UNIVERSITAS AMIKOM YOGYAKARTA

Creative Economy Park

ARTIFICIAL INTELLIGENCE
MTI-PJJ

Mulia Sulistiyono, M.Kom

muliasulistiyono@amikom.ac.id

Learning Objective

Peserta mampu menjelaskan konsep dasar AI dengan benar dan mengidentifikasi pemanfaatan teknologi AI

Course SubTopics

- Definisi Artificial Intelligence
- Perancangan Intelligent Agent
- Jenis Teknologi Artificial Intelligence
- Perkembangan Teknologi Artificial Intelligence
- Penerapan Teknologi Artificial Intelligence
- Tantangan dalam Pengembangan Teknologi Artificial Intelligence

ARTIFICIAL INTELLIGENCE, IS IT A HYPE?

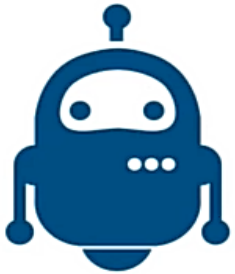


Image Processing

Facebook Face Recognition

Text Processing

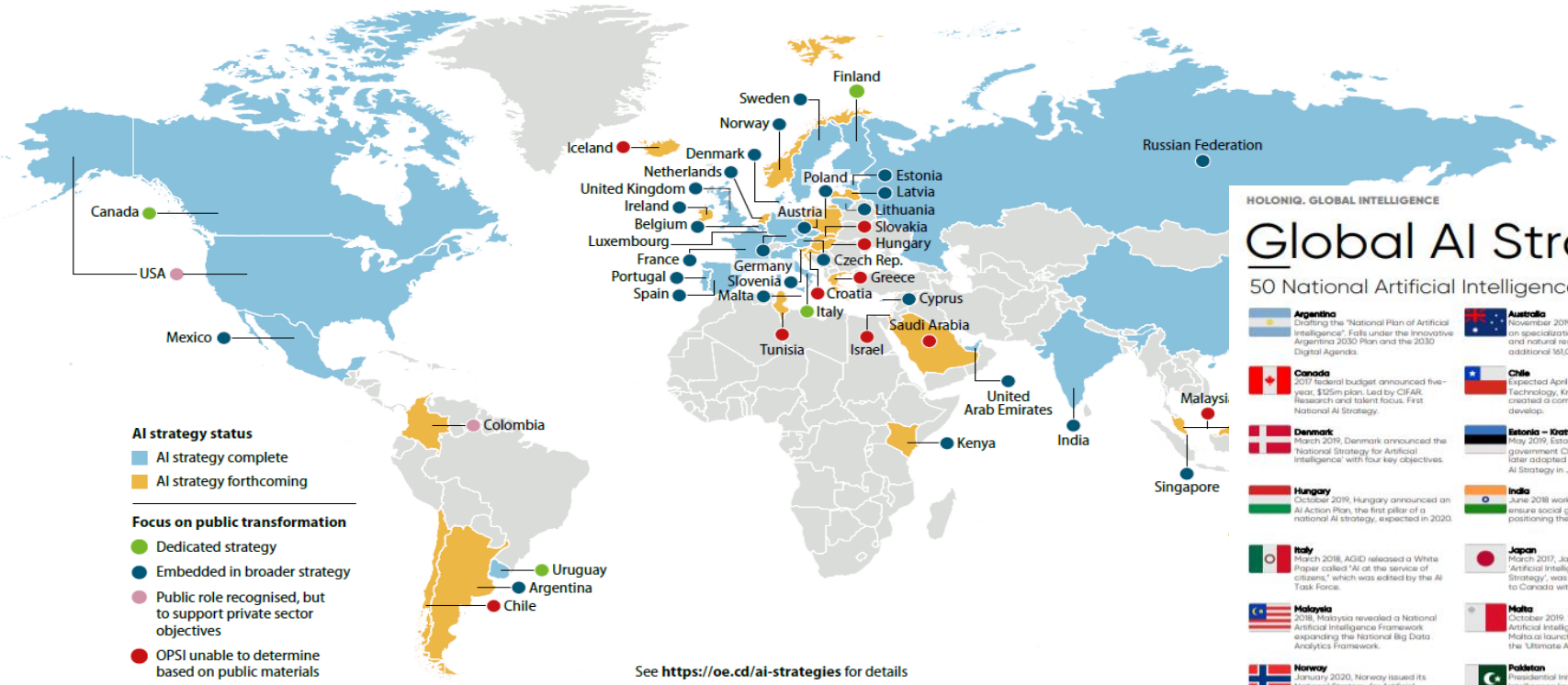
Google YAHOO! Yandex Aol. Ask.com Baidu 百度 Bing

IBM Watson

Speech Processing

Speech Recognition

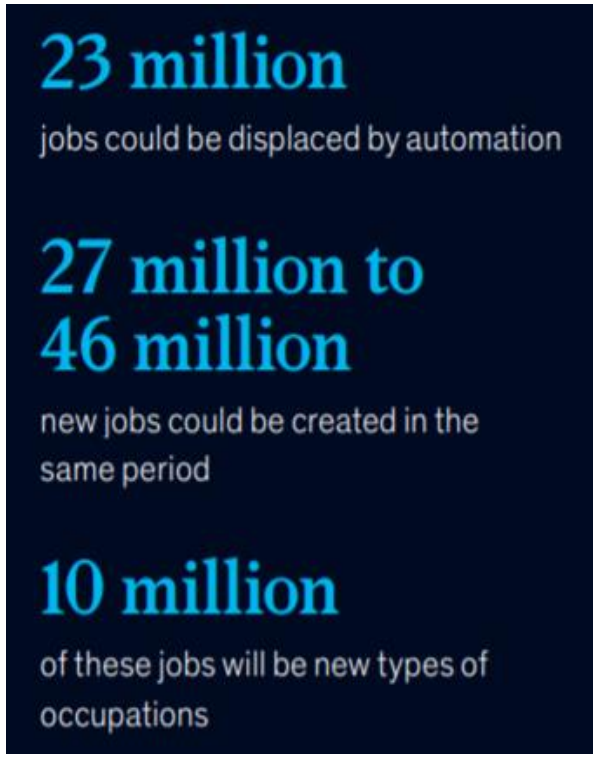
AI Di Berbagai Negara



AI as Disruptive Technology

- Jobs replaced by Artificial Intelligence technology are the repetitive one and can be easily predicted. Most of AI Technology aims to help human work
- Industry in Indonesia has started to use AI technology to reduce cost, increase revenue, giving added value to product

McKinsey: Sept 2019 Automation Effect in Indonesia:

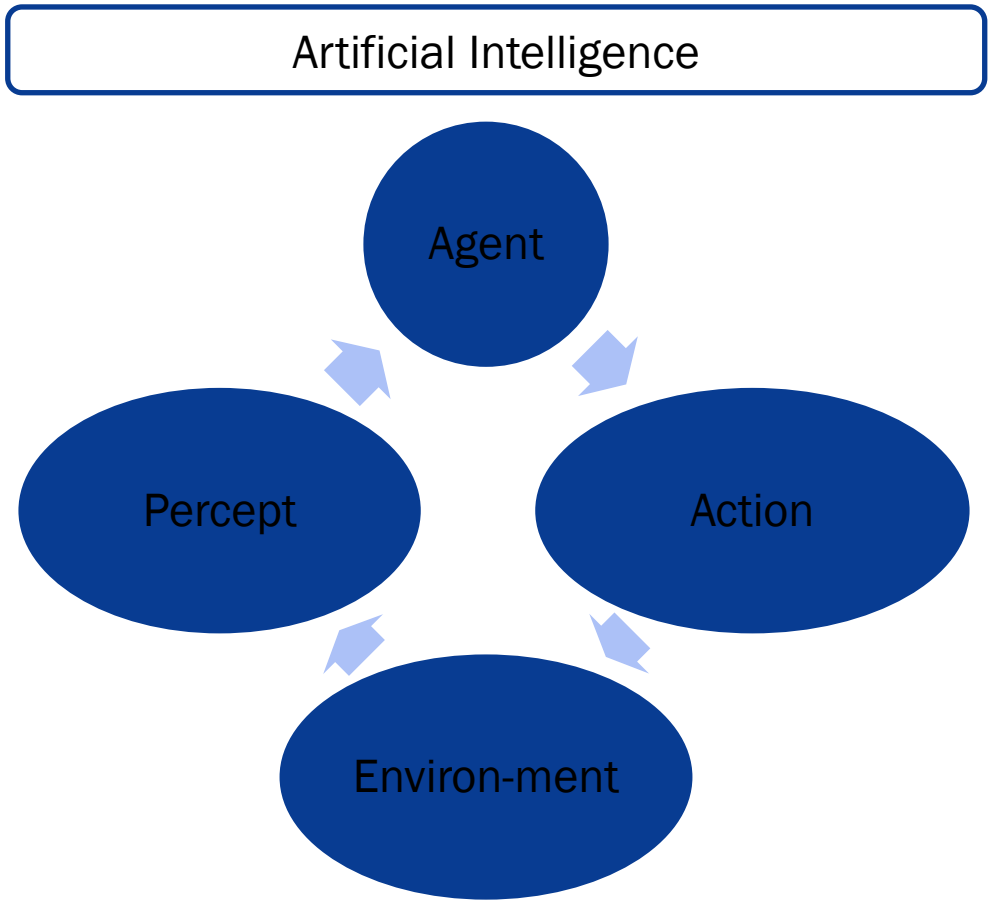


Artificial Intelligence Agent

Cloud Computing

Big Data

IoT



Internet of Things

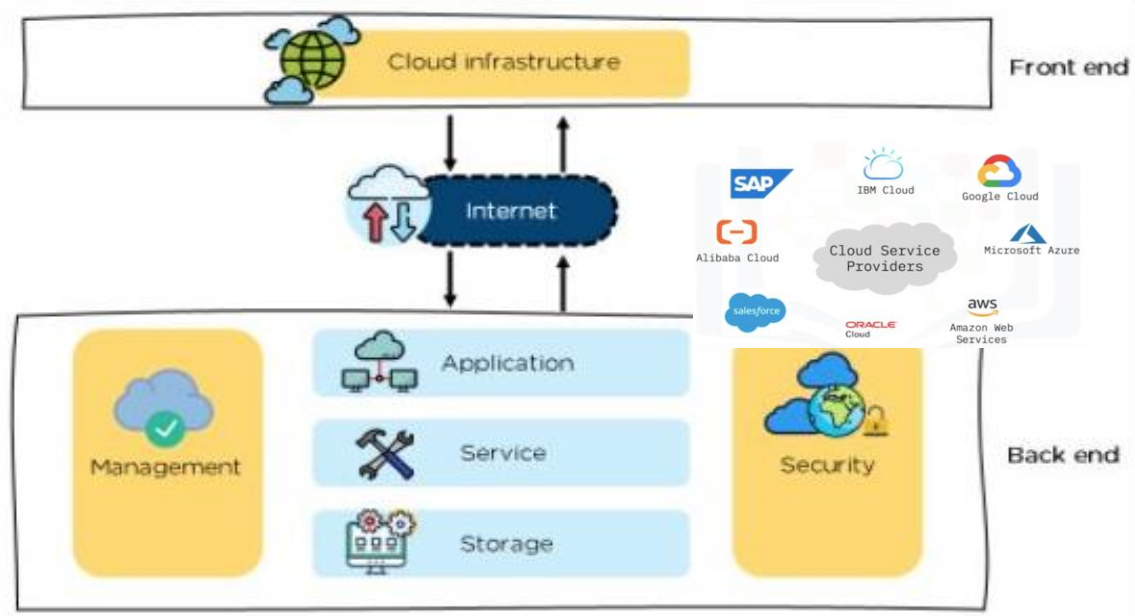
Definisi:

Peralatan/*gadget* sehari-hari atau objek yang terhubung dengan Internet dan memiliki kemampuan untuk mengumpulkan dan mengirimkan data

Contoh IoT pada keseharian/rumah dalam bentuk smart consumer goods: *smart bulb, smart light switch, smart doorlock, smart watch, smartphone, fitness tracker, smart tv, smart thermostat, smart toilet, smart bike lock* dll.

Cloud & Edge Computing

- Menyimpan dan memproses data di komputer (*datacenter*) orang lain melalui jaringan Internet
- Pemrosesan data di peralatan seperti smartphone (yang saat ini semakin powerful)
- Sudah banyak dipakai di kehidupan sehari-hari
  - Saat mengakses e-mail berbasis Web (misal Gmail)
  - Saat upload foto/video di Facebook/Youtube/Google Drive
  - Saat menggunakan Office 365, Google Doc
  - Saat order gojek atau booking hotel lewat apps di smartphone
- Untuk bisnis, platform untuk consumer services, inventory management, recruiting & HR, design, retail dan shipping (oleh cloud provider kebanyakan sudah disediakan sebagai “software-as-a-service”)



Sumber gambar: https://www.simplilearn.com/tutorials/cloud-computing-tutorial/cloud-computing-architecture

Big Data

Statistics and Probability

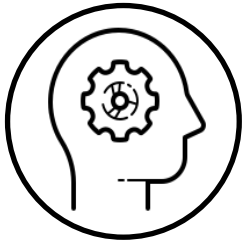
1900

Data Warehouse

1980

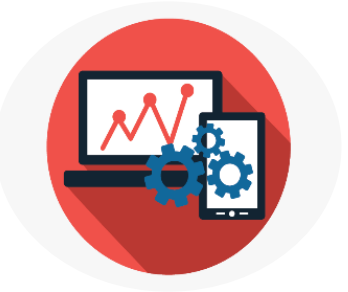
Data Mining

1990



AI - Machine Learning

2000



Big Data

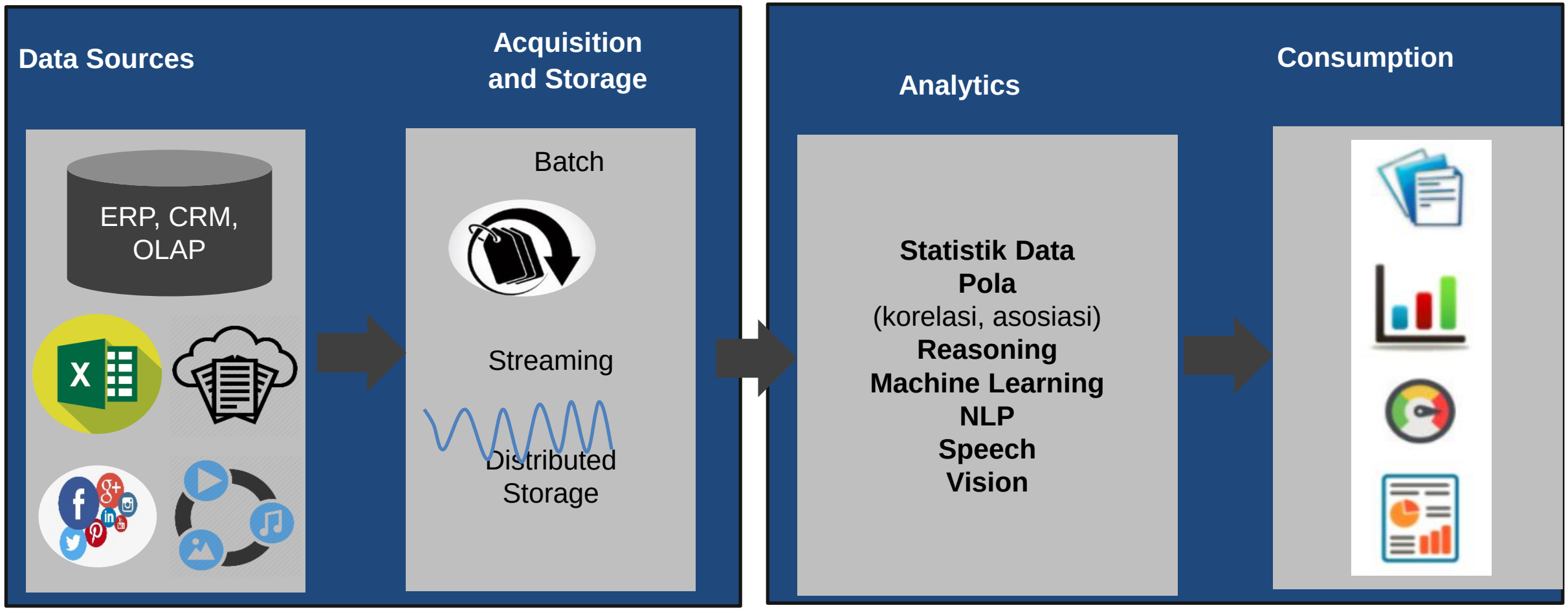
Today

Big Data

- High-volume, high-velocity, and/or high-variety information assets
- Require new forms of processing: capture, curation, storage, search, sharing, transfer, analysis, visualization
- To enable:
  - enhanced decision making
  - insight discovery
  - and process optimization

- **Karakteristik Big Data**
  - Velocity: kecepatan data yang dihasilkan (per detik, per menit, per jam, per hari, dst).
  - Volume: jumlah data yang diakumulasikan (terabyte, petabyte, exabyte, zettabye, yottabyte dst)
  - Variety: jenis/ragam data yang bermacam-macam: terstruktur, semi-terstruktur, tidak terstruktur (teks, suara, gambar, video dll)
  - Veracity: kesesuaian dengan fakta dan akurasi (khususnya dari data tidak terstruktur)
  - Value: kemampuan untuk mengubah data ke value (profit, manfaat medis & social, customer satisfication)

Ekosistem Big Data



Analytics on Data

01

Descriptive:
Menjelaskan keadaan bisnis saat ini melalui data historis.

02

Diagnostic:
Menjelaskan mengapa suatu masalah terjadi dengan melihat data historis.

03

Predictive:
Memproyeksikan atau memprediksi hasil masa depan berdasarkan data historis.

04

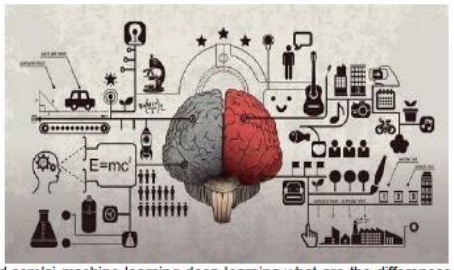
Prescriptive:
Menggunakan hasil analitik prediktif dan pengetahuan lain dengan menyarankan upaya terbaik di masa depan.

Definisi Artificial Intelligence

Thinking Humanly	Thinking Rationally
"The exciting new effort to make computers think.. Machines with minds, in the full and literal sense" (Haugeland, 1985) "[The automation of] activities that we associate with human thinking, activities such as decision making, problem solving, learning …" (Bellman, 1978)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	**Acting Rationally**
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990) "The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"Computational Intelligence is the study of the design of intelligent agents." (poole et al., 1998) "AI .. Is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

Definisi Artificial Intelligence (2)

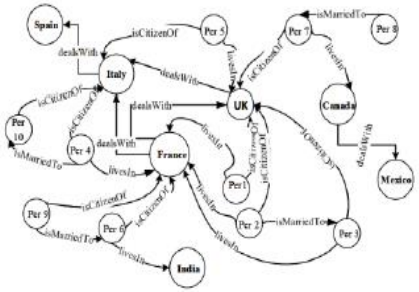
Thinking humanly



https://levelup.gitconnected.com/ai-machine-learning-deep-learning-what-are-the-differences-3c2c13c0388e

Acting humanly

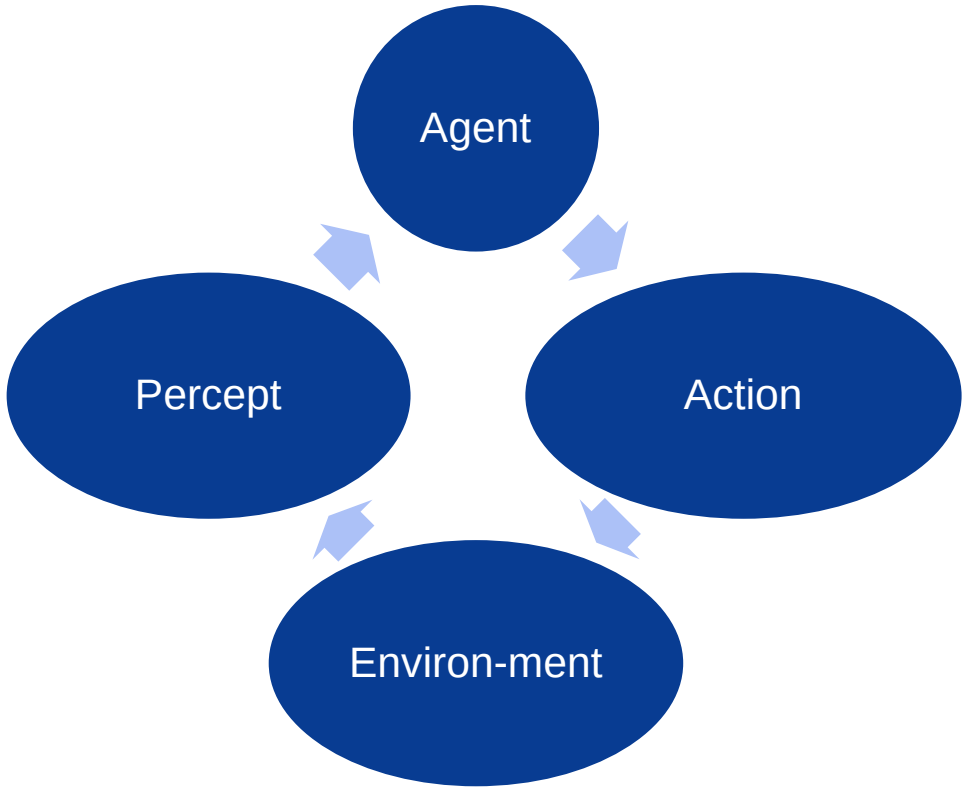
https://www.bloomberg.com/features/2020-self-driving-car-race/



Thinking rationally

Acting rationally

Intelligent Agent



Merancang PEAS:

- **Performance**/Pengukuran performansi: aman, cepat, tidak melanggar aturan lalu lintas, kenyamanan penumpang
- **Environment**/Lingkungan: jalan, rambu-rambu lalu lintas, kendaraan lain, penumpang
- **Actuator**: kemudi, gas, rem, klakson
- **Sensor**: kamera, sonar, speedometer, GPS

Environment Type

Fully observable (vs. partially observable)	An agent's sensors give it access to the complete state of the environment at each point in time.
Deterministic(vs. stochastic)	The next state of the environment is completely determined by the current state and the action executed by the agent. (If the environment is deterministic except for the actions of other agents, then the environment is strategic)
Episodic (vs. sequential)	The agent's experience is divided into atomic "episodes" (each episode consists of the agent perceiving and then performing a single action), and the choice of action in each episode depends only on the episode itself

Environment Type (2)

Static (vs. dynamic)	**The environment is unchanged while an agent is deliberating.**
Discrete(vs. continuous)	A limited number of distinct, clearly defined percepts and actions.
Single agent(vs. multiagent)	An agent operating by itself in an environment
Known(vs Unknown)	This distinction refers not to the environment itself but to the agent's (or designer's) state of knowledge about the "laws of physics" of the environment

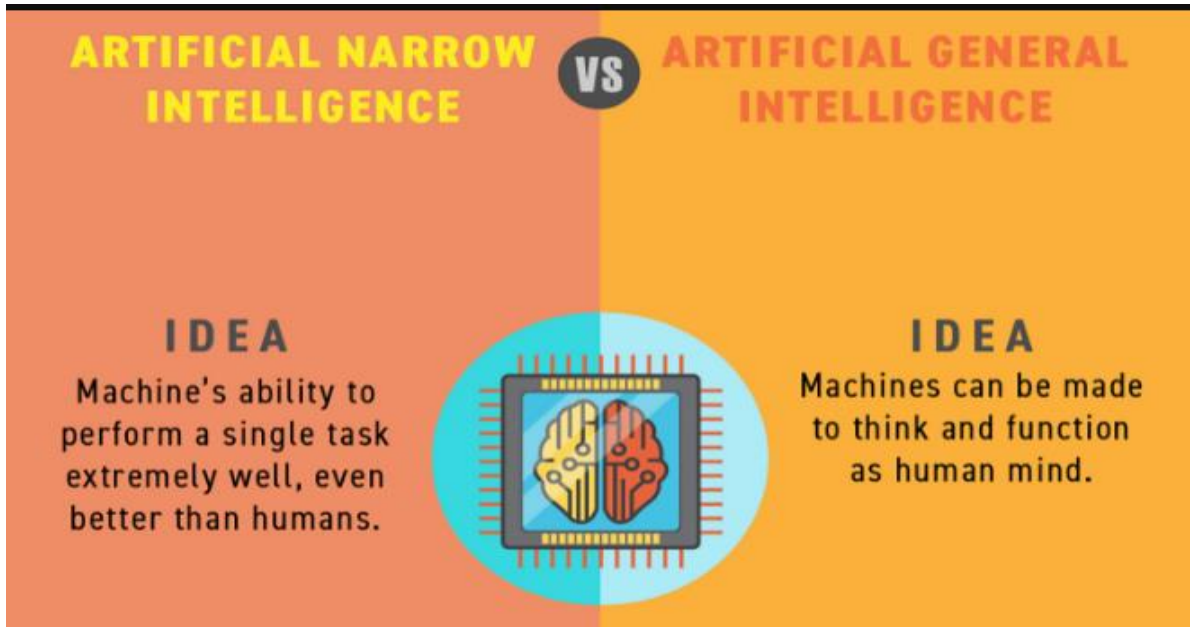
Example on Environment Type

	Chess with a clock	Chess without a clock	Taxi driving
Fully Observable	Yes	Yes	No
Deterministic	Deterministic	Deterministic	No
Episodic	No	No	No
Static	Semi	Yes	No
Discrete	Yes	Yes	No
Single agent	No	No	No

- The environment type largely determines the agent design
- The real world is (of course) partially observable, stochastic, sequential, dynamic, continuous, multi-agent

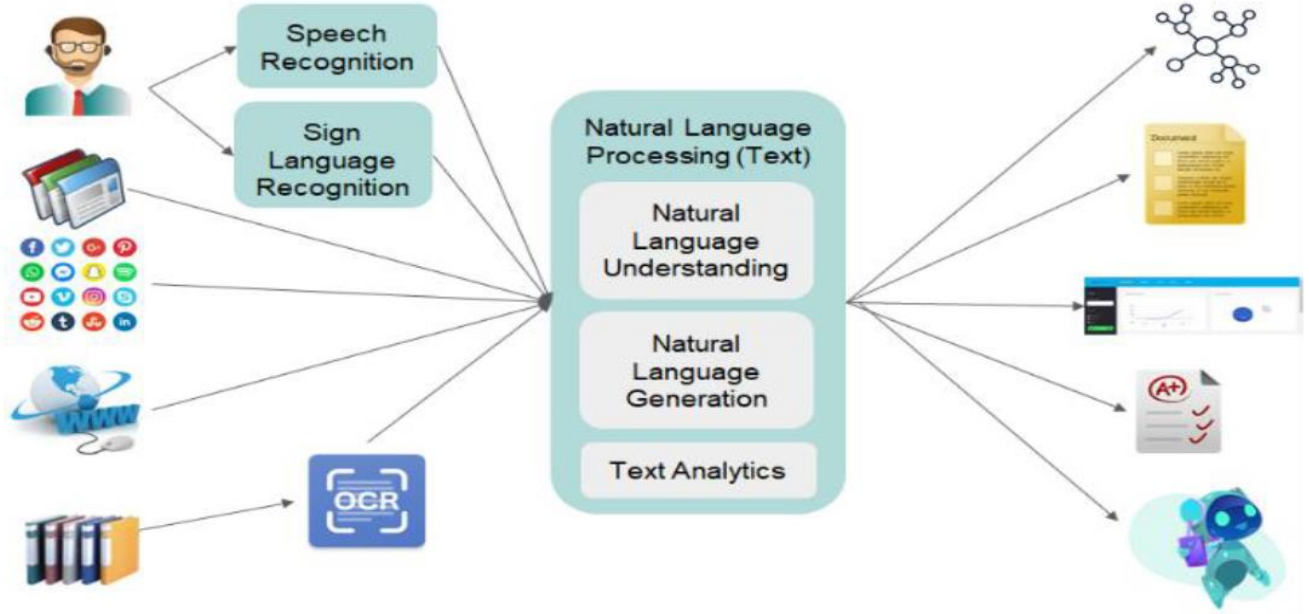
Pembagian Jenis Teknologi Artificial Intelligence (1)

- Berdasar **task scope**:
  - Artificial Narrow Intelligence (ANI) – weak AI: teknologi AI yang ditujukan untuk melakukan satu task khusus
    - Contoh: chatbot pemesanan tiket pesawat, klasifikasi jenis penyakit kulit
  - Artificial General Intelligence (AGI) – strong AI: teknologi AI yang bisa menangani semua task yang dilakukan manusia

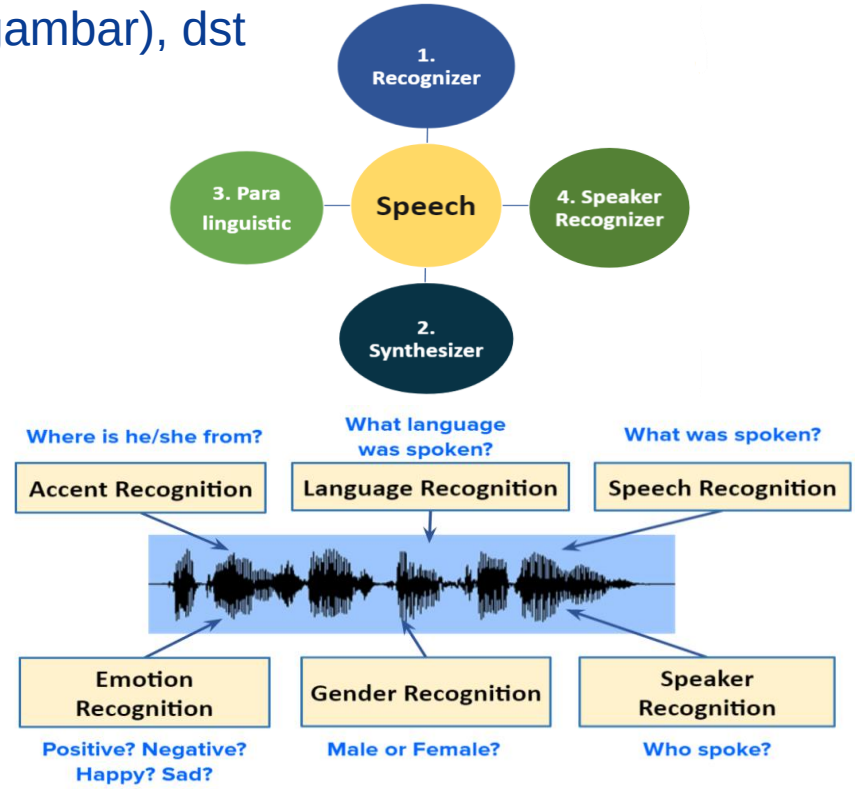


Pembagian Jenis Teknologi Artificial Intelligence (2)

- Berdasar **domain persoalan**:
  - Teknologi AI juga dapat dibagi menjadi cabang-cabang domain persoalan yang diselesaikan, contohnya: Natural language processing (input/output berupa Bahasa), Speech Processing (input/output berupa sinyal suara), Image Processing/Computer Vision (input/output berupa gambar), dst



Gambar Lingkup Teknologi Natural Language Processing (Text)



Pembagian Jenis Teknologi Artificial Intelligence (3)

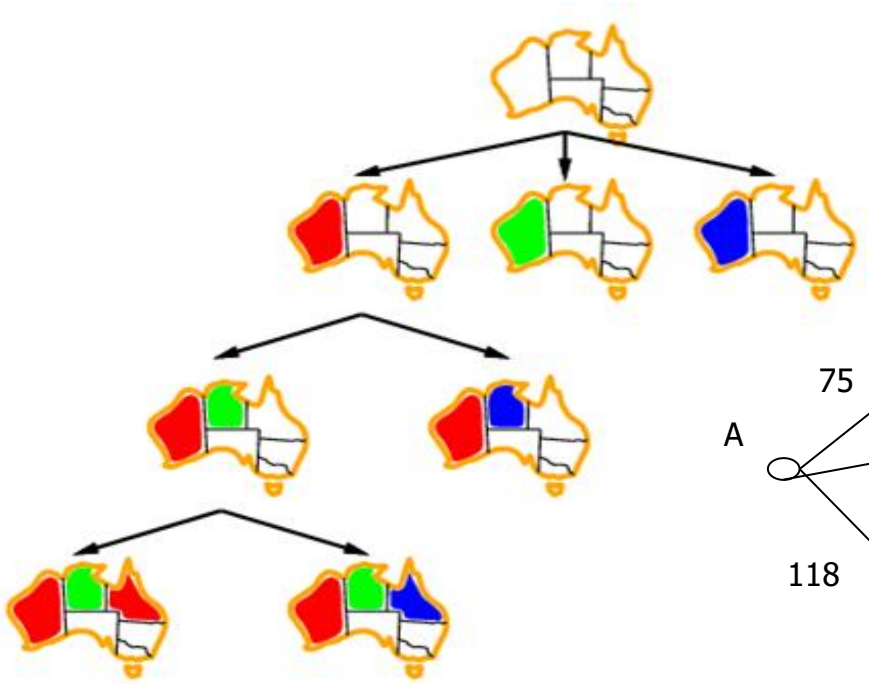
- Berdasar **prinsip kerja** dalam teknologi AI:
  - **Problem solving agent**
    - Solution state space sudah terdefinisi, agent bertugas mencari solusi terbaik dari solution state space tersebut
    - Diselesaikan menggunakan searching algorithm
  - **Knowledge based agent**
    - Solution state space belum terdefinisi (non deterministic)
    - Agent mencari solusi berdasar knowledge yang dimiliki dimana knowledge dapat berasal dari expert/sumber informasi atau berdasar knowledge yang dipelajari (**learning agent**) dari data

Problem Solving Agent

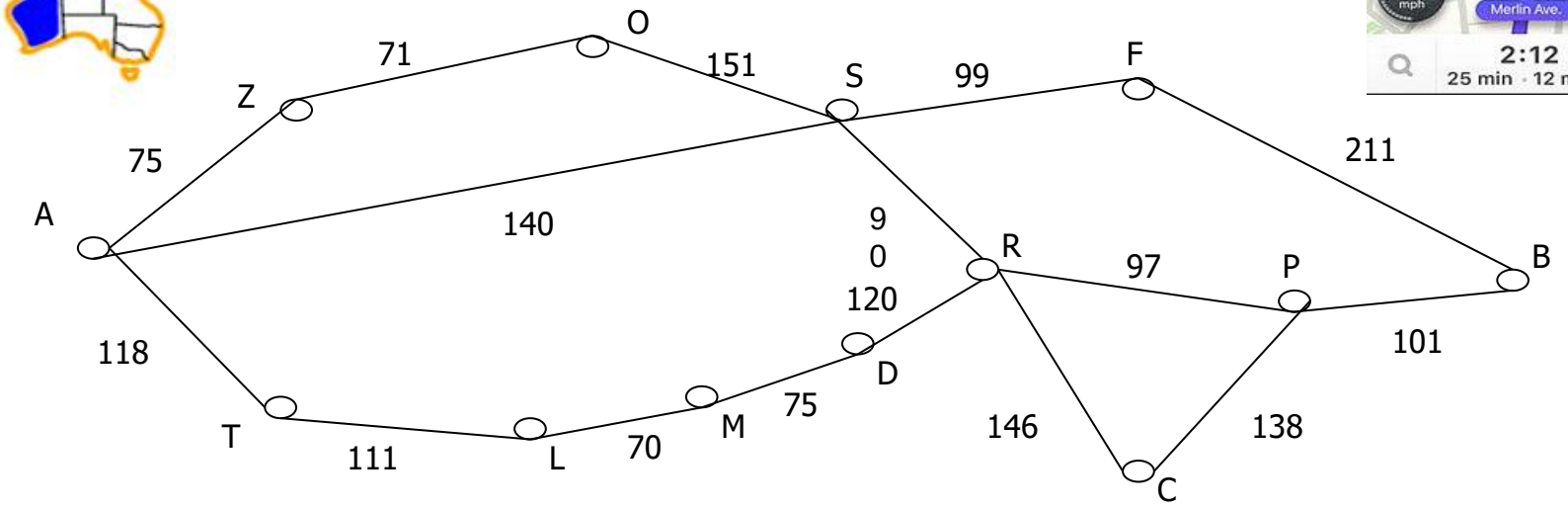
- Agent design:
  - formulate problem → search solution → execute
  - Task Environment: Remember PEAS
- Problem: satisfy goal (goal state)
  - Agent task: find out which sequence of actions will get it to a goal state
  - 4 components of **a problem**: initial state, operator/successor function, goal test, path cost
- Searching: process of looking for sequence of action
- Solution: sequence of action to goal state

Agent knows world dynamics
World states, actions
[when agent doesn't know →learning]
World state is finite, small enough to enumerate
[when state is infinite →logic]
World is deterministic
[when non-deterministic →uncertainty]
Agent knows current state
[when agent doesn't know → logic, uncertainty]
Utility for a sequence of states is a sum over path

Contoh Persoalan pada Problem Solving Agent



Map Coloring

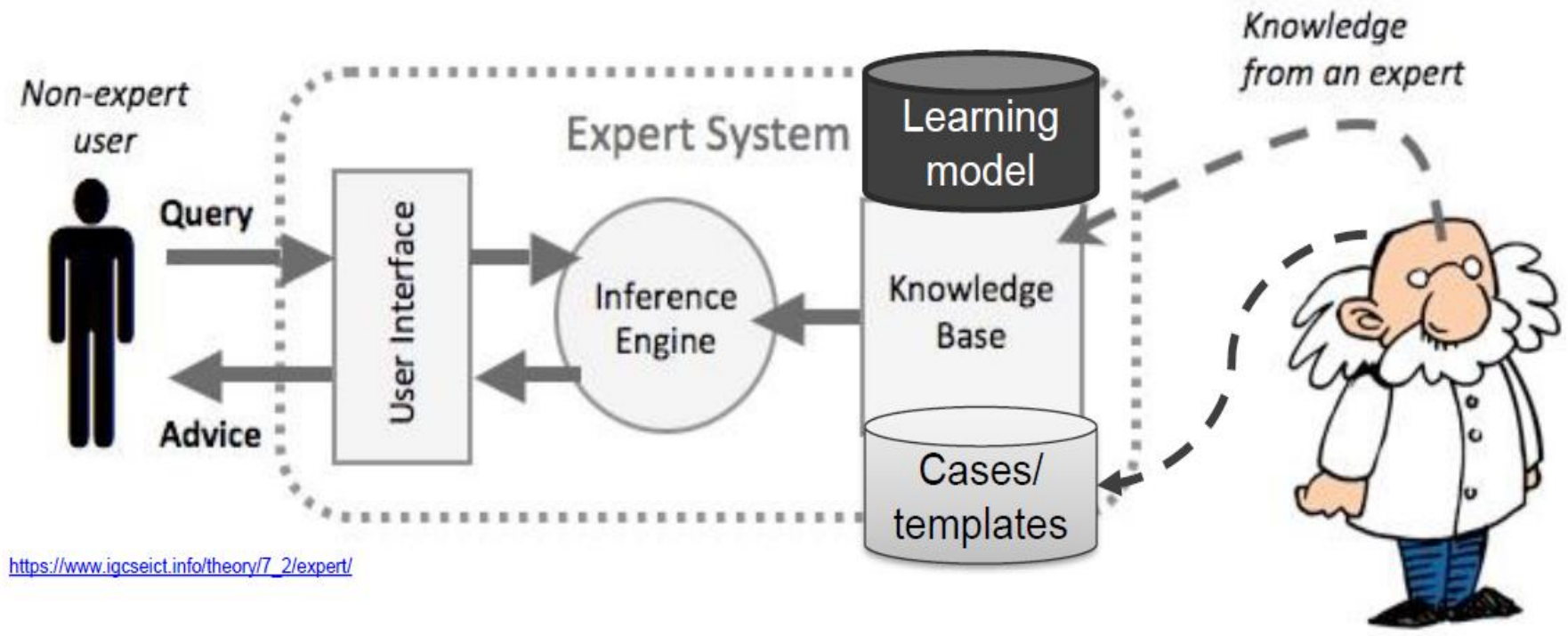


Route Planning

Searching Algorithm pada Problem Solving Agent

- **UnInformed/Blind Search**
  - Look around, don't know where to find the right answer
  - No additional information beyond that provided in problem definitional
  - Example: DFS, BFS, IDS, UCS , DLS
- **Informed Search**
  - Heuristic Search
    - Know some information that sometimes helpful
    - Know whether one non-goal state is "more promising" than another
    - Example: Best FS, A*,
- **Local Search (for Optimization Problem) Beyond Classical Search**
  - Path to goal is irrelevant
  - Use very little memory
  - Can find reasonable solutions in large or infinite state spaces for which systematic algorithms are suitable
  - Example: Hill-climbing search, simulated annealing search, GA

Knowledge based Agent



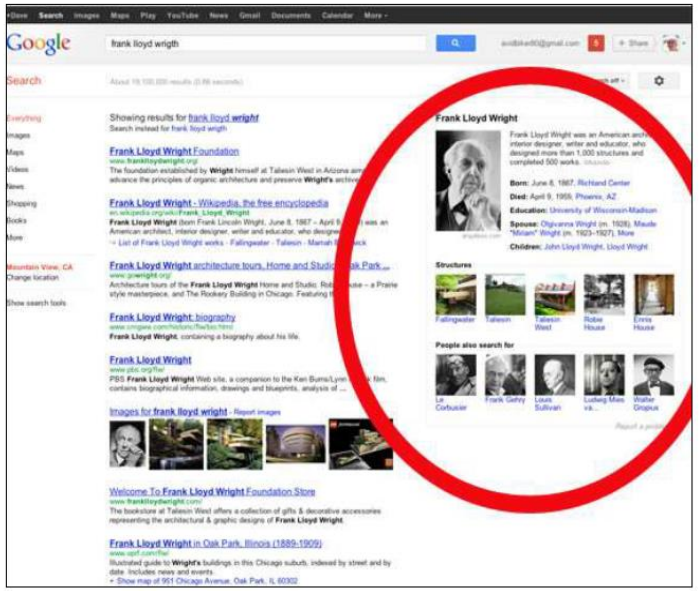
KBS vs Conventional Program

KBS	Conventional Program
ill structured problem (uncertain solution, undefined goal, unknown operator)	well structured problem (exact/certain solution, explicit goal, explicit operator)
expert determine actions, but execution order by interpreter	programmer determines actions and execution order
problem solving method + domain knowledge + data	algorithm + data

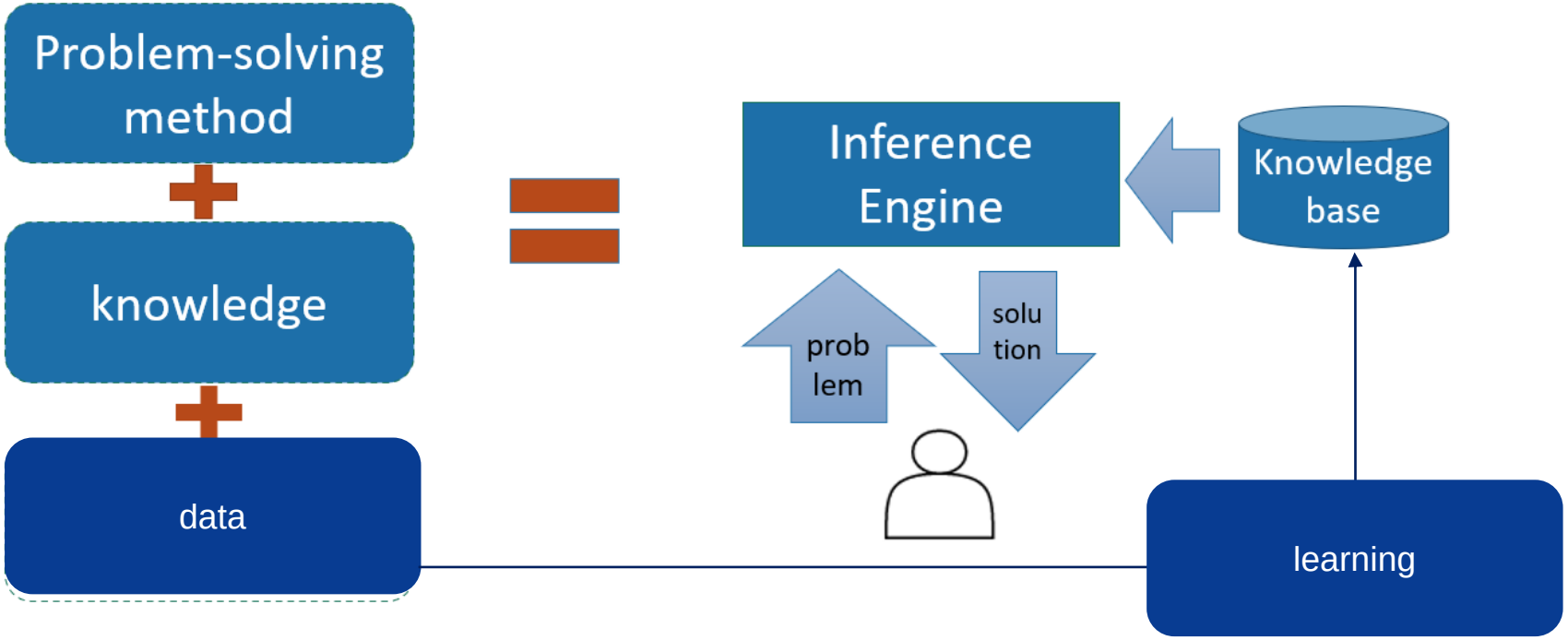
Pendekatan pada KBS

- Symbolic vs Statistical
- Statistical □ speech recognition, vision
- Why symbolic still needed?
  - Explanation
  - Planning
  - Diagnosis
- Many AI systems are hybrid:
  - Watson
  - SIRI

Google knowledge graph



Alur Proses dalam KBS



Symbolic based KBS: Knowledge Type

- Declarative knowledge
  - Know about something: concepts, facts, objects
  - Also called descriptive knowledge
- Procedural knowledge
  - Knowing how to do something: rule, strategy, procedure, agenda
  - Also known as imperative knowledge
- Meta knowledge
  - Knowledge about other type of knowledge
- Heuristic knowledge
  - Representing knowledge in a field/subject
  - Rules of thumb based on previous experience, good to work but not guaranteed
- Structural knowledge
  - Describe relationship between concepts such as kind-of, part-of, group of something

Symbolic based KBS: Knowledge Representation Technique

Production Rules

- rule as condition and action pair
- forward & backward chaining

Logical Representation

- propositional logic, first order logic, default logic, etc

Semantic Networks

- knowledge as a form of graphical networks

Frame Representation

- As structure consists of collection of attributes and its values to describe an entity in the world

Statistical based Knowledge Based System

- Learning Agent
  - Changes in the system that are adaptive in the sense that they enable the system to do the task or tasks drawn from the same population more efficiently and more effectively the next time
- Why need learning?
  - Learning is essential for unknown environment
    - i.e., when designer lacks omniscience, agent doesn't know world dynamic
  - Learning is useful as a system construction method
    - i.e., expose the agent to reality rather than trying to write it down
  - Learning modifies the agent's decision mechanism to improve performance
    - Learning from observations, feedback for improving the agent's ability to act in the future

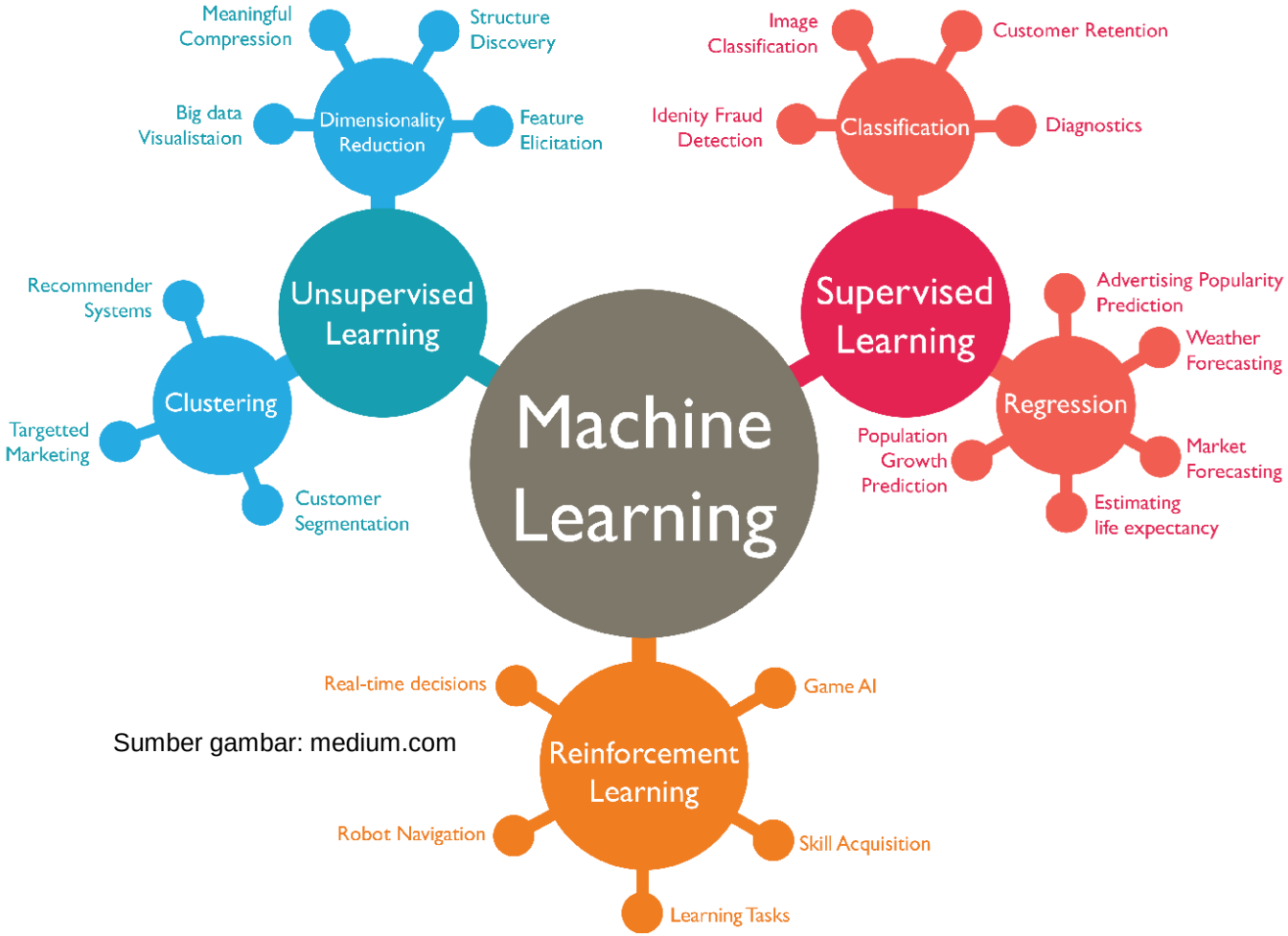
Taxi Driver as Learning Agent

http://www.gettyimages.com/detail/83988175/Stone

http://www.stahle.com/

- Brake decision
  - Whether to push the **brake** or not based on the **current state**
  - Feedback: instructor shouts
- Buses recognition
  - Input: image from camera
  - Output: whether it is a bus or not
  - Feedback: labeling bus images

Machine Learning Type



Sumber gambar: medium.com

Unsupervised Learning (no feedback)

- Given set of examples without label, detect potentially useful clusters of input examples, e.g: customer clustering

Supervised Learning

- Given set of examples (input-output pairs), learns a function that maps from input to output, e.g: object classification

Reinforcement Learning

- Agent learns from a series of reinforcements (rewards or punishments)

Perkembangan Teknologi AI

IBM **Deep Blue** mengalahkan Garry Kasparov dalam permainan Catur.

1997

Sistem AI IBM **Watson** mengalahkan dua kontestan (manusia) pada Jeopardy game show

2011

DeepMind **AlphaStar** mengalahkan pemain professional kelas dunia dalam game StarCraft II

2018

Micrsoft AI **Suphx** mengalakan pemain top pada tile game Mahjong.

2019

DeepCubeA dari UCLA-Irvine dapat menyelesaikan Rubik Cube dalam 1.2 detik (2 detik lebih cepat dari pemegang rekor dunia)

2019

Why Now?

- Computing Hardware
  - GPU,TPU, etc
  - Cloud
- Algorithm
  - Deep Learning
- Data availability
  - IoT device, Social Media

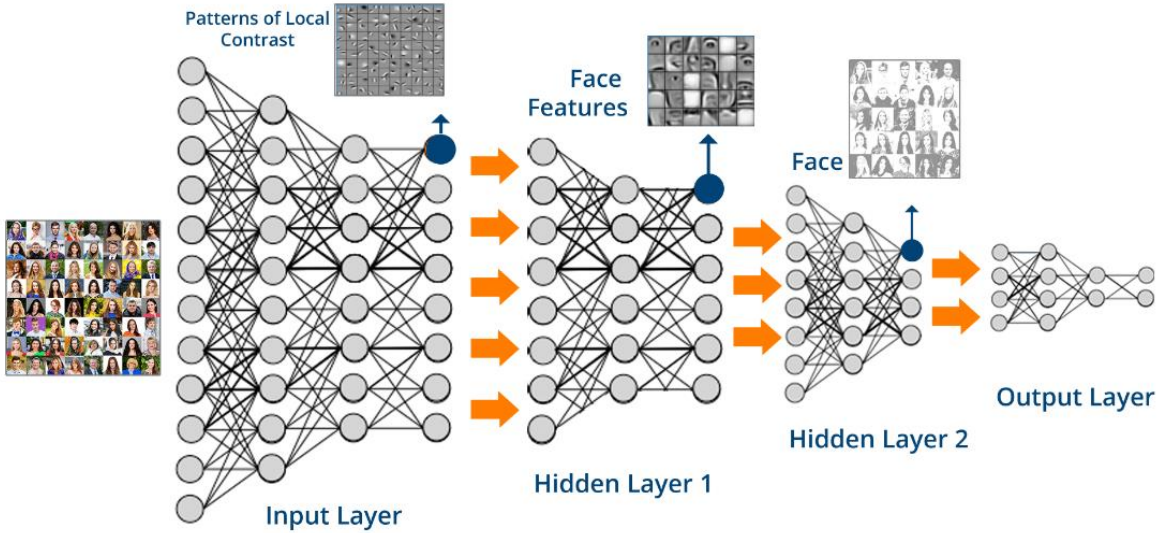


Image Credit: Familian

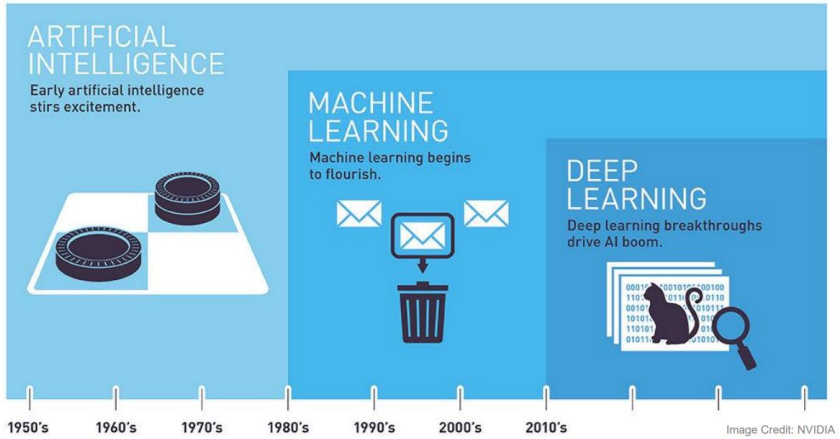
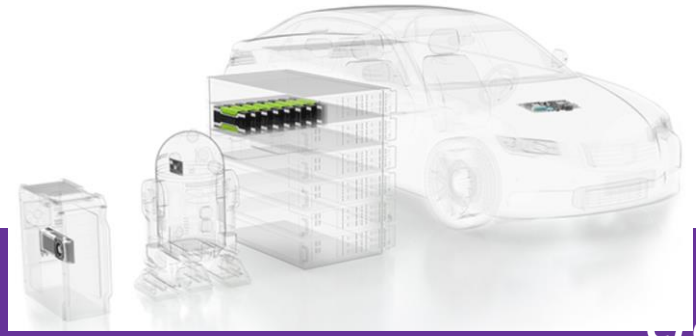
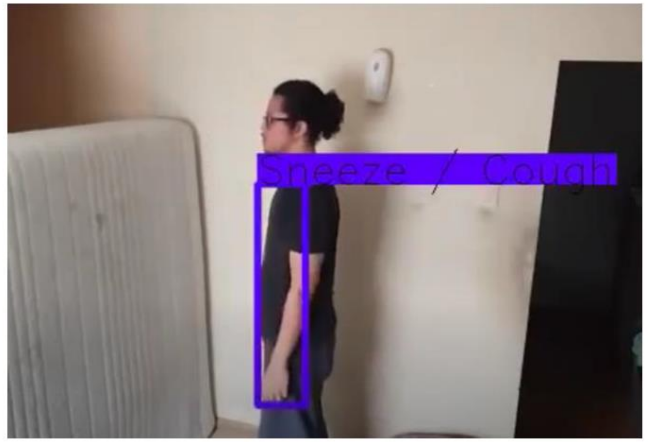


Image Credit: NVIDIA



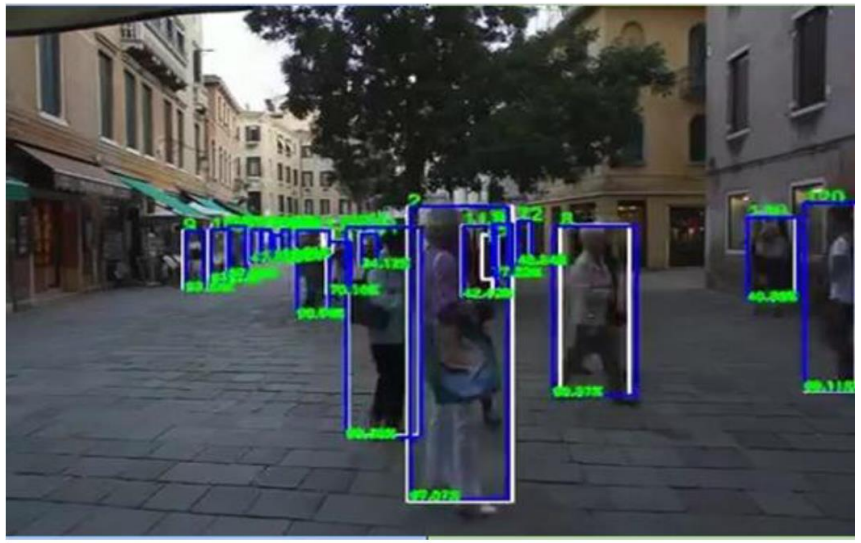
Penerapan AI: Monitoring

Contoh hasil inferensi model-AI deteksi penggunaan masker-wajah



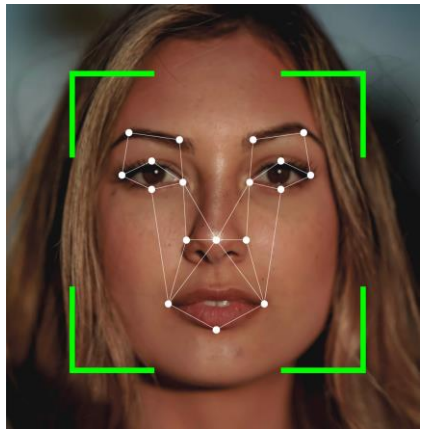
Gambar . Contoh hasil inferensi model-AI untuk deteksi aktivitas manusia

Contoh hasil inferensi model-AI estimasi jarak sosial aman dan kerumunan



Gambar . Hasil inferensi model-AI pelacakan dan penelusuran manusia

Penerapan AI: Verification & Identification



Face Recognition

BENEFITS

- Better User Experience (UX) Personalized; Greater Accuracy; Convenient; Frictionless; Fast; Automated
- Improved Security
- Reduce Cost
- Accessibility: Disabled person (blind, can't type)

USE CASE SCENARIOS

- Electronic-Know Your Customer (eKYC)
- "Kependudukan & Pencatatan Sipil" ("Dukcapil")
- Verify Login
- Verify Transactions
- Customer Service Conversational Analytics

Voice Biometrics

Faster Authentication

*Up to 10 times faster than traditional authentication methods**

Accurate & Secure

Using state-of-the-art AI technology to achieve real-time result with guaranteed high accuracy

Wide Application

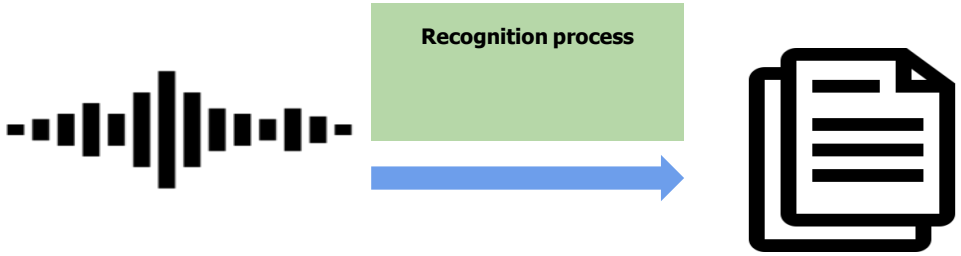
Applicable to banking, financial services, insurance & healthcare, and other industries

Penerapan AI: Document Digitization

Go paperless. Digitize and secure your past, present and future

Voice Recording

Speech Transcription



BENEFITS

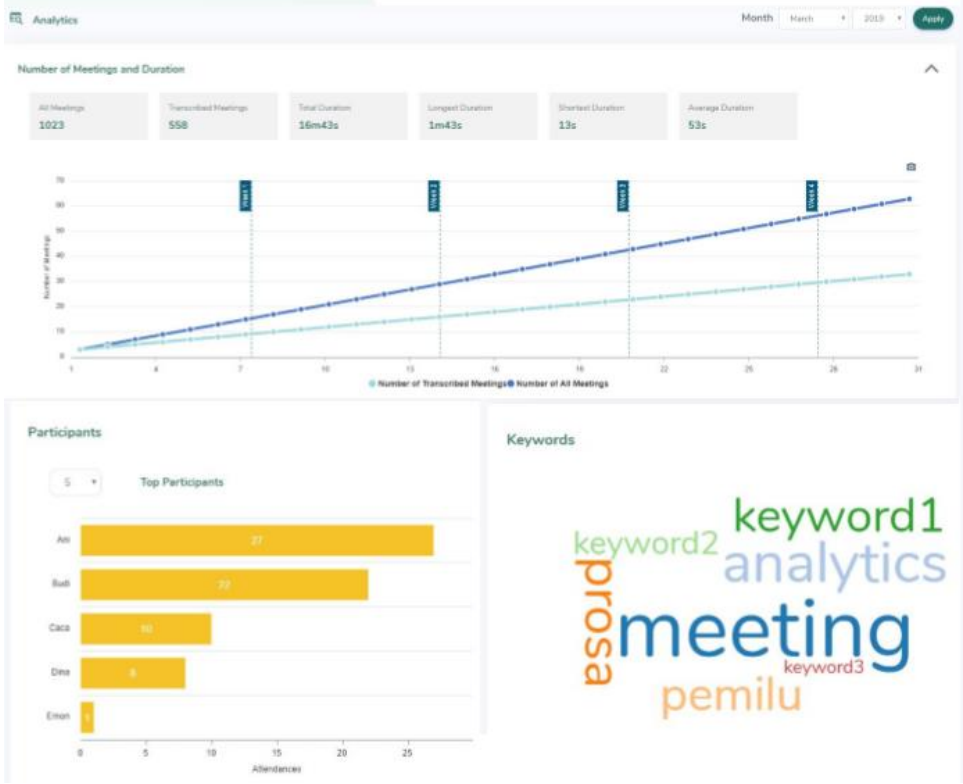
- Reduce Clerical Work
- Faster and Accurate Data Input
- Reduce Operational Costs
- Convenience
- Automated
- Improve User Experience
- Save time
- Save money

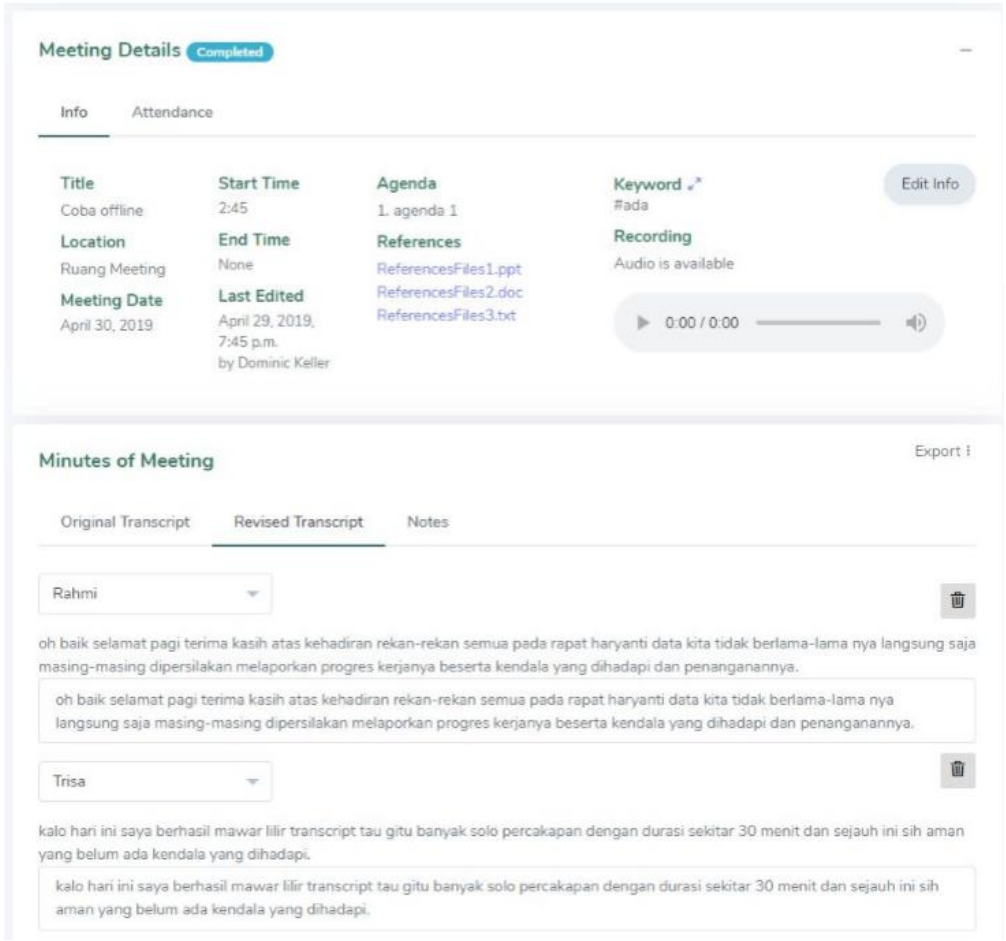
USE CASE SCENARIOS

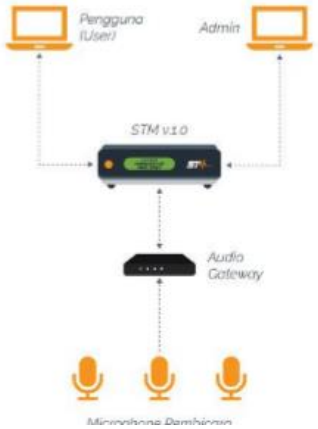
- Electronic-Know Your Customer (eKYC)
  eKTP, NPWP, Passport, ITAS, ITAP
- Digitize Invoice and Purchase Orders
- Credit Card, Birth Certificate, etc
- Digitize Documents and Forms
- Digitize Name Cards
- Digitize Video/Speech Recording

Penerapan AI: Meeting analytics

Notulensi dan analisis untuk rapat, pidato, diskusi, dan lain-lain secara real-time dari suara mikrofon maupun rekaman. Produk ini memanfaatkan teknologi Automatic Speech Recognition, Speaker diarization dengan voice biometric, dan Text Analytics.







Tantangan dalam Perkembangan AI

- Regulasi
  - Pengaturan etika dan pemakaian AI yang lebih bertanggung-jawab
- Privasi
  - Terkait dengan penggunaan data yang dipakai untuk pembangunan model AI
- Kurangnya penjelasan
  - Bagaimana model AI sampai pada suatu keputusan/kesimpulan tertentu (terkait dengan akuntabilitas dan trust)
- Ketersediaan data
  - Sejauh mana data yang dipakai cukup representative dan tidak bias
- Kurangnya Talenta

Referensi Video

- Introduction to AI
  - https://www.youtube.com/watch?v=s9vDgPotU-4
  - https://www.youtube.com/watch?v=wfmM5-d0Zh0
  - https://www.youtube.com/watch?v=eUpRwSrwbHY
  - https://www.youtube.com/watch?v=XfEOoAlArXw
  - https://www.youtube.com/watch?v=uyWHthN3Q9c
- Intelligent Agent
  - https://www.youtube.com/watch?v=XqAUPrLu8_s
  - https://www.youtube.com/watch?v=ehXgvsl8i_I
  - https://www.youtube.com/watch?v=NqeVTW4DUuU
  - https://www.youtube.com/watch?v=btffOHgYsBc
  - https://www.youtube.com/watch?v=d2608-UCcR8
  - https://www.youtube.com/watch?v=Spia43l493c
- Introduction to Knowledge based Agent
  - https://www.youtube.com/watch?v=P2DVmc4Zf7I
  - https://www.youtube.com/watch?v=VhKPNctwInw&t=338s
  - https://www.youtube.com/watch?v=7iZWC_NtegM
  - https://www.youtube.com/watch?v=o2aIb-eJNqc

Assignment

1. Pelajarilah video yang menjelaskan strategi AI dari sebuah negara dan buatlah rangkuman dari video tsb
2. Rancanglah sebuah Intelligent Agent untuk robot pembersih ruangan dengan mengisikan informasi di bawah ini:
   - Performance indicator: …
   - Environment: …
   - Actuator: …
   - Sensor: ...
3. Rancanglah sebuah ide teknologi AI yang dapat bermanfaat di masa pandemi. Tuliskan deskripsi dari teknologi tersebut dan tuliskan jenis teknik manakah (searching, knowledge, atau learning) yang digunakan untuk membangun teknologi tsb, jelaskan alasannya

Tools yang diperlukan

Daftar Tools

Selama pembelajaran berbagai tools akan dipergunakan, seperti:

- python
- Development Environment:
  - Google Colab (https://colab.research.google.com/).
  - Jupyter Notebook (https://jupyter.org/)
- Library python seperti
  - NumPy,
  - SciPy,
  - Pandas,
  - Matplotlib,
  - Seaborn,
  - Scikit-learn

Tools perlu dipasang sebelum pelaksanaan kegiatan

Instalasi python (windows)

1. Buka browser, kunjungi http://www.python.org/downloads/windows/
   Tergantung dari versi windows yang dipergunakan maka pilih versi stabil (stable version) yang akan didownload
   python-3.9.6 atau
   python-3.8.10
2. Buka (dengan melakukan klik 2x) file installer python yang baru saja didownload
3. Ikuti langkah instalasi sampai selesai
4. Cek apakah python berhasil terpasang:
   Buka promp Command >
   Ketikkan **python** atau **pyton3**
   Jika terpasang maka akan ditampilkan versi pythonnya

Instalasi Library python

Beberapa library yang akan dipergunakan:

- NumPy,
- SciPy,
- Pandas,
- Matplotlib,
- Seaborn,
- Scikit-learn

Library tersebut dipasang dengan melalui **pip** atau **conda**

Instalasi Library python

- Instalasi melalui pip pada command prompt >

```
pip install <nama_library>
```

Contoh
pip install numpy
pip install scikit-learn

```
$ pip
 Usage:
   pip  [options]
 Commands:
   install                     Install packages.
   download                    Download packages.
   uninstall                   Uninstall packages.
   freeze                      Output installed packages in requirements
format.
   list                        List installed packages.
   show                        Show information about installed packages.
   check                       Verify installed packages have compatible
dependencies.
   config                      Manage local and global configuration.
   search                      Search PyPI for packages.
   wheel                       Build wheels from your requirements.
   hash                        Compute hashes of package archives.
   completion                  A helper command used for command
completion.
   help                        Show help for commands.
```

- Lakukan instalasi terhadap semua library yang diperlukan

Instalasi Library python

- Instalasi melalui anaconda
  - Buka browser, kunjungi **https://docs.anaconda.com/anaconda/install/windows/**
  - Klik dua kali file installer yang telah didownload
  - Ikuti langkah instalasi hingga selesai
  - Jalankan anaconda Navigator

    atau

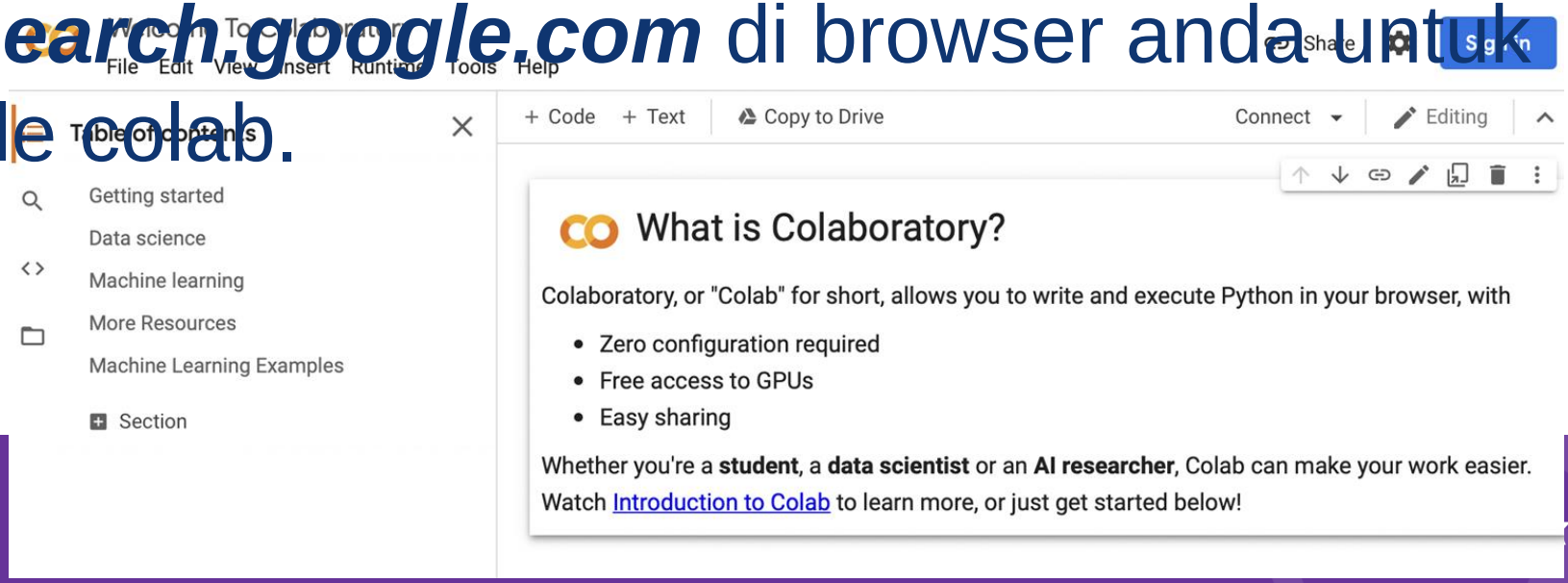
    di command prompt >
  - conda install <nama-library>

```
$ conda
 usage: conda [-h] [-V] command …
 conda is a tool for managing and deploying applications,
environments and packages.
 Options:
 positional arguments:
   command
     clean        Remove unused packages and caches.
     config       Modify configuration values in .condarc. This
is modeled
                  after the git config command. Writes to the
user .condarc
                  file (/home/hadoop/.condarc) by default.
     create       Create a new conda environment from a list of
specified
                  packages.
     help         Displays a list of available conda commands
and their help
                  strings.
     info         Display information about current conda
install.
     init         Initialize conda for shell interaction.
[Experimental]
     install      Installs a list of packages into a specified
```

Instalasi Lingkungan Pengembangan (Development Environment)

1. Google Collab

Untuk menulis dan mengeksekusi Python di browser anda tanpa mengkonfigurasi, dapat menggunakan GPU, dan dapat di-share dengan rekan kerja. Pergunakan link ***https://colab.research.google.com*** di browser anda untuk mengakses google colab.



Instalasi Lingkungan Pengembangan (Development Environment)

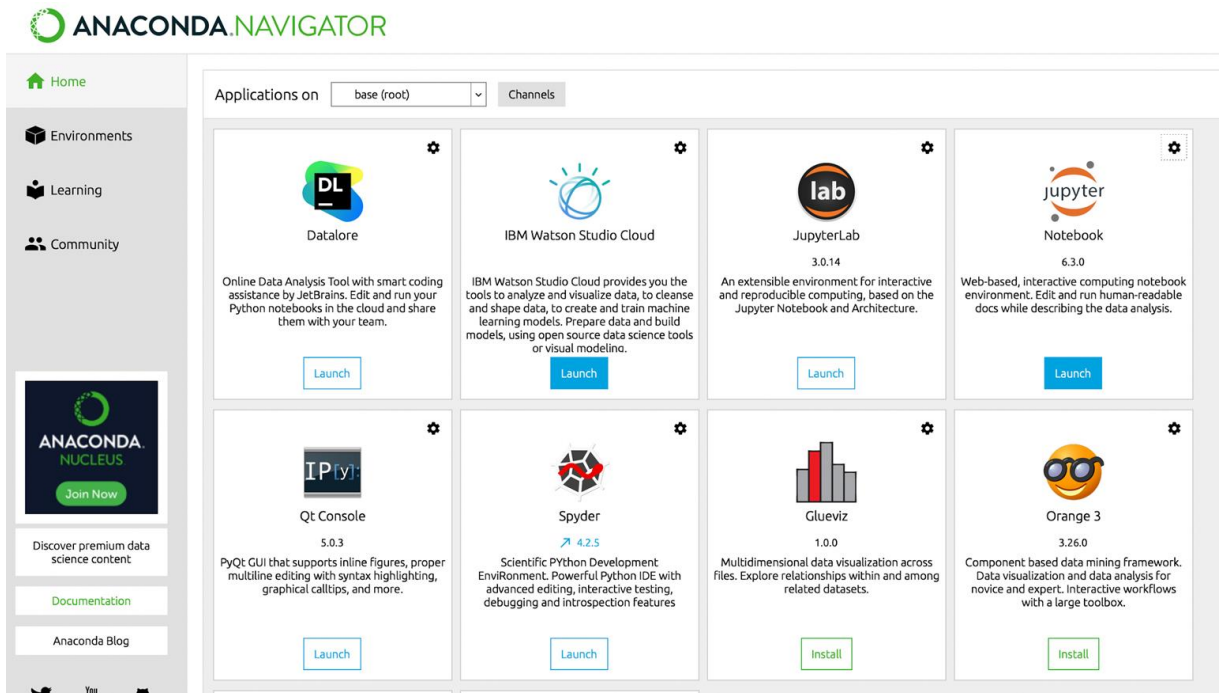
2. Jupyter Notebook

Di command prompt >
pip install jupyter

atau

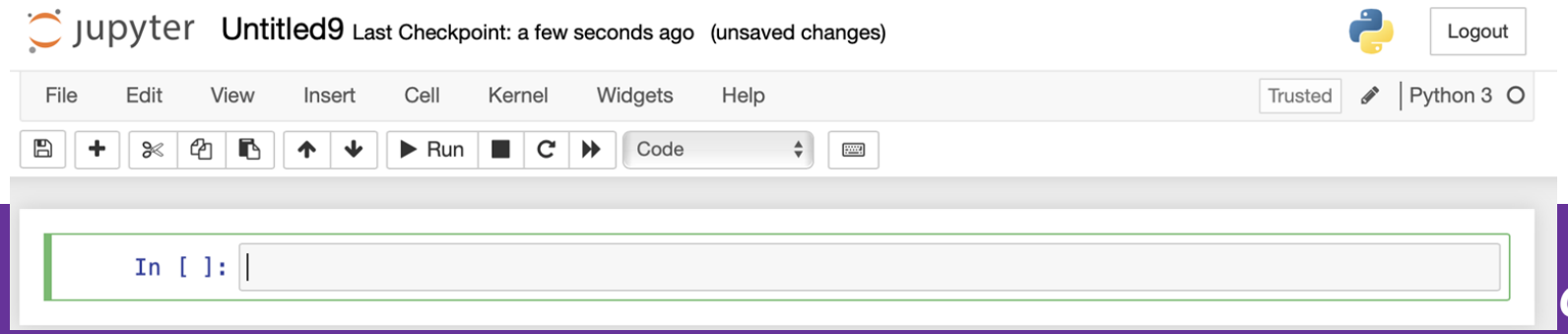
jika sudah memiliki Anaconda Navigator, bisa dilihat apakah status Launch/ Install. Jika **install** maka berarti belum terpasang, klik satu kali untuk menginstall.

Klik **Launch** untuk menjalankan/ mengaktif-kan.



Instalasi Lingkungan Pengembangan (Development Environment)

- Python dapat dipergunakan dengan memilih tombol New – Pythor



Referensi

- https://www.anaconda.com
- https://jupyter.org
- https://colab.research.google.com
- https://www.python.org
- https://numpy.org
- https://scikit-learn.org
- https://pandas.pydata.org
- https://www.scipy.org
- https://matplotlib.org
- https://seaborn.pydata.org

Terima Kasih