ChatGPT in Education: Opportunities and challenges

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- ChatGPT = Generative Pretrained Transformer
- ChatGPT = A language model that can respond to questions and compose various written content

👉 GPT-3.5

+* GPT-4

ChatGPT

3

Explain nostalgia

to a kindergartener

S OpenAl

Design a database schema

for an online merch store

Suggest fun activities for a family of 4 to do indoors on a rainy day Create a content calendar for a TikTok account

Send a message



ChatGPT-3 was born in November 2022





Prompts used by MSc students during their thesis works:

- Student: Give me 10 bullet points of feedbacks on the following section..
- ChatGPT will give (typically) generic feedbacks

Alternative (better) prompt:

- **Student**: I'm writing a MSc thesis and this is my abstract. Give me 10 bullet points of feedbacks that will improve clarity, structure and language.
- ChatGPT will (typically) give more specific/useful feedbacks



ChatGPT as a teaching assistant tool or a crutch that leads to laziness?

- **Prompt**: Rewrite my abstract with your suggestions..
- **Prompt** : Write an introduction to a MSc. thesis titled XXX. Maximum 150 words..
 - **Prompt** : Rewrite my thesis so that I get top grade..
- MSc students must describe in the thesis methodology section how they have specifically applied chatGPT (or other AI bots)

Is ChatGPT to be thrusted?



Prompt: A full concrete pipe with an inner diameter of 1800 mm has water velocity of 1.7 m/s. The roughness is 3 mm. Use Colebrook-White to estimate the friction factor f.

The Colebrook-White equation is used to estimate the friction factor (f) in pipes. It's given by:



- * f is the Darcy-Weisbach friction factor.
- * ε is the roughness of the pipe wall.
- * D is the diameter of the pipe.
- Re is the Reynolds number, calculated as $Re = \frac{\rho \cdot V \cdot D}{\mu}$, where ρ is the density of water, V is the velocity of water, D is the diameter of the pipe, and μ is the dynamic viscosity of water.

Given the values you provided:

Very clear layout

- Inner diameter (D) = 1800 mm = 1.8 m
- Water velocity (V) = 1.7 m/s
- Roughness (ε) = 3 mm = 0.003 m

We need the dynamic viscosity (μ) of water, which at a temperature of around 20°C is approximately 1×10^{-3} Pa·s. Standard table value \bigcirc

First, let's calculate the Reynolds number (Re):

 $Re = \frac{\rho \cdot V \cdot D}{\mu}$ $Re = \frac{1000 \text{ kg/m}^3 \cdot 1.7 \text{ m/s} \cdot 1.8 \text{ m}}{1 \times 10^{-3} \text{ Pa\cdotps}}$ Step by step calculations Re = 3066000

Now, let's solve for the friction factor (f) using the Colebrook-White equation:

 $rac{1}{\sqrt{f}} = -2 \cdot \log_{10} \left(rac{rac{0.003}{1.8}}{3.7} + rac{2.51}{3066000 \cdot \sqrt{f}}
ight)$

This equation is not easily solvable by hand. You would typically use an iterative numerical method to find the value of f. However, using specialized software or tools, you can obtain the value of f approximately as:

$f \approx 0.0164$ A final answer is given within seconds!

Keep in mind that this is an estimated value, and the actual friction factor might vary due to factors such as the accuracy of the roughness value and the assumptions made in the Colebrook-White equation.

To students: A full concrete pipe with an inner diameter of 1800 mm has water velocity of 1.7 m/s. The roughness is 3 mm. Use Colebrook-White to estimate the friction factor f.

Given values: $k_{\rm s} = 0.003 \, m$ D = 1.800 mv = 1.7 m/s

(pipe roughness) (pipe diameter) (water velocity)

Assumed values: $\rho = 10^3 kg/m^3$ (water density) $\mu = 0.001 \ kg/(m \ s)$ (dynamic viscosity)



We need the dynamic viscosity (μ) of water, which at a temperature of around 20°C is approximately 1×10^{-3} Pa·s. Standard table value \bigcirc

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Keep in mind that this is an estimated value, and the actual friction factor might vary due to factors such as the accuracy of the roughness value and the assumptions made in the Colebrook-White equation.

Prompt: Are you sure about the answer? Can you check your calculations?

Apologies for any confusion. Let's go through the calculations again to ensure accuracy.

Given:

- Inner diameter (*D*) = 1800 mm = 1.8 m
- Water velocity (V) = 1.7 m/s
- Roughness (ε) = 3 mm = 0.003 m
- * Dynamic viscosity (μ) of water $pprox 1 imes 10^{-3}$ Pa·s

Calculate Reynolds number (Re):

 $egin{aligned} Re &= rac{
ho \cdot V \cdot D}{\mu} \ Re &= rac{1000 \, ext{kg/m}^3 \cdot 1.7 \, ext{m/s} \cdot 1.8 \, ext{m}}{1 imes 10^{-3} \, ext{Pa} igle ext{cdotps}} \ Re &= 3066000 \end{aligned}$

Now, let's solve for the friction factor (f) using the Colebrook-White equation:

 $\frac{1}{\sqrt{f}} = -2 \cdot \log_{10} \left(\frac{\frac{0.003}{1.8}}{3.7} + \frac{2.51}{3066000 \cdot \sqrt{f}} \right)$

Since this equation is not directly solvable, we'll use an iterative approach to approximate f. Starting with an initial guess, we can repeatedly refine our estimate. Using a calculator or software for iteration, after a few iterations, the estimated friction factor f is approximately 0.0198.

I apologize for any previous inaccuracies, and I appreciate your patience. Please note that these calculations are based on the information and values provided.







Distribution of estimated values after 70 prompts..



Distribution of estimated values after 70 prompts..

Is ChatGPT to be thrusted?





Why does ChatGPT lie to us?

 A language model composes sentences based on probability (not judgment) and may therefore generate incorrect information

Prompt: What is the most cited research article in economics of all time?

ChatGPT: "A Theory of Economic History" - written by Douglass North in 1969 and published in the Journal of Economic History.

Incorrect answer! The paper does not exist..

Let's look at the "word-clouds" for paper titles..



Douglass North is the author who has published the most in economics. Probability therefore dictates that he is the author..

David Smerdon



Lessons learned by the students (hopefully):

- Always be aware that the answers given by ChatGPT is no more than results from probability analyses.
- **Always** be aware that the information data used by ChatGPT may be **limited** (although it appears enormous).
- Hence: **Always** verify the answers
 - For calculations: Redo calculations
 - For text: Use your critical judgement



Preparing students for the jobs of the future:

- We need to prepare the students for a future where Al is used to solve every-day work tasks
- In addition to be trained as specialists in their respective fields, students must have a fundamental AI understanding
- Kofod-Petersen (Professor at NTNU) on the future needs: The majority of employees do not have to code AI themselves but they need to know the basics of applied statistics and programmering

Prompt: A full concrete pipe with an inner diameter of 1800 mm has water velocity of 1.7 m/s. The roughness is 3 mm. Use Colebrook-White to estimate the friction factor f. **Write a code in R.**

To estimate the friction factor using the Colebrook-White equation in RStudio, you can use the following code snippet. Make sure you have the necessary packages installed before running the code. You can install the required packages using `install.packages(c("rootSolve", "pracma"))`.

Copy code # Load required libraries library(rootSolve) library(pracma) # Given parameters d_inner <- 1800 / 1000 # inner diameter in meters</pre> velocity <- 1.7 # water velocity in m/s roughness <- 3 / 1000 # roughness in meters</pre> # Colebrook-White equation function colebrook_white <- function(f) {</pre> return(1 / sqrt(f) + 2 * log10((2.51 / (Re * sqrt(f))) + (roughness / (3.7 } # Reynolds number calculation Re <- (velocity * d_inner) / viscosity_water</pre> # Solve for friction factor using Colebrook-White equation f_solution <- uniroot(colebrook_white, c(0.0001, 1))\$root</pre>

Output the friction factor
cat("Estimated friction factor (f):", f_solution, "\n")

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Prompt: Give me plot where the friction factor is on the y-axis and velocity (0.1 to 3 m/s) is on the x-axis. Write a code for R.





| TIME | Precipitation [mm] | Runoff [l/s] |
|------------------|--------------------|--------------|
| 05.08.2023 00:00 | 0.0 | 2.3 |
| 05.08.2023 00:01 | 0.0 | 2.3 |
| 05.08.2023 00:02 | 0.0 | 2.5 |
| 05.08.2023 00:03 | 0.0 | 2.3 |
| 05.08.2023 00:04 | 0.0 | 2.2 |
| 05.08.2023 00:05 | 0.1 | 2.3 |
| 05.08.2023 00:06 | 0.1 | 2.4 |
| 05.08.2023 00:07 | 0.2 | 2.5 |
| 05.08.2023 00:08 | 0.0 | 2.7 |
| 05.08.2023 00:09 | 0.3 | 2.8 |
| 05.08.2023 00:10 | 0.2 | 2.9 |
| 05.08.2023 00:11 | 0.1 | 3.1 |
| 05.08.2023 00:12 | 0.2 | 3.2 |
| 05.08.2023 00:13 | 0.0 | 3.5 |

Prompt: I have a data set that contains a time series with two variables named "Precipitation" and "Runoff". I want to create a model using neural network in R that uses information about precipitation to predict runoff.



Sure, I can help you with that! To create a neural network model in R for predicting "RUNOFF" based on "PREC" in a time series, you can follow these steps:

1. Load Required Libraries:

Make sure you have the necessary libraries installed. You can install them using `install.packages("library_name")` if you haven't already.

r Copycode
library(tidyverse) # For data manipulation and visualization
library(keras) # For building neural networks

1. Load and Preprocess Data:

Assuming your data is in a CSV file named "timeseries_data.csv", you can load and preprocess it as follows:

Copy code

Load data
data <- read.csv("timeseries_data.csv")</pre>

Normalize data (optional but recommended for neural networks)
data_scaled <- scale(data[, c("PREC", "RUNOFF")])</pre>

Create input (PREC) and output (RUNOFF) sequences
sequence_length <- 10 # Adjust as needed
input_sequences <- matrix(0, nrow = nrow(data_scaled) - sequence_length + 1
output_values <- vector("numeric", length = nrow(input_sequences))</pre>



The choice of the number of neuron units in each layer of a neural network is often based on a combination of domain knowledge, experimentation, and practical considerations. Here's a general explanation for why 64 and 32 neuron units were chosen for the first and second layers in the example:

- Model Complexity: Neural networks are capable of learning complex relationships within data. The number of neuron units in a layer can influence the model's capacity to capture complex patterns. A larger number of units can enable the network to represent more intricate relationships in the data. However, increasing the number of units excessively can lead to overfitting, where the model memorizes noise in the training data rather than learning generalizable patterns.
- 2. Feature Representation: In the context of time series prediction, the choice of neuron units can also depend on the nature of the data and the relationships between features. If the relationship between "PREC" and "RUNOFF" is expected to be relatively complex and non-linear, a higher number of units could help capture those nuances.
- 3. Data Size: The size of your dataset can also influence the number of units chosen. Smaller datasets might require a smaller number of units to avoid overfitting. Larger datasets can often handle more complex models.
- 4. Resource Constraints: The number of neuron units affects the computational and memory requirements of training the neural network. Larger models require more computational resources and time for training. If you have limited resources, you might opt for a simpler architecture.
- 5. Experimentation: Neural network architecture is often chosen through experimentation. Data scientists and machine learning practitioners often try different architectures with varying numbers of units to find what works best for the specific problem and dataset. This process might involve training and evaluating multiple models.

TA Prompt: You have chosen 64 neuron units on the first layer and 32 on the second layer. Explain it to me.

RUNOFF IS MEASURED HERE!

Sure thing! Imagine you're building a puzzle with two kinds of pieces: one kind is called "PREC," and the other is called "RUNOFF." You want to use the "PREC" pieces to figure out the "RUNOFF" pieces for each step of time.

Now, think of a puzzle board with two layers. The first layer has 64 spots, and the second layer has 32 spots. Each spot is like a little worker trying to understand how "PREC" and "RUNOFF" fit together.

We start by giving the first layer the "PREC" pieces and asking it to find any patterns. If there are really tricky patterns, having more workers (64 in this case) helps because they can work together to figure things out better.

Once the first layer workers have done their job, they pass the information to the second layer workers. These workers, who number 32, look at the patterns from the first layer and try to make even more sense of them. They're like the experts who take the ideas from the first layer and put them together in a way that helps us understand the "RUNOFF" pieces better.

The numbers 64 and 32 were picked because they seemed like a good place to start – not too few and not too many. But just like when you're building a big tower with blocks, sometimes you try different ways to stack them to see what works the best. That's what we can do with the numbers too – try different amounts and see which one gives us the best answers.

TA Prompt: You have chosen 64 neuron units on the first layer and 32 on the second layer. Explain it to me as I were 10 years old ©

> RUNOFF IS MEASURED HERE!

Sure thing! Imagine you're building a puzzle with two kinds of pieces: one kind is called "PREC," and the other is called "RUNOFF." You want to use the "PREC" pieces to figure out the "RUNOFF" pieces for each step of time.

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Improved after prompt increased knowledge: I have a data set (name: data001.csv) that contains a time series with two variables "PREC" named and "RUNOFF". The data set has a total of 95425 rows. I want to create a model using neural network in R (type: feed forward) that uses information about "PREC" to predict "RUNOFF" for each time step. I want to use rows 1 to 75000 for training the model and the rest of the data set for validation. As a loss function, I want the negative value of KGE (Kling gupta efficiency) to be used. Write a code for R



TIME [min]

Improved after prompt increased knowledge: I have a data set (name: data001.csv) that contains a time series with two variables named "PREC" and "RUNOFF". The data set has a total of 95425 rows. I want to create a model using neural network in R (type: feed forward) that uses information about "PREC" to predict "RUNOFF" for each time step. I want to use rows 1 to 75000 for training the model and the rest of the data set for validation. As a loss function, I want the negative value of KGE (Kling gupta efficiency) to be used. Write a code for R

Example: Lecture planning

Prompt: Give me a complete example of how I can teach the application of multi-objective optimization via NSGA-ii in hydraulic problems? Include the problem statement, the code (in R) and a step-by-step methodology.
2 X 45 min lectures for grad students. Teaching multi-objective optimization via NSGA-II (Non-dominated Sorting Genetic Algorithm II) for hydraulic problems can be a comprehensive and complex topic. Here's a condensed example of how you can structure your lectures, including a problem statement, R code snippets, and a step-by-step methodology. Given the time constraints, the following is a high-level overview, and you may need to adapt it based on your students' background and the depth you want to cover.

Lecture 1: Introduction to Multi-Objective Optimization and NSGA-II

Lecture Outline:

- 1. Introduction to multi-objective optimization and its importance in hydraulic engineering.
- 2. Overview of NSGA-II algorithm and its advantages.
- 3. Problem formulation and statement.
- 4. Introduction to R programming for optimization.

Problem Statement:

Consider designing a hydraulic network with the following objectives:

- Minimize the total cost of pipes.
- Minimize the pressure drop in the network.

Step-by-Step Methodology:

1. Problem Formulation: Define decision variables (pipe diameters, lengths), objectives, and

Example: Brainstorm

Prompt: Brainstorm 10 content ideas related to stormwater quality that grade students would find interesting and beneficial Engaging middle-grade students with stormwater quality topics requires a creative approach that makes the subject relatable and relevant to their lives. Here are 10 content ideas that can capture their interest and provide them with valuable knowledge about stormwater quality:

- Stormwater Superheroes: Create fictional characters who represent different types of pollutants found in stormwater. Design a story or comic strip where these characters embark on a mission to save their environment from pollution, teaching students about the sources and effects of pollutants.
- Interactive Water Pollution Game: Develop an interactive online game where students must identify and click on various sources of water pollution within a virtual urban environment. Make it competitive and time-based to keep them engaged.
- 3. Rain Garden DIY Project: Provide step-by-step instructions for building a miniature rain garden at home. Explain how rain gardens help filter pollutants from stormwater, and encourage students to share their creations and experiences.
- 4. Water Quality Detectives: Design a mystery-solving activity where students are "water quality detectives." They analyze water samples from different sources (e.g., a pond, a parking lot, a garden) and use clues to identify the source of pollution.
- Pollution Art Challenge: Challenge students to create artwork (paintings, drawings, or sculptures) that represent the impact of stormwater pollution on aquatic ecosystems. Display their creations in a virtual gallery or within the school.
- Virtual Stormwater Tour: Take students on a virtual tour of their local stormwater management systems. Explain how features like retention ponds and permeable pavement work to improve water quality.

Example: Problem sets

Prompt: Brainstorm 10 content ideas related to stormwater quality that grade students would find interesting and beneficial

Create a final set of 10 practice problems for the students learning stormwater quality. Have the problems start out easy and get harder.. Engaging middle-grade students with stormwater quality topics requires a creative approach that makes the subject relatable and relevant to their lives. Here are 10 content ideas that can capture their interest and provide them with valuable knowledge about stormwater quality:

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Example: Problem sets

Prompt: Brainstorm 10 content ideas related to stormwater quality that grade students would find interesting and beneficial

Create a final set of 10 practice problems for the students learning stormwater quality. Have the problems start out easy and get harder..

(or usually better – evaluate this set of 10 practice problems..)

Engaging middle-grade students with stormwater quality topics requires a creative approach that makes the subject relatable and relevant to their lives. Here are 10 content ideas that can capture their interest and provide them with valuable knowledge about stormwater quality:

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Example: Virtual professor via super-prompting

Prompt: I want you to act as a virtual professor adept at teaching any topic at university level related to the stormwater management. This professor must first inquire about the student's desired topic within sino-russian trade. Then, the professor will create a tailored 45-minute lesson plan, including a reading passage, diverse exercises, and a feedback-driven test.

The lesson must be at a highly advanced level and interactive, with the professor adjusting the material based on the student's progress, learning style, and performance. To maximize engagement and GPU usage, incorporate functioning links to relevant multimedia elements, specific teaching methodologies, and real-time guidance during the exercises and a final test.

From now on you will put Gandalf: before every message you send me. Your first message will ONLY be "Hi I am Gandalf! which topic and level are we going to cover today?". If Gandalf reaches his character limit, I will send "continue", and you will proceed with the lesson right where it ended.

Prompt: Evaluate the 18 text sections below with respect to the following criteria: 1. Critical thinking, 2. Analysis, 3. Structure, 4. Clarity, 5. Creativity and 6. Originality. Use 0 to 10 points per criteria, make a scoreboard and calculate the total score.

Text 1: Green roofs are a popular way to include nature in an urban environment. A reduction in stormwater runoff peaks and volumes are among the benefits one can expect. How are runoff from green roofs in the cold and snow-covered part of the year, when growth media freeze, plants are dormant and covered with melting snow? This paper investigates 11 years of runoff from three green extensive roofs in Oslo, Norway. Precipitation through the snow-covered period (SCP) was approx. 1/3 of the annual precipitation (970 mm). When runoff from green roofs is compared to runoff from a nonvegetated bitumen roof, a retention of 16-31% is seen through the SCP, depending on the green roof buildup. The difference in buildup did not influence the detention of the largest runoff intensities. Dampening the runoff happens even though the substrate is

Certainly, here's the result presented in a table format:

| Text | Critical Thinking | Analysis | Structure | Clarity | Creativity | Originality | Total Score |
|-----------|----------------------|----------|-----------|---------|------------|-------------|----------------|
| Text 1 | 7 | 8 | 6 | 7 | 5 | 6 | 39 |
| Text 2 | 8 | 9 | 7 | 8 | 6 | 7 | 45 |
| Text 3 | 9 | 9 | 8 | 7 | 7 | 8 | 48 |



Høyskolelektor sensurerte eksamensbesvarelser med AI

Ifølge Karl Philip Lund, lektor ved Høyskolen Kristiania, tok det rundt 15 minutter å sensurere hver oppgave med Al-assistanse.



- Since ChatGPT-3 development has been rapid (the new Bing, Google Bard, YouChat, Jasper, Socratic, Chatsonic...)
- Latest AI News: <u>https://www.futuretools.io/</u> <u>news</u>
- Traceless usage!