# DSA Datastructures and algorithms

FALL-2025

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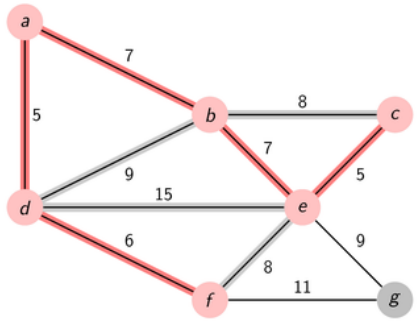
# DSA Course Syllabus

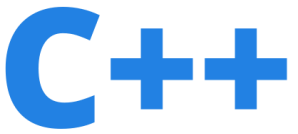





- Algorithm, pseudocode
- Algoritm design strategies:
  - Decrease and conquer
  - Divide and conquer
- Sorting algorithms
  - InsertionSort
  - QuickSort
  - MergeSort
- Efficiency
  - Asymptotic notations (Big-O, Omega, Theta)
  - Amortized efficiency
- STL-Standard Template Library (C++)
  - Containers, iterators, algorithms
  - Lambda-functions
- Hash tables, hash functions
- Graphs and trees
  - Different types of graphs and trees
  - Tree travelsal algorithms (pre-, in- and post-order)
  - Heap (special binary tree)
  - Graph algorithms (BFS, DFS, Dijkstra, A*)
  - Binary seach trees

# Prerequisite

- The course requires basic knowledge of the C++ programming language.
  - If you have never used C++ you will probably need to work some extra to learn the basics:
    - https://plus.tuni.fi/comp.cs.110/fall-2025-per-1/toc/
- Assumed that you are familiar with:
  - Git and version control, if not learn the basics:
    - https://plus.tuni.fi/comp.cs.060/25-26/)
  - Qt – editor (if not, this is easy to learn)
  - C++ compiler and debugger (if not, can be learned during the course)






# Weekly work

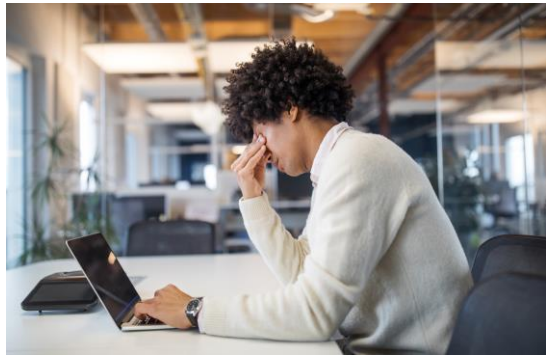
- Course material is divided into course weeks
  - https://plus.tuni.fi/COMP.CS.300/fall-2025/
- Each week, self-study material contains:
  - Video lectures
  - Quiz questions about the videos
  - Homework assignments
  - Deadline for these is Sunday at 23.59


- Each week, learning to together:
  - Discussion sessions (with teacher)
    - Thu 12-14 (TB104)
    - About the previous self-study material, learning diary questions
  - Practice sessions (with TAs)
    - Mon 8-10 (TB206)
    - Tue 8-10 (TB214)
    - Working in small groups
- Interactive, to help understanding the concepts and retaining knowledge
- Important to learn to communicate
  - Job interviews, work place

# What causes poor knowledge retention?

- Poor knowledge retention is caused by lack of engagement, insufficient repetition, information overload, stress, poor teaching methods, and inadequate reinforcement; without active learning, meaningful connections, or regular practice, the brain struggles to store and recall information effectively, leading to forgetfulness and reduced long-term retention.

https://theecmconsultant.com/what-is-knowledge-retention/



# Time management

- A lot of material to be learned!
  → Keep up with the weekly schedule:
  - Lecture videos: 34h (~5h per week)
  - Homework: 10h (1-1.5h per week)
  - Practice sessions: 12h (2h per week)
  - Discussion sessions: 14h (2h per week)
  - Exam: 1h (+4h for preparation)
  - Course project: ~60h
- 5 ECTS credits = 135h of work
- ~10-20h work per week

- The course project deadline is 7.12. at 23.59

  → you are meant to do it parallel to the other course work

  → course-gitlab repositories are given on week 2

  → coding should start on week 3 after we have covered C++ STL-library

  → this is not a small project, so start early, use kooditorio sessions

  First kooditorio is in week 4

# Grading

- Course project
  - Grades 1-5
  - The quantity of methods implemented
  - The efficiency of the solutions
  - The quality of the code AND efficiency estimations
- Additional points (max +1)
  - Theory (lecture quizes)
  - Exercises (homework)
  - Attendance (both discussion and practice sessions)
- Exam
  - Pass/failed
  - First exam period 8.12.-31.12.
  - Second in January/February

# Communication

- Email: tiraka@lists.tuni.fi
- Moodle (FAQ): https://moodle.tuni.fi/course/view.php?id=53764
- Weekly emails from teacher (via Sisu)
- English only

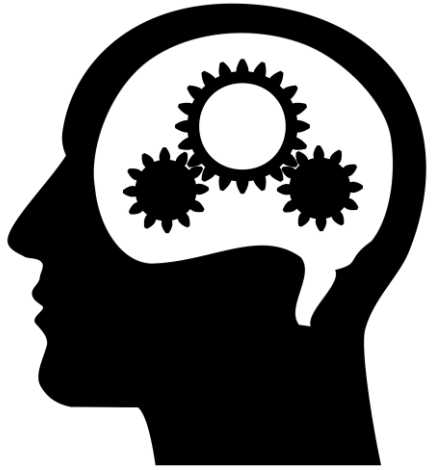
# About using AI

- Artificial intelligence can be used in the creation of outputs, but the student must clearly report its use. Failure to disclose the use of AI will be interpreted as fraud. The use of AI may affect the assessment. *)

*) The use of AI may compromize your learning outcomes.

Learning:

- is slow
- takes effort
- requires thinking

# Questions, requests…

- I watched videos but didn't get any points, when will the video – points be given?
  - The points don't come automatically, we have to run a script, this will be done after 1-2 weeks.

# Registering attendance:

There is QR-code for registering attendance in each session.

# Why stydy algorithms?

- Theoretical importance
  - In the core of computer science
- Practical importance
  - A toolkit for solving problems, no need to "invent the wheel again"
  - Basis for designing and analysing algorithms for new problems

TOP 11 Algorithms for Developers in 2025

https://www.index.dev/blog/must-know-algorithms-for-developers

TOP 100 DSA Interview questions:

https://www.geeksforgeeks.org/dsa/top-100-data-structure-and-algorithms-dsa-interview-questions-topic-wise/

# Algorithm visualizations

Sorting:

- https://algorithm-visualizer.org/divide-and-conquer/pigeonhole-sort

Binary tree:

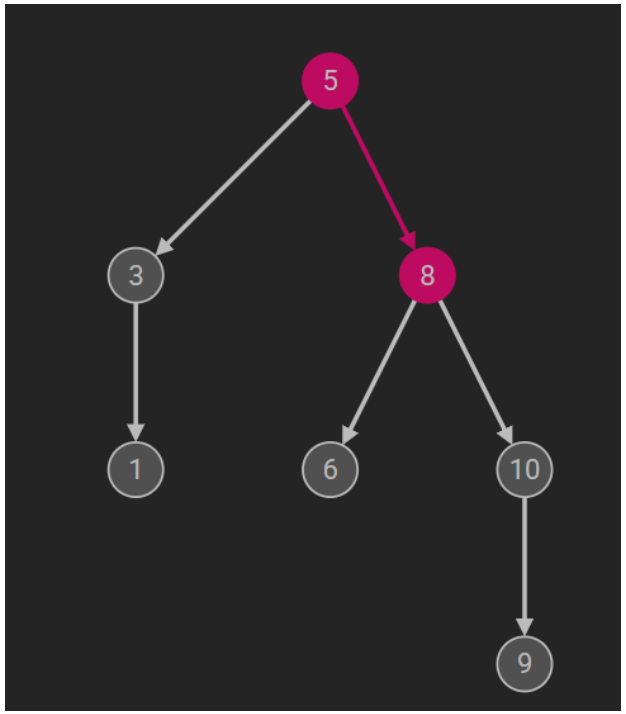
- https://algorithm-visualizer.org/brute-force/binary-tree-traversal

Graph:

- https://algorithm-visualizer.org/brute-force/breadth-first-search

Searching:

- https://algorithm-visualizer.org/branch-and-bound/binary-search-tree



# Activity: Bubble sort

- https://en.wikipedia.org/wiki/Bubble_sort

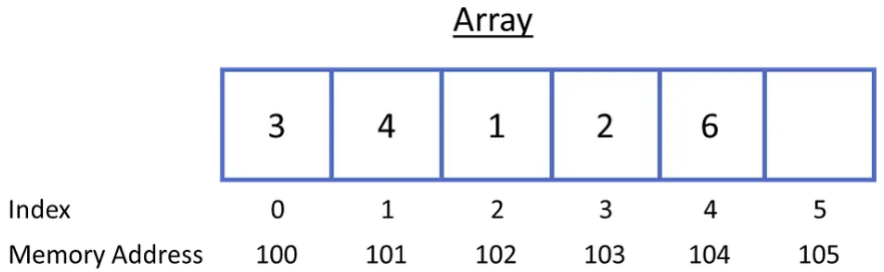
- Use bubble sort to sort your team in accending order of their birth month
  - No talking allowed
  - ~10 people in the team
  - To keep it together, make comparisons so that two people step one step ahead to do the "comparison operation"

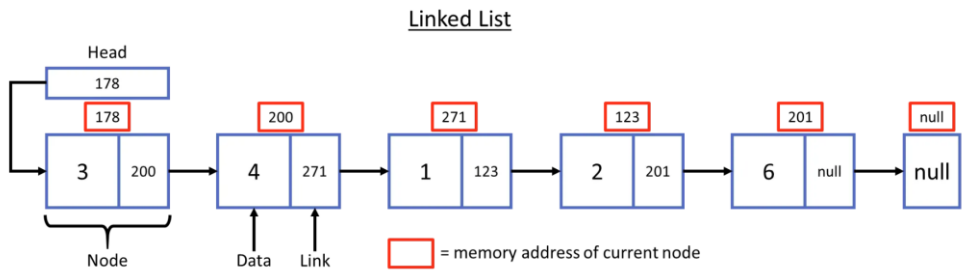
# Group work:

- Compare two datastructures that you propably have already used:
  - Vector (array)
  - Linked list

- Discuss in your team:
  - What are the pros and cons of each data structure?
  - When would you use them, when would you not use them?

https://medium.com/@alejandro.itoaramendia/arrays-vs-linked-lists-a-complete-guide-bc23c0ab0e7c



# Algorithm news

- https://scitechdaily.com/ending-a-90-year-old-challenge-superfast-algorithm-rewrites-network-flow-rules/
- https://scitechdaily.com/quantum-computers-just-outsmarted-supercomputers-heres-what-they-solved/
- https://www.clrn.org/how-fast-can-quantum-computers-break-encryption/