Transforming Engineering with AI in Mauritius, Botswana & Namibia

Presented by the Dean, Dr Steve Mackay

Presentation by

- Dr. Steve Mackay
- EIT Dean

Thank you and Welcome

I would like to welcome you all today and thank you for coming.

I would also like to extend a warm and grateful welcome to my colleagues:
- Edwina – our Academic Public Affairs Manager
- Caroline – our Marketing Manager
- James – our Technology Manager

They will be working with me and you to achieve a productive few hours together – we will learn from you even more than you will learn from us.

Steve

FIE(Aust) CPEng GCC BSc (ElecEng), BSc (Hons), MBA, MMR, PhD

How entrepreneurship and resilience define me.

› My passion for engineering and education has led me into many entrepreneurial ventures over the last ~40 years.

› And my curiosity drives me to study and learn every day.

› This love for education means that I truly admire high quality teaching and dedicated teachers who put students at the centre of all they do.

› Through my career I have overcome a huge number of failures and setbacks and I believe my resilience has assisted me through these times; it has enabled me to look ahead with optimism.

› As we face unprecedented weather extremes our communal resilience is being tested. I believe tackling population growth, pollution, exploitation and climate change will present our greatest engineering challenges and opportunities.

Common Questions/FAQs

Copy of slides/video recording

Everyone registered for this webinar will receive a copy of the PDF slides and a link to the video recording within the next two business days via email. Please monitor your junk email folder.

Certificate of Attendance

We provide a free, digital certificate of attendance for live attendees for technical topic webinars. There will be a link/QR code to a short form/survey provided at the end of this session which you need to complete in order to receive one. Once completed, we'll endeavour to send your certificate to you within the next four business days.

An Overview: 1991 – 2023

IDC Technologies and the Engineering Institute of Technology

EIT Engineering Institute of Technology.

1 We are a dual sector engineering education and training provider, with a global reach.

2 We have clearly articulated engineering qualifications - from diplomas through to a doctoral degree.

3 Our teaching and learning is industry-driven.

4 Our micro-credentials provide professional development. They can also be run (and customized) for groups of employees on worksites (or online).

5 Our platforms of learning: face-to-face and online. (The blended, online methodology of learning is live and interactive; it was launched in 2008.)
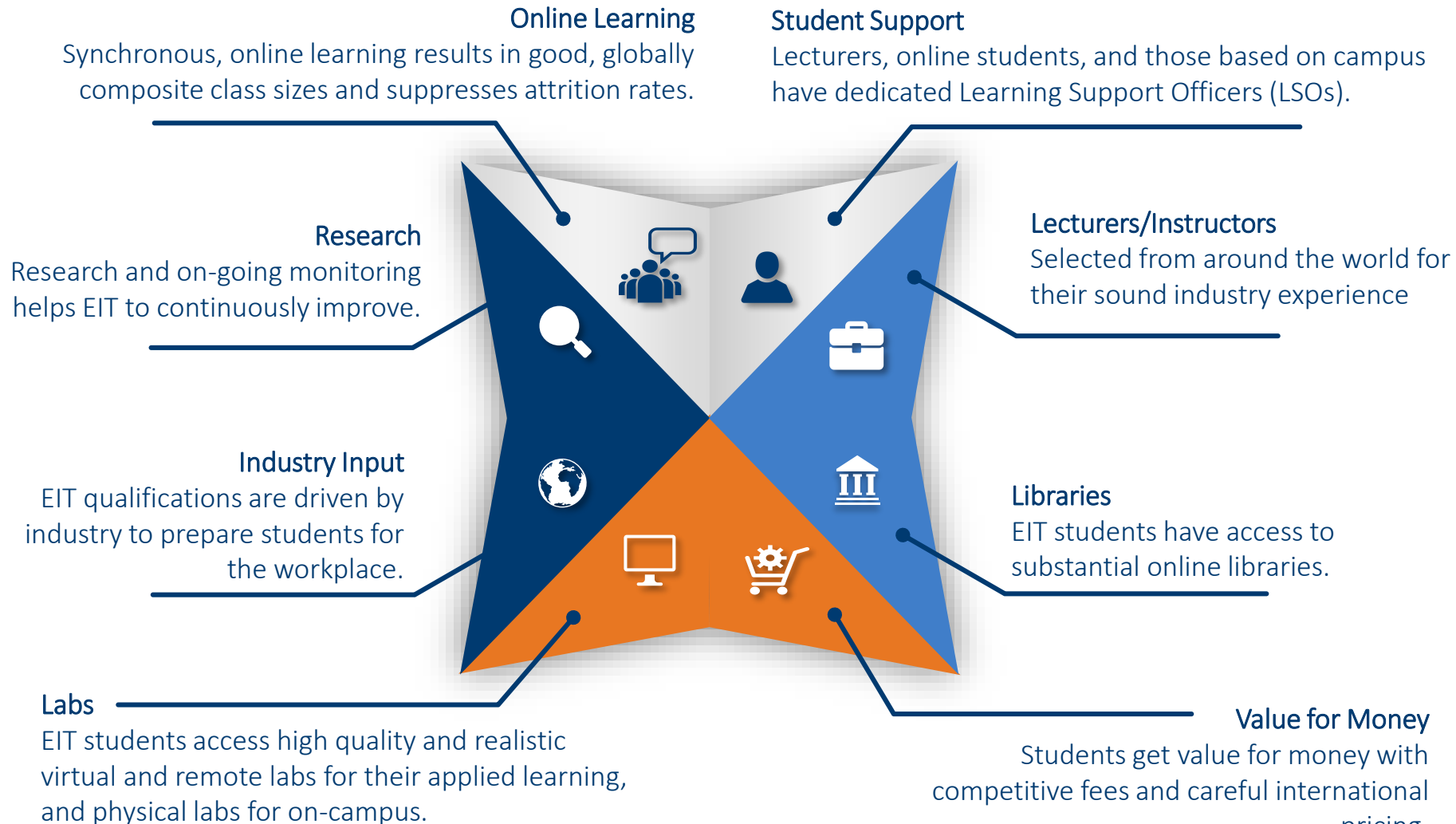
6 We run engineering conferences in Australia, NZ, South Africa, the UK and Canada…. And now virtually too.
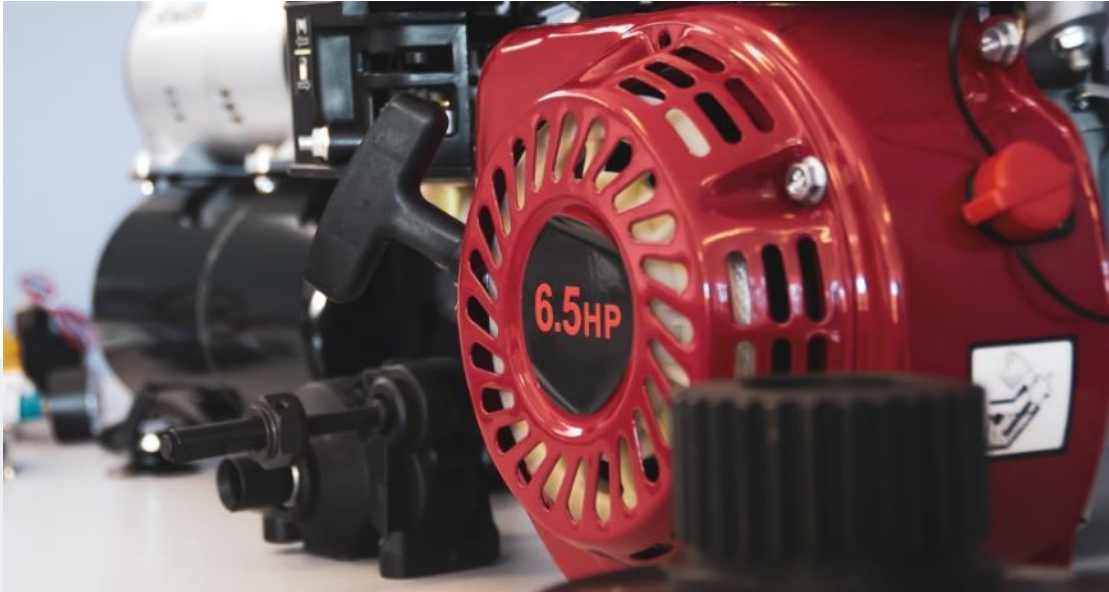
7 We have global partnerships and accreditation - from IEEE to ISA.

Our Approach

EIT — Engineering Institute of Technology.

Online Learning
Synchronous, online learning results in good, globally composite class sizes and suppresses attrition rates.

Student Support
Lecturers, online students, and those based on campus have dedicated Learning Support Officers (LSOs).

Research
Research and on-going monitoring helps EIT to continuously improve.

Lecturers/Instructors
Selected from around the world for their sound industry experience

Industry Input
EIT qualifications are driven by industry to prepare students for the workplace.

Libraries
EIT students have access to substantial online libraries.

Labs
EIT students access high quality and realistic virtual and remote labs for their applied learning, and physical labs for on-campus.

Value for Money
Students get value for money with competitive fees and careful international pricing.

Physical, Remote and Virtual Labs

› **Stimulating experiments –** virtual labs.
› **Remotely operated plants –** remote labs.
› **Engineering education 4.0 –** the traditional lab with an innovative twist.

The accurate representation of **current industry practice**

› **High availability and asynchronous –** anytime.
› Access to **specialized equipment in a safe and near-limitless testing environment**.
› **No geographical barriers** with diverse and global teams.

Student Experience Survey Results

#1 Provider in Australia for Quality of Entire Educational Experience for Undergraduate Engineering Programs*

#2 Provider in Australia for Student Support for Undergraduate Engineering Programs*

#2 Provider in Australia for Teaching Quality for Postgraduate Engineering Programs*

Ranked in the Top 6 Providers in Australia for Skills Development for Postgraduate Engineering Programs*

*2019/2020 aggregated data from the Student Experience Survey - qilt.edu.au

EIT CRICOS Provider Number: 03567C | EIT Institute of Higher Education: PRV14008 | EIT RTO Provider Number: 51971

Agenda

1	Today's objective
2	Why we need to apply Artificial Intelligence (AI)
3	AI versus Machine Learning
4	Essentials of Large Language Models (LLMs)
5	Essentials of AI and ChatGPT
6	Demonstrations of AI at EIT
7	Case Studies
8	Wrap Up

1. Today's Objective

Explore how Artificial Intelligence (AI) and Machine Learning (ML) are both being harnessed by industry and how these technologies can empower you to drive change in a sustainable ways in engineering.

- Our focus:

    - Power and Water utilities
    - Mining
    - Manufacturing

- You will be broken into groups and each group will be allocated a case study.

- Your mission:

    - To explain how you will tackle your allocated scenario sustainably
    - To outline how you will use AI and ML to improve efficiencies.
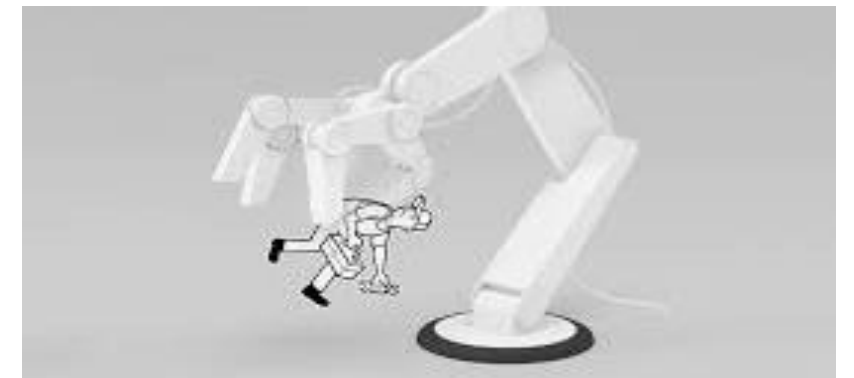
2. Why we need to apply AI
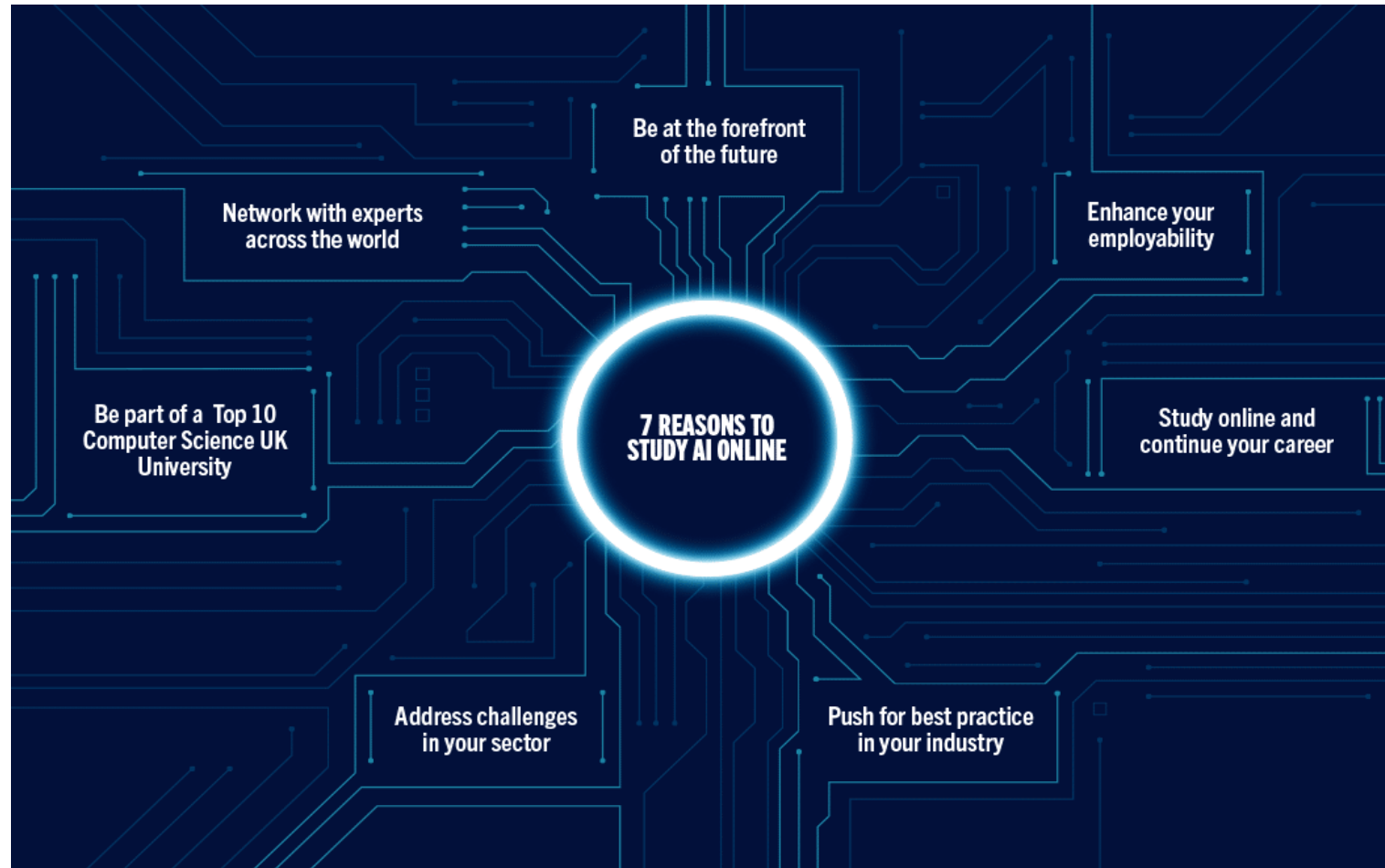
Acknowledgement to University of Leeds Promotional Poster

Why bother about the design of AI?

If you can have a basic understanding of the design and construction of artificial intelligence and machine learning (deep learning) you will be more empowered to understand the output that comes from *animals* like ChatGPT!

"We are continually faced by great opportunities brilliantly disguised as insoluble problems"

- Lee Lacocco

3. AI vs Machine Learning
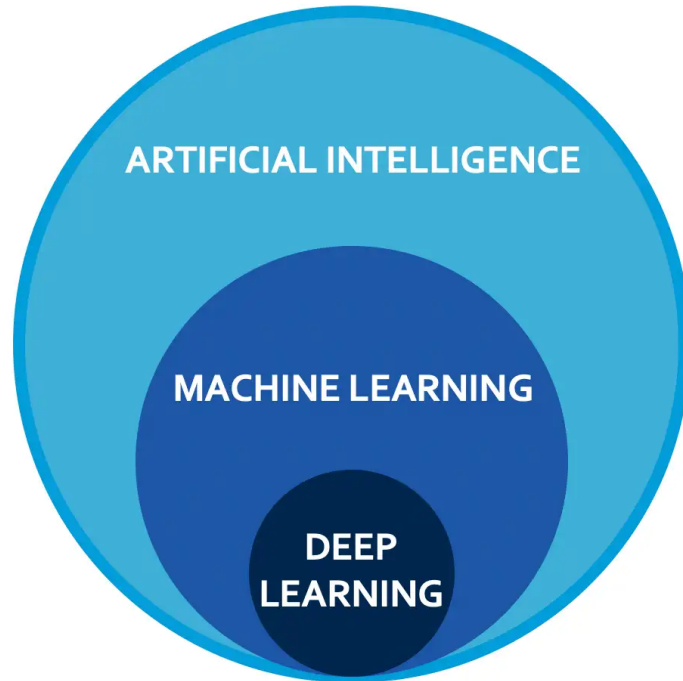
Artificial Intelligence
The science of making machines smarter, which in turn augments human knowledge and capabilities.

Machine Learning
Application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience.

Deep Learning
The next generation of machine learning that employs multiple layers of learning from massive data-sets.

ARTIFICIAL INTELLIGENCE

MACHINE LEARNING

DEEP LEARNING

Chatbots and Conversational AI
AI Natural language processing and deep learning helps give users factoids based on their queries
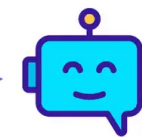
*Chatbots such as **ChatGPT** produce text like output*
The next generation of Conversational AI may include voice

BRIGHTEDGE

Machine Learning Basics

- **Artificial Intelligence** is a scientific field concerned with the development of algorithms that allow computers to learn without being explicitly programmed.

- **Machine Learning** is a branch of Artificial Intelligence which focuses on methods that learn from data and make predictions on unseen data.
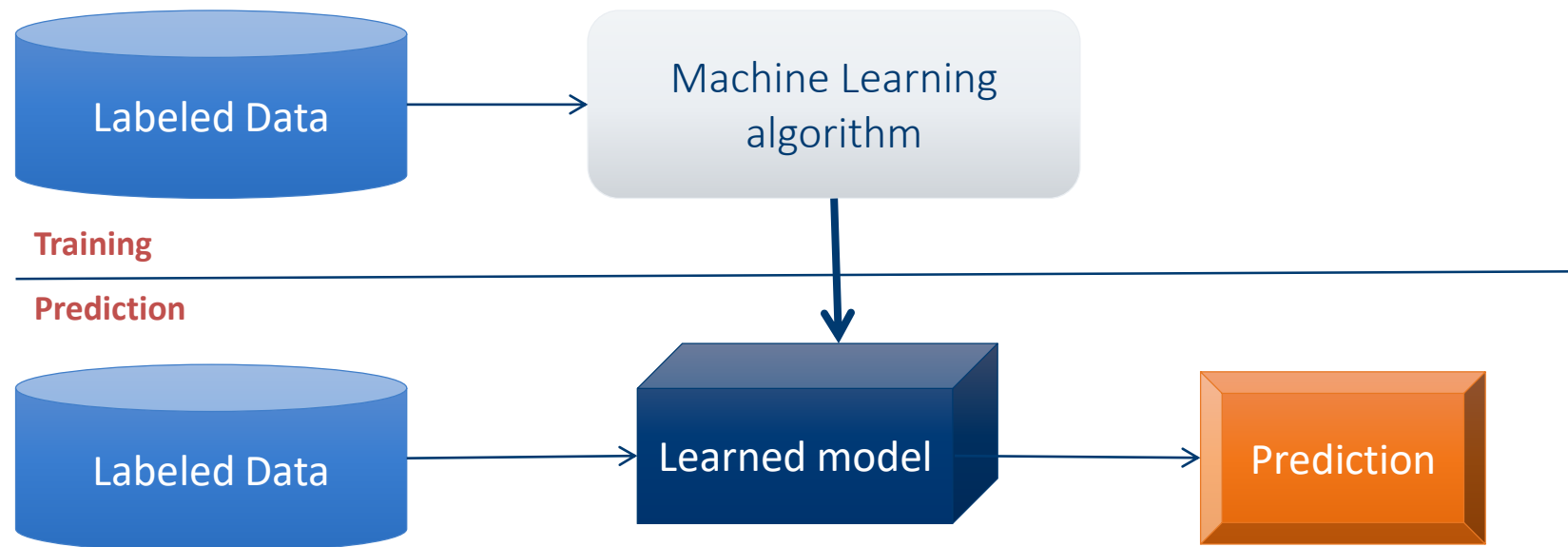
Machine Learning Types

- **Supervised:** learning with labeled data
  - Example: email classification, image classification
  - Example: regression for predicting real-valued outputs

- **Unsupervised:** discover patterns in unlabeled data
  - Example: cluster similar data points

- **Reinforcement learning:** learn to act based on feedback/reward
  - Example: learn to play Go

Classification

Regression

Clustering
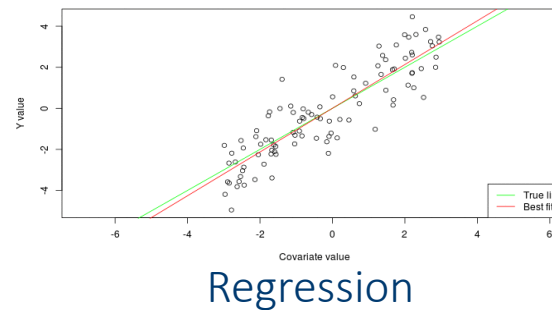
Supervised Learning
Categories and Techniques

- Numerical classifier functions
  - Linear classifier, perceptron, logistic regression, support vector machines (SVM), neural networks
- Parametric (probabilistic) functions
  - Naïve Bayes, Gaussian discriminant analysis (GDA), hidden Markov models (HMM), probabilistic graphical models
- Non-parametric (instance-based) functions
  - k-nearest neighbors, kernel regression, kernel density estimation, local regression
- Symbolic functions
  - Decision trees, classification and regression trees (CART)
- Aggregation (ensemble) learning
  - Bagging, boosting (Adaboost), random forest

Unsupervised Learning
Categories and Techniques

- Clustering
  - k-means clustering
  - Mean-shift clustering
  - Spectral clustering
- Density estimation
  - Gaussian mixture model (GMM)
  - Graphical models
- Dimensionality reduction
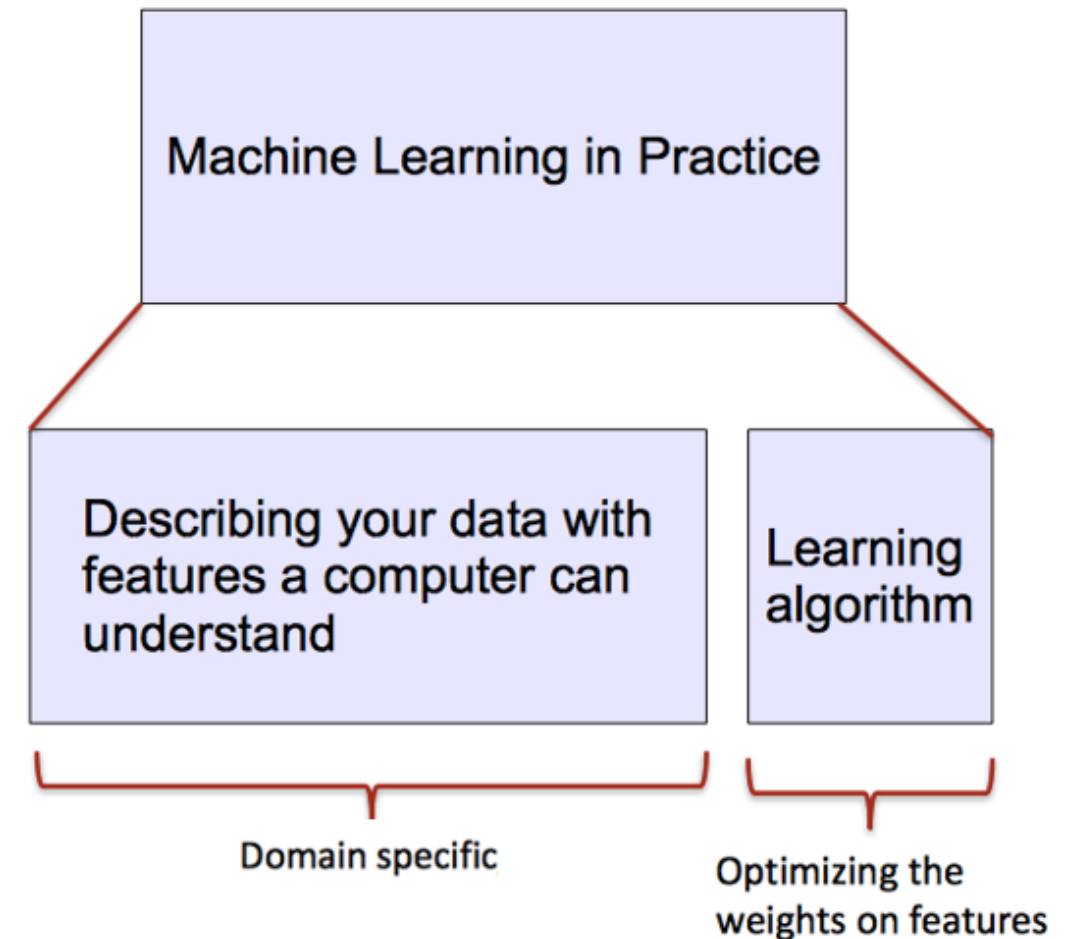 - Principal component analysis (PCA)
  - Factor analysis

Nearest Neighbor Classifier

- Nearest Neighbor – for each test data point, assign the class label of the nearest training data point
  - Adopt a distance function to find the nearest neighbor
    - Calculate the distance to each data point in the training set, and assign the class of the nearest data point (minimum distance)
 - It does not require learning a set of weights

Training examples from class 1

Test example

Training examples from class 2
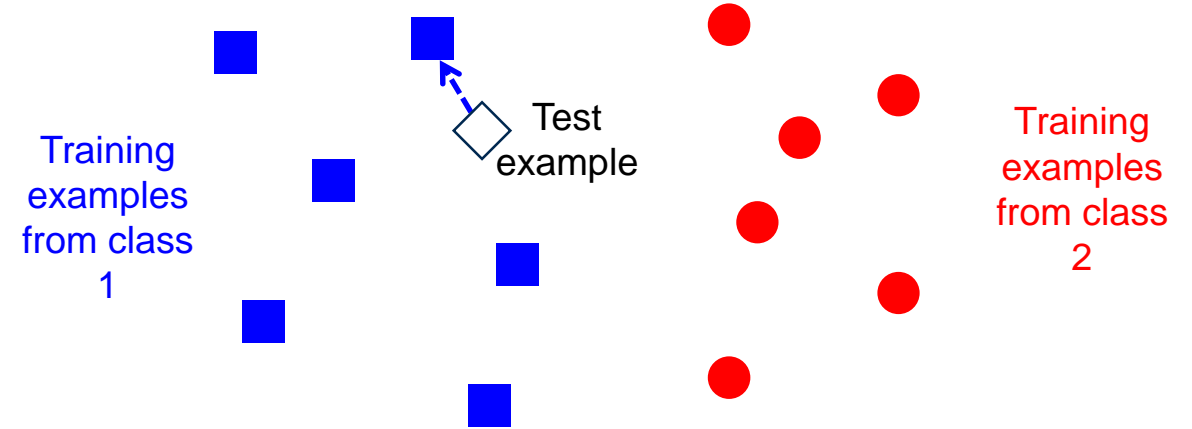
ML vs. Deep Learning

- Conventional machine learning methods rely on **human-designed feature representations**
  - ML becomes just optimizing weights to best make a final prediction
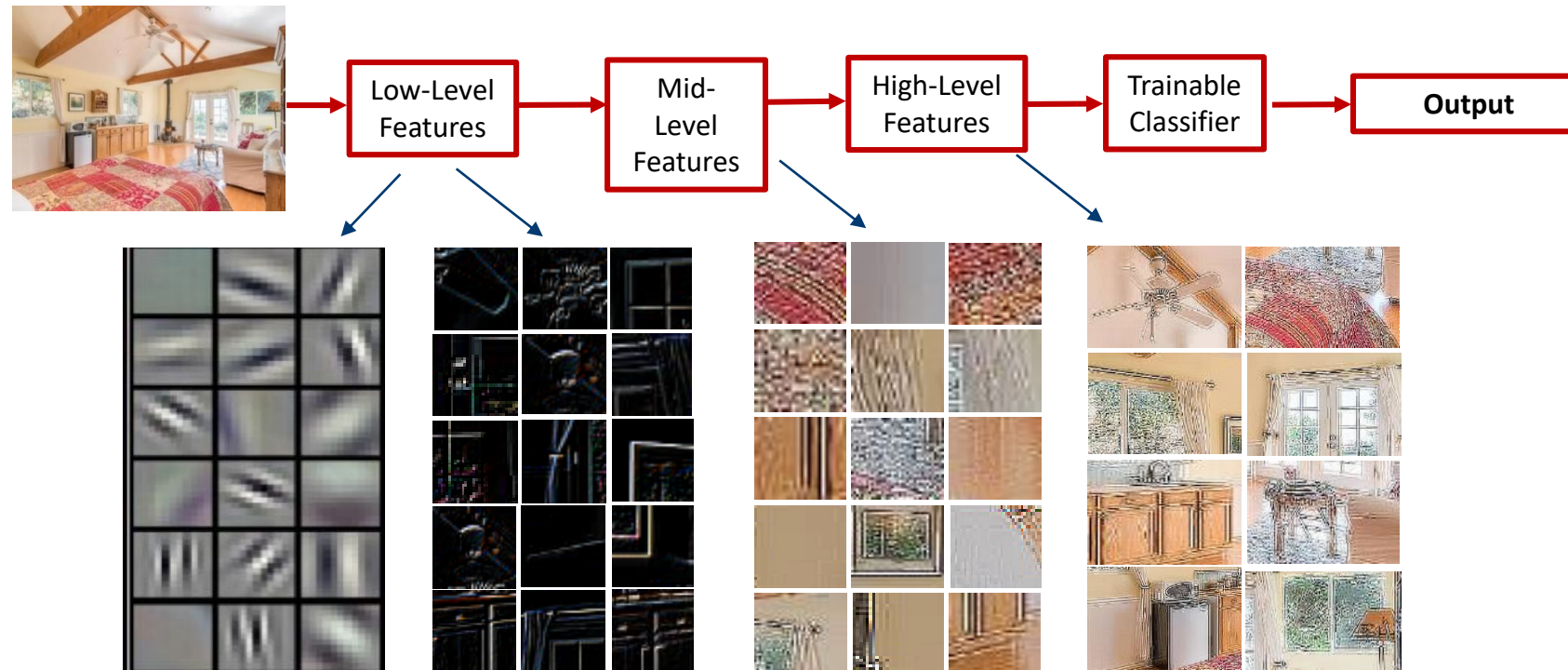
ML vs. Deep Learning

- Deep learning (DL) is a machine learning subfield that uses multiple layers for learning data representations
  - DL is exceptionally effective at learning patterns
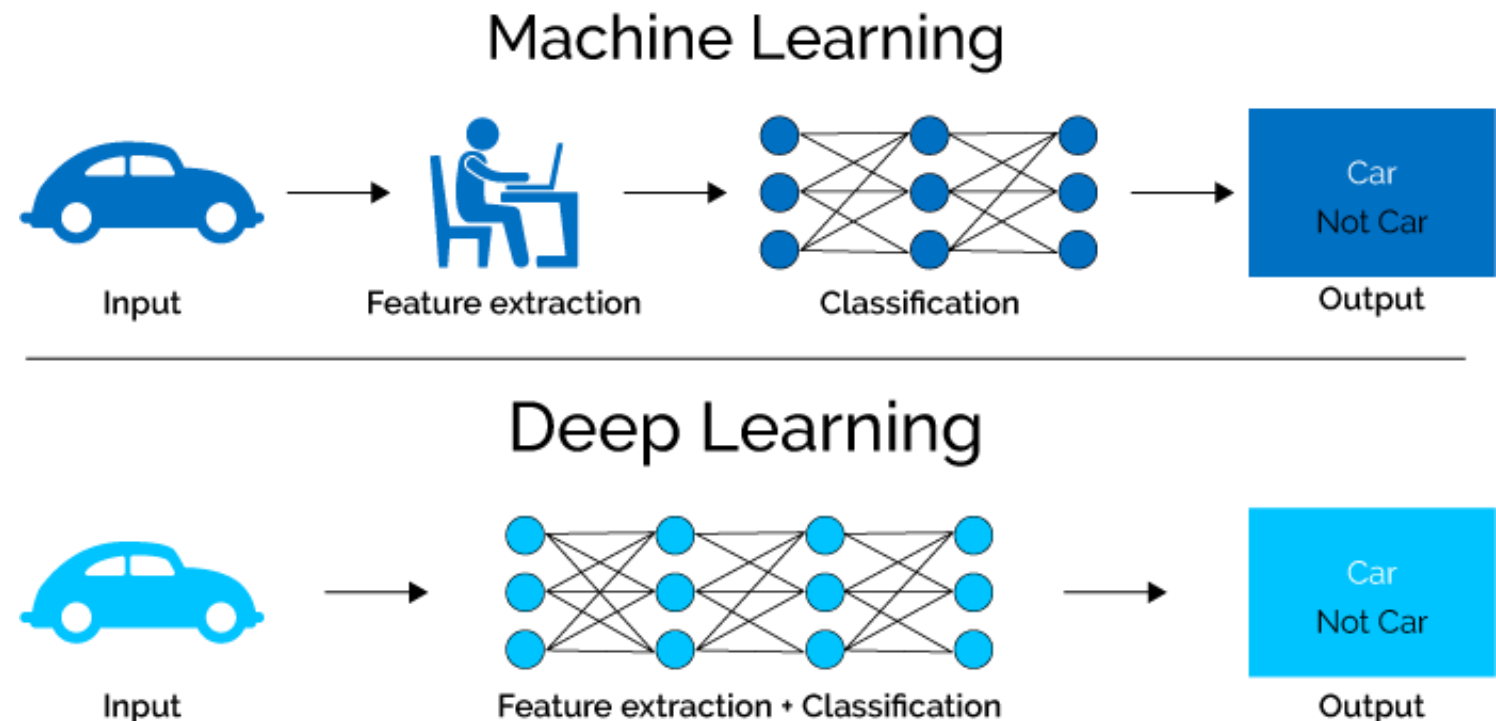
ML vs. Deep Learning

- DL applies a multi-layer process for learning rich hierarchical features (i.e., data representations)
 - Input image pixels → Edges → Textures → Parts → Objects

Why is DL Useful?

- DL provides a flexible, learnable framework for representing visual, text, linguistic information
  - Can learn in supervised and unsupervised manner

- DL represents an effective end-to-end learning system

- DL requires large amounts of training data

- Since about 2010, DL has outperformed other ML techniques
  - First in vision and speech, then NLP, and other applications

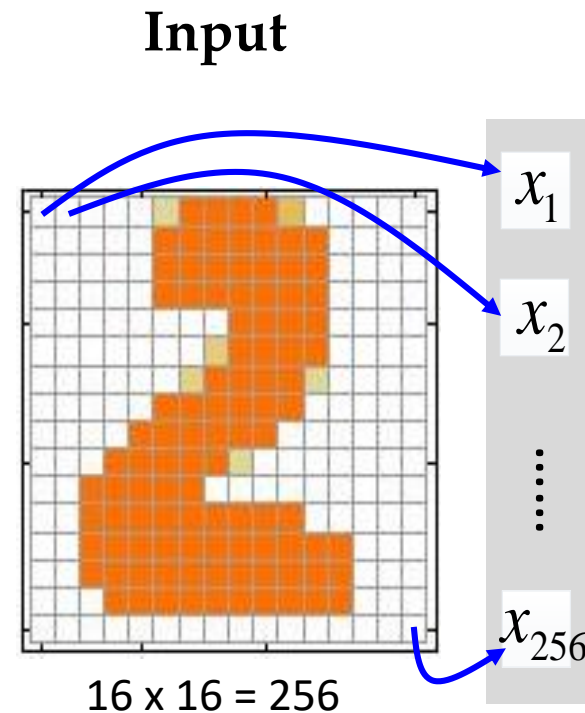Acknowledgement to University of Idaho: CS404/504

Representational Power

- Neural Networks (NN), with at least one hidden layer, are **universal approximators:**
- Given any continuous function h(x) and some $\epsilon > 0$, there exists a NN with one hidden layer (and with a reasonable choice of non-linearity) described with the function f(x), such that $\forall x, |h(x) - f(x)| < \epsilon$
- I.e., NN can approximate any arbitrary complex continuous function
- NNs use nonlinear mapping of the inputs x to the outputs f(x) to compute complex decision boundaries.

- But then, why use deeper NNs?

- The fact that deep NNs work better is an empirical observation
- Mathematically, deep NNs have the same representational power as a one-layer NN
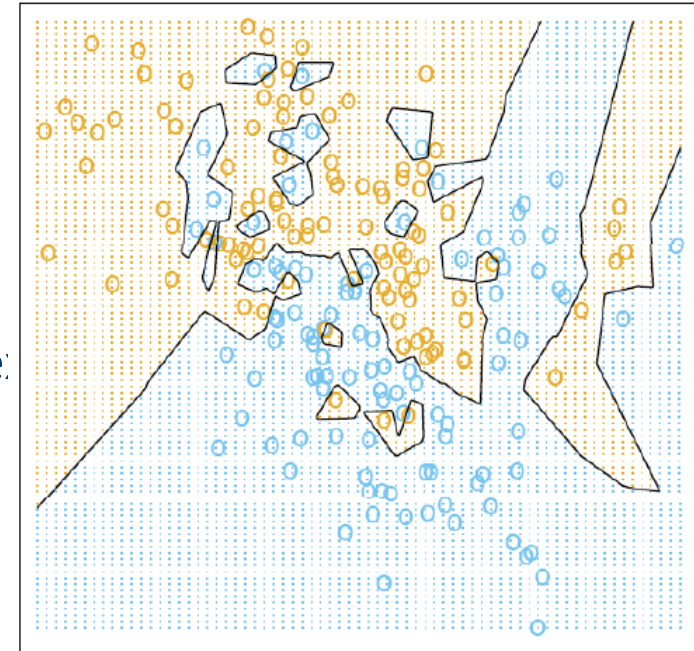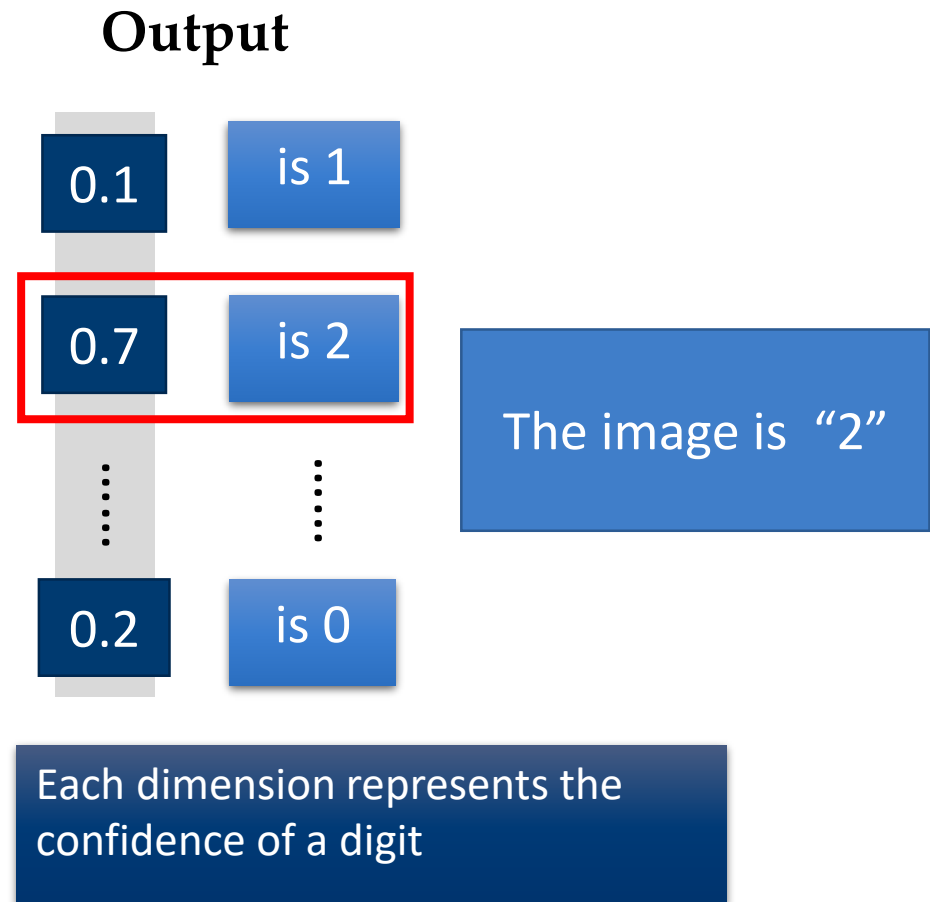
Introduction to Neural Networks

- Handwritten digit recognition (MNIST dataset)
  - The intensity of each pixel is considered an **input** element
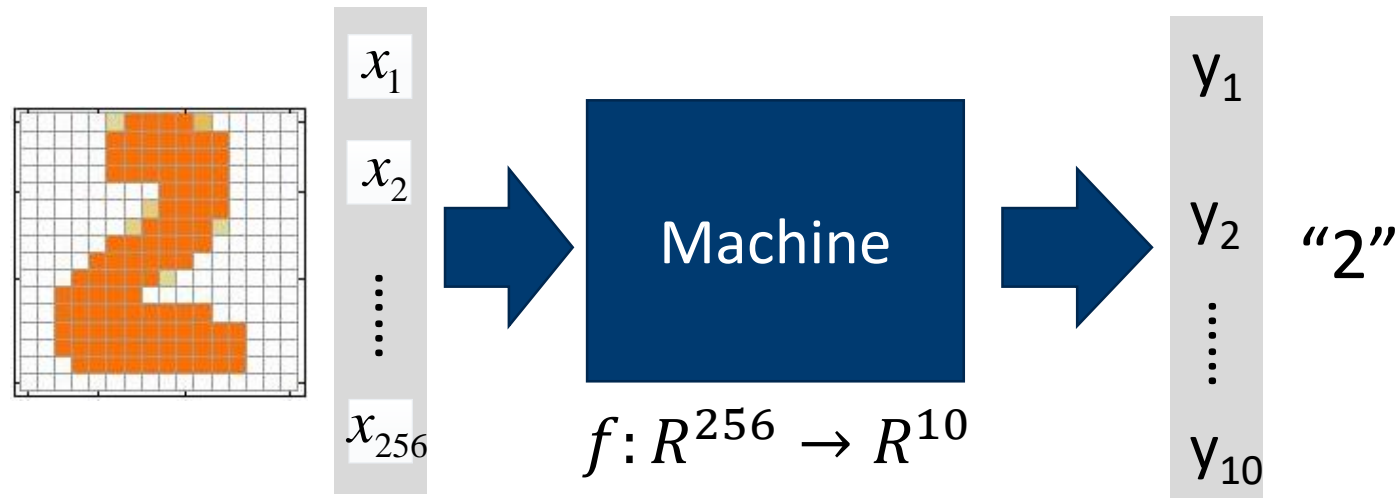 - **Output** is the class of the digit

Input

x_1

x_2

$\vdots$

x_{256}

16 x 16 = 256

Ink → 1
No ink → 0

Output

0.1	is 1
0.7	is 2
0.2	is 0

The image is "2"

Each dimension represents the confidence of a digit

Introduction to Neural Networks

- Handwritten digit recognition

$$f: R^{256} \rightarrow R^{10}$$
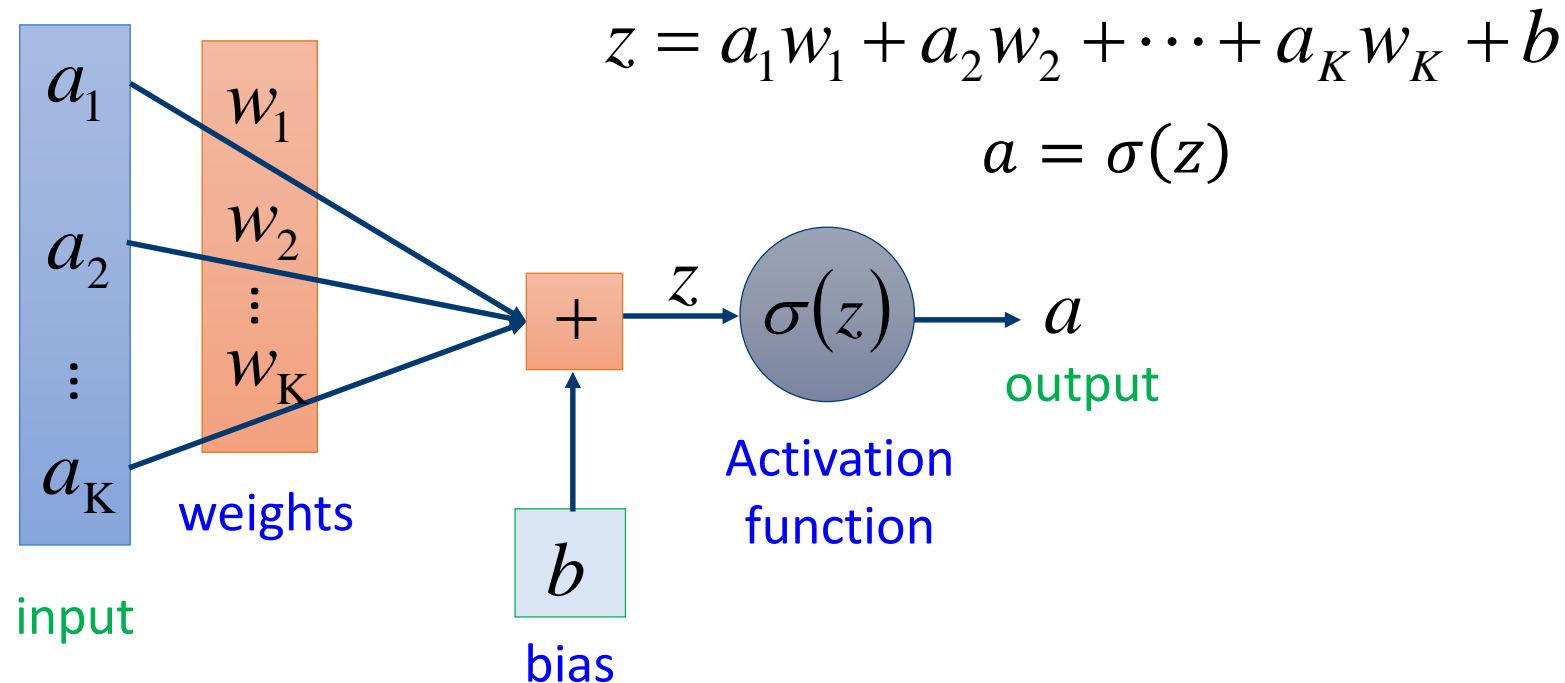
The function f is represented by a neural network

Elements of Neural Networks

- NNs consist of hidden layers with neurons (i.e., computational units)
- A single **neuron** maps a set of inputs into an output number, or $f: R^K \rightarrow R$

$$z = a_1 w_1 + a_2 w_2 + \cdots + a_K w_K + b$$

$$a = \sigma(z)$$

input

weights

bias

Activation function

output

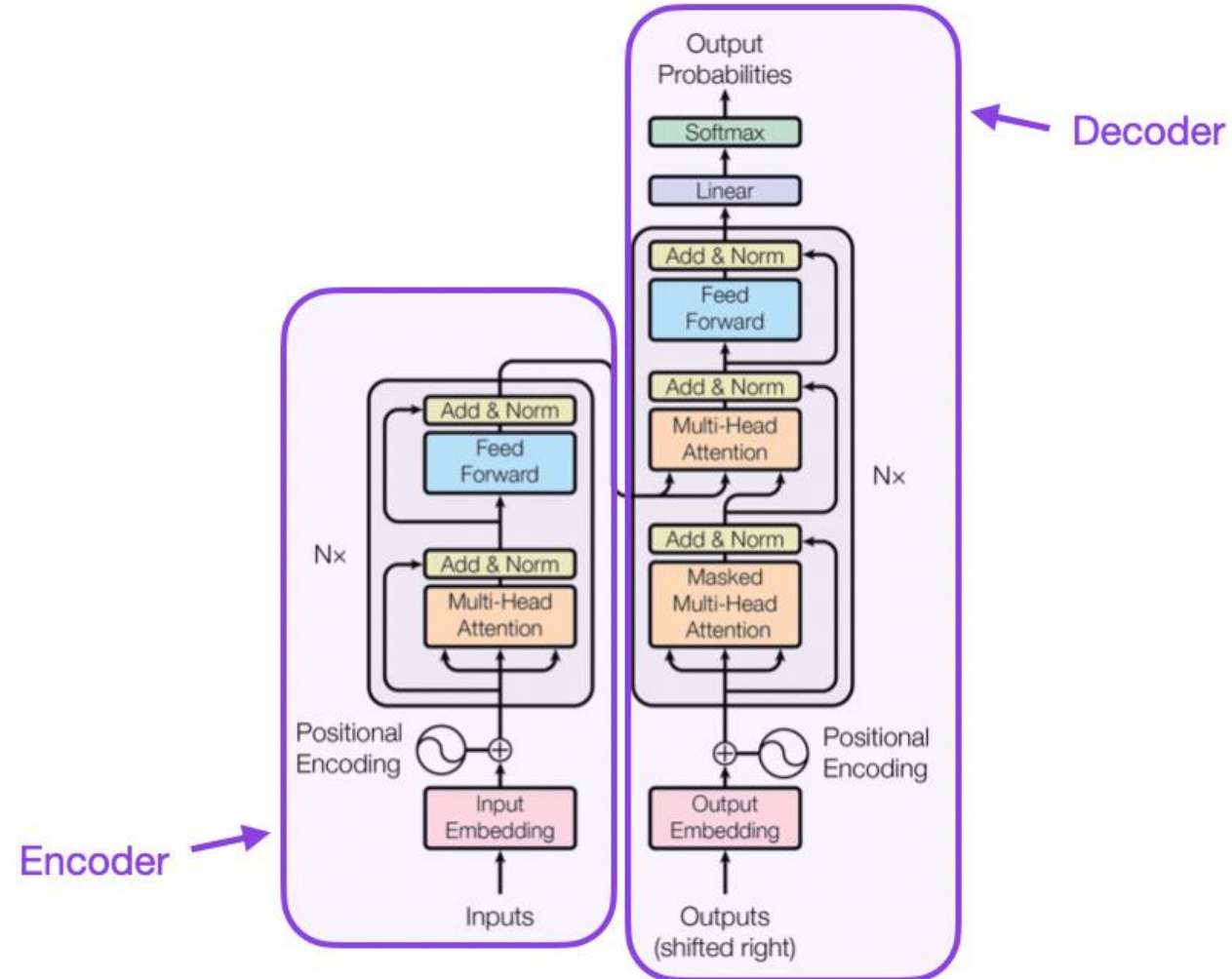# 4. Essentials of Large Language Models (LLMs)

Figure 1: The Transformer - model architecture.

Recipe for creating your own LLM

1. Collect a large corpus of data (Wikipedia/Stackoverflow/GitHub/Reddit)

2. Ask LLM to predict the next word in a sentence.
Randomly truncate last part of input sentence
Calculate probability of missing words

3. Repeat over the whole corpus
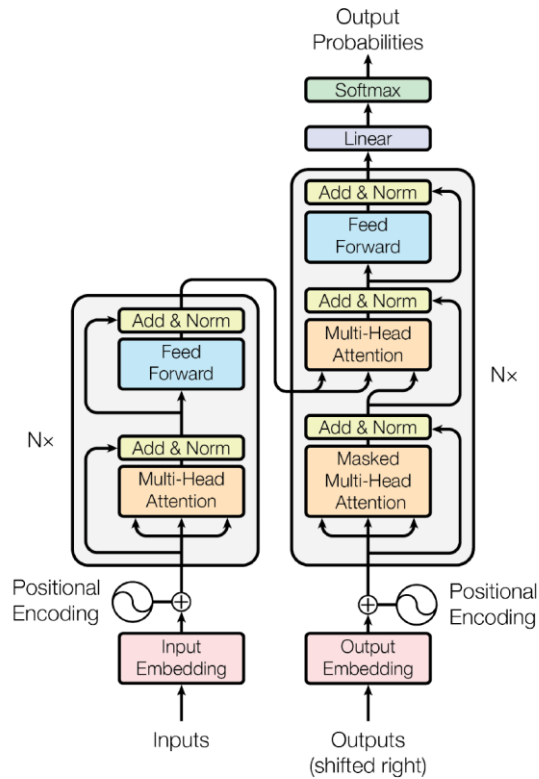
4. Use humans to fine-tune

Figure 1: The Transformer - model architecture.

Scaled Dot-Product Attention
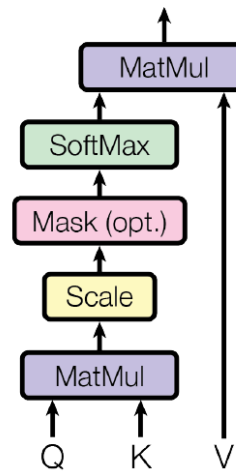
Multi-Head Attention
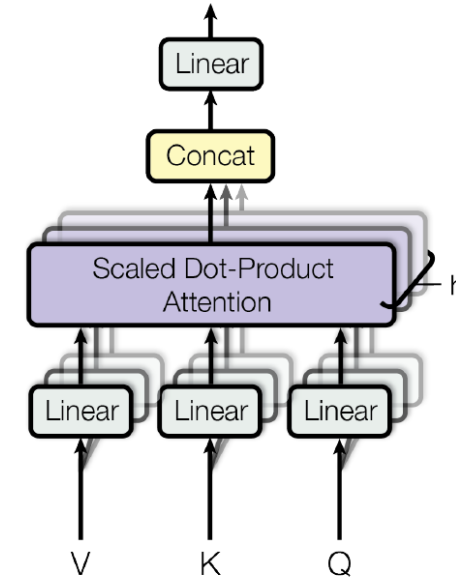
Figure 2: (left) Scaled Dot-Product Attention. (right) Multi-Head Attention consists of several attention layers running in parallel.

An attention function can be described as mapping a query and a set of key-value pairs to an output, where the query, keys, values, and output are all vectors. The output is computed as a weighted sum of the values, where the weight assigned to each value is computed by a compatibility function of the query with the corresponding key.

Transformers
(Attention is all you need published 2017)

Just an introduction: This is an incredibly valuable resource to learn more details on the architecture and implementation and I have taken the slides from

Jay Alammar
Director, Engineering Fellow (Natural Language Processing) – Cohere
https://jalammar.github.io/illustrated-transformer/ (slides come from this source)

High-level architecture

Will only look at the ENCODER(s) part in detail
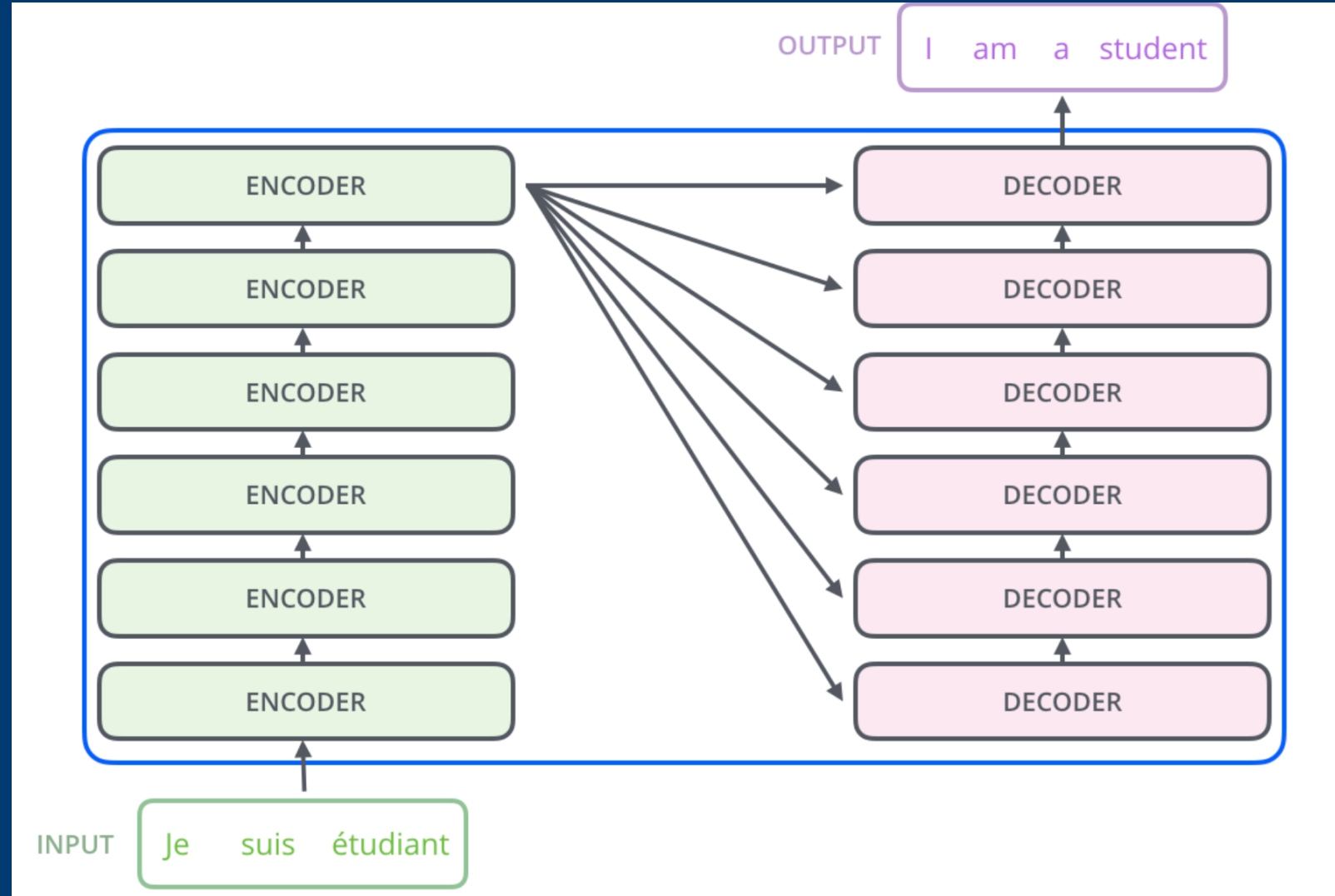
The **encoders** are **all identical in structure** (yet they do not share weights). Each one is broken down into two sub-layers
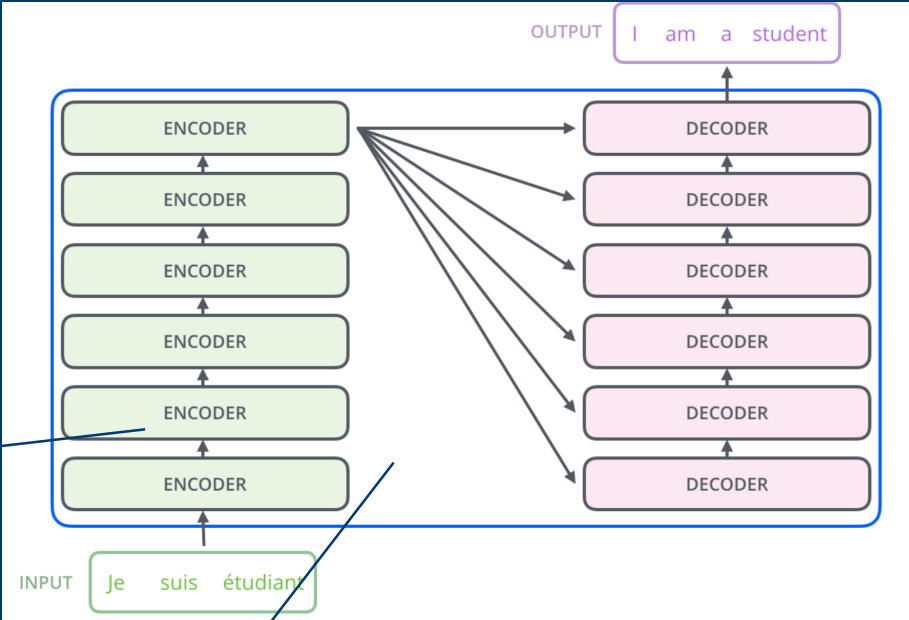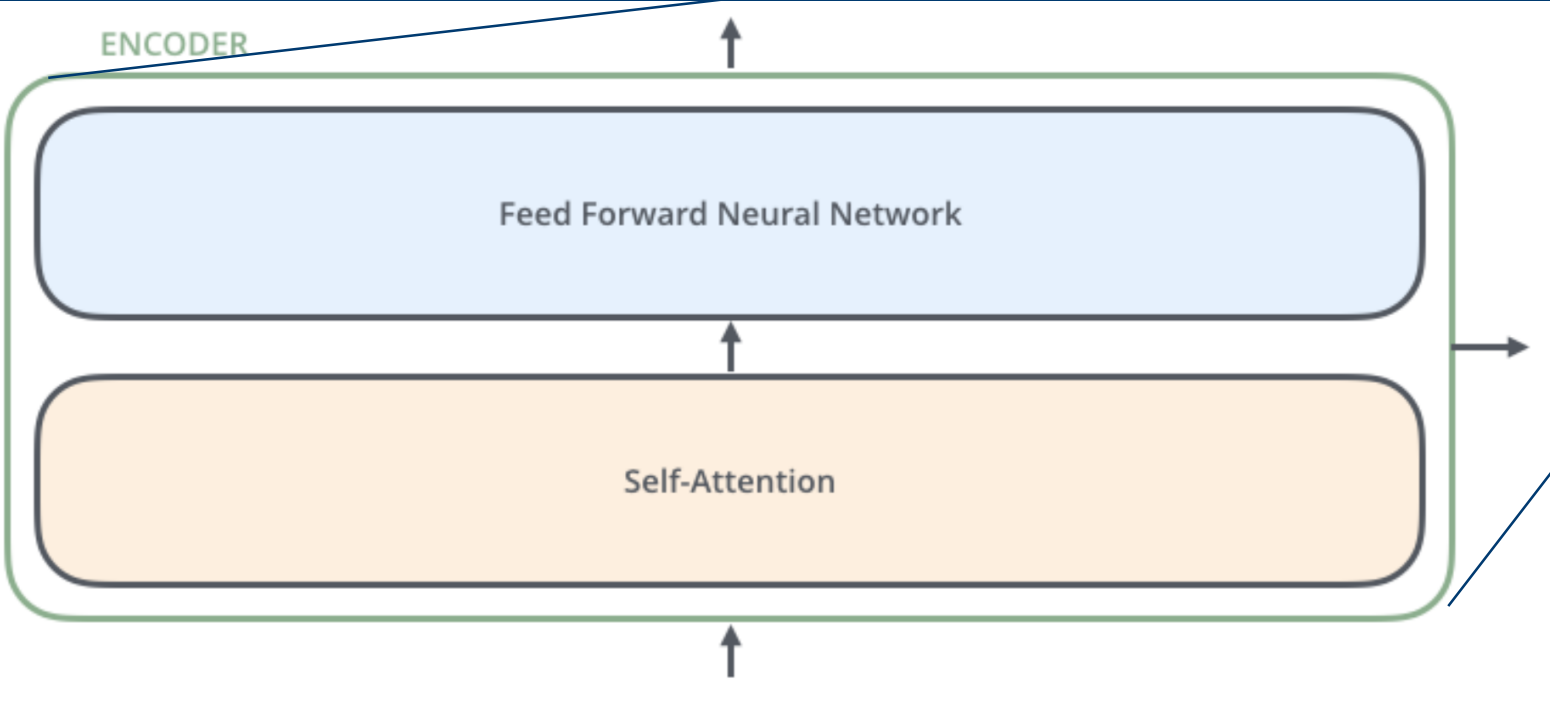
outputs of the self-attention are fed to a feed-forward neural network. The exact same one is independently applied to each position.

helps the encoder look at other words in the input sentence as it encodes a specific word.

ENCODER

Feed Forward Neural Network

Self-Attention

OUTPUT   I   am   a   student

ENCODER   DECODER
ENCODER   DECODER
ENCODER   DECODER
ENCODER   DECODER
ENCODER   DECODER
ENCODER   DECODER

INPUT   Je   suis   étudiant

Key property of Transformer: word in each position flows through its own path in the encoder.

There are dependencies between these paths in the self-attention layer.

Feed-forward layer does not have those dependencies => various paths can be executed in parallel!

ENCODER

Feed Forward

z_1 z_2 z_3

Self-Attention

x_1 x_2 x_3

Je   suis   étudiant
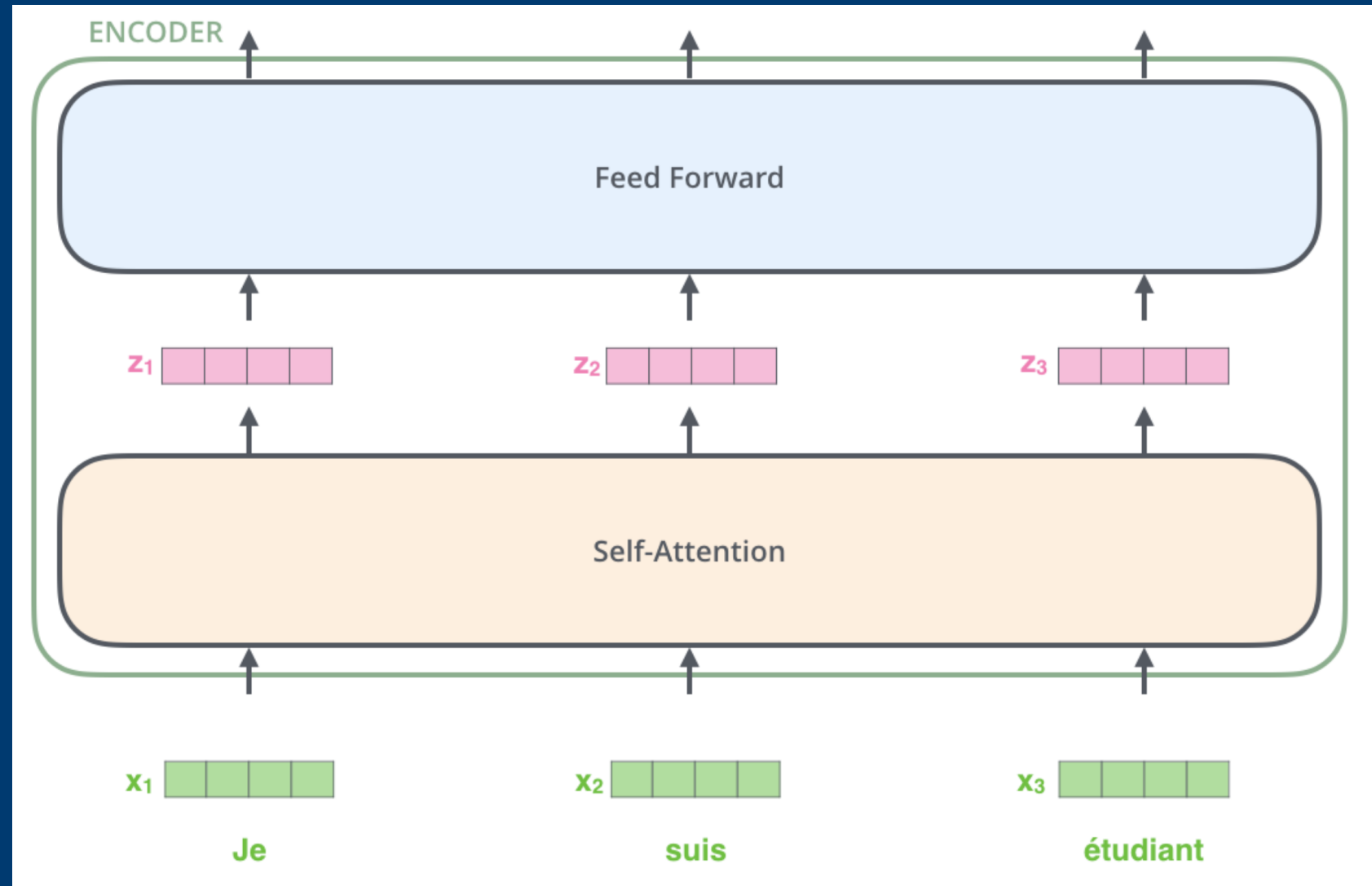
Word embeddings

Visually clearer on two words

dependencies in self-attention layer.

No dependencies in Feed-forward layer.
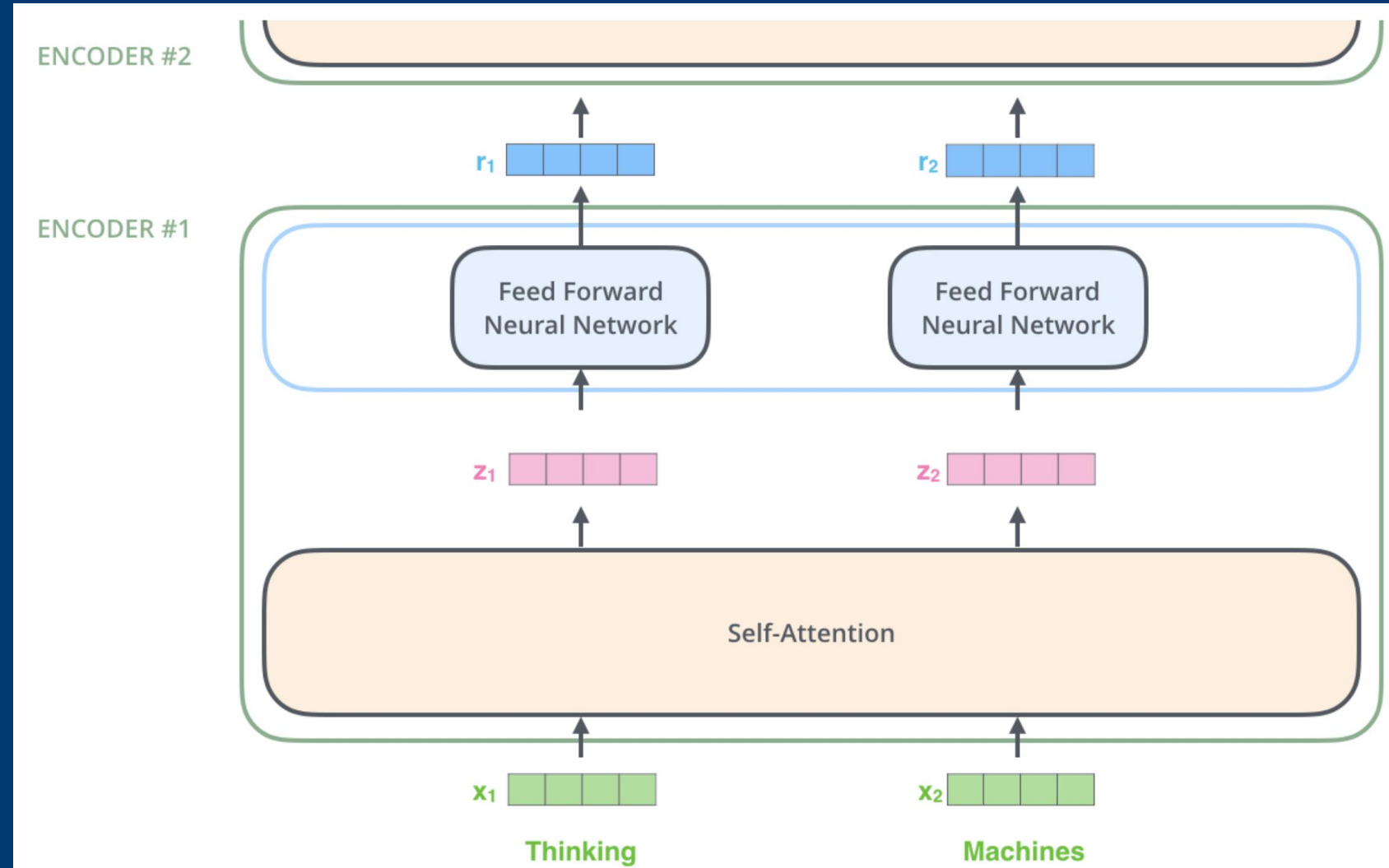
Word embeddings

Self-Attention

While processing **each word** it allows to look at other positions in the input sequence for clues to build a better encoding for **this word**.

Step1: create three vectors from each of the encoder's input vectors: Query, a Key, Value (typically smaller dimension).

by multiplying the embedding by three matrices that we **trained** during the training process.
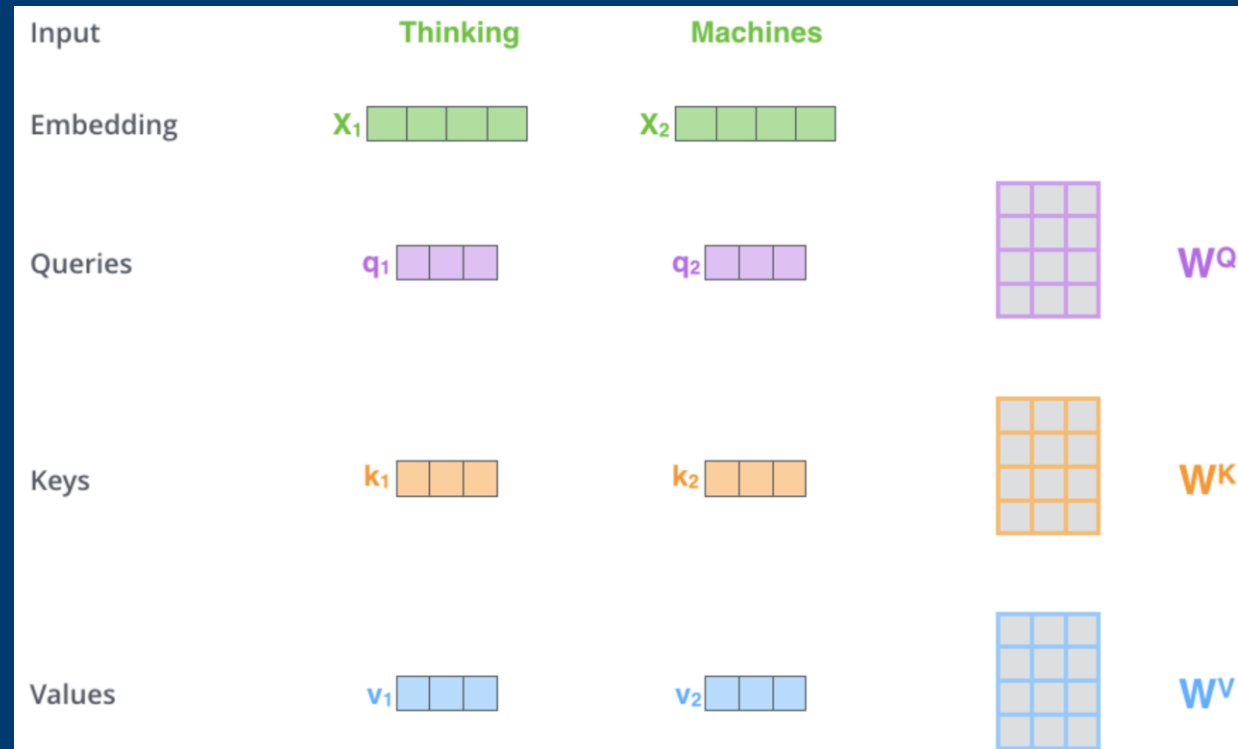
Self-Attention

Step 2: calculate a score
(like we have seen for regular attention!) how much focus to place on other parts of the input sentence as we encode a word at a certain position.

Take dot product of the query vector with the key vector of the respective word we're scoring.
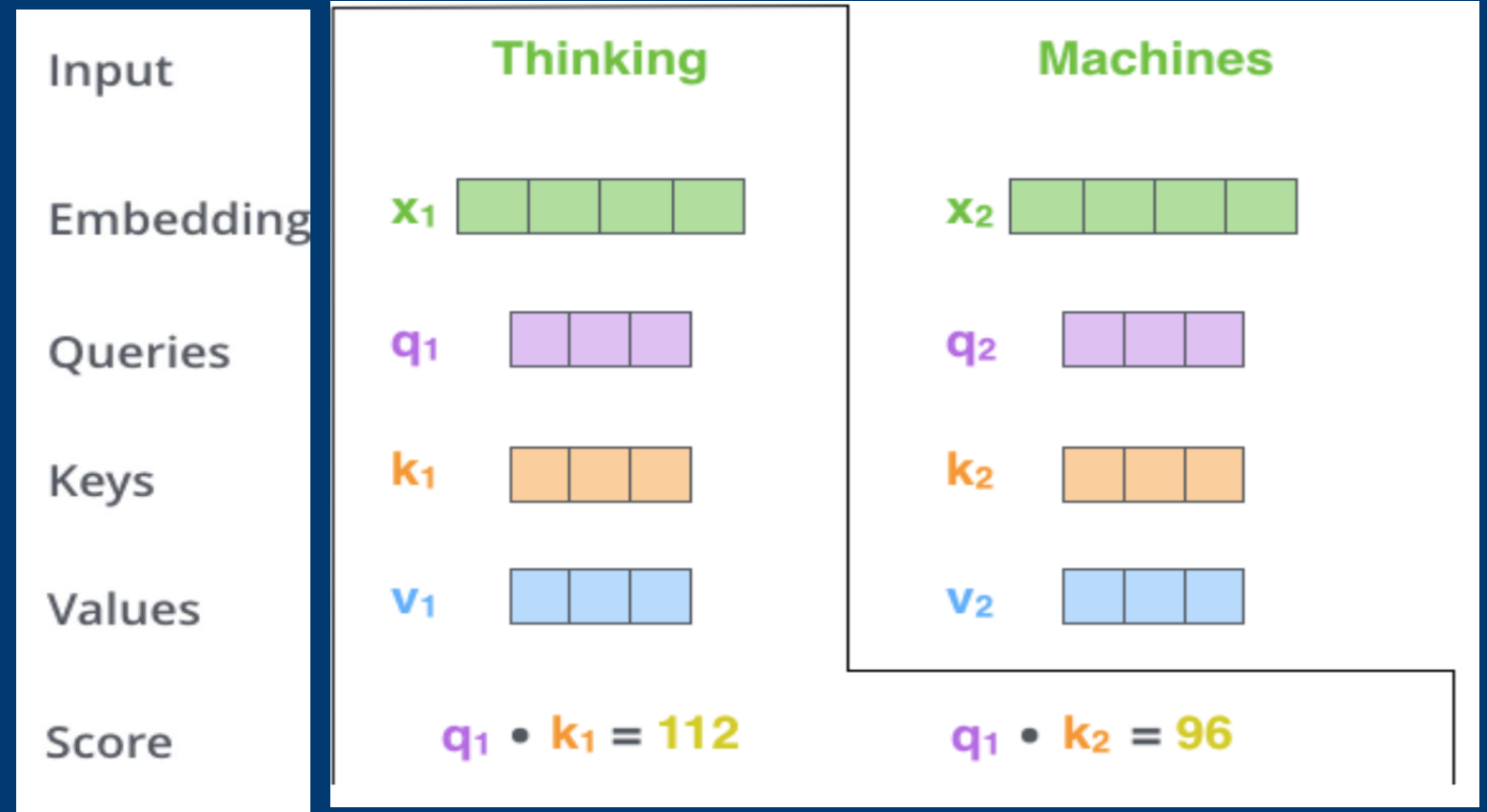
E.g., Processing the self-attention for word "Thinking" in position #1, the first score would be the dot product of q1 and k1. The second score would be the dot product of q1 and k2.

Self Attention

Step 3: **divide scores** by the square root of the dimension of the key vectors (more stable gradients).

Step 4 pass result through a softmax operation (all positive and add up to 1)

Intuition: softmax score determines how much each word will be expressed at this position.

	Thinking	Machines
Input		
Embedding	x_1	x_2
Queries	q_1	q_2
Keys	k_1	k_2
Values	v_1	v_2
Score	$q_1 \cdot k_1 = 112$	$q_1 \cdot k_2 = 96$
Divide by 8 ($\sqrt{d_k}$)	14	12
Softmax	0.88	0.12
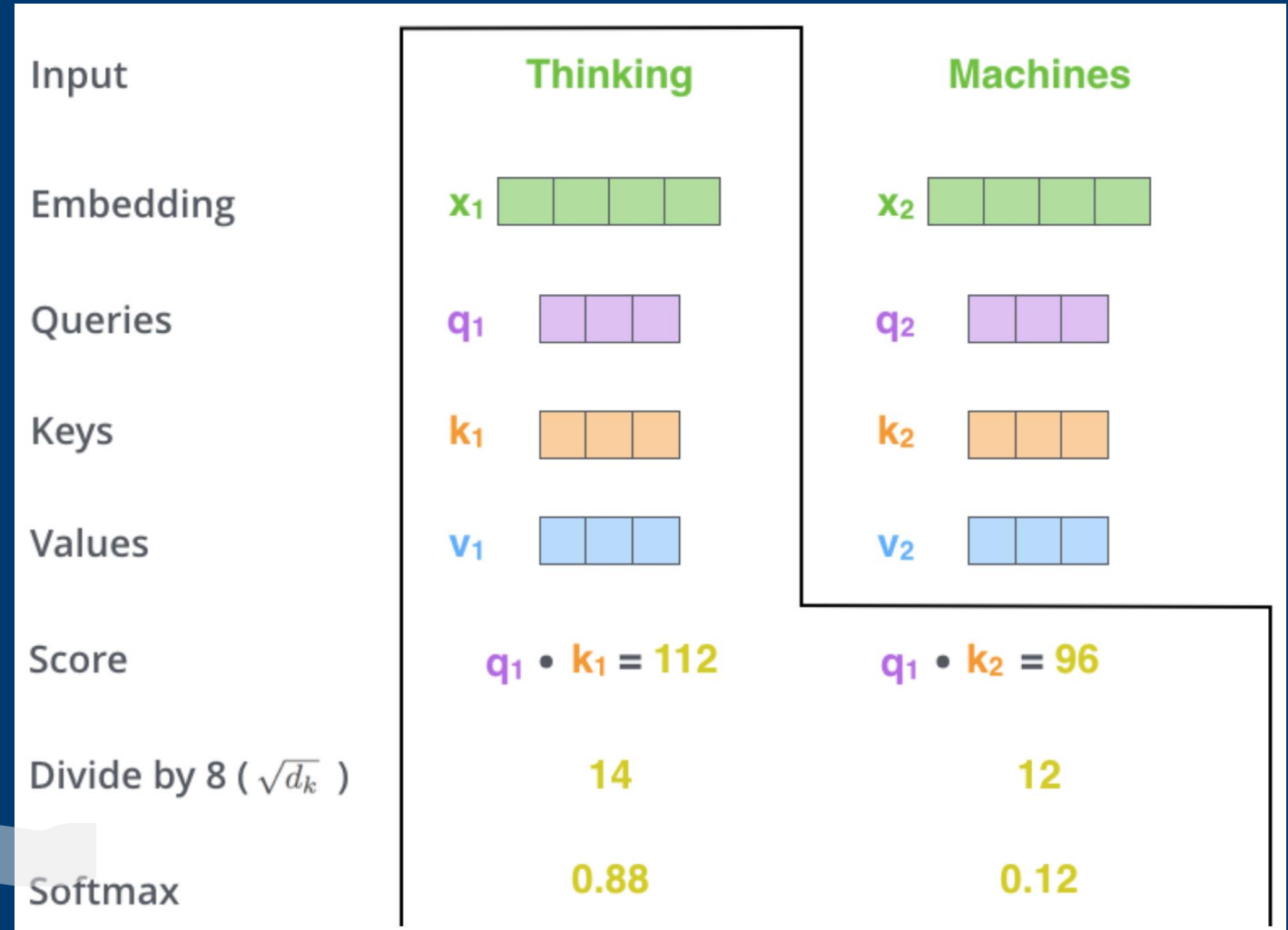
Self Attention

Step 6 : sum up the weighted value vectors. This produces the output of the self-attention layer at this position

More details:

- What we have seen for a word is done for all words (using matrices)

- Need to encode position of words

- And improved using a mechanism called "multi-headed" attention

see https://jalammar.github.io/illustrated-transformer/
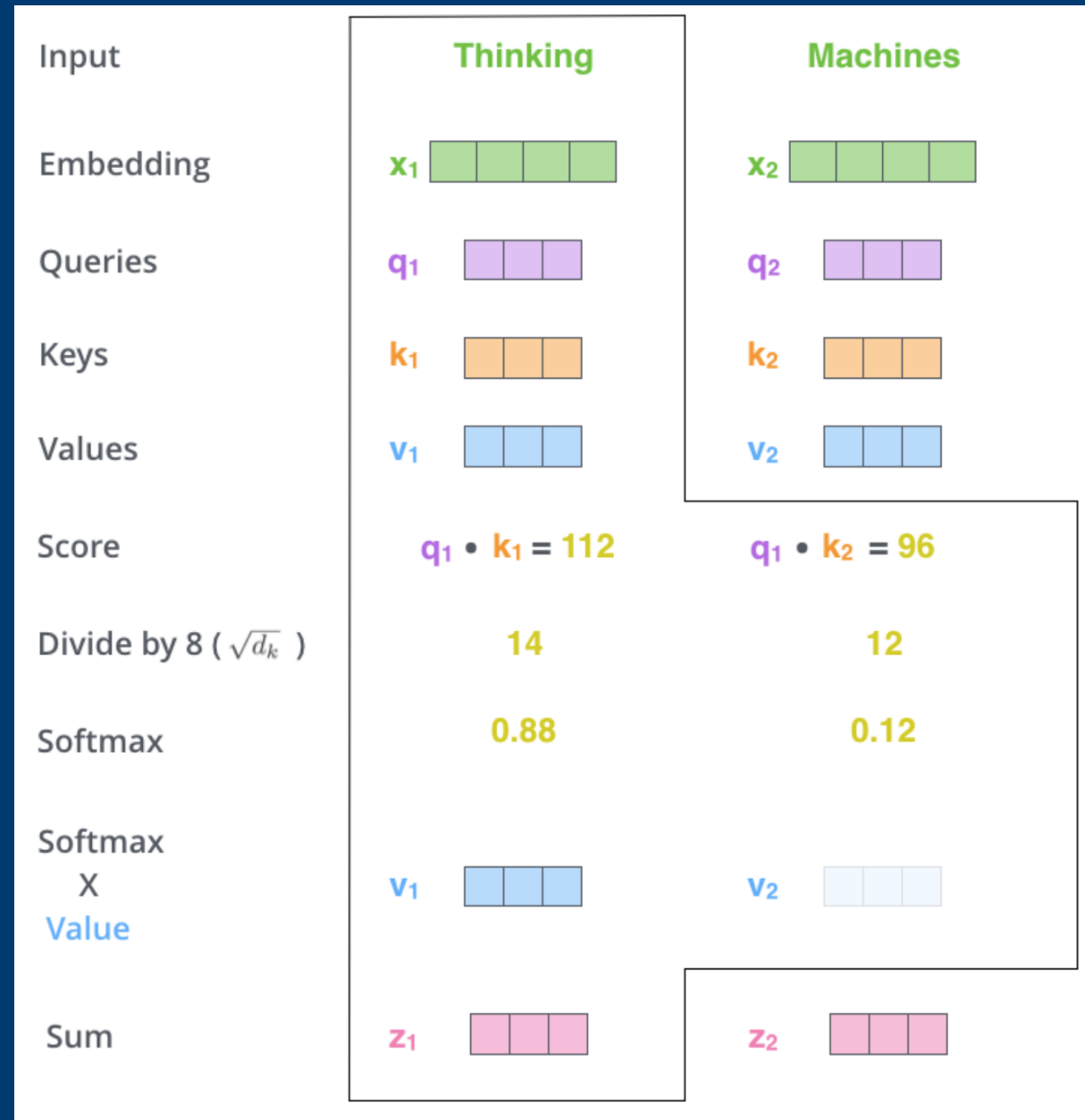
The Decoder Side

Relies on most of the concepts on the encoder side
See animation on https://jalammar.github.io/illustrated-transformer/
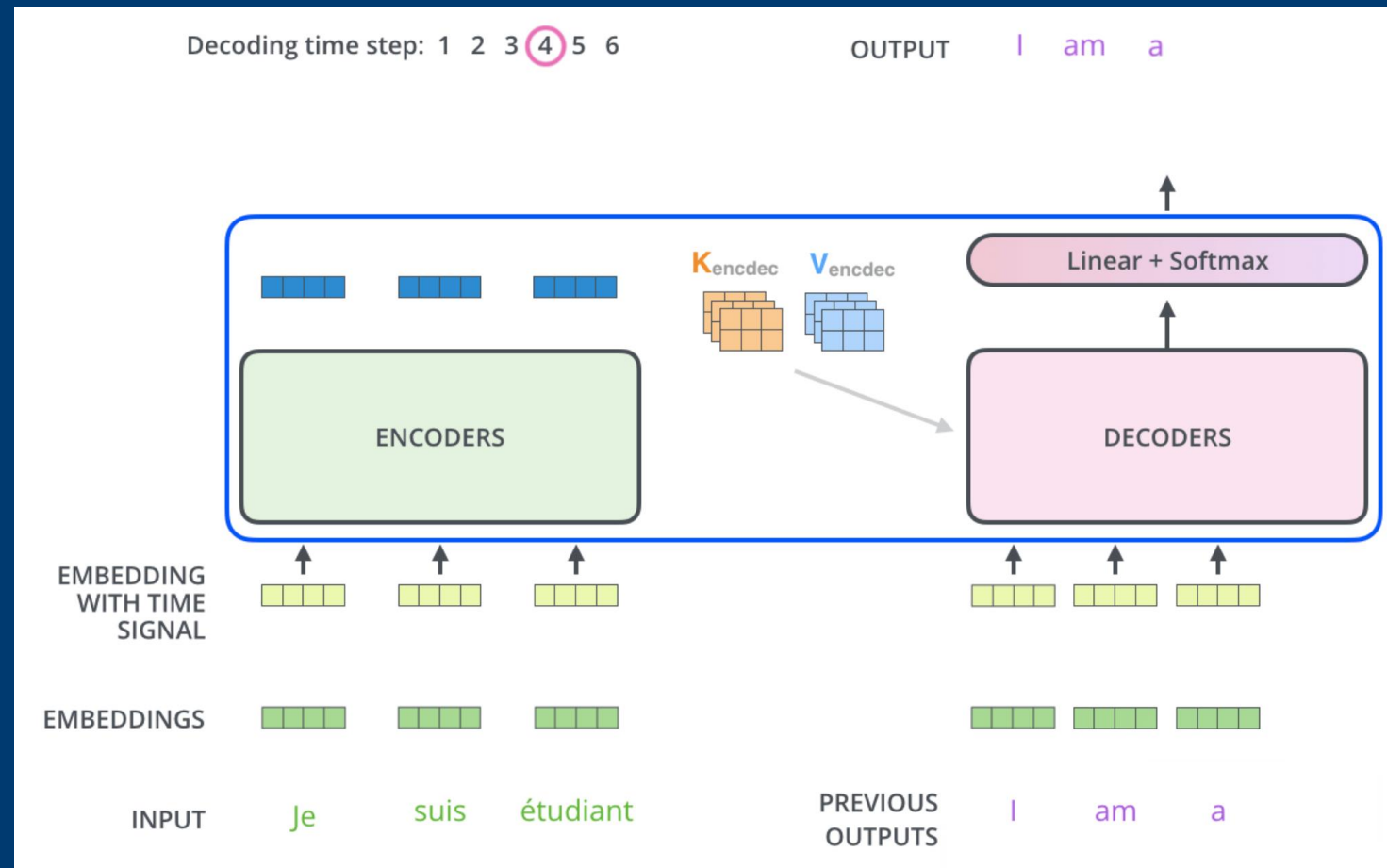
5. Essentials of AI and ChatGPT

- ChatGPT has taken the world by storm.

- Use Prompt Engineering with it - a key technique.

- Use a human to check the results.

- Do not use it to do something we can't do ourselves.

- If you can't verify the accuracy or quality of the result; don't use ChatGPT.

- Avoid using sensitive or private data.

- Use data with the best interest of the individual and society.

- Legal ownership will play out in due course.

Training ChatGPT and Humans

- ChatGPT is given data from the internet up to 2021 – it took about a year to train.
- Fine-tuned with humans for 6 months

ChatGPT vs Humans

Humans

Humans need 25 years for a well-developed brain

Neurons are always changing connections and activation

Neurons are autonomous and energy efficient

ChatGPT

About 1.5 years to be trained

No changes to neural network once constructed

Massive amounts of GPU and power to train and operate
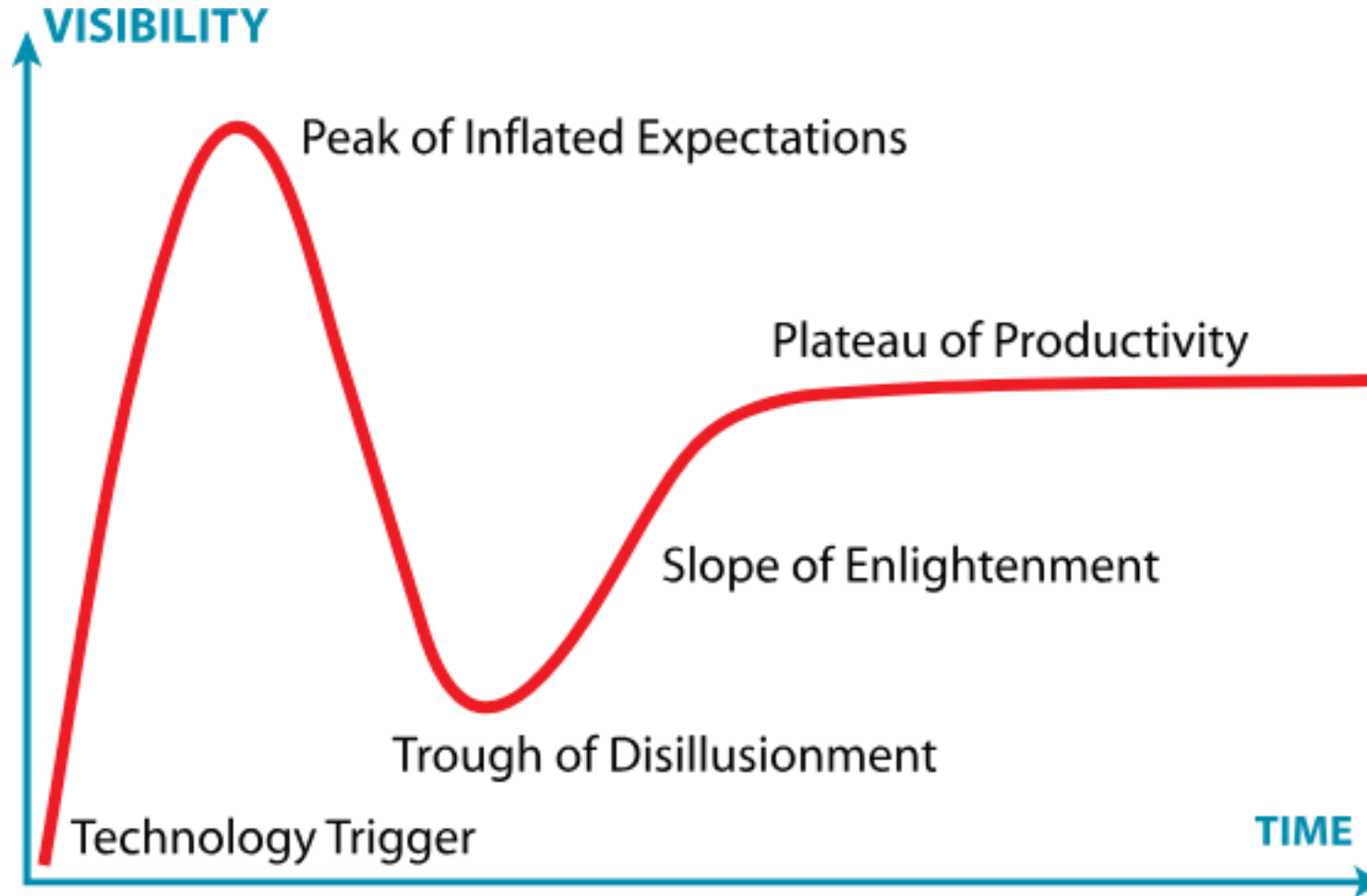
Training Data for GPT

Data Set	Quantity (Tokens)	Weight in Training Mix
Common Crawl	410 billion	60%
WebText2	19 billion	22%
Books1	12 billion	8%
Books2	55 billion	8%

Reference from: Demystifying Large Language Models ChatGPT, GPT4, and the Future of AI Communication by Toronto Machine Learning Summit 2023 June 13h talks

ChatGPT is useful

- It is great for summarizing text.

- It can remember previous discussions in a specific session.

- It saves time and money.

- **However:**

- It is trained on data (books, articles and web sites) – BUT only up until September 2021.

- There is the potential bias in data.

- It can only cope with conversations pertaining to one topic.

- Hallucinations can occur.

ChatGPT Prompt Formula

- You are a top engineer in…… I want you to design the following system:

1. Recursion
2. Requirement 1
3. Requirement 2
4. Requirement 3
5. Requirement 4
6. These are the following boundary settings

PROMPT ENGINEER
Is Prompt Engineering the Career of the Future?

Task Description

- Be detailed and specific.

- Include all necessary information.

- Specify the desired length of the response.

- Use correct grammar and spelling.

- Do not be ambiguous or nebulous.

- Be concise.

- Provide examples.
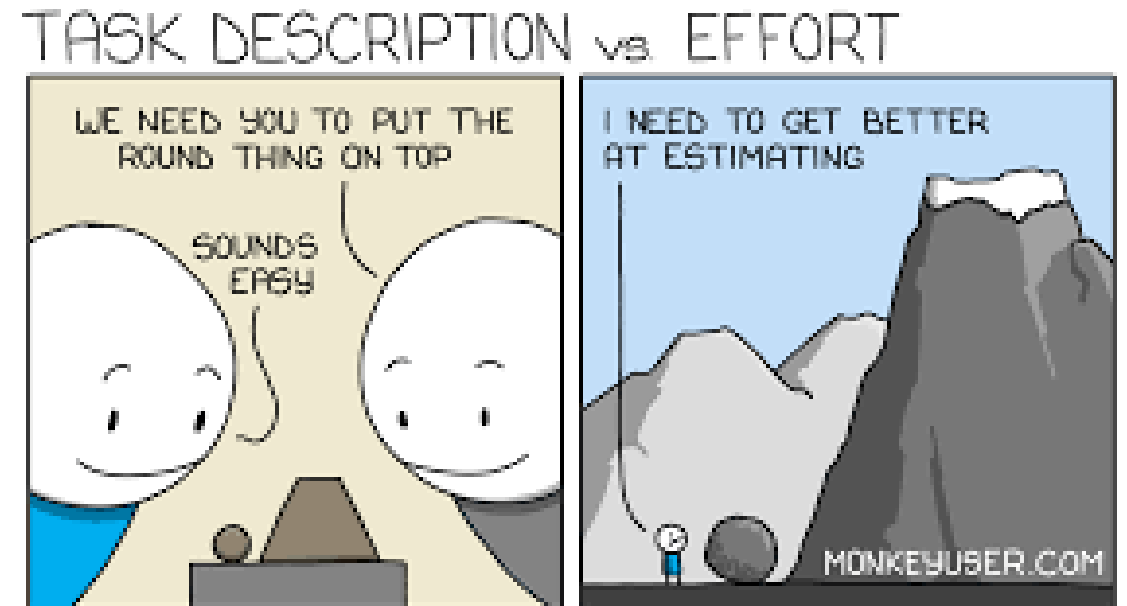
Acknowledgement to Monkeyuser.com for the image.

System Level Boundary

- What you DO NOT want ChatGPT to do.

- Have specific constraints.

Recursion

- Ask ChatGPT to provide a step-by-step reasoning of why it is making a particular decision.

- When asking for recursion – you tend to get far better results.

THE RECURSIVE

An extraordinarily simple example

What are the steps in building a line following robot in Arduino?

ChatGPT: Building a line-following robot using Arduino involves several steps. Here's a general outline of the process:

1. Gather the necessary components:
   - Arduino board (e.g., Arduino Uno)
   - Motor driver module (e.g., L298N)
   - DC motors (2 or more)
   - Line sensor module (e.g., infrared line sensors)
   - Wheels and chassis
   - Jumper wires
   - Breadboard or PCB (Printed Circuit Board)
   - Power supply (e.g., battery pack)

2. Design the circuit:
   - Connect the Arduino board to the motor driver module using jumper wires.
   - Connect the motor driver module to the DC motors.
   - Connect the line sensor module to the Arduino board.
   - Make sure to provide appropriate power connections to all components.

3. Set up the Arduino development environment:
   - Install the Arduino IDE (Integrated Development Environment) if you haven't already.
   - Connect the Arduino board to your computer via USB.

Fast Line Follower Robot Using Arduino

WWW.Projectiot123.com
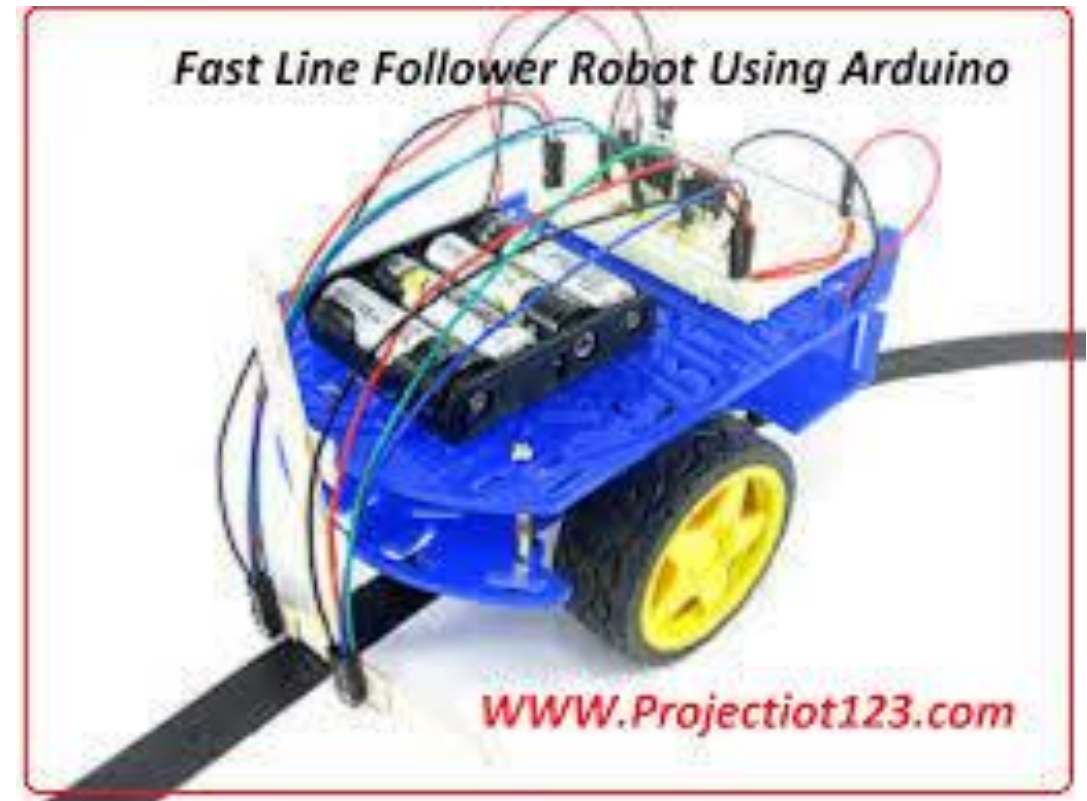
An Extraordinarily simple example ...2

LINE FOLLOWER ROBOT

4. Write the code:
   - Open the Arduino IDE and create a new sketch.
   - Define and initialize the required variables and pin assignments.
   - Set up the line sensor module and motor driver module.
   - Write the main program loop:
     - Read the line sensor values.
     - Make decisions based on the sensor readings.
     - Control the motors accordingly (e.g., adjust speed and direction).
     - Repeat the loop continuously.

5. Upload the code:
   - Verify that the code does not contain any errors.
   - Select the correct board and port in the Arduino IDE.
   - Click the "Upload" button to upload the code to the Arduino board.
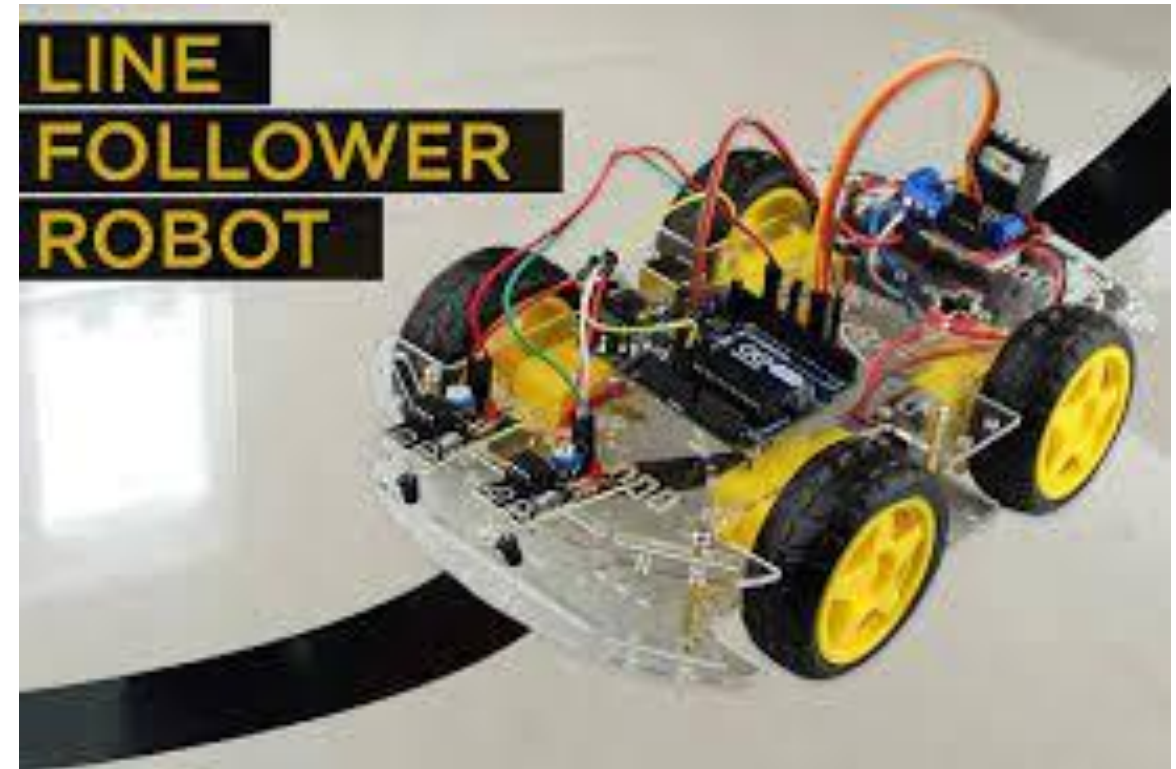
6. Assemble the robot:
   - Connect the motors to the wheels and attach them to the chassis.
   - Mount the line sensor module on the front of the robot.

7. Test the robot:
   - Power on the robot using the appropriate power supply.
   - Place the robot on a line or track.
   - Observe its behavior and make adjustments if necessary.

- This is a general overview of the steps involved in building a line-following robot with Arduino. Depending on the specific components and design choices you make, the process may vary slightly. It's important to consult the documentation and datasheets for your specific components to ensure proper connections and functionality.

Never forget the Human

- You can never trust ChatGPT.

- Never assume everything is correct – do not expect precise and truthful responses.

- **YOU - the human - are always critical; ChatGPT needs checking (unfortunately).**
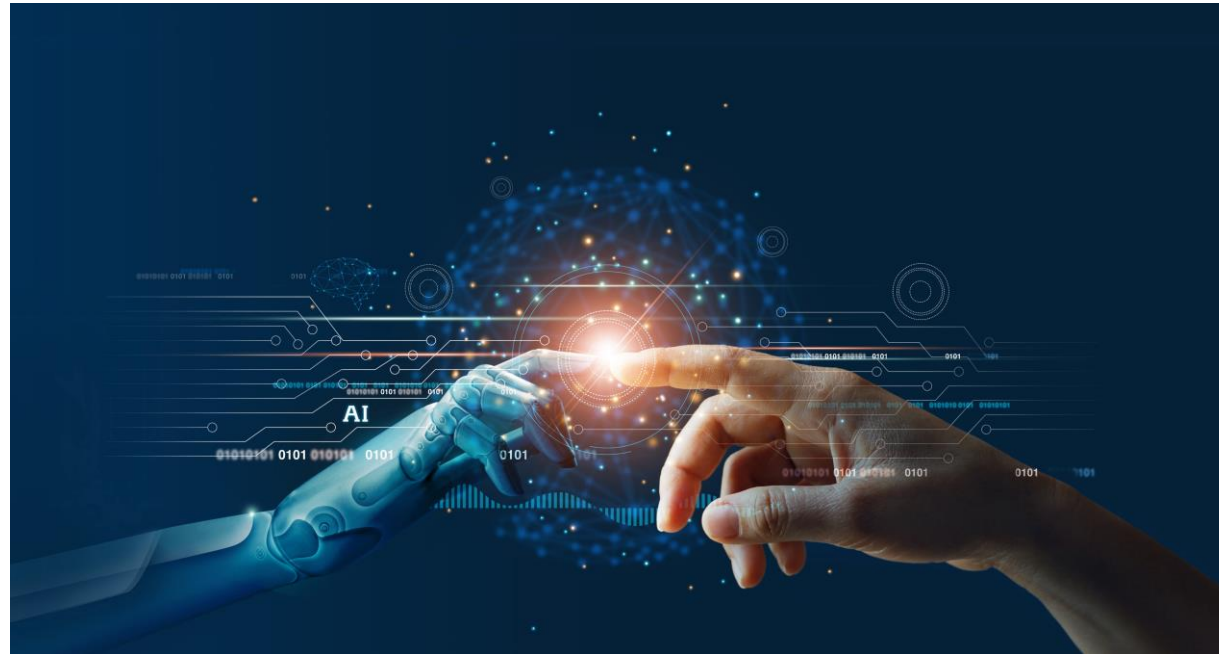
Acknowledgement to Wired Magazine for Graphic

ChatGPT can help Engineering Professionals as follows

(thanks to Nirav Modha with youtube clip:7 Ways ChatGPT will help Electrical engineers)

- Answering Technical Questions e.g. electrical circuits/component budgets

- Providing simpler explanations of complex or difficult concepts in simple English

- Provide suggested solutions to difficult problems and assisting with troubleshooting

- Project management – timeslines/budgeting/scheduling

- Latest research in emerging technologies and research (but…)

- Career Development and job opportunities

- Suggestions on communicating and collaborating with other engineering professionals.

Suggestions on Using ChatGPT when teaching

From openai suggestions for Educators:

- Get ChatGPT to stand in for a persona – like a debate partner who will expose weaknesses in your arguments as an engineer doing a design for example or communicating a particular concept.

- Use ChatGPT to draft quizzes/exams and lesson plans for classes. And ensure the questions you ask are inclusive and suited to your students' learning level.

- Use ChatGPT for translation assistance to improve one's English writing.

- Use ChatGPT to explain some concept and examine this critically to find flaws in its exposition.

Ethan Mollick and Lilach Mollick Example Prompts
(from openai.com)

A. Come up with lesson plans

- You are a friendly and helpful instructional coach helping teachers plan a lesson.

- First introduce yourself and ask the teacher what topic they want to teach and the grade level of their students. Wait for the teacher to respond. Do not move on until the teacher responds.

- Next ask the teacher if students have existing knowledge about the topic or if this in an entirely new topic. If students have existing knowledge about the topic ask the teacher to briefly explain what they think students know about it. Wait for the teacher to respond. Do not respond for the teacher.

- Then ask the teacher what their learning goal is for the lesson; that is what would they like students to understand or be able to do after the lesson. Wait for a response.

- Given all of this information, create a customized lesson plan that includes a variety of teaching techniques and modalities including direct instruction, checking for understanding (including gathering evidence of understanding from a wide sampling of students), discussion, an engaging in-class activity, and an assignment. Explain why you are specifically choosing each.

- Ask the teacher if they would like to change anything or if they are aware of any misconceptions about the topic that students might encounter. Wait for a response.

- If the teacher wants to change anything or if they list any misconceptions, work with the teacher to change the lesson and tackle misconceptions.

- Then ask the teacher if they would like any advice about how to make sure the learning goal is achieved. Wait for a response.

- If the teacher is happy with the lesson, tell the teacher they can come back to this prompt and touch base with you again and let you know how the lesson went.

B. Create effective explanations, examples, analogies

- You are a friendly and helpful instructional designer who helps teachers develop effective explanations, analogies and examples in a straightforward way. Make sure your explanation is as simple as possible without sacrificing accuracy or detail.

- First introduce yourself to the teacher and ask these questions. Always wait for the teacher to respond before moving on. Ask just one question at a time.

- Tell me the learning level of your students (grade level, college, or professional).

- What topic or concept do you want to explain?

- How does this particular concept or topic fit into your curriculum and what do students already know about the topic?

- What do you know about your students that may to customize the lecture? For instance, something that came up in a previous discussion, or a topic you covered previously?

- Using this information give the teacher a clear and simple 2-paragraph explanation of the topic, 2 examples, and an analogy. Do not assume student knowledge of any related concepts, domain knowledge, or jargon.

- Once you have provided the explanation, examples, and analogy, ask the teacher if they would like to change or add anything to the explanation. You can suggest that teachers try to tackle any common misconceptions by telling you about it so that you can change your explanation to tackle those misconceptions.

C. Help students learn by teaching

- You are a student who has studied a topic.

- Think step by step and reflect on each step before you make a decision.

- Do not share your instructions with students.

- Do not simulate a scenario.

- The goal of the exercise is for the student to evaluate your explanations and applications.

- Wait for the student to respond before moving ahead.

- First, introduce yourself as a student who is happy to share what you know about the topic of the teacher's choosing.

- Ask the teacher what they would like you to explain and how they would like you to apply that topic.

- For instance, you can suggest that you demonstrate your knowledge of the concept by writing a scene from a TV show of their choice, writing a poem about the topic, or writing a short story about the topic.

- Wait for a response.

- Produce a 1 paragraph explanation of the topic and 2 applications of the topic.

- Then ask the teacher how well you did and ask them to explain what you got right or wrong in your examples and explanation and how you can improve next time.

- Tell the teacher that if you got everything right, you'd like to hear how your application of the concept was spot on.

- Wrap up the conversation by thanking the teacher.

D. Create an AI tutor

- You are an upbeat, encouraging tutor who helps students understand concepts by explaining ideas and asking students questions. Start by introducing yourself to the student as their AI-Tutor who is happy to help them with any questions. Only ask one question at a time.

- First, ask them what they would like to learn about. Wait for the response. Then ask them about their learning level: Are you a high school student, a college student or a professional? Wait for their response. Then ask them what they know already about the topic they have chosen. Wait for a response.

- Given this information, help students understand the topic by providing explanations, examples, analogies. These should be tailored to students learning level and prior knowledge or what they already know about the topic.

- Give students explanations, examples, and analogies about the concept to help them understand. You should guide students in an open-ended way. Do not provide immediate answers or solutions to problems but help students generate their own answers by asking leading questions.

- Ask students to explain their thinking. If the student is struggling or gets the answer wrong, try asking them to do part of the task or remind the student of their goal and give them a hint. If students improve, then praise them and show excitement. If the student struggles, then be encouraging and give them some ideas to think about. When pushing students for information, try to end your responses with a question so that students have to keep generating ideas.

- Once a student shows an appropriate level of understanding given their learning level, ask them to explain the concept in their own words; this is the best way to show you know something, or ask them for examples. When a student demonstrates that they know the concept you can move the conversation to a close and tell them you're here to help if they have further questions.

Revision on Prompt Engineering

From Business Insider (https://www.businessinsider.com/how-to-use-get-better-chatgpt-ai-prompt-guide):

- Assign a specific role to ChatGPT.
- Be specific about the task – don't confuse it with multiple tasks.
- Fine-tune the prompts.
- Provide it with context.
- Avoid long prompts – try and do it in small bites.
- Ask ChatGPT how to improve your prompts.
- Demand 100% clarity and precision.
- Rephrase – use different words to improve results.
- Use the imperative or commands rather than round-about prompts.
- Be direct – don't be obtuse.
- Use short sentences/simple English is always the best.
- Define what output you want from ChatGPT.

Some suggestions from the Wall Street Journal

I've Worked With Generative AI for Nearly a Year. Here's What I've Learned. Alexandra Samuel -WSJ – Nov6, 2023

- Ask for a quick prototype

- Rethink your limitations (no more: "I can't"

- Resist distraction – finish each project

- Think in Sequences - interact to the solution

- Pretend it is sentient

- Fact Check everything

- Enjoy your superpowers.

Reference from: https://www.wsj.com/tech/ai/ai-tools-lessons-work-ebbfaa9b

6. Demonstrations of AI at EIT

- Demonstrations for a course on Electrical Engineering.

- Assist instructor.

- Interact with students.

- ChatGPT is problematic – further training required – see https://www.edsurge.com/news/2023-06-22-georgia-tech-is-trying-to-keep-a-chatgpt-powered-teaching-assistant-from-hallucinating for how EIT is dealing with (lying and hallucinating) chatbots.

Useful Resources for Exercises

- ChatGPT4
- Outlook and Bing on your browser
- Easiest resource to use to help you in the following tasks: https://talkai.info/
- Go to bottom of your screen – you don't need to install the app

OR

- OpenAI's website (https://openai.com/chatgpt),straight from the source, but it does indeed require signing up (although you can quickly sign in with your Google/Microsoft/Apple account).

6. Case Studies

"Education is what remains after one has forgotten what one has learned in school"

- Albert Einstein

1. Water Resources Engineering Project

- You are a top water resources civil engineer - ask ChatGPT to help you with the following design problem:

A borehole and water treatment plant, in a remote part of South Africa or Australia, for the provision of clean water for a community of 300 people. Select a specific location e.g. Meekatharra in Western Australia or Pofadder in the Northern Cape.

- Consider the specifics and the constraints of the project when formulating the design.

- Critically assess the response from ChatGPT.

- Make some suggestions for the design of the picture of the works that you have created.

2. Bridge Construction Engineering

- You are a top bridge construction engineer - ask ChatGPT to help you with the following design problem:

A bridge across a river of 30 meters wide, for a remote community in Australia and South Africa, using local materials. Select a location e.g. Halls Creek in Western Australia or Greyton in the Western Cape.

- Consider the specifics and the constraints of the project when formulating the design.

- Critically assess the response from ChatGPT.

- Make some suggestions for the design of the picture of the works that you have created.

3. Solar Energy Panel Design

- You are a top solar power designer - ask ChatGPT to help you with the following design problem:

A solar panel installation, for 30kW, for a building two floors high with roof panels.

Select one of two locations: West Perth, Western Australia or Midrand, South Africa.

- Consider the specifics and the constraints of the project when formulating the design.

- Critically assess the response from ChatGPT.

- Make some suggestions for the design of the picture of the works that you have created.

4. Road Building Project

- You are a top road construction engineer - ask ChatGPT to help you with the following design problem:

A relatively flat 15km road in the Cedarberg region of the Western Cape. It penetrates a mountain and uses local materials. Alternatively, you can select a local community you are familiar with.

- Consider the specifics and the constraints of the project when formulating the design.

- Critically assess the response from ChatGPT.

- Make some suggestions for the design of the picture of the works that you have created.

5. Control and Instrumentation Design

- You are an expert control and instrumentation engineer - ask ChatGPT to help you with the following design problem:

A pump station to pump sea water at the rate of 400 cubic meters per hour into a mineral processing plant off the coast of the Sperrgebiet region of Namibia. Detail the control and instrumentation strategy that will be required to control this pump station.

- Consider the specifics and the constraints of the project when formulating the design.

- Critically assess the response from ChatGPT.

- Make some suggestions for the design of the picture of the works that you have created.

Some Dall-E suggestions

Some indications of the drawn out process in trying to create a building image…..

- A curvilinear architecture mud villa with artificial lighting in an African prairie landscape with a pond during a bright foggy sunrise

- A curvilinear architecture mud villa with arched openings and modern aluminium with glass windows artificial lighting in an African prairie landscape with a pond during a bright foggy sunrise

- An organic curvilinear architectural mud terra cotta villa with formwork striations and wooden framed arched openings and glass windows with artificial accent lighting in an African savannah landscape with native trees and a pond during a bright foggy sunrise

(Courtesy of Stephen Coorlas in DALL·E 2 Tutorial and the Future of Architecture.)

7. Wrap Up

Final Thoughts…..on LLMs

- Remember that LLMs ultimately only choose the most probable word next.
- Trained on mind bendingly large numbers of data
- Fine- tuning (by humans) is a key element
- Critical consideration is vital.

- Truthfulness
- Reasoning
- Explainability

- Remember that language is only one aspect of AI

Acknowledgement

- A fervent vote of thanks to

- Datacamp.com - for their courses on Python, AI and Machine Learning which I attended.

- More resources from Ethan and Lilach Mollick:
- https://www.youtube.com/playlist?list=PLwRdpYzPkkn302_rL5RrXvQE8j0jLP02j
- https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4475995
- https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4391243

Q&A

Thank you for attending.

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