A human face to education in an age of AI
Co-Pilot: Prepare a 3-slide presentation on geotechnical engineering education and artificial intelligence:

1. Introduction to GEE and AI:
   - Geotechnical engineering is a critical field in civil, mining, and geological engineering programs worldwide.
   - AI techniques are increasingly applied to complex geotechnical problems due to their efficiency and potential to represent complexity.

2. Applications of AI in GEE:
   - Artificial Neural Networks (ANN): Used for modelling soil behaviour, slope stability, and settlement prediction.
   - Support Vector Machines (SVM): Applied to geotechnical data classification and regression tasks.
   - Genetic Algorithms (GA): Optimize foundation design parameters.
   - Fuzzy Logic: Handles uncertainty in soil properties.

3. Challenges and Future Directions:
   - Resource Constraints: Lack of resources and experience hinder widespread adoption.
   - Pedagogy Alignment: Integrating TEL with instructional strategies (problem-based learning, experiential learning, etc.).
   - Quantifying Impact: Research needed to assess TEL’s impact on GEE and student learning experiences.
   - Outcome-Based Education (OBE): Proposed quadruple framework for efficient TEL implementation in GEE.

Enduring challenges - not really AI specific

Surprised no mention of Natural Language Processing / Large Language Models

Fairly generic

Not all acronyms were defined by Co-pilot
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Natural Language Processing / Large Language Models?

Handling existing knowledge

Concerns about ensuring originality

Tool to create knowledge

Geotechnical engineering is a qualitative domain: We use a lot of words!

- Knowledge-Based / Expert systems (e.g. Moula et al. (1995))
- Natural Language Processing the next step?

Few equations, Many words!

Figures by Charles MacRobert or AI generated
Artificial intelligence is a very attractive tool to add to the curricula.

But is education limited to the acquisition of tools and skills?

Should education not be serving a higher purpose?

- Critical thinking skills
- Deep conceptual understanding
- Strong moral compass

History can help!
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A brief history of slope stability analysis (the role of AI to date):

- **Pettersen (1955):** Hand calculation: Know all the maths
- **Morgenstern (1963):** Charts: Maths hidden; but changes can be seen
- **Fredlund (1984):** User methods: Maths hidden; Iterative so changes can be seen
- **Malkawi et al (2001):** Algorithmic methods: Maths hidden; changes can be seen *if* desired
- **Furtney et al. (2024):** ML methods: Maths hidden; changes can be seen *if* desired

Some observations:

- A lot of what we do is already ‘hidden’
- So far, we have kept the option to ‘see changes’
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A brief history of South African geotechnical engineering (the role of humans to date):

Tony Brink: Founding father of South African engineering geology
Assisted two Nobel laureates Albert Luthuli and Nelson Mandela while on the run from the authorities.

Kenneth Knight: Influential South African geotechnical engineering
“My ideal is that of educating and training engineers of any ethnic group and of either sex to perform engineering work wherever engineering work is required to be done, for the benefit of the community.” (SAICE Presidential Address 1977)
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Two conclusions:

1. Paraphrasing Victor de Mello’s presidential speech: *We are first humans, then civil engineers, and then specialists; let us not lose sight of this order of priority. Geotechnical is of service to all civil engineering.* (Ref 9)

2. Making sound engineering decisions requires a deep conceptual understanding of how changes in inputs influence outputs. May our tools never prevent us from getting this sense. Paraphrasing Jere Jennings: *Do as many calculations as you can before making your decision.* (Ref 10)


Thank you
Enkosi
Dankie

Photo by Stefan Els