0 Administrativa

28 September 2023

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COMP526 (Fall 2023)
University of Liverpool
version 2023-09-27 23:41 H

Welcome to COMP 526 – Applied Algorithms

- Instructor: Dr. Sebastian Wild
  Ashton Building 2.23
  wild@liverpool.ac.uk

  Tutorials: Ben Smith
  b.m.smith@liverpool.ac.uk

- Module website: www.wild-inter.net/teaching/comp526
  → your first address for any infos on COMP 526

- *Campuswire:* collaborative Q&A (more on this later)
  also used for announcements
  → please register via link from the Canvas announcement
  https://campuswire.com/p/GBE440C1A PIN 4967

- *Slido:* student response system for formative feedback
  please bring your smartphone, laptop, etc. to class

- Final mark: 60% final exam + 40% continuous assessments (more later)

Audience Response System: *Slido*

- Goal: Collect immediate, formative feedback
  - Stay focused and engaged! ("active learning")
  - Quick feedback (for you individually) if you are on track.
  - Quick feedback (for me) whether (most of) you are on track.
- . . . and there's marks for *participation*! (not for correct answers)
- Slido has 2 useful features:

1. Quicks Polls

2. Audience Questions

My approach to lectures

My conclusions (from years of own experience, a pandemic, and observing others)

irrespective of the mode of delivery!

0. Good explanations (intuitions!) and well-structure material are the most important aspect.

1. **Synchronous (live) lectures** beat videos in keeping up with class. (but recordings are great!)

2. Only a small minority of students asks questions in class. ⇝ other backchannels

3. **Interaction** makes content memorable (and keeps brains awake!) ⇝ *Slido* tasks

Components of COMP 526

Slido questions

immediate feedback
simple questions

Lectures

new material
discussions
big picture

Tutorials

practice problems
solve deep questions

Campuswire

collaborative Q&A knowledge base

Class tests

frequent test of
basic understanding

Programming tasks 1 & 2

find & realize creative solutions

Overview of the module

Goals:

- build / enhance your toolbox of algorithmic methods and techniques
  - ⇝ here: focus on practical methods
- enable you to reason about and communicate algorithmic solutions
  - ⇝ level of abstraction, proofs, mathematical analysis, vocabulary
- enable you to apply, combine and extend methods

Units:

0. Administrativa & Proof Techniques
1. Machines & Models
2. Fundamental Data Structures
3. Efficient Sorting
4. String Matching
5. Compression
6. Error-Correcting Codes
7. Parallel Algorithms
8. Text indexing
9. Range-Minimum Queries

Assessments

= continuous assessment

(More details on CA tasks later in the term)

$$
\begin{aligned}
\text{final mark} = \quad & 0.6 \cdot \text{exam mark} \\
& + 0.1 \cdot \text{CA1 (programming puzzle 1) mark} \\
& + 0.1 \cdot \text{CA2 (programming puzzle 2) mark} \\
& + 0.15 \cdot \text{class test mark} \\
& + 0.05 \cdot \text{participation mark}
\end{aligned}
$$

Class Tests

- $\approx$ *offload 15% of mark from exam to CA*
- several quizzes throughout term
- very short (1 question)
- fair format (IMHO)
  1. unmarked practice questions
     (try as often as you like, answer shown)
  2. same question type as marked quiz
- quick intermediate feedback

Participation Marks

for good engagement, not correct answers!

- 5% for regular participation on *Slido*

Academic Integrity

- You must show *"good academic practice"* in all your assessments.
  (e. g., our programming puzzles)
  → definition on next few slides

- UK higher education has extremely **strict** rules and **zero-tolerance** policies
  - some forms of misconduct entail **immediate termination** of studies at first offense!
  - rules could differ from what you are used to, so pay attention

- In short: **It is *not* OK to**
  (Gets you **both** in trouble!)
  - **let** others **copy** your work
  - work **together** with others on assessments (except where explicitly allowed)
  - use anyone's ideas/work/code/etc. without explicitly **citing** the source
  - use any tools (in particular GenAI) without proper citation (unless explicitly allowed)

Academic Integrity: Definitions

- ***Collusion:***

"Collusion occurs when, unless with official approval (e.g. in the case of group projects), two or more students consciously collaborate in the preparation and production of work that is **submitted** by each student in an identical or **substantially similar** form **and/or** is represented by each to be the product of their **individual efforts**. Collusion also occurs where there is unauthorised co-operation between a student and another person in the preparation and production of work which is presented as the student's own."

- ***Plagiarism & Copying:***

"Copying occurs when a student consciously presents as their own work material copied directly from a fellow student or other person without their knowledge. It includes the passing off of another's intellectual property or ideas as one's own. It differs from collusion in that the originator of the copied work is not aware of or party to the copying.
Copying of work from published sources would be dealt with as plagiarism. [. . .] Examples of forms of plagiarism include: [. . .] the close paraphrasing of another's work by simply changing a few words, altering the order of presentation, or using software applications to paraphrase another's work without appropriate and correctly presented acknowledgement and citation of the original source(s)."

University of Liverpool *Code of Practice on Assessment*

Academic Integrity: Generative AI

We live in exciting times!

LLMs (ChatGPT etc.), Media generators (Midjourney etc.), GitHub CoPilot, . . .

- Generative Artificial Intelligence (GenAI) is amazing!
  - full of flaws (hallucination, bias, copyright, data privacy, cost, . . .)
  - and yet . . . often helpful, surprisingly versatile
- Why not use for everything?
  - Need for *deeply skilled* humans here to stay (for now anyways)

⇝ **Skill comes from practice!** (We still teach mental arithmetic in primary school!)

assessments designed for upskilling *humans*

⇝ For our assessments: *Don't take away the **thinking**! = Don't cheat yourself!*

Acceptable use:

- preparatory research (≈ Wikipedia)
- proof reading (spelling, grammar)

Unacceptable use: (not exhaustive!)

- use generated parts w/o acknowledgment & citation
- tools to paraphrase others' work to pass as own
- generated parts with inappropriate prompt, e. g., "write me a conclusion for this essay"

GenAI Guidelines: `liverpool.ac.uk/centre-for-innovation-in-education/digital-education/generative-artificial-intelligence/`
GenAI Literacy: `pcwww.liv.ac.uk/knowhow/GAI/story.html`

Academic Integrity: Categories of Misconduct

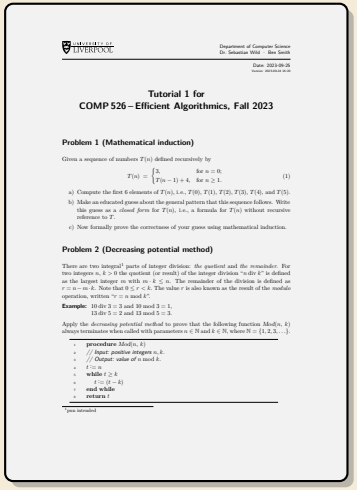
Category	Informal Definition	Consequences
A	Minor Errors (e. g., in citations)	10% deduction on assessment
B	Poor Practice, no intention to deceive	cap this assessment at 50%
C	Plagiarism, Copying, Collusion, Unacceptable use of generative AI **first offense** ⇝ no intention to deceive	0% for this assessment
D	Repeated Cat. C offense	0% for entire module
E	Serious Malpractice e. g., submitting purchased coursework, generate entire submission with ChatGPT (without citation)	0% for module, suspension, or **termination** of studies

⇝ You can ruin your future quite quickly with this. 🙏 *Please don't do it.*

- *plagiarism-checking software* runs over all submissions
  - ⇝ Plagiarism cases are regularly found and investigated.
  - ⇝ Don't be one of them. *Start early, work honestly.*

Tutorials

- *tutorial sheet* published on module page (every Monday)
  - practice problems (old exam questions!)
  - enhancement problems
- *tutorials* (week after sheet)
  - small group teaching
  - discussion of solutions
- written *solution hints* released after tutorials



Department of Computer Science
Dr. Sebastian Wild · Ben Smith

Date: 2023-09-25

Tutorial 1 for
COMP 526 – Efficient Algorithms, Fall 2023

Problem 1 (Mathematical induction)

Given a sequence of numbers $T(n)$ defined recursively by

$$T(n) = \begin{cases} 3, & \text{for } n = 0; \\ T(n-1) + 4, & \text{for } n \geq 1. \end{cases} \quad (1)$$

a) Compute the first 6 elements of $T(n)$, i.e., $T(0)$, $T(1)$, $T(2)$, $T(3)$, $T(4)$, and $T(5)$.
b) Make an educated guess about the general pattern that this sequence follows. Write this guess as a *closed form* for $T(n)$, i.e., a formula for $T(n)$ without recursive reference to T.
c) Now formally prove the correctness of your guess using mathematical induction.

Problem 2 (Decreasing potential method)

There are two integral[1] parts of integer division: *the quotient* and *the remainder*. For two integers $n, k > 0$ the quotient (or result) of the integer division "n div k" is defined as the largest integer m with $m \cdot k \leq n$. The remainder of the division is defined as $r := n - m \cdot k$. Note that $0 \leq r < k$. The value r is also known as the result of the *modulo* operation, written "$r = n \bmod k$".

Example: $10 \operatorname{div} 3 = 3$ and $10 \bmod 3 = 1$,
$13 \operatorname{div} 5 = 2$ and $13 \bmod 5 = 3$.

Apply the *decreasing potential method* to prove that the following function $Mod(n, k)$ always terminates when called with parameters $n \in \mathbb{N}$ and $k \in \mathbb{N}$, where $\mathbb{N} = \{1, 2, 3, \ldots\}$.

```
1  procedure Mod(n, k)
2    // Input: positive integers n, k.
3    // Output: value of n mod k.
4    t := n
5    while t ≥ k
6      t := (t − k)
7    end while
8    return t
```

[1] para. intended

What should you do?

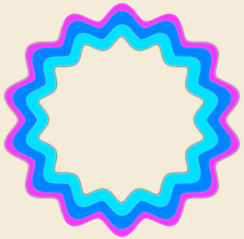
1. Work through problems on sheet (in the week it is released)
   Not assessed ⇝ you are welcome to work in groups
2. Write down your answers
3. Ask questions during tutorial (in the week after release)
4. Check your answers with the solution hints

*Use the tutorials to **practice** your thinking*! = Don't cheat yourself!

What is Campuswire?

Campuswire is an online space for lectures

1. ***Class Feed:*** questions on material
2. ***Chatrooms:*** structured social space
   similar to Slack or Discord



Join via link on website:
`campuswire.com/p/GBE440C1A`

Use in brower
`campuswire.com/c/GBE440C1A`

or via app
`campuswire.com/download`

We use Class Feed for **collaborative Q&A**

- Ask *public* questions
  - *"Why is* $\lg(n^3) = \Theta(\log n)$*?"*
  - *"Will there be classes during Carneval?"*
- ***Answer* your peers' questions!**
  - Know the answer? → put it in!
  - Know a partial answer? → Post it, others can build on it!
  - Found a helpful answer (or question)? → Vote it up!
- Ask *private* questions
  - if your question might contain "spoilers" for assessments
  - if you feel the answer is only relevant for you personally

How to Campuswire

- My goals for Campuswire Q&A:
  1. **be fair** Same answers for everyone
  2. **learning by teaching** YOU will answer most questions!
  3. **be inclusive** posts can be anonymous; you can take your time to ask and answer

- Therefore, we instructors will
  - redirect you to Class Feed for questions,
  - wait before answering, to give other students a chance to answer first,
  - explicitly mark good answers (and questions!) as such

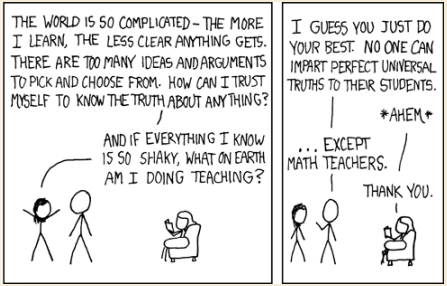
Philosophy of the module

COMP 526 is part of a *scientific* course.

Less . . .

https://imgur.com/gallery/vX118

. . . and more



https://xkcd.com/263/

- ⇝ Focus on *universal truths* of practical algorithms
  - model of reality (machines, programs, data)
  - quantitative predictions
  - validate model in experiments
- ⇝ Need some math techniques. (up next)