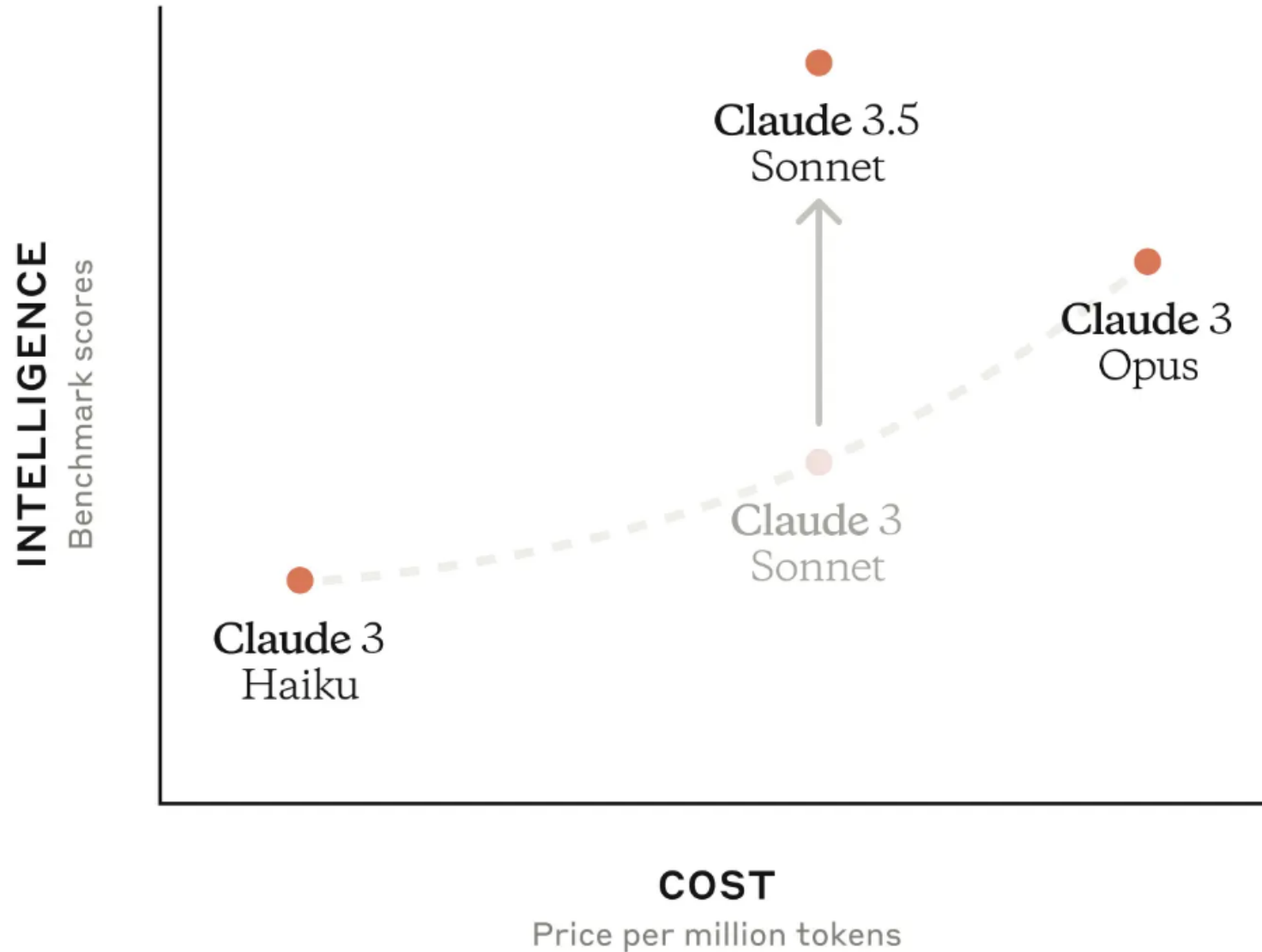
🔗 Message ChatGPT



ChatGPT can make mistakes. Check important info.

<https://chat.openai.com/>

Claude 3.5 Sonnet



Claude 3.5, GPT-4o, Gemini 1.5 Pro

	Claude 3.5 Sonnet	Claude 3 Opus	GPT-4o	Gemini 1.5 Pro	Llama-400b (early snapshot)
Graduate level reasoning <i>GPQA, Diamond</i>	59.4%* 0-shot CoT	50.4% 0-shot CoT	53.6% 0-shot CoT	—	—
Undergraduate level knowledge <i>MMLU</i>	88.7%** 5-shot	86.8% 5-shot	—	85.9% 5-shot	86.1% 5-shot
	88.3% 0-shot CoT	85.7% 0-shot CoT	88.7% 0-shot CoT	—	—
Code <i>HumanEval</i>	92.0% 0-shot	84.9% 0-shot	90.2% 0-shot	84.1% 0-shot	84.1% 0-shot
Multilingual math <i>MGSM</i>	91.6% 0-shot CoT	90.7% 0-shot CoT	90.5% 0-shot CoT	87.5% 8-shot	—
Reasoning over text <i>DROP, F1 score</i>	87.1 3-shot	83.1 3-shot	83.4 3-shot	74.9 Variable shots	83.5 3-shot Pre-trained model
Mixed evaluations <i>BIG-Bench-Hard</i>	93.1% 3-shot CoT	86.8% 3-shot CoT	—	89.2% 3-shot CoT	85.3% 3-shot CoT Pre-trained model
Math problem-solving <i>MATH</i>	71.1% 0-shot CoT	60.1% 0-shot CoT	76.6% 0-shot CoT	67.7% 4-shot	57.8% 4-shot CoT
Grade school math <i>GSM8K</i>	96.4% 0-shot CoT	95.0% 0-shot CoT	—	90.8% 11-shot	94.1% 8-shot CoT

* Claude 3.5 Sonnet scores 67.2% on 5-shot CoT GPQA with maj@32

** Claude 3.5 Sonnet scores 90.4% on MMLU with 5-shot CoT prompting

Claude 3.5 Sonnet State-of-the-art vision

	Claude 3.5 Sonnet	Claude 3 Opus	GPT-4o	Gemini 1.5 Pro
Visual math reasoning <i>MathVista (testmini)</i>	67.7% 0-shot CoT	50.5% 0-shot CoT	63.8% 0-shot CoT	63.9% 0-shot CoT
Science diagrams <i>AI2D, test</i>	94.7% 0-shot	88.1% 0-shot	94.2% 0-shot	94.4% 0-shot
Visual question answering <i>MMMU (val)</i>	68.3% 0-shot CoT	59.4% 0-shot CoT	69.1% 0-shot CoT	62.2% 0-shot CoT
Chart Q&A <i>Relaxed accuracy (test)</i>	90.8% 0-shot CoT	80.8% 0-shot CoT	85.7% 0-shot CoT	87.2% 0-shot CoT
Document visual Q&A <i>ANLS score, test</i>	95.2% 0-shot	89.3% 0-shot	92.8% 0-shot	93.1% 0-shot

LMSYS Chatbot Arena Leaderboard

GPT-4o

Claude 3.5

Rank* (UB)	Model	Arena Score	95% CI	Votes	Organization	License	Knowledge Cutoff
1	ChatGPT-4o-latest (2024-08-08)	1316	+4/-4	24358	OpenAI	Proprietary	2023/10
2	Gemini-1.5-Pro-Exp-0827	1301	+5/-5	19976	Google	Proprietary	2023/11
2	Gemini-1.5-Pro-Exp-0801	1298	+4/-3	25471	Google	Proprietary	2023/11
2	Grok-2-08-13	1295	+4/-6	10170	xAI	Proprietary	2024/3
5	GPT-4o-2024-05-13	1286	+3/-3	83181	OpenAI	Proprietary	2023/10
6	GPT-4o-mini-2024-07-18	1274	+4/-4	23318	OpenAI	Proprietary	2023/10
6	Gemini-1.5-Flash-Exp-0827	1270	+7/-6	6610	Google	Proprietary	2023/11
6	Claude 3.5 Sonnet	1270	+3/-3	53610	Anthropic	Proprietary	2024/4
6	Gemini Advanced App (2024-05-14)	1266	+3/-3	52225	Google	Proprietary	Online
6	Grok-2-Mini-08-13	1266	+6/-6	10939	xAI	Proprietary	2024/3
7	Meta-Llama-3.1-405b-Instruct	1266	+3/-4	24855	Meta	Llama 3.1 Community	2023/12
7	GPT-4o-2024-08-06	1262	+7/-5	14960	OpenAI	Proprietary	2023/10
10	Gemini-1.5-Pro-001	1259	+3/-3	74909	Google	Proprietary	2023/11

<https://lmarena.ai/>

Perplexity.ai



Anonymous Like



New Thread

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Try Pro

Upgrade to Claude-2 or GPT-4, boost Copilot uses, and upload more files.

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Large Language Models for Data Science

Sources

What Is a Large Language Model and What Can...

snowflake · 1

What are Large Language Models? | NVIDIA

nvidia · 2

Catch Up On Large Language Models | by...

towardsdatascien... · 3



View 3 more

Answer

Large Language Models (LLMs) are advanced AI systems designed to understand human language intricacies and generate intelligent, creative responses to queries ¹. They are deep learning algorithms that can recognize, summarize, translate, predict, and generate content using very large datasets ². LLMs are trained on enormous data sets typically measured in petabytes, sourced from books, articles, websites, and other text-based sources ¹. They are dynamic tools that are continuously updated and refined as new data becomes available ¹.

In the field of data science, LLMs can potentially transform how teams source, manage, and analyze data ¹. They are used in numerous data science applications, and their ability to process and interpret vast amounts of text data has made them an indispensable part of

Ask follow-up...

Copilot



social media posts or customer reviews, to determine whether the overall sentiment is

<https://www.perplexity.ai/>



Generative AI and LLMs for Sustainability and ESG Data Analytics

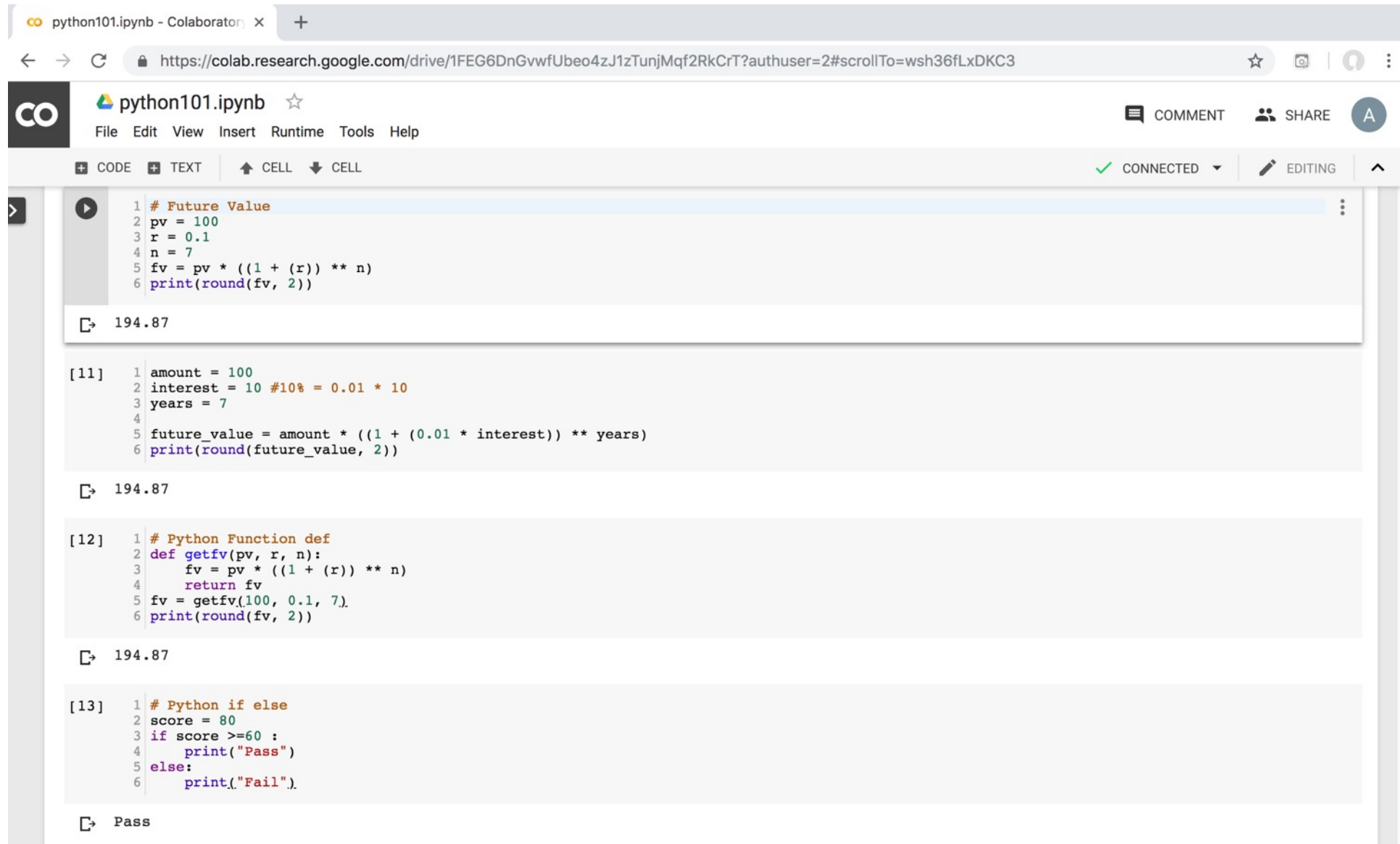


Sustainability and ESG Data Analytics



Python in Google Colab (Python101)

<https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT>



The screenshot shows a Google Colab notebook interface. The browser address bar displays the URL: <https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT?authuser=2#scrollTo=wsh36fLxDKC3>. The notebook title is "python101.ipynb". The interface includes a menu bar (File, Edit, View, Insert, Runtime, Tools, Help) and a toolbar with options for CODE, TEXT, CELL, and a status indicator showing "CONNECTED" and "EDITING".

The notebook contains four code cells:

- Cell 1:** A code cell with the following Python code:

```
1 # Future Value
2 pv = 100
3 r = 0.1
4 n = 7
5 fv = pv * ((1 + (r)) ** n)
6 print(round(fv, 2))
```

The output is "194.87".
- Cell [11]:** A code cell with the following Python code:

```
1 amount = 100
2 interest = 10 #10% = 0.01 * 10
3 years = 7
4
5 future_value = amount * ((1 + (0.01 * interest)) ** years)
6 print(round(future_value, 2))
```

The output is "194.87".
- Cell [12]:** A code cell with the following Python code:

```
1 # Python Function def
2 def getfv(pv, r, n):
3     fv = pv * ((1 + (r)) ** n)
4     return fv
5 fv = getfv(100, 0.1, 7).
6 print(round(fv, 2))
```

The output is "194.87".
- Cell [13]:** A code cell with the following Python code:

```
1 # Python if else
2 score = 80
3 if score >=60 :
4     print("Pass")
5 else:
6     print("Fail").
```

The output is "Pass".

<https://tinyurl.com/aintpupython101>

Teaching



- **Artificial Intelligence**
 - Spring 2021, Fall 2022, Fall 2024
- **Sustainability and ESG Data Analytics**
 - Spring 2024, Fall 2024
- **Big Data Analytics**
 - Fall 2020, Spring 2023, Spring 2024
- **Software Engineering**
 - Fall 2020, Fall, 2021, Spring 2022, Spring 2023, Spring 2024
- **Artificial Intelligence in Finance and Quantitative**
 - Fall 2021, Fall 2022, Fall 2023
- **Artificial Intelligence for Text Analytics**
 - Spring 2022, Fall 2023
- **Python for Accounting Applications**
 - Fall 2023, Fall 2024
- **Foundation of Business Cloud Computing**
 - Spring 2021, Spring 2022, Spring 2023, Spring 2024

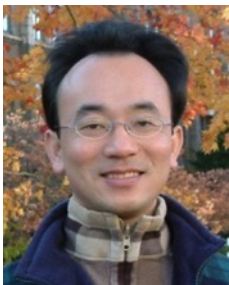
Research Projects



- 1. Fintech Green Finance for Carbon Market Index, Corporate Finance, and Environmental Policies. Carbon Emission Sentiment Index with AI Text Analytics**
 - NTPU, 113-NTPU_ORDA-F-003, 2023/01/01~2024/12/31
- 2. Digital Support, Unimpeded Communication: The Development, Support and Promotion of AI-assisted Communication Assistive Devices for Speech Impairment (2/3). Multimodal Cross-lingual Task-Oriented Dialogue System for Inclusive Communication Support**
 - NSTC 113-2425-H-305-002-, 3 Years (2023/05/01-2026/04/30) Year 1: 2024/05/01~2025/04/30
- 3. Research on speech processing, synthesis, recognition, and sentence construction of people with language disabilities. Multimodal Cross-lingual Task-Oriented Dialogue System**
 - NTPU, 113-NTPU_ORDA-F-004, 2023/01/01~2025/12/31
- 4. Metaverse AI Multimodal Cross-Language Task-Oriented Dialogue System**
 - ATEC Group, Fintech and Green Finance Center (FGFC, NTPU), NTPU-112A413E01, 3 Years (2023/05/01~2026/04/30)
- 5. Generative AI-Driven ESG Report Generation Technology**
 - Industrial Technology Research Institute (ITRI), Fintech and Green Finance Center (FGFC, NTPU), NTPU-113A513E01, 2024/03/01~2024/12/31
- 6. Establishment and Implement of Smart Assistive Technology for Dementia Care and Its Socio-Economic Impacts (3/3). Intelligent, individualized and precise care with smart AT and system integration**
 - NSTC, 113-2627-M-038-001-, 2024/08/01~2025/07/31
- 7. Prospective longitudinal study on peri-implant bone loss associated with peri-implantitis**
 - USTP (NTPU, TMU), USTP-NTPU-TMU-113-03, 2024/01/01~2024/12/31

Summary

- This course introduces the **fundamental concepts and hands-on practices of Python for Accounting Applications.**
- **Topics include**
 1. Introduction to Python for Accounting Applications,
 2. Python Programming and Data Science,
 3. Foundations of Python Programming,
 4. Data Structures,
 5. Control Logic and Loops,
 6. Functions and Modules,
 7. Files and Exception Handling,
 8. Data Analytics and Visualization with Python,
 9. Obtaining Data From the Web with Python,
 10. Statistical Analysis with Python,
 11. Machine Learning with Python,
 12. Text Analytics with Generative AI and Python,
 13. Applications of Accounting Data Analytics with Python, and
 14. Applications of ESG Data Analytics with Python.



Python for Accounting Applications



2020 Cohort



Accredited
Educator



Solutions
Architect
Associate



Cloud
Practitioner

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