HKUSPACE
香港大學專業進修學院
HKU School of Professional and Continuing Education

Business Process Automation with VBA and Python

Mr. Eddie Chow / 5 July 2025

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- Introduction to project management for business process automation
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- Final Group Presentation

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Lecturer Biography

https://www.linkedin.com/in/eddie-chow-a3860464/

- Founder of InnoVi, Co-founder of 4 companies, covering from property, retail, education and ESG
- 19+ Years' programming experience, including 7 Years' IT Management Experience
- 7 years' teaching experience in tertiary education
- 10+ years' coaching or mentoring experience on large project development. .
- Development experience on blockchain, computer vision, machine learning/deep learning
- Researcher in Cutting-edge AI Research, particular in area in Computer vision
- AI Tech Speaker, AI Mentor
- Personal Website : eddiecityu.github.io

Assessment

- **Continuous Assessment**

  In-class discussions and computer assignments which include the usage of different applications & methodologies

- **Final Assessment**

  20-mins (3 persons) group project presentation which integrate knowledge in this module, apply different AI methodologies and software to business applications of process automation

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- What is Process Automation, RPA, IPA?
- Overview of the technological building blocks related to process automation
- Contemporary tools for process automation
- Challenges and opportunities of business process automation
- Business implications of process automation

Intended Learning Outcomes

1. describe the contemporary trends of process automation and explain the opportunities and challenges of business process automation;
2. outline key steps in process automation project management and illustrate the significance of each step;
3. apply computational tools to implement process automation;
4. discuss the development of process automation and practical cases for business.

Assessment

Memory Test?

- NO Midterm / Final exams

Essays?

- NO research paper
- NO project report

Practical Work!

- 2 in-class coding exercises
- 1 Group Project

Taking Exams

Building Solutions

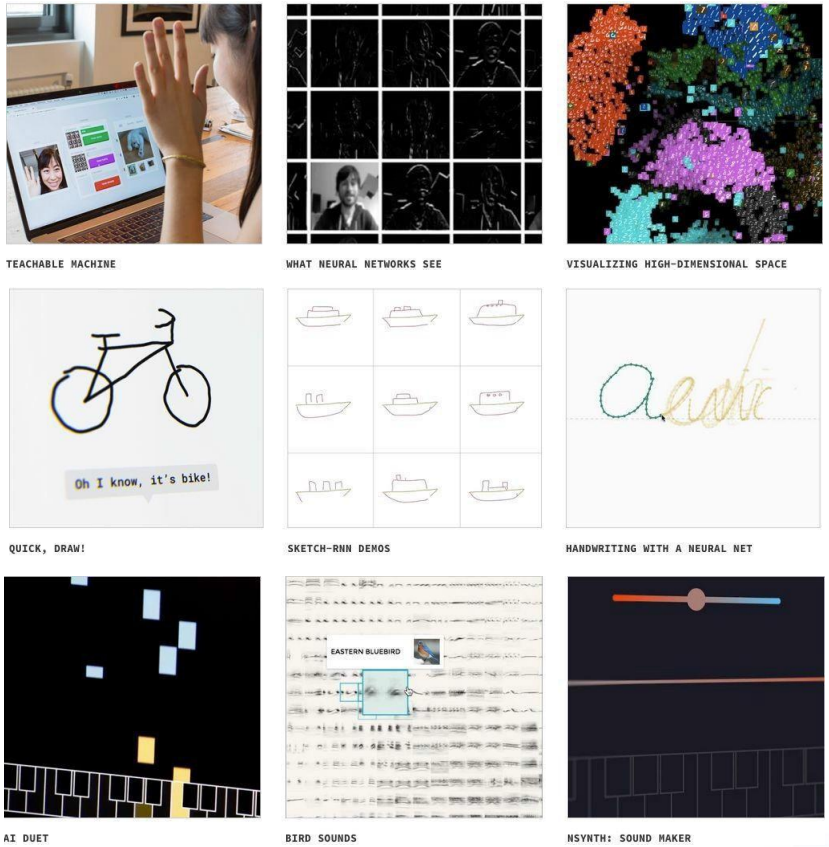
Lecture 1 - Business Process Automation with VBA and Python

Business Case Studies: Artificial Intelligence

Artificial Intelligence

Common Use Cases:

Object Detection
Speech Recognition
Natural Language Processing
Translation between languages
Creativity - Style Transfer
Art Restoration



Machine Learning Business Use Case

Face Recognition Algorithm

Machine Learning Business Use Case

Hotel Recommendation Engine

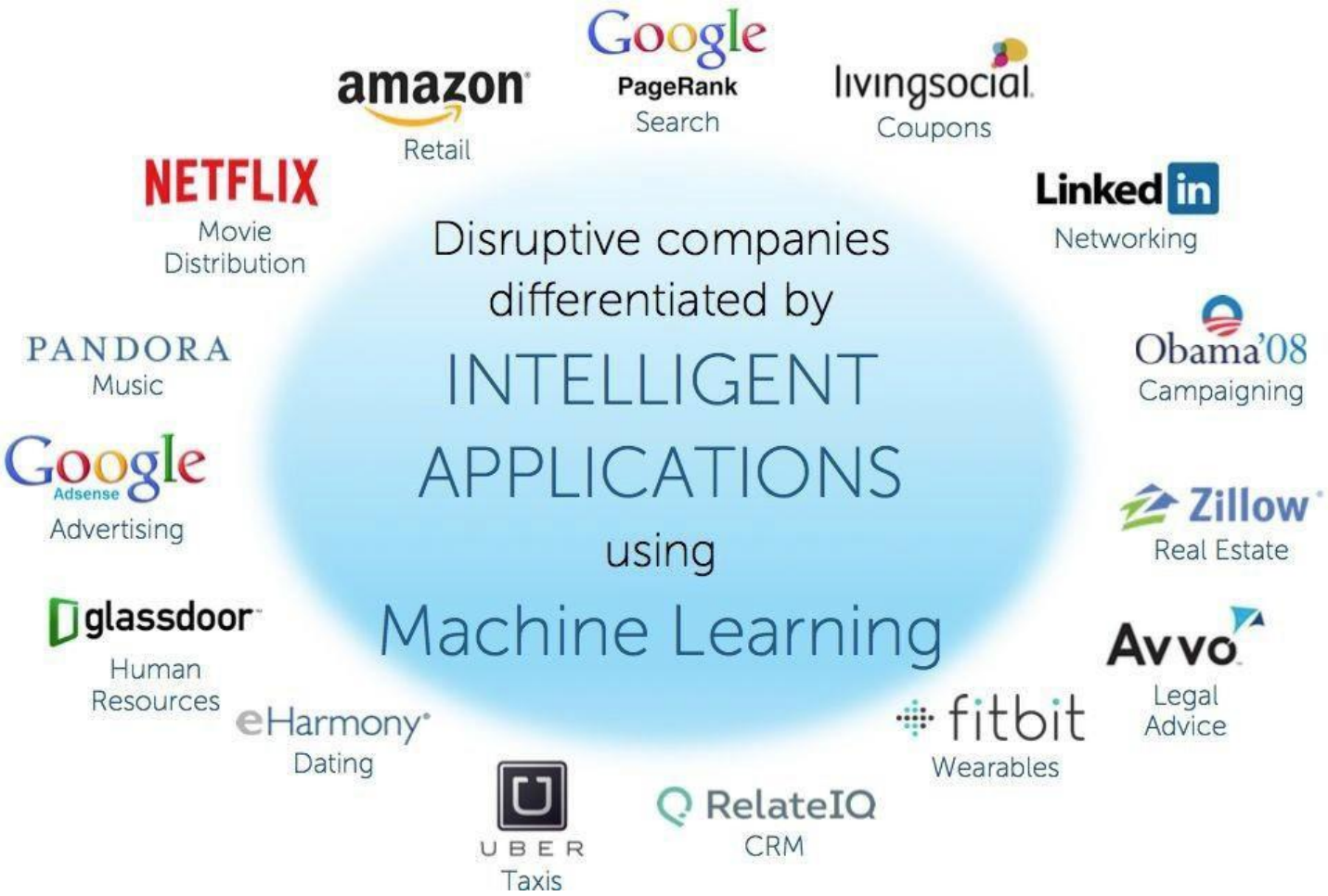
Shifting mindsets of customers: From Products To Relationships

Products 1970s

Customer Centric

Relationship Centric Today

The new disruptors



These companies applied analytics to stay 1 step ahead of the competition

AI Features in Retail

- Chatbots, Virtual Assistants
- Facial Recognition
- Demographic Segmentation
- Facial Personality Analytics
- AI-enabled Customer Analytics
- Real-time insights
- Personalization
- Inventory Management
- Visual Recognition
- Customer Purchase Prediction
- Trend Prediction
- Purchasing Recommendation
- Ideal Price Point Recommendation
- Predict the trends in Fashion, e-commerce, etc
- Predictive Analysis
- Predictive Personalization

NLP in real life

- Machine Translation
  - Google Translate translates language from one language to another.
- Text Simplification
  - Rewordify simplifies the meaning of sentences.
- Sentiment Analysis
  - Hater News gives us the sentiment of the user.
- Text Summarization
  - Smmry or Reddit's autotldr gives a summary of sentences.
- Auto-Predict
  - Google Search predicts user search results.
- Auto-Correct
  - Google Keyboard and Grammarly correct words otherwise spelled wrong.
- Speech Recognition
  - Google WebSpeech or Vocalware.
- Question Answering
  - IBM Watson's answers to a query.
- Natural Language Generation
  - Generation of text from image or video data

Cases : Facial recognition for customer analytics

Face Detection

Reliably detect human faces in a photo, along with their coordinates and sizes.

Emotions, Gender, Age

Recognize people's facial expressions and detects primary and secondary emotions. Also detects age and gender

https://findface.pro/en/solutions/face-recognition-for-customer-analytics.html

What is Business Automation?

From ChatGPT…

JA

What is business automation? asking for a friend :)

Business automation refers to the process of using technology to automate repetitive or routine tasks and processes within a business, such as data entry, invoicing, and inventory management. It can also involve the integration of various software applications and systems to streamline workflows and improve overall efficiency.

Types of Business Automation

1. Basic Automation
2. Process Automation
3. Advanced Automation
4. Intelligent Automation

1. *The Basics of Business Automation*. (2021, May 12). The Basics of Business Automation | IBM. https://www.ibm.com/cloud/blog/basics-of-business-automation

Types of Business Automation – Basic Automation

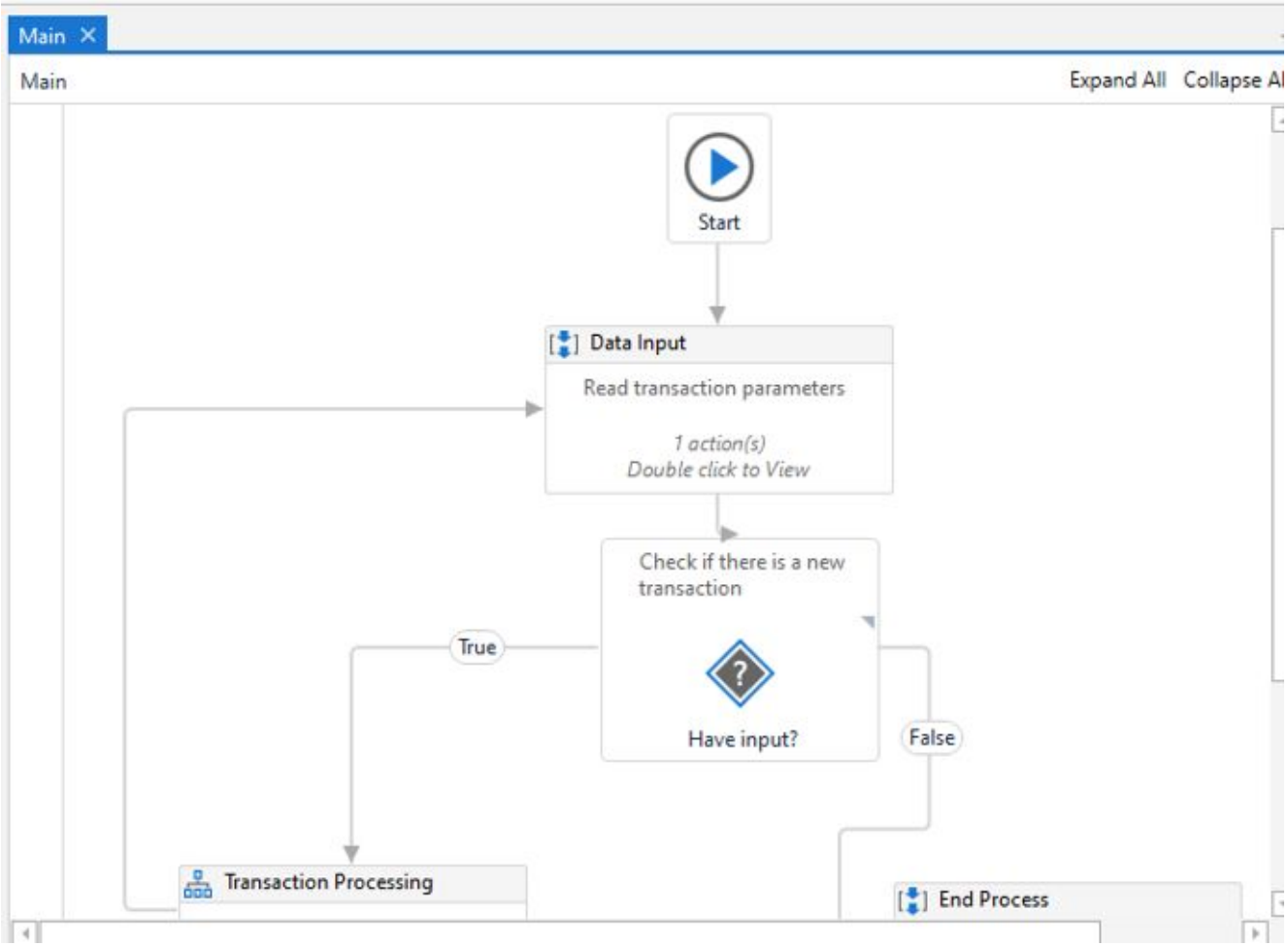
- **Target** ➔ Simple / Repetitive tasks
- **Why**
  - Eliminate human errors
  - Accelerate pace of transactional work
- **Example** ➔ Robotic Process Automation (RPA)*

* To be covered in the next section

Types of Business Automation – Process Automation

- **Target** ➔ Process requiring dedicated solutions
- **Why**
  - Increase productivity and efficiency
- **Example** ➔ Process Mining, workflow automation

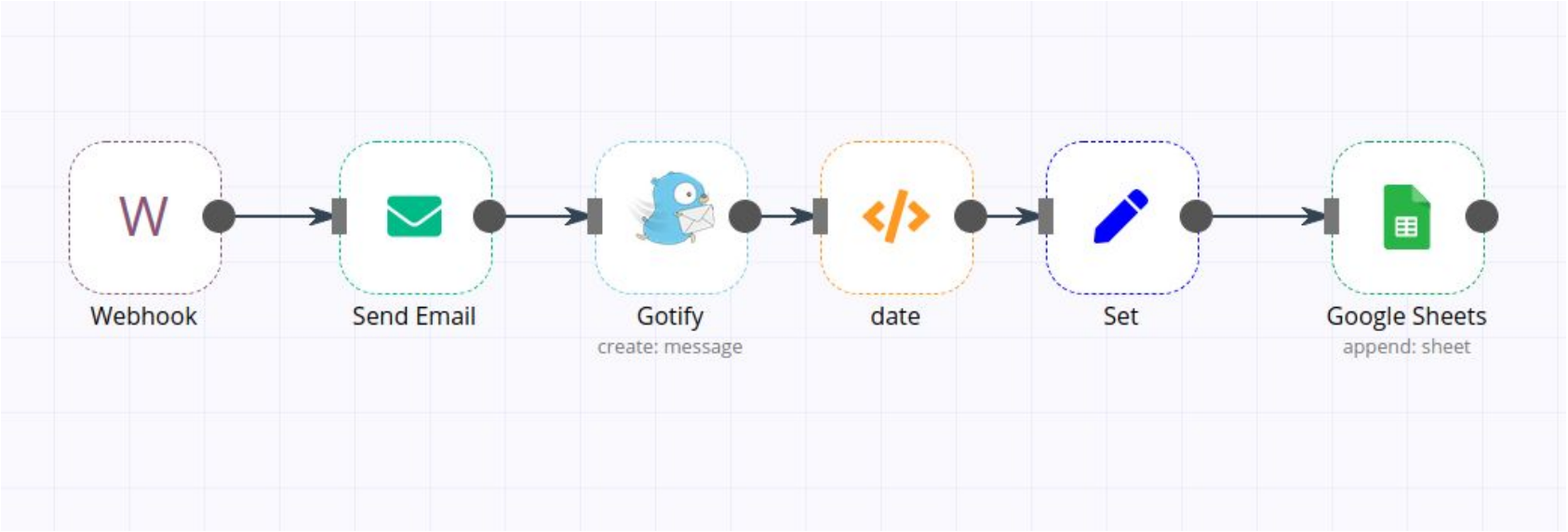
Process Automation Software Example 1 : UiPath



https://www.uipath.com/rpa/robotic-process-automation

Process Automation Software Example 2 : n8n

Simple enough to ship in hours, sophisticated enough to scale. n8n lets you automate business processes without limits on your logic.



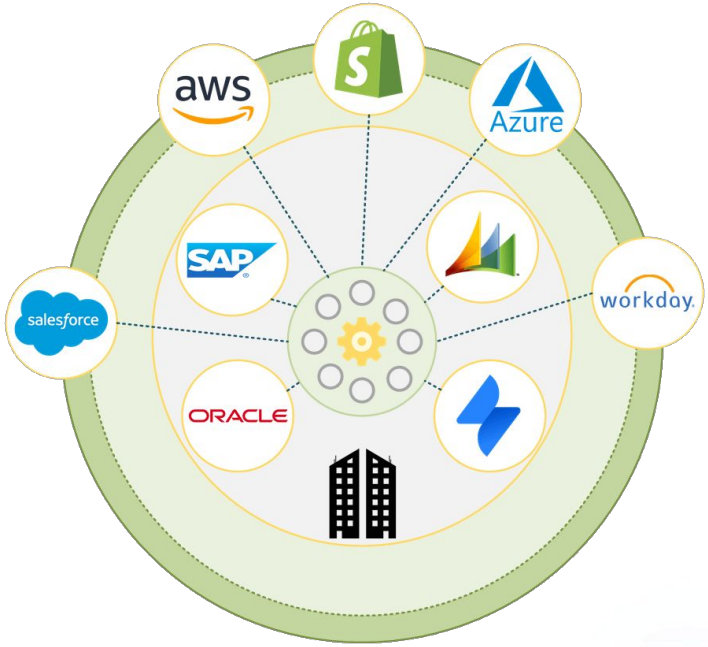
https://n8n.io/features/

Types of Business Automation – Advanced Automation

- **Target** ➔ Complex process: Multiple systems + Human
- **Why**
  - Handles unstructured data / methods of access
- **Example** ➔ Machine learning, natural language processing

Advanced Automation : System Integration

https://fitsmallbusiness.com/crm-integration/



https://iwconnect.com/making-multiple-systems-work-as-one-through-integration/

Types of Business Automation - Intelligent Automation

- **Target** ➔ Processes requiring AI/customized decisions
- **Why**
  - Smarter interactions, personalization
- **Example** ➔ Voice-based interfaces

Types of Business Automation - Checkpoint

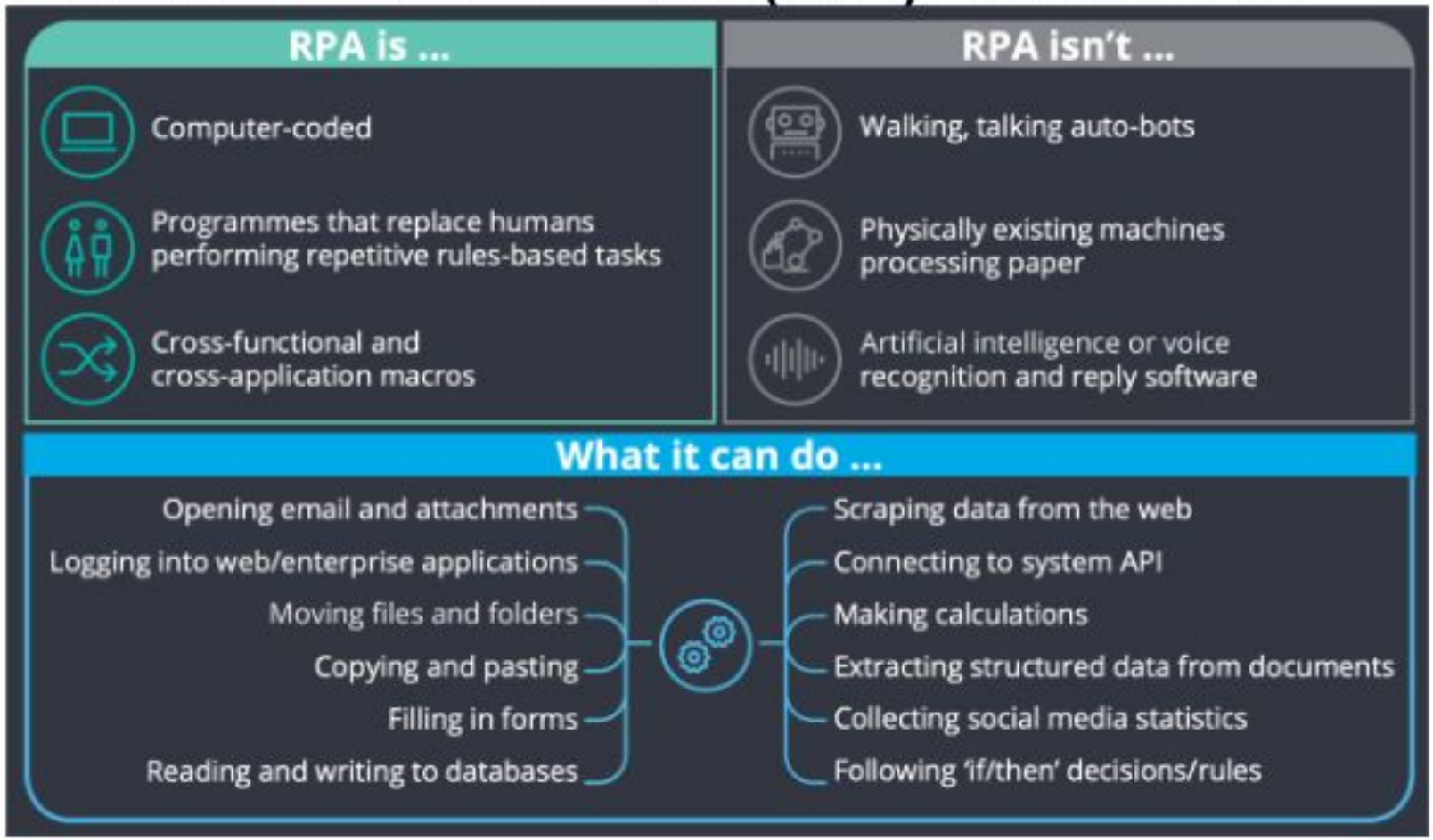
1. Daily email template to enter Market commentary
2. HR time off workflow
3. Online supermarket order processing
4. Voice-automated credit card hotline

Robotic Process Automation (RPA) - Introduction

- Rule-based software
- Automating high-volume activities
- Free up human workers (for more meaningful tasks)

1. *What is Robotic Process Automation (RPA)? | IBM*. What Is Robotic Process Automation (RPA)? | IBM. https://www.ibm.com/topics/rpa

Robotic Process Automation (RPA) - Introduction



1. Deloitte. (2018). *The robots are ready. Are you?* https://www2.deloitte.com/content/dam/Deloitte/tr/Documents/technology/deloitte-robots-are-ready.pdf

Robotic Process Automation (RPA) - Components

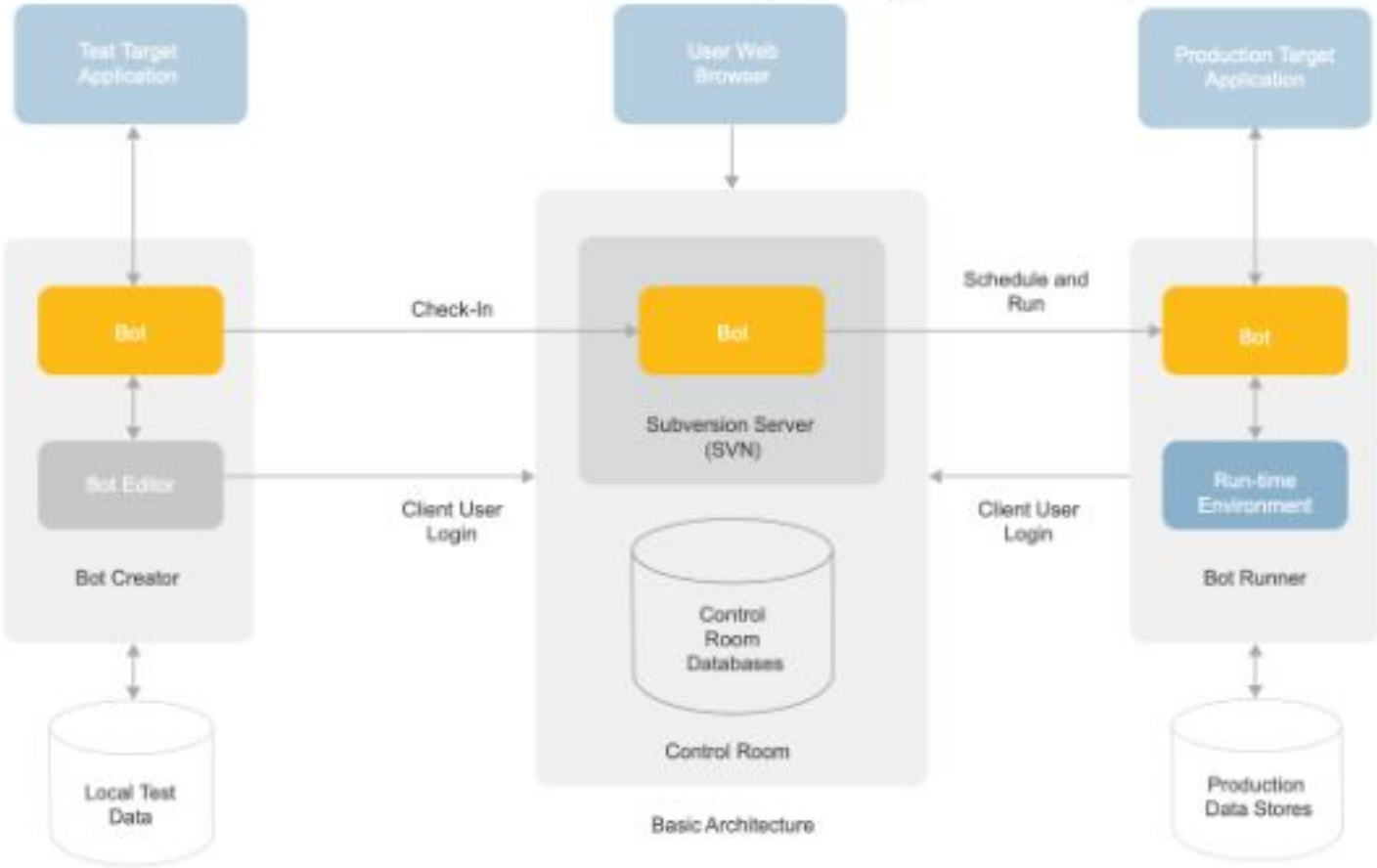
- **Bot modeling**
  - Bot Creator ➔ development/ testing
  - Bot Runner ➔ execution of tested codes in production
- **Control Room**
  - Deployment / Scheduler
  - Audit trails
  - Performance Analytics
  - Role-based access control

blueprism

AUTOMATION ANYWHERE
Go be great.

UiPath™

Robotic Process Automation (RPA) - Components



1. Automation Anywhere. *Enterprise-class Security for Robotic Process Automation*. https://www.automationanywhere.com/sites/default/files/internal-assets/uberflip/security-whitepaper_en.pdf

Intelligent Process Automation (IPA)

- Using Artificial Intelligence (AI), e.g.,
  - Machine Learning (ML)
  - Natural Language Processing (NLP)
- Enhancing cognitive ability of the automation

Intelligent Process Automation (IPA)

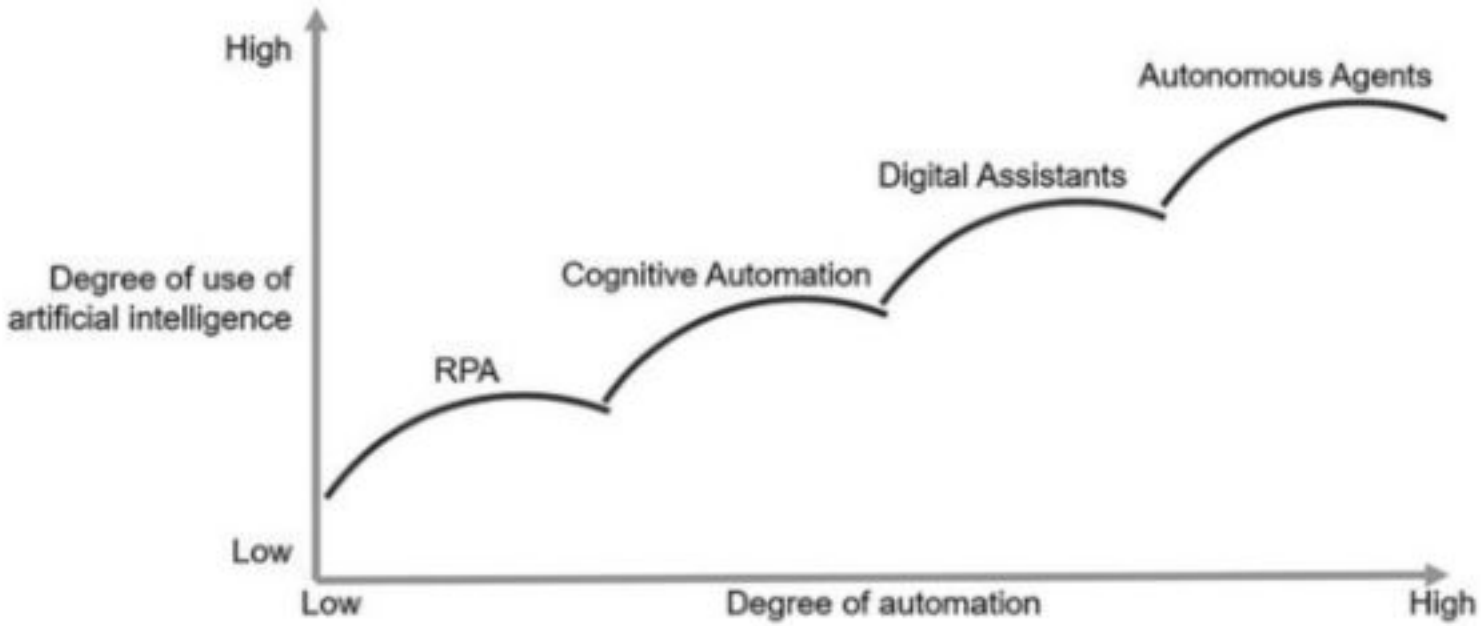
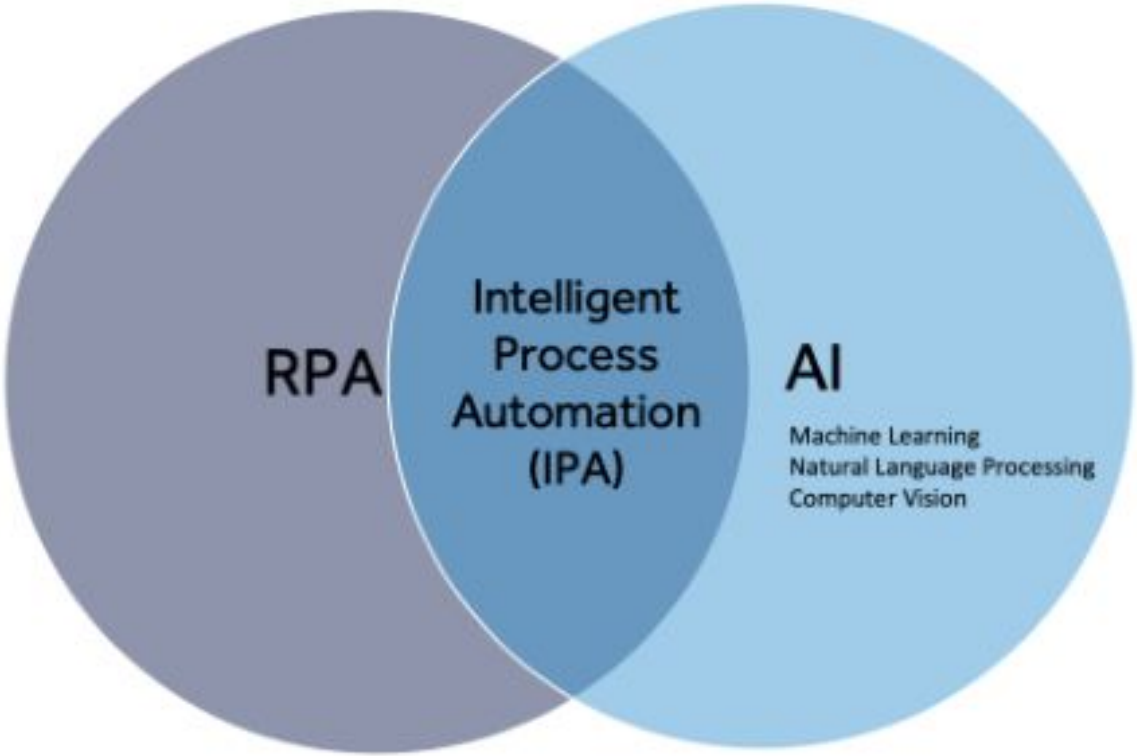


Fig. 2.2 Classification of RPA according to the degree of automation and the use of artificial intelligence (based on Ostrowicz 2018, p. 4)

1. Smeets, M., Erhard, R., & Kaußler, T. (2021, July 30). *Robotic Process Automation (RPA) in the Financial Sector: Technology - Implementation - Success for Decision Makers and Users*. Springer. https://doi.org/10.1007/978-3-658-32974-7

Intelligent Process Automation (IPA)

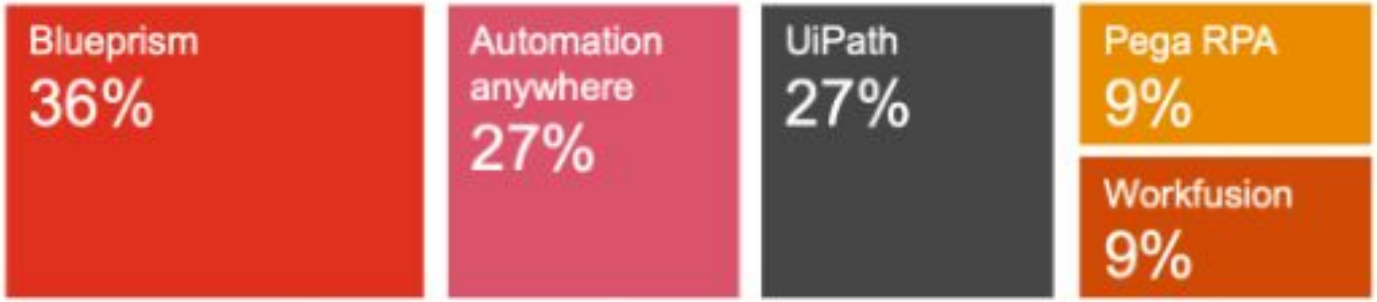


1. Kosmopoulos, C. (2021, May 11). *What is Intelligent Process Automation (IPA)? | Blueprint*. What Is Intelligent Process Automation (IPA)? | Blueprint. https://www.blueprintsys.com/blog/rpa/what-is-intelligent-process-automation-ipa

Tools for Automation - Overview

Which tool is being used ?

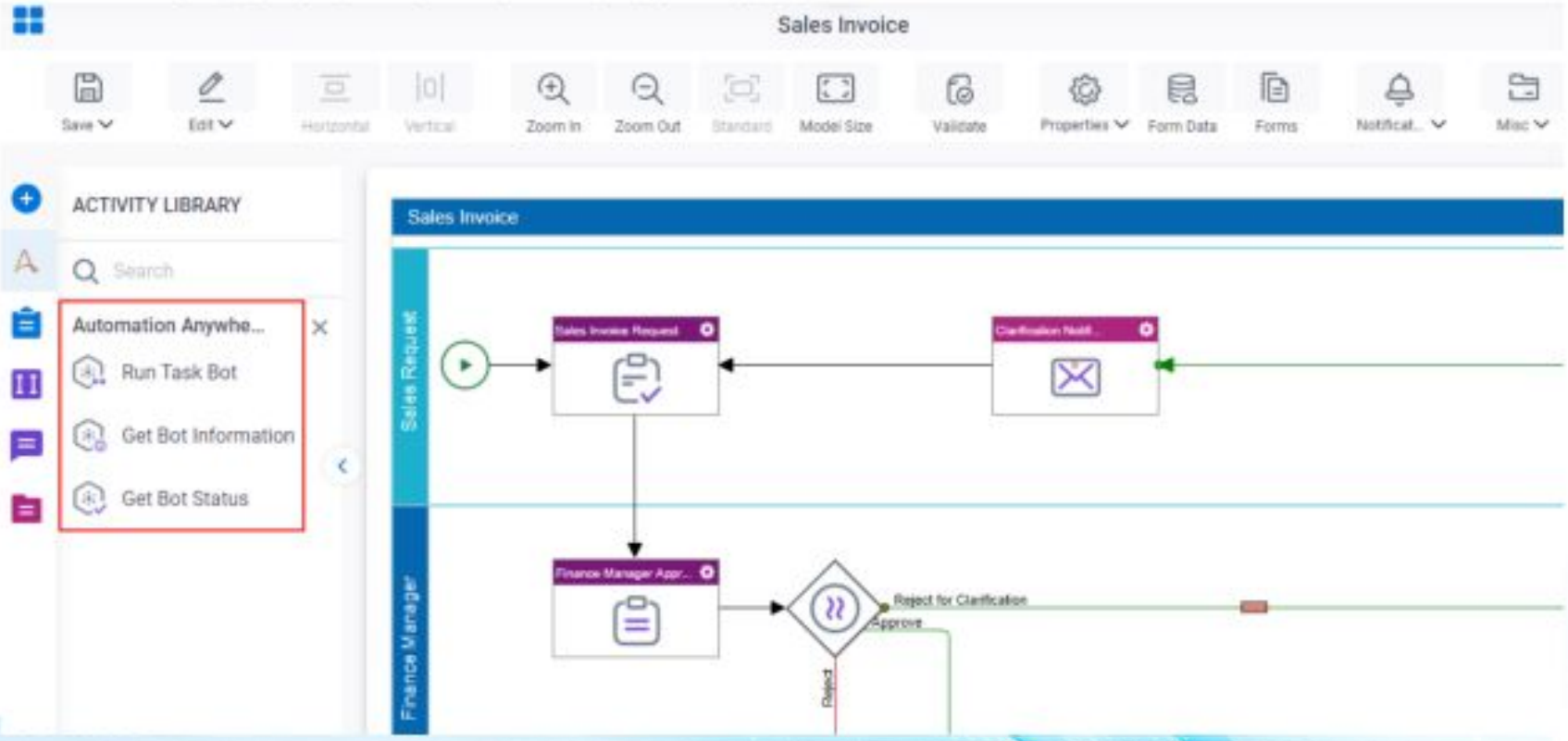
As some companies use more than one tool, the percentages in this graphic total to more than 100%



1. *2019 actuarial robotic process automation (RPA) survey report*. PwC. https://www.pwc.com/gx/en/industries/financial-services/publications/pwc-2019-actuarial-robotic-process-automation-survey-report.html

Tools for Automation - Types

- **Low-code platforms**
  - Automation Anywhere, XCEPTOR, Microsoft Power Automate



Tools for Automation - Types

- **In-house Solutions**
  - Excel VBA, Java, Python, Web

Most in-demand functional areas	In-demand technical skills and experience
Compliance	IFRS 17 Reporting and Accounting Policy
Operational Risk	RBC and Capital Reporting
Fund Accounting	IT skills (Python, C+ BASIC, C, C++, COBOL, Java, R, Tableau, SQL, VBA, and Macro)
Corporate Accounting	
Actuarial	Operational Risk, Information and IT Risk, Risk Transformation, Risk Analytics, Internal Control Framework
Finance Operations	
IT Audit	

Microsoft® Excel VBA

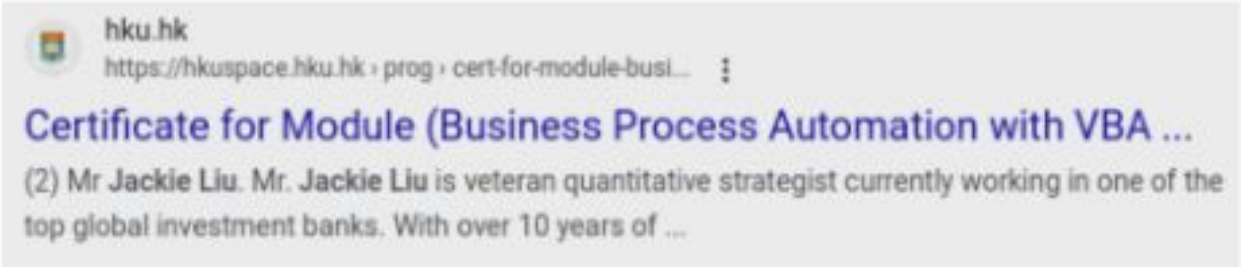
python™

1. Robert Half. *2024 Salary Guide HK.* https://content.roberthalfonline.com/SG24/SG24-PDF/2024-Salary-Guide-HK.pdf

Tools for Automation – Getting a taste

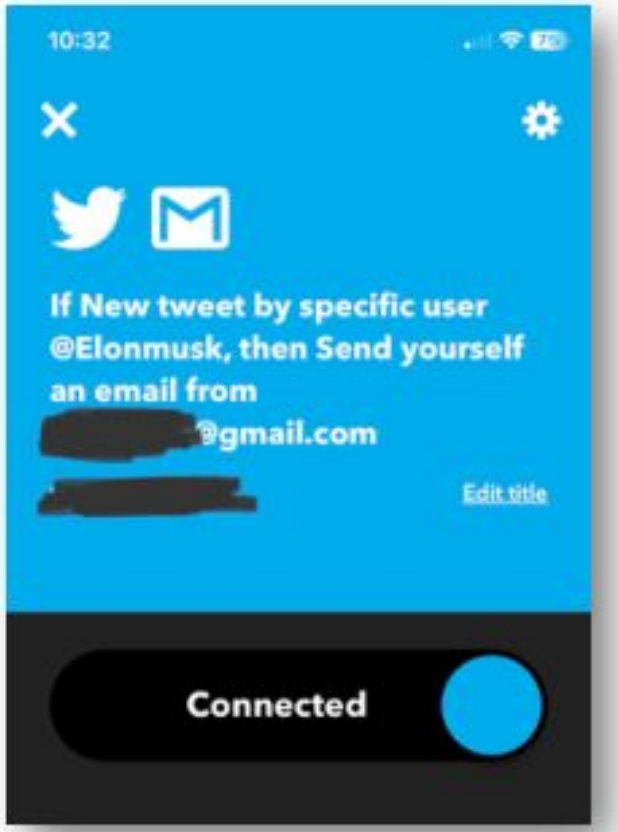
- **Visualping (https://visualping.io/)**
  - Websites monitoring

visualping



Tools for Automation – Getting a taste

- **IFTTT (https://ifttt.com/)**
  - Web + App interfaces
  - Service-based triggers and actions



Tools for Automation – Considerations

- **Cost**
  - **One-time cost**
    - Initial effort of adaptation
    - Implementation and rollout
  - **Running cost**
    - License, e.g., Power Automate: $Millions/year[1]
    - Infrastructure, e.g., Cloud storage
    - Training, e.g., Automation Anywhere, 10+ hours[2]
    - Support, e.g., bot re-configuration

1. *RPA Pricing: Comparison of Leading RPA Vendors' Fees in 2023.* https://research.aimultiple.com/rpa-pricing/
2. *RPA Course Learning Trails | Automation Anywhere University.* https://university.automationanywhere.com/training/rpa-learning-trails/

Tools for Automation – Considerations

- **Flexibility**
  - Specialized vs Generalized, e.g., XCEPTOR ➔ Tax
- **Scalability**
  - Desktop vs Enterprise, e.g., Excel VBA
  - Version Control, e.g., Use of repository
- **Time to delivery**
  - "Perfect" solution does not exist

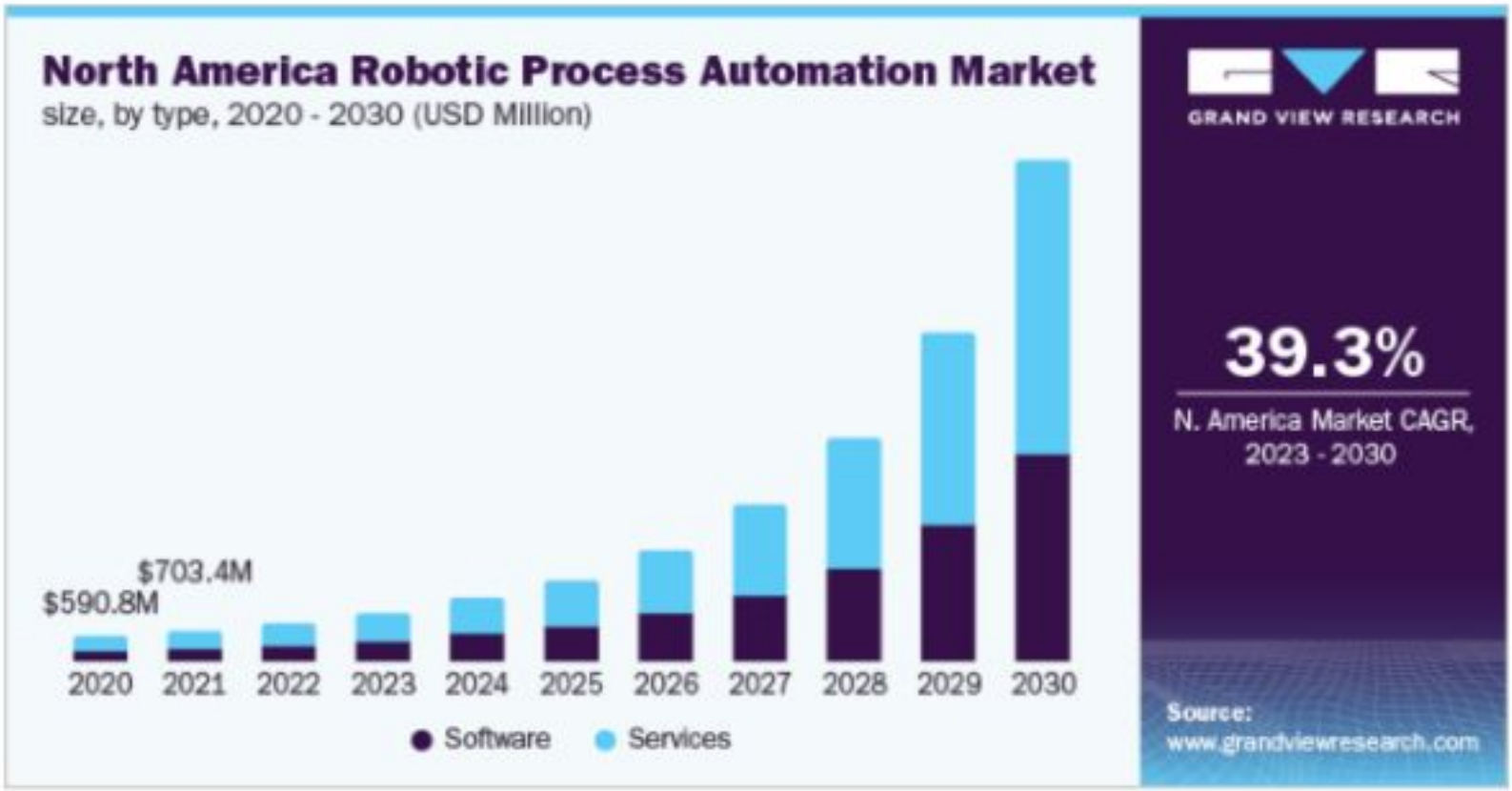
GitHub

Bitbucket

XCEPTOR

1. Smeets, M., Erhard, R., & Kaußler, T. (2021, July 30). *Robotic Process Automation (RPA) in the Financial Sector: Technology - Implementation - Success for Decision Makers and Users*. Springer. https://doi.org/10.1007/978-3-658-32974-7

Opportunities of BPA – The Money



1. *Robotic Process Automation Market Size & Share Report 2030*. Robotic Process Automation Market Size & Share Report 2030. https://www.grandviewresearch.com/industry-analysis/robotic-process-automation-rpa-market

Opportunities of BPA – Sectors

Industries	% of RPA Solutions
Banking, Financial Services & Insurance	51 %
Business Process Outsourcing (BPO)	14 %
Manufacturing – Consumer Packaged Goods (CPG)	7 %
Professional, Legal & Accountancy Services	7 %
Retail Trade	7 %
Technology (IT, Internet, SAAS)	7 %
Utilities	7 %

1. *Top 15 RPA Use Cases & Examples in Banking in 2023.* https://research.aimultiple.com/banking-rpa/

Opportunities of BPA – Sectors

- **Healthcare**
  - Monitoring, drug dispensing
- **Retail**
  - Auto-checkout, smart shelf, inventory management
- **Marketing**
  - Lead generation
  - social media management
- **Finance**
  - Fraud detection, Credit management, Regtech

Opportunities of BPA – Regtech

- **Follow the money**

CNN

Wells Fargo ordered to pay $3.7 billion for 'illegal activity' including unjust foreclosures and vehicle repossessions

The CFPB said the more than $2 billion in customer refunds Wells Fargo has been ordered to pay includes more than $1.3 billion to consumers hurt...

20 Dec 2022

Spiceworks

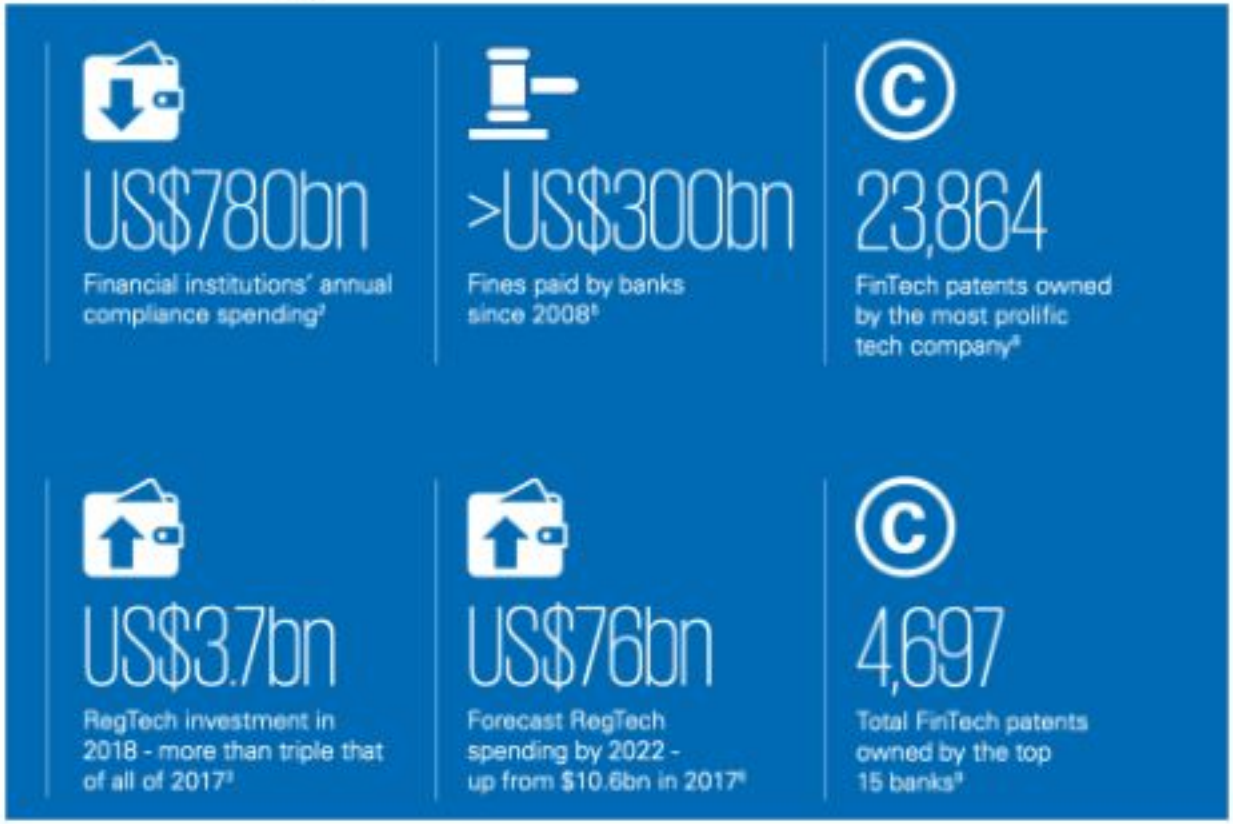
SEC Penalizes Major Wall Street Firms $1.97B For Using Unauthorized Messaging Apps

If there are allegations of wrongdoing or misconduct, we must be ... Morgan Stanley recently agreed to a $35 million fine by the SEC for...

28 Sept 2022

Opportunities of BPA – Regtech

- **Follow the money**



1. KPMG. (2019, June). *There's a revolution coming.* https://assets.kpmg.com/content/dam/kpmg/cn/pdf/en/2019/06/embracing-the-challenge-of-the-new-regtech-era.pdf

Opportunities of BPA – Regtech

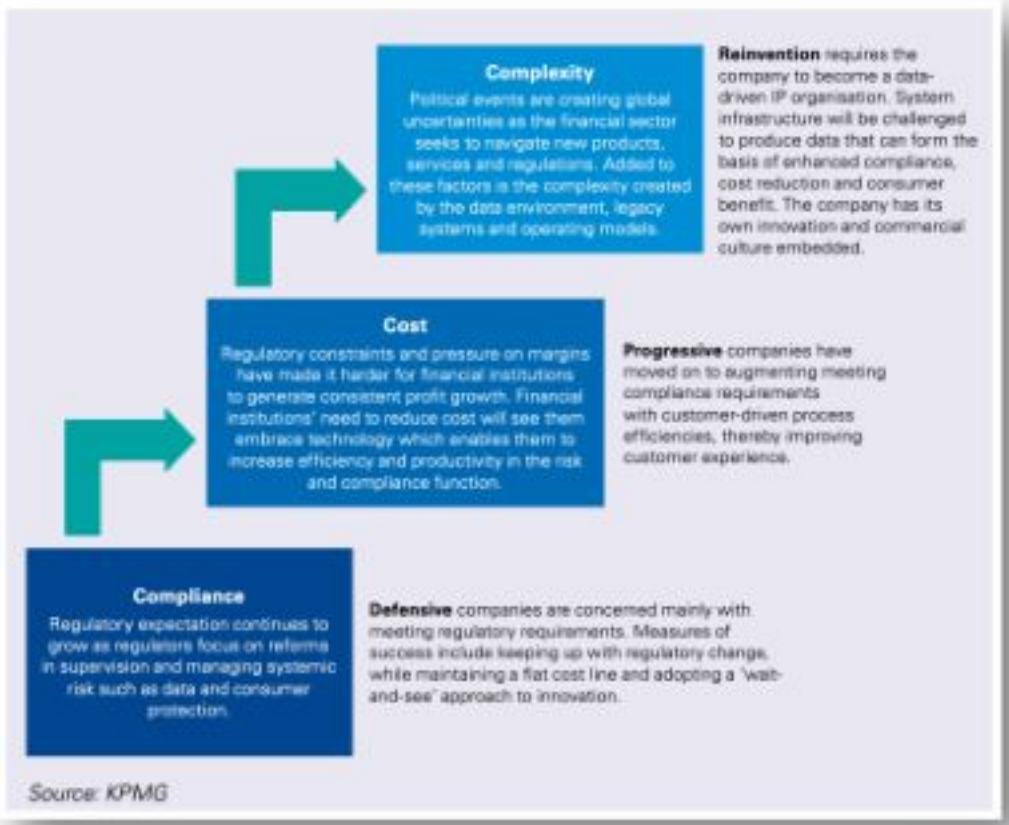
- **Common themes**

1. KPMG. (2022, November). https://assets.kpmg.com/content/dam/kpmg/uk/pdf/2022/11/innovate-finance-regtech-industry-and-adoption.pdf. https://assets.kpmg.com/content/dam/kpmg/uk/pdf/2022/11/innovate-finance-regtech-industry-and-adoption.pdf

Opportunities of BPA – Regtech

Adoption phases:

1. Defensive
2. Progressive
3. Reinvention



1. KPMG. (2019, June). *There's a revolution coming.* https://assets.kpmg.com/content/dam/kpmg/cn/pdf/en/2019/06/embracing-the-challenge-of-the-new-regtech-era.pdf

Opportunities of BPA – Regtech

- **HKMA 3-Year Roadmap**
  - **RPA**: automating rule-based processes
  - **Network Analysis**: Company holdings and exposures

Illustrative Network Analysis Solution

1. HKMA. (2021, June). *Regtech Watch Issue No. 7.* https://www.hkma.gov.hk/media/eng/doc/key-information/guidelines-and-circular/2021/20210617e1a1.pdf

Opportunities of BPA – Regtech

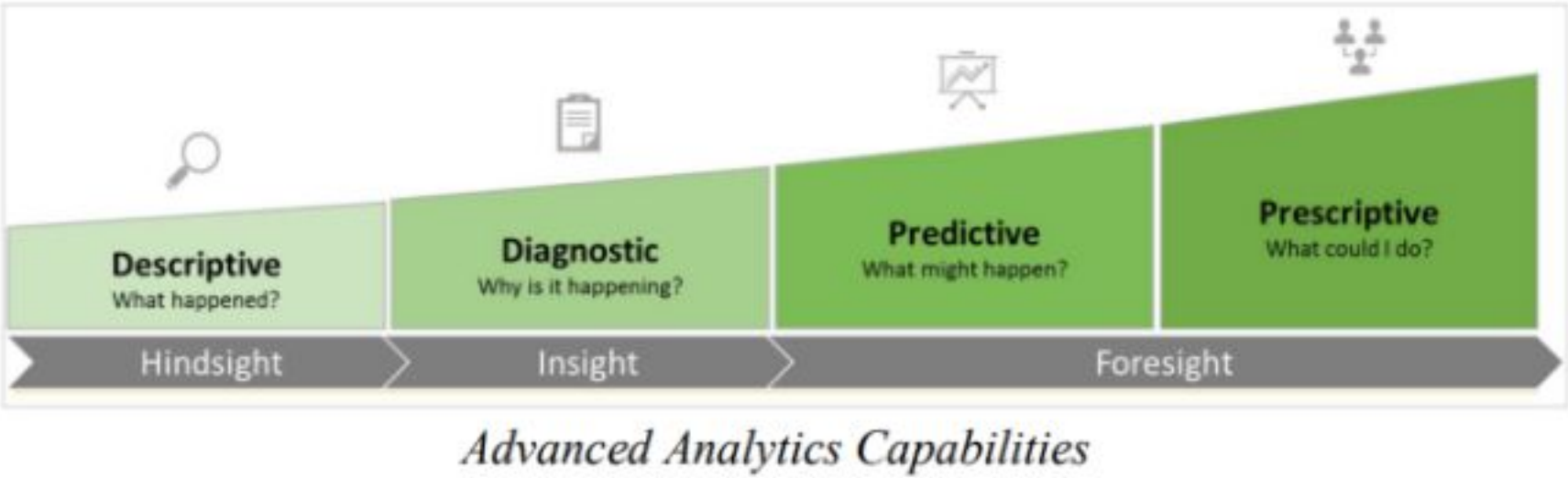
- **HKMA 3-Year Roadmap**
  - **Speech-to-text (STT):** Audio to time-stamped text
  - **Sentiment Analysis**: Realtime news monitoring

Illustrative Sentiment Analysis Heat Map

1. HKMA. (2021, June). *Regtech Watch Issue No. 7.* https://www.hkma.gov.hk/media/eng/doc/key-information/guidelines-and-circular/2021/20210617e1a1.pdf

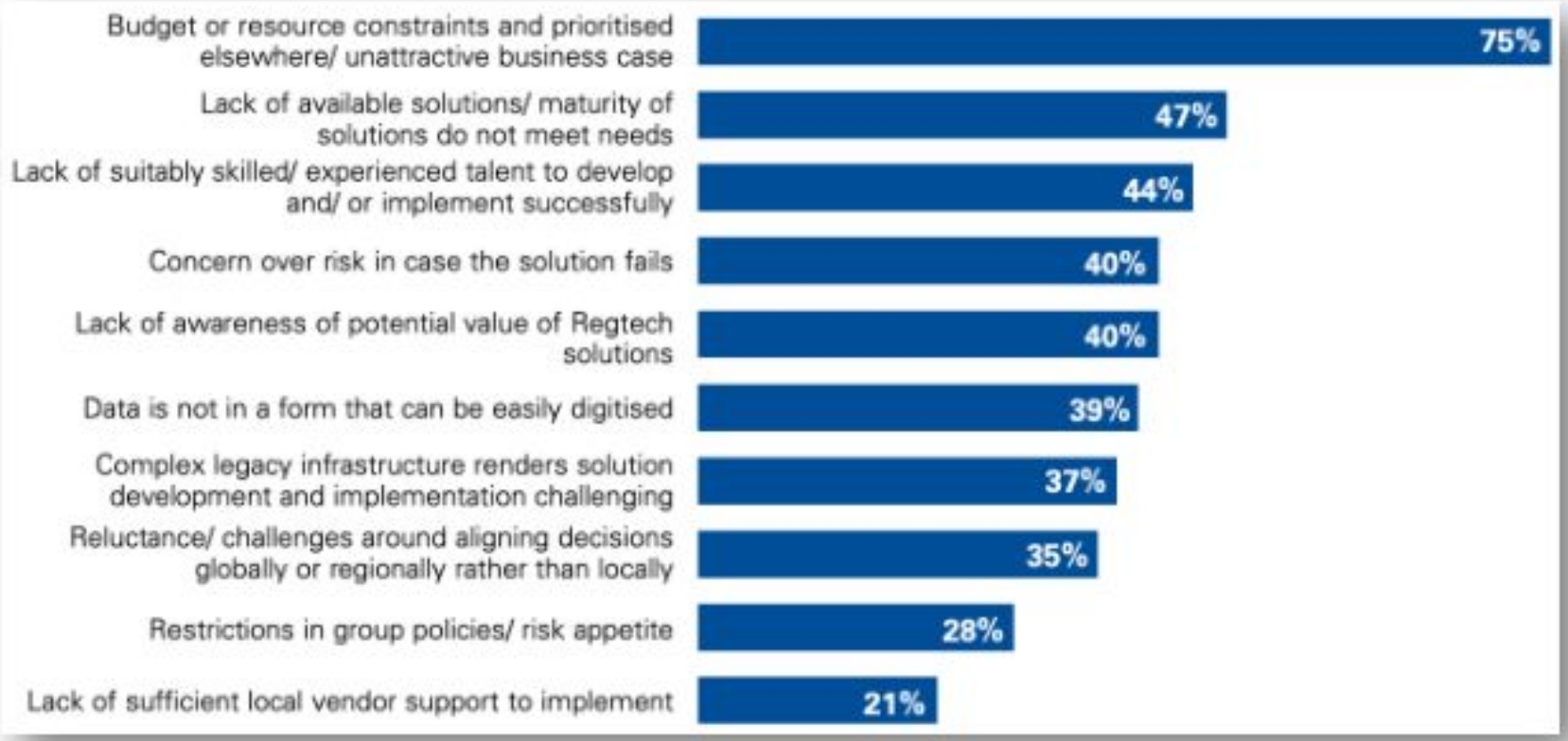
Opportunities of BPA – Regtech

- **Analytics enabled by BPA**



1. HKMA. (2021, June). *Regtech Watch Issue No. 7.* https://www.hkma.gov.hk/media/eng/doc/key-information/guidelines-and-circular/2021/20210617e1a1.pdf

Challenges of BPA – Insight from the banks

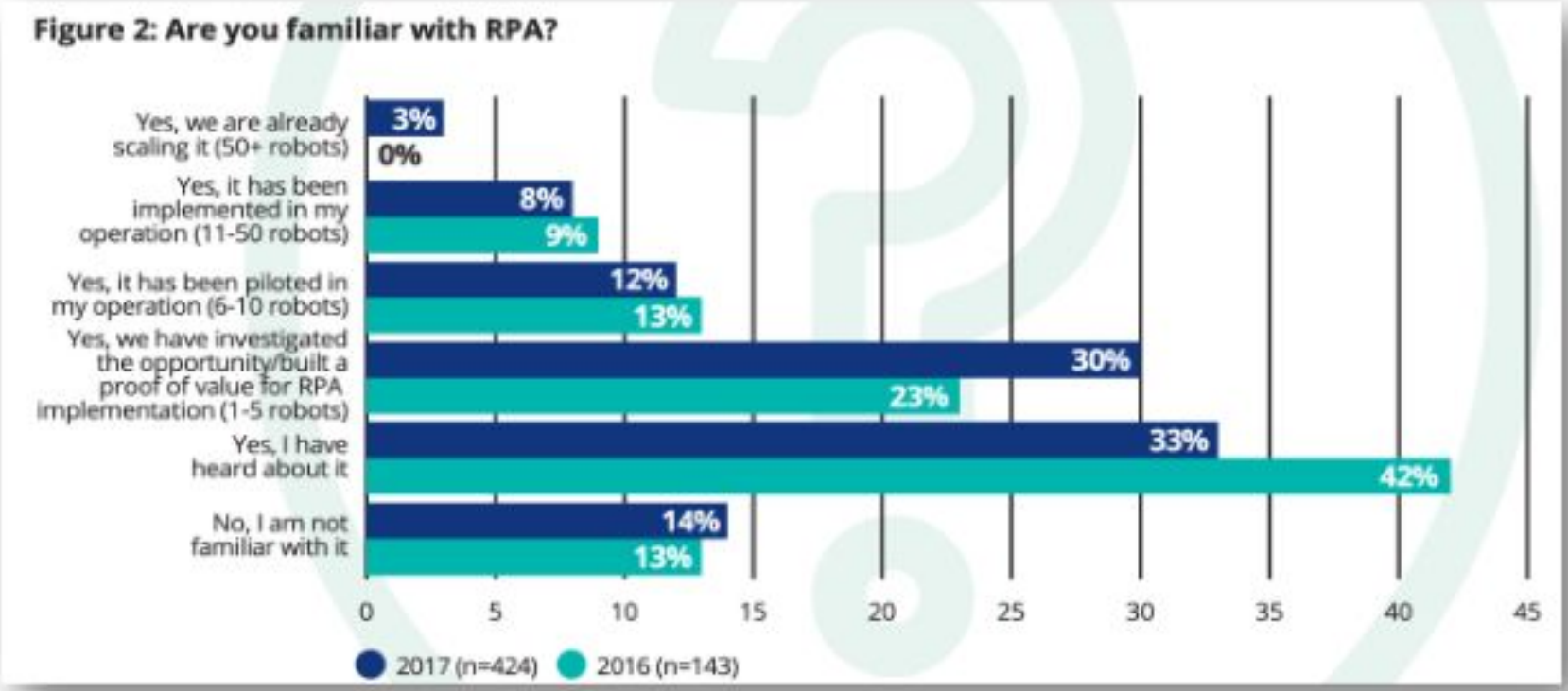


1. KPMG & HKMA. (2020). *Transforming Risk Management and Compliance: Harnessing the Power of Regtech.* https://www.hkma.gov.hk/media/chi/doc/key-information/press-release/2020/20201102c3a1.pdf

Challenges of BPA – Worries from the workers?

1. Deloitte. (2018). *The robots are ready. Are you?* https://www2.deloitte.com/content/dam/Deloitte/tr/Documents/technology/deloitte-robots-are-ready.pdf

Challenges of BPA – Hesitant to scale up



1. Deloitte. (2018). *The robots are ready. Are you?* https://www2.deloitte.com/content/dam/Deloitte/tr/Documents/technology/deloitte-robots-are-ready.pdf

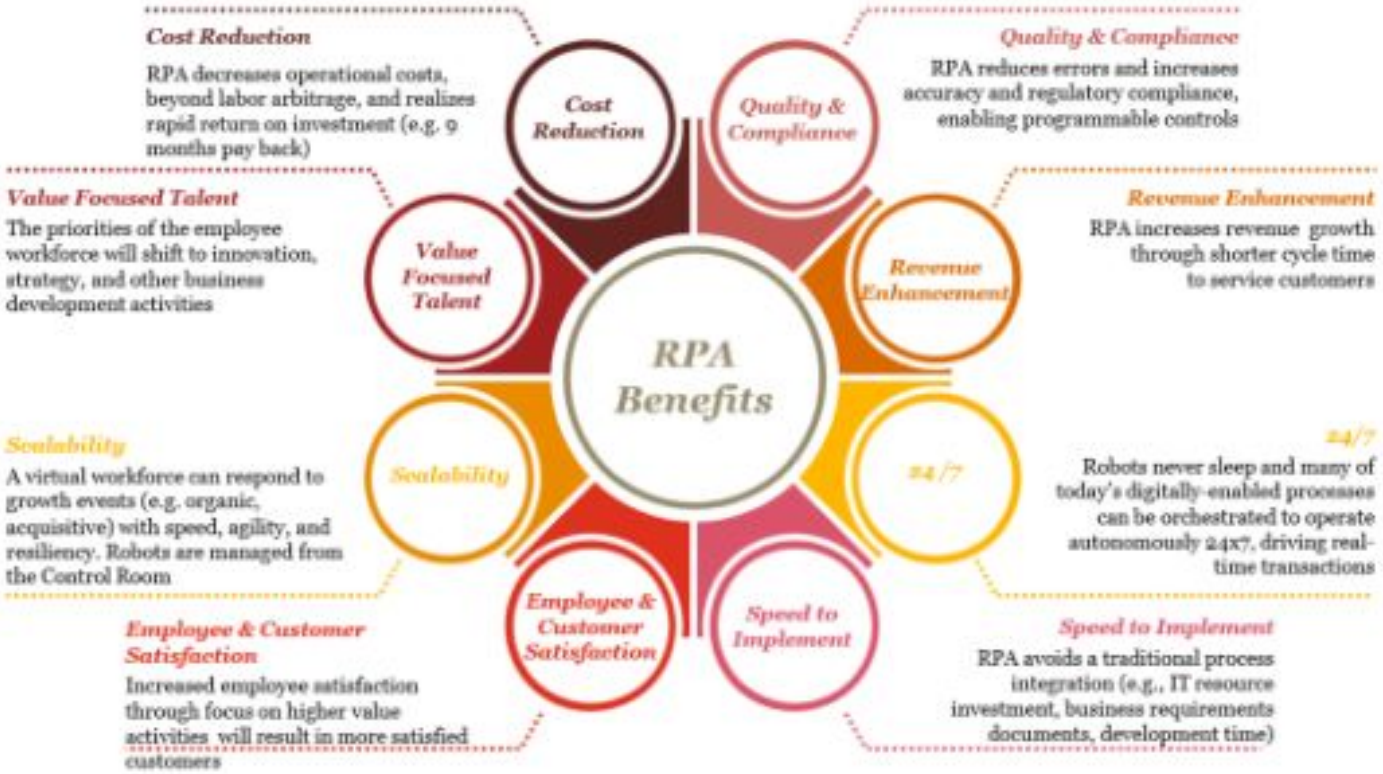
Challenges of BPA

- **Shortage**
  - Budget / Resource/ Talent
- **Concerns**
  - Risk of rushing / failing
  - Moral / Structural unemployment

* Success depends on planning
(More on project management later)

Implications of BPA – The Good

- Cost, Efficiency, Customer Experience



1. *PwC Robotics Process Automation Solutions*. PwC. https://www.pwchk.com/en/services/entrepreneurial-and-private-business/new-technology-digitalisation-and-transformation/process-automation-solutions.html

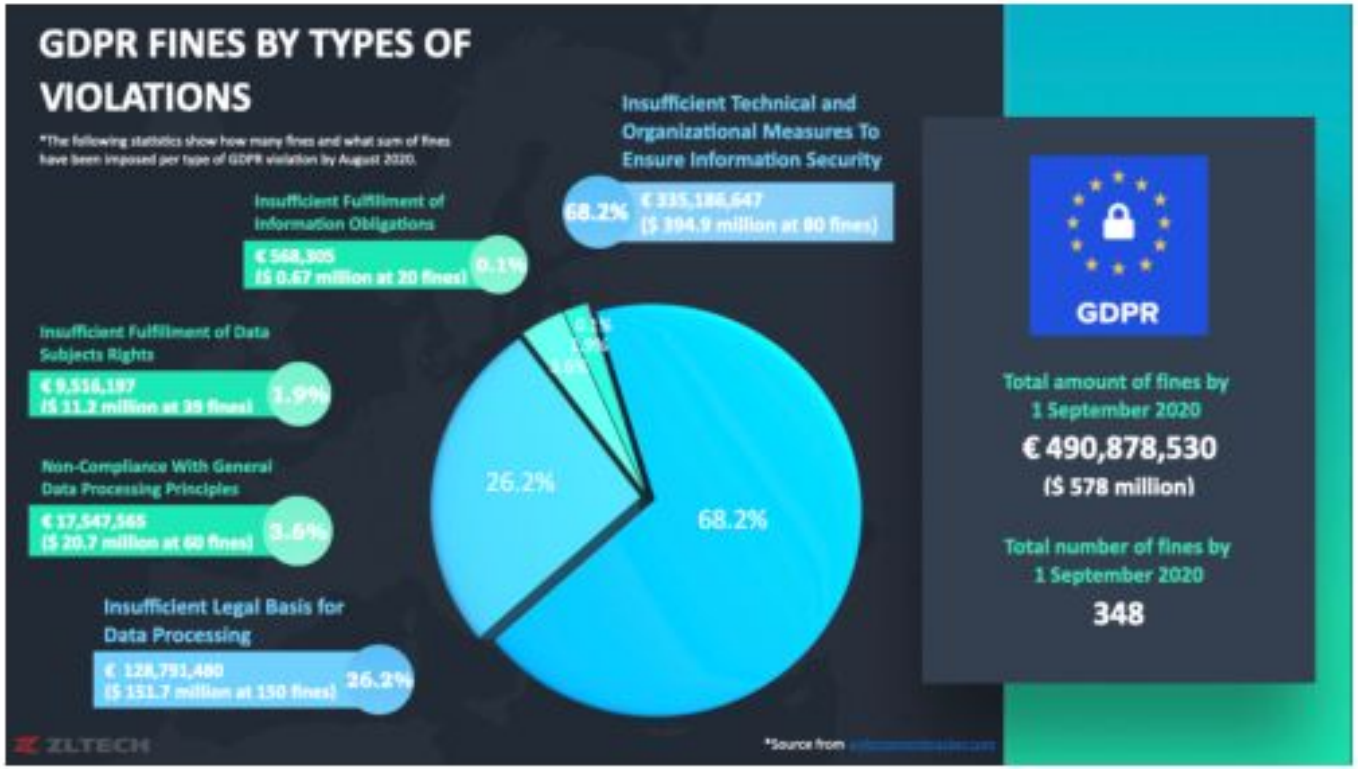
Implications of BPA – The Bad

- Automation complacency / dependency
- Risk of Technical Issues / Downtime

Image: Civil Aviation Safety Authority

Implications of BPA – The Ugly

- Data Collection and Analysis [1]
- Vulnerability to Cyberattacks

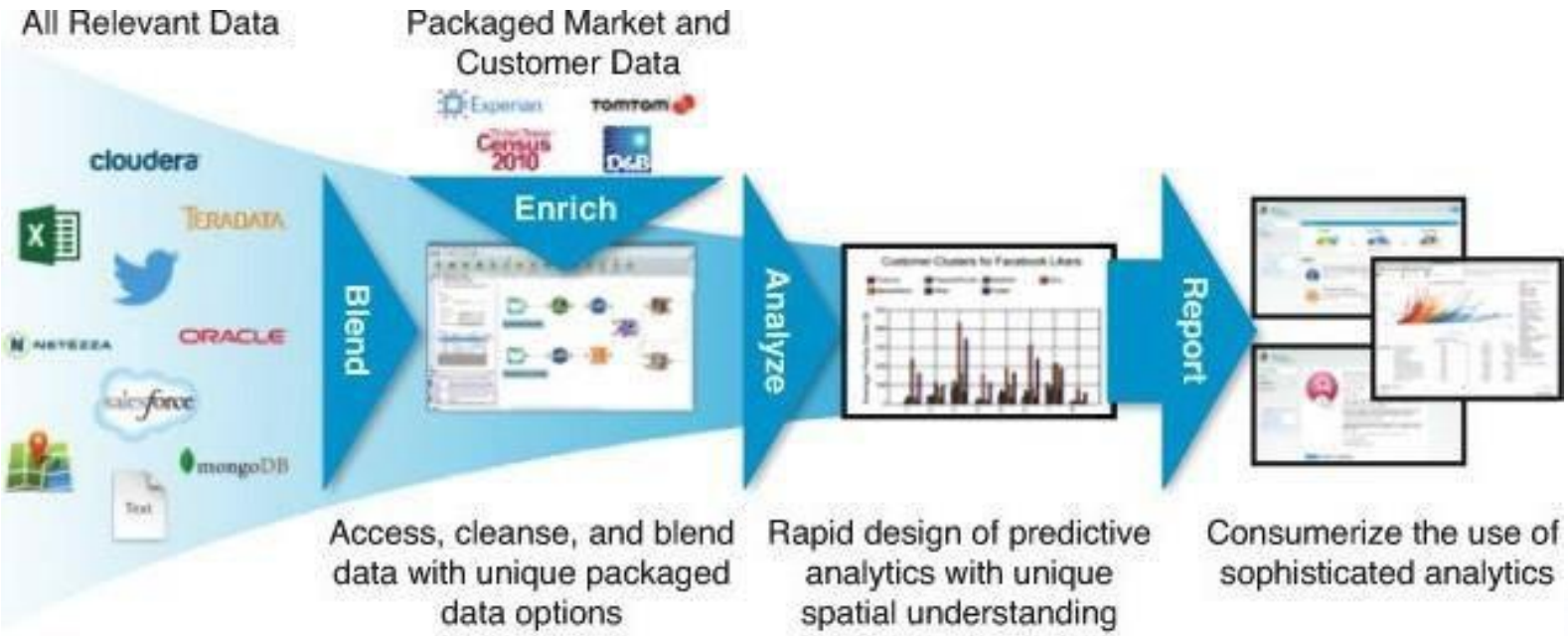


1. Chen, B. (2020, September 9). *GDPR Recap: 28 Nations, 348 Fines, Half a Billion Euros*. ZL Tech. https://www.zlti.com/blog/gdpr-recap-28-nations-343-fines-half-a-billion-euros/

Modern BI Process - Blend, Enrich, Analyze, and Report

Predictive Analytics: By applying machine learning algorithms to historical project data, organizations can forecast outcomes more accurately and mitigate risks in project delivery
.

Business Intelligence: Automating the preparation of data for analytics tools allows organizations to gain actionable insights more rapidly, enhancing their decision-making capabilities.

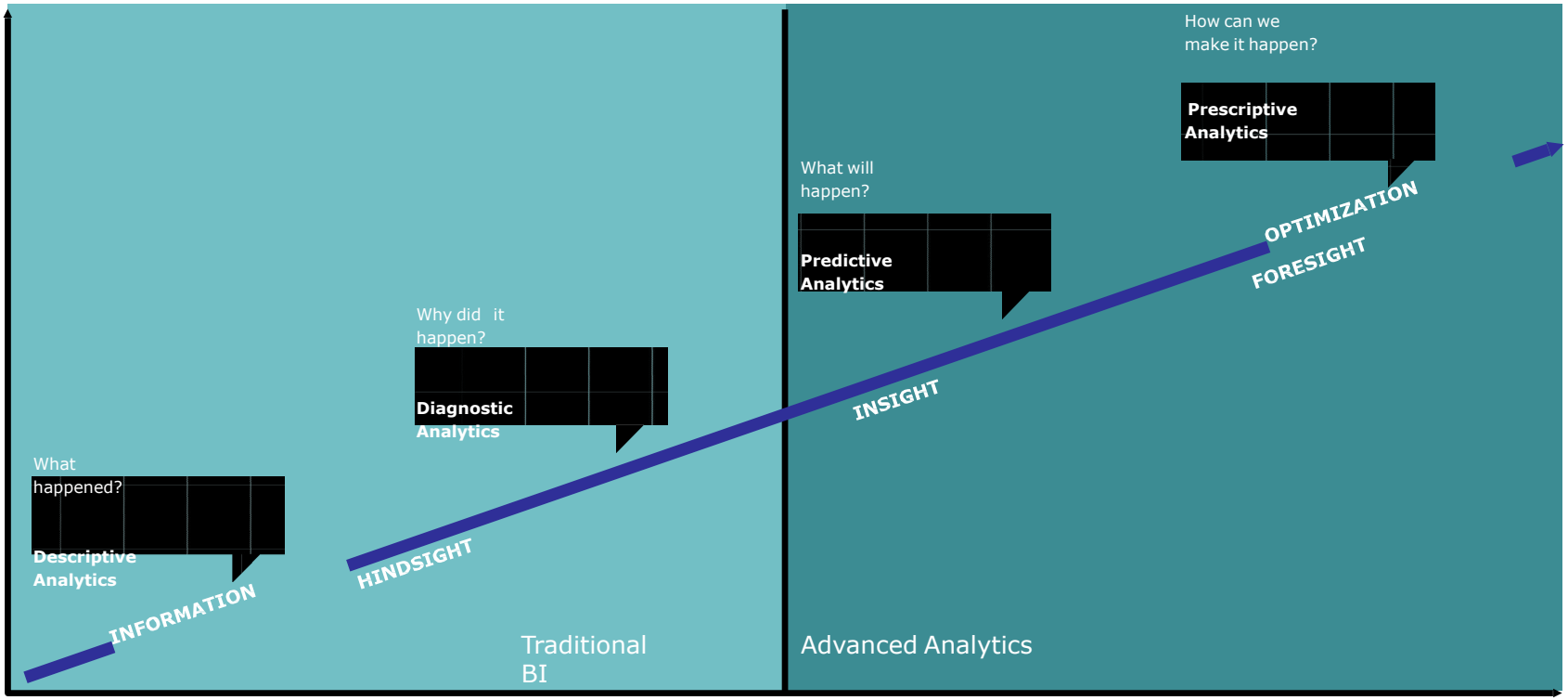


What Is Data Science?

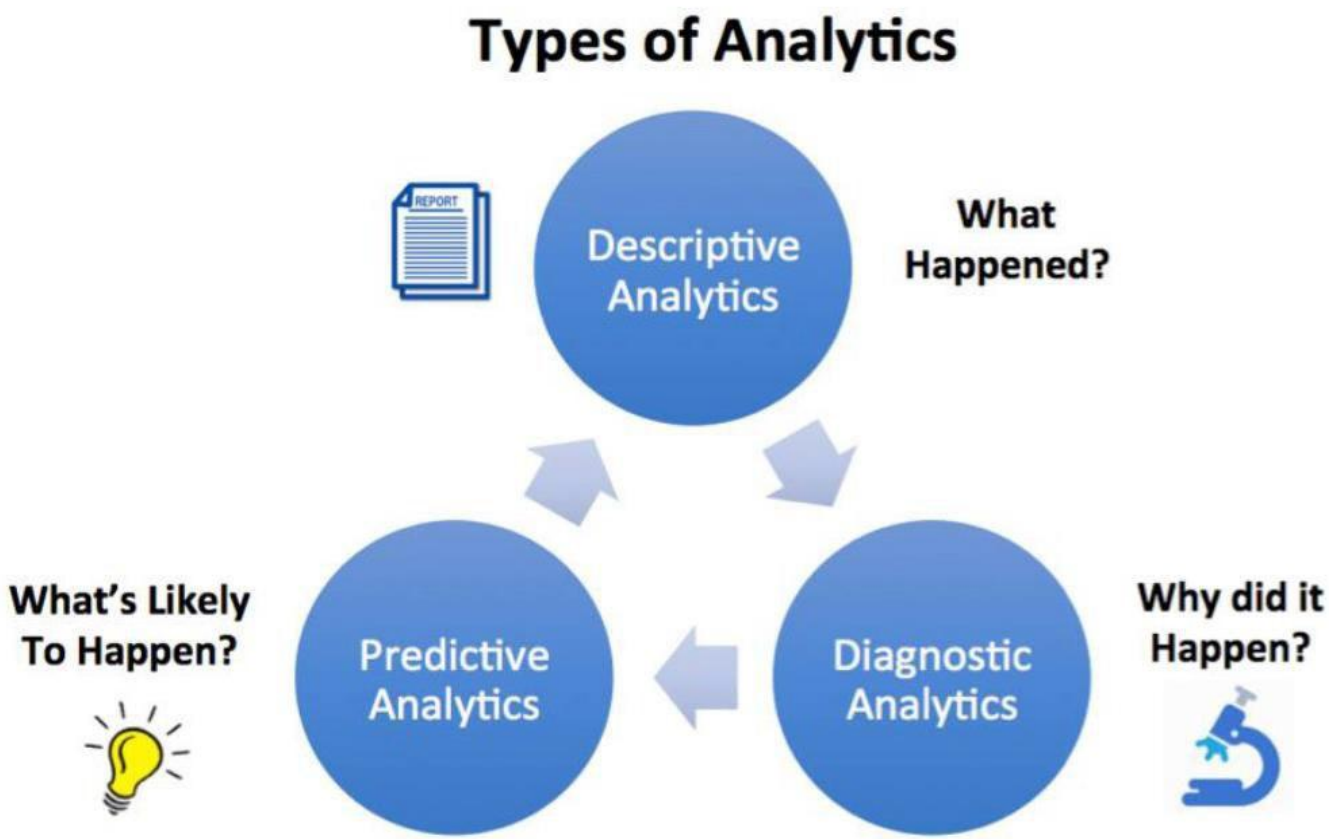
From Wikipedia:

Data science, also known as data-driven science, is an interdisciplinary field about scientific processes and systems to extract knowledge or insights from data in various forms, either structured or unstructured, which is a continuation of some of the data analysis fields such as statistics, machine learning, data mining ,and predictive analytics similar to Knowledge Discovery in Databases (KDD).

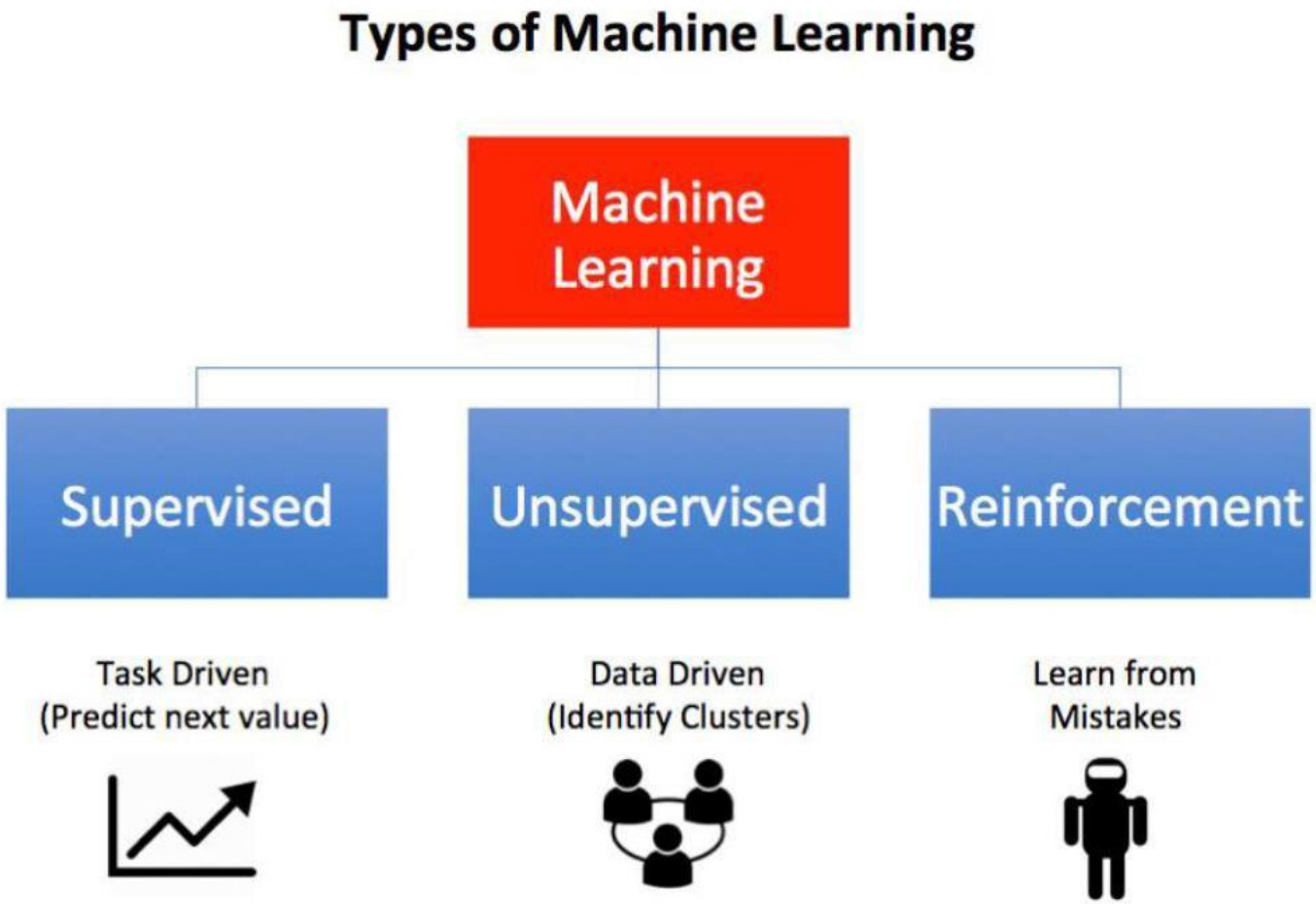
How Is Business Intelligence Different From Data Science?



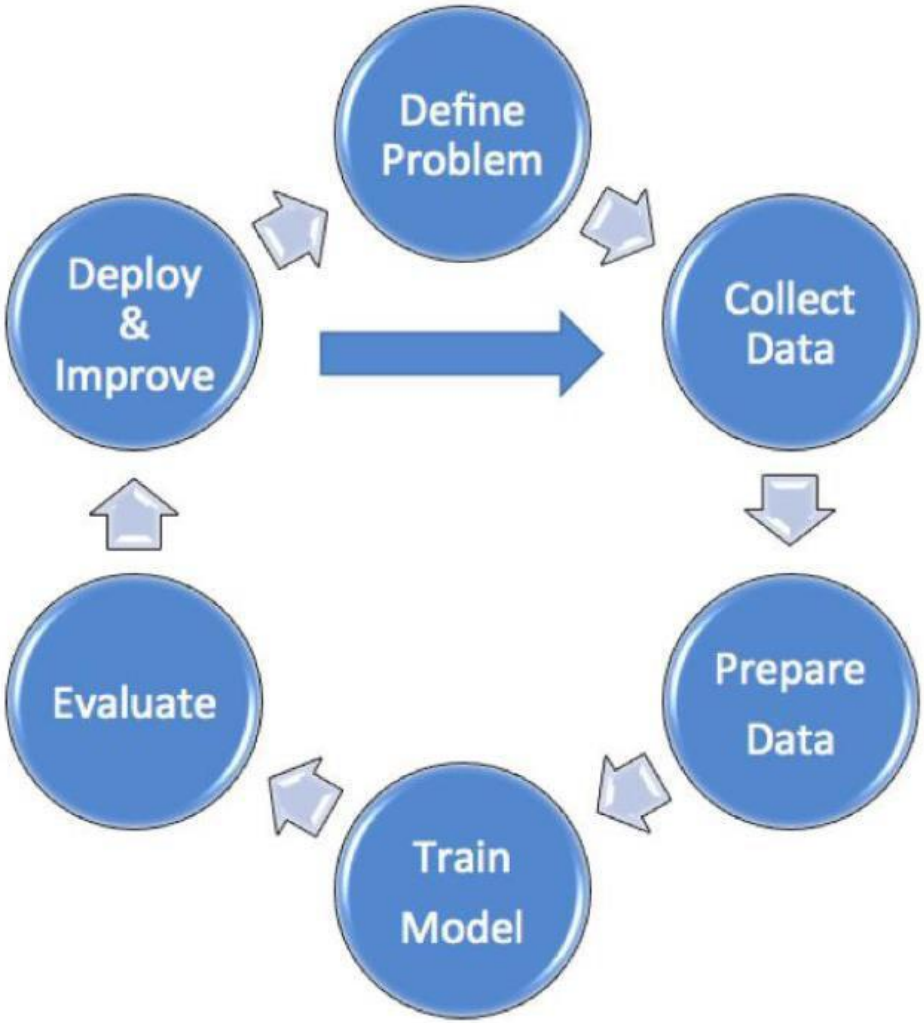
What is Business Analytics & Machine Learning?



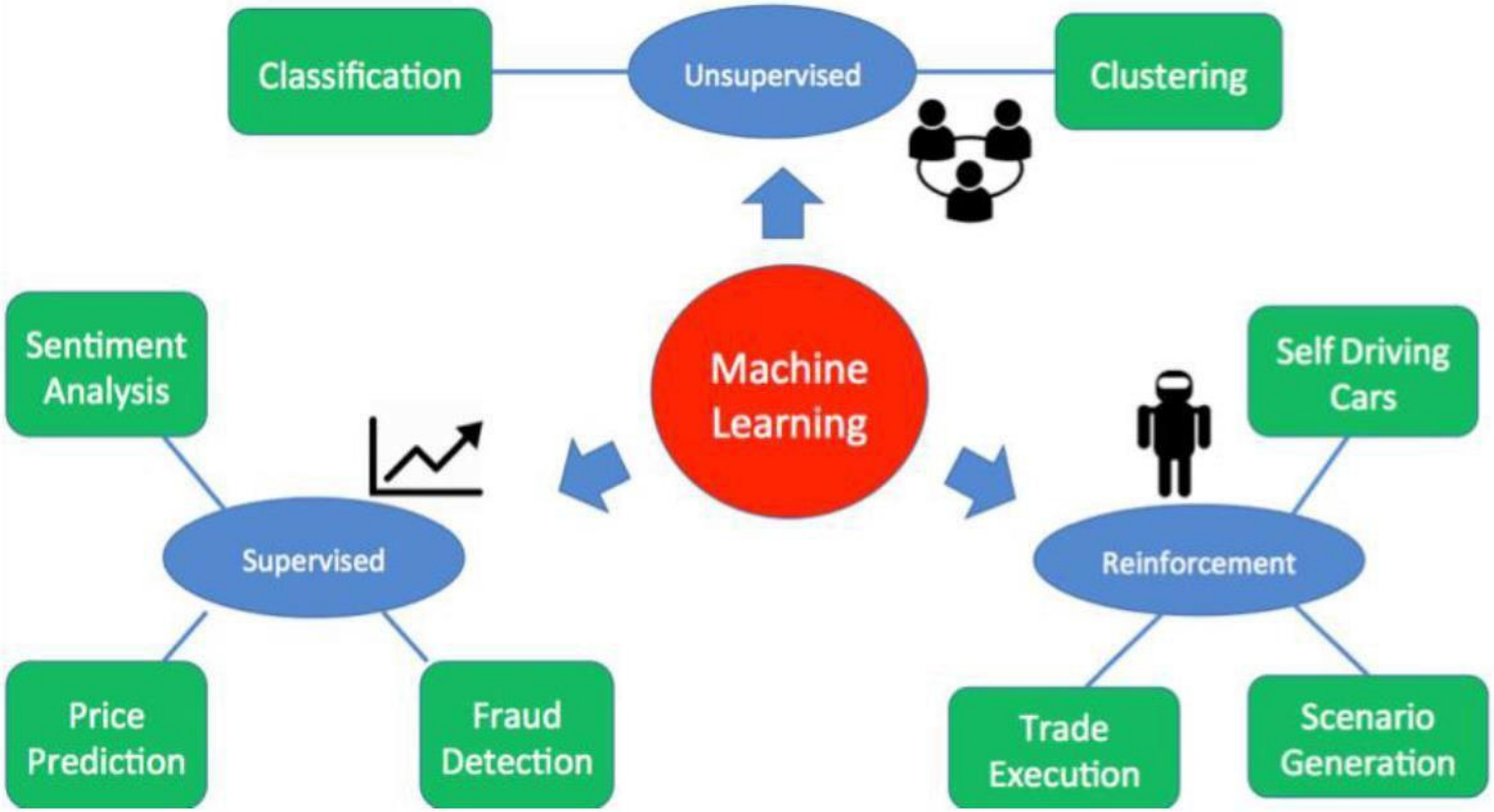
What is Business Analytics & Machine Learning?



What is Business Analytics & Machine Learning?



What is Business Analytics & Machine Learning?



How To Do Data Mining: Machine Learning Techniques

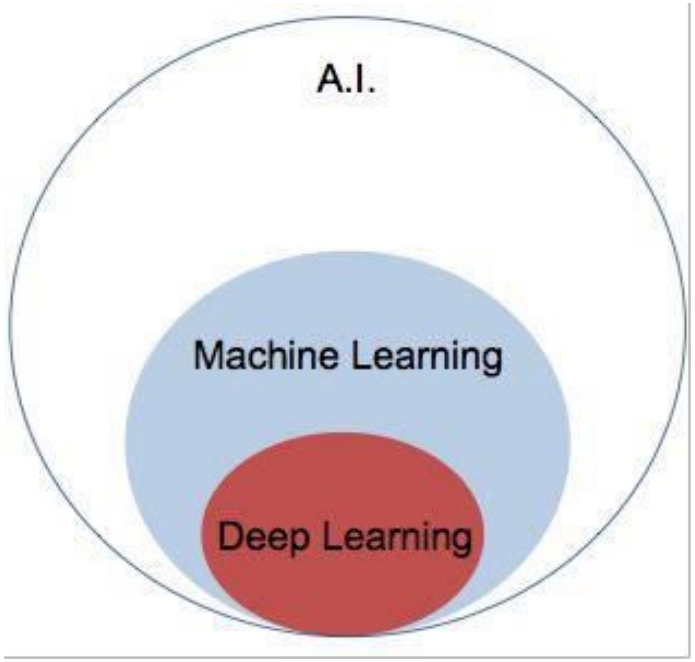
Artificial Intelligence

Machine Learning

Deep Learning

Source:https://www.becomingadatascientist.com/2017/07/17/introductory - machine-learning-terminology-with-food/

Clearing The Confusion About Data Science And Big Data



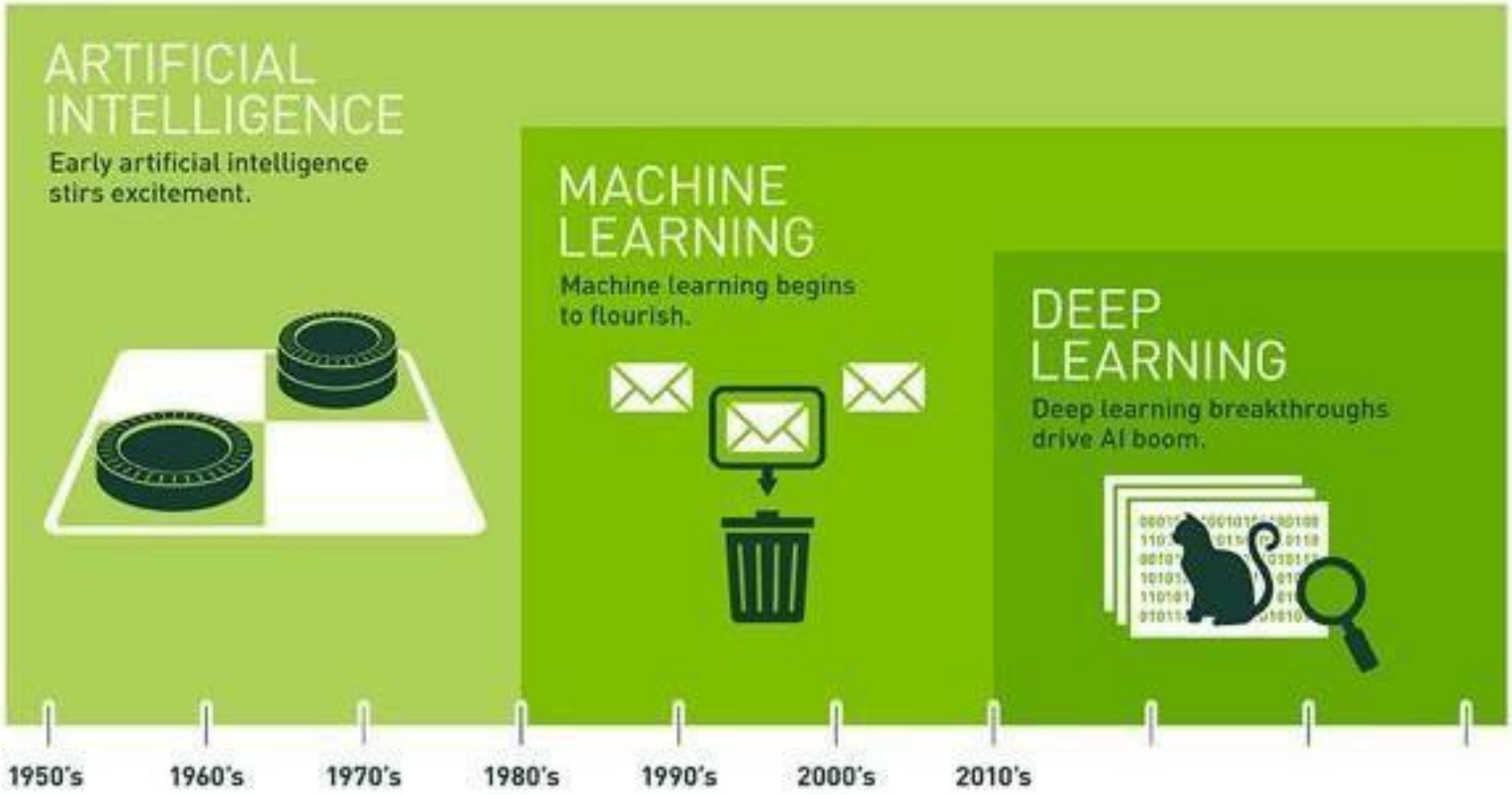
Frank Chen of a 16z

Definition of AI: a branch of computer science trying to get computers to exhibit intelligence.

- Machine Learning is a range of techniques for computers to perform cognitive functions
- Deep Learning (a type of Machine Learning that uses layers of neural networks) has been the most accurate and productive technique in AI research

Big Data Tools and Algorithm Exploration

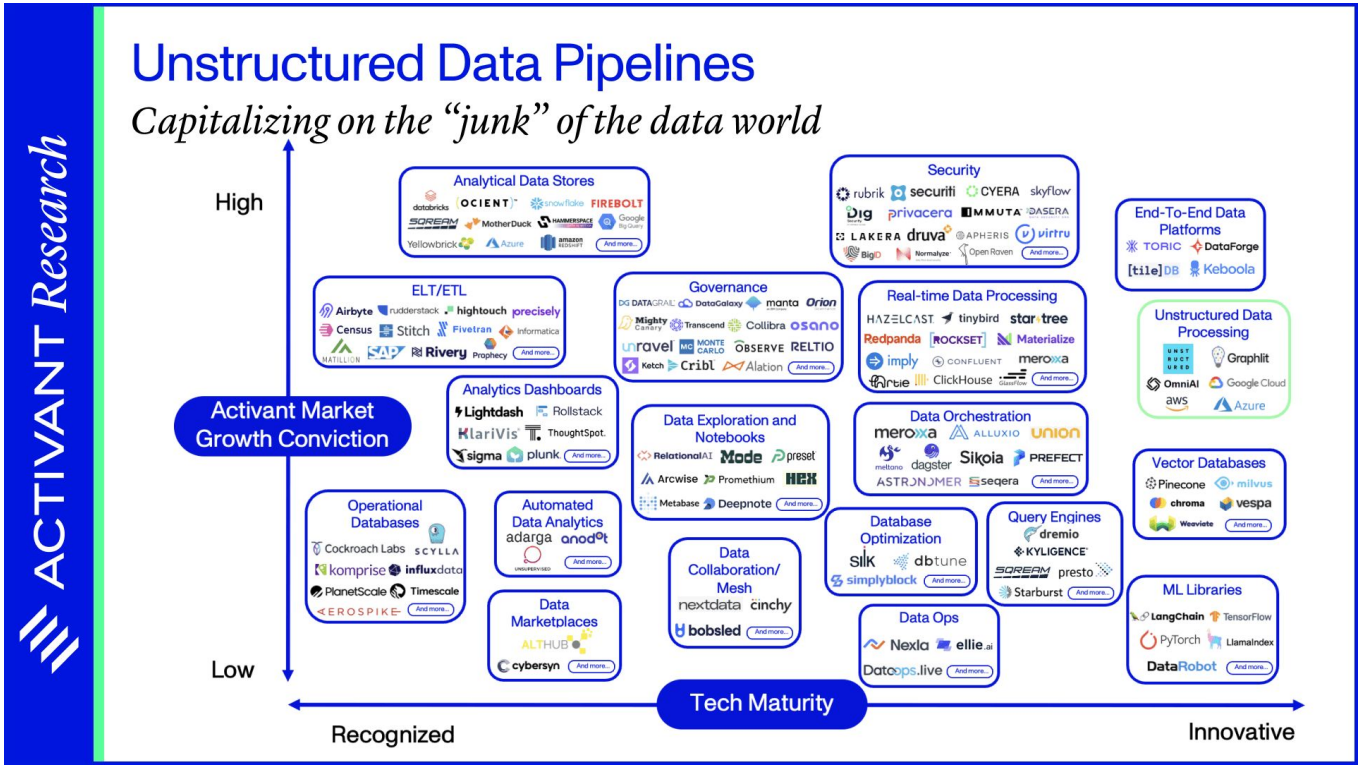
Difference Between AI, Machine Learning & Deep Learning



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

IPA – Data Science

IPA's integration with data science is particularly impactful in several areas: Unstructured Data Processing: IPA can convert unstructured data into structured formats suitable for analysis, enabling businesses to leverage insights from previously untapped data source.



Python – Origin

- Released in 1991 (same as Visual Basic)
- Free and open-source

Motivation – Soft Limits

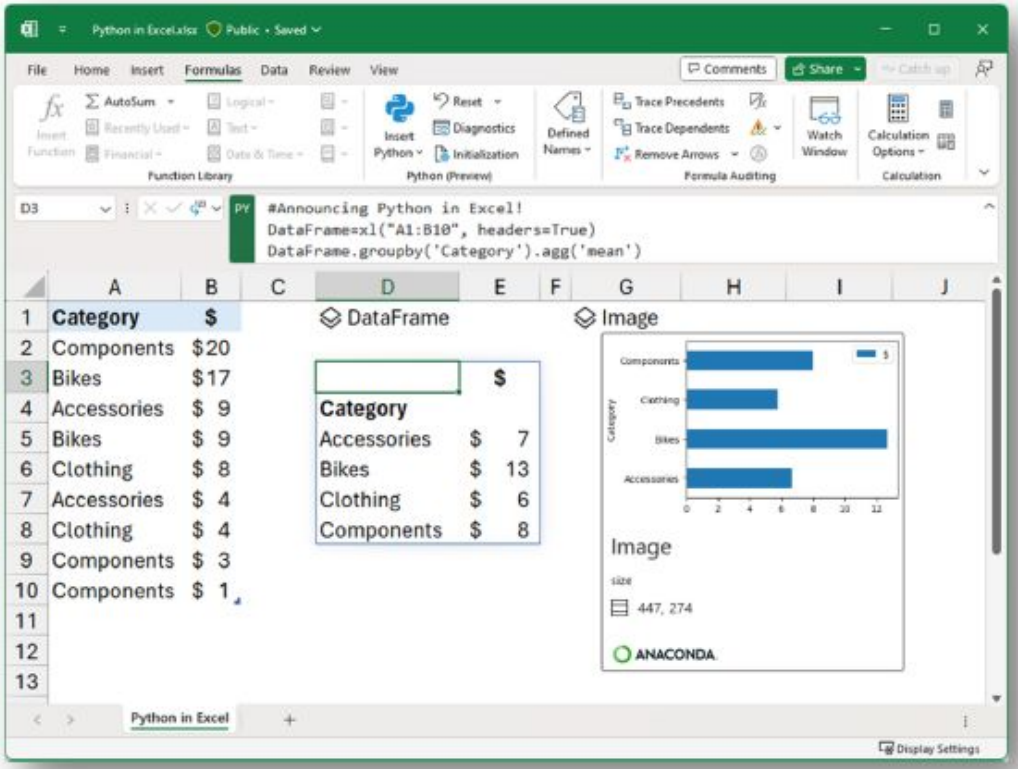
- Protective measures not matching modern days

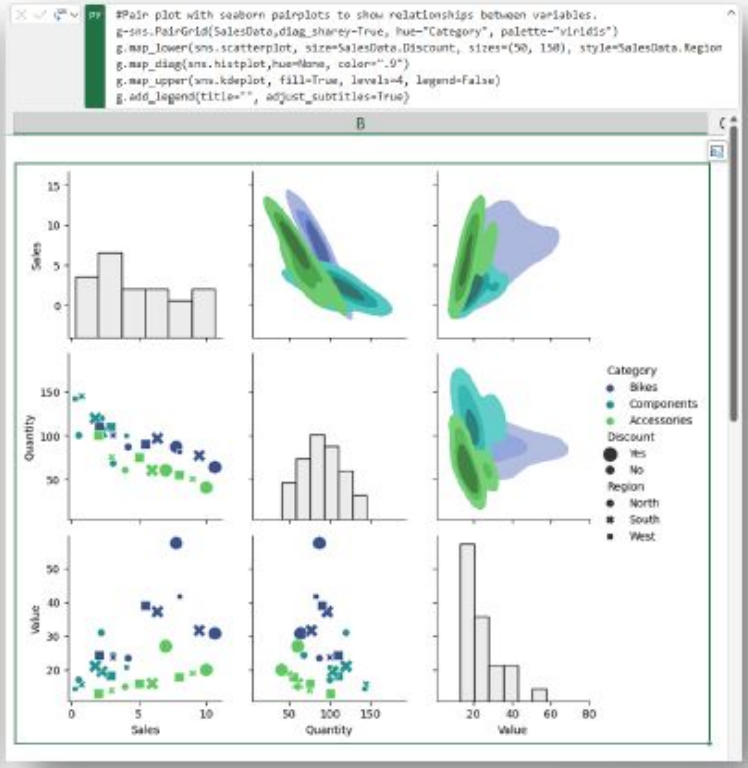
Feature	Maximum limit
Total number of rows and columns on a worksheet	1,048,576 rows by 16,384 columns
Column width	255 characters
Row height	409 points
Page breaks	1,026 horizontal and vertical

1. Microsoft. Excel Specifications and limits. https://support.microsoft.com/en-us/office/excel-specifications-and-limits-1672b34d-7043-467e-8e27-269d656771c3

Motivation – Extensibility

- Python in Excel [1]

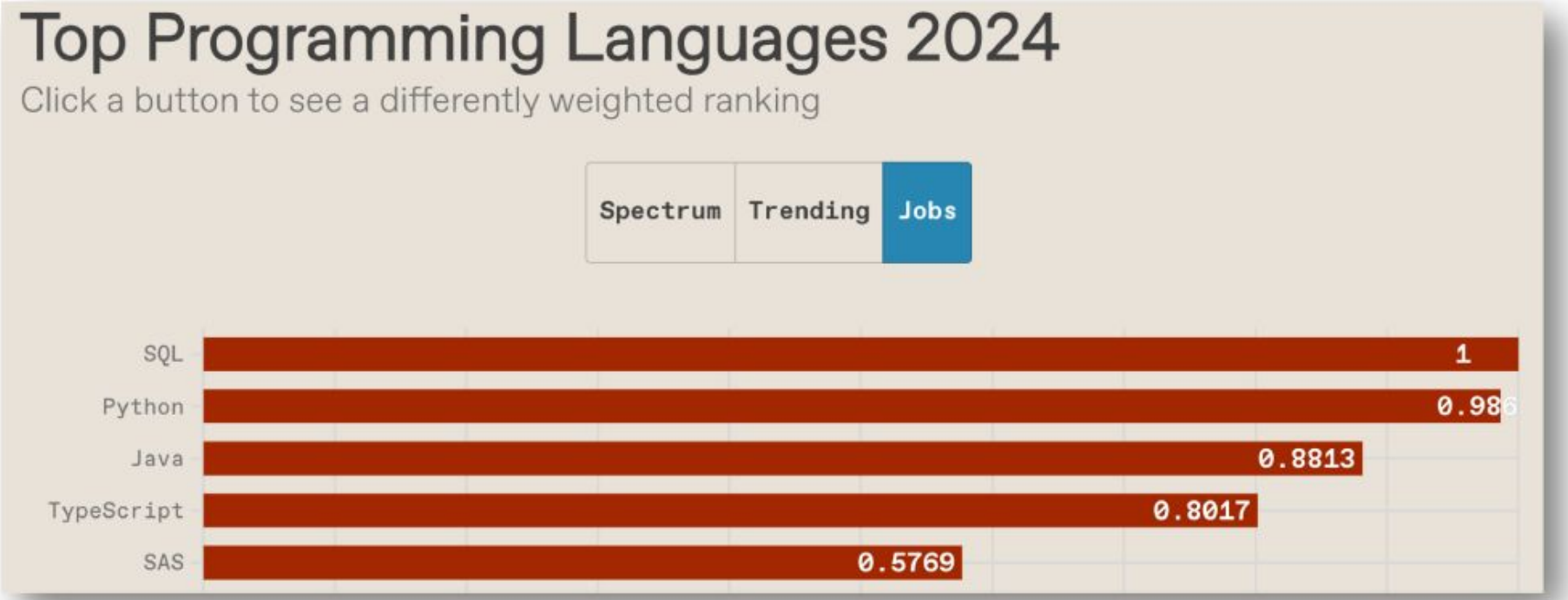




1. *Announcing Python in Excel: Combining the power of Python and the flexibility of Excel.* TECHCOMMUNITY.MICROSOFT.COM. https://techcommunity.microsoft.com/t5/excel-blog/announcing-python-in-excel-combining-the-power-of-python-and-the/ba-p/3893439

Motivation – Jobs

- Python ➔ 1 of the top languages for work



1. *The Top Programming Languages 2024*. (2024 August 22). IEEE Spectrum. https://spectrum.ieee.org/top-programming-languages-2024

Motivation – Jobs

- Python ➔ Recently added as part of CFA exams

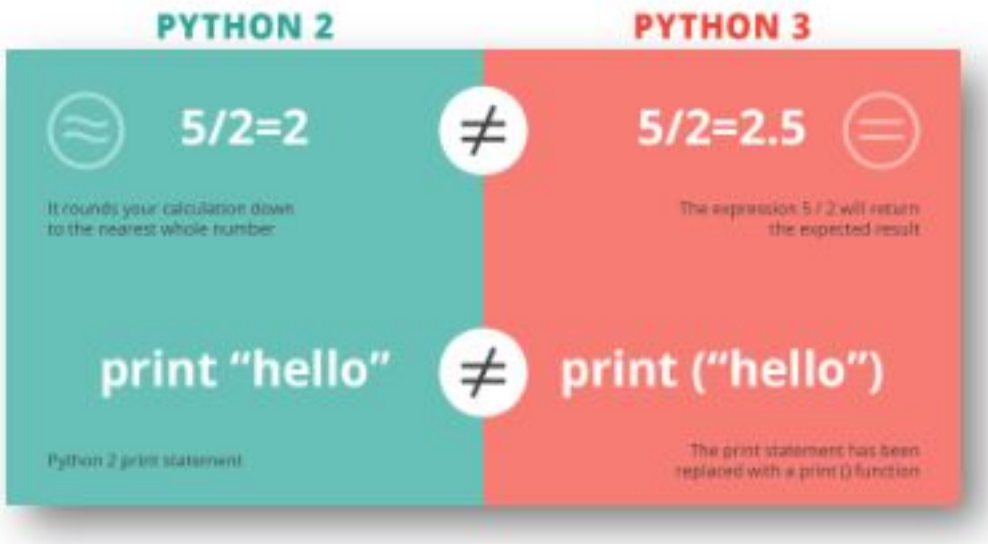
Level II

- **Python Programming Fundamentals**
  A fundamentals course to demonstrate the basics of Python and how to use Jupyter Notebook for developing, presenting, and sharing data science projects related to finance. (if not taken at Level I)
- **Analyst Skills**
  Focuses on the skills equity and credit analysts need using insights gained from hundreds of successful analysts.
- **Python, Data Science & AI**
  Introduces candidates to machine learning, artificial intelligence, and data science to understand financial statements, reporting, and analysis using Python.

1. *Practical Skills Module | CFA Program Evolution*. Practical Skills Module | CFA Program Evolution. https://evolve.cfainstitute.org/practical-skills-modules.html

Python runtime

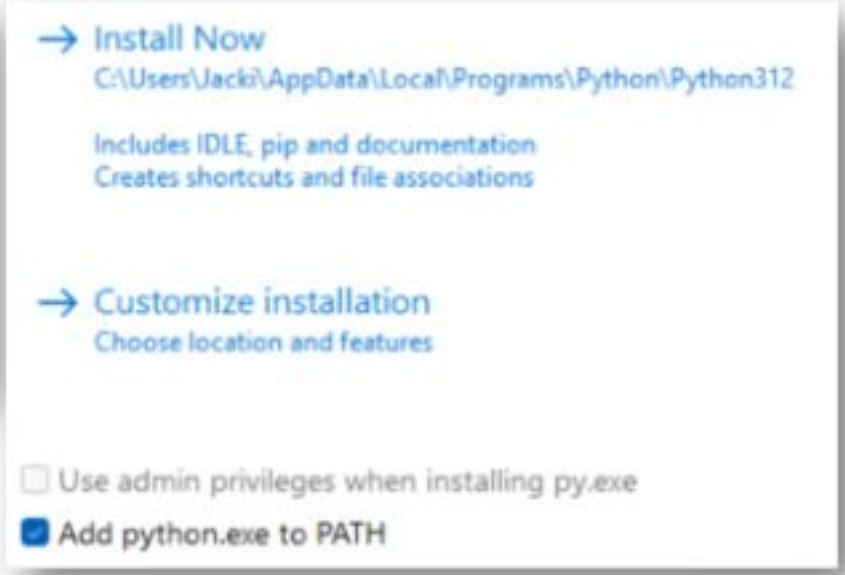
- The language and basic runtime environment
- Just like Apple iOS, it keeps updating (e.g., Python 3.12.2)
  - Python 2 was no longer supported from 2020[1]



1. *Sunsetting Python 2*. Python.org. https://www.python.org/doc/sunset-python-2/

Installation – Python Runtime

- Official website
  - https://www.python.org/downloads/
- Installing in Windows ➔ Tick “Add python.exe to PATH”



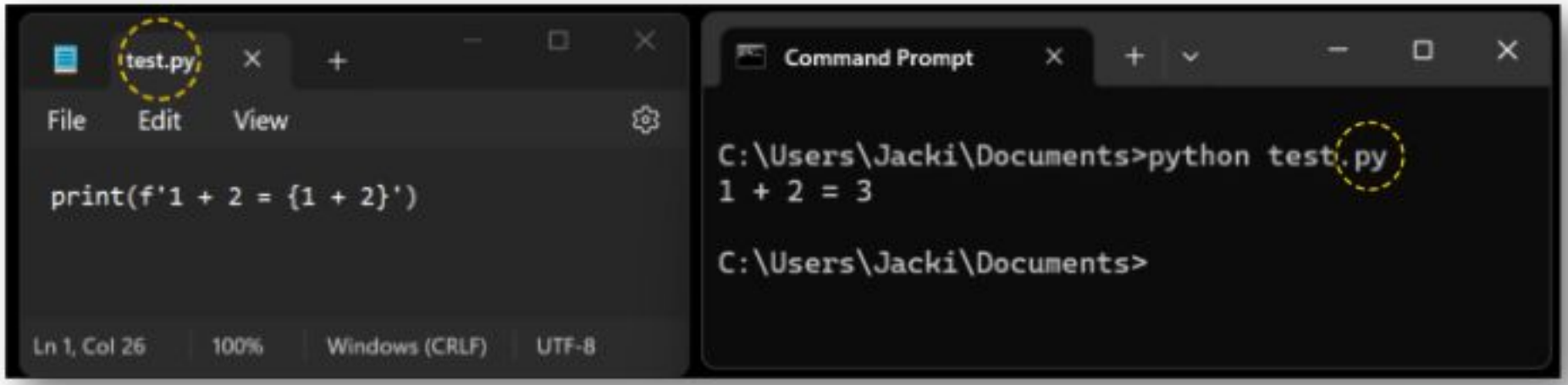
How to run Python – In the old days

- Python interpreter
  - This is the core of Python
  - Input a line of codes ➔ Press Enter ➔ Run

```
jackieliu — Python — 106×24

jackieliu@Jackies-MacBook-Air-2 ~ % python3
Python 3.12.2 (v3.12.2:6abddd9f6a, Feb  6 2024, 17:02:06) [Clang 13.0.0
Type "help", "copyright", "credits" or "license" for more information.
>>> 1+2
3
>>> 8 / 4
2.0
>>> print('each line is executed one by one')
each line is executed one by one
>>>
```

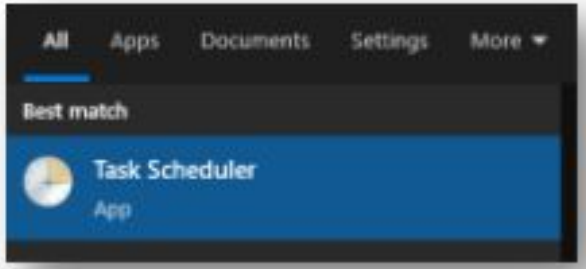
How to run Python – Running as a file

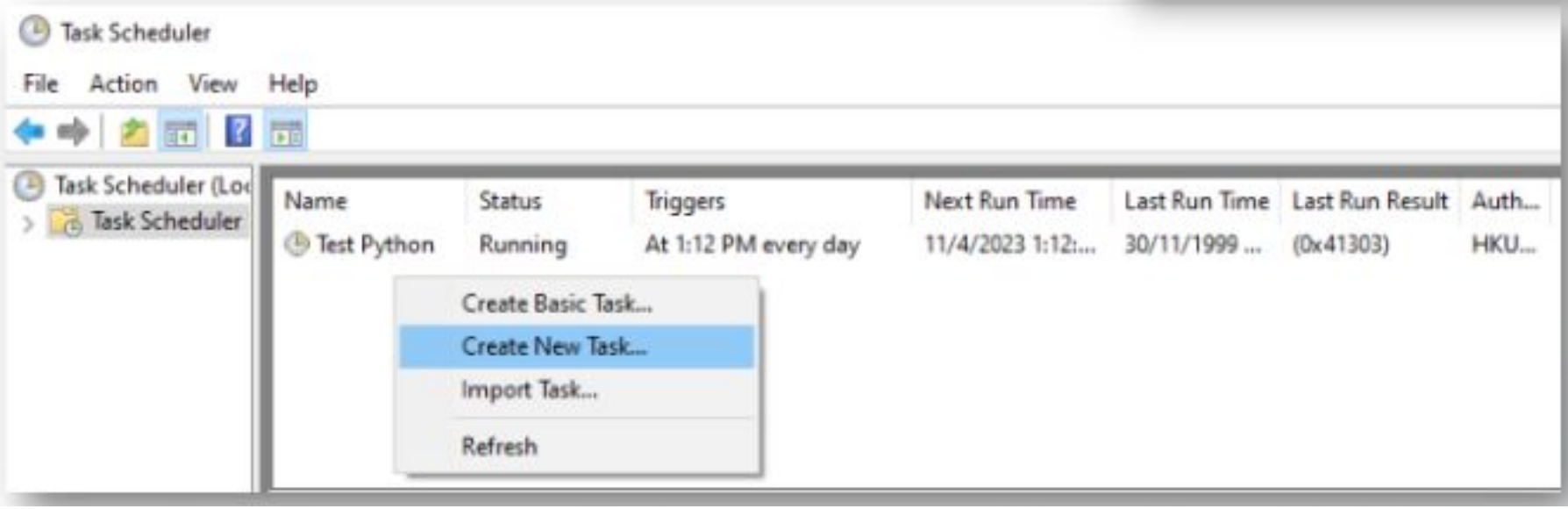
- Python interpreter + Text editor
  - Write codes in a text editor (e.g., Notepad, Vim, Sublime Text)
  - Save codes as a ".py" file
  - Run all the lines in one go



How to run Python – Running as a file (bonus)

- Python interpreter + Text editor + Task Scheduler
  - Running a Python script daily/ hourly
    - e.g., Task Scheduler/ Cron / Autosys etc
  - Create a task pointing to the .py file





How to run Python – IDE

- Integrated Development Environment (IDE)
  - A smart editor tailored for writing codes
    - e.g., Syntax highlighting, variable tracking, debugging mode
    - May support useful extensions/plugins (e.g., GitHub Copilot)
  - Common IDEs
    - e.g., Spyder, PyCharm, Visual Studio Code

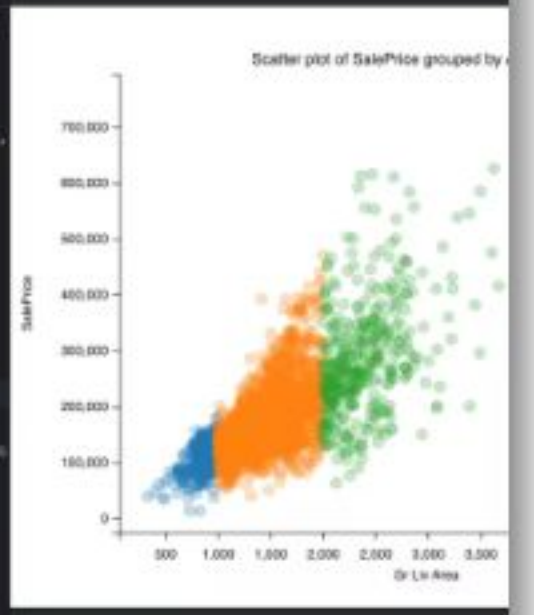
Example - PyCharm

scientificProject1 Version control

notebook.ipynb notebook.py

```python
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np

df = pd.read_csv("/Users/Stanislav.Garkusha/Downloads/Shad_Python_01_2/Ames_dataset/AmesHousing.csv",

# Handle Missing Values
# Use apply function to apply a specific function across each column of the DataFrame
df = df.apply(lambda x: x.fillna(x.mean()) if x.dtype.kind in 'biufc' else x.fillna(x.mode()[0]))

# Feature Engineering
df["AreaCategory"] = pd.cut(df["Gr Liv Area"], bins=[0, 1000, 2000, df["Gr Liv Area"].max()],
                            labels=["small", "medium", "large"], include_lowest=True)

print(df.groupby("AreaCategory")[
          "SalePrice"].mean())  # printing mean sales price for small, medium, and large living areas

# Statistical Analysis
print(df.describe())  # prints descriptive statistics of all numerical columns

# Data Visualization
fig, ax = plt.subplots()
ax.scatter(df["Gr Liv Area"], df["SalePrice"], alpha=0.5)
ax.set_title('Scatter plot of Gr Liv Area vs SalePrice')
ax.set_xlabel('Gr Liv Area')
ax.set_ylabel('SalePrice')

# Scatter plot instead of boxplot
fig, ax = plt.subplots()
area_categories = ['small', 'medium', 'large']
for category in area_categories:
    ax.scatter(df[df['AreaCategory'] == category]['Gr Liv Area'], df[df['AreaCategory'] == category][
```

Plots



Data View df*

	Order	PID	MS SubClass	MS
1553	1554	9102510...	20	A (agr
2903	2904	923125...	20	A (agr
942	943	9111030...	50	C (all)
727	728	9024771...	30	C (all)
726	727	9024771...	30	C (all)
1557	1558	9112260...	30	C (all)

How to run Python – Jupyter Notebook

- Google Colaboratory (Colab)
  - Jupyter Notebook powered by Google Cloud [1]
    - https://colab.research.google.com/
  - Benefits [2]
    - "Zero configuration required"
    - Easy sharing
    - Free access: CPU & GPU

1. *Google Colab FAQ*. https://research.google.com/colaboratory/faq.html
2. *Google Colaboratory*. https://colab.research.google.com

Cloud Software Introduction

Colaboratory, or Colab for short, is a Google Research product, which allows developers to write and execute Python code through their browser. Google Colab is an excellent tool for deep learning tasks. It is a hosted Jupyter notebook that requires no setup and has an excellent free version, which gives free access to Google computing resources such as GPUs and TPUs.

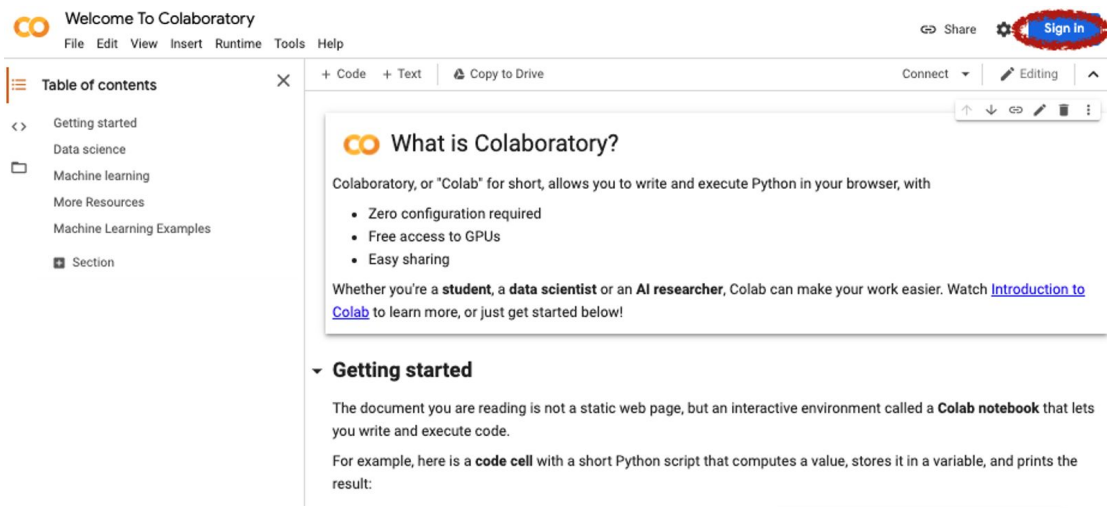
Why Should I Use Google Colab?

There are several reasons to opt to use Google Colab instead of a plain Jupyter Notebook instance:

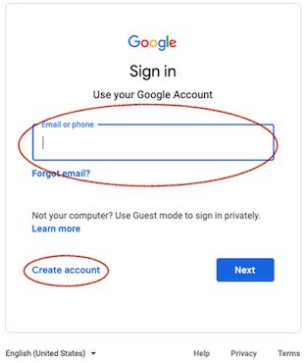
- Pre-Installed Libraries
- Saved on the Cloud
- Collaboration
- Free GPU and TPU Use

Google Colab Setup

1. Visit the Google Colab (http://colab.research.google.com/) page, which will direct you to the Google Colaboratory Welcome Page.
2. Click the **Sign in** button on the right top.



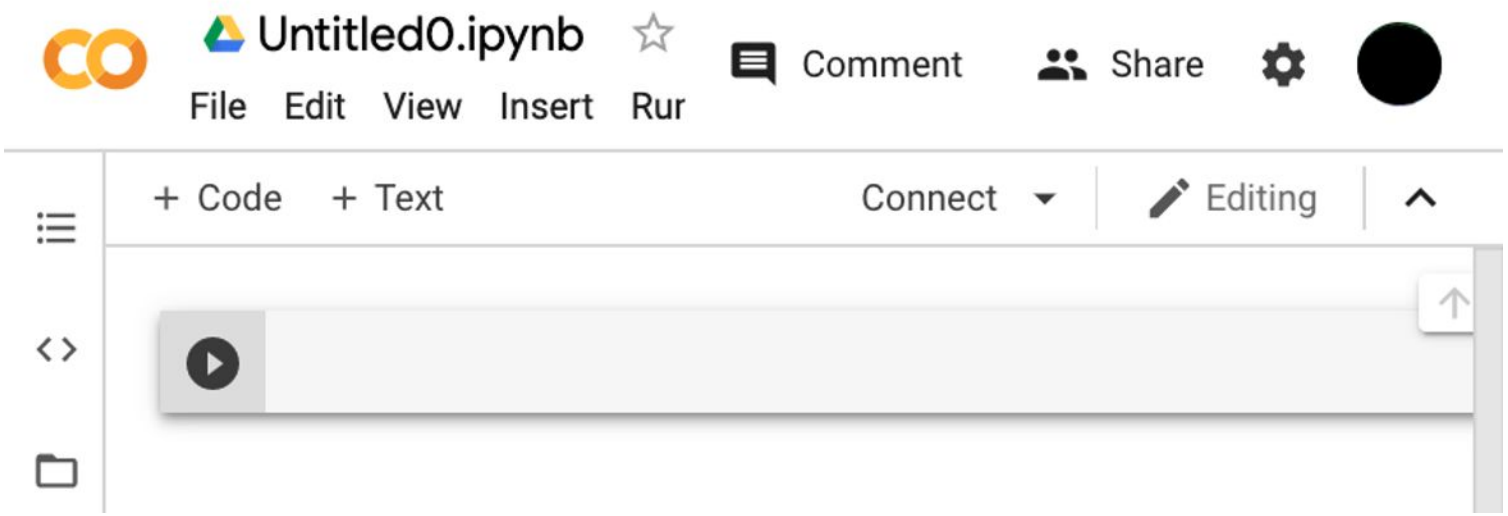
3. Sign in with your Gmail account.



Google Colab Setup

4. As soon as you complete the sign-in process, you are ready to use Google Colab.

5. You may easily create a new Colab notebook on this page by clicking *File> New notebook*.

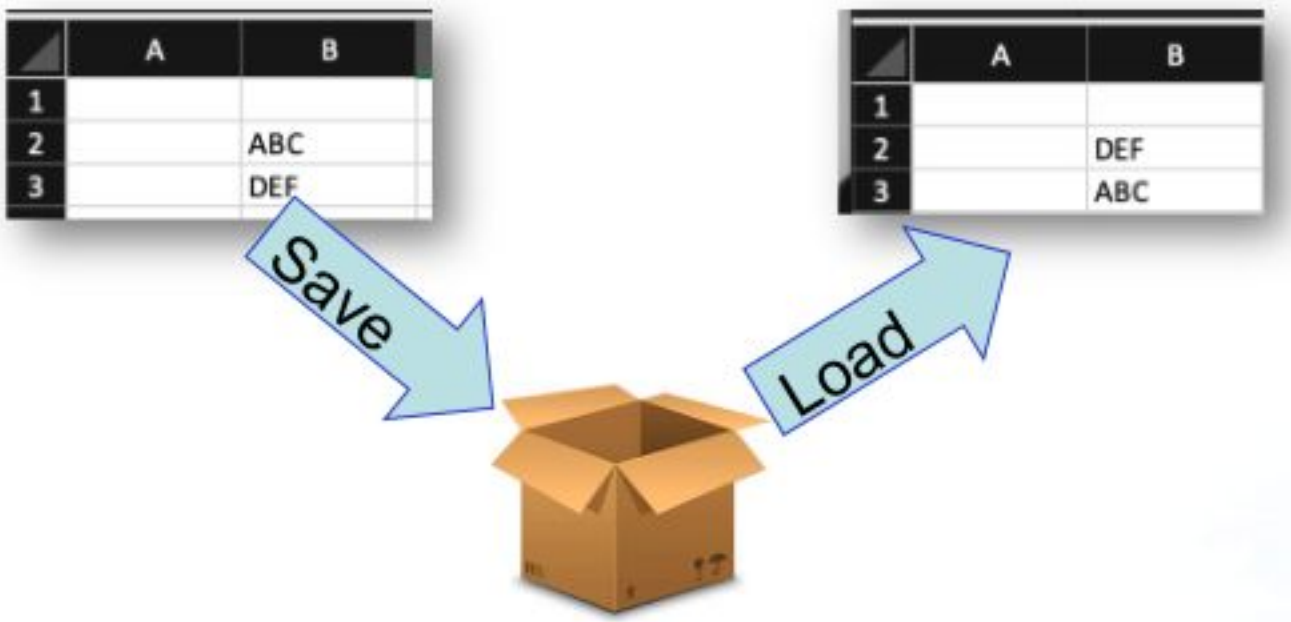


How to run Python – Summary

- Python interpreter
- Python (.py) files with
  - Text editors
  - IDEs
- Jupyter Notebook running
  - Locally
  - Remotely

Variables

- From the previous lecture
  - Variables ➔ Storage of values
  - Values ➔ carry data types



Variables

- Declaration
  - In VBA, declarations ("dim") are recommended
    - Dim year As **Integer**
    - year = 2024
  - In Python, variables are created during assignment
    - year = 2024
  - To assign without an actual value
    - year = None

Value Check

- VBA
  - Debug.Print()

```
Sub HighlightCell()
    If Range("B1").Value > 50 Then
        Range("B1").Interior.Color = vbYellow
    Else
        Range("B1").Interior.Color = vbGreen
    End If
    Debug.Print (Range("B1"))
End Sub
```

```
40
```

- Python
  - print()

```
print(1 + 2)          # This gives 3
print(1 + 2 + 3)      # This gives 6
```

```
3
6
```

  - Last line in a block

```
1 + 2          # This is not shown
1 + 2 + 3      # This is shown
```

```
6
```

Primitive Data Types - Numeric

- Int

```
x = 1
y = 2
x + y
```

```
3
```

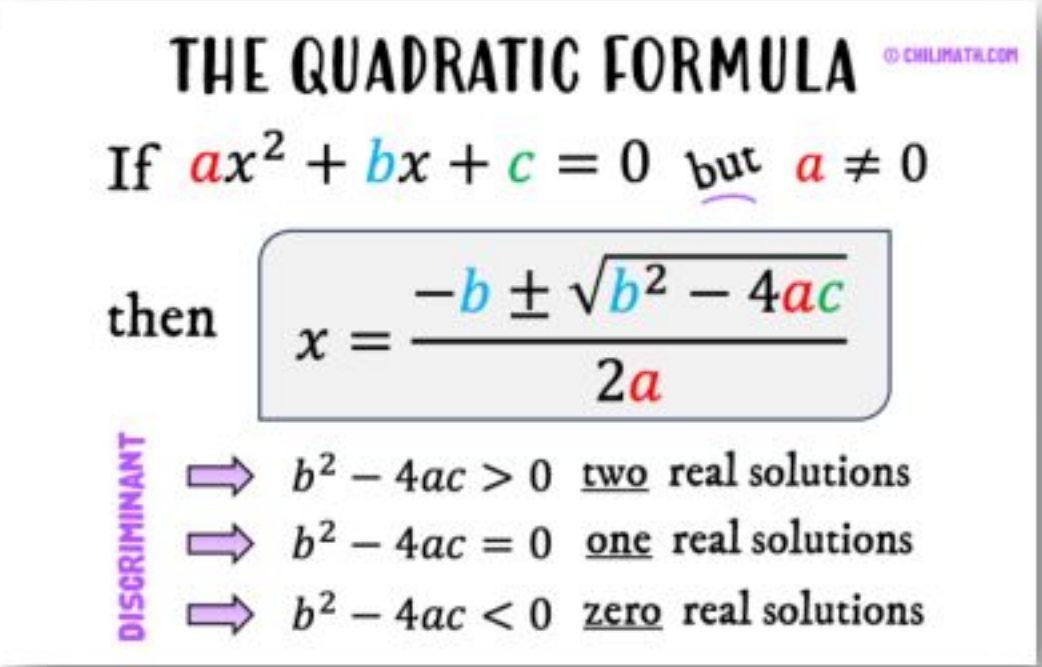
- Float

```
x = 2.5
y = 10.0
x * y
```

```
25.0
```

Primitive Data Types - Numeric

- Complex (For scientific calculations)




```
x = 3 + 4j
y = 2 + 2j
x - y
```

```
(1+2j)
```

$$i = \sqrt{-1}$$

Primitive Data Types - Numeric

- Common Functions
  - round() / pow() / abs()

```
print(round(9876.54321, 2))   # Round to 2 decimal places
print(round(9876.54321, 0))   # Round to nearest integer
print(pow(2, 3))              # 2 * 2 * 2 = 8
print(abs(-5))                # Negative numbers become positive
```

```
9876.54
9877.0
8
5
```

Primitive Data Types - Boolean

- Bool – Logical operators

```
x = True
y = False
```

```
x and y
```

```
False
```

```
x or y
```

```
True
```

```
not x
```

```
False
```

Primitive Data Types - Boolean

- Bool – comparators
  - Generates True/ False

Operator	Name	Example
==	Equal	5 == 5
!=	Not equal	26 != 3
>	Greater than	100 > 67
<	Less than	89 < 216
>=	Greater than or equal to	90 >= 54
<=	Less than or equal to	23 <= 77

Primitive Data Types - Text

- String
  - Representation

```
x = 'This is a string'                    # Single quote
y = "This is also a string"               # Double quote
z = '''This is a very long string
spanning across more than 1 line'''       # Multi-line

print(x)
print(y)
print(z)
```

```
This is a string
This is also a string
This is a very long string
spanning across more than 1 line
```

Primitive Data Types - Text

- String
  - Concatenation ➔ "+" ➔ glue 2 strings together

```
x = 'This is a string'
y = "This is also a string"
```

```
print(x + ' and ' + y)  # Adding 2 strings together
```

```
This is a string and This is also a string
```

Primitive Data Types - Text

- String
  - Concatenation ➔ Number vs Text

```python
lobster_price = 936
lobster_text = str(lobster_price)
print(2 * lobster_price)  # 1872
print(2 * lobster_text)   # 936936
```

```
1872
936936
```

```python
print(10 * '=')
print('WELCOME')
print(10 * '=')
```

```
==========
WELCOME
==========
```

1. 星島日報. (2023, May 6). *荃灣中菜館驚現「天價龍蝦」兩隻竟索價90萬元 酒樓親解釋*. Singtaousa.com; 星島日報. https://www.singtaousa.com/2023-05-06/%e8%8d%83%e7%81%a3%e4%b8%ad%e8%8f%9c%e9%a4%a8%e9%a9%9a%e7%8f%be%e3%80%8c%e5%a4%a9%e5%83%b9%e9%be%8d%e8%9d%a6%e3%80%8d-%e5%85%a9%e9%9a%bb%e7%ab%9f%e7%b4%a2%e5%83%b990%e8%90%ac%e5%85%83-%e9%85%92/4488305

Primitive Data Types - String formatting

- F-String (Python 3.6 or newer)
  - A smart way to format strings

```
x = 4
y = 8.8
f'x is {x} and y is {y}; y divided by x is {y / x}'
```

```
'x is 4 and y is 8.8; y divided by x is 2.2'
```

1. *Input and Output*. Python Documentation. https://docs.python.org/3/tutorial/inputoutput.html

Primitive Data Types - String formatting

- F-String (Python 3.6 or newer)
  - A smart way to format strings (advanced)

```
z = 1234.56789
print(z)
print(f'{z:.2f}')
print(f'{z:,.2f}')
```

```
1234.56789
1234.57
1,234.57
```

1. *Input and Output*. Python Documentation. https://docs.python.org/3/tutorial/inputoutput.html

Primitive Data Types - String

- Common Functions
  - upper() / lower() / replace()

```python
# Common functions
test_string = 'Hello Hong Kong!'
print(test_string.upper())
print(test_string.lower())
print(test_string.replace('Hello', 'Bello'))
```

```
HELLO HONG KONG!
hello hong kong!
Bello Hong Kong!
```

Primitive Data Types - Conversion

- **VBA**
  - CInt() / CDbl() / Format()

- **Python**
  - int() / float() / str() / bool()

```
int(4.5)
4
```

```
float(5)
5.0
```

```
str(5.55)
'5.55'
```

```
bool('Some values')
True
```

```
bool('')
False
```

Methods

- VBA
  - Sub-routine: reusable code blocks
  - Function: sub-routine which gives an output
- Python
  - Methods: Use "return" if output is required

VBA

```
Function AddNumbers(x As Double, y As Double) As Double
     AddNumbers = x + y
End Function
```

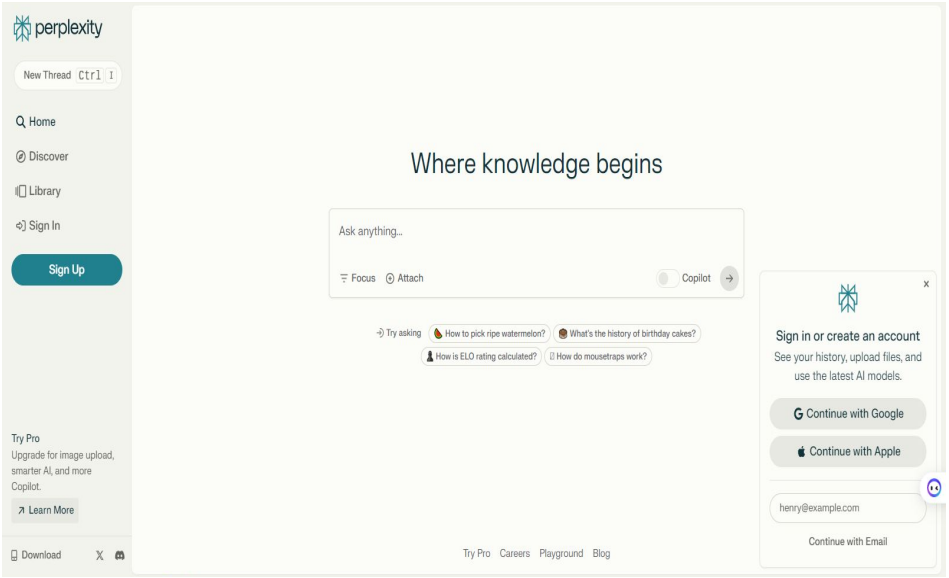
```
?AddNumbers(1,2)
 3
```

Python

```
def add_numbers(x, y):
    return x + y
```

```
def add_numbers(x, y):
    return x + y

print(add_numbers(1,2))
```

Generative AI Tools Introduction – Perplexity




```python
def compound_interest(principal, rate, time, n):
    """
    Calculate compound interest.

    principal: initial amount (float)
    rate: annual interest rate in decimal (e.g., 5% as 0.05)
    time: time in years (float)
    n: number of compounding periods per year (int)

    Returns:
    tuple containing (final amount, compound interest)
    """
    amount = principal * (1 + rate / n) ** (n * time)
    interest = amount - principal
    return amount, interest

# Example usage:
principal = 1000      # $1000
```

```
# Example usage:
principal = 1000      # $1000
rate = 0.05           # 5% interest rate
time = 10             # 10 years
n = 12                # compounded monthly

final_amount, interest = compound_interest(principal, rate, time, n)
print(f"Final Amount: ${final_amount:.2f}")
print(f"Compound Interest: ${interest:.2f}")
```

Output:

```text
Final Amount: $1647.01
Compound Interest: $647.01
```

- Enter https://www.perplexity.ai/
- Input prompt "write python compound interest calculations”

Practice 1 – Market Capitalization

- Compute market capitalization of 2 companies
- Show the difference between the two
- Format the result up to 2 decimal places

- **Starting notebook:**
  https://github.com/innoviai/IPA_Courses-July2025-/blob/main/practice1_simple_calc_202409.ipynb

Data Processing & Analysis
Decision Trees: Ensemble Linear Regression, Decision Tree

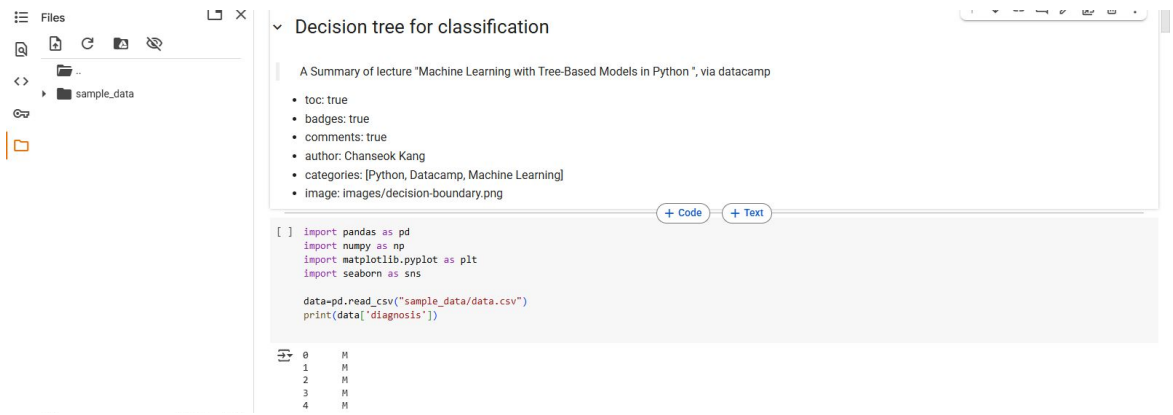
Practice 2 – Run machine learning model

Colab Lab Materials :

https://colab.research.google.com/drive/1T59haRQLd3KSL6rSa4CKFXG2AyRflcIP

Data :

https://github.com/innoviai/IPA_Courses-July2025-/blob/main/data.csv



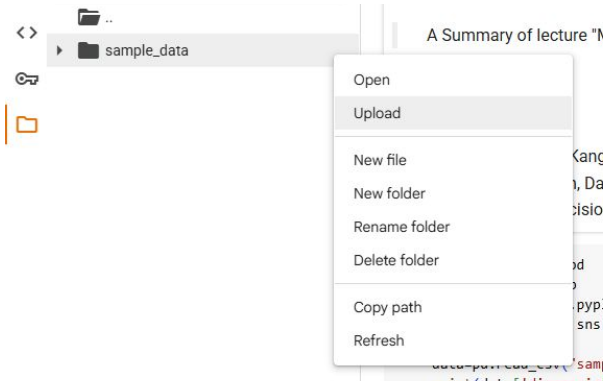
How to Fit a Decision Tree Model using Scikit-Learn

https://www.kdnuggets.com/2020/04/visualizing-decision-trees-python.html

Data Processing & Analysis
Decision Trees: Ensemble Linear Regression, Decision Tree

Practice 2 – Run machine learning model

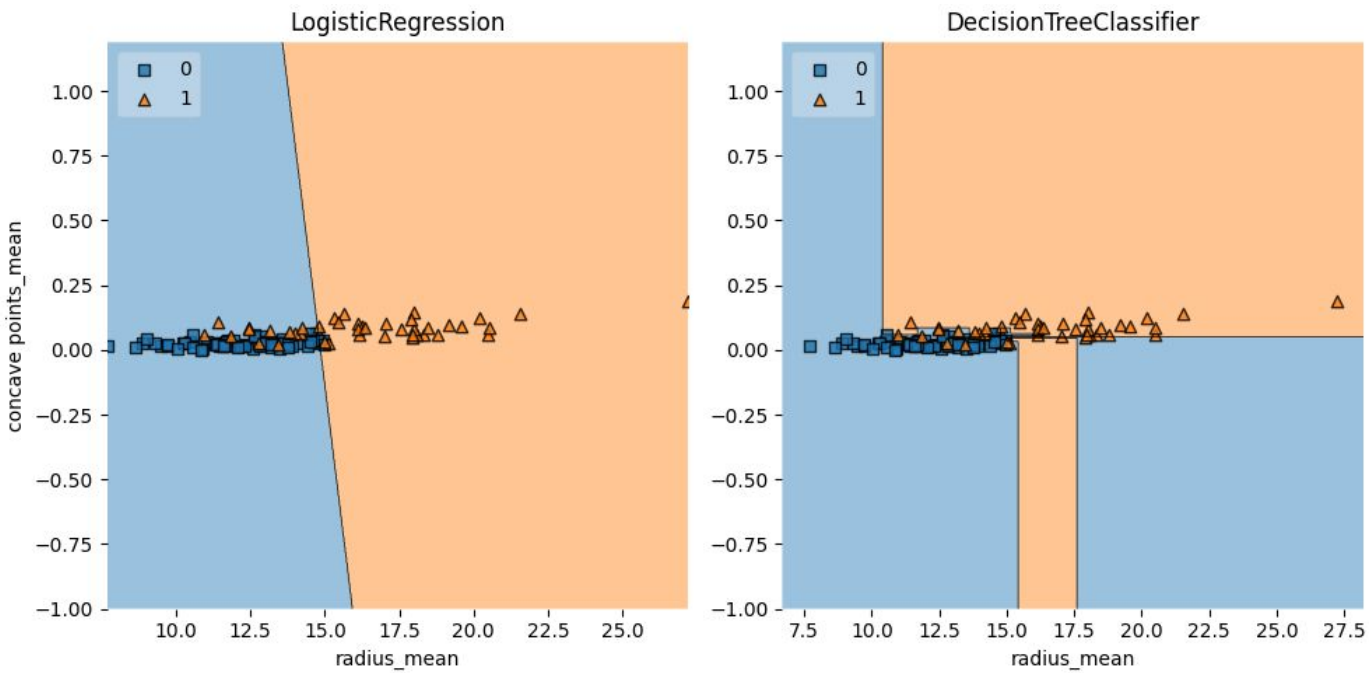
1. Open Colab Lab Materials at https://colab.research.google.com/drive/1T59haRQLd3KSL6rSa4CKFXG2AyRflcIP
2. Click File -> Save a copy in Drive
3. Download the data at https://github.com/innoviai/IPA_Courses-July2025-/blob/main/data.csv and save in C:\Users\user\data.csv
4. In colab, right click the sample files and click “Upload” ->select the data.csv



Data Processing & Analysis
Decision Trees: Ensemble Linear Regression, Decision Tree

Practice 2 – Run machine learning model

1. X = wbc[['radius_mean', 'concave points_mean']]
2. y = wbc['diagnosis']
3. y = y.map({'M':1, 'B':0})
4. X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=1)



How To Do Data Mining: Machine Learning Techniques

Artificial Intelligence

Artificial Intelligence (**AI**) is the science of making things smart. Can be defined as:

"Human intelligence exhibited by machines"

A broad term for getting computers to perform human tasks. The scope of AI is disputed and constantly changing over time. Let's go deeper...

How To Do Data Mining: Machine Learning Techniques

Machine Learning

An approach to achieve artificial intelligence through '*software*' systems that can ***learn*** from ***experience*** to find ***patterns*** in a ***set of data***.

Write a computer program
with **explicit rules** to follow

```
if email contains V!agrå
  then mark is-spam;
if email contains …
if email contains …
```

Traditional Programming

Write a computer program
to **learn from examples**

```
try to classify some emails;
change self to reduce errors;
repeat;
```

Machine Learning Programs

How To Do Data Mining: Machine Learning Techniques

Gathering Data

香港特別行政區政府
土地註冊處

香港特別行政區政府
差餉物業估價署

市區重建局
URBAN RENEWAL AUTHORITY

Source: https://www.becomingadatascientist.com/2017/07/17/introductory-machine-learning-terminology-with-food/

How To Do Data Mining: Machine Learning Techniques

Features / Attributes

Are used to train a Machine Learning algorithm

Facts and Features

Type Single Family	**Year Built** 1989	**Heating** Other
Cooling No Data	**Parking** 2 spaces	**Lot** 6,300 sqft

INTERIOR FEATURES

Bedrooms	**Flooring**
Beds: 6	Floor size: 3,138 sqft

Using a Home Valuation Prediction Model as an example

How To Do Data Mining: Machine Learning Techniques

Features / Attributes

Are used to train a Machine Learning algorithm

- Sales Price
- Saleable Area
- Number of Bedrooms
- Year built
- (Refurbished) Schools in the area
- Transportation (MTR, buses)

Address: 270-280 QUEEN'S ROAD WEST
Price per sqft.: 17,841
Qty transaction: 2
Year: 2017

Using a Home Valuation Prediction Model as an example

How To Do Data Mining: Machine Learning Techniques

Machine Learning

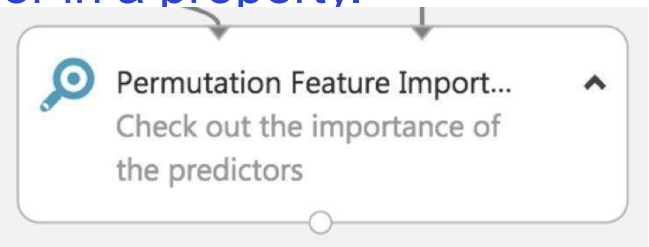
Feature	Score
SaleableArea	0.858545
Eff_Build_Ages	0.166877
Bus_Route	0.076519
Parks	0.019011

Choosing a 'useful' or ***significant*** feature (predictors) ***makes*** or ***breaks*** a data science project.

Domain experts, property agents will tell you what property buyers value in a home.

Data scientists would ***NOT*** have a clue what home buyers look for in a property.

But not all is lost!



Data Processing & Analysis - What Is Machine Learning?

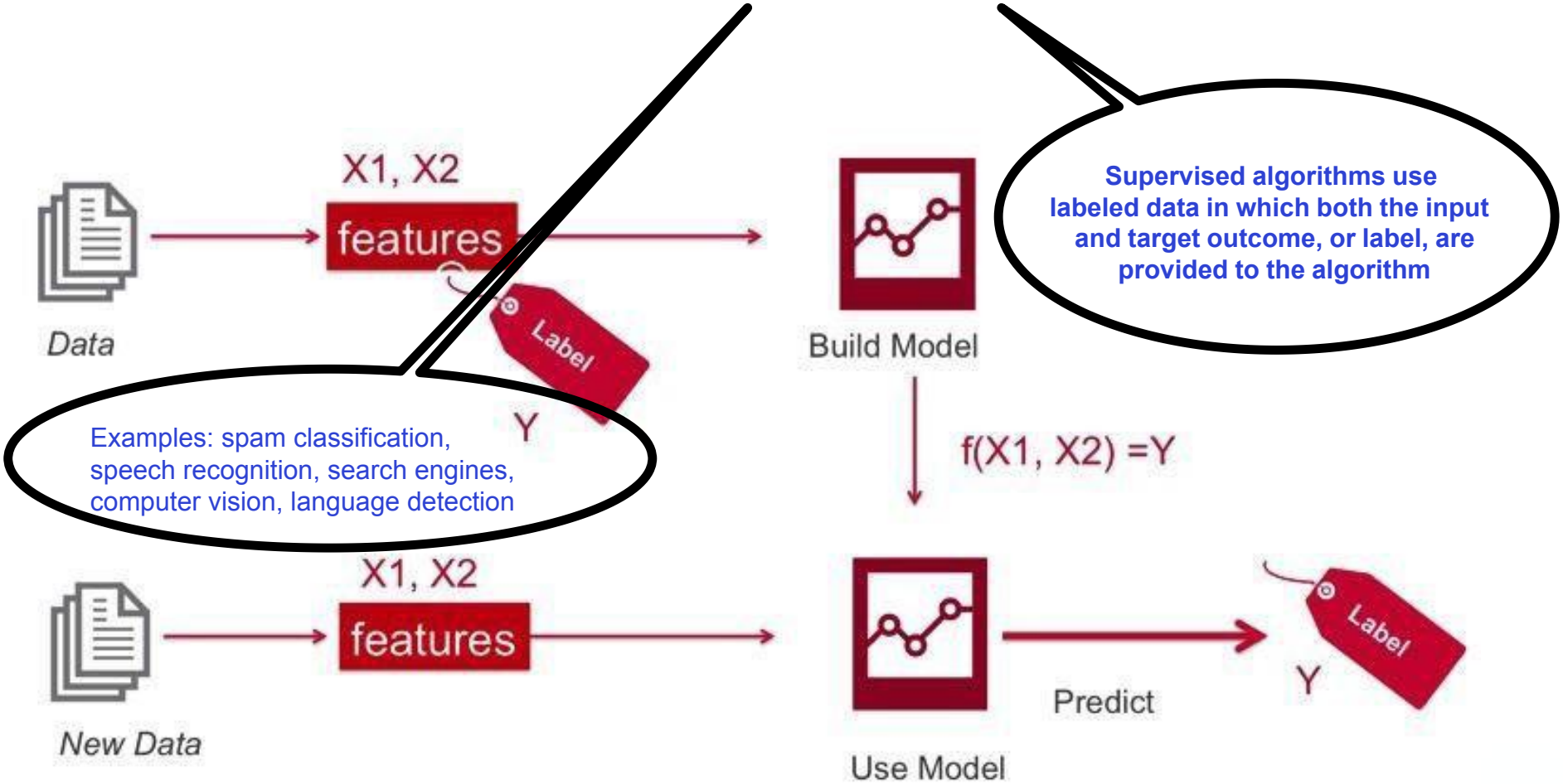
Supervised Learning	Unsupervised Learning
Used as an advanced form of *predictive modeling*	Used either as a form of automated data analysis or automated signal extraction
Each observation must be labeled with a "correct answer"	Unlabeled data has no predetermined "correct answer"
Only then can you build a predictive model because you must tell the algorithm what's "correct" while training it (hence, "supervising" it)	You'll allow the algorithm to directly learn patterns from the data (without "supervision")
Regression is the task for modeling continuous target variables	Clustering is the most common unsupervised learning task, and it's for *finding groups* within your data
Classification is the task for modeling categorical (a.k.a. "class") target variables	

Source: https://dzone.com/articles/demystifying-ai-machine-learning-and-deep-learning

Data Processing & Analysis
Supervised Learning: Classification For Debit Card Fraud

Source: https://dzone.com/articles/demystifying-ai-machine-learning-and-deep-learning

Data Processing & Analysis
Machine Learning: Supervised Learning



Supervised algorithms use labeled data in which both the input and target outcome, or label, are provided to the algorithm

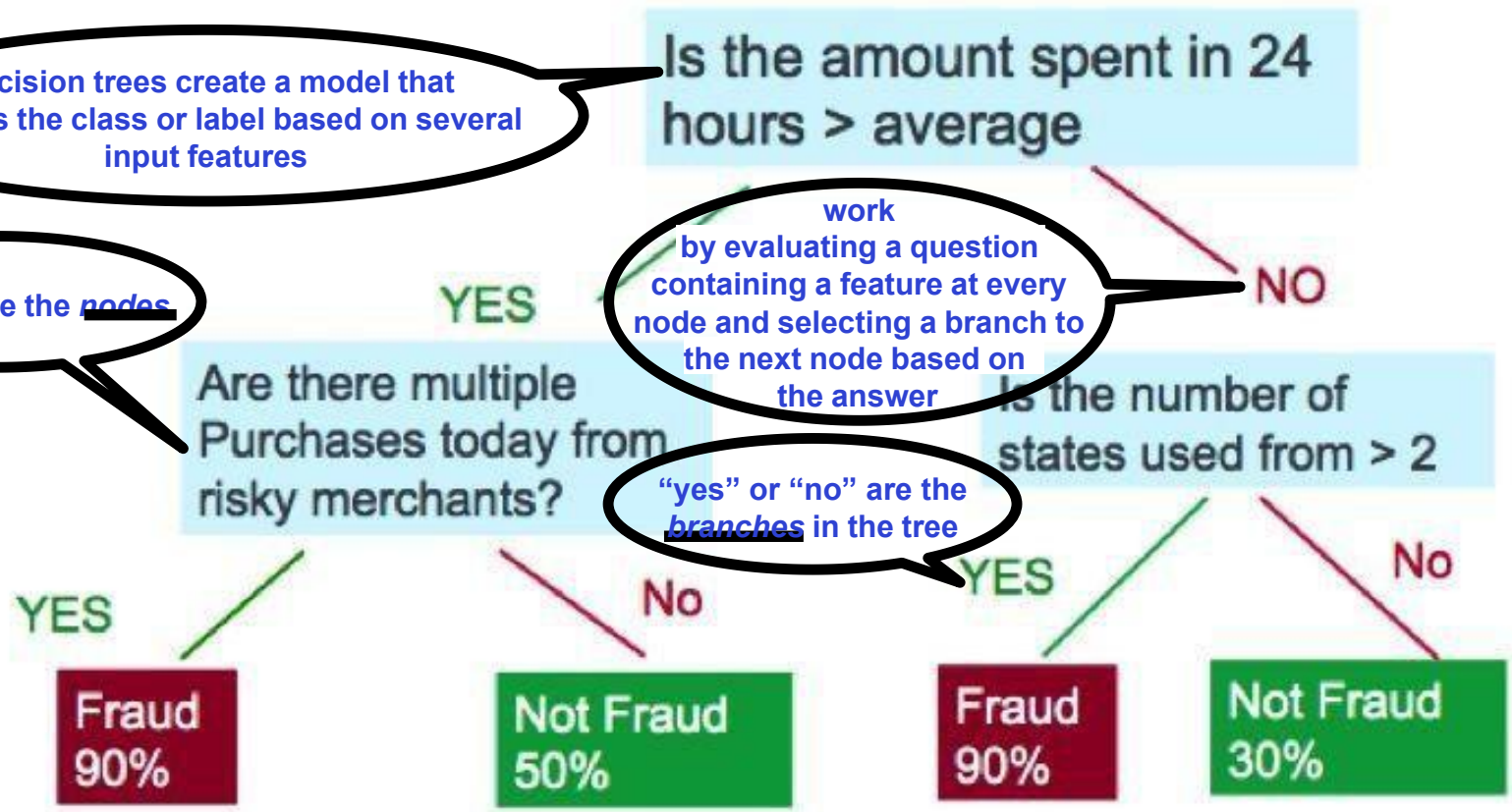
Examples: spam classification, speech recognition, search engines, computer vision, language detection

Source: https://dzone.com/articles/demystifying-ai-machine-learning-and-deep-learning

Data Processing & Analysis
Machine Learning: Decision Trees

decision tree for predicting debit card fraud

Decision trees create a model that predicts the class or label based on several input features



questions are the ***nodes***

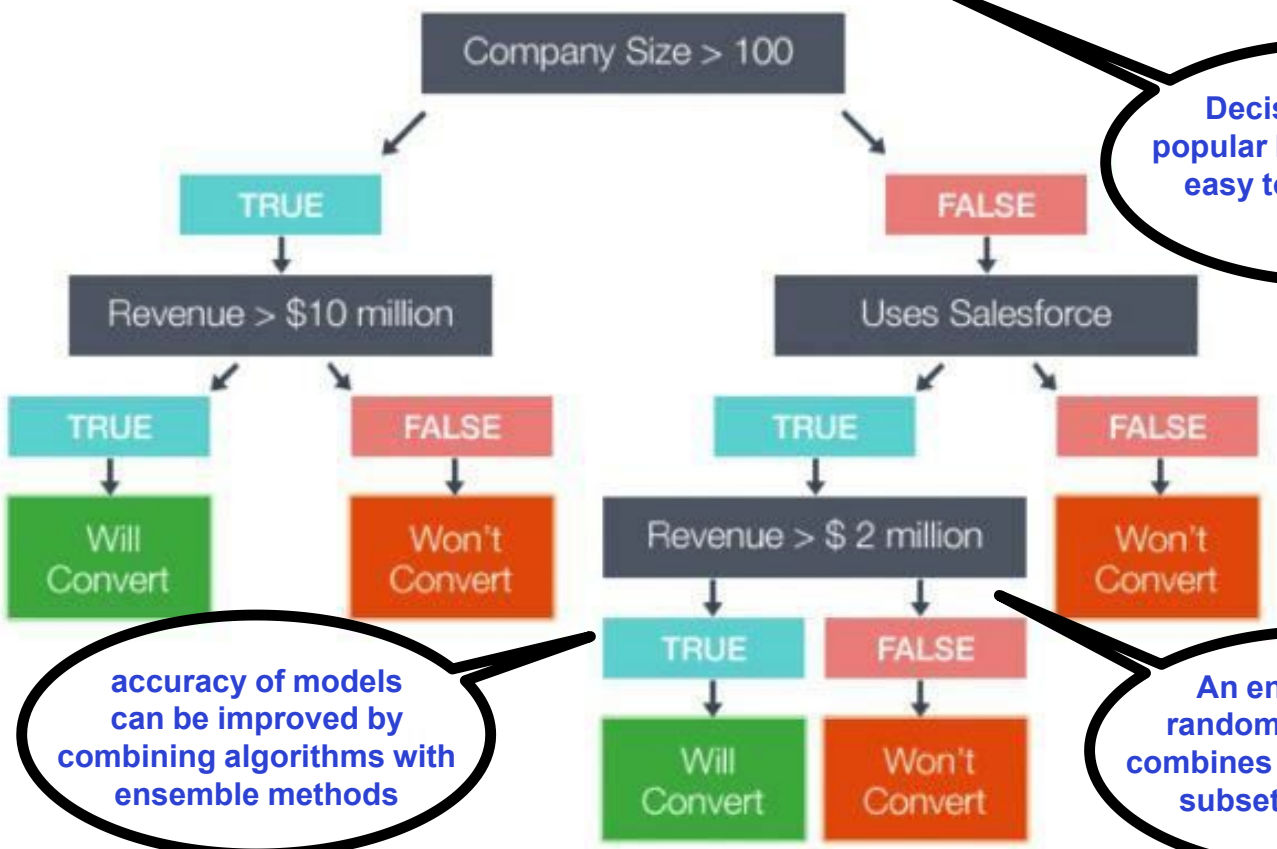
work by evaluating a question containing a feature at every node and selecting a branch to the next node based on the answer

"yes" or "no" are the ***branches*** in the tree

Source: https://dzone.com/articles/demystifying-ai-machine-learning-and-deep-learning

Data Processing & Analysis

Decision Trees: Ensemble Random Forests



Decision trees are popular because they are easy to visualise and explain

accuracy of models can be improved by combining algorithms with ensemble methods

An ensemble is a random forest, which combines multiple random subsets of decision trees

Source: http://dataconomy.com/2015/05/predictive-machine-learning-behind-the-scenes-at-fliptop-and-predictions-for-the-future-of-martech/

Data Processing & Analysis
Quick Test

Which Data Type is Structured/Unstructed, Discret/Continuous?

E-mails	
Digital Images	
Stock Market Logs	
Historical Gold Prices	
Credit Approval Records	
Social Media Friend Relationships	
Tweets & Trending Topics	
Sales Records	

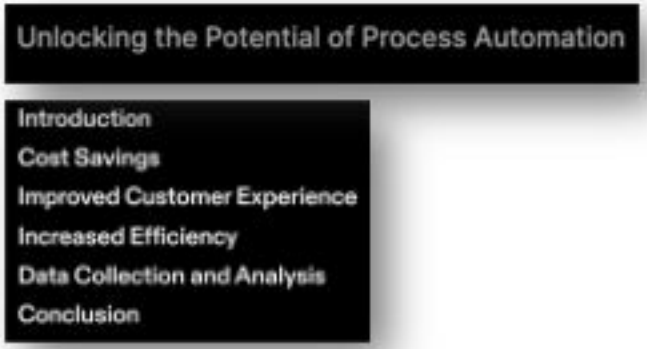
Source: Practical Data Analysis - Second Edition Hector Cuesta, Dr. Sampath Kumar OACKT Publishing BIRMINGHAM - MUMBAI

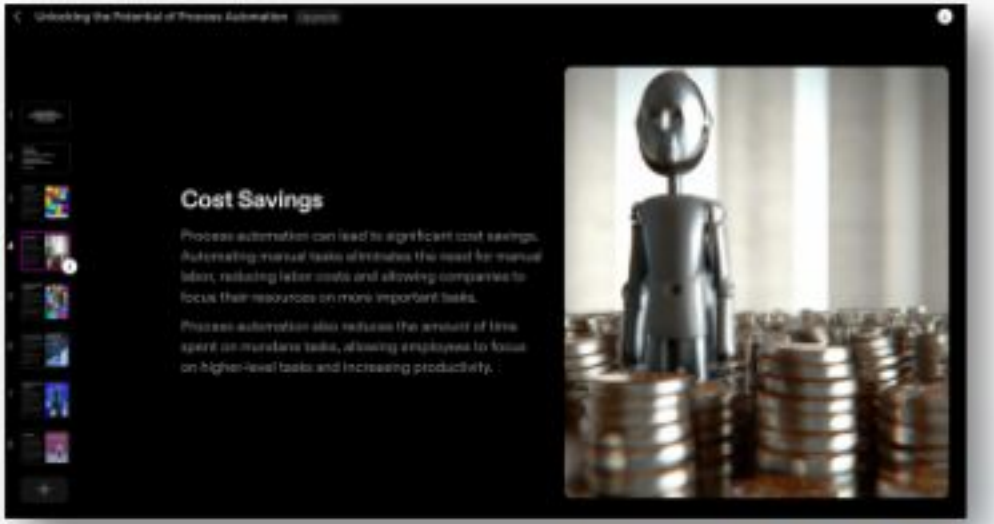
AI Applications

- You could be next Steve Jobs
  but please check what could be reused first!
- You can revisit this after you mastered Python ☺
- https://www.kaggle.com/models

AI Applications – Tome

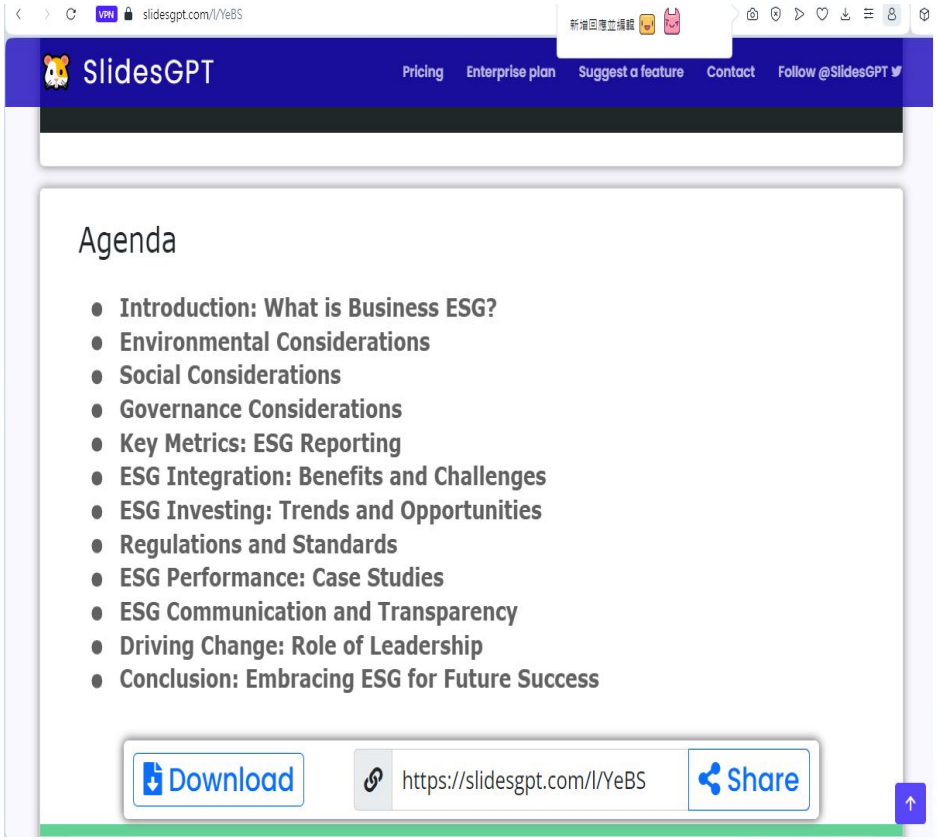
- Input ➔ Presentation topic
- Output ➔ Slides with outlines and artworks
- https://tome.app/





PPT AI Generator – SlideGPT

1. Open Browser and enter https://slidesgpt.com
2. Enter Prompt "I want to create a deck that includes Business ESG"



https://slidesgpt.com/l/YeBS

PPT AI Generator – SlideGPT

What is Business ESG?

ESG, Environmental, Social, Governance, Definition

- **ESG Framework:** ESG refers to Environmental, Social, and Governance factors that measure the sustainability and ethical impact of an investment in a business or industry.
- **Environmental Considerations:** The environmental aspect of ESG encompasses the impact of a company's operations on the environment, including resource usage, emissions, and waste management.
- **Social Considerations:** The social aspect of ESG evaluates a company's relationships with its employees, stakeholders, and the communities in which it operates, focusing on diversity, labor practices, and human rights.
- **Governance Considerations:** The governance aspect of ESG assesses the internal systems and controls of a company, including leadership, executive pay, shareholder rights, and ethical business practices.

Photo by Omar Quazi on Unsplash

Environmental Considerations

Environmental Impact, Climate Change, Carbon Footprint, Renewable Energy

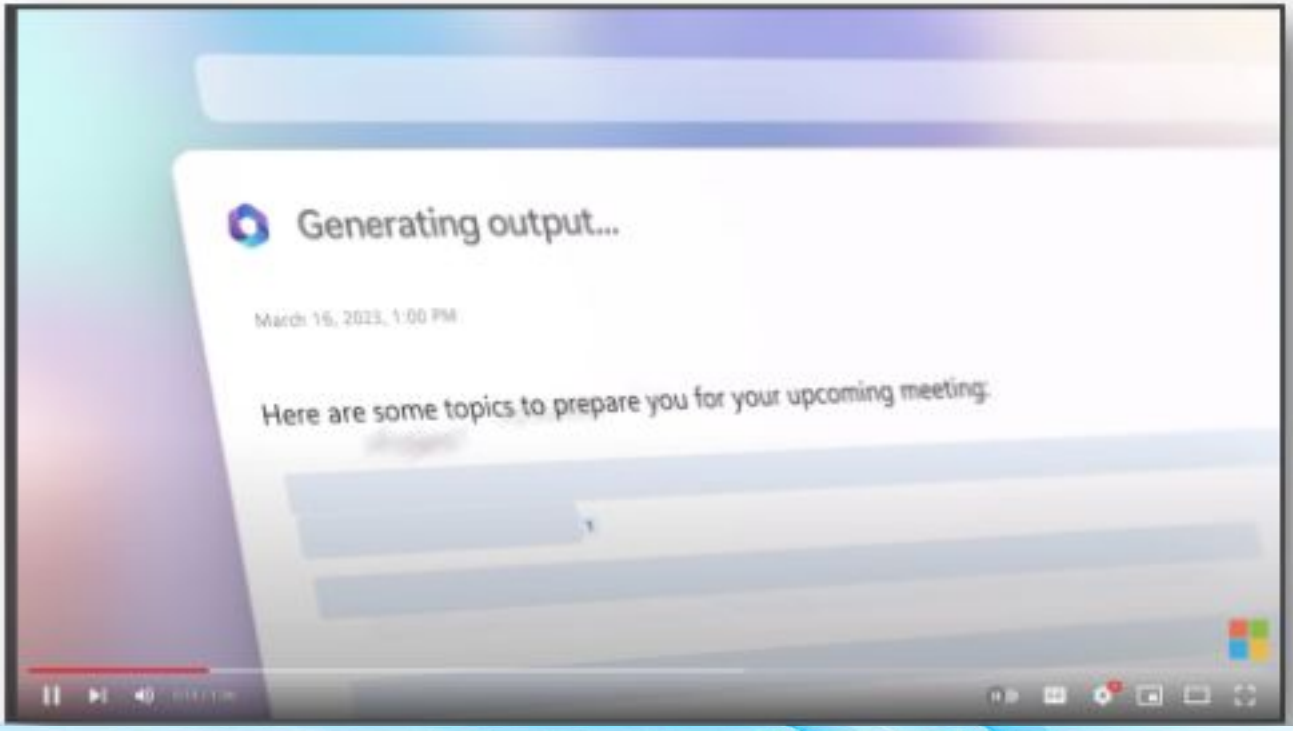
- **Environmental Impact:** Assessing and mitigating the impacts of business activities on the natural environment, ecosystems, and resource depletion.
- **Climate Change:** Understanding and addressing the contribution of business activities to climate change through the reduction of greenhouse gas emissions and adaptation strategies.
- **Carbon Footprint:** Measuring and managing the total amount of greenhouse gases emitted directly or indirectly by a company, including Scope 1, 2, and 3 emissions.
- **Renewable Energy:** Exploring and investing in sustainable and renewable energy sources to reduce reliance on non-renewable resources and minimize environmental impact.

Photo by Tomasz Bazylinski on Unsplash

https://slidesgpt.com/l/YeBS

AI Applications – Microsoft 365 Copilot

- Virtual Assistant
  - Word / Excel / PowerPoint / Outlook / Teams
- Ad: https://youtu.be/S7xTBa93TX8



AI Applications – Gemini

- Geolocation + Image/Video as Inputs
- Ad: https://youtu.be/s4InWsd-J6g?si=rwCwgMyHwUb40GAY&t=58

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THANK YOU