

# Python for Accounting Applications

## Introduction to Python for Accounting Applications

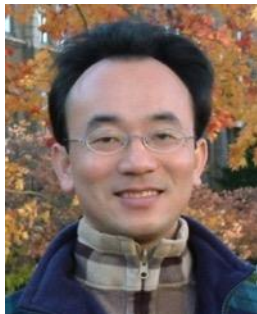
1141PAA01

ACC2, NTPU (U2004) (Fall 2025)

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

 **NVIDIA**  
University Ambassador  
Certified Instructor

 **aws** educate | Cloud  
Ambassador  
2020 Cohort



Min-Yuh Day, Ph.D,  
Professor and Director

Institute of Information Management, National Taipei University

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

2025-09-10

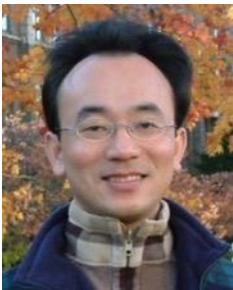




國立臺北大學  
National Taipei University



2020 Cohort



# Prof. Min-Yuh Day



**Director, Information Management, NTPU**

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

Director, Fintech and Green Finance Center (FGFC), NTPU

Division Director, Sustainable Development, Sustainability Office, NTPU

**Visiting Scholar, IIS, Academia Sinica**

**Ph.D., Information Management, NTU**

Artificial Intelligence, Agentic AI, ESG and Green Financial Technology,  
Big Data Analytics, Electronic Commerce



# Course Syllabus

## National Taipei University

### Academic Year 114, 1<sup>st</sup> Semester (Fall 2025)

- **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(B3F10)**
- **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 2025/09/10 Introduction to Python for Accounting Applications**

**2 2025/09/17 Python Programming and Data Science**

**3 2025/09/24 Foundations of Python Programming**

**4 2025/10/01 Data Structures**

**5 2025/10/08 Control Logic and Loops**

**6 2025/10/15 Functions and Modules; Files and Exception Handling**

**7 2025/10/22 Data Analytics and Visualization with Python**

**8 2025/10/29 Self-Learning**

# Syllabus

**Week    Date    Subject/Topics**

**9 2025/11/05 Midterm Project Report**

**10 2025/11/12 Obtaining Data From the Web with Python**

**11 2025/11/19 Statistical Analysis with Python**

**12 2025/11/26 Machine Learning with Python**

**13 2025/12/03 Text Analytics with Generative AI and Python**

**14 2025/12/10 Applications of Accounting Data Analytics with Python**

**15 2025/12/17 Applications of ESG Data Analytics with Python**

**16 2025/12/24 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

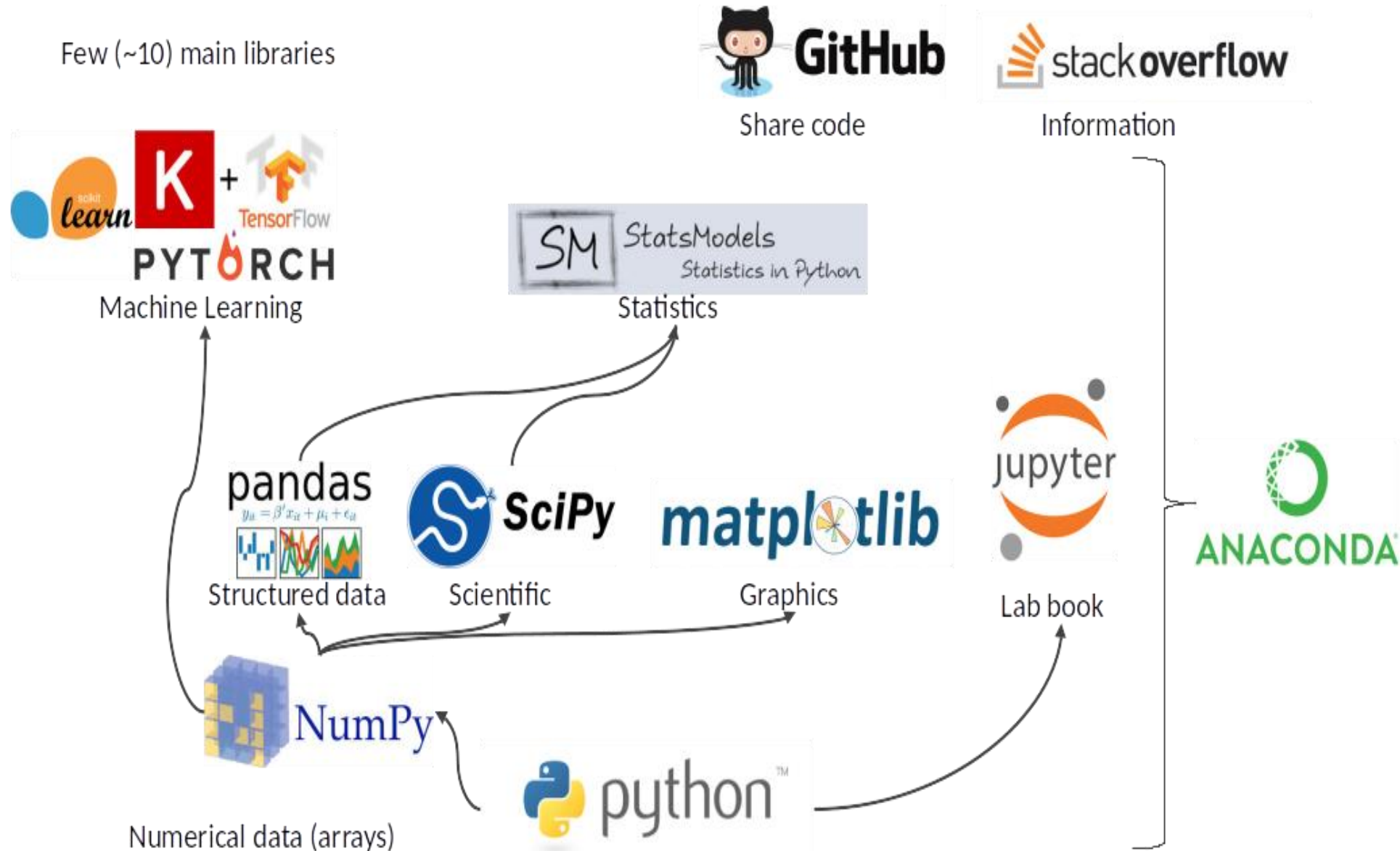
1. **Frederick Kaefer and Paul Kaefer (2020), Introduction to Python Programming for Business and Social Science Applications, SAGE Publications**
2. **Abdullah Karasan (2021), Machine Learning for Financial Risk Management with Python: Algorithms for Modeling Risk, O'Reilly Media**
3. **Vic Anand, Khrystyna 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. **Numa Dhamani and Maggie Engler (2024), Introduction to Generative AI, Manning**
6. **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**
7. **Ben Auffarth (2023), Generative AI with LangChain: Build large language model (LLM) apps with Python, ChatGPT and other LLMs, Packt Publishing.**
8. **Thomas R. Caldwell (2025), The Agentic AI Bible: The Complete and Up-to-Date Guide to Design, Build, and Scale Goal-Driven, LLM-Powered Agents that Think, Execute and Evolve, Independently published.**

# Other References

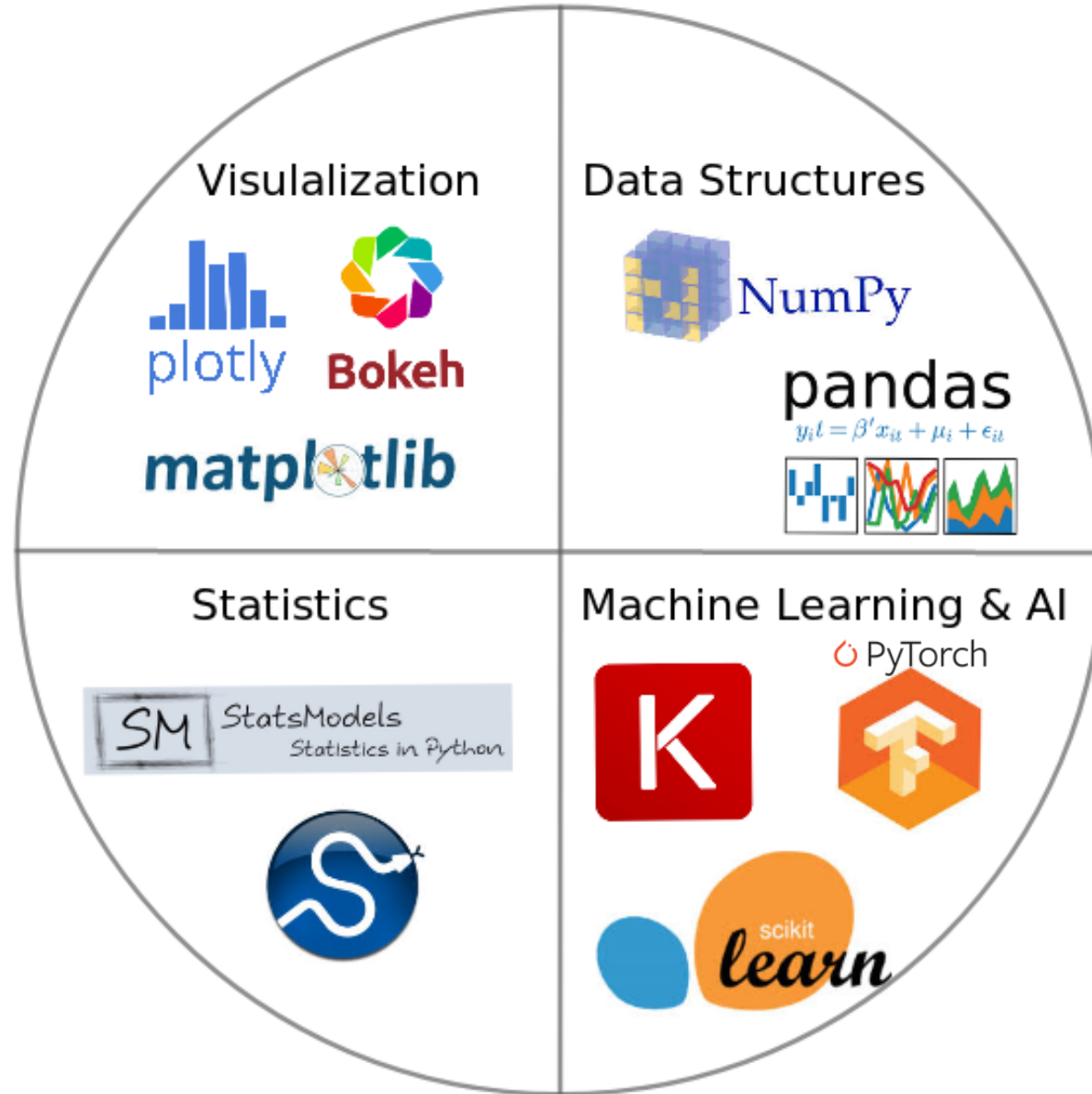
- Python, <https://www.python.org/>
- GRI (Global Report Initiative):  
<https://www.globalreporting.org/>
- CDP (Carbon Disclosure Project):  
<https://www.cdp.net/>
- SASB (Sustainability Accounting Standards Board):  
<https://sasb.org/>
- ISSB (International Sustainability Standards Board):  
<https://www.ifrs.org/groups/international-sustainability-standard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



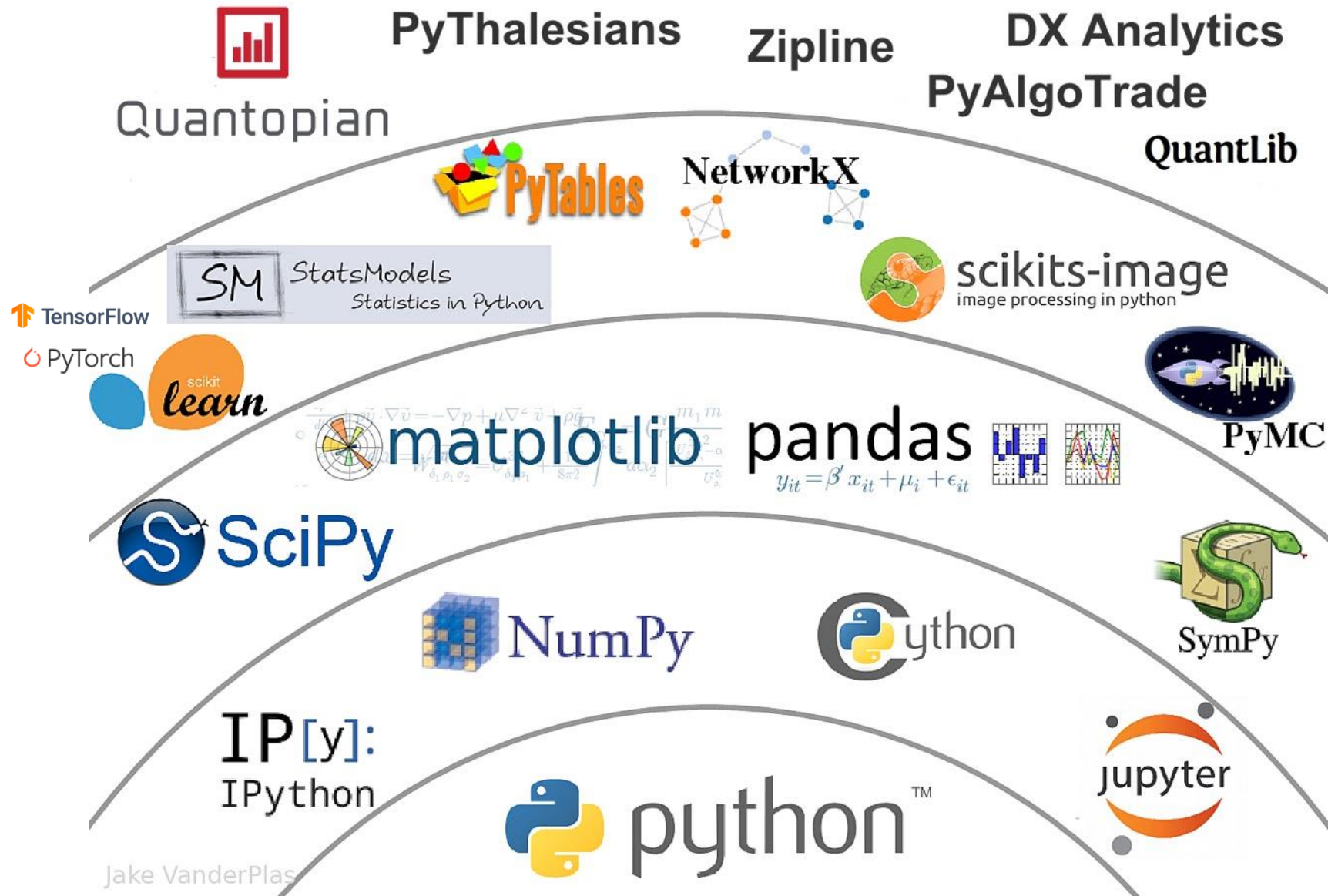
# Python Ecosystem for Data Science



# Python Ecosystem for Data Science



# The Quant Finance PyData Stack

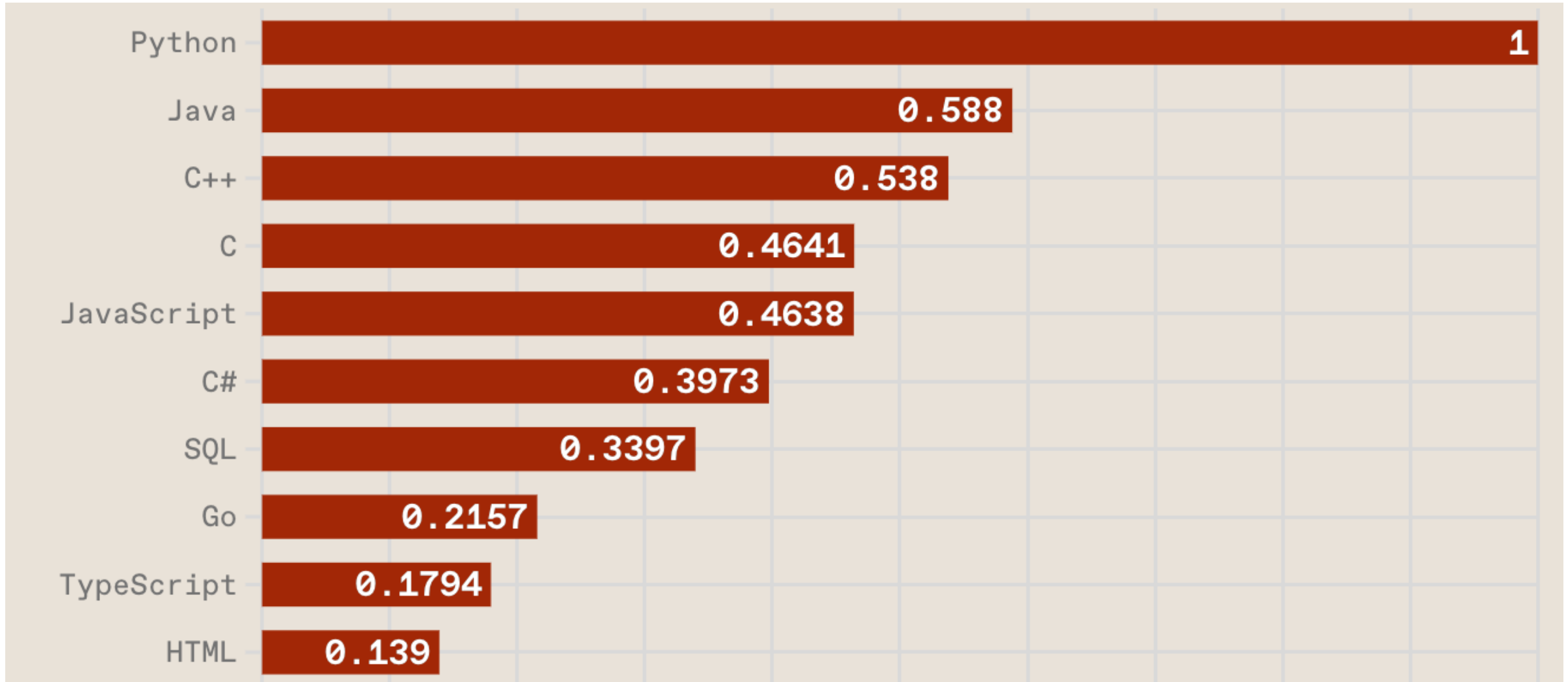




# Python

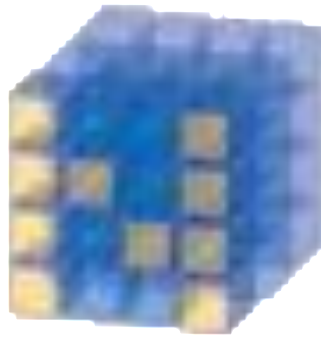
# Programming

# Top Programming Languages



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

# NumPy



NumPy

Base

**N-dimensional array**  
package

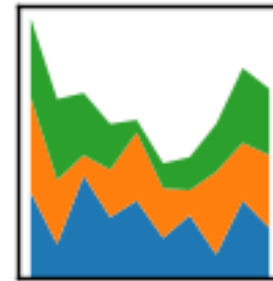
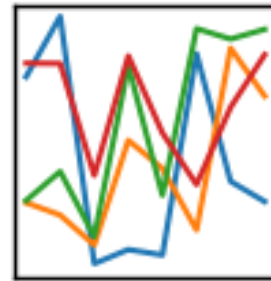
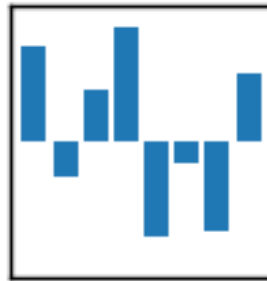
**Python**  
**matplotlib**  
*matplotlib*



# 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.

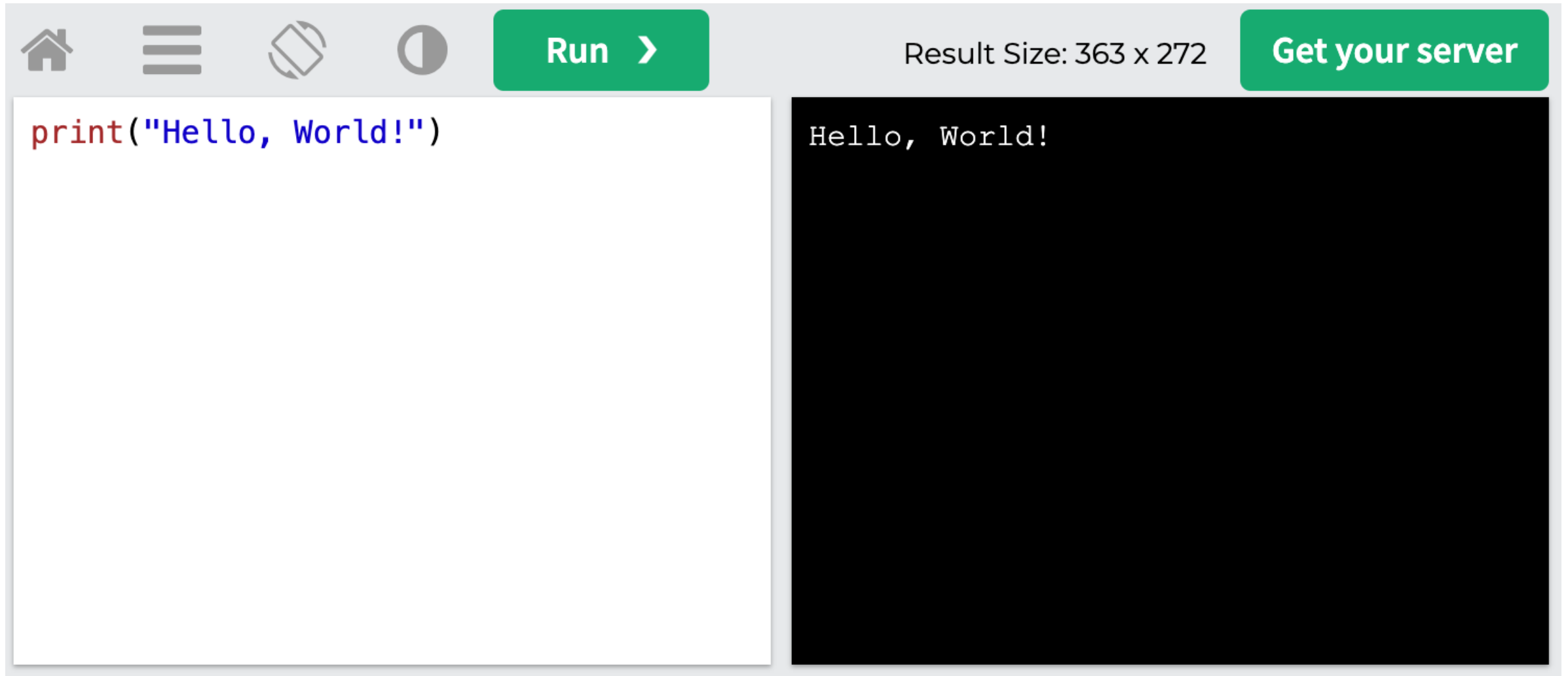
Start learning Python now »

## Learning by Examples

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

<https://www.w3schools.com/python/>

# W3Schools Python: Try Python

A screenshot of the W3Schools Python 'Try Python' interface. The interface has a light gray header bar with navigation icons (home, menu, refresh, moon) on the left, a green 'Run >' button in the center, and 'Result Size: 363 x 272' and a green 'Get your server' button on the right. Below the header, there is 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!' in white text.

Run >

Result Size: 363 x 272

Get your server

```
print("Hello, World!")
```

Hello, World!

# LearnPython.org



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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

The screenshot shows the Google Colaboratory web interface. At the top, a browser tab is labeled 'Hello, Colaboratory - Colabora x' and the address bar shows 'Secure https://colab.research.google.com/notebooks/welcome.ipynb'. The main header includes the 'Hello, Colaboratory' logo, a menu (File, Edit, View, Insert, Runtime, Tools, Help), a 'SHARE' button, and a user profile icon. Below the header is a toolbar with buttons for '+ CODE', '+ TEXT', 'CELL', 'COPY TO DRIVE', 'CONNECT', 'EDITING', and an expand/collapse icon. A left sidebar contains a 'Table of contents' with links to 'Getting Started', 'Highlighted Features', 'TensorFlow execution', 'GitHub', 'Visualization', 'Forms', 'Examples', and 'Local runtime support'. The main content area features a 'Welcome to Colaboratory!' message, a 'Getting Started' section with a list of links, a 'Highlighted Features' section with a 'Seedbank' link, and a 'TensorFlow execution' section with a matrix addition example.

co Hello, Colaboratory

File Edit View Insert Runtime Tools Help

+ CODE + TEXT CELL CELL COPY TO DRIVE CONNECT EDITING

Table of contents Code snippets Files X

Getting Started

Highlighted Features

TensorFlow execution

GitHub

Visualization

Forms

Examples

Local runtime support

+ SECTION

co **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 screenshot shows the Google Drive web interface. The browser address bar displays 'https://drive.google.com/drive/u/2/my-drive'. The interface includes a search bar, a 'New' button, and a left sidebar with navigation options: 'My Drive', 'Computers', 'Shared with me', 'Recent', 'Starred', 'Trash', 'Backups', and 'Storage'. The 'Storage' section indicates '0 bytes of 15 GB used' and provides a link to 'UPGRADE STORAGE'. A 'Get Backup and Sync for Mac' notification is visible at the bottom left. The 'New' menu is open, showing options like 'New folder...', 'Upload files...', 'Upload folder...', 'Google Docs', 'Google Sheets', 'Google Slides', and 'More'. The 'More' option is highlighted with a red dashed box. A secondary menu is open for the 'More' option, listing 'Google Forms', 'Google Drawings', 'Google My Maps', 'Google Sites', and a '+ Connect more apps' button, which is also highlighted with a red dashed box. The main content area shows a list of files with a 'Name' header and an upward arrow.



# Google Colab

The screenshot shows the Google Drive web interface. A modal titled "Connect apps to Drive" is open in the center, displaying a grid of application cards. The "colab" app is highlighted with a red dashed border. The background interface includes a sidebar with navigation options like "My Drive", "Computers", "Shared with me", "Recent", "Starred", "Trash", "Backups", and "Storage". The top of the browser shows the address bar with the URL "https://drive.google.com/drive/u/2/my-drive".

**Connect apps to Drive**

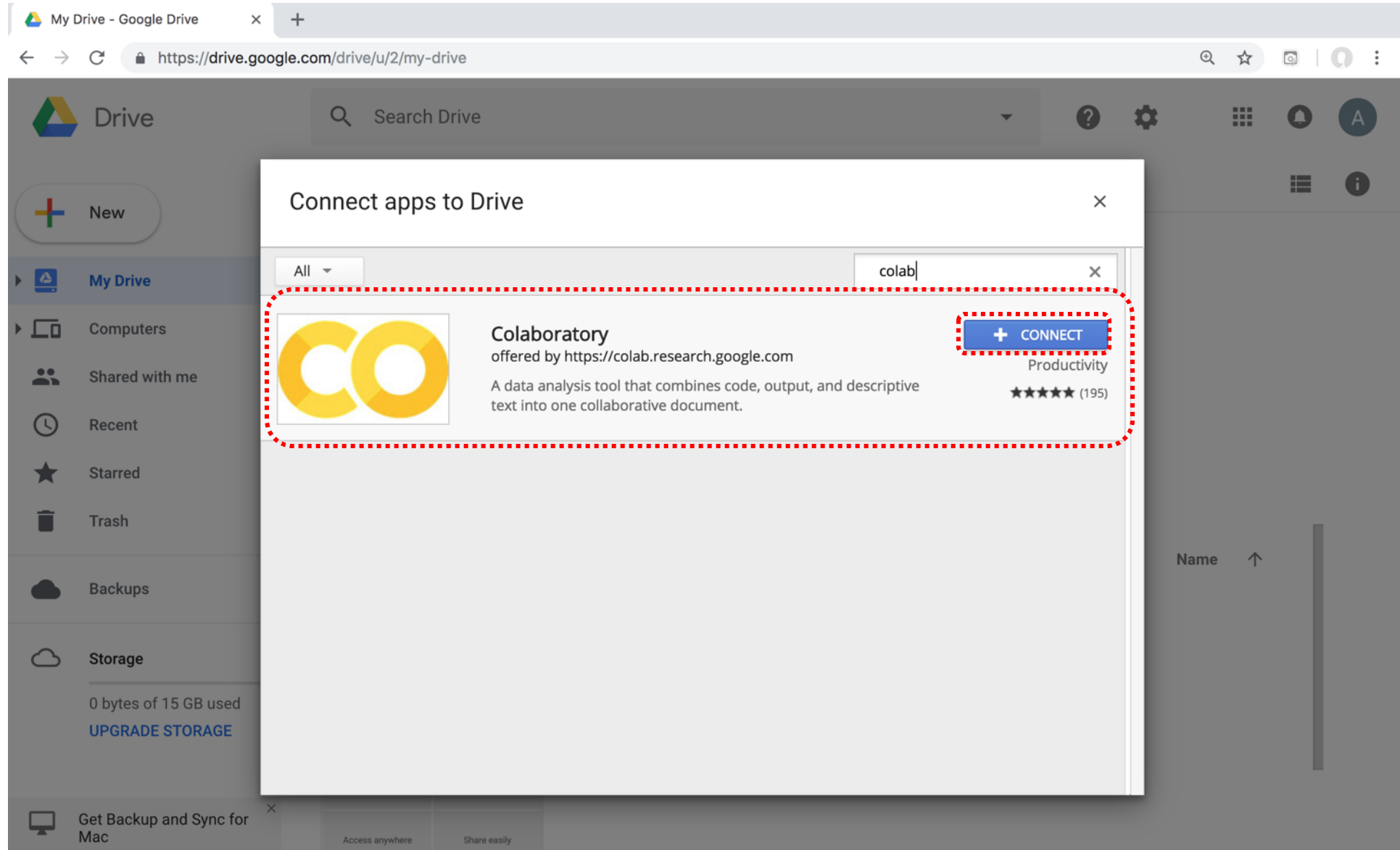
ZIP Extractor	LUMIN PDF	cloudconvert
 Extract ZIP files to Google Drive Extraction complete. View extracted files   Share   Extract another Test.zip	 The fast and simple PDF Viewer box	
ZIP Extractor 307,585 users	Lumin PDF - Beautiful PDF Editor 289,310 users	CloudConvert 373,161 users

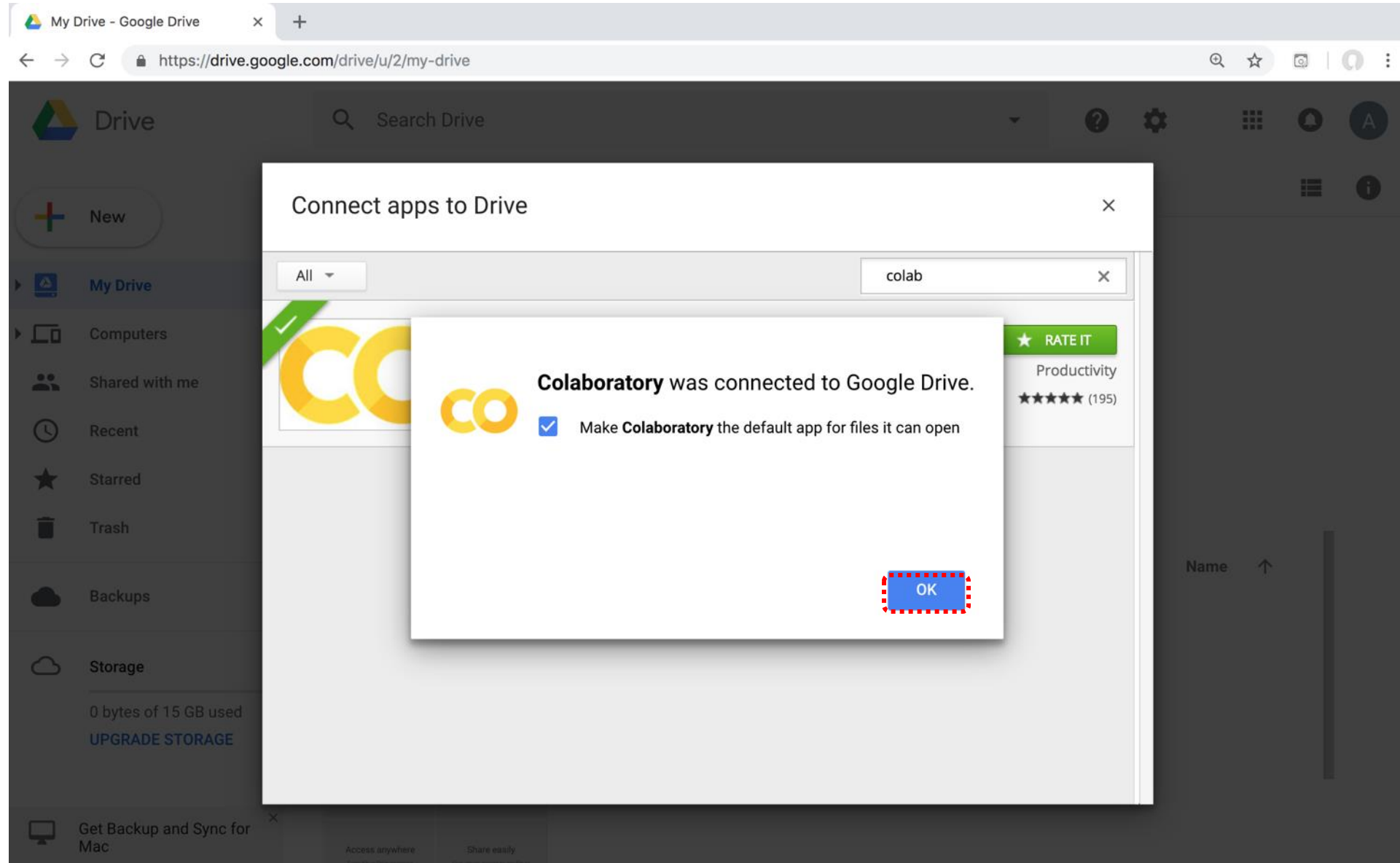
Sejda	DocHub	Google Forms
	 Edit, Send & Sign PDFs	
Merge PDF - Split PDF - Sejda.com ★★★★★ (1106)	DocHub - Edit and Sign PDF Docu... 2,131,600 users	Google Forms 4,803,614 users



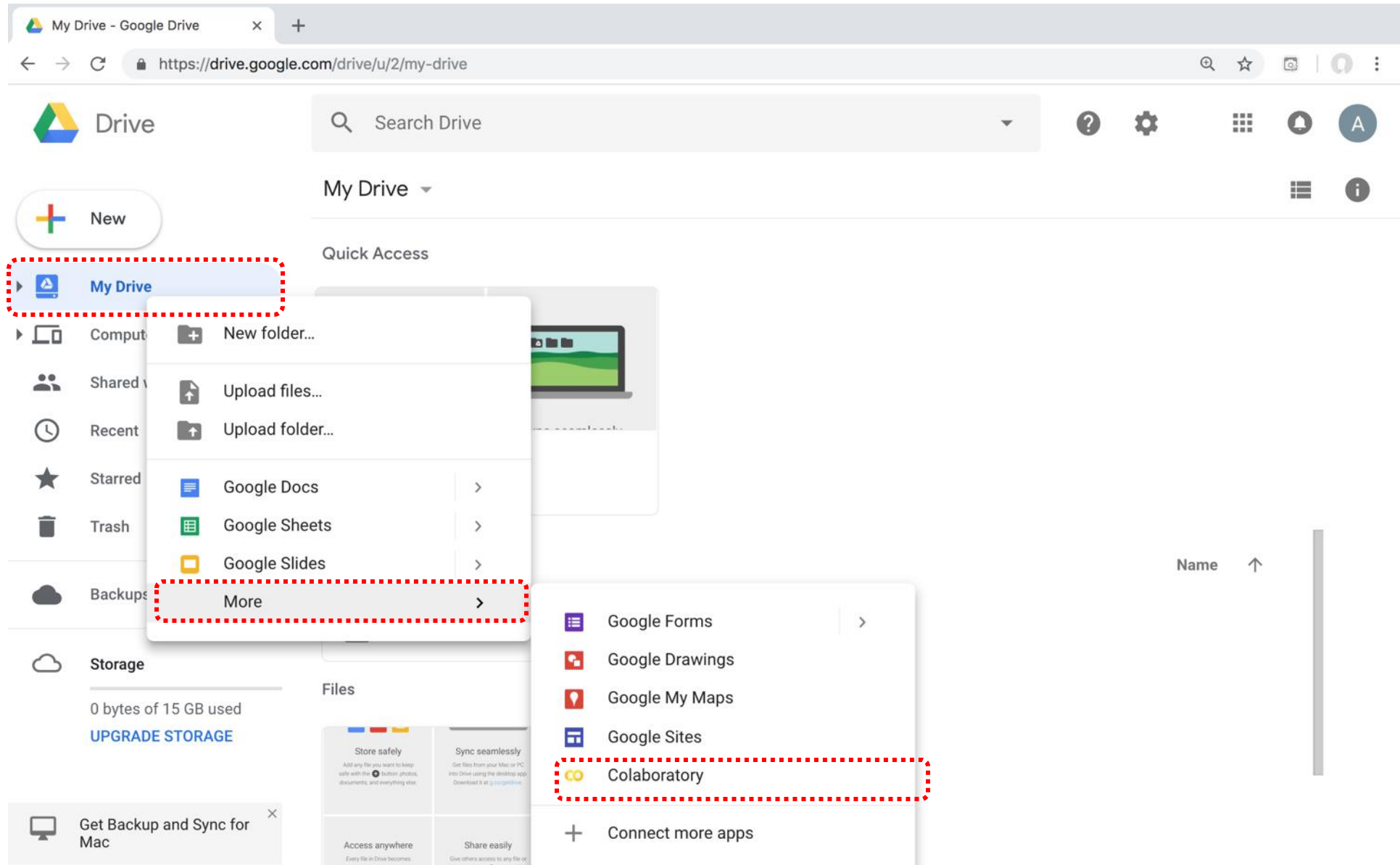
# Google Colab



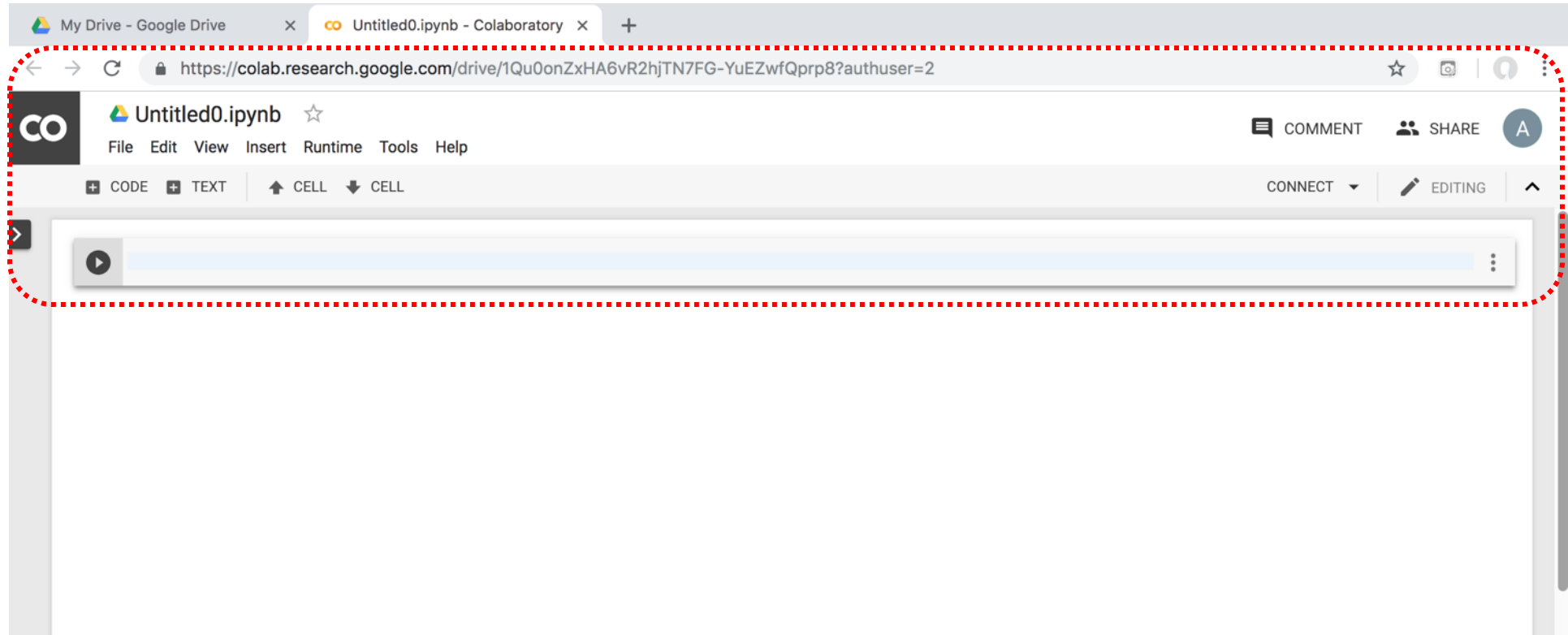
# Connect Colaboratory to Google Drive



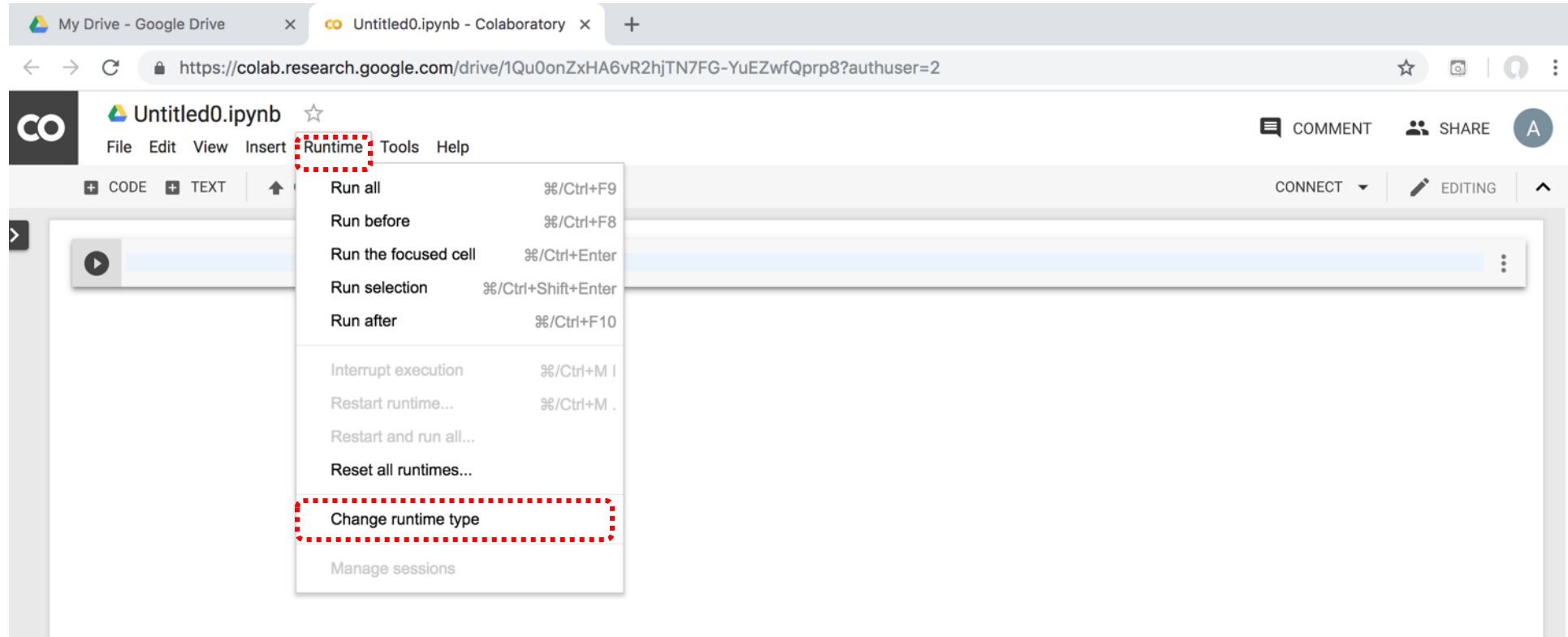
# Google Colab



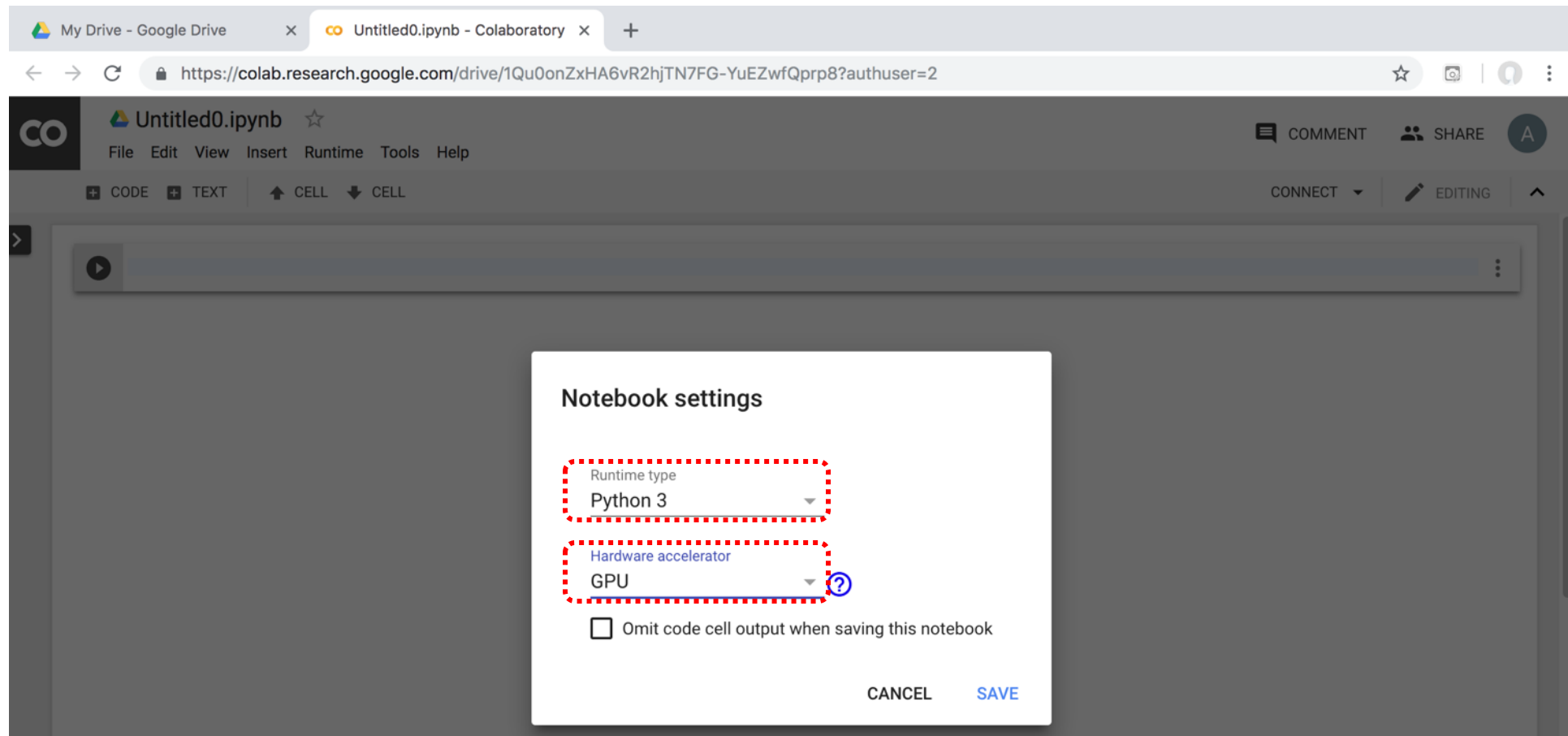
# Google Colab



# 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>

python101.ipynb - Colaboratory

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT?authuser=2#scrollTo=wsh36fLxDKC3

python101.ipynb

File Edit View Insert Runtime Tools Help

COMMENT SHARE

CODE TEXT CELL CELL

CONNECTED EDITING

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

194.87

```
[11] 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))
```

194.87

```
[12] 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))
```

194.87

```
[13] 1 # Python if else
2 score = 80
3 if score >=60 :
4     print("Pass")
5 else:
6     print("Fail").
```

Pass

<https://tinyurl.com/aintpuppython101>





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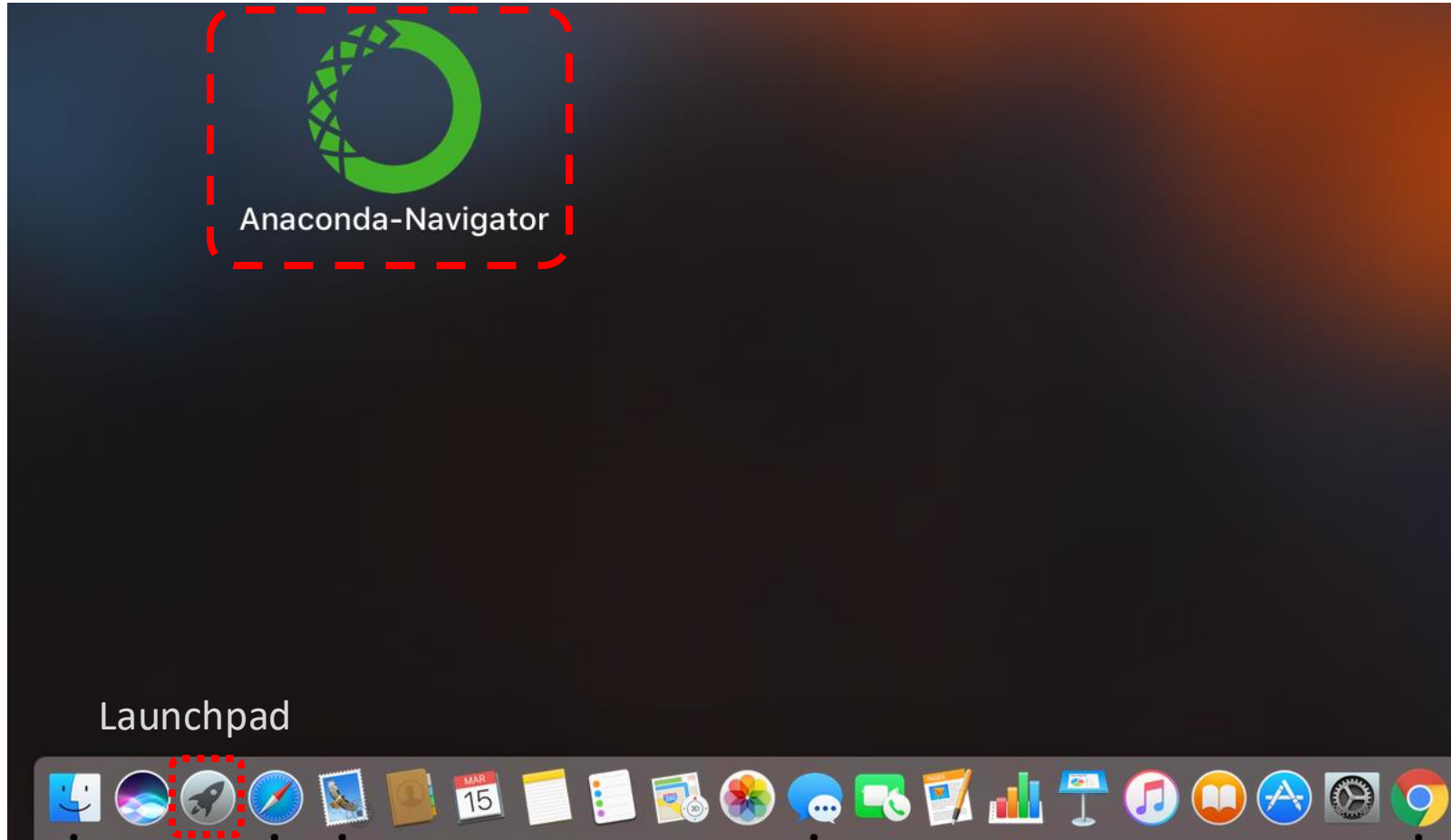




# Python

# HelloWorld

# Anaconda-Navigator



# Anaconda Navigator

Anaconda Navigator

ANACONDA NAVIGATOR

Sign in to Anaconda Cloud

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Learning

Community

Documentation

Developer Blog

Feedback

Applications on base (root) Channels Refresh

jupyterlab  
0.31.5  
An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture.  
[Launch](#)

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](#)

# Jupyter Notebook

The screenshot displays the Jupyter Notebook web interface in a browser window. The address bar shows the URL `localhost:8888/tree/Documents/Data/BDA`. The page header includes the Jupyter logo and a "Logout" button. Below the header, there are tabs for "Files", "Running", and "Clusters", with "Files" being the active tab. A message "Select items to perform actions on them." is displayed above a list of files. The file list shows a folder named `..` with a "Name" column and a "Last Modified" column. The "Last Modified" column shows "seconds ago". A red dashed box highlights the file list area. Below the file list, a message states "The notebook list is empty."

Home

localhost:8888/tree/Documents/Data/BDA

jupyter Logout

Files Running Clusters

Select items to perform actions on them.

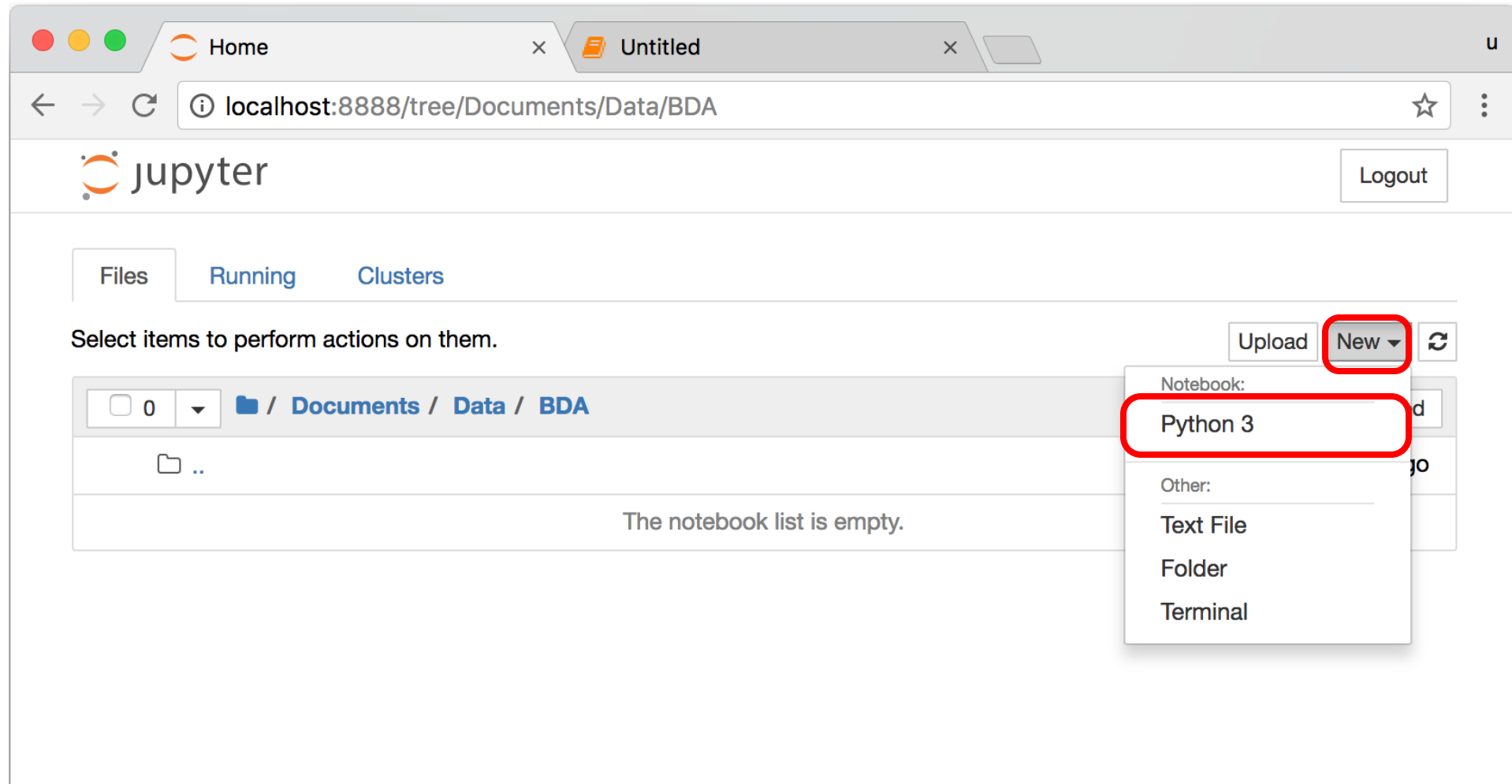
Upload New ↕ ↺

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

The notebook list is empty.

# Jupyter Notebook

## New Python 3



# 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 Jupyter Notebook interface is displayed, with the title 'jupyter HelloWorld (autosaved)' and a 'Logout' button. The menu bar includes 'File', 'Edit', 'View', 'Insert', 'Cell', 'Kernel', 'Widgets', and 'Help'. The toolbar contains icons for saving, adding, deleting, and running cells. The 'Run' button, represented by a play icon, is highlighted with a red rectangle. Below the toolbar, a code cell is shown with the prompt 'In [1]:' followed by the code 'print("hello, world")'. The code is highlighted with a red rectangle. The output of the cell is 'hello, world'. Below the code cell, there is an empty input field with the prompt 'In [ ]:'.





# Python

# Programming

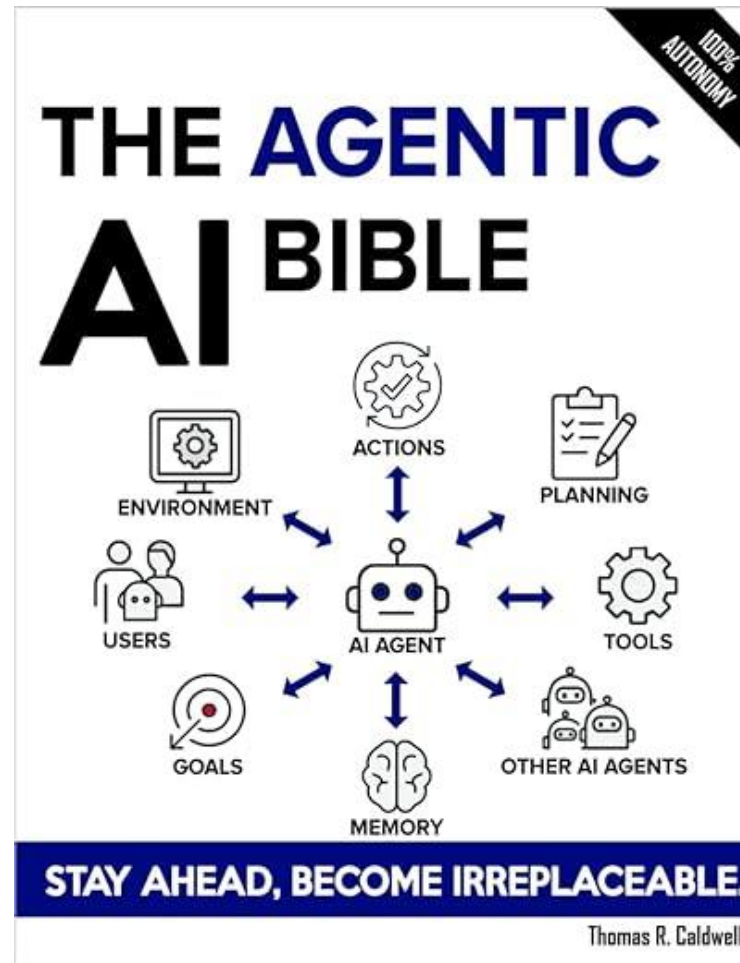
# Foundations of Python Programming

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

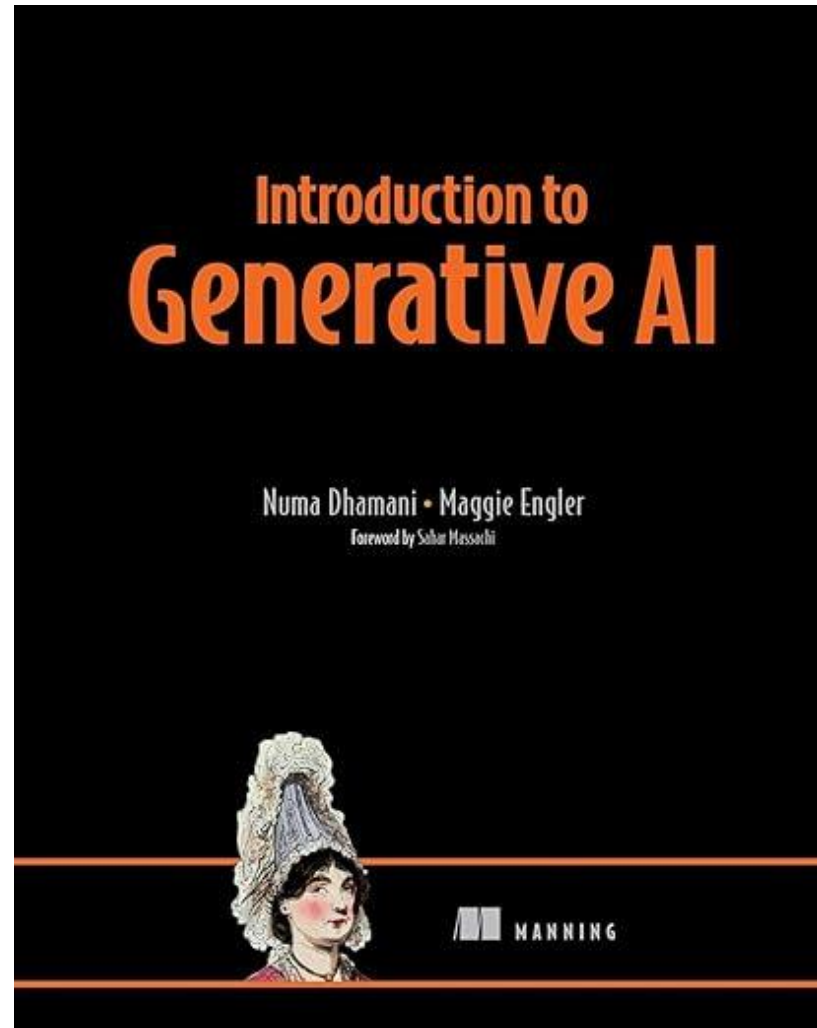
Thomas R. Caldwell (2025),

# The Agentic AI Bible:

The Complete and Up-to-Date Guide to Design, Build, and Scale Goal-Driven,  
LLM-Powered Agents that Think, Execute and Evolve,  
Independently published



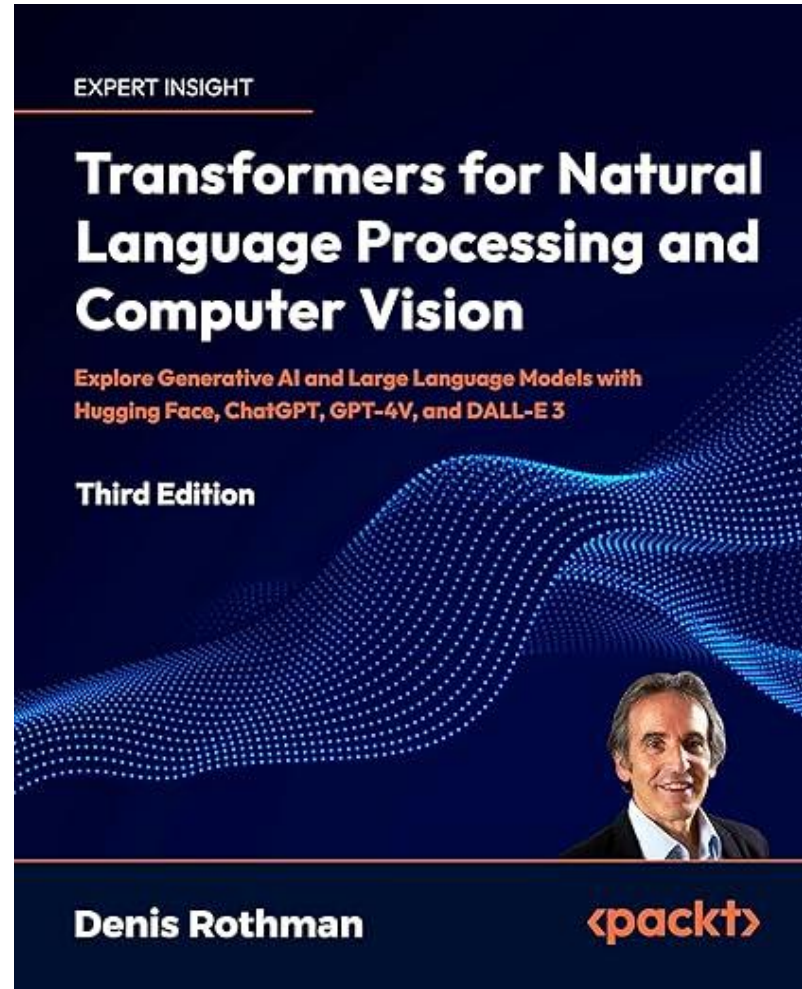
Numa Dhamani and Maggie Engler (2024),  
**Introduction to Generative AI,**  
Manning



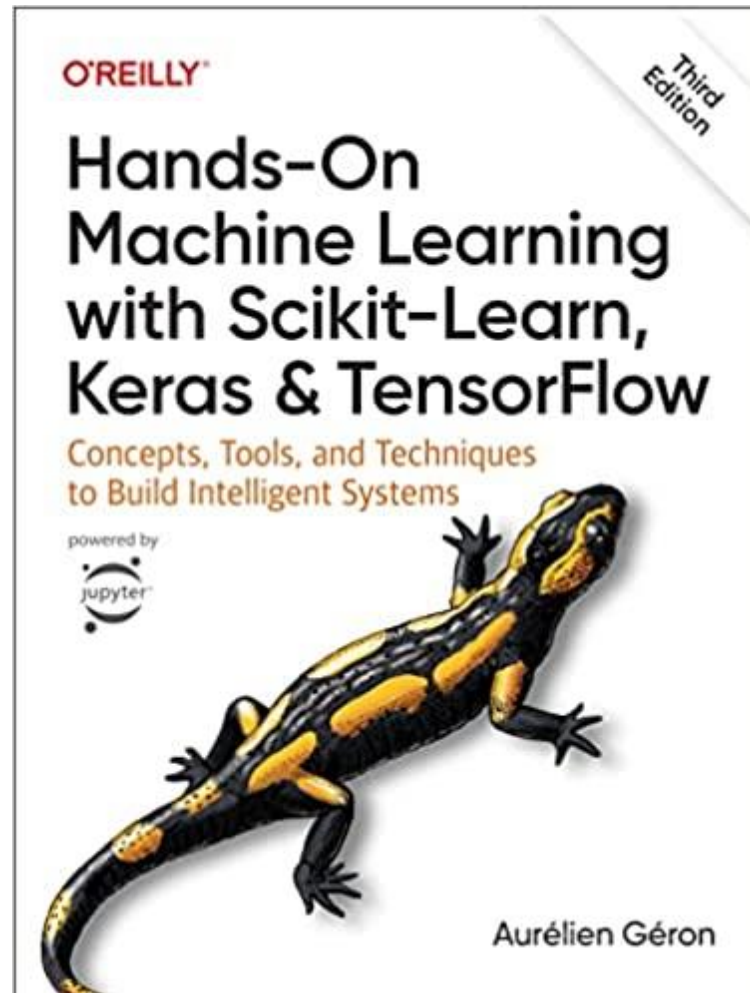
Denis Rothman (2024),

# 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](#)



[✉ Subscribe](#) [⬇ Download Standards](#)

[About](#) [SASB Standards](#) [Using the SASB Standards](#) [Pathway to ISSB](#) [Education](#) [Membership](#)

The background of the hero section is an aerial photograph of a landscape. It shows a winding river or stream flowing through a green field, with a dense forest of tall evergreen trees on the right side. The lighting suggests a sunset or sunrise, with warm tones on the left and cooler tones on the right.

## SASB Standards: Your pathway to ISSB

[Learn more](#)

<https://sasb.org/>



# ISSB (International Sustainability Standards Board)



ABOUT US | IFRS ACCOUNTING | IFRS SUSTAINABILITY

Home > International Sustainability Standards Board

## International Sustainability Standards Board

ABOUT

MEMBERS

MEETINGS

RESOURCES

NEWS

### 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

**SDGs:**

**Sustainable Development Goals**

**SDGs**

Innovative Financial Instrument

**Impact Investing**

**ESG:** Environmental, Social, and Governance

**CSR:** Corporate Social Responsibility

**Conscious Capitalism**

**Climate Financing**

**Carbon Financing**

**Green Financing**

**Ethical Investing**

**Socially Responsible Investing**

Topic

1986

1995

2005

2015

2020

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

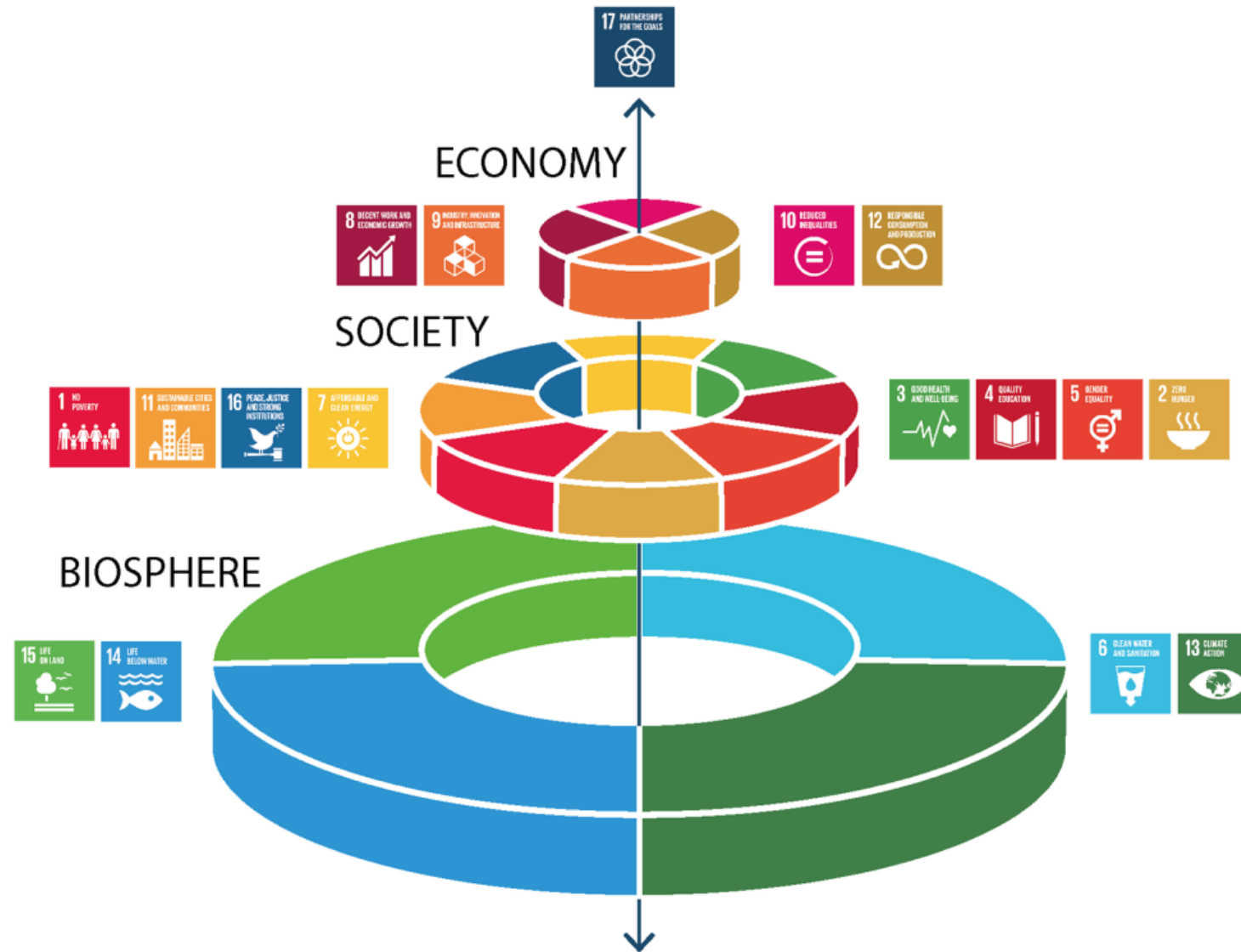
Partnership

Peace

Prosperity

People

Planet

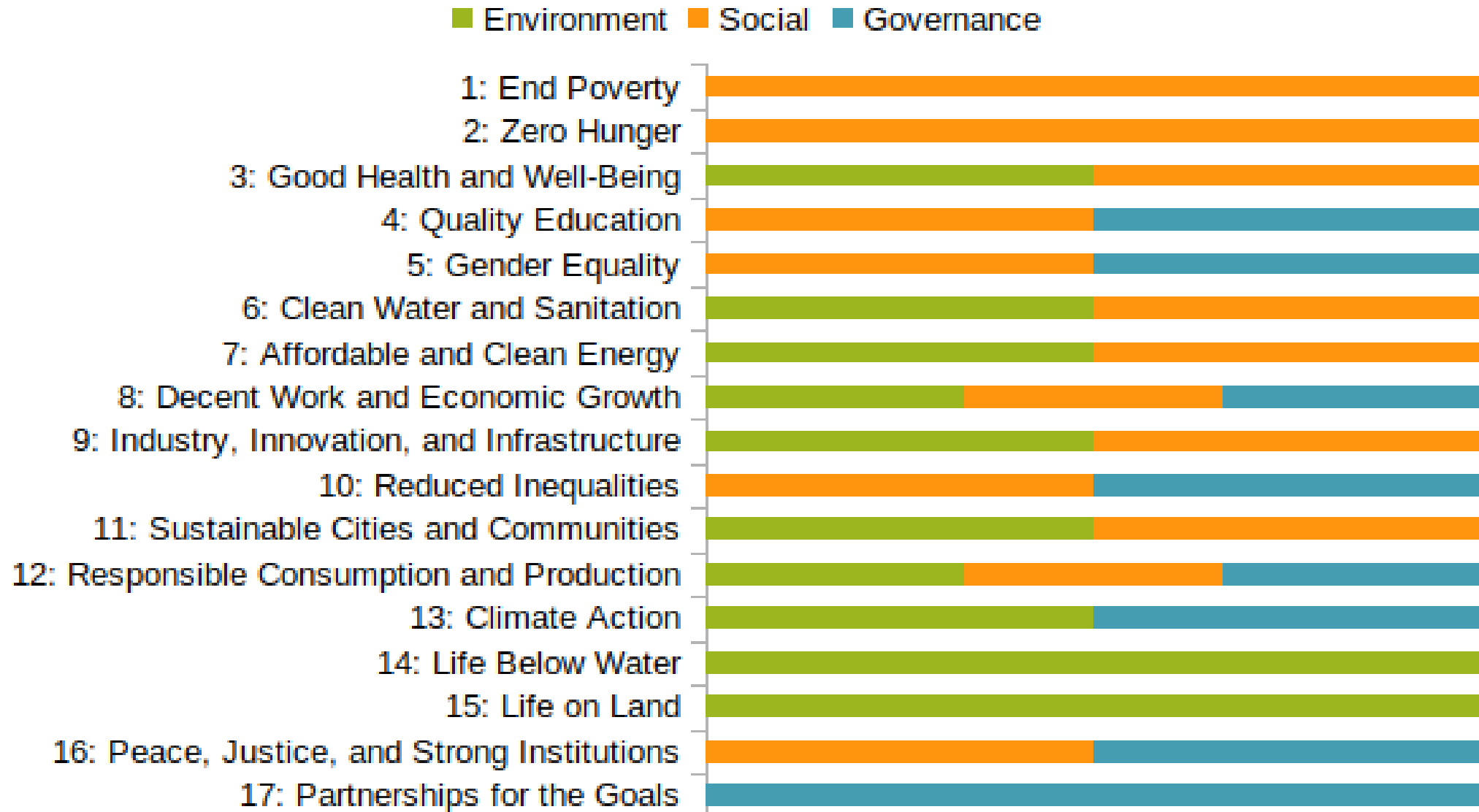




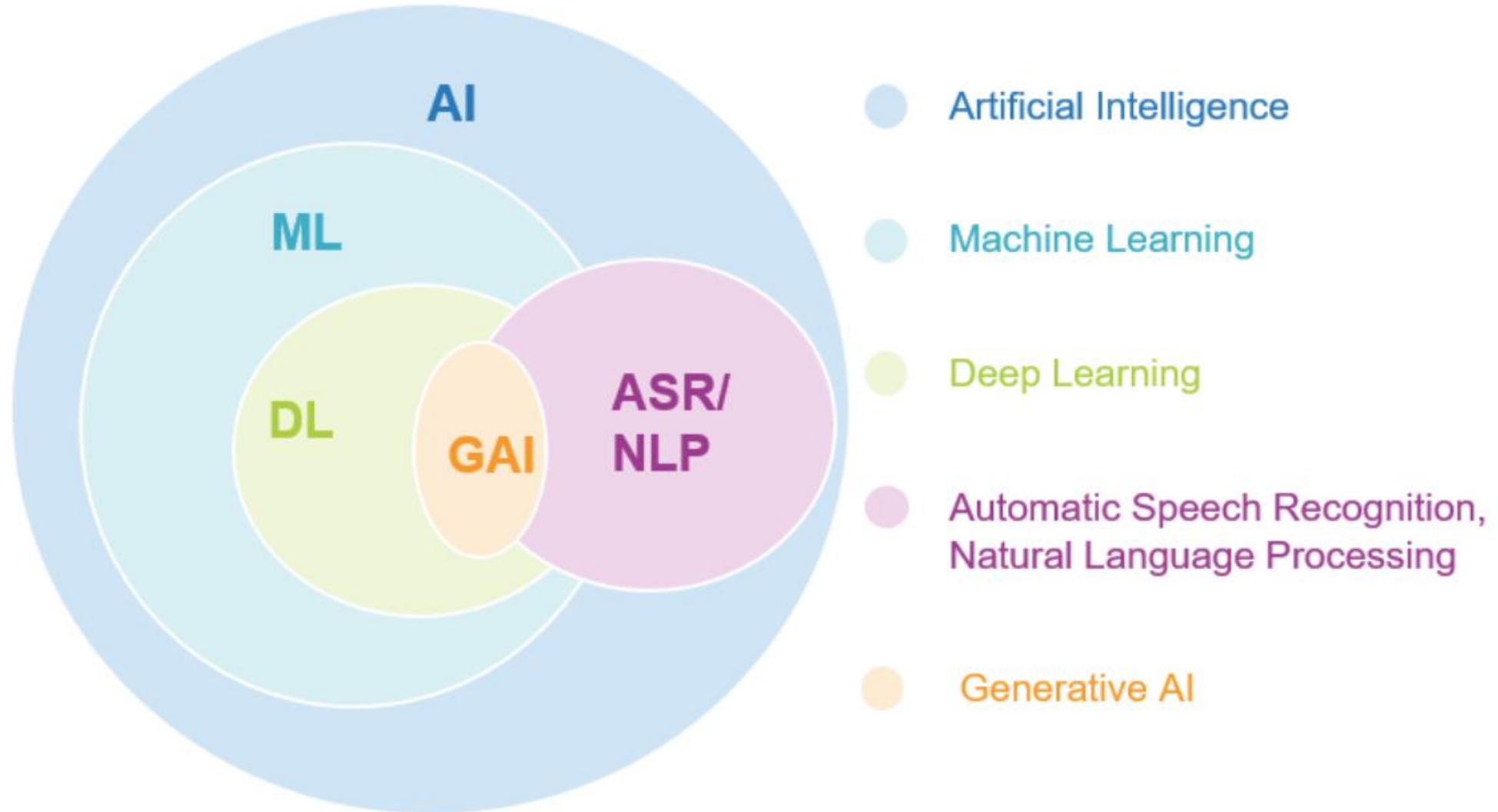
# ESG to 17 SDGs



# ESG to 17 SDGs



# AI, ML, DL, Generative AI



# Generative AI, Agentic AI, Physical AI

## Physical AI

Self-driving cars  
General robotics

## Agentic AI

Coding assistants  
Customer service  
Patient care

## Generative AI

Digital marketing  
Content creation

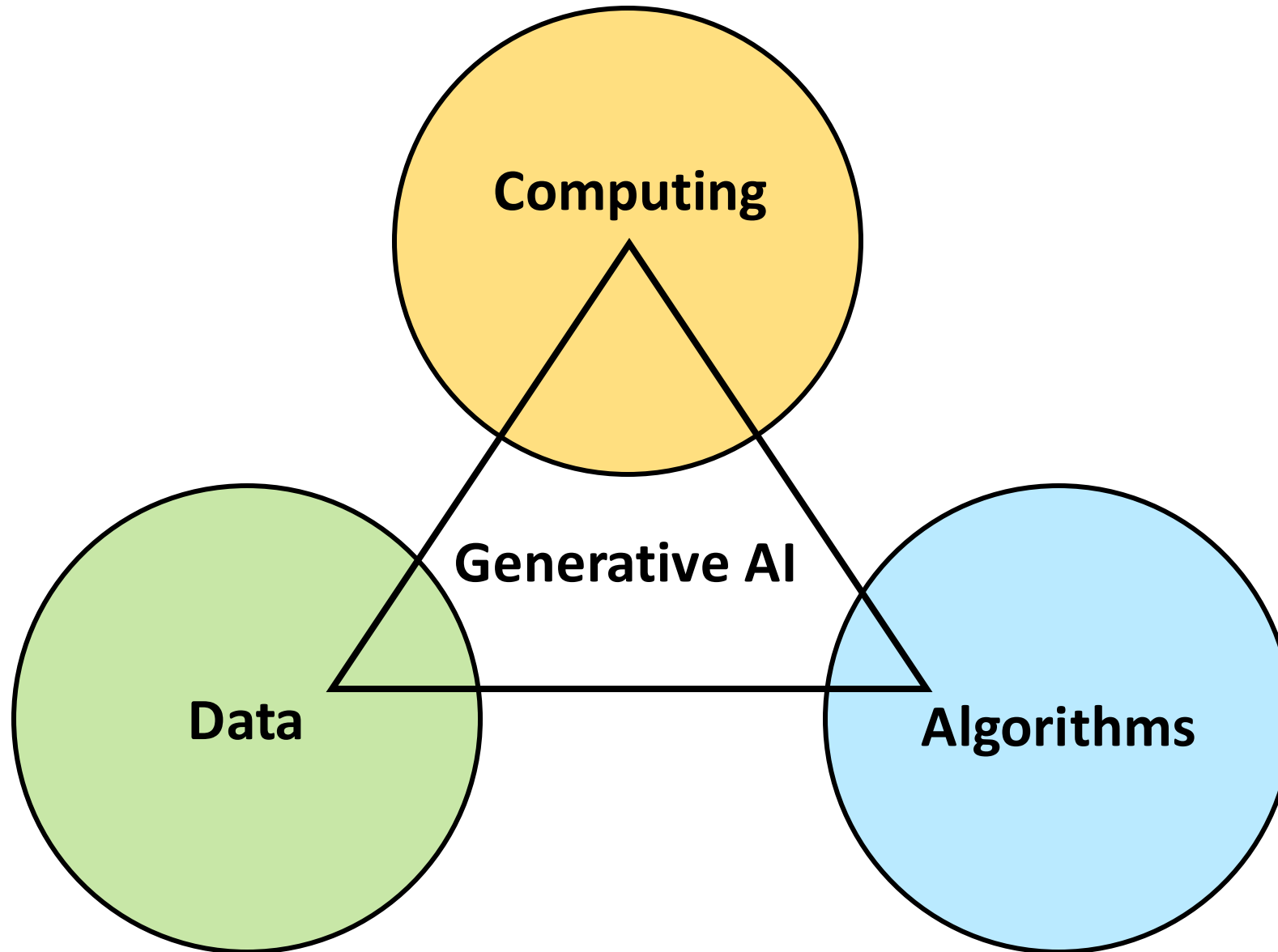
## Perception AI

Speech recognition  
Deep recommender systems  
Medical imaging

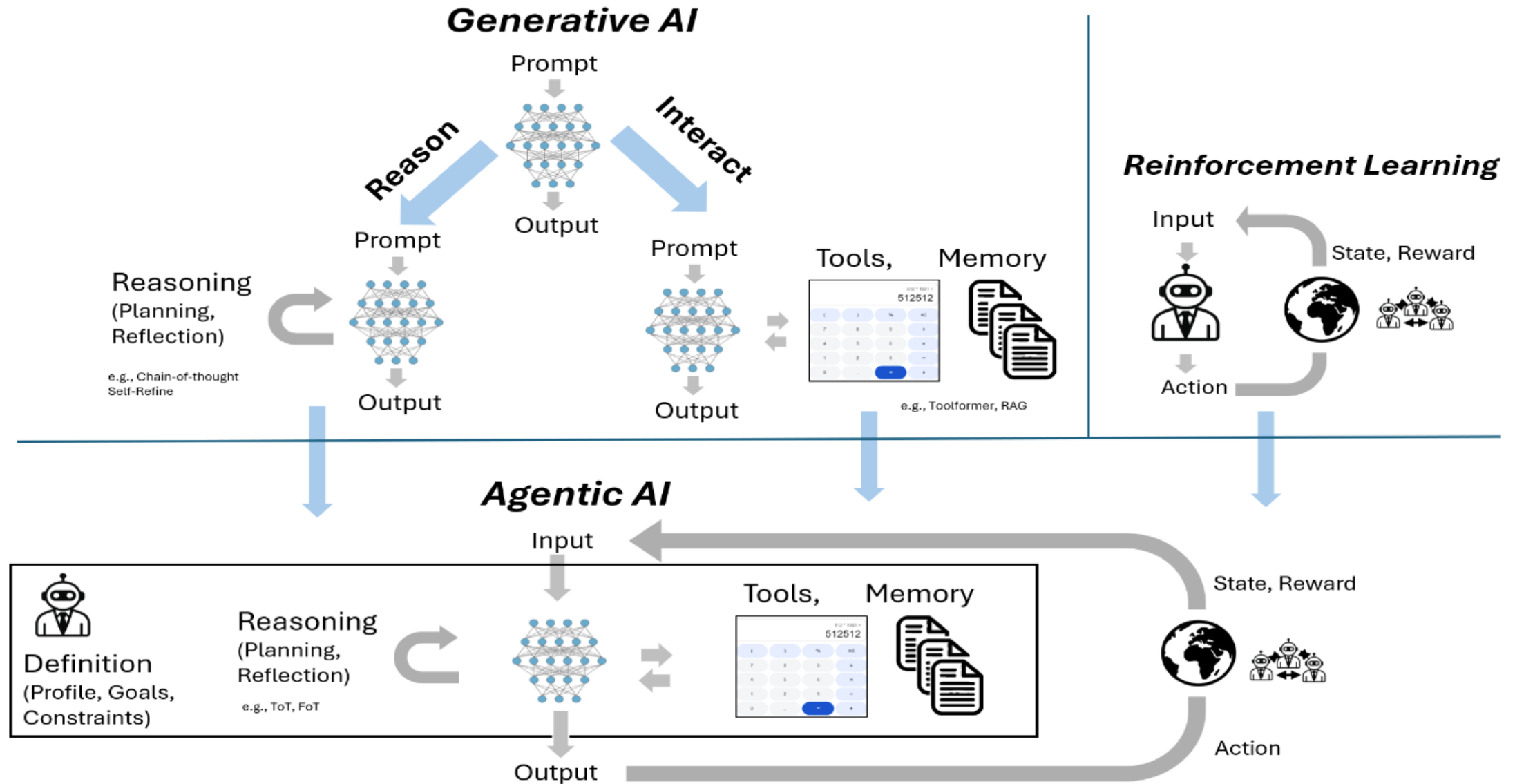
## 2012 AlexNet

Deep learning breakthrough

# Generative AI

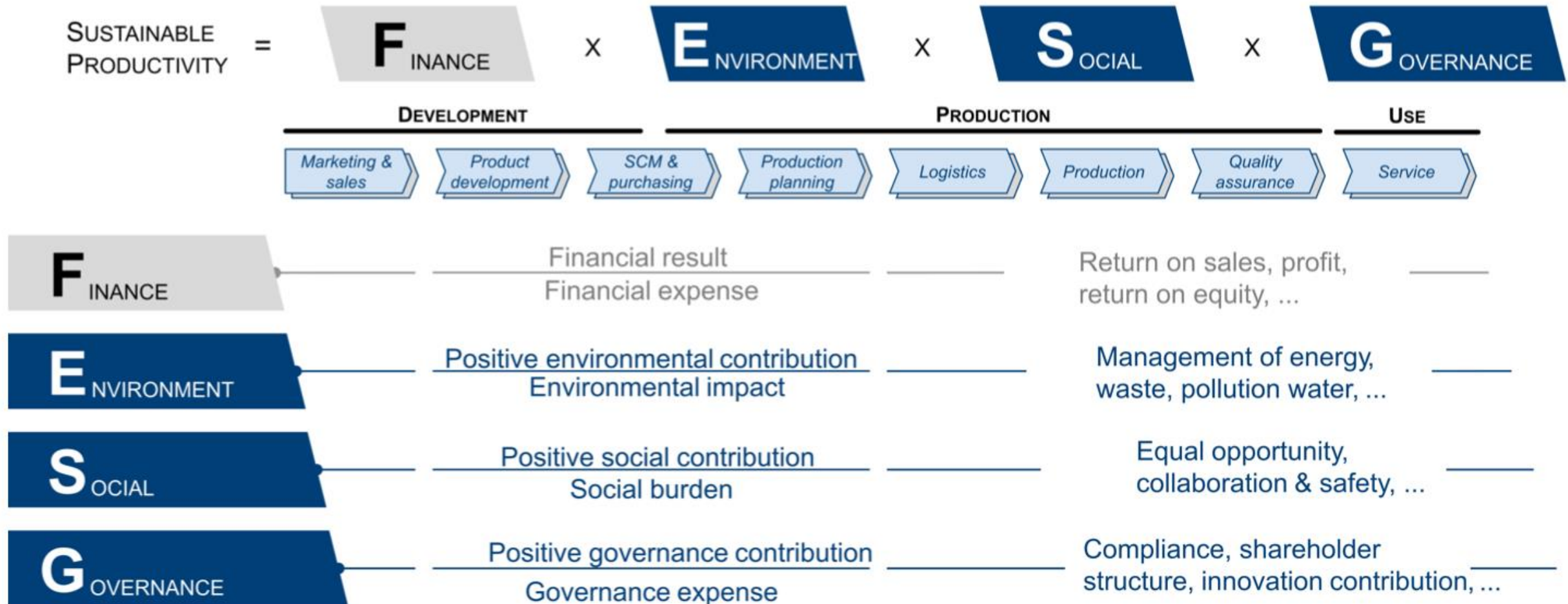


# From Generative AI to Agentic AI



# Sustainable Productivity:

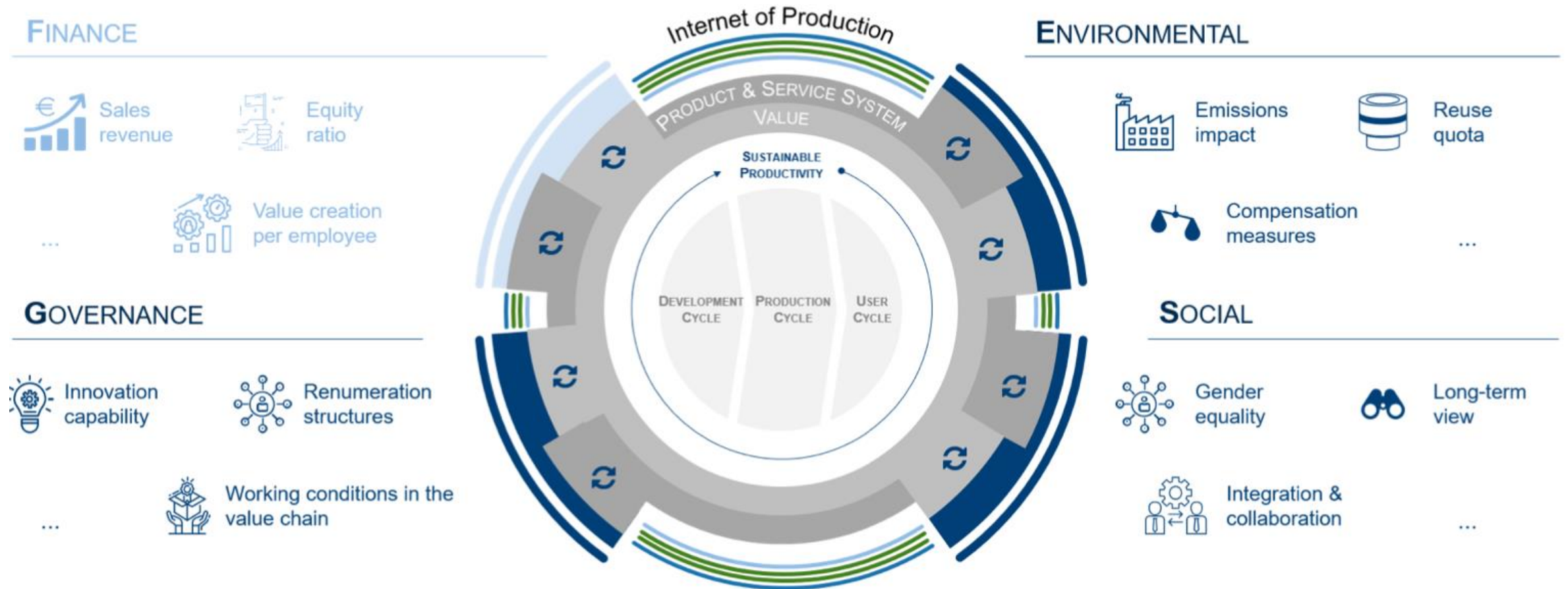
## Finance ESG





# Sustainable Resilient Manufacturing

## ESG

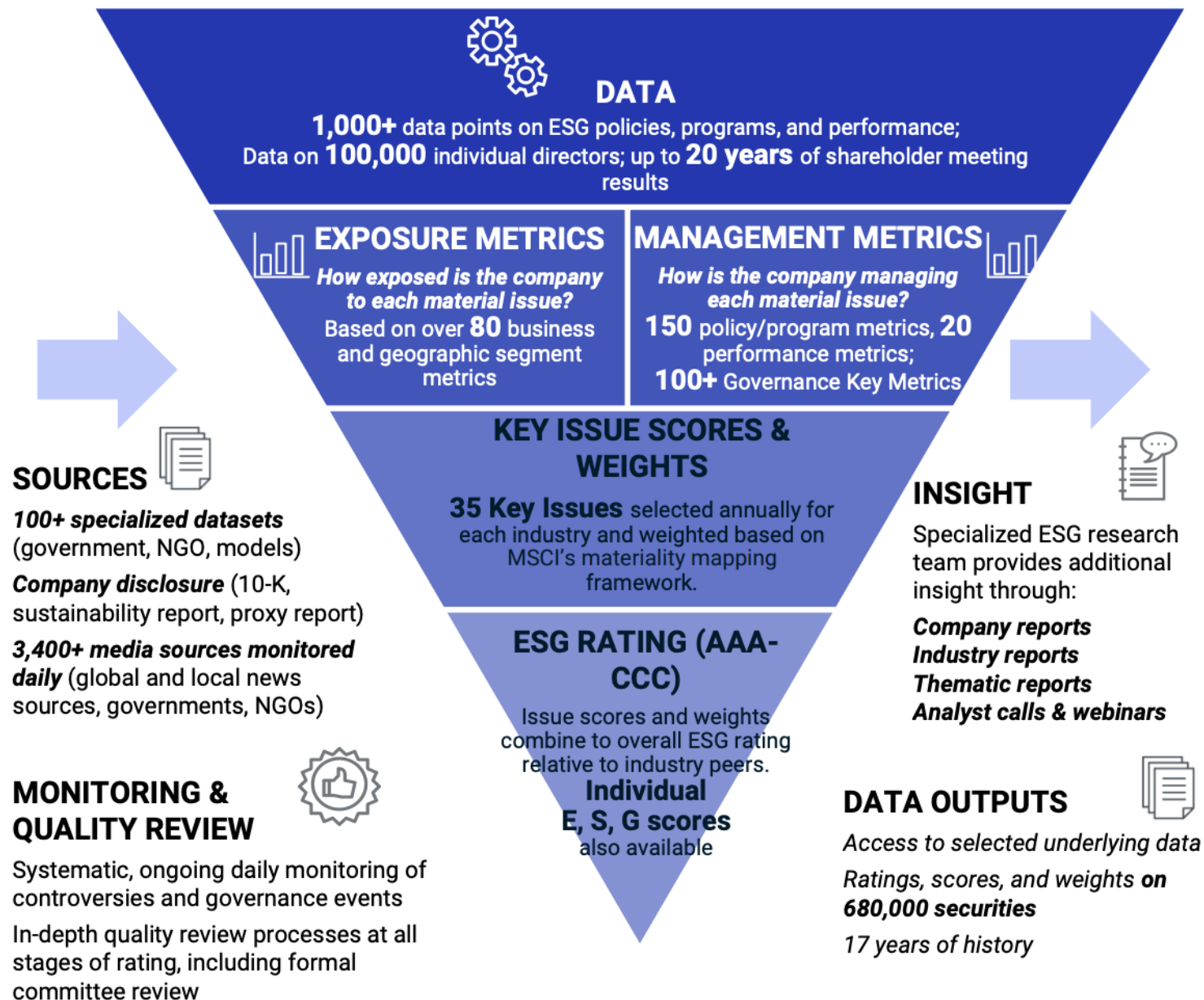




# ESG Indexes

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

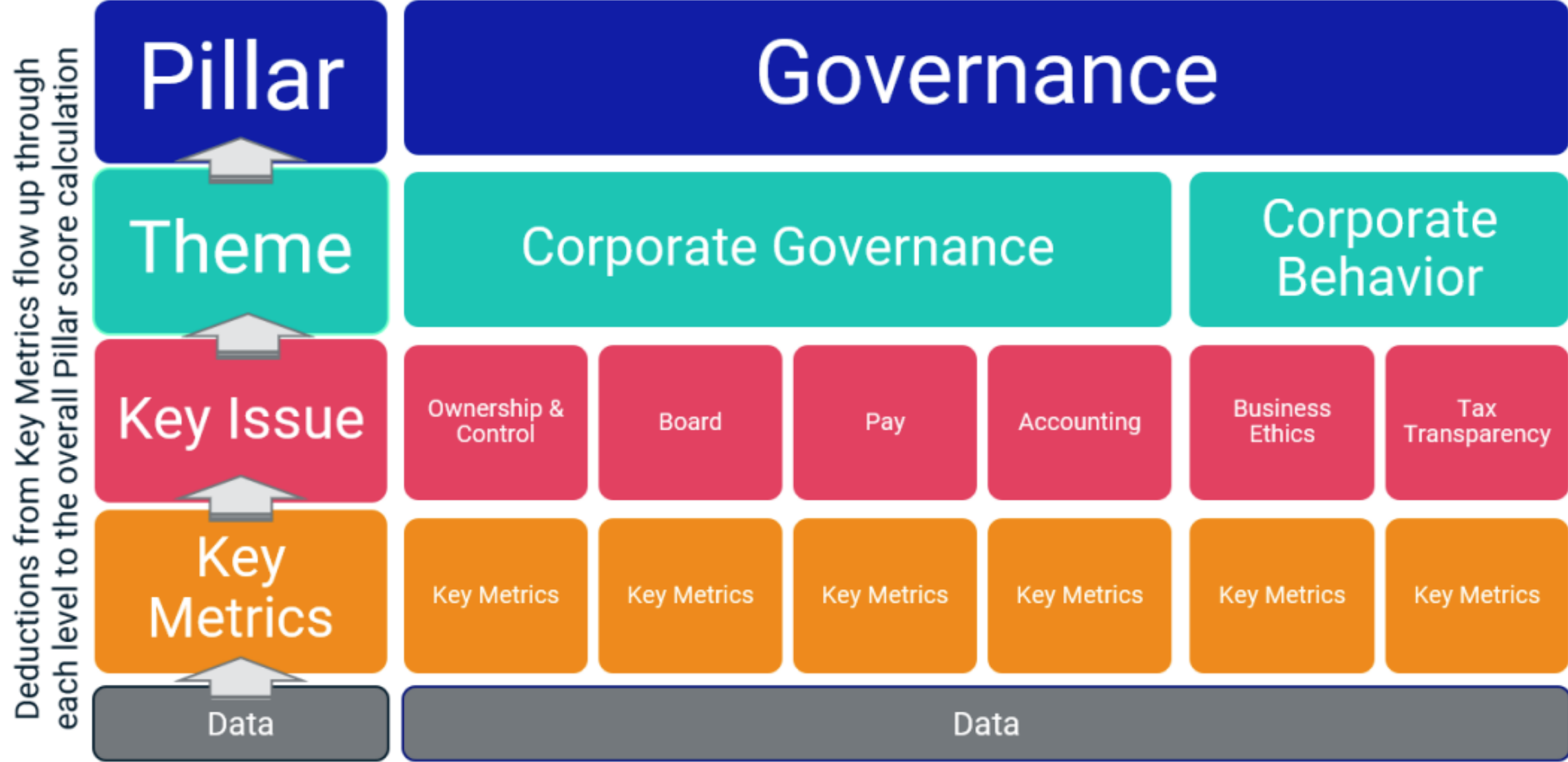
# MSCI ESG Rating Framework



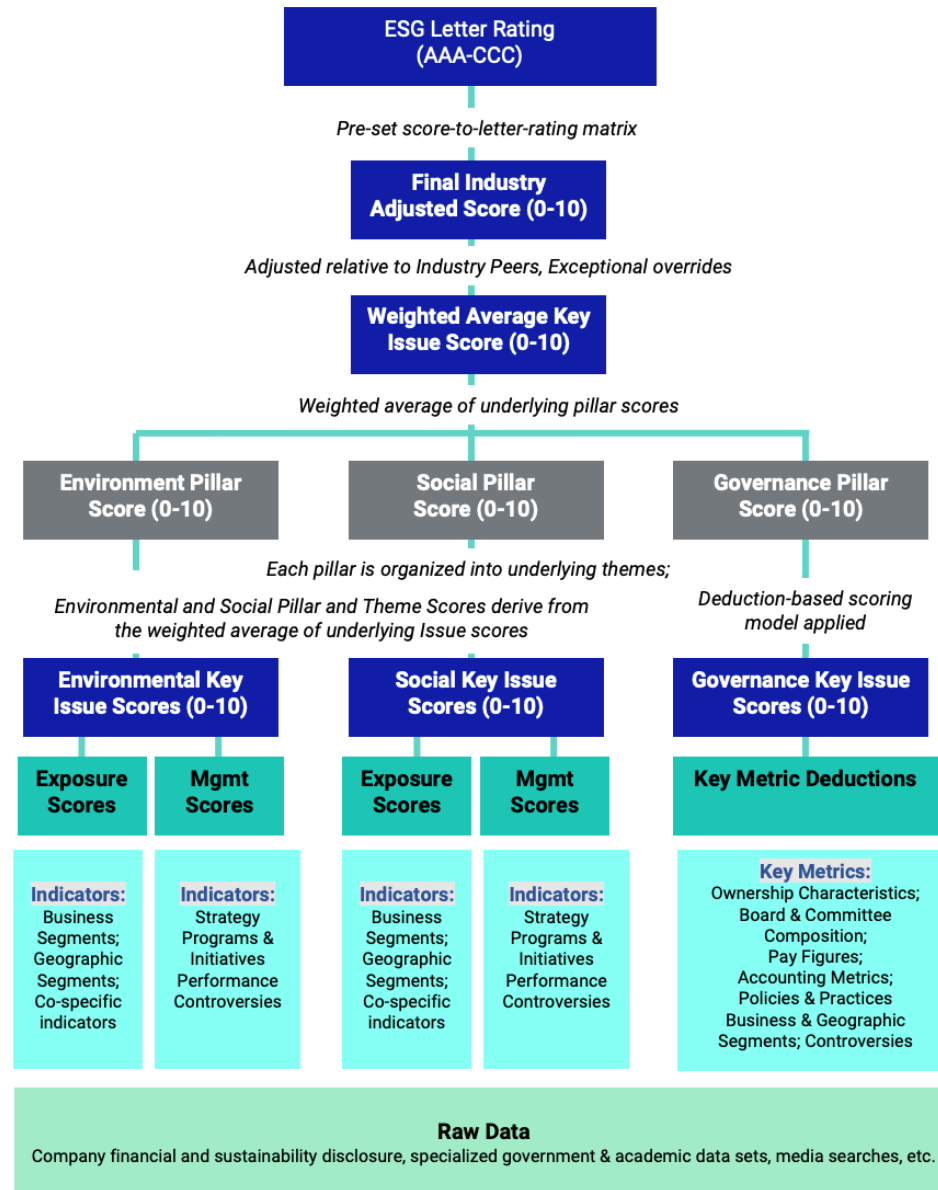
# MSCI ESG Key Issue Hierarchy

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

# MSCI Governance Model Structure



# MSCI Hierarchy of ESG Scores



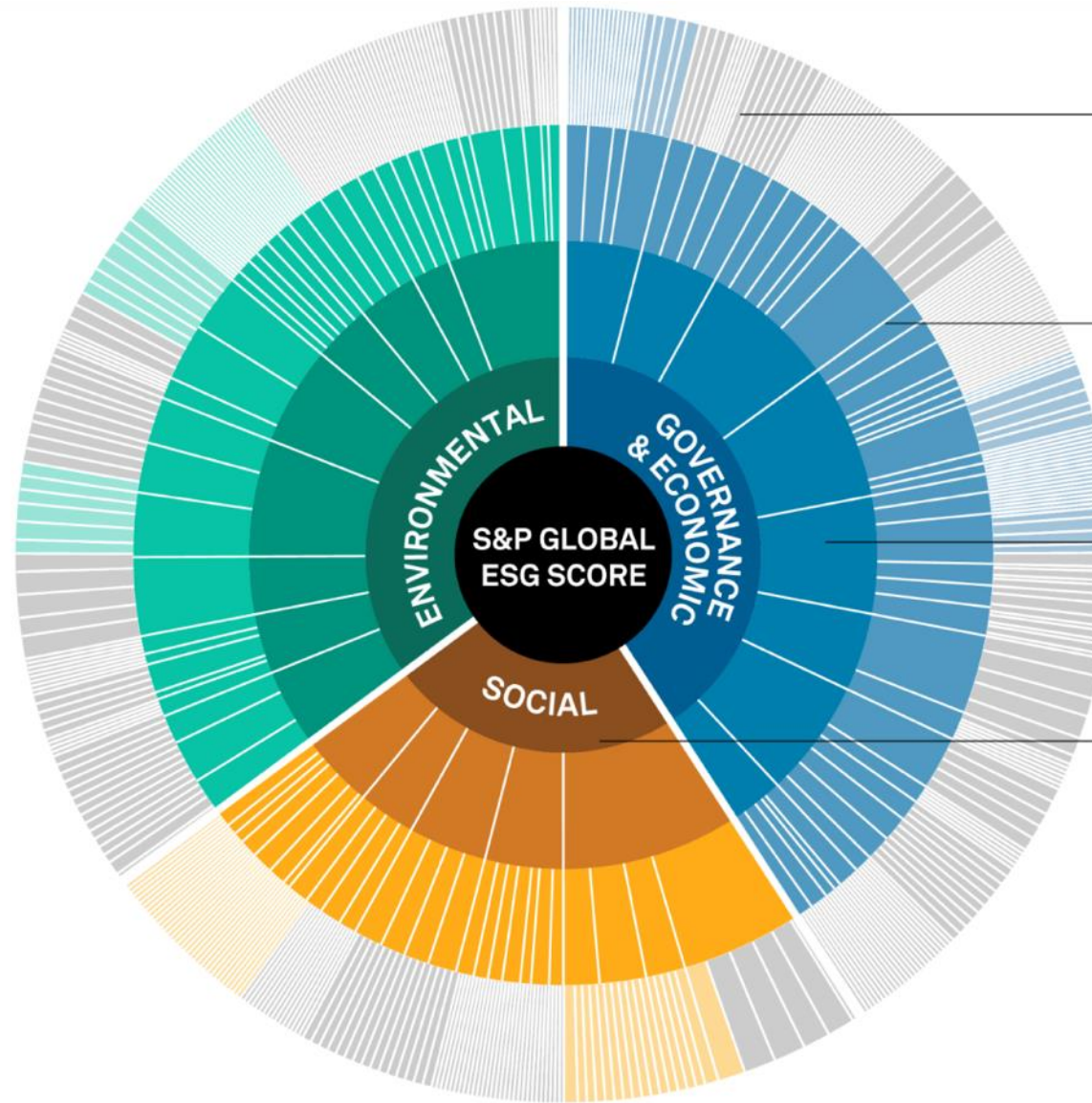


# DJSI S&P Global ESG Score

**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

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

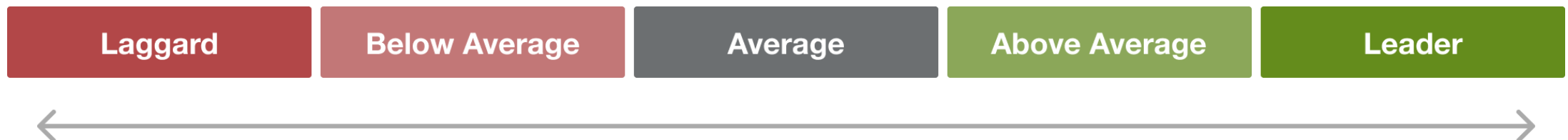
Negligible	Low	Medium	High	Severe
0 - 10	10 - 20	20 - 30	30 - 40	40+



# 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

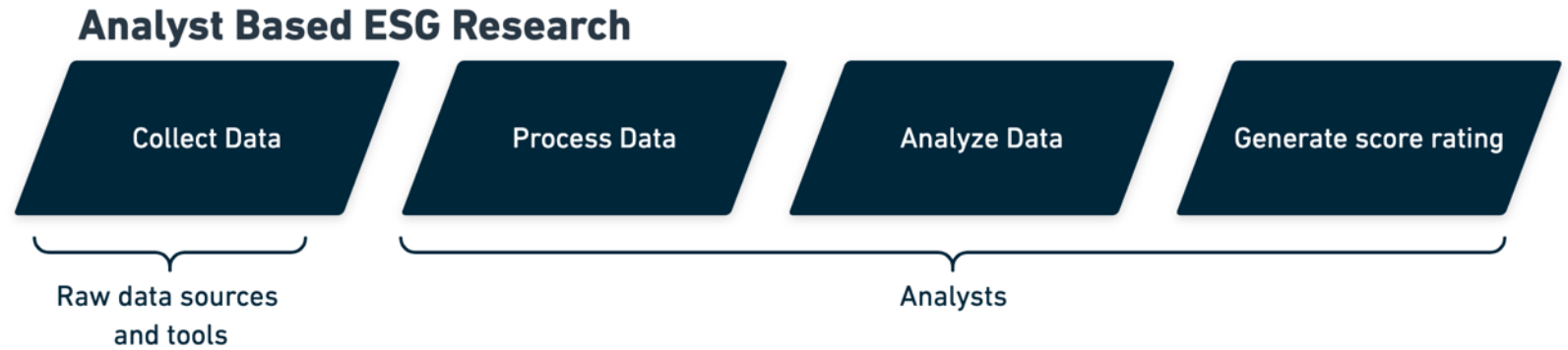
Derives signals from unstructured data



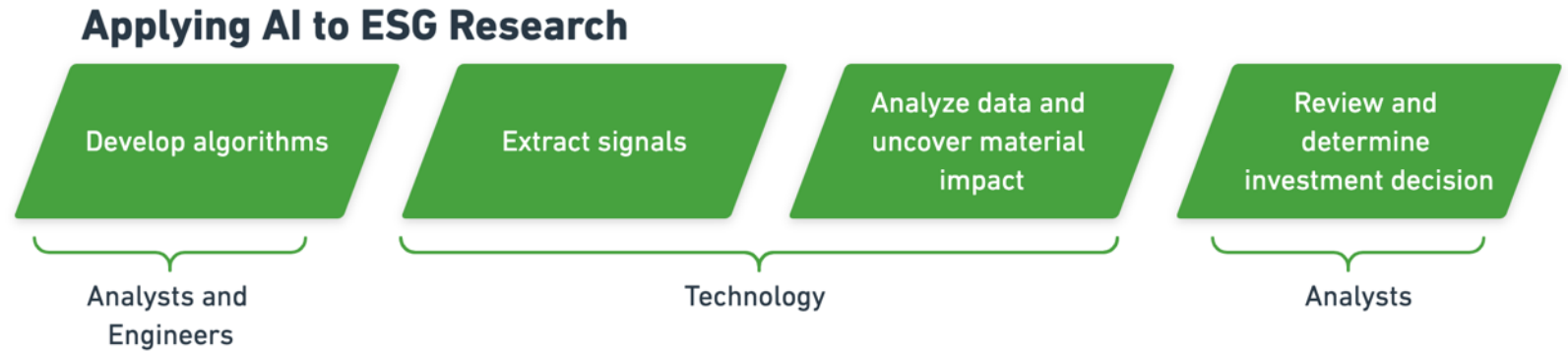
## Truvalue Labs

*Analyst expertise at the beginning of the process produces consistent results*

# Analyst based ESG Research

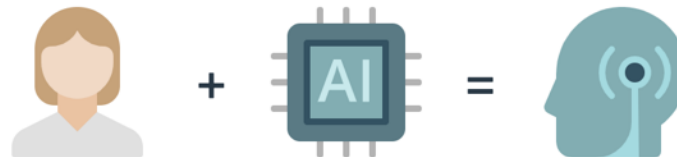


# AI based ESG Research



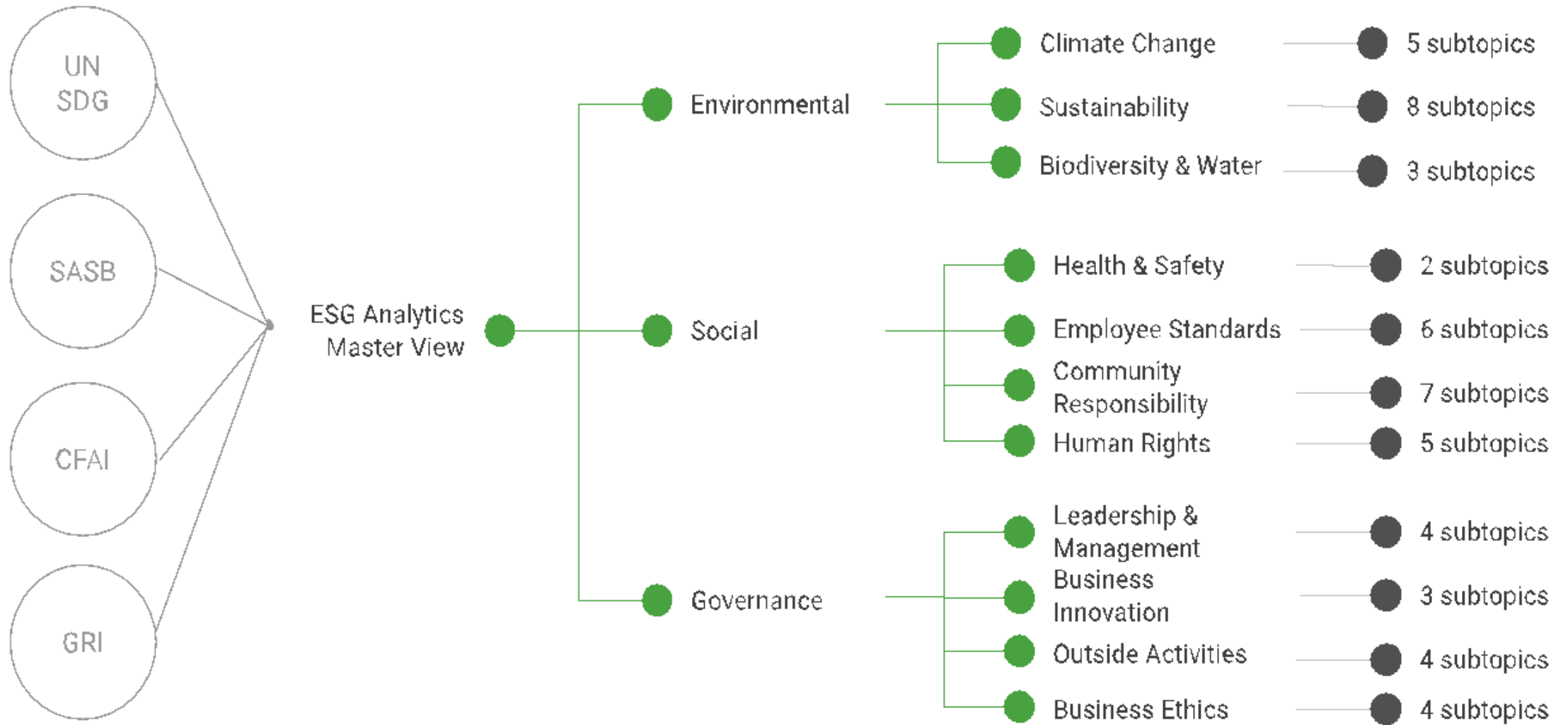
**It would take an analyst over 5 years to do what our AI can in 1 week**

Combining analysts with AI creates gives you the full picture



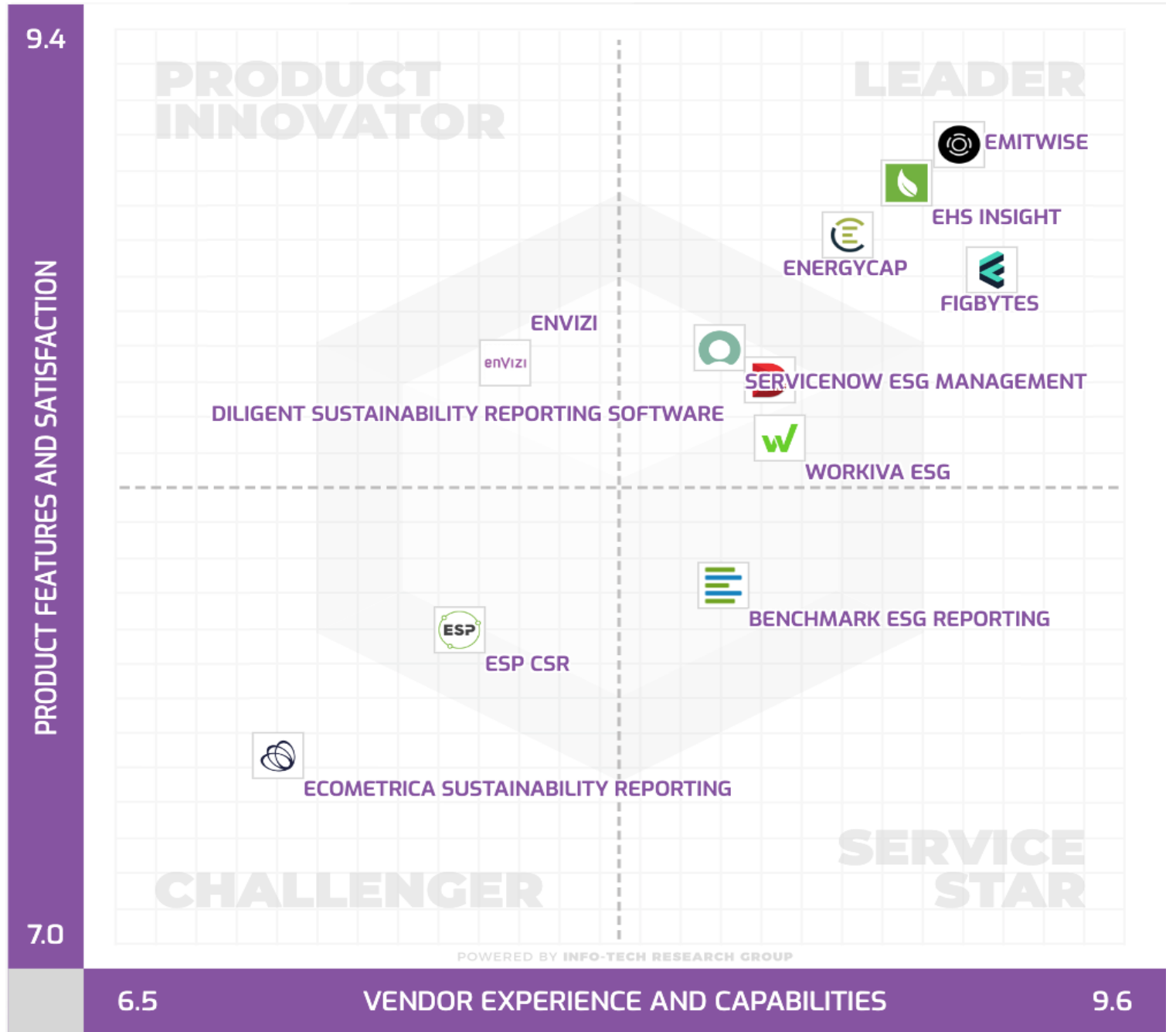
**ESG ANALYTICS**  
Invest where it matters.

# ESG Analytics: NLP Taxonomy

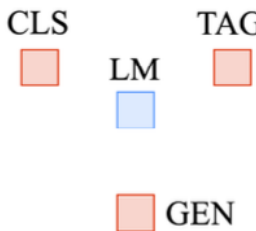
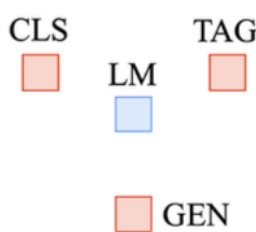
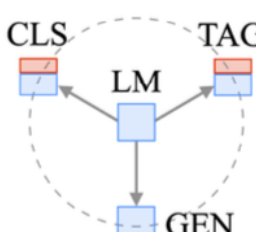
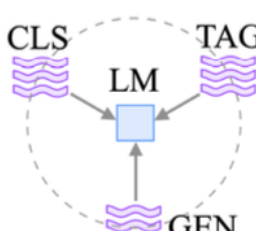


# Top ESG Reporting Software


**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.**



# 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)	
<b>Transfer Learning: Pre-training, Fine-Tuning (FT)</b>		
c. Pre-train, Fine-tune	Objective (e.g. masked language modeling, next sentence prediction)	
<b>GAI: Pre-train, Prompt, and Predict (Prompting)</b>		
d. Pre-train, Prompt, Predict	Prompt (e.g. cloze, prefix)	

# LMarena Leaderboard

Rank (UB) ↑	Model ↑↓	Score ↑↓	95% CI (±) ↑↓	Votes ↑↓	Organization ↑↓	License ↑↓
1	 gemini-2.5-pro	1455	±5	41,731	Google	Proprietary
1	 claude-opus-4-1-20250805-thinking-16k	1451	±6	11,750	Anthropic	Proprietary
2	 o3-2025-04-16	1444	±4	43,898	OpenAI	Proprietary
2	 gpt-5-high	1442	±6	15,076	OpenAI	Proprietary
2	 chatgpt-4o-latest-20250326	1441	±4	36,426	OpenAI	Proprietary
3	 gpt-4.5-preview-2025-02-27	1439	±6	15,271	OpenAI	Proprietary
3	 claude-opus-4-1-20250805	1438	±6	18,341	Anthropic	Proprietary
5	 gpt-5-chat	1430	±6	11,808	OpenAI	Proprietary
6	 qwen3-max-preview	1428	±7	8,781	Alibaba	Proprietary
8	 grok-4-0709	1422	±5	21,446	xAI	Proprietary

# LMarena Leaderboard

Q Model ▾ 239 / 239	Overall ↑↓	Hard Prompts ↑↓	Coding ↑↓	Math ↑↓	Creative Writing ↑↓	Instruction Following	Longer Query ↑↓	Multi-Turn ↑↓
AI claude-opus-4-1-...	1	1	1	1	1	1	1	1
gemini-2.5-pro	1	2	3	1	1	1	1	1
chatgpt-4o-lates...	2	4	3	13	2	5	4	1
gpt-5-high	2	2	3	1	7	5	11	6
o3-2025-04-16	2	4	3	1	8	6	13	7
AI claude-opus-4-1-...	3	2	1	1	1	1	1	1
gpt-4.5-preview-...	3	5	4	8	1	4	3	1
gpt-5-chat	5	3	3	8	3	5	3	1
qwen3-max-preview	6	4	2	1	7	4	4	3
AI claude-opus-4-20...	8	4	3	6	2	2	2	7
deepseek-r1-0528	8	8	4	10	8	15	13	14
deepseek-v3.1	8	6	4	1	7	6	5	9
deepseek-v3.1-th...	8	4	3	1	2	4	1	7
xi grok-4-0709	8	10	12	1	4	6	8	7
kimi-k2-0711-pre...	8	10	7	13	16	24	22	7
kimi-k2-0905-pre...	8	5	3	-	6	16	12	7
qwen3-235b-a22b-...	8	4	3	2	9	6	4	7
z glm-4.5	10	7	4	7	14	7	8	10

<https://huggingface.co/spaces/lmarena-ai/lmarena-leaderboard>

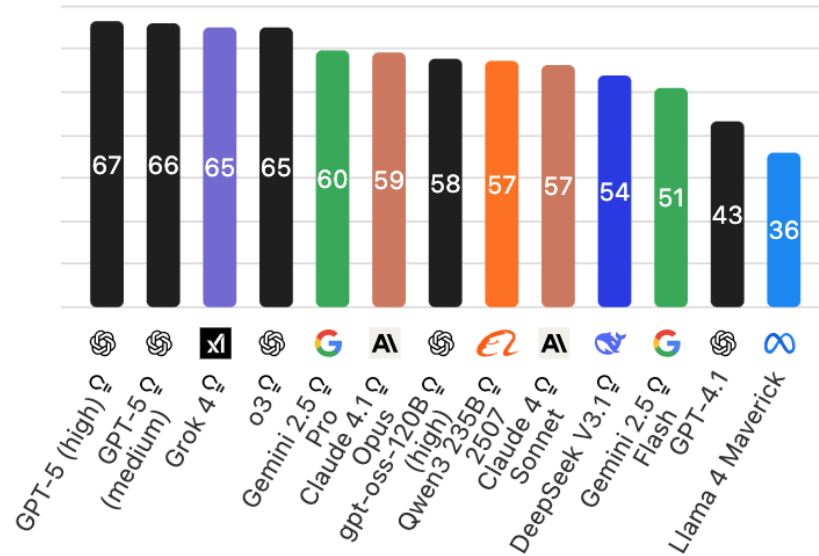


# Artificial Analysis Intelligence Index

## Intelligence, Speed, Price

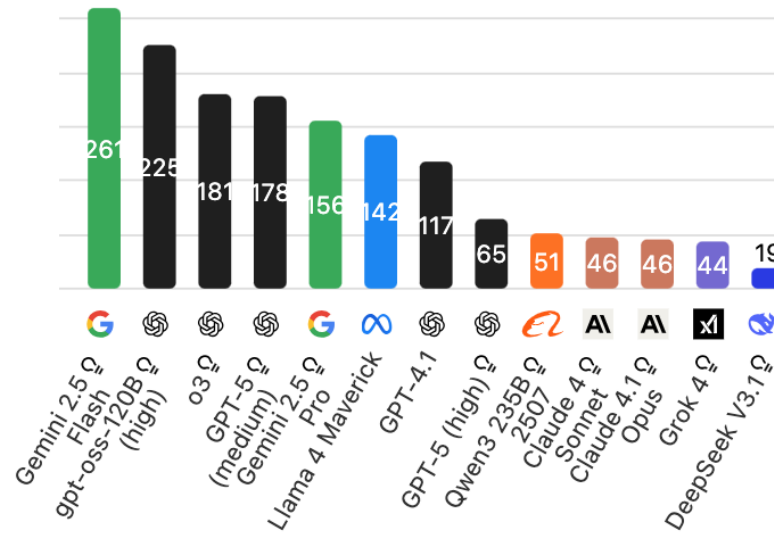
### INTELLIGENCE

Artificial Analysis Intelligence Index; Higher is better



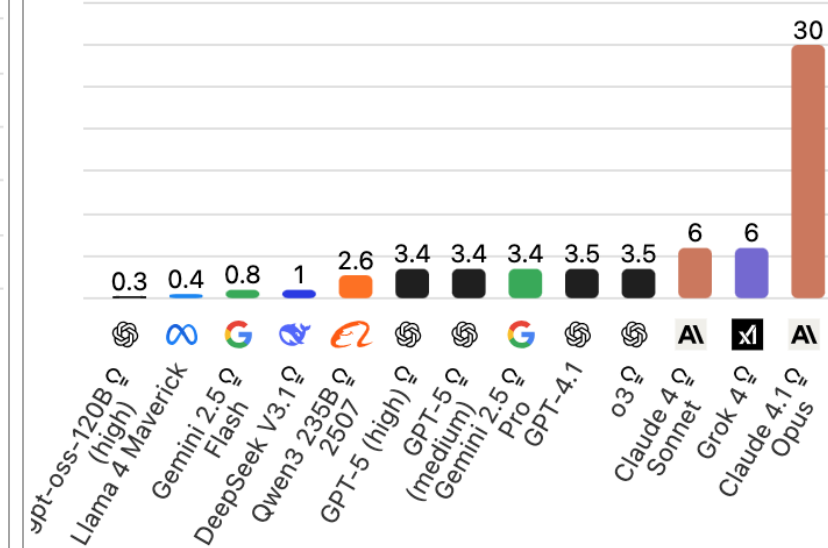
### SPEED

Output Tokens per Second; Higher is better



### PRICE

USD per 1M Tokens; Lower is better

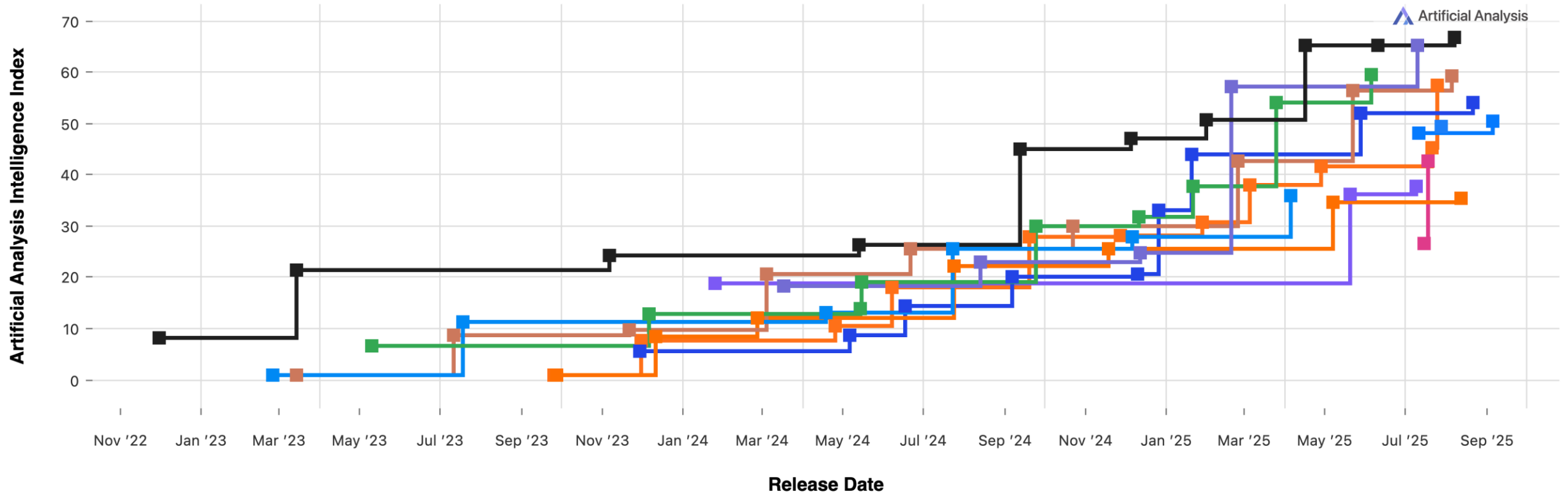


# Artificial Analysis Intelligence Index 2022-2025

## Frontier Language Model Intelligence, Over Time

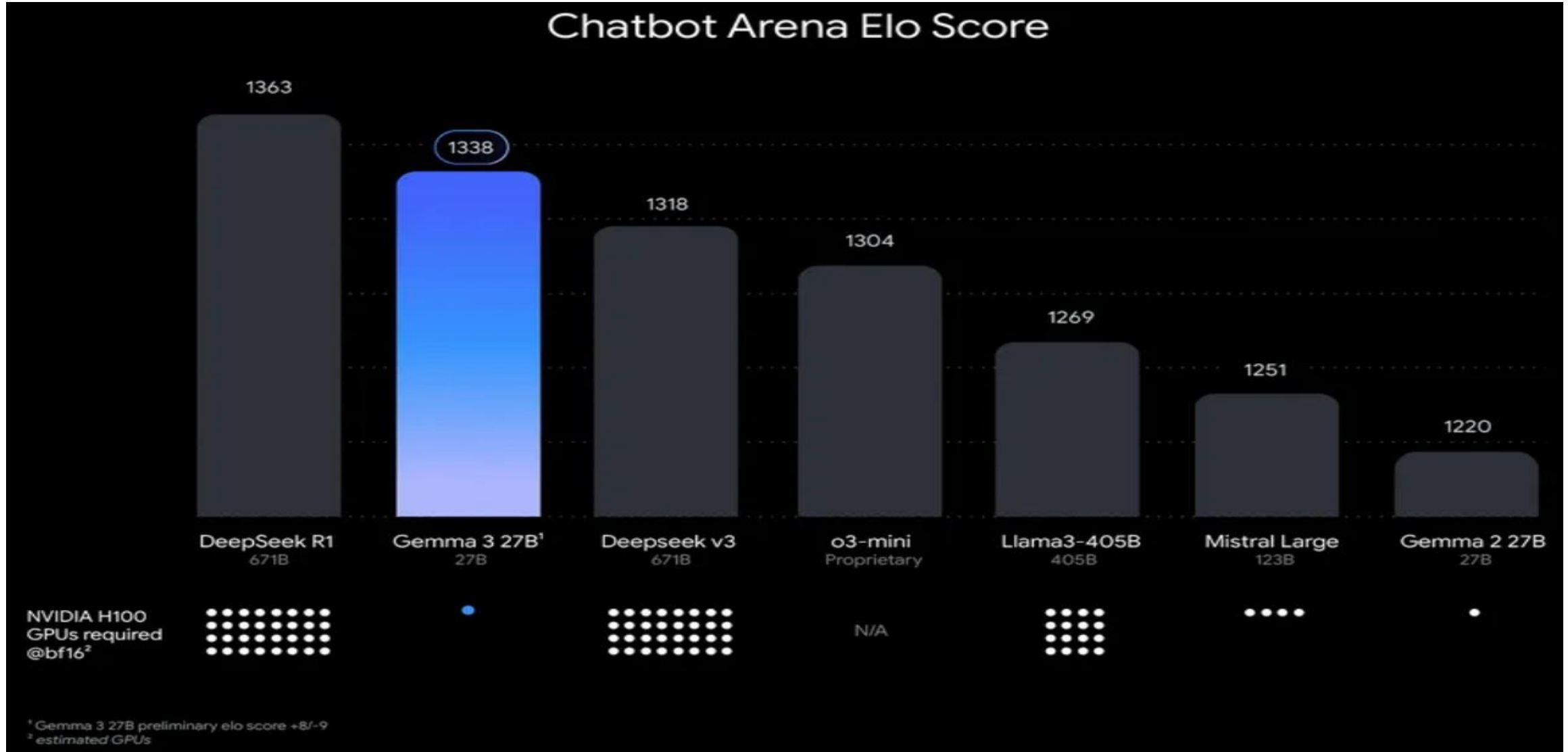
Artificial Analysis Intelligence Index v3.0 incorporates 10 evaluations: MMLU-Pro, GPQA Diamond, Humanity's Last Exam, LiveCodeBench, SciCode, AIME 2025, IFBench, AA-LCR, Terminal-Bench Hard,  $\tau^2$ -Bench Telecom

Alibaba Anthropic DeepSeek Google LG AI Research Meta Mistral Moonshot AI OpenAI Upstage xAI Z AI



# Google Gemma 3 27B

The most capable model you can run on a single GPU or TPU

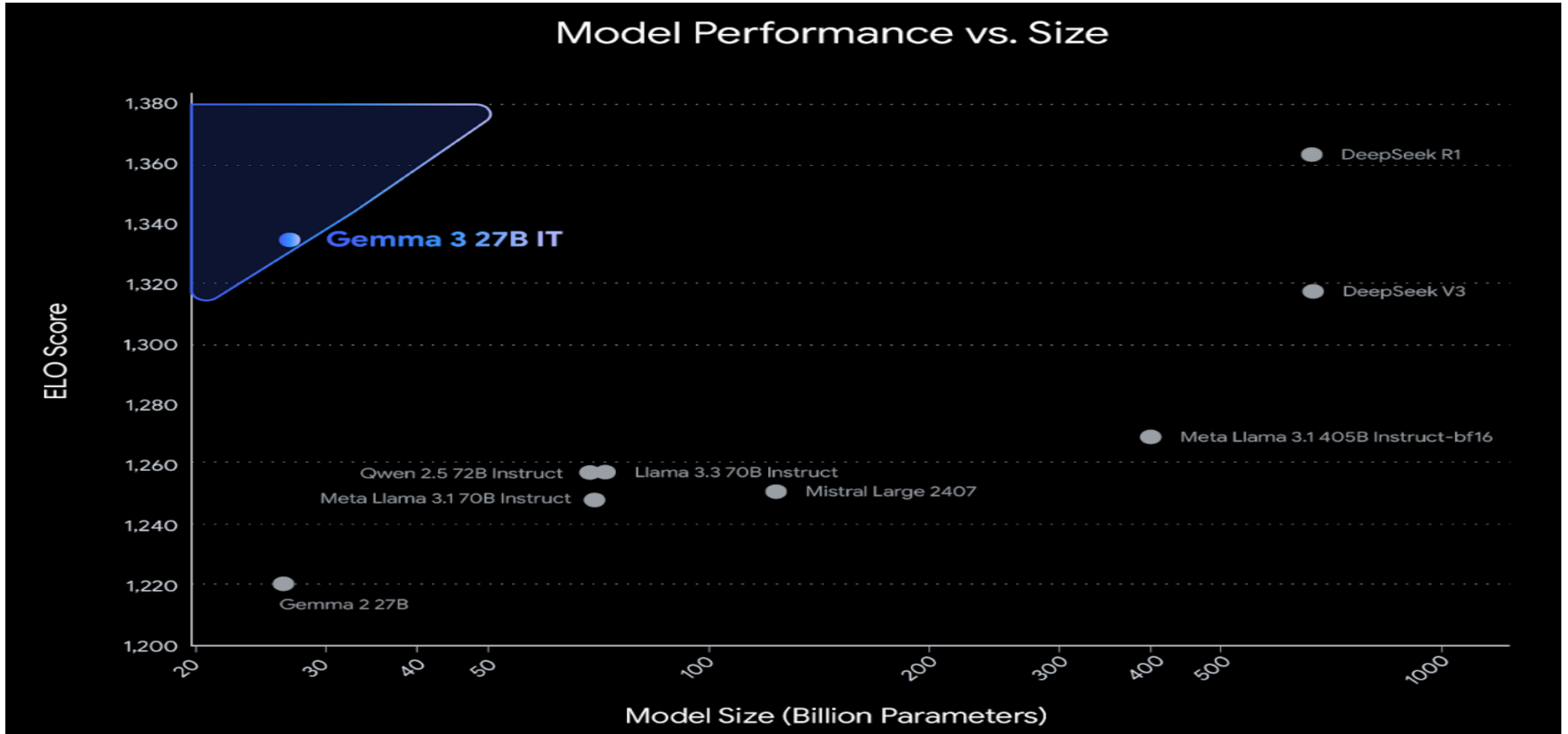


# Google Gemma 3 Multimodality (vision-language input and text outputs)

MODEL	SIZE (in billion parameter)	CONTEXT LENGTH	LANGUAGES	INPUT MODALITIES
Gemma 3 1B (IT)	1B	32k	English	Input: Text Output: Text
Gemma 3 4B (IT)	4B	128k	+140 Languages	Input: Text, Image Output: Text
Gemma 3 12B (IT)	12B	128k	+140 Languages	Input: Text, Image Output: Text
Gemma 3 27B (IT)	27B	128k	+140 Languages	Input: Text, Image Output: Text
Shield Gemma 2	4B	8k	+140 Languages	Input: Text, Image Output: Text

Source: <https://developers.googleblog.com/en/introducing-gemma3/>

# Google Gemma 3: Pre-training and Post-training (distillation, reinforcement learning, and model merging)



# Google AI Studio (Gemma 3 27B)

The screenshot displays the Google AI Studio web interface. The top navigation bar includes the 'Google AI Studio' logo, a breadcrumb trail 'Generative AI: A Comprehensive Overview', and utility links for 'Enable Autosave', 'Compare', 'Open in Kaggle', and 'Open in Vertex AI'. A user profile icon is in the top right.

The left sidebar contains navigation options: 'Get API key', 'Create Prompt', 'Stream Realtime', 'Starter Apps', 'Tune a Model', 'Library', 'Enable chat history', 'Prompt Gallery', 'Developer documentation', 'Developer forum', 'Changelog', and 'Settings'.


The main content area features an article titled 'Generative AI: A Deep Dive'. The article text states: 'Generative AI is one of the most exciting and rapidly evolving fields in artificial intelligence right now. Here's a comprehensive overview, covering what it is, how it works, its types, applications, limitations, and future trends:'. The first section, '1. What is Generative AI?', defines it as machine learning models that 'create new content' (text, images, audio, video, code) resembling training data. It contrasts this with traditional AI that 'analyzes or acts on existing data'. A 'Key Characteristics' list follows:





- **Learns Patterns:** Generative AI models learn the underlying patterns and structures within a dataset.
- **Generates Novel Content:** They use this learned knowledge to create new, original content that wasn't explicitly present in the training data.
- **Probabilistic:** Generation isn't deterministic. The models predict probabilities, leading to variations in output even with the same input.
- **Requires Large Datasets:** Effective generative AI typically needs massive amounts of data for training.

The right sidebar shows the 'Run settings' panel with a 'Get code' button, a 'Model' dropdown set to 'Gemma 3 27B', a 'Token count' of '1,760 / 131,072', a 'Temperature' slider set to '1', and an 'Advanced settings' section with 'Safety settings' (including an 'Edit safety settings' link) and an 'Add stop sequence' button.


At the bottom, there is a text input field with the placeholder 'Type something', a 'Run' button, and a 'Settings' icon.


# Grok 3 Deep Search








Generative AI

 **Completed**  
49s · 71 Sources

 Thinking


 **Exploring user intent**


 Researching recent developments


 Investigating healthcare applications


### Exploring user intent


- The request is "Generative AI," which feels a bit unclear. It could be asking for a definition, recent updates, or use cases.


 Searching for **"definition of generative AI"**


 10 results found

 **Generative artificial intelligence - Wikipedia** [en.wikipedia.org](https://en.wikipedia.org)


 **Generative AI – What is it and How Does it Work? | NVIDIA** [nvidia.com](https://nvidia.com)

 **What is generative AI? - IBM Research** [research.ibm.com](https://research.ibm.com)

 **What is Generative AI? - Gen AI Explained - AWS** [aws.amazon.com](https://aws.amazon.com)




 **Explained: Generative AI | MIT News | Massachusetts I...** [news.mit.edu](https://news.mit.edu)



See more (5)

 Browsing results


- Currently looking for a definition from the search results, including sources like Wikipedia and IBM. Generative AI creates

How can Grok help?

  DeepSearch  Think

Grok 3  

# Perplexity.ai Deep Research

 perplexity

New Thread

Home

Discover

Spaces

Library

Generative AI

Deep Research

Images

Sources 39

54 steps

linkedin

The Future of Generative AI: Key Trends and Opportunities in...

ciklum

Top 10 GenAI Trends to Watch in Technology 2025 and Beyond

research.aimultiple

Top 100+ Generative AI Applications with Real-Life...

+36 sources

## Generative AI: Current State, Applications, and Future Trends in 2025

Generative AI has rapidly evolved into a transformative technology, revolutionizing content creation, business operations, and digital interactions across industries. As of early 2025, this technology has moved beyond experimental phases into mainstream adoption, with McKinsey reporting that 65% of organizations now regularly use generative AI, demonstrating its growing significance in the business landscape 4 .

### Understanding Generative AI

Generative AI refers to a sophisticated branch of artificial intelligence that employs machine

Ask follow-up

Deep Research

↑

Networks), which have enabled increasingly sophisticated applications 1 .



# Generative AI and LLMs for Sustainability and ESG Data Analytics



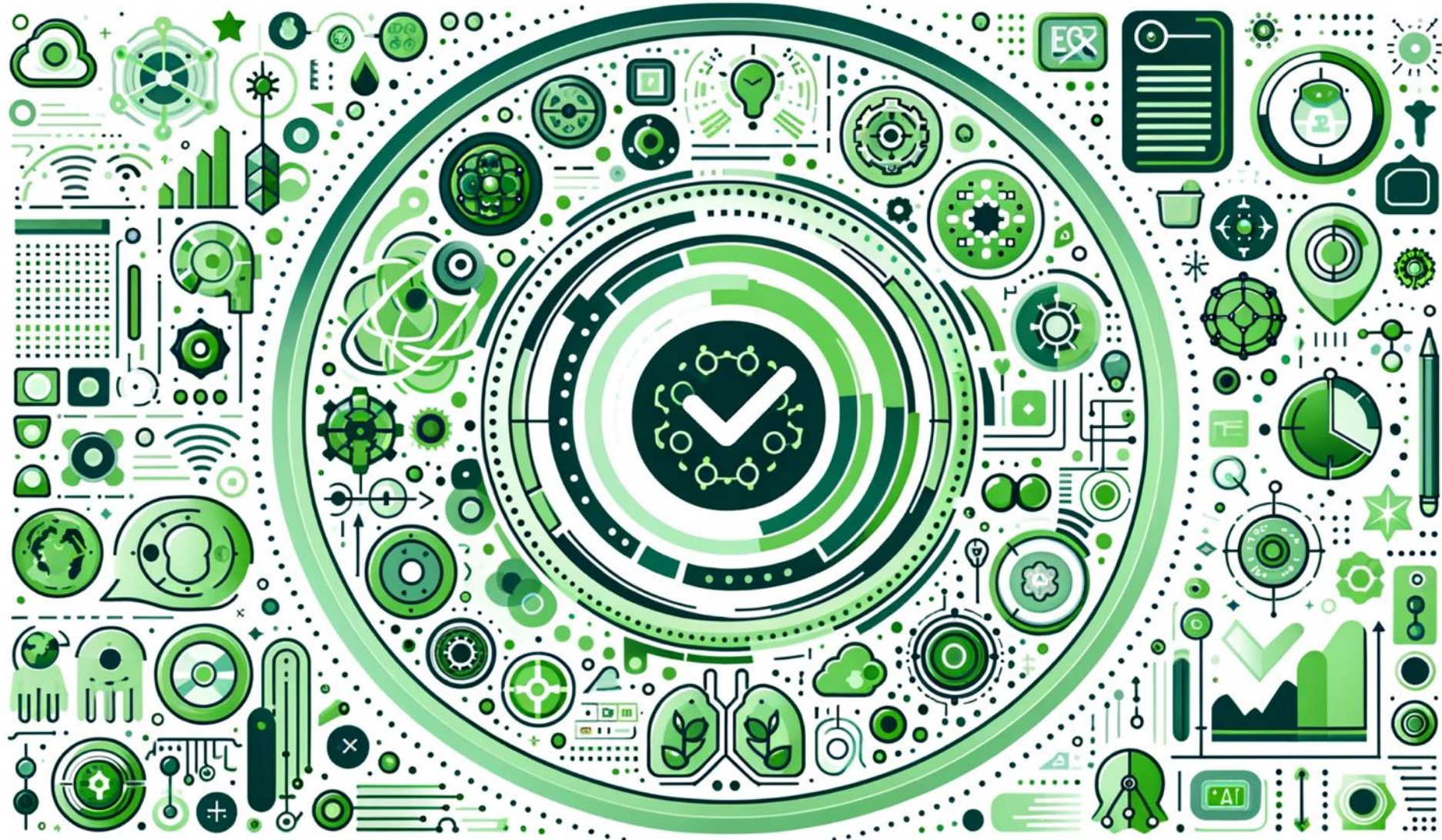


# Sustainability and ESG Data Analytics





# Generative AI for ESG Rating and Reporting Generation



# Python in Google Colab (Python101)

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

python101.ipynb - Colaboratory

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT?authuser=2#scrollTo=wsh36fLxDKC3

python101.ipynb

File Edit View Insert Runtime Tools Help

COMMENT SHARE

CODE TEXT CELL CELL

CONNECTED EDITING

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

194.87

```
[11] 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))
```

194.87

```
[12] 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))
```

194.87

```
[13] 1 # Python if else
2 score = 80
3 if score >=60 :
4     print("Pass")
5 else:
6     print("Fail").
```

Pass

<https://tinyurl.com/aintpuppython101>

# Teaching



- **Artificial Intelligence**
  - Spring 2021, Fall 2022, Fall 2024, Fall 2025
- **Sustainability and ESG Data Analytics**
  - Spring 2024, Fall 2024, Fall 2025
- **Software Engineering**
  - Fall 2020, Fall, 2021, Spring 2022, Spring 2023, Spring 2024, Spring 2025
- **Generative AI Innovative Applications**
  - Spring 2025
- **Artificial Intelligence in Finance and Quantitative**
  - Fall 2021, Fall 2022, Fall 2023, Spring 2025
- **Big Data Analytics**
  - Fall 2020, Spring 2023, Spring 2024
- **Artificial Intelligence for Text Analytics**
  - Spring 2022, Fall 2023
- **Python for Accounting Applications**
  - Fall 2023, Fall 2024, ,Fall 2025
- **Foundation of Business Cloud Computing**
  - Spring 2021, Spring 2022, Spring 2023, Spring 2024



# Research Projects



- 1. Generative AI Multi-Agent Systems with LLM-Based RAG for ESG Reporting Automation**
  - NSTC (E4104), NSTC 114-2221-E-305-002-, 2025/08/01~2026/07/31
- 2. Innovative Agentic AI Technology for Autonomous ESG Report Generation**
  - Industrial Technology Research Institute (ITRI), Fintech and Green Finance Center (FGFC, NTPU), NTPU-114A513E01, 2025/03/01~2025/12/31
- 3. Digital Support, Unimpeded Communication: The Development, Support and Promotion of AI-assisted Communication Assistive Devices for Speech Impairment(3/3), Sub-project 3: Multimodal Cross-lingual Task-Oriented Dialogue System for Inclusive Communication Support,**
  - NSTC (HZZ22), NSTC 114-2425-H-305-003-, 3 Years (2023/05/01-2026/04/30) Year 3: 2025/05/01~2026/04/30
- 4. Research on speech processing, synthesis, recognition, and sentence construction of people with language disabilities, Sub-project 3: Multimodal Cross-lingual Task-Oriented Dialogue System**
  - NTPU, 114-NTPU\_ORDA-F-004, 3 Years (2023/01/01-2025/12/31) Year 3: 2025/01/01~2025/12/31
- 5. Development of a Deep Learning for Dental Implant Detection in Panoramic Radiographs,**
  - University System of Taipei Joint Research Program (NTPU, TMU), USTP-NTPU-TMU-114-02, 2025/01/01~2025/12/31

# 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



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