

# Development of information technology

From analogous computer to LLM

(1970-2025)

(K.-P. Pleissner- Alumni meeting 30.08.2025)

- Analogous computer
- Digital computer
- Personal computer
- Internet with HTML (~1991) (game changer)
- Mobil phone, Laptop, mini PC
- Big server farms, Cloud computing
- Artificial Intelligence (AI) with Large Language Models (LLM) (game changer)

## Analogrechner Meda 42



Electrical components:

Amplifiers

Multipliers

Integrators

Differentiators

Resistors

X-y plotter

Potentiometers

Programming by connecting  
components using cords

Baujahr: ab 1968, Serienfertigung bis Ende der 70er Jahre

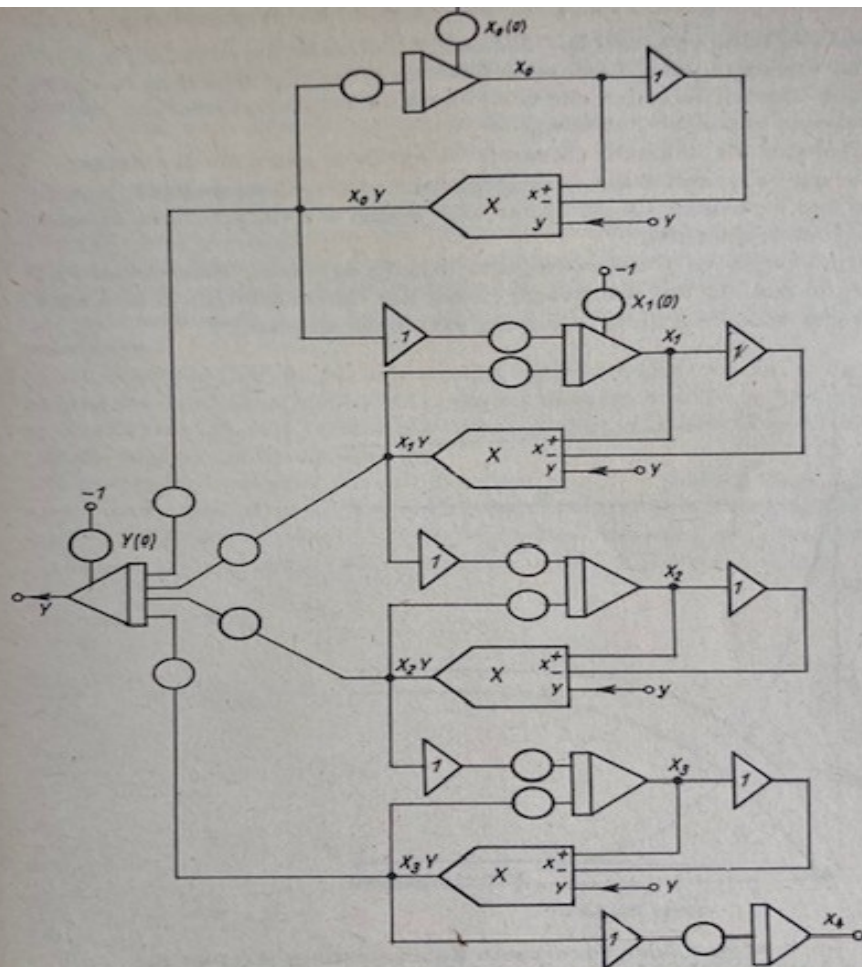


Bild 4. Analogrechartschaltung für die zeitlichen Reaktionsvorgänge bei der Methanchlorierung



# **Digital computer**

## **Process computer KRS 4200**

Collection and analysis of data  
of physical devices used in molecular  
biological research such as  
MS, ESR, X-Ray Diffractometer etc.

## MiniComputer /Process computer



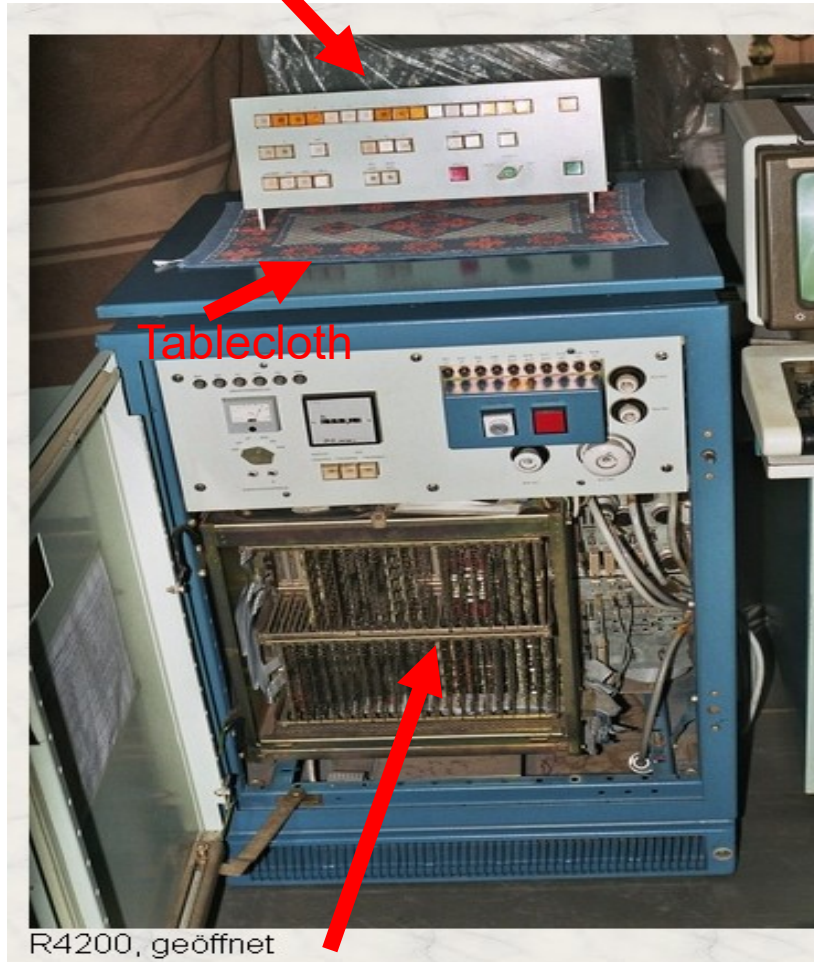
KRS 4200

All infos under:

<http://www.robotrontechnik.de/index.htm?/html/computer/r4200.htm>



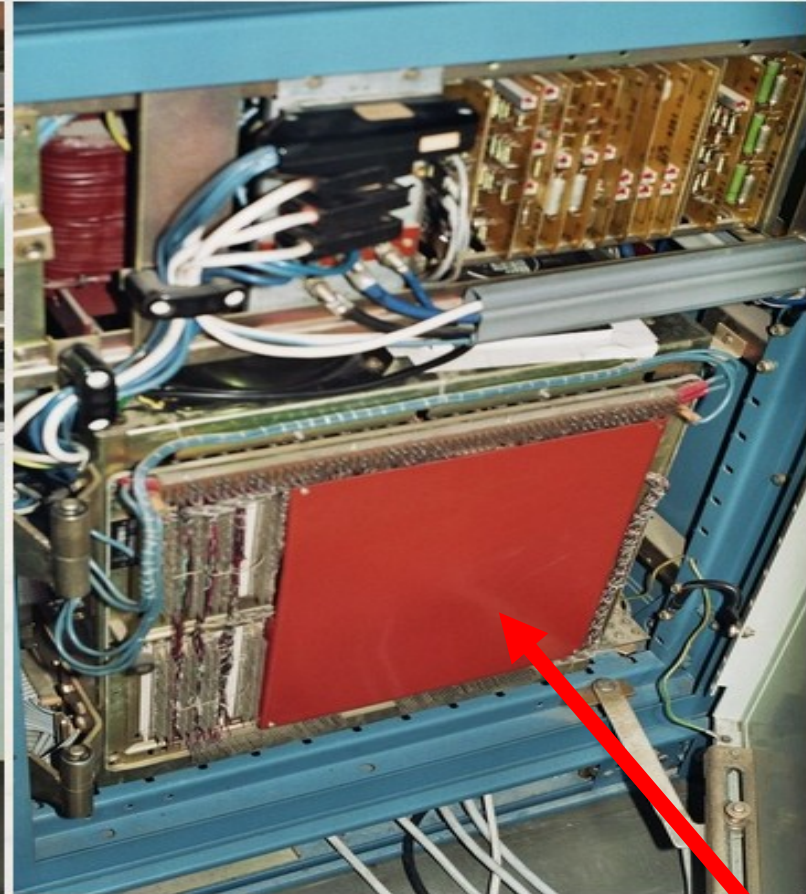
Terminal



Tablecloth

R4200, geöffnet

CPU



Rückseite des R4200 mit dem Kernspeicher

Magnetic core memory  
(16 KByte)



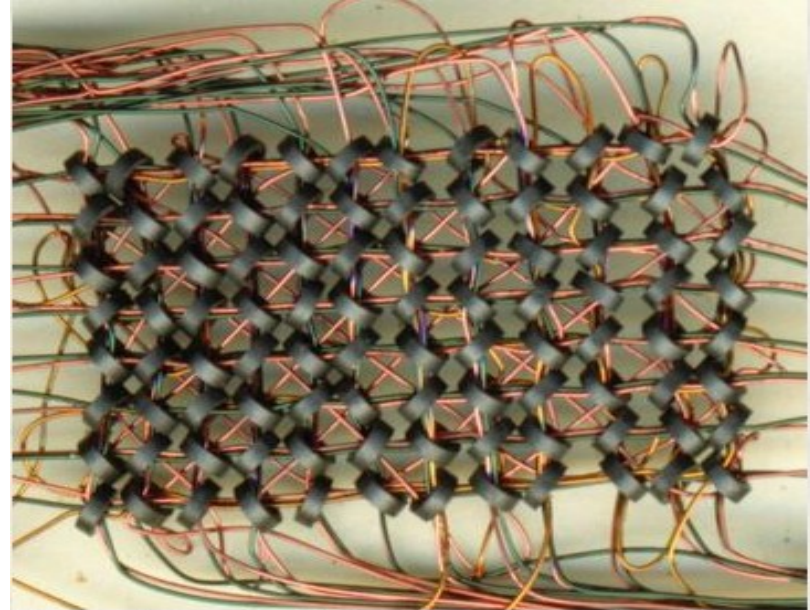
## Kernspeicher

(RAM)

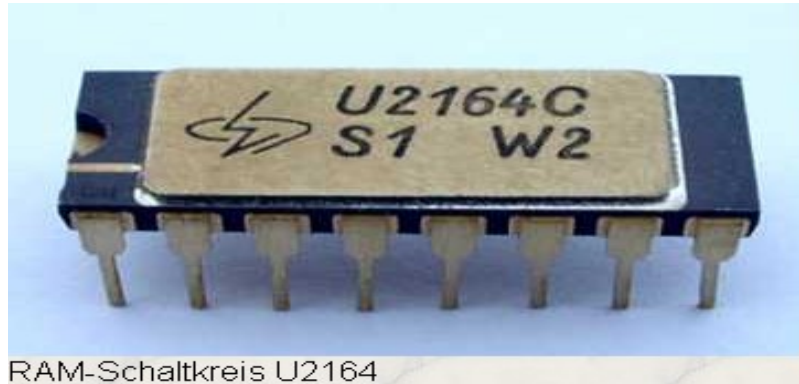
Magnetic core memory



Kernspeicher des R300-Großrechners



Kernspeicher des Tischrechners Soemtron 220



RAM-Schaltkreis U2164

Electrical circuit

## Datenträger / Speicher



# Punch card

Lochband (=Lochstreifen)

# Perforated paper tape



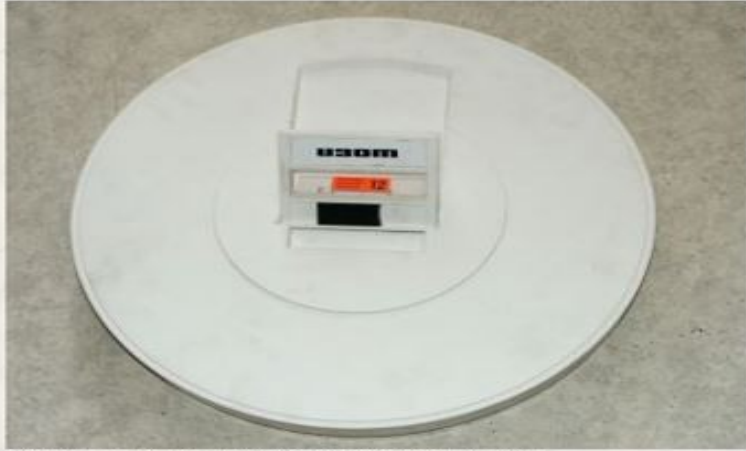
Program debugging:

- 1: by new perforation
2. Manual input of code via terminal

## Personal Computer PC1715



### Wechselplatte mit 1 Magnetscheibe



Wechselplatte EC5269.01, Oberseite

**1 MByte**

### Wechselplatte mit mehreren Magnetscheiben



Wechselplattenstapel Z30M für EC5261



Wechselplattengerät EC5061

Die Speicherkapazität betrug für eine Wechselplatte mit 10 Scheiben ca. 300 MByte.

**300 MByte**



## Magnetband (Spulenmagnetband)



Magnetbandspulen

Magnetic tape

## Magnetbandkassette

Magnetic tape cartridge



Magnetkassette, ältere Version



Magnetkassette, neuere Version





# Software development

## Programming languages

- Assembler
- FORTRAN
- HTML
- JAVA
- DELPHI
- PHP
- Perl
- KNIME
- **R**
- **Python**
- 
- 

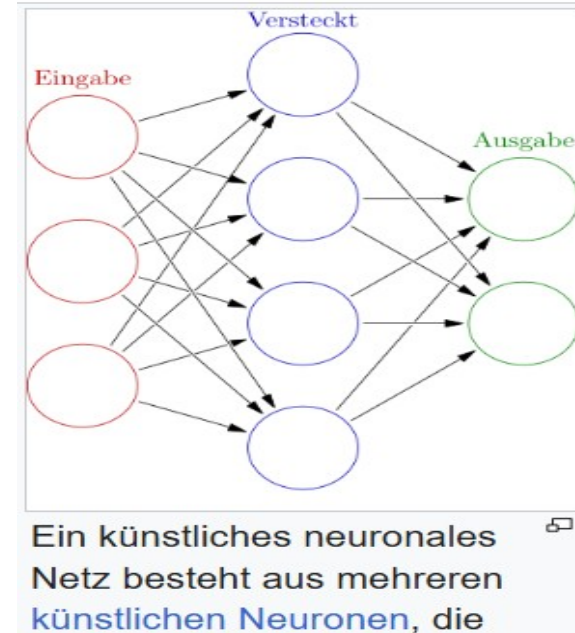
## Operating systems

- Unix/Linux
- Windows
- Mac

## IDEs

- Emacs
- Borland
- Turb Pascal
- Eclipse
- PyCharm
- Netbeans
- IntelliJ
- Spider
- RStudio
- 
- **with AI support:**
  - VS Code
  - Positron
  - Windsurf
  - Cursor
  -

## KNN



# My intensions:

- Searching of all publications of Thomas F. Meyer in PubMed ?
- via PubMed search
- Using AI
- Creating own LLM using information of publications
- AI assisted coding
- Working with models (in future)


# **Publication search in PubMed**

***(using the [author Meyer, TF] as example)***

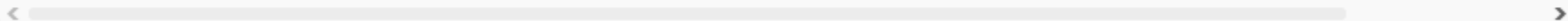
## Suchabfrage für PubMed:

text

 Kopieren

 Bearbeiten

Meyer TF[Author] AND (Chlamydia OR Helicobacter) AND ("2015"[Date - Publication] : "2025"[Date - I



Save

Email

Send to

Sort by:

Best match



Display options



MY CUSTOM FILTERS



32 results



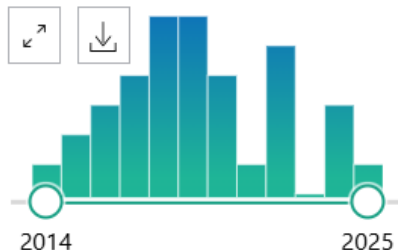
Page

1

of 4



RESULTS BY YEAR



PUBLICATION DATE

- ☐ 1 year  
☐ 5 years  
☐ 10 years  
☐ Custom Range

TEXT AVAILABILITY

☐ Abstract


1

Enhanced LRP8 expression induced by **Helicobacter** pylori drives gastric cancer progression by facilitating beta-Catenin nuclear translocation.

Cite

Liu B, Bukhari I, Li F, Ren F, Xia X, Hu B, Liu H, **Meyer TF**, Marshall BJ, Tay A, Fu Y, Wu W, Tang Y, Mi Y, Zheng PY.

Share

J Adv Res. 2025 Mar;69:299-312. doi: 10.1016/j.jare.2024.04.002. Epub 2024 Apr 10.

PMID: 38609049 [Free PMC article.](#)

INTRODUCTION: **Helicobacter** pylori (H. pylori) infection has been associated with gastric carcinogenesis. ...



2

Inflammation promotes stomach epithelial defense by stimulating the secretion of antimicrobial peptides in the mucus.

Cite

Vllahu M, Voli A, Licursi V, Zagami C, D'Amore A, Traulsen J, Woelffling S, Schmid M, Crickley R, Lisle R, Link A, Tosco A, **Meyer TF**, Boccellato F.

Share

Gut Microbes. 2024 Jan-Dec;16(1):2390680. doi: 10.1080/19490976.2024.2390680. Epub 2024 Sep 8.

PMID: 39244776 [Free PMC article.](#)

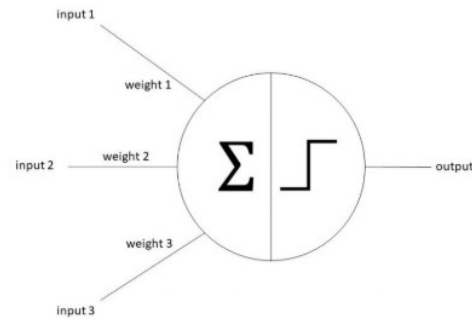
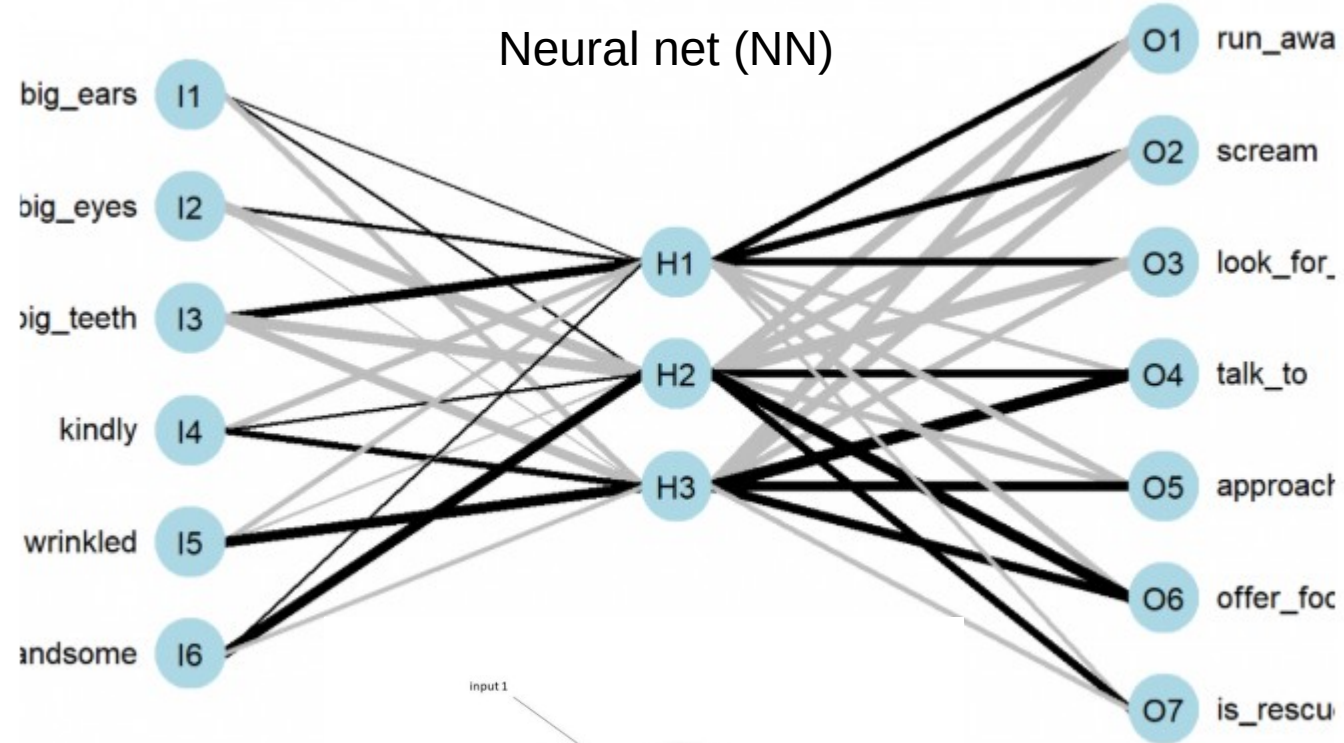
This antimicrobial-enriched mucus can partially eliminate **Helicobacter** pylori, a key stomach pathogen. The bactericidal activity depends on the concentration of each antimicrobial and their gene expression is higher in patients with inflammation and H.pylori-associated chr ...

# Artificial Intelligence (AI)

(Better to be naturally stupid than artificially intelligent ?? )



## Neural net (NN)



Simple artificial neuron

# • Transformer- Large Language Model

- **Neural Networks** build a representation of the world based on their training data
- **Markov chains** showed us that text generation is fundamentally about predicting the next word
- **Word embeddings** convert words into numerical vectors that capture meaning
- **Self-attention** lets the model focus on relevant words when making predictions

## The Unreasonable Effectiveness of Transformers

What's truly remarkable is that this simple architecture –  
predicting the next word using self-attention –  
gives rise to seemingly intelligent behavior.

### Our tiny model learned:

Grammar rules (without being taught grammar)  
Character relationships (without being told who's who)  
Story structure (without understanding “plot”)  
Writing style (without lessons in literature)

Die “vernunftwidrige” Effektivität von Transformatoren

Das wirklich Bemerkenswerte daran ist,  
dass diese einfache Architektur –  
die Vorhersage des nächsten Wortes mithilfe von Selbstaufmerksamkeit –  
zu einem scheinbar intelligenten Verhalten führt.

### Unser kleines Modell hat Folgendes gelernt:

Grammatikregeln (ohne Grammatikunterricht)  
Beziehungen zwischen Charakteren (ohne zu wissen, wer wer ist)  
Story-Struktur (ohne „Handlung“ zu verstehen)  
Schreibstil (ohne Literaturunterricht)

# ChatGPT

## (Generative Pre-trained Transformer)

AI-Chatbot based on LLM

**It can:**

- Understanding natural language
- create answers
- Writing / analysing text
- creating / analysing images (GPT-4o)
- etc.
- **Creating code in different programming languages (AI-assisted coding) - Copilot**

# **AI-assisted publication search**

*(using the [author Meyer, TF] as example)*

A **prompt** for ChatGPT is a textual instruction that guides the AI to generate a specific response.

Prompt for ChatGPT -->

Extract all publications of author  
Thomas F. Meyer stored in PubMed .  
Use the R-package "easyPubMed " to  
get title, authors, years and abstract  
and save these data in csv-file

A prompt for ChatGPT is a textual instruction that guides the AI to generate a specific response,

Got it 👍 — you can do this in R with the **easyPubMed** package. Below is a script that:

1. Queries PubMed for *Thomas F. Meyer* as author,
2. Retrieves all records (title, authors, year, abstract),
3. Builds a data frame,
4. Saves it to a CSV file.



# Code generated by ChatGPT

```
# Install easyPubMed if not already installed
if (!requireNamespace("easyPubMed", quietly = TRUE)) {
  install.packages("easyPubMed")
}

library(easyPubMed)

# Step 1: Define your PubMed query
query <- 'Meyer TF[Author]'

# Step 2: Get PubMed IDs (PMIDs)
pmid_list <- get_pubmed_ids(query)

# Step 3: Fetch article data in XML format
pubmed_data <- fetch_pubmed_data(pmid_list)

# Step 4: Parse the XML into a data frame (with title, abstract, etc.)
data <- articles_to_list(pubmed_data)

# Step 5: Extract required information
extract_info <- function(article) {
  xml <- read_xml(article)
  title <- xml_text(xml_find_first(xml, ".//ArticleTitle"))
  #article <- xml_text(xml_find_first(xml, ".//Article/ArticleText"))
  abstract <- xml_text(xml_find_first(xml, ".//Abstract/AbstractText"))
  authors <- paste(xml_text(xml_find_all(xml, ".//Author/LastName")), collapse = ", ")
  pub_year <- xml_text(xml_find_first(xml, ".//PubDate/Year"))
  return(data.frame(
    Title = title,
    Author = authors,
    Year = pub_year
  ))
}
```



# Search result as .csv-file:

▲	Title	Author	Year	Abstract
1	Decoding microbe-diet-host synergy in colorectal ca...	Quevedo-Olmos, Wang, Meyer	2025	NA
2	Inhibition of ADAM17 increases the cytotoxic effect ...	Holthaus, Rogmans, Gursinski, Quevedo-Olmos, Ehs...	2024	Cervical cancer represents one of the main causes ...
3	Inflammation promotes stomach epithelial defense ...	Vllahu, Voli, Licursi, Zagami, D'Amore, Traulsen, Wo...	2024	The mucus serves as a protective barrier in the gast...
4	Revealing the pathogenesis of gastric intestinal met...	Liu, Wen, Li, Xue, Sun, Li, Hu, Xi, Boccellato, Meyer, ...	2024	Gastric intestinal metaplasia (GIM) is an essential pr...
5	Enhanced LRP8 expression induced by Helicobacter ...	Liu, Bukhari, Li, Ren, Xia, Hu, Liu, Meyer, Marshall, T...	2025	Helicobacter pylori (H. pylori) infection has been ass...
6	Decoding spatiotemporal transcriptional dynamics a...	Kumar, Prakash, Wentland, Kurian, Jethva, Brinkman...	2024	The gastroesophageal squamocolumnar junction (G...
7	Copper regulates the host innate immune response ...	Lu, Liu, Li, Li, Shi, Xia, He, Meyer, Li, Sun, Yang	2024	Copper is an essential trace element for the human ...
8	$\gamma\delta$ T cell-mediated cytotoxicity against patient-deriv...	Dong, Holthaus, Peters, Koster, Ehsani, Quevedo-Ol...	2023	Cervical cancer is a leading cause of death among ...
9	DNA methylation in human gastric epithelial cells d...	Fritsche, Boccellato, Schlaermann, Koepfel, Deneck...	2022	Epigenetic modifications in mammalian DNA are co...
10	IFN $\gamma$ -dependent silencing of TFF1 during Helicobact...	Eletto, Mentucci, Vllahu, Voli, Petrella, Boccellato, M...	2022	Chronic Helicobacter pylori infection is the leading c...

395	Bacteriophage fd gene II-protein. I. Purification, invo...	Meyer, Geider	1979	NA
396	Cleavage site of bacteriophage fd gene II-protein in ...	Meyer, Geider, Kurz, Schaller	1979	NA
397	Gene-II protein of bacteriophage fd in enzymatic rep...	Geider, Meyer	1979	NA

# Building Your Own Mini-ChatGPT with R: From Markov Chains to Transformers!



Learning Machines

June 16, 2025

How Things Work,  
Machine Learning,  
NLP, R, R-Bloggers



Remember our journey so far? We started with simple *Markov chains* showing how statistical word

prediction works, then dove into the core concepts of word *embeddings*, *self-attention*, and *next word prediction*. Now, it's time for the grand finale: if you want to build your own

# R-script in RStudio

“mini\_ChatGPT\_extended\_by\_saving\_model.R” (method: copy / paste)

```
#####  
## See accompanying blog post: ##  
## https://blog.ephorie.de/building-your-own-mini-chatgpt-with-r-from-markov-chains-to-transformers ##  
#####  
  
# 1. Combining (concatenate) Title, author, year and abstract of all  
# papers in one large string  
# Read file obtained by script:  
# extract\_abstracts\_from\_PubMed\_by\_easyPubMed\_prompted\_to\_ChatGPT  
#  
df <- read.csv("meyer_tf_pubmed_title_author_year_abstract.csv", stringsAsFactors = FALSE)  
  
combined_text <- paste(df$Title, df$Author, df$Year, df$Abstract, collapse = " ")  
  
# From here training is launched  
# Optional: put it back into a one-row data frame  
  
# install torch package with GPU support:  
# https://torch.mlverse.org/docs/articles/installation  
  
library(torch)
```

Result: model.pt (python torch .pt-file)

**AI - assisted coding**

## IDE Positron with AI-assistant

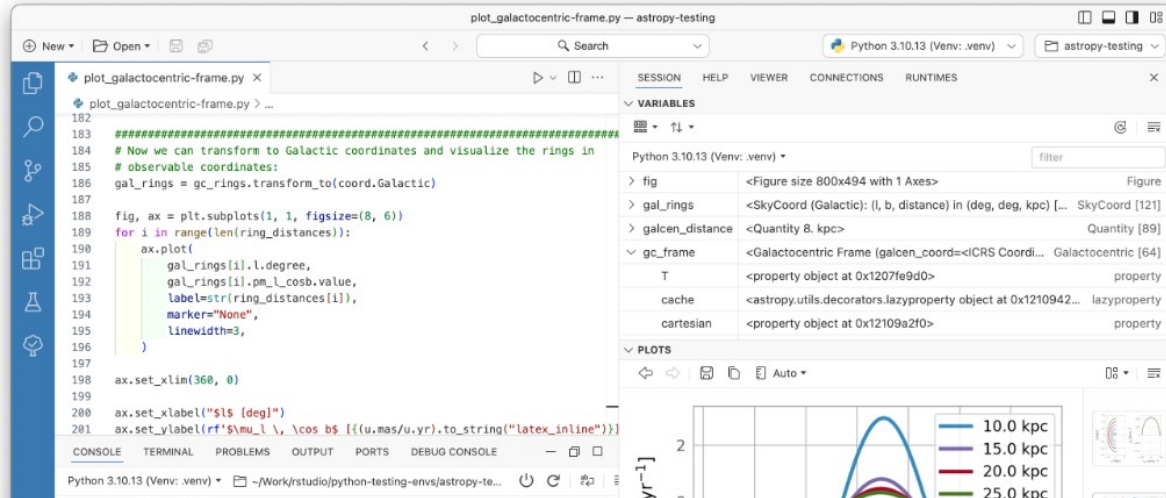
### ! Important

Positron Assistant is a **preview** feature in Positron 2025.07.0-204 and beyond.

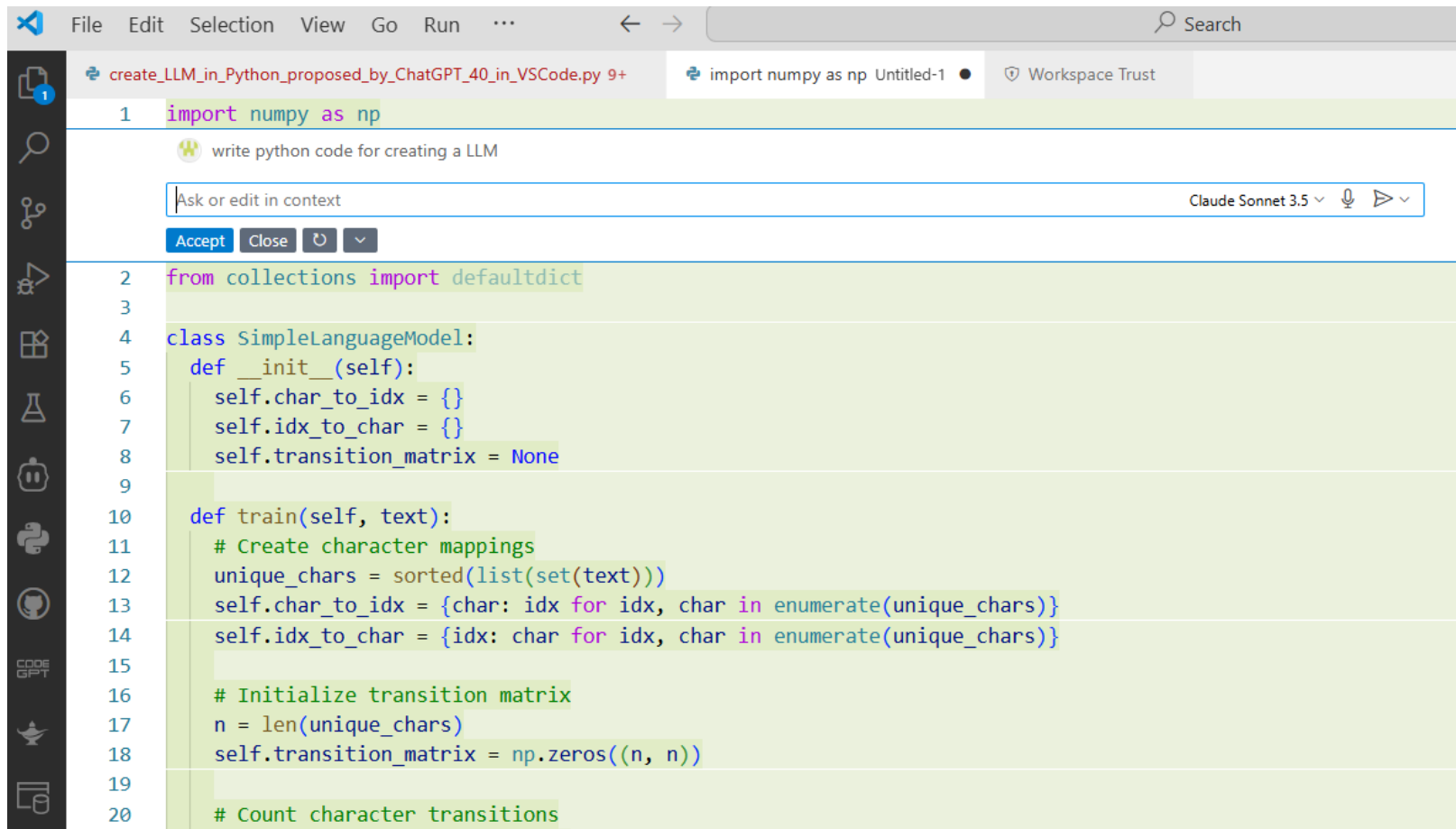
At this time, we support **Anthropic for chat**, and **GitHub Copilot for inline code**  
s. We will continue to add more language model providers in future

## What is Positron?

- A free, next-generation data science IDE built by [Posit PBC](#)
- An extensible, polyglot tool for writing code and exploring data
- A familiar environment for reproducible authoring and publishing



# IDE: VSCode



The screenshot shows the VS Code interface. The top menu bar includes File, Edit, Selection, View, Go, Run, and a search bar. The left sidebar contains icons for Explorer, Search, Source Control, Run and Debug, Extensions, Testing, Python, AI, and a custom icon labeled 'CODE GPT'. The main editor area has two tabs: 'create\_LLM\_in\_Python\_proposed\_by\_ChatGPT\_40\_in\_VSCode.py 9+' and 'import numpy as np Untitled-1'. The first tab is active, showing a Python file with the following code:

```
1 import numpy as np

2 from collections import defaultdict
3
4 class SimpleLanguageModel:
5     def __init__(self):
6         self.char_to_idx = {}
7         self.idx_to_char = {}
8         self.transition_matrix = None
9
10    def train(self, text):
11        # Create character mappings
12        unique_chars = sorted(list(set(text)))
13        self.char_to_idx = {char: idx for idx, char in enumerate(unique_chars)}
14        self.idx_to_char = {idx: char for idx, char in enumerate(unique_chars)}
15
16        # Initialize transition matrix
17        n = len(unique_chars)
18        self.transition_matrix = np.zeros((n, n))
19
20    # Count character transitions
```

Below the code, there is a chat interface with a prompt: 'write python code for creating a LLM'. The chat area shows a response from 'Claude Sonnet 3.5' with a microphone icon and a play button. The chat interface includes buttons for 'Accept', 'Close', and a refresh icon.



 ChatGPT ▾

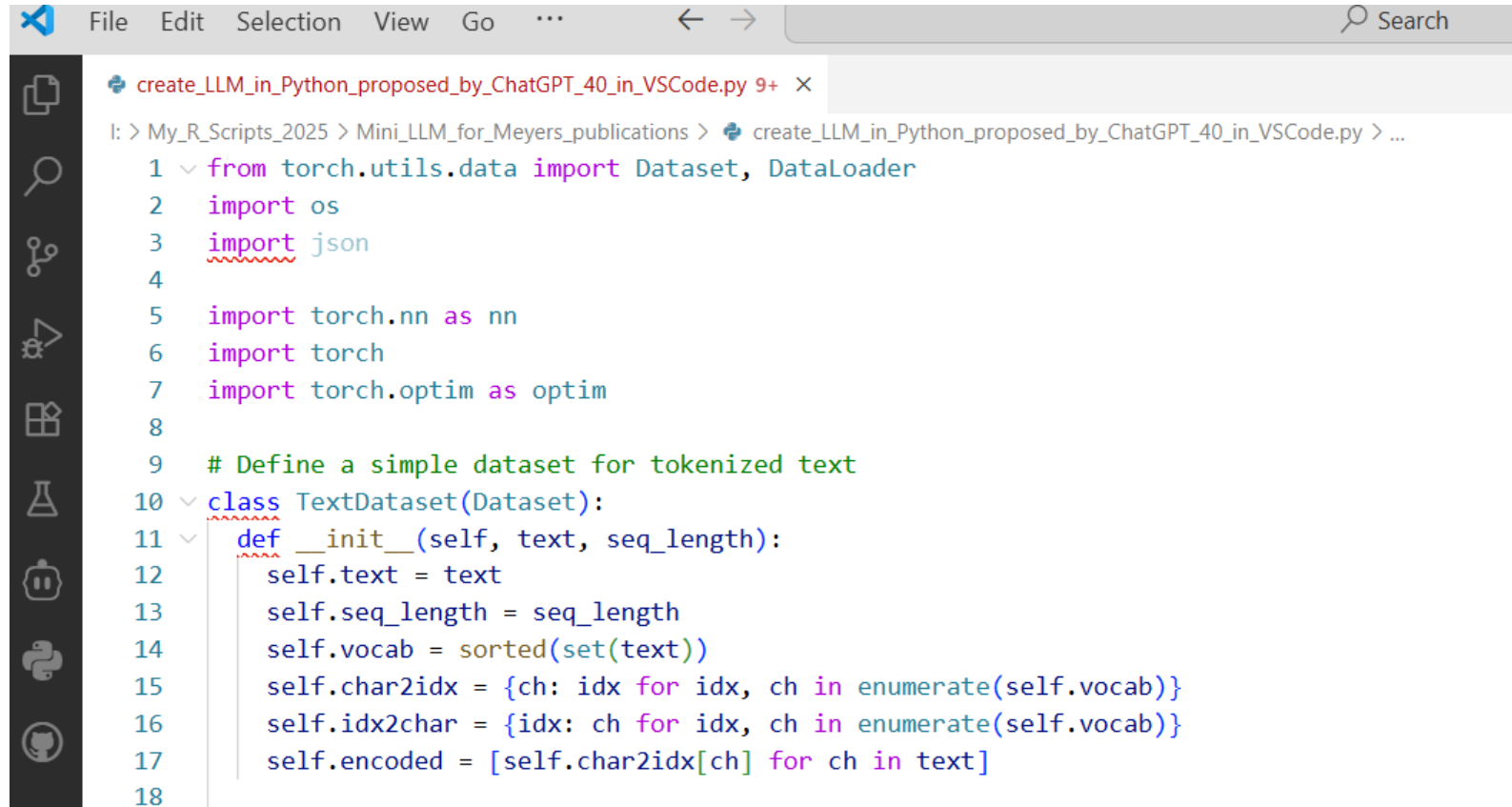
(

Prompt for ChatGPT -->

Given a large text file. Write Python code for creating a LMM using the text file as input and use torch. The format of the generated model should be GGUF to use it in ollama.

# Python script proposed by ChatGPT in VSCode

“create\_LLM\_in\_Python\_proposed\_by\_ChatGPT\_40\_in\_VSCode.py”



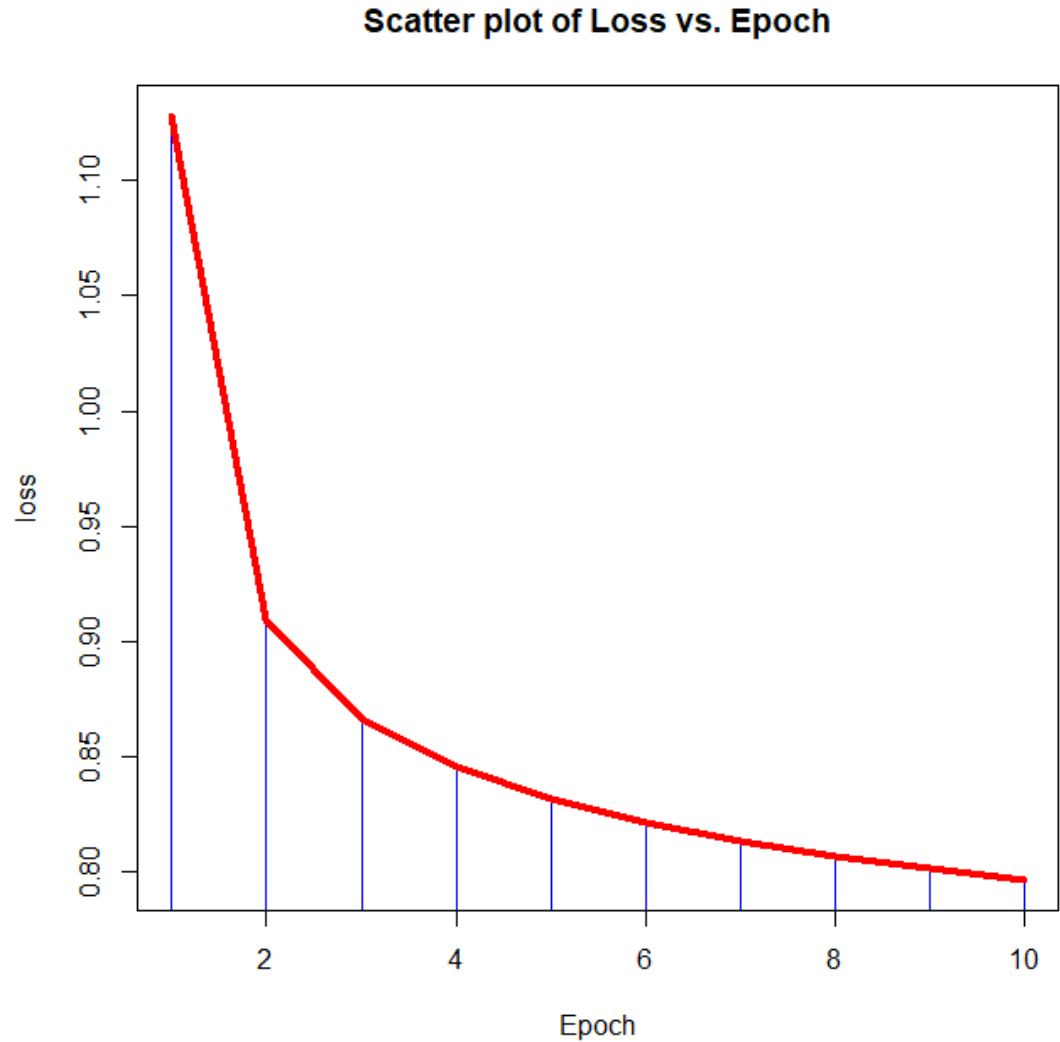
```
1 from torch.utils.data import Dataset, DataLoader
2 import os
3 import json
4
5 import torch.nn as nn
6 import torch
7 import torch.optim as optim
8
9 # Define a simple dataset for tokenized text
10 class TextDataset(Dataset):
11     def __init__(self, text, seq_length):
12         self.text = text
13         self.seq_length = seq_length
14         self.vocab = sorted(set(text))
15         self.char2idx = {ch: idx for idx, ch in enumerate(self.vocab)}
16         self.idx2char = {idx: ch for idx, ch in enumerate(self.vocab)}
17         self.encoded = [self.char2idx[ch] for ch in text]
18
```

**Result: model.gguf ( GPT-Generated Unified Format )**

Time of calculation on my Laptop:

~ 4 h

Enhancement of training quality  
by iteration (loss vs. epochs):  
( see plot)



# LLM in usage (Prompting / Response)

Prompt for ChatGPT -->

What are the most important impacts of publications written by Thomas F. Meyer. Thomas F. Meyer was the head of the department of molecular biology in the Max Planck Institut for Infection Biology in Berlin.

Here's an overview of the **most important impacts** of publications by **Prof. Dr. Thomas F. Meyer**, who led the Department of Molecular Biology at the Max Planck Institute for Infection Biology in Berlin. His work spans multiple groundbreaking discoveries that have shaped our understanding of microbial pathogenesis, host-pathogen interactions, and even the link between chronic infection and cancer.



# Key Scientific Impacts

## 1. Fundamental Insights into Microbial Genetics and Virulence

- In vitro replication of bacteriophage fd DNA before PCR revolutionized understanding of DNA replication mechanisms [mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de) .
- He cloned the first *Neisseria gonorrhoeae* gene for pilin, laying the foundation for understanding antigenic variation in bacteria [mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de) .
- Discovered **slipped-strand mispairing**—a variable pentamer repeat mechanism explaining how bacteria switch gene expression—key to understanding genetic regulation in pathogens like *Neisseria* [mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de) .
- Uncovered the **IgA protease autotransporter system**, a novel secretion pathway (now known as Type V secretion) in Gram-negative bacteria, including *Neisseria*

## Summary: Why His Work Matters

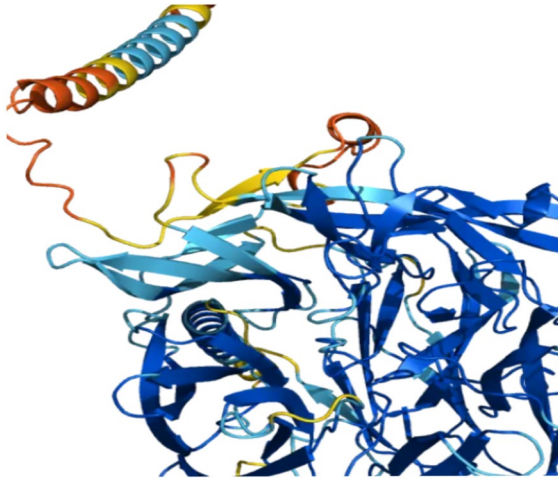
Domain	Key Impact
Microbial Genetics & Pathogenesis	Fundamental mechanisms of antigen variability, secretion systems, and adhesion in pathogens.
Innovation in Methodology	First use of slipped-strand mispairing and autotransporter secretion models; pioneering organoid and murine models.
Host-Pathogen Therapeutics	Introduced concept of host-directed therapy to counter infections and antibiotic resistance.
Cancer Biology	Demonstrated molecular links between bacterial infections and carcinogenesis, particularly via colibactin signatures.
Clinical Modeling & Translation	Used organoid systems to explore infection dynamics and test therapeutics, including for SARS-CoV-2.
Scientific Influence	High citation metrics, major awards, and institutional leadership confirm his transformational role in infection biology.

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In short, Thomas F. Meyer's publications and research have had **profound and multifaceted impact**—spanning from molecular microbiology foundations to translational models of infection-related cancer, with broad methodological innovations and enduring influence. Let me know if you'd like exploration of any particular paper or discovery!

# Applied AI

AlphaFold is an AI system developed by Google DeepMind that predicts a protein's 3D structure from its amino acid sequence. It regularly achieves accuracy competitive with experiment.



# Nobel Prize in Chemistry 2024

**David Baker**

University of Washington, Seattle, WA, USA  
Howard Hughes Medical Institute, USA

*“for computational protein design”*

and the other half jointly to

**Demis Hassabis**

Google DeepMind, London, UK

**John Jumper**

Google DeepMind, London, UK

*“for protein structure prediction”*





# Open Source Large Language Models selbst betreiben

 Künstliche Intelligenz  19. Jan.. 2024

 Thorsten Honroth, Dr. Julien Siebert und Patricia Kelbert

# Take home message

- Breathtaking advances in digital information technology
- Increased computing power (factor > 1000-1000000) for cpu, storage, connectivity
- Intelligent software (AI) with databases and packages (CRAN, BioConductor, PyPi)
- **Game changers: Internet LLM**
- Creating own LLM is possible. They can be used for specialized applications
- Overwhelming flood of information (for LLM)
- LLM revolutionizes software development
- What I have learned over 50 years:
  - Nothing stays the same !
  - Something can happen and suddenly everything is different

## 2. Advancement of Host–Pathogen Interaction Models


- Revealed central **adhesins and host cell receptors** essential for *Neisseria* infections, advancing insight into bacterial adhesion and infection initiation [meyer-laboratory.de](https://meyer-laboratory.de)  
[mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de)
- His lab's mechanistic work on autotransporters included insights into **protein folding via periplasmic oxidoreductases (DsbA)** for secretion [mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de)

## 3. Shift Towards Host-Directed Therapies

- Meyer was an early proponent of **host-targeted therapies**, blocking infection by modulating host cell pathways rather than targeting the pathogens directly—a strategy that helps avoid resistance and repurpose existing drugs [Christian-Albrechts-Universität zu Kiel](https://christian-albrechts-universitaet-zu-kiel.de)

#### 4. Linking Chronic Bacterial Infection to Cancer

His most transformative contributions lie in demonstrating how long-term bacterial infections may initiate or drive carcinogenesis:

- For **Helicobacter pylori**, his team elucidated:
  - The role of **cagPAI type IV secretion systems** and the **CagA effector protein** in inflammation and cancer risk [mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de) [meyer-laboratory.de](https://meyer-laboratory.de) .
  - Discovery of a **glucosyl- $\alpha$ -cholesterol transferase**, which depletes host cholesterol and disrupts lipid raft-based immune signaling, enabling bacterial persistence [mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de) .
- Developed **mouse lineage tracing and organoid models** to analyze epithelial damage, regeneration, and cancer emergence; for example, exploring roles of **R-spondin** signaling in gastric carcinogenesis [mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de) +1 .
- In **Chlamydia trachomatis** research, he identified infection-induced mechanisms of:
  - **DNA damage**, increased proliferation, **anti-apoptosis**, and metabolic  ic changes that promote carcinogenesis [mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de) .

- His lab also made pioneering contributions on **colibactin from E. coli**, revealing:
  - That colibactin causes **double-strand DNA breaks** with a distinct **mutational signature** found in human colorectal cancers — direct molecular evidence of bacterial genotoxin involvement in human cancer [mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de) +1 .

## 5. Innovative Use of Organoids & Advanced Models

- Meyer's lab was a forerunner in using **human organoids and mucosoids** as advanced models to mimic infection processes, cancer initiation, and even neuroinflammatory pathways via gut–brain interactions [mpiib-berlin.mpg.de](https://mpiib-berlin.mpg.de) .
- Developed **lung epithelial organoid systems** to screen potential antivirals, including agents against SARS-CoV-2

## Recognition & Academic Metrics

- D-index (discipline-specific H-index) of 130 (Microbiology) and 129 (Molecular Biology), with over ~60,000 citations—ranking him in the global top scientists in both fields [Research.com](#) +2 .
  - Awarded the **Robert Koch Medal in Gold (2020)** for his groundbreaking lifetime achievements in infection biology, especially linking infection and cancer [mpiib-berlin.mpg.de](#) [Christian-Albrechts-Universität zu Kiel](#) .
  - Member of **EMBO** and the **German Academy of Sciences Leopoldina**, reflecting his stature in molecular biology [mpiib-berlin.mpg.de](#) [Max-Planck-Gesellschaft](#) .
-