

# Programming

## Introduction, organizational matters & more

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```
332
333
334     if extrapolate is None:
335         x = np.asarray(x)
336         x_shape, x_ndim = x.shape, x.ndim
337         x = np.ascontiguousarray(x.ravel(), dtype=np
338
339     # With periodic extrapolation we map x to the
340     # [self.t[k], self.t[n]].
341     if extrapolate == 'periodic':
342         n = self.t.size - self.k - 1
343         x = self.t[self.k] + (x - self.t[self.k]) *
344         extrapolate = False
345
346     out = np.empty((len(x), prod(self.c.shape[1:])),
347 self._ensure_c_contiguous()
348 self._evaluate(x, nu, extrapolate, out)
349 out = out.reshape(x_shape + self.c.shape[1:])
350 if self.axis != 0:
351     # transpose to move the calculated values to t
352     l = list(range(out.ndim))
353     l = l[x_ndim:x_ndim+self.axis] + l[:x_ndim] +
354     out = out.transpose(l)
355 return out
356 def _evaluate(self, xp, nu, extrapolate, out):
357     _bspl.evaluate_spline(self.t, self.c.reshape(self.c
358 self.k, xp, nu, extrapolate, out)
359
360 def _ensure_c_contiguous(self):
361     """
362     c and t may be modified by the user. The Cython code
363     c and t may be C contiguous.
364     """
365     if not np.iscarray(self.c).flags['C_CONTIGUOUS']:
```

# Who am I?

- ❖ M.Sc. Luna Pianesi

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*office:* UHG U10-120

- ❖ PhD student in the research group “Genome Data Science” headed by Prof. Dr. Alexander Schönhuth

`https://gds.techfak.uni-bielefeld.de`

***Organizational  
matters***

***What is  
Programming?***

***What is  
ChatGPT?***

***Games!***

# ***Organizational matters***

- ❖ Course prerequisites: *none*

# Organizational matters

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- ❖ Coursework
  - ❖ Weekly exercises
    - Submission in groups of 2-3
    - Upload to corresponding assignment in the Moodle (former “LernraumPlus”)
    - Submission deadline is every **Wednesday 14:00**
    - Every Thursday (except the first) one of you (by yourself or in group) will present the solutions of the previous week’s exercises
  - ❖ Written exams on **29 January** and **26 February????**
    - Admitted: everyone exceeding 50% of total exercise points

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- ❖ Lecture part of module 39-Inf-Pro “Programming”, study program *Data Science*

# Course material

- ❖ ... available on course website: `https://gds.techfak.uni-bielefeld.de/teaching/2024winter/prog`
  - ❖ Slides and pointers to literature
  - ❖ Exercise sheets
- ❖ Moodle (former LernraumPlus):
  - ❖ Recorded lectures from previous years
  - ❖ Exercise sheets
  - ❖ Pointers to literature
  - ❖ Forum
  - ❖ **Weekly submission of exercise solutions**

# Lectures

Hybrid, but recommended in presence!

- ❖ Every **Wednesday, 2-4pm** in **U10-146**
- ❖ ZOOM meeting: <https://uni-bielefeld.zoom-x.de/j/61227023254?pwd=h7d6eTb0FFcaKEsxlgwWyfT6DwvEjg.1>  
(passcode: 244625)
- ❖ Q&A on videos



# Tutorials

Hybrid, but recommended in presence!

- ❖ Every **Thursday, 10am-12pm** in **C01-220**
- ❖ ZOOM meeting: <https://uni-bielefeld.zoom-x.de/j/66718144762?pwd=mLH4Ru4jArfQ7eAzmR2qaahrQgbUTk.1>  
(passcode: 586435)
- ❖ Discussion of exercise solutions
- ❖ You will present solutions to your classmates

# Literature

- ❖ VanderPlas, Jake. (2016). *Python data science handbook*. Beijing; Boston; Farnham; Sebastopol; Tokyo: O'Reilly.
- ❖ Toomey, Dan. (2017). *Jupyter for data science*. Birmingham; Mumbai: Packt.
- ❖ Ana Bell, Eric Grimson, John Guttag (2016) MIT 6.0001 *Introduction to Computer Science and Programming in Python*: <http://ocw.mit.edu/6-0001F16>
- ❖ Eric Grimson, John Guttag, Ana Bell (2016) MIT 6.0002 *Introduction to Computational Thinking and Data Science*: <http://ocw.mit.edu/6-0002F16>

# *Course syllabus*

## **Part 1**

- ❖ Programming basics and terminology
- ❖ Introduction to Python

## **Part 2**

- ❖ Scientific Programming
- ❖ Data Science with Python

# Course syllabus - in detail

## Part 1

- ❖ T0: how to use ChatGPT
- ❖ T1: programming and Python basics
- ❖ T2: data types and arithmetic operations
- ❖ T3: conditions, comparisons, and loops
- ❖ T4: functions and debugging
- ❖ T5: functional programming and lazy evaluation

## Part 2

- ❖ T6: object-oriented programming
- ❖ T7: input, file processing, and text mining
- ❖ T8: data visualization and NumPy
- ❖ T9: Pandas
- ❖ T10: machine learning
- ❖ T11: databases and distributed computing

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# *What is a programming language?*

- ❖ Natural vs. programming language
- ❖ Human-readable vs. machine-readable

# *Syntax and semantics*

## ***Syntax***

Symbols, words, sentences

## ***Semantics***

Meaning behind symbols, words, and sentences

# Syntax and semantics

## Syntax

Symbols, words, sentences

e.g. English:

- Words: He, She, It, Program, ...
- Sentence grammar rule:  
*Subject + Verb + Object*

She loves Python ✓

The house table the cup ✗

The table reads the cup ✓

## Semantics

Meaning behind symbols, words, and sentences



# Syntax and semantics

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Symbols, words, sentences

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## Semantics

Meaning behind symbols, words, and sentences

She loves Python ✓

The table reads the cup ✗

# Programming languages ...

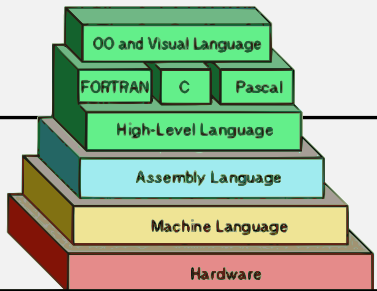
- are formal languages with unambiguous context-free grammars,  
syntactic ambiguity:  
*"I saw the man with the telescope."*
- offer different levels of abstraction,

## High level language

- Easy to understand

## Low level language

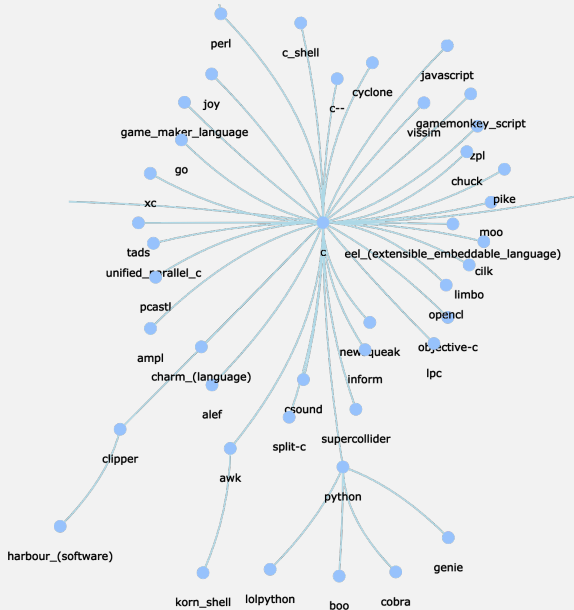
- Machine code  
(processor instructions  
and binary code)



Source: <https://thebittheories.com>

# Programming languages ...

- are formal languages with unambiguous context-free grammars,
- syntactic ambiguity:  
*"I saw the man with the telescope."*
- offer different levels of abstraction,
- change over time,
- inspire new generations of languages.



Source: <http://svalver.github.io/Proglang/paradigms.html>

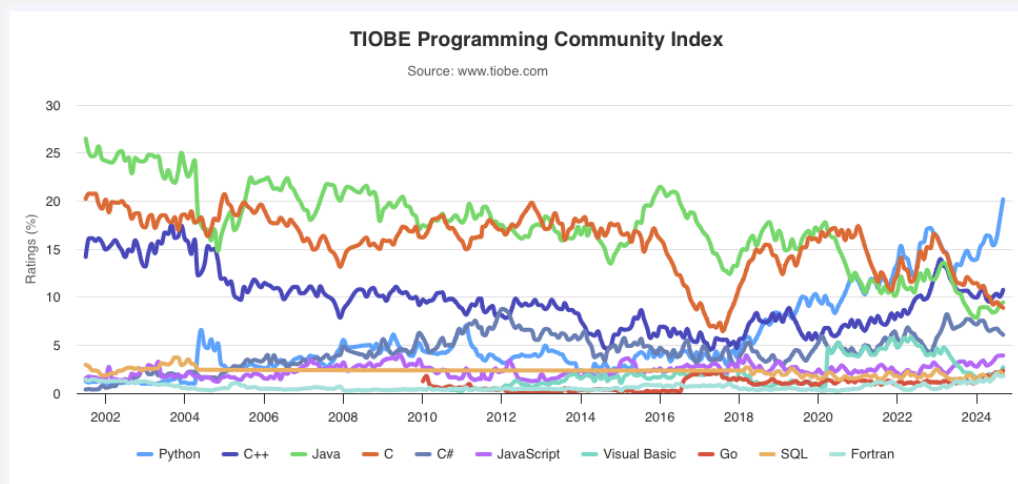
# Programming paradigms

Many different general paradigms (notable excerpts):

- ❖ Imperative – *Do this, then do that!*
  - ❖ Procedural (C)
  - ❖ Object-oriented (C++, C#, Java)
- ❖ Declarative – *I want this, I want that!*
  - ❖ Logic (Prolog)
  - ❖ Functional (Haskell, Lisp)
- ❖ Mixed (Python, R)

There are also special-purpose languages (not necessarily considered “programming” languages), e.g. *LaTeX*, *HTML*, *XML*.

# Language popularity



Source: Python is steadily growing as the world's most popular coding language - TIOBE Index (September 2024)

# Quiz

## ❖ *Syntactic or semantic ambiguity?*

- ❖ “Milk drinkers are turning to powder.”
- ❖ “Stolen painting found by tree.”
- ❖ “She went to her house, and so did Jane.”

## ❖ *True or false?*

- ❖ “All context-free grammars are unambiguous.”
- ❖ “Assembly language is a low level language.”
- ❖ “Functional programming is a form of imperative programming.”

# Quiz

## ❖ *Syntactic or semantic ambiguity?*

- ❖ “Milk drinkers are turning to powder.” syntactic
- ❖ “Stolen painting found by tree.” syntactic
- ❖ “She went to her house, and so did Jane.” semantic

## ❖ *True or false?*

- ❖ “All context-free grammars are unambiguous.” false
- ❖ “Assembly language is a low level language.” true
- ❖ “Functional programming is a form of imperative programming.” false

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# What is ChatGPT?

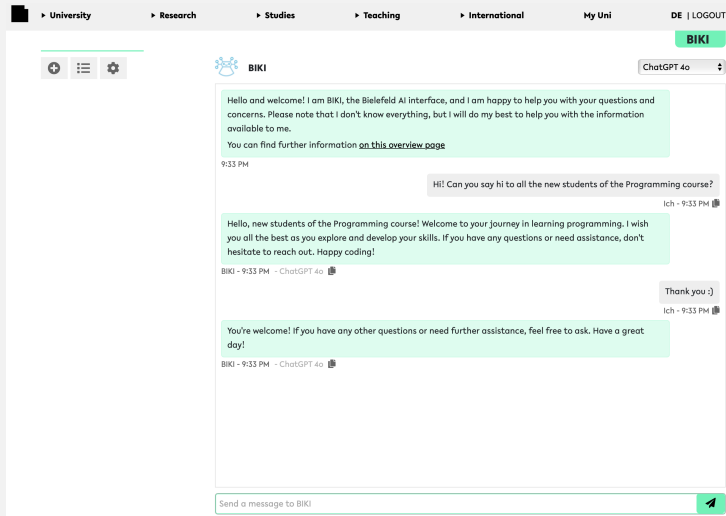


ChatGPT's logo. Source: ChatGPT's website

- ❖ ChatGPT is a chatbot based on a deep neural network (specifically, a large language model) that interacts in a conversational way;
- ❖ It was developed by OpenAI and it was launched on November 30th, 2022; since then, its popularity has spiked

# BIKI! (Bielefeld AI Interface)

BIKI is the brand new AI portal of Bielefeld University. Let's check out its details together:



The screenshot displays the BIKI AI interface within a university website. The navigation bar at the top includes links for University, Research, Studies, Teaching, International, My Uni, and DE | LOGOUT. The BIKI logo is in the top right corner, and the chat model is identified as ChatGPT 4o. The chat history shows a welcome message from BIKI, a user question about new students, a response from BIKI, a thank you message, and a final response from BIKI. The input field at the bottom is labeled 'Send a message to BIKI'.

University Research Studies Teaching International My Uni DE | LOGOUT

BIKI

ChatGPT 4o

+

☰

⚙️

BIKI

Hello and welcome! I am BIKI, the Bielefeld AI interface, and I am happy to help you with your questions and concerns. Please note that I don't know everything, but I will do my best to help you with the information available to me.  
You can find further information [on this overview page](#)

9:33 PM

Hi! Can you say hi to all the new students of the Programming course?

Ich - 9:33 PM

Hello, new students of the Programming course! Welcome to your journey in learning programming. I wish you all the best as you explore and develop your skills. If you have any questions or need assistance, don't hesitate to reach out. Happy coding!

BIKI - 9:33 PM - ChatGPT 4o

Thank you :)

Ich - 9:33 PM

You're welcome! If you have any other questions or need further assistance, feel free to ask. Have a great day!

BIKI - 9:33 PM - ChatGPT 4o

Send a message to BIKI

BIKI interface. Source: BIKI's website

# Guidelines for using LLMs

## 1. **Review the content of the reply!**

- ❖ It can happen quite often that the response that ChatGPT or any other conversational agent gives you sounds plausible, but it's actually incorrect.

## 2. **State your request clearly!**

- ❖ Be as detailed as possible when asking something to a chatbot. This might include specifying what type of output you want (structured?), how long (a line?), how formal (for a friend?), etc.

## 3. **If you're not sure, ask again!**

- ❖ Whether the reply sounds a bit weird or you're not quite sure about how to ask what you want to ask, just ask the model directly! Something like: "Ask me what details you need to reply before actually replying" or "I did not get this. Please explain it to me in a simpler language."

## *Useful links (clickable)*

- BIKI's website
- BIKI's portal
- AI tools in education and teaching

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# *Programming is fun*

- Scratch: website
- BIKI

# *Recap*

# Summary

- ❖ Course logistics
- ❖ Introduction to Programming
- ❖ Guidelines for using LLMs



## *What comes next?*

- ❖ Go to the course website (<https://gds.techfak.uni-bielefeld.de/teaching/2024winter/prog>) or Moodle (<https://moodle.uni-bielefeld.de/course/view.php?id=6494>) and download this week's exercise sheet
- ❖ Group yourselves into pairs or triples
- ❖ Due date for this week's exercises is **Wednesday, October 16, 2pm, 2024.**

*Next lecture:* Programming & Python basics ...