



Swansea University
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The Art of Teaching Theory Across Diverse Backgrounds

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In this talk...

Context

Storytelling as a pedagogical tool

Common challenges

Generative AI in education

Why is theory challenging?

Other tips

About Me

- BA in Pedagogy & MA in Linguistics
- 8 years outside of academia ...
- MSc in Computer Science
- PhD in (Theoretical) Computer Science



Context



BSc in Applied Software Engineering (Degree Apprenticeship)

- 18 y.o. - early 60s
- experienced software engineers to recent school leavers
- working in Wales, but not necessarily from Wales originally

Common Challenges



Varying levels of prior
knowledge and
experience



Cultural and language
barriers



Diverse learning styles
and preferences



Motivation and
engagement

Why do students find theory challenging?



Abstraction

Theoretical computer science deals with abstract ideas and mathematical models, which may be hard to visualise



Mathematical rigour

Gaps in the mathematical background can hinder a student's ability to grasp and apply the theoretical concepts



Perceived irrelevance

Some students may perceive TCS as too abstract or disconnected from the practical, hands-on applications



Storytelling to the rescue

Storytelling is an instructional method that uses narratives to engage learners, improve acquisition and retention of knowledge, and helps them to create emotional connections with the material.



Storytelling to the rescue

Automata with problem-based learning



Pose a problem, e.g. any
river crossing puzzle



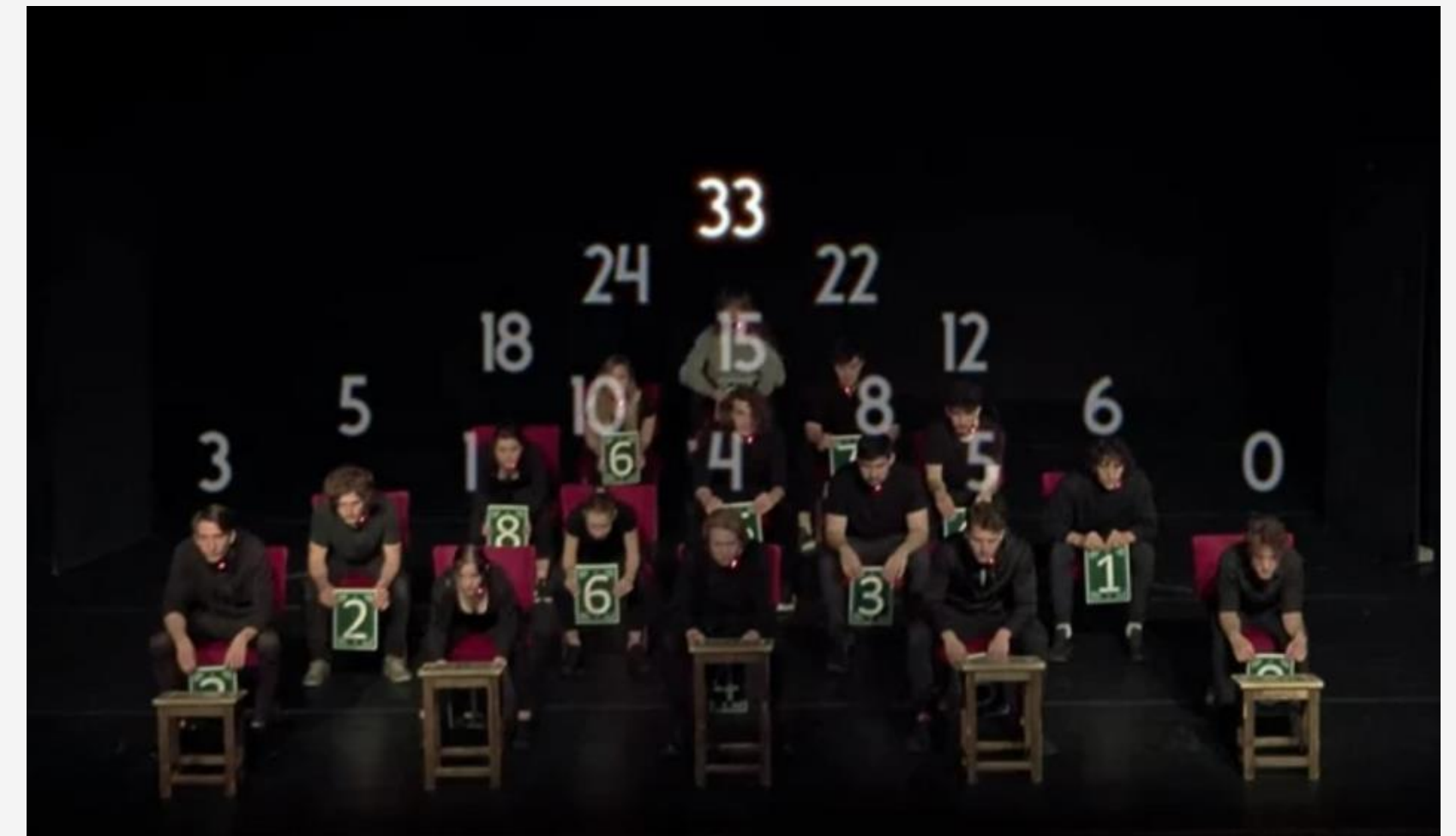
Provide an intuitive
understanding of a state
and allow students to
explore potential solutions



Formalise the problem-
solving approach

Storytelling to the rescue

Algorithms through visual storytelling:
dances and films



From the Pyramid Game short film, showing ad hoc, greedy and dynamic approach to solving the “escape room” problem of finding the largest top-down sum



Generative Artificial Intelligence



Solve a problem manually



Ask GenAI to solve the
same problem



Analyse and reflect

Analysis of AI output as a technique to
develop understanding

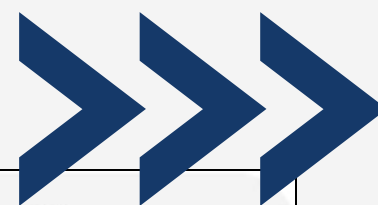
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Generative AI

Interactive games and AI tutors



Let's play a text-based interactive puzzle game together. The game should be aimed at 2nd year computer science students studying algorithms. The game should help students find solutions step by step, without explicitly stating the answers. It should be challenging. Thoroughly rest their understanding before moving to the next challenge. At each step, ask for justifications of their reasoning. The puzzles should be based around time complexity algorithms. Let's start the first game.

Puzzle 1: The Mysterious Sorting Algorithm

You are given the following function to sort an array:

```
python Copy Edit

def mysterious_sort(arr):
    n = len(arr)
    for i in range(n):
        for j in range(n - i - 1):
            if arr[j] > arr[j + 1]:
                arr[j], arr[j + 1] = arr[j + 1], arr[j] # Swap elements
    return arr
```

Question 1: Time Complexity Analysis

Before we dive into the logic of the algorithm, let's break down the time complexity.

1. What is the time complexity of the function `mysterious_sort` in terms of the input size `n`? Justify your answer step by step.
2. How does the number of iterations depend on the value of `n`?



Other Tips

- ◆ Consider students' **motivations and interests**, so that you can engage them more
- ◆ Offer **accessible content in different formats**, so that they can find the ones that suit their learning style
- ◆ Make your content **relatable**, so that students can see how theory translates into real world examples
- ◆ Break down complex concepts into **simpler parts** and use **visualisation** tools
- ◆ Use **formative assessments**, encourage **questions** and **feedback**



Thank you
Questions?

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