

# **Some thoughts on Generative AI**

ChatGPT & Co

Large Language Models, Foundation Models

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HD

Write a short poem about the Workshop

"The impact of pandemic years to informatics education: review and next step" in Shkodra  
with special thanks to Klaus



In Shkodra's grace, a workshop did unfold,  
"Pandemic's Impact on Education" told,  
Informatics thrived despite the stormy cold,  
Thanks to Klaus, whose wisdom paved the road.

ChatGPT

✓ Searching for: **history of Shkodra**

✓ Generating answers for you...

## Tell me something about the history of Shkodra

Shkodra, also known as Shkodër, is a town located in northwestern Albania. It is one of the oldest continuously inhabited cities in the country, with roughly 2,200 years of recorded history<sup>1</sup>. The city was founded under the name Skodra in the 4th century BCE on the traditional lands of the Illyrian tribes of the Ardiaei and Labeates<sup>1</sup>. It has historically developed on a 130m hill strategically located in the outflow of Lake Shkodër into the Buna River<sup>1</sup>.

The oldest wall of the Shkodër castle dates from the 1st millennium BCE. The Roman historian Livy cited the town as the capital of the Illyrian king Gentius, who surrendered to the Romans in 168 BCE<sup>2</sup>. The town was subsequently held by various powers including the Byzantines, Bulgars, Serbs, and Turks. It was a stronghold of the Albanian national hero Skanderbeg in the 15th century<sup>2</sup>.

Shkodër has a rich history and has played an important role in Albanian culture. It was home to many influential personalities who helped shape the Albanian Renaissance. The city is also known for its religious diversity and tolerance, with its architecture being dominated by mosques and churches<sup>1</sup>. Is there anything else you would like to know? 😊

Learn more: [1. en.wikipedia.org](https://en.wikipedia.org) [2. britannica.com](https://www.britannica.com) [3. shkoder.net](https://shkoder.net)

7 of 30 ●

Bing

GPT = **Generative Pretrained Transformer**. (OpenAI, Microsoft)

- **Generative**: Generating texts
  - **Pretrained**: Trained in Machine Learning for language understanding
  - **Transformer**: Deep Neural Network architecture
- 
- GPT-3.5. Basis for **ChatGPT** (free)  
    payed version: ChatGPT Plus
  - GPT-4     20 \$ per month  
    free in **BING** by Microsoft.

# Substantial Progress in Natural Language Processing (NLP) by Large Language Models (LLM)

Using **Transformers**: Deep Neural Network architecture originally invented by Google/DeepMind for language translation

Systems by big players:

- **GPT** family (OpenAI, Microsoft)
- **Bard** with LaMDA (Language Model for Dialogue Applications) by Google/DeepMind
- **LLaMA** (Large Language Model Meta AI) by Meta

More: in China, South Korea, Russia,

# Potentials of Large Language Models (LLM)

- Language-Interface
- Communication with programs and machines
- Recommendation systems
- FAQ/Call Center
- Communication
  - Chatbots
  - Search engines
  - Office
  - ...

**GPT-API for services by third party**

## More immediate contact with the machines

Machine Operator



Homecomputer, Windows, Mouse



Apps



Language assistants using scripts



Language generators with (some) understanding

Tell me something about Shkodra

# ChatGPT: Training in 2 Phases

## 1. Pretraining: Language in general

- 300 000 000 000 Documents
- Web pages, Wikipedia, digital books
- Until September 2021

Unlabelled data

Repair a text where a word is masked:

Input:

*Shkodër is one of Albania's oldest continuously [REDACTED] cities.*

Expected output:

*Shkodër is one of Albania's oldest continuously inhabited cities.*



# ChatGPT: Training in 2 Phases

## 2. Finetuning:

Special Preparation for Chats

Guided by humans

Additionally measures against

- Unwanted contents
- Wrong answers
- Misconceptions („I am an AI“)

## Fine-Tuning for sentiment analysis with labelled examples

```
{"input_text": "This movie totally surprised me. It wasn't the same old stuff I keep seeing. Way more imaginative and creative",  
"output_text": "POSITIVE")
```

```
{"input_text": "Everything was a disaster! The actors, the scripting, and most of all the music", "  
output_text": "NEGATIVE")
```

```
{"input_text": "Would totally watch this again. Couldn't get enough of that rad dialog",  
"output_text": "POSITIVE"}
```

# ChaGPT

175 000 000 000 Neurons  
in 96 Layers

Energy consumption for training:

- about 1 000 000 kW
- Annual consumption of 300 households

Generation of answers: 1000 times more expensive as Google queries

Expenses per day: estimated 100.000 - 700.000 \$

Profitability for providers?

- payment services
- technological supremacy
- market dominance

## New milestones in IT

- with great impacts to society
- with huge economic potential
- fostering the concentration of power by few giants

# Development of IT

## Methods for exact structure and data

- Classical IT
- Rules, formal logics
- Data banks
- Classical AI

## Methods for unsecure structure and data

- Statistics
- Machine Learning
- Neuronal Networks
- Large Language Models

Book keeping  
Logistics  
Navigation systems  
Chess  
...

Picture processing  
Natural language  
Road traffic  
Robotics  
...

How to recognize cars?



How to understand language?

“Uhhh,  
that shakes ...”



- **Traditional program** (characteristic attributes):

*Car has 4 wheels, motor, , Motor, seats, steering wheel, ...*

- **Picture interpretation**

*What is that:*



->

*Cars on a street in a residential area*

- **Generative AI:**

*Write a poem on a car. ->*

*On the open road, the car does glide,  
Its sleek form gleaming with confident pride.  
With each turn of the wheel, a world unfurls,  
Asphalt beneath, an adventure it hurls.*

*Paint a car in the style of Rembrandt: ->*





What is new?

The new systems need no special instructions (e.g. Cmd-Shift-S)

They react to common language requests given by a „prompt“

*e.g.*

- *Tell me something about Shkodra.*
- *Give me a program for the shortest path in a graph.*
- *Who explored America?*
- *Write a poem for the birthday of my mother.*

Some efforts needed to write a good prompt.

Significant progress by:

- Powerful Hardware (GPU)
- Deep Neuronal Networks (Transformer)
- Parallel Processing  
(up to 3000 words in ChatGPT, 25 000 in GPT-4)
- Large repositories of models, programs and data

ChatGPT:

175 000 000 000 Neurons  
in 96 Layers

**Hugging Face, Inc.**

French-American company



**The AI community building the  
future.**

The platform where the machine learning community collaborates on  
models, datasets, and applications.

# Language Generation by **Large Language Models (LLM)**

Method:

**Autocompletion:** Prediction/generation of the following word

- Smartphone: by simple statistics about the usage
- Humans: by expectations
- LLM: by trained Deep Neural Networks

Probabilities computed according to

- Prompt
- Knowledge about the **meaning** of words/text
- Knowledge about the related domain
- Common language understanding

# Representation of the meaning of words by embeddings

## Embedding:

Vector of numbers with up to 1000 dimensions

Not words or concepts.

The numbers encode certain useful features.

Similar Embedding  $\longleftrightarrow$  Similar meanings

In some models:

$\text{Embedding}(\text{"King"}) - \text{Embedding}(\text{"Man"}) + \text{Embedding}(\text{"Woman"}) \approx \text{Embedding}(\text{"Queen"})$

$\text{Embedding}(\text{"Physician"}) - \text{Embedding}(\text{"Man"}) + \text{Embedding}(\text{"Woman"}) \approx \text{Embedding}(\text{"Nurse"})$

LLM are so perfect, that they even reflect the biases in our world

Limited number of words in Natural Languages

English: 1 million (Oxford dictionary: 600 000),

Individuals use 20 000 - 30 000

For daily purposes: 1000 (beginners level)

LLM with 100 000 Tokens

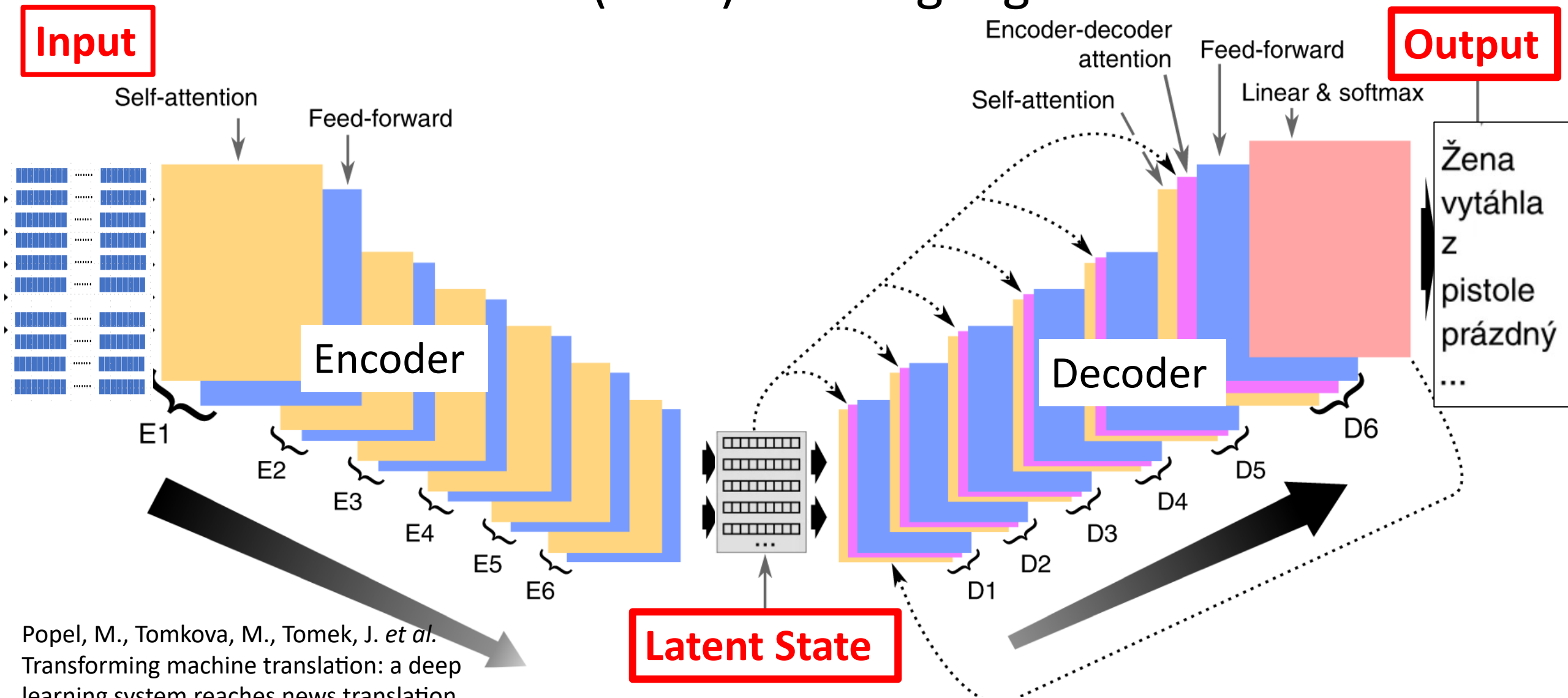
But: Infinitely many combinations, - each defining a special meaning

Transformer: Calculate embedding of text to a „Latent state“

Originally developed by Google for language translation



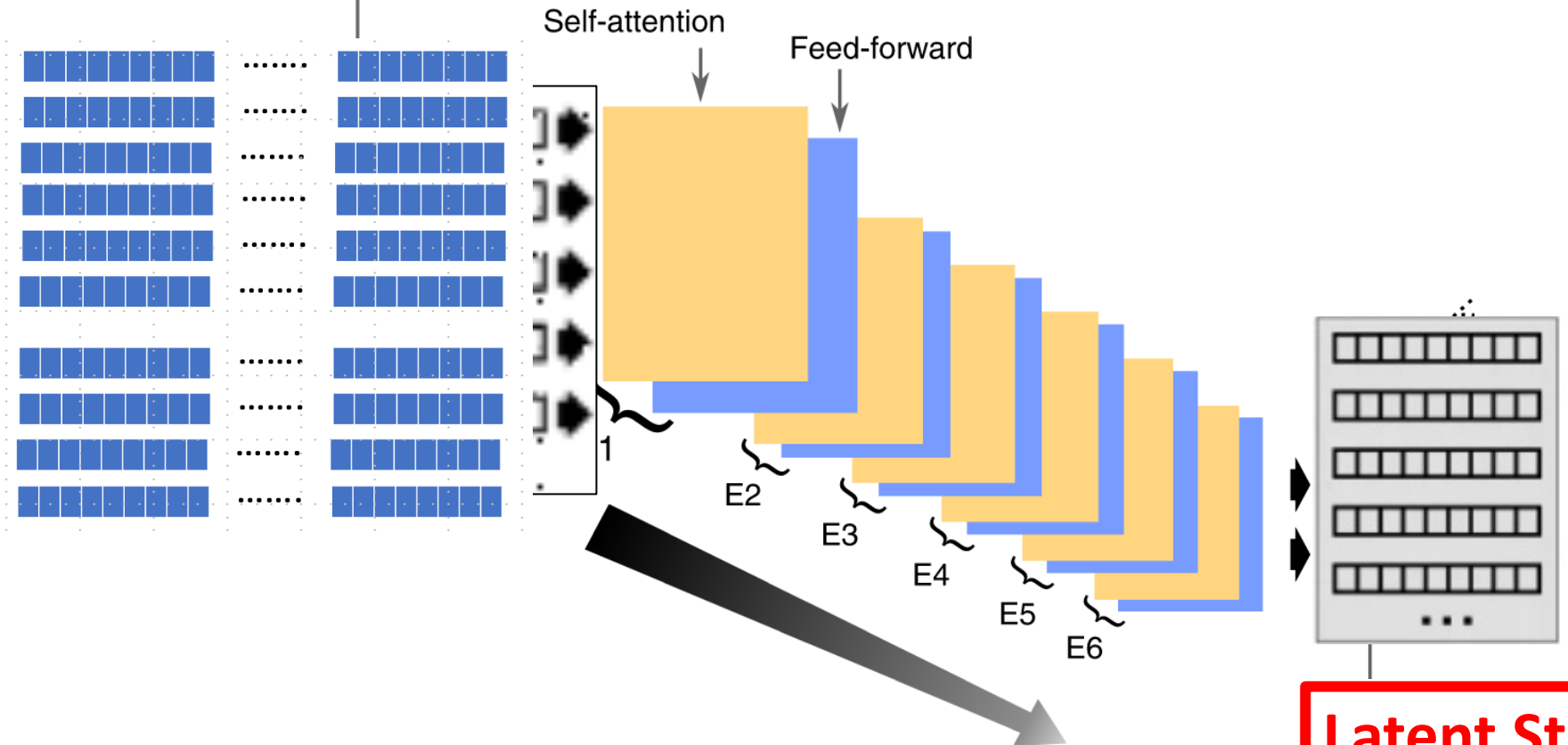
# Transformer (DNN) for Language Translation



Popel, M., Tomkova, M., Tomek, J. *et al.*  
Transforming machine translation: a deep  
learning system reaches news translation  
quality comparable to human professionals.  
*Nat Commun* **11**, 4381 (2020).  
<https://doi.org/10.1038/s41467-020-18073-9>

**Input**

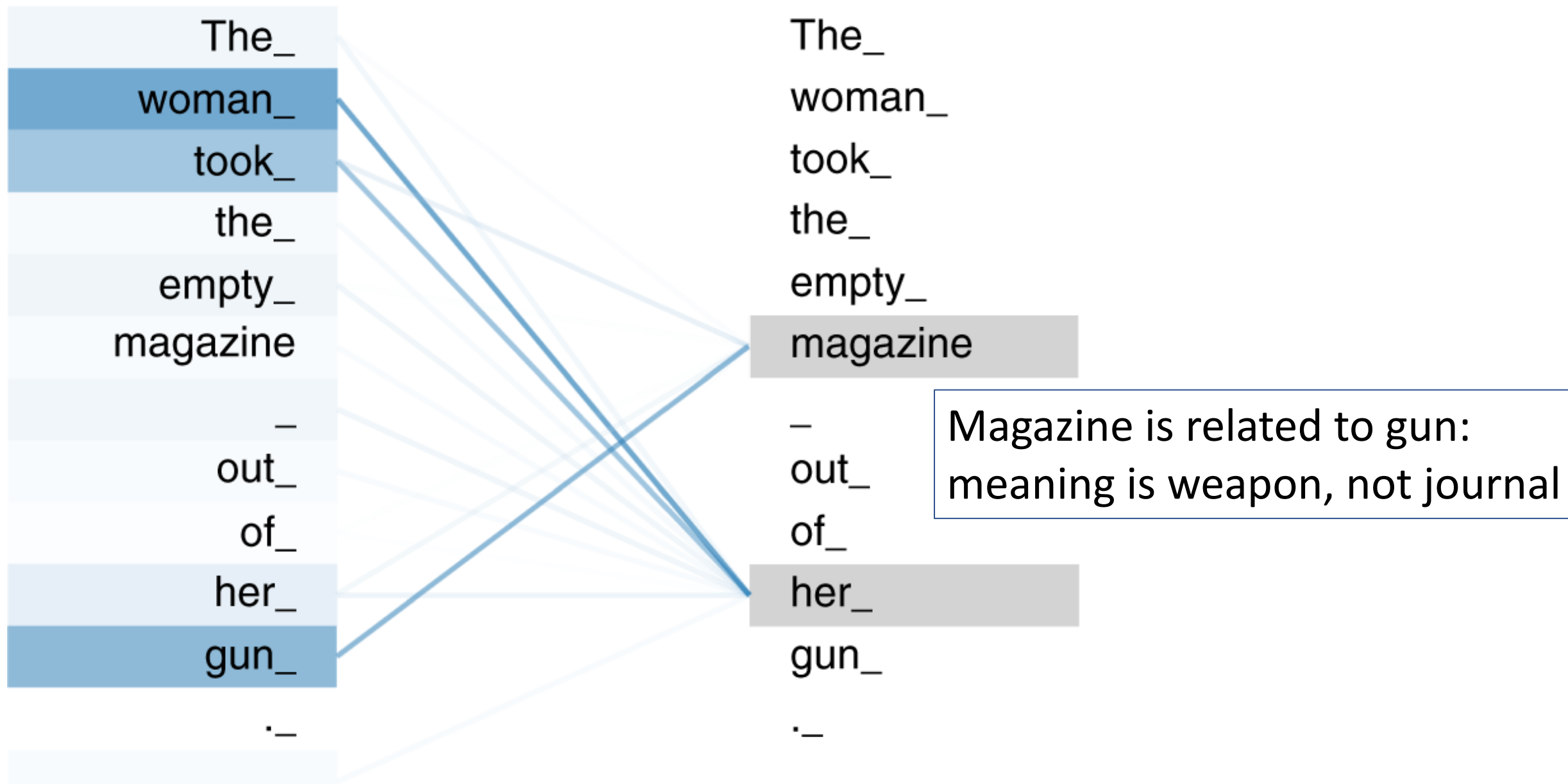
Encoder:  
calculates the input embedding (Latent State)  
from the embeddings of the input words



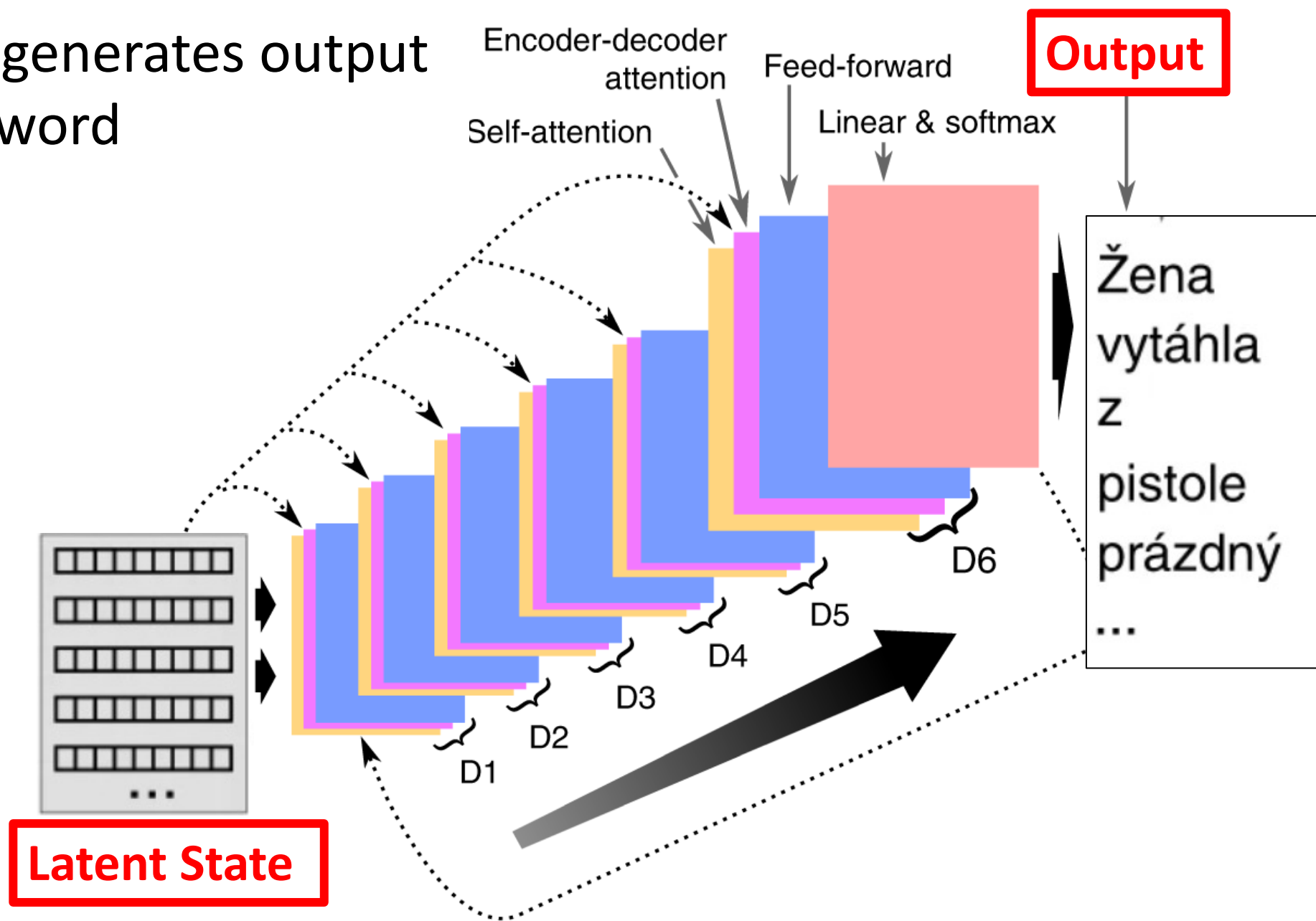
**Latent State**



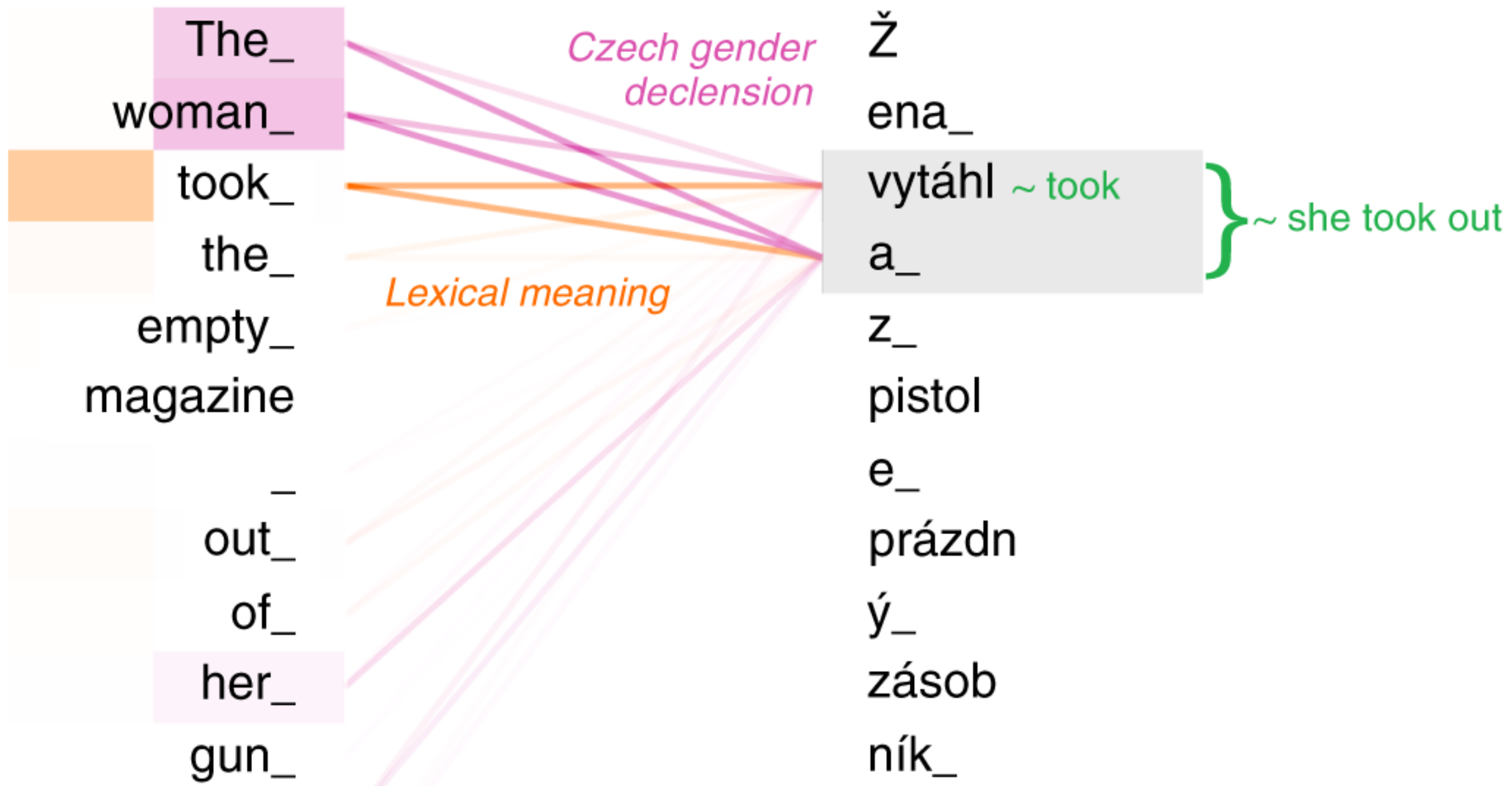
# Attentions: Analyse related words



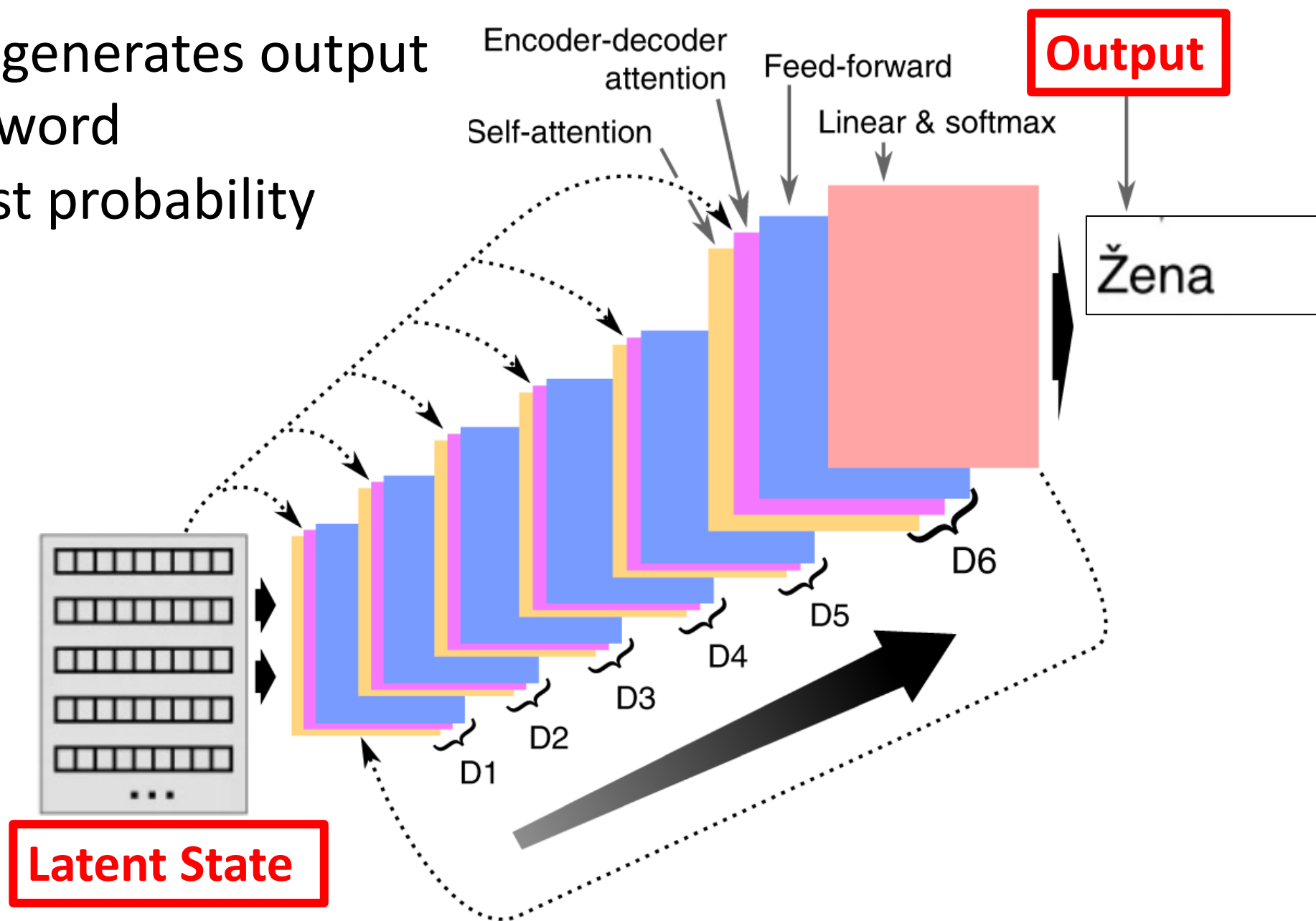
Decoder generates output word by word



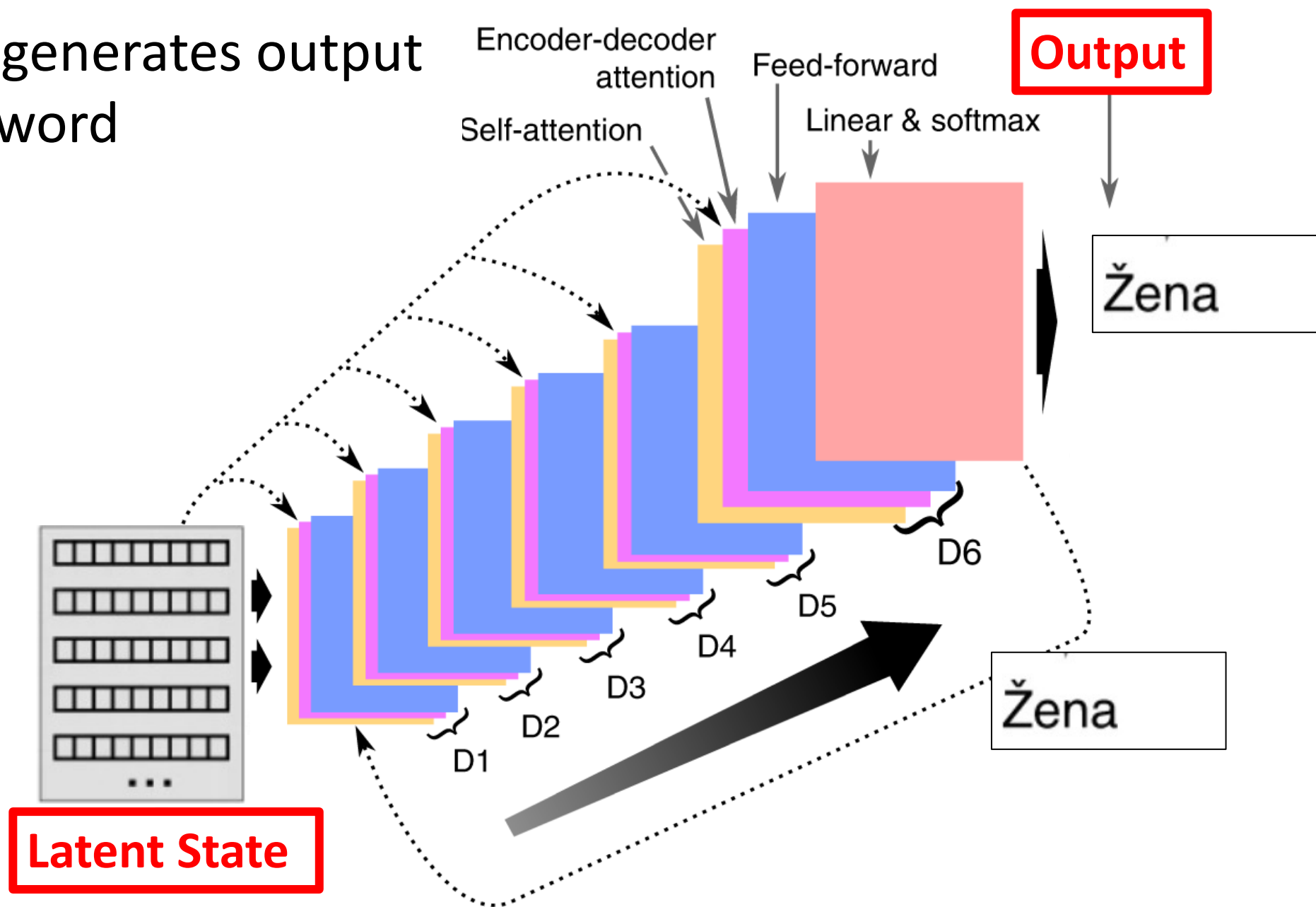
# More attentions



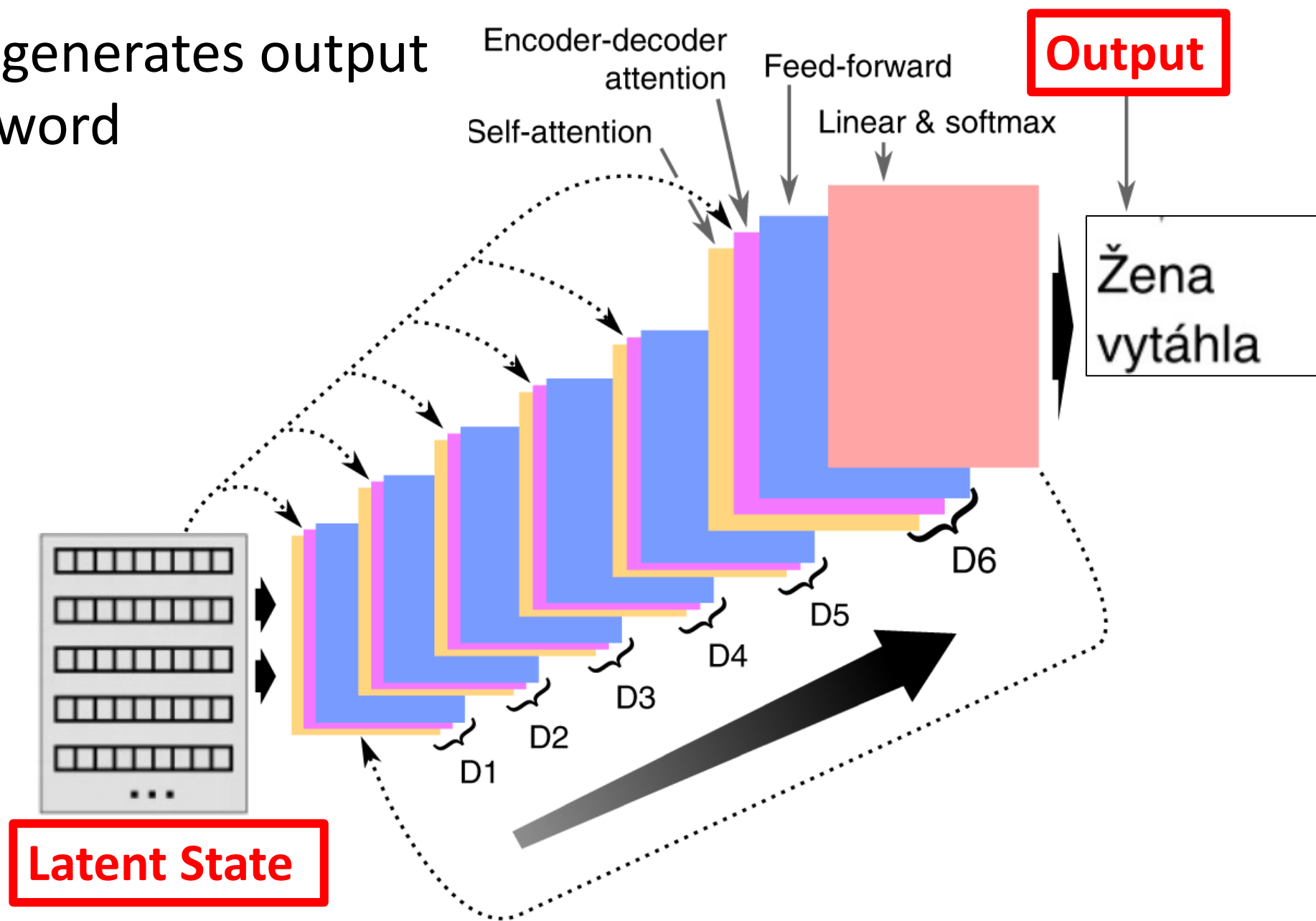
Decoder generates output word by word by highest probability



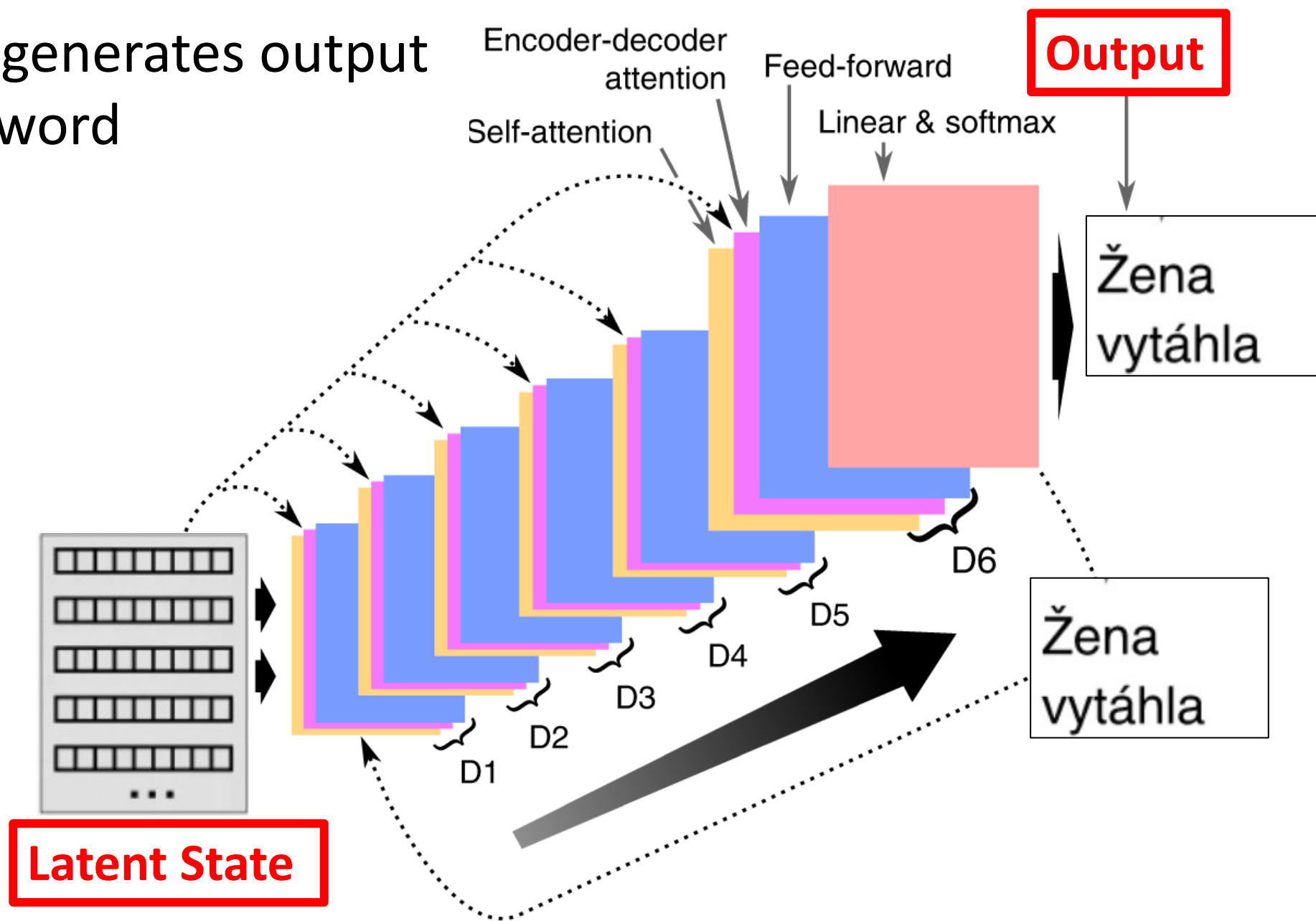
Decoder generates output word by word



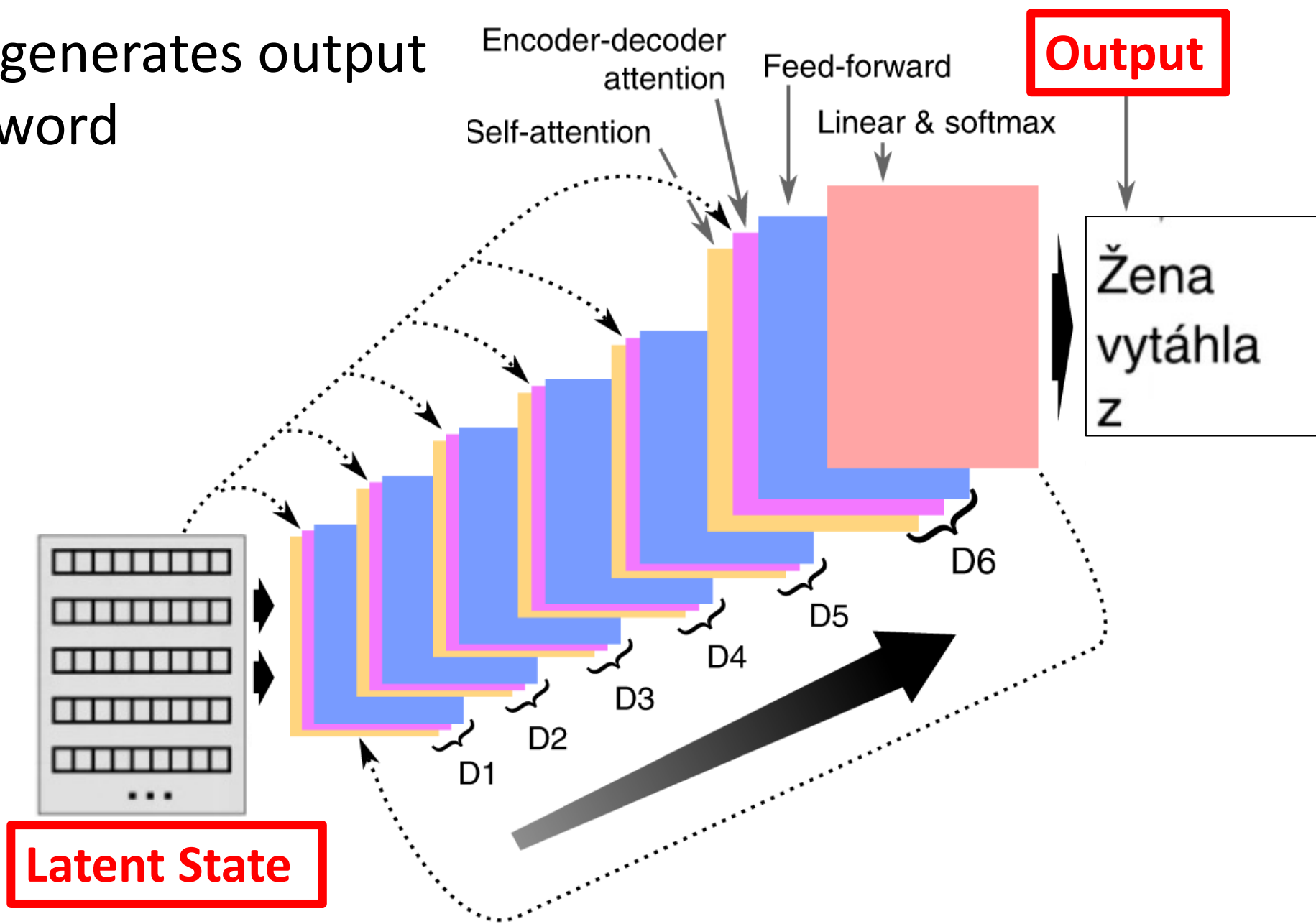
Decoder generates output word by word



Decoder generates output word by word

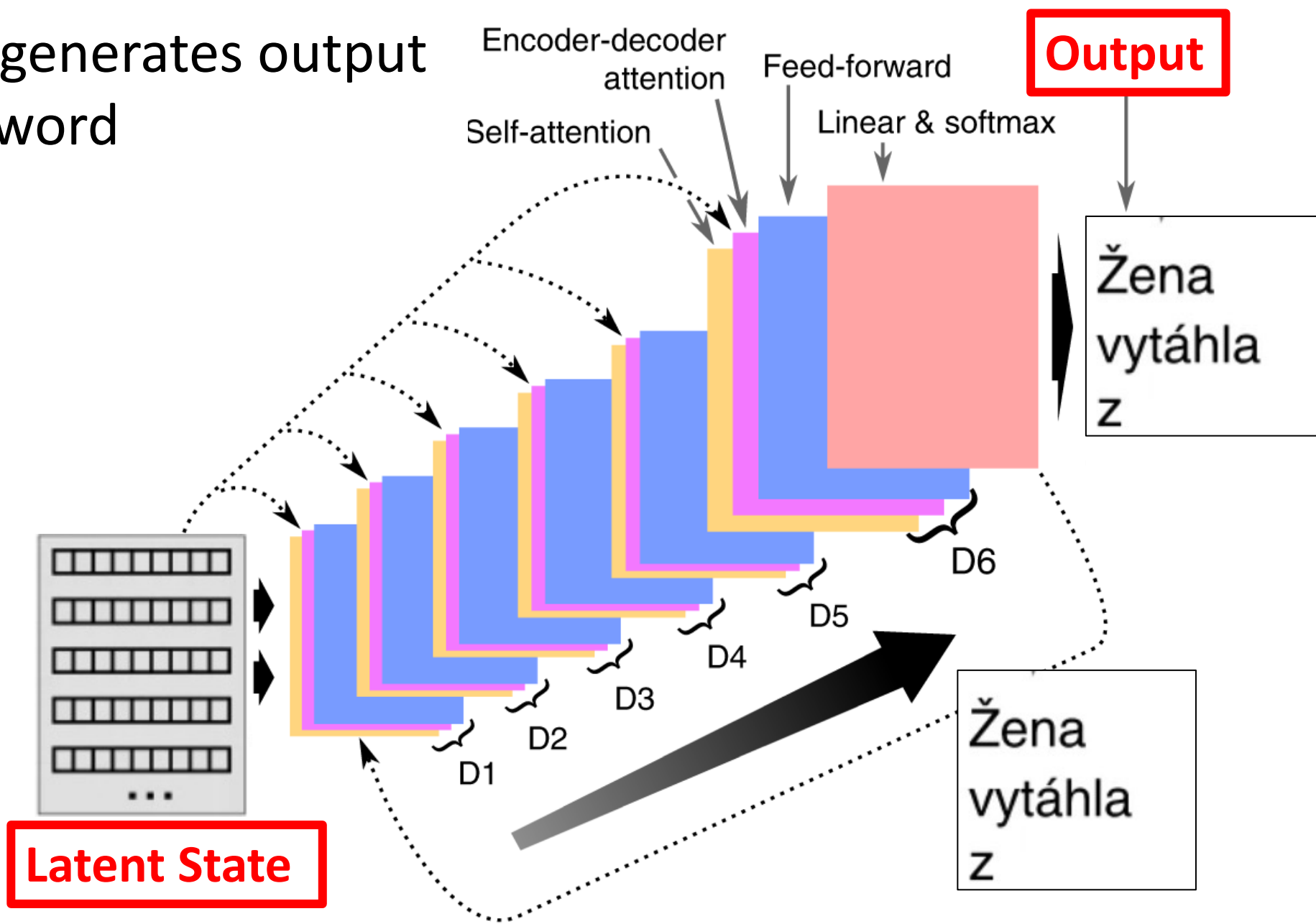


Decoder generates output word by word

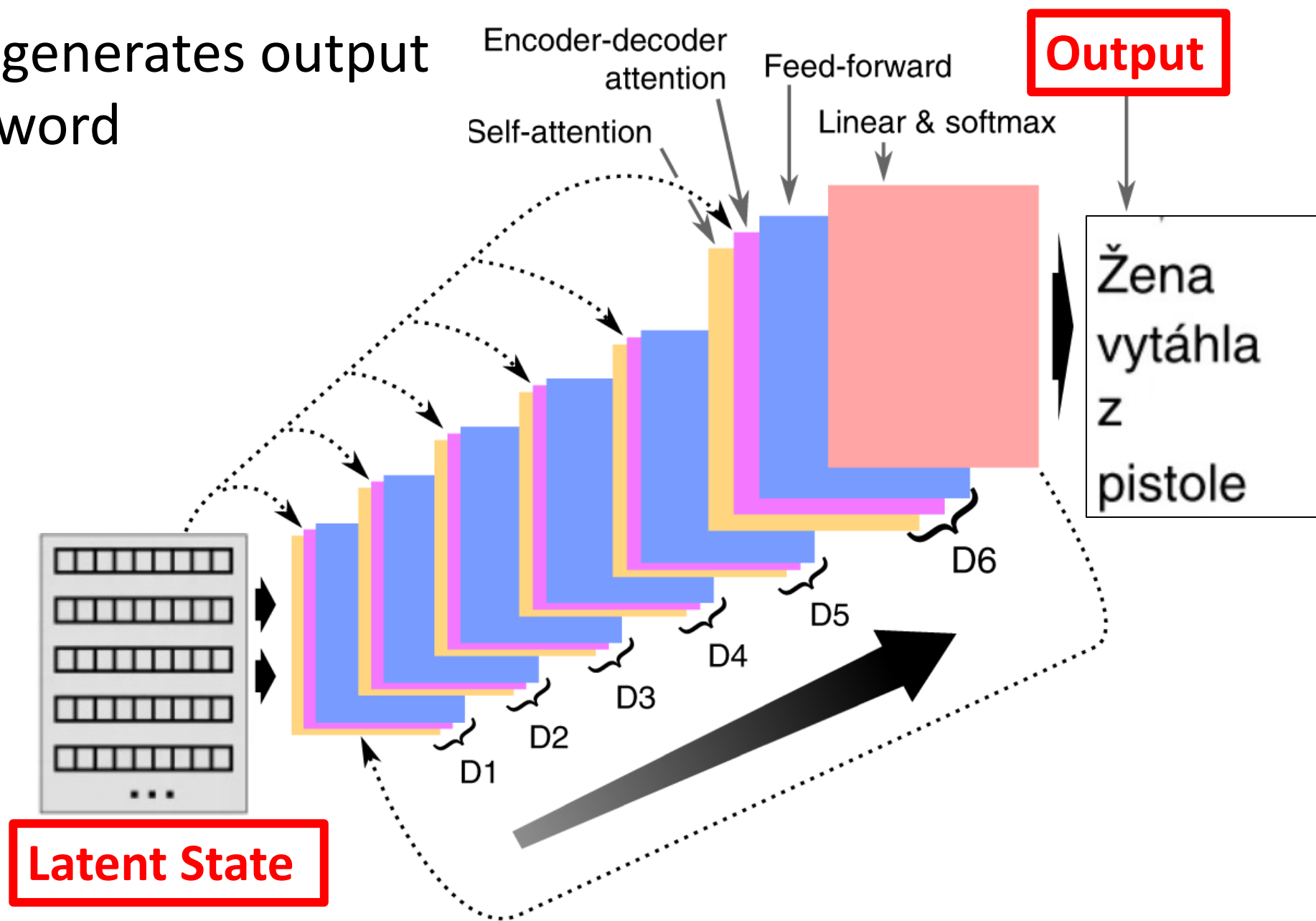




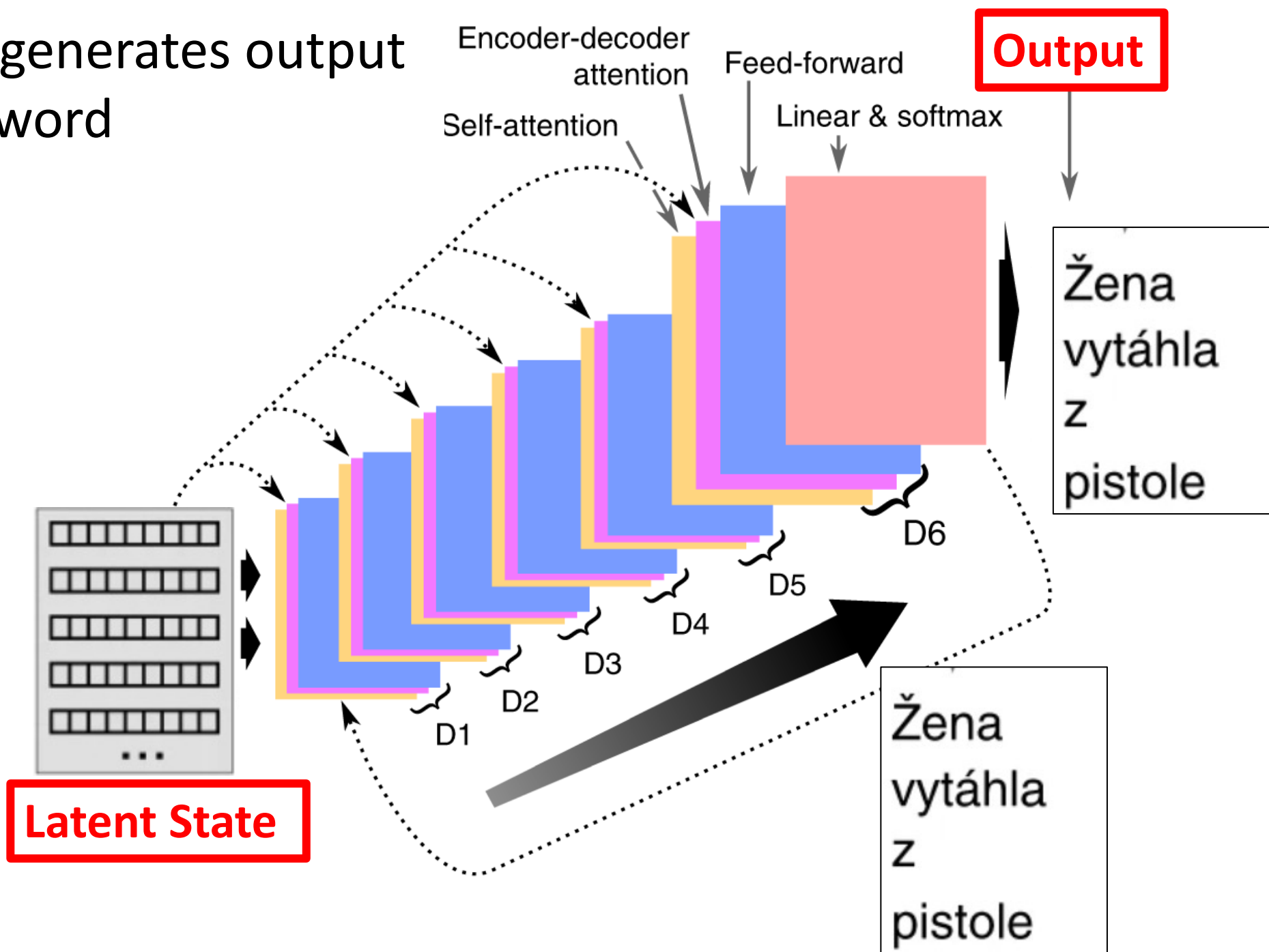
Decoder generates output word by word



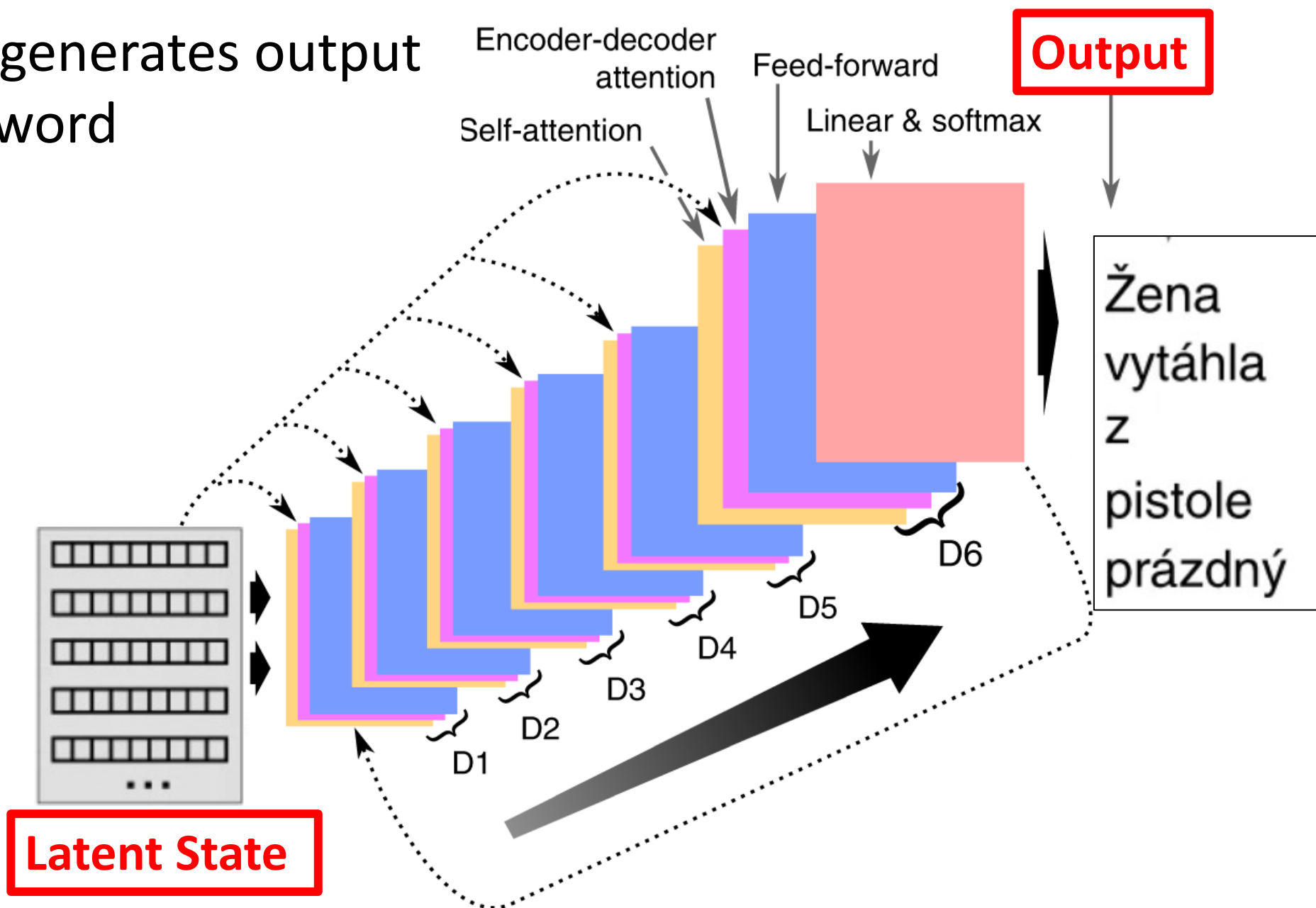
Decoder generates output word by word



Decoder generates output word by word



Decoder generates output word by word



# More usages of transformers or parts of it

## Data

Text



Images



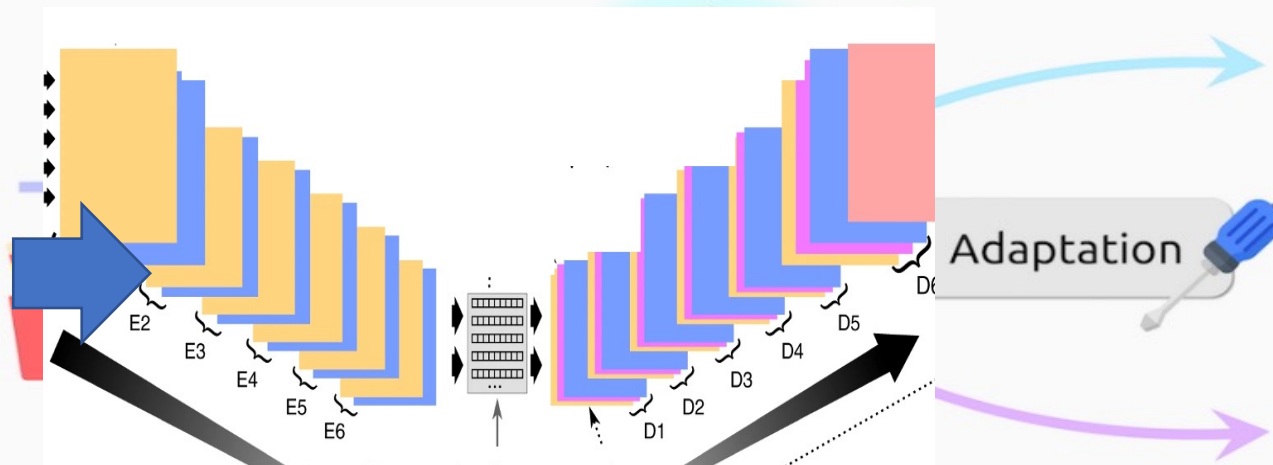
Speech



Structured Data



3D Signals



Question Answering



Sentiment Analysis



Information Extraction



Image Captioning



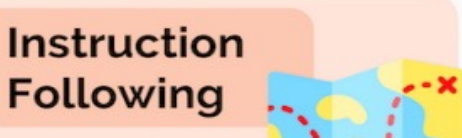
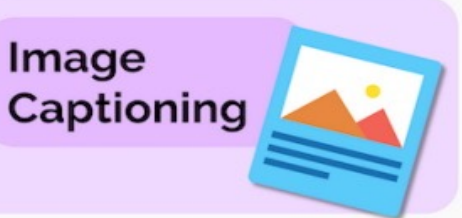
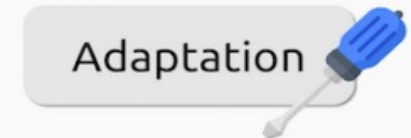
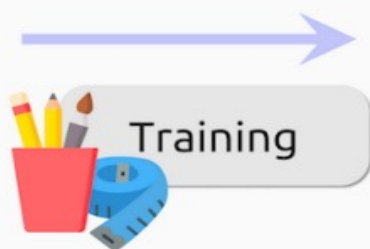
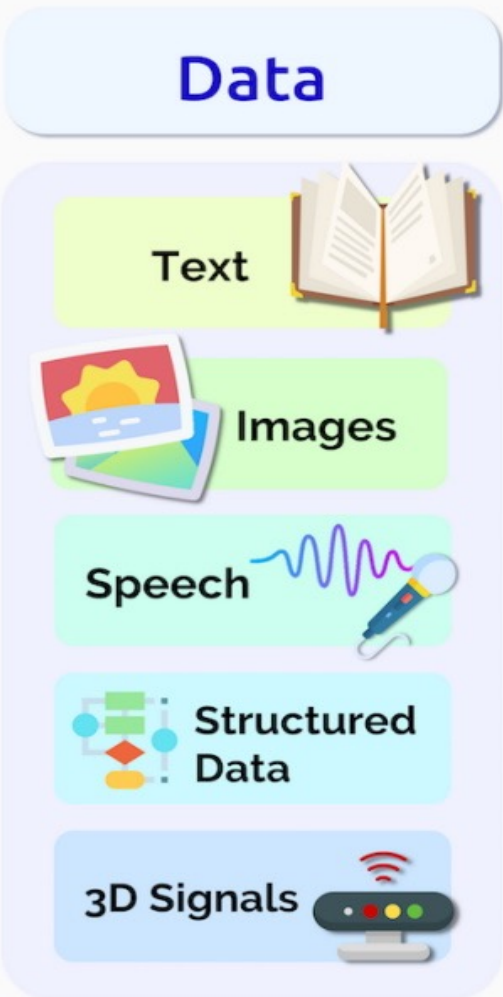
Object Recognition



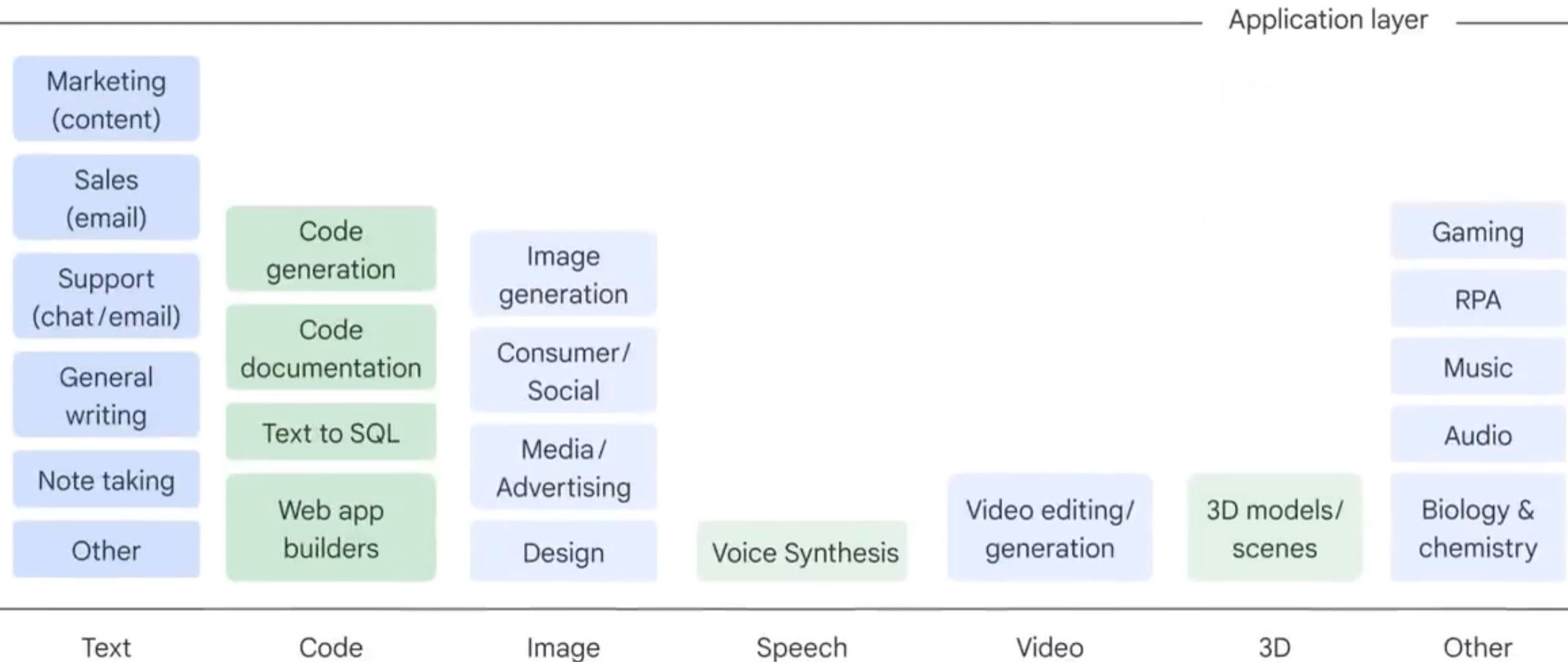
Instruction Following



# Foundation models



# The generative AI Application Landscape




 HD

write me a program for the shortest path in a graph



Sure, I can provide you with a Python program to find the shortest path in a graph using Dijkstra's algorithm. Dijkstra's algorithm is a popular algorithm for finding the shortest path from a source vertex to all other vertices in a weighted graph. Here's a Python program to do that using an adjacency matrix representation of the graph:

python

 Copy code

```
import sys

class Graph:
    def __init__(self, vertices):
        self.V = vertices
```



```
def dijkstra(self, src):
    dist = [sys.maxsize] * self.V
    dist[src] = 0
    spt_set = [False] * self.V

    for _ in range(self.V):
        u = self.min_distance(dist, spt_set)
        spt_set[u] = True

        for v in range(self.V):
            if not spt_set[v] and self.graph[u][v] and dist[u] != sys.ma
                dist[u] + self.graph[u][v] < dist[v]:
                    dist[v] = dist[u] + self.graph[u][v]

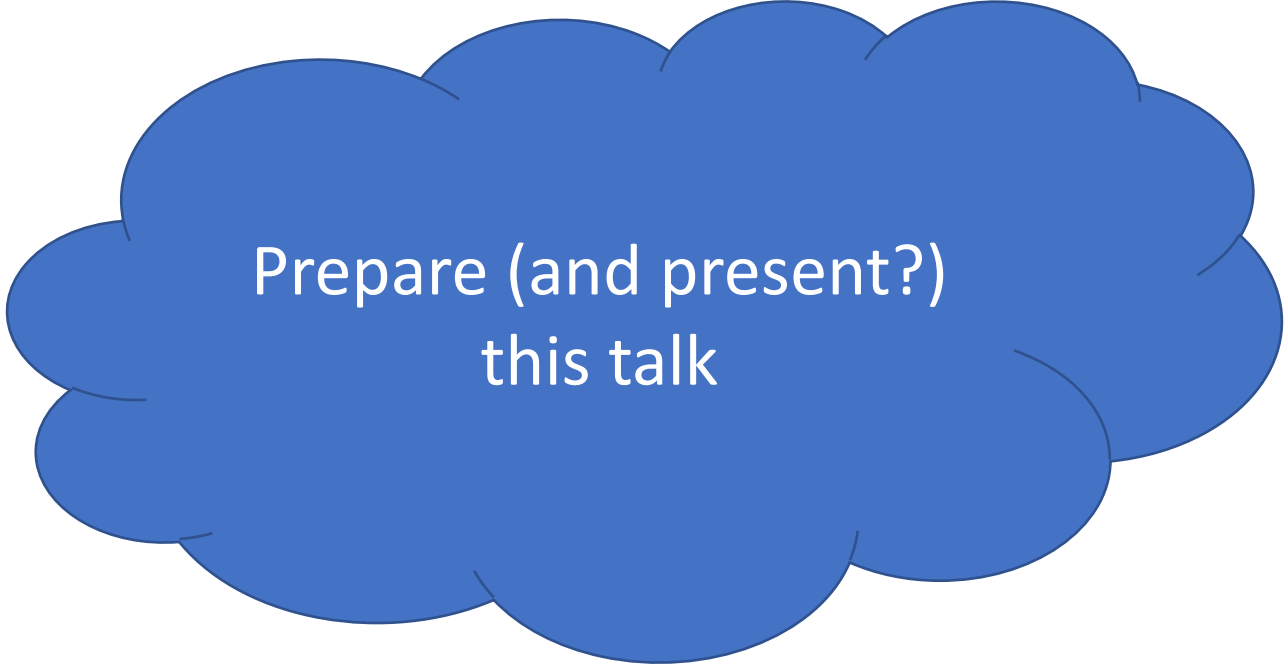
    self.print_solution(dist)
```

# Promises for office jobs (MicroSoft: Copilot, Google: Bard)

Multi modality

Automatized office work using multiple data

- Protocols
- Emails
- Chats
- Presentations
- Contracts
- 
- for
  - Proposals
  - Concepts
  - Planning
  - ....



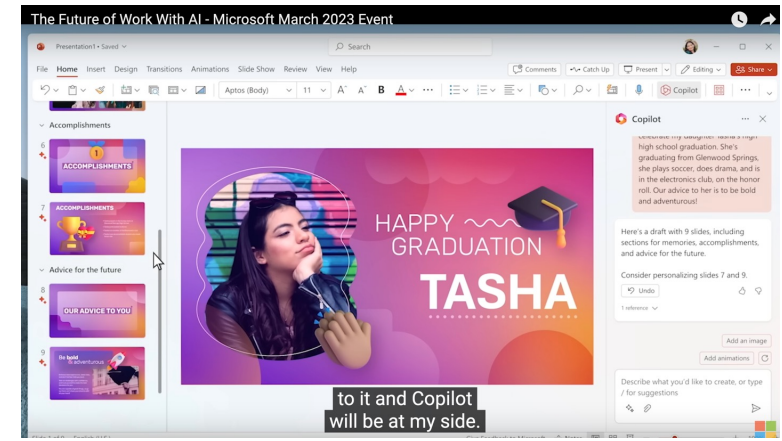
Prepare (and present?)  
this talk

# The Future of Work With AI - Microsoft March 2023 Event

<https://www.youtube.com/watch?v=Bf-dbS9CcRU>

## GPT-4 Developer Livestream.mp4

<https://www.youtube.com/live/outcGtbnMuQ?app=desktop>



## Google I/O '23 in under 10 minutes

<https://www.youtube.com/watch?v=QpBTM0GO6xl>

## Bard

<https://www.youtube.com/watch?v=35pSeFWWatk>

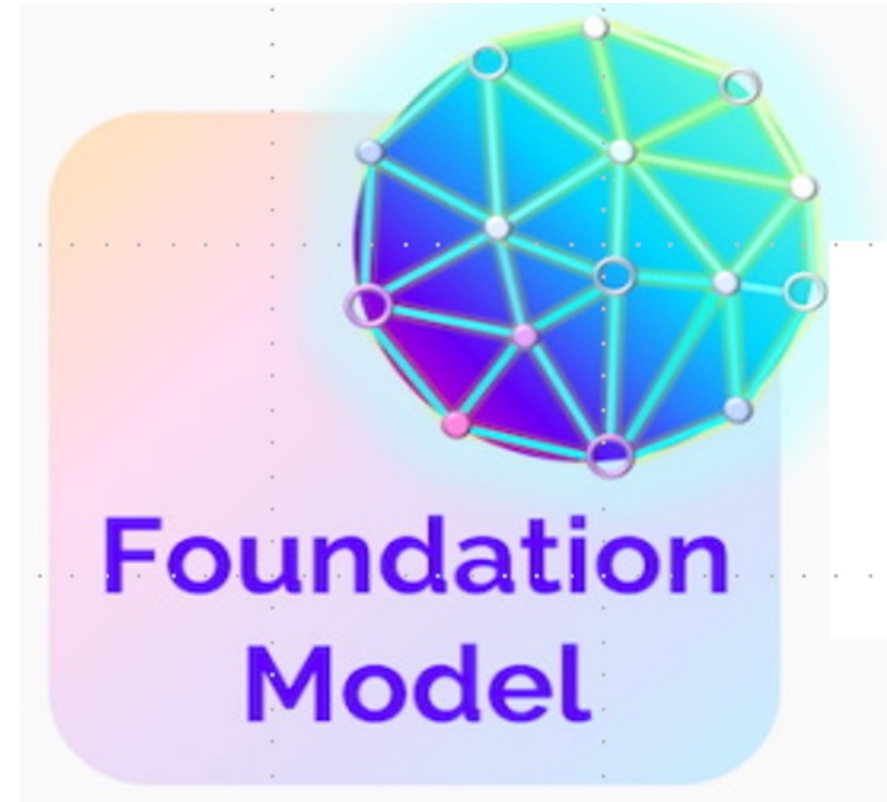


## Achievements of Generative AI:

Representation of deep knowledge about

- Language
- Images
- Audio
- Programs
- ...

by „Foundation Models“ (e.g. Large Language Models, LLM)



## Technical Limitations (as today)

- Missing data
- No experience by a body
- Intransparency of Neuronal Networks
- Hallucination“: fictive facts

Who can decide what is true  
- technical realization?

Who should decide what is true  
- **political/cultural** question



Uncle Sam



Witch as prophecy



Mao

May be one of these?

Who should decide what is true  
- **political/cultural** question

Sculptures of Auguste Rodin alias Stable Diffusion  
Prompt:  
Foto of a sculpture of Uncle Sam/ of a witch / of Mao  
in the style of Rodin, black-and-white fotograf

## **Problems for society**

- Expensive techniques
- Market control by very few powerful actors
- Misuse
- Questions concerning law
- Data for training
  - Mainly English texts
  - Biases
  - Left liberal
  - Rights of authors
  - Private information



## Conclusions

- Exciting new techniques
- Multi purposes (und multi problems ...)
- High Potential
- Still at the beginning
- ...

You may try:

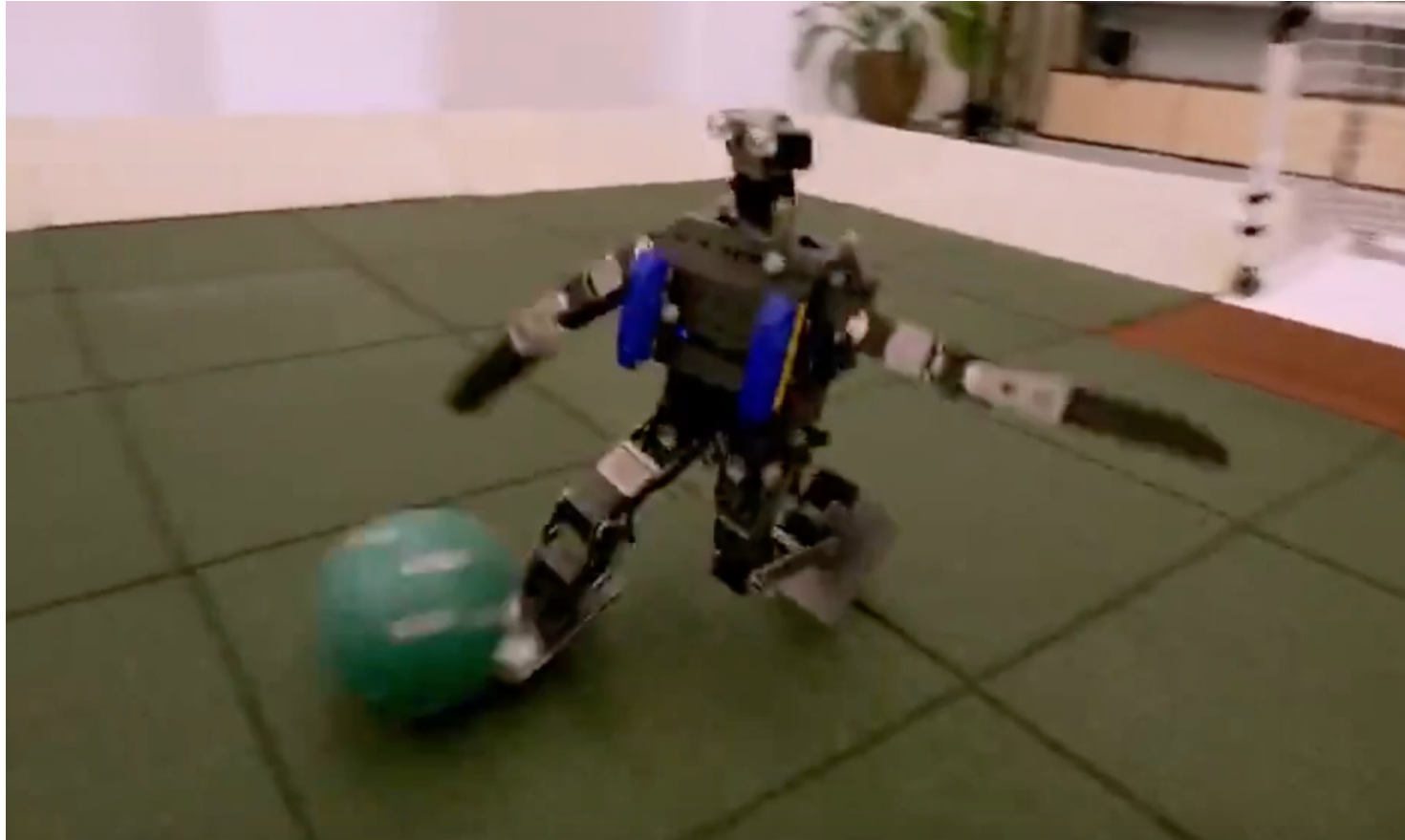
Picture generation: Stable Diffusion, Dall-E, ...

- Trained with millions of example (Image + Description)
- Generates pictures from texts (prompts) or pictures



Prompt:  
Tortoise driving bike

# DeepMind Demos AI: Training Robots to Play Soccer by Deep Learning



<https://www.youtube.com/watch?v=RbyQcCT6890>

Roboter OP-3 von Robotis (Südkorea)

Thank you!