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# Applied Data Science Project

L3 - Foundation models

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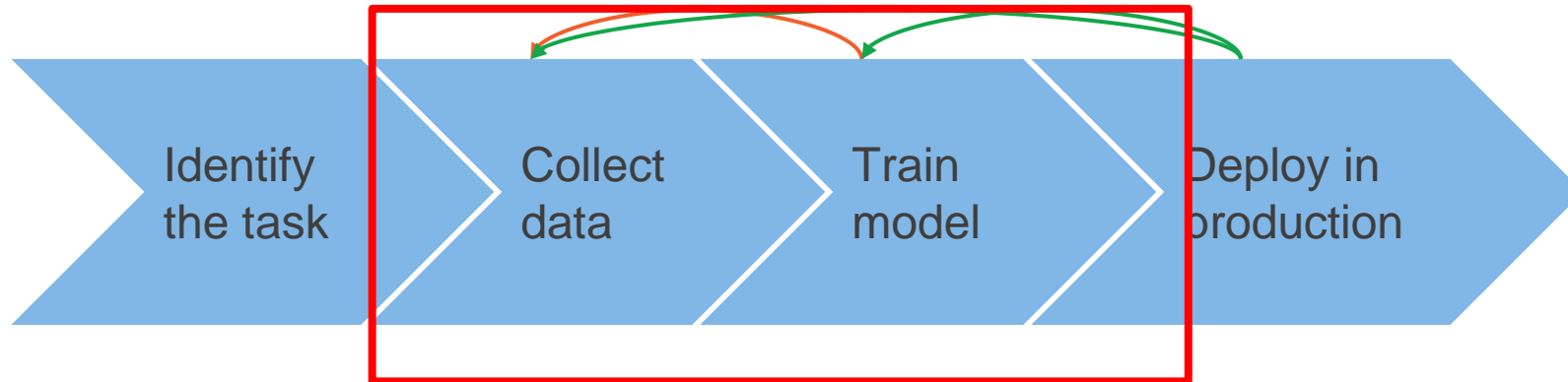
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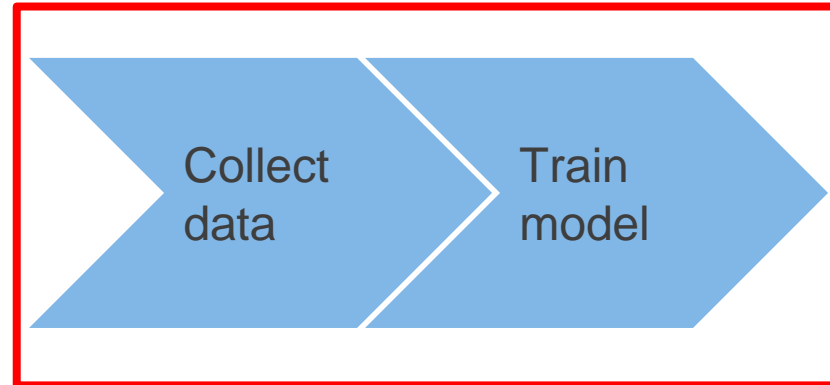
**e l i i s**  
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# (Today) artificial intelligence

iterative processes meant to refine the quality of the solution

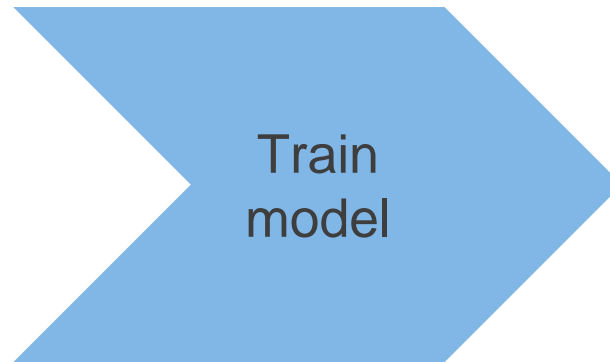


# Data + model



machine intelligence = data + model (software + algorithm)

# Should intelligence start from scratch always?



Re-use existing already trained models and adapt to address specific scenarios



# Foundation models

## Re-use & Adapt

Foundation models are defined in the scope of the machine learning field

It is a similar concept than pre-trained, self-supervision, fine-tuning, or transfer learning

The term foundation inherits both the intrinsic value of a basic component plus the uncomplete essence of the component, yet unfinished





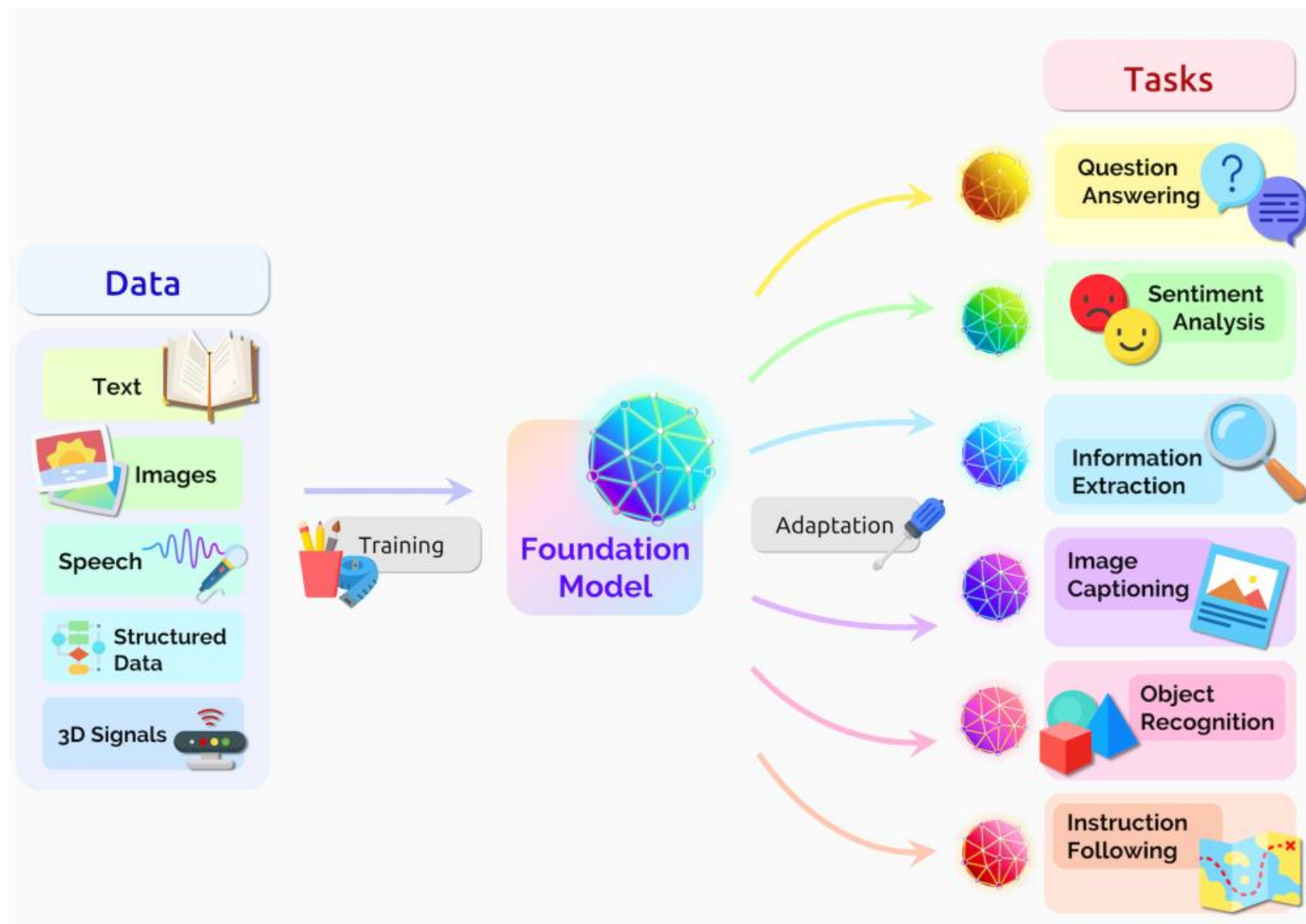
# Definition

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A foundation model is a **large** artificial intelligence **model** trained on a vast quantity of (unlabelled) **data at scale** (usually by self-supervised learning) resulting in a model that can be adapted to a wide range of downstream tasks



# Foundation models





# Foundation models

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Foundation models are scientifically interesting due to their **impressive performance** and **capabilities**

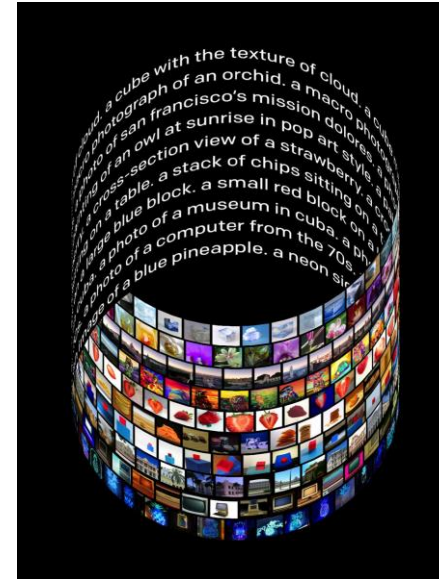




# Examples



BERT, 100M+ parameters  
Language model



DALL-E, 10M+ parameters  
Text descriptions -> images



# Who generates foundation models today?

It is a business of a handful of very large companies with very large resource capabilities such as **Google**, **Facebook**, **Microsoft**, **Huawei**

Two startups are part of this business namely **OpenAI**, **AI21 Labs** with significant resource facilities

What about others universities, research centers, other organizations such as companies locally?

They simply cannot keep up with what these players are generating, because they do not possess the same resources namely computing power, data at disposal



# Availabilities

Are foundation models available?

Often yes and usually there are available both source codes, models, reports

Some examples:

- BERT <https://github.com/google-research/bert>
- DALL-E <https://github.com/openai/DALL-E>
- CLIP <https://github.com/openai/CLIP>



# GPT-3

It is only available the report

They are not released both the source code and models

It can be tested and utilized via the API <https://beta.openai.com>





# Standing on the shoulders of giants

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It has been a common practise since the advent of humanity mostly

It is considered a default in research and adopted by most of the researchers worldwide

It is a value given back to practitioners and society for the predominant position they acquired in these years for this business and the digital business as whole





# Opportunities

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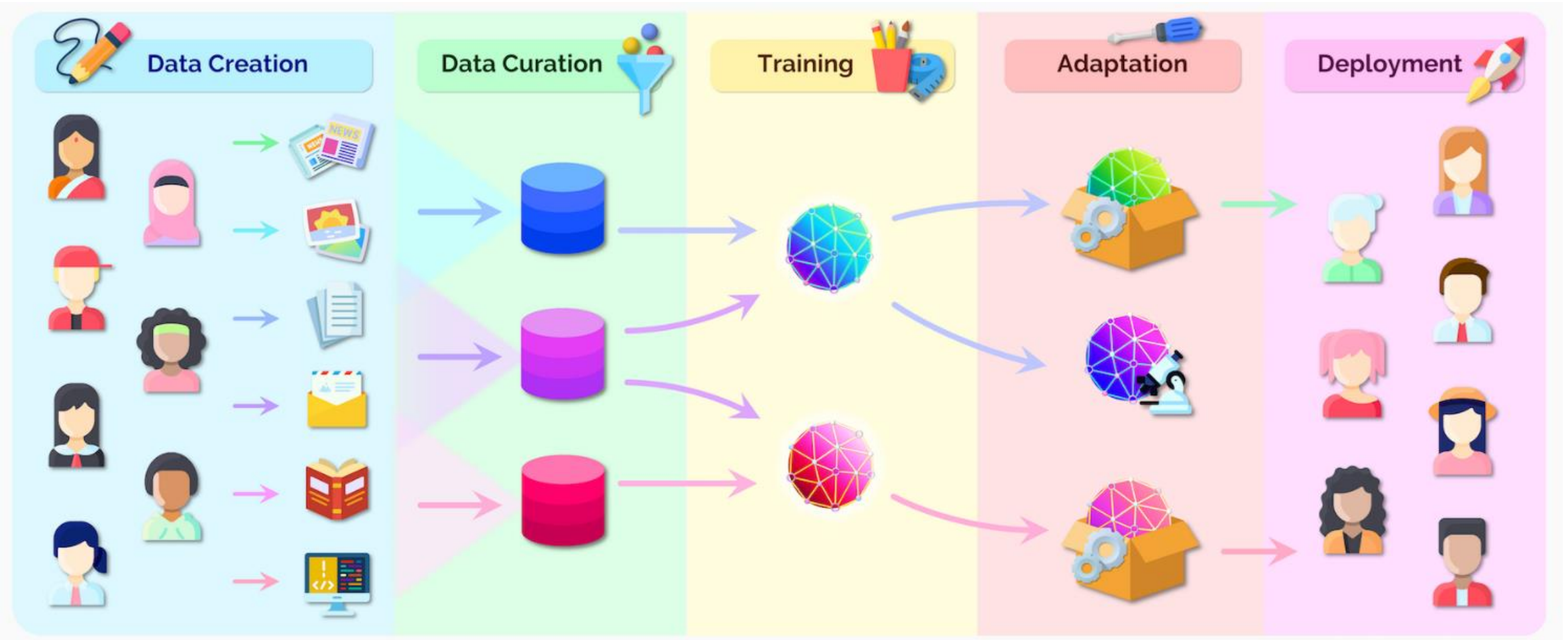
- Having at disposal Google-level performance in text analysis, generation, image rendering with limited resources
- Reducing the impact of the generation of machine intelligence to environment and people
- Learning from examples and fostering a culture of AI
- Fostering a culture of these exact tools, shedding light on key aspects but also risks



# Risks

- Inequity and fairness
  - furthering the unjust treatment of people who have been historically discriminated against
  - lack of diversity in the training examples
- Misuse
  - utilizing the models to harm people (not the original intent of their design)
- Environment
  - increasing pollution in their making
- Legality
  - who is responsible for a wrong action or decision?
- Economics
  - benefits spread not just in the hands of the giants
- Ethics of scale
  - homogenizing decisions, lowering the diversity in the making and the acceptance

# Foundation models ecosystem





# Foundation models ecosystem

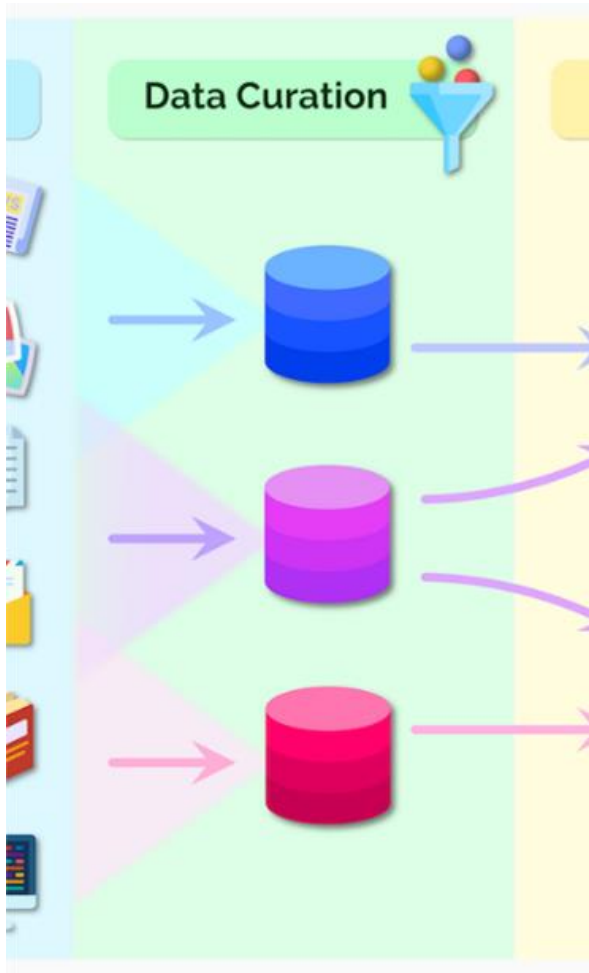


It has a dual impact because any foundation model needs good data to be bootstrapped and its adaptation needs good data to be tailored to the specific task

For instance, if we aim to identify sentiment of text, we may use a foundation that is rooted in a collection of newswire contents, but then we need examples of reviews



# Foundation models ecosystem

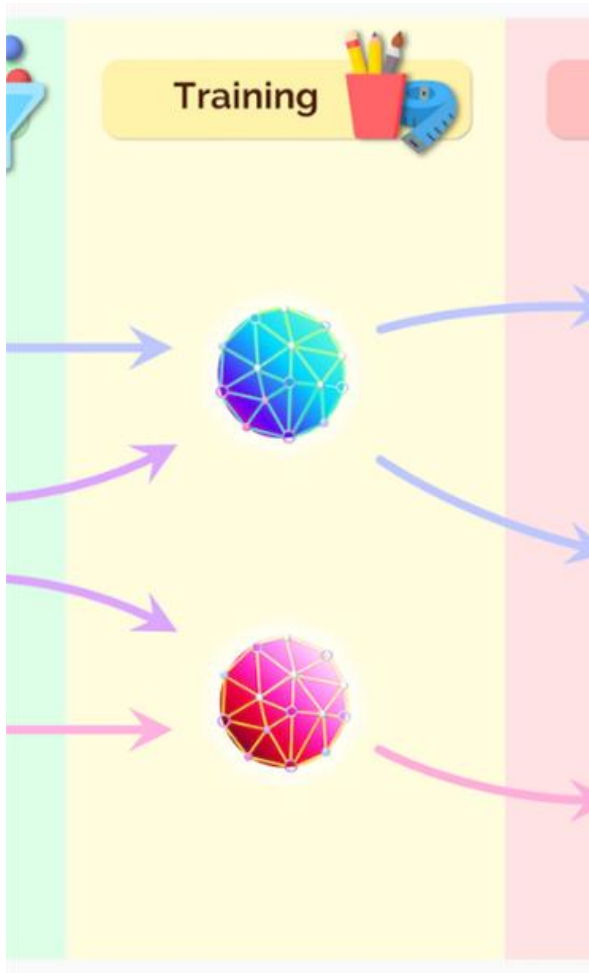


Dual impact given the need for data curation both for creating a consistent and complete dataset

If our target is to classify images according to emotions, we will first need a dataset of images with labels of objects and then a set of images rated by emotions



# Foundation models ecosystem

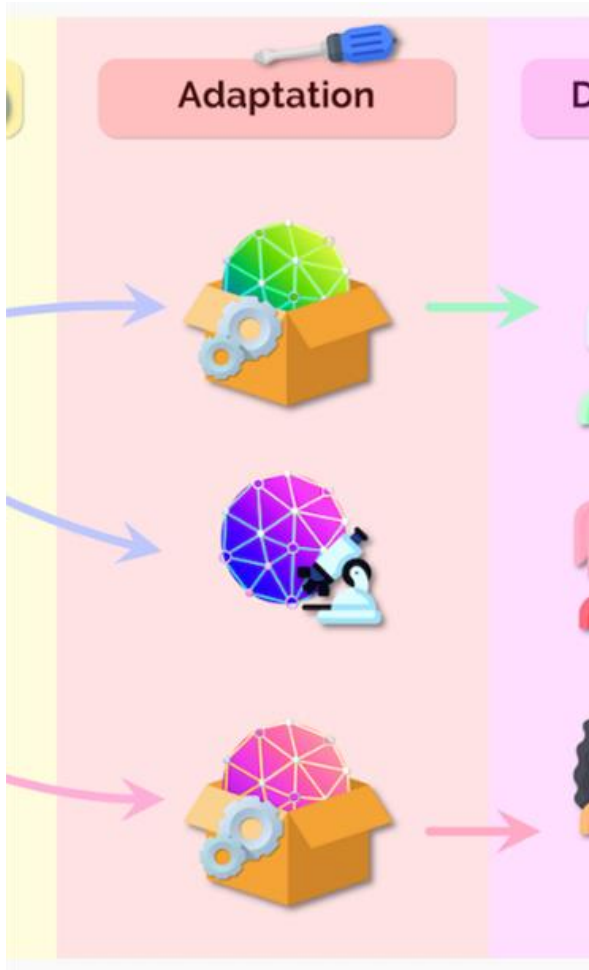


Training is a step required to generate the foundation model

For instance, starting from a set of newswire content we will package a model by instructing the software to repeat the task by indexing all examples present in the dataset



# Foundation models ecosystem

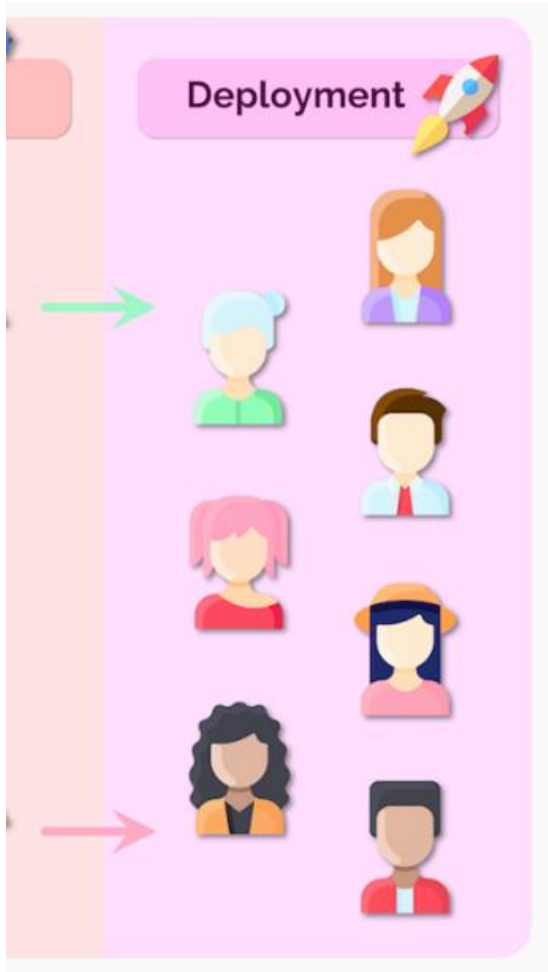


It is a step required to generate a task specific (narrow) intelligence by adapting the (broader) intelligence represented by the foundation model

For instance, it is about leveraging the collected dataset in a training procedure meant to specialize the foundation model. In practise: it adds up some additional components (for instance neural network layers) to rework the input of the foundation model to address the targeted task



# Foundation models ecosystem



It is about reaching the users of the models by offering them access to the intelligence developed

For instance, users of a web application that helps users to compute the number of positive vs negative reviews of their products

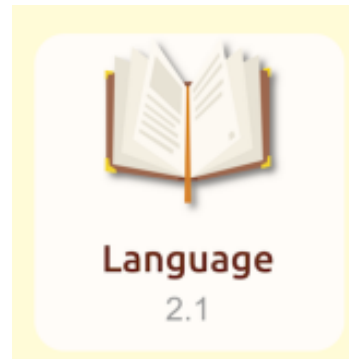


# Capabilities

What foundation models can offer?



# Capabilities



Predict the next word

Translate text

Identify from text key relevant information

Recognize sentiment

...



# Capabilities



- Recognize objects
- Recognize face expressions
- Recognize emotions
- ...





# Capabilities



Routing in an closed unknown environment

Physical understanding

...



# Capabilities



First stub content generation (news, source code)

Multimodal interaction (voice, vision)

...



# Capabilities



Truly and deep understanding of the environment (such as meanings of objects and their intertwinings)

...





**Thank you for your attention.**

Questions?



# CONTACTS

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