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Improving First-Year Petroleum Engineering Students Experience Through First Common Year Curriculum

Talal D. Gamadi

Marshall Watson (Professor & Chair)

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Dr. Talal Gamadi, Texas Tech University. Dr. Talal Gamadi is an Assistant Professor in Bob L. Herd Department of petroleum engineering at Texas Tech University, Lubbock, TX, USA. Dr. Gamadi has a Ph.D. and master's in petroleum engineering from TTU and ULL.

Dr. Marshall Watson, Texas Tech University. Dr. Marshall is an associate professor and the head of the Bob L. Herd Department of petroleum engineering at Texas Tech University, Lubbock, TX, USA.

Abstract

A first-year experience is critical for the long-term academic growth of a student. The literature is full of works that argue how important is the first-year experience. At Whitacre College of Engineering (WCE), we adopted the importance of having excellent and skilled-based experience in engineering students' first year. This paper provides a review of an engineering education practice, including teaching approaches and institutional strategies to support student success during their first college year. Undergraduate students in Whitacre College of Engineering (WCE) at Texas Tech University follow a common core curriculum in their first and second semesters of study. The First common First Year (FCY) curriculum was implemented in Fall2020 and formed to introduce certain basic skills to engineering students; and acquaint students with the interaction of skills, techniques, logic, and creativity in engineering problem formulation and solving. The FCY curriculum includes classical foundational studies in calculus, chemistry, physics, English, and new studies in computational thinking (programming/ data science), Bioinspired engineering design class, and Ethics/humanities science. Since the first-year experience is critical in the long-term academic growth of a student, a plan was designed to integrate and advance what students are learning from the first common year to their sophomore, junior, and senior year with more emphasis, given to programming/ data science, Bio-inspired engineering design class, and ethics & humanities. To effectively integrate these courses into the upper-level courses, a group of faculty members from different engineering departments, called disciples, were designated. The main duties of these disciples are:

1. providing relevant examples from each engineering major related to computational thinking, bio-inspired design, ethics, and humanities to the faculty members teaching the common first year (FCY).
2. monitoring the advancement and integration of First common year (FCY) newly added courses through sophomore (second year), junior (third year), and senior years (fourth year).
3. Evaluating the impact of the newly added courses on the attainment of ABET student outcomes 1-7.

An example of how the FYC content is carried out and integrated into the petroleum engineering curriculum is presented in this paper. Furthermore, the paper shows how ABET student outcomes were mapped to these courses.

1. Background

Engineering is the process of developing an efficient mechanism that quickens and eases the work using limited resources, with the help of technology. Adding computational thinking, bio-inspired engineering, and ethics /humanities courses to the first-year curriculum is an attempt from the Whitacre College of Engineering to enhance the abilities of our future engineers to solve complex problems using modern tools as well considering the impact of their solutions on the welfare of the society. The FCY curriculum includes classical foundational studies in calculus, chemistry, physics, English, and new studies in computational thinking (programming/ data science), Bio-inspired engineering design class, and Ethics/humanities science. Tables 1 and 2 show the first common year plan.

Table 1: First Semester	
Course	Hours
Calculus I	4
Chemistry I	4
Computational thinking/ Data Science	3
English 1	3
Engineering Seminar	1
Total Hours	15

Table2: Second Semester	
Course	Hours
Calculus II	4
Physics I	4
Bio Mimicry/Bio-Inspired Design	3
English 2	3
Ethics and Humanities	3
Total Hours	17

1.1 Course description as stated in the university catalog and course objectives

I. Computational thinking and data science Introduction to Computer Science and Programming in Python is intended for students with little or no programming experience. It aims to provide students with an understanding of the role computation can play in solving problems and to help students, regardless of their major, feel justifiably confident in their ability to write small programs that allow them to accomplish useful goals. The class uses the Python 3.5 programming language.

II. Bio-inspired engineering is the application of biological methods and systems found in nature to the study and design of engineering systems and modern technology. The biology-inspired design uses analogous biological phenomena to develop solutions for engineering problems. Understanding, learning, and practicing this approach to design is challenging because biologists and engineers speak different languages, have different perspectives on design, with different constraints on design problems, and have different resources for realizing an abstract design. In this first common year, the curriculum contains this interdisciplinary introductory course that will be advanced in each engineering department curriculum.

III. Ethics and Humanities: students acquire an understanding of professional and ethical responsibility.

These courses are being specifically added because of the following reasons:

1.2 Computational thinking!

Wing (2006) argued that computational thinking involves three key constructs: Algorithms, Abstraction, and Automation. An algorithm is a step-by-step series of instructions. Abstraction involves generalizing and transferring the problem-solving process to similar problems (Barr and Stephenson 2011). Finally, automation involves using digital and simulation tools to mechanize problem solutions. The idea of computational thinking in education can be traced back to the work of **Papert** in 1980, with the term most often associated with Wing from 2006. The recent focus on computational thinking as a key 21st-century skill for all students has led to several curriculum initiatives. But only over the last five years or so has computational thinking become a common focus in education because it plays a vital role in today's technology and globally connected world. Furthermore, jobs requiring computing skills are growing tremendously every year.

1.3 Bio-inspired engineering design!

Bio-inspired engineering (BiE) uses biological structures and functions to solve specific technical problems either through inspiration from, or direct mimicking of, existing biological designs. To truly unlock the potential of BiE to expand the engineering design solution space, we must train future engineers in new ways of thinking and solving problems.

1.4 Ethics and Humanities!

Ethics are the principles accepted by society, which also equate to the moral standards of human beings. An engineer with ethics can help society in a better way. Hence the study of Engineering ethics, where such ethics are implemented in engineering by the engineers, is necessary for the good of society. Engineering Ethics is the study of decisions, policies, and values that are morally desirable in engineering practice and research.

2. Whitacre College of Engineering Strategies to Support Student Success During and After FCY

Since the first-year experience is critical in the long-term academic growth of a student, a plan was designed to integrate and advance what students are learning from the first common year to their sophomore, junior, and senior year with more emphasis, given on computational thinking and data science, Bio-inspired engineering design, and ethics & humanities. The main approach followed by the Dean of WCE is through opening direct communication among faculty members of engineering departments/programs and faculty members teaching first common year courses. This was done by selecting two faculty members from each department, called disciples, to

1. Provide relevant examples related to computational thinking, bio-inspired design, ethics, and humanities to be used in developing the content of these courses.
2. Plan the advancement and integration of the First common year newly added courses through the sophomore, junior, and senior years of each engineering department.
3. Map and evaluate the impact of the newly added courses on the attainment of ABET 1-7 student outcomes.

Since the FCY curriculum was implemented in Fall 2020, the faculty member(s) of each newly added course to the FCY curriculum gave a presentation to Dean, associate deans, department heads, and disciples in Fall 2021. They presented their evaluation of students' attainment of each course objective and the mapped ABET student outcomes, an example is shown in the later section of this paper. Also, they presented samples of students' projects and presentations. At the end of their presentation, they presented what went well and what did not since this was the first experience of the FCY curriculum. The disciples provided feedback to faculty members of the FCY during and after the presentation. Furthermore, the disciples help in the improvement of the FCY course's content based on the evaluation results conducted in their department, as shown in figure 2.

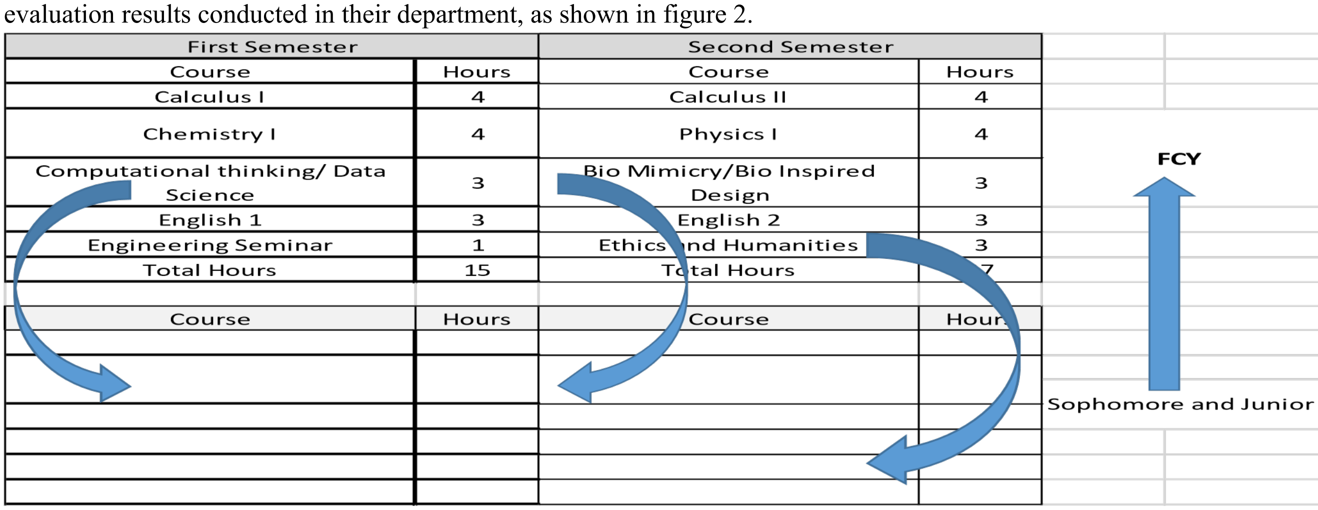

Figure 1: shows the loop of exchanging feedback between FCY and PE advanced years

3. The Disciples of the FCY Curriculum

Whitacre College of Engineering (WCE) has about seven undergraduate engineering programs following the FCY curriculum. There are about seven designated disciples for each newly added course (7 for computational thinking and data science, 7 for Bio-inspired engineering design, and 7 for ethics & humanities). First, the disciples of each course meet with the faculty member(s) teaching in the FCY. The disciples provide various examples related to computational thinking, bio-inspired design, and Ethics /humanities studies to FCY faculty members to expose first-year students to relevant materials from different engineering majors, such as petroleum, mechanical, chemical, industrial engineering .. etc. For example, in the summer of 2020, the faculty members of the Computational Thinking (CT) and the 7 disciplines attended a summer workshop. The CT class faculty members showed the materials that will be covered in their class, and the project that will be given to students at the end of the semester. At the end of the workshop, the disciples provided feedback about the project and course content. Furthermore, the disciple monitors the integration of the FCY course`s content in each department curriculum by identifying certain courses in their upper-level courses, in this paper, an example is shown of how petroleum engineering disciplines are integrating what is learned in FCY to the sophomore year of the petroleum engineering curriculum, Figure 1. in the end, each department disciples at the senior year evaluate the attainment of the FCY's main objectives which are :

1. Did the students use programming and data science in their final senior design?
2. Did students use bio-inspired engineering in designing their projects?
3. Did students consider the impact of their solutions on the welfare of society or consider professional and ethical responsibility in their design project?
4. Did FCY newly added courses help in improving the attainment of the ABET 1-7 student outcomes?

4. Mapping FCY Courses to ABET Student Outcomes 1-7

The program must have documented student outcomes that support the program's educational objectives. Attainment of these outcomes prepares graduates to enter the professional practice of engineering. Student outcomes are outcomes (1) through (7), plus any additional outcomes that may be articulated by the program.

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Table 3: shows how the FCY curriculum is mapped to ABET student outcomes 1-7

ABET Outcome	FCY courses and learned content
EAC 1	Computational thinking
EAC 2	Ethics and Humanities
EAC 2	Bio Mimicry/Bio-Inspired Design
EAC 4	Ethics and Humanities
EAC6=CAC1	Computational thinking
EAC 7	Bio Mimicry/Bio-Inspired Design

It is obvious that the FCY curriculum adds value to students by helping the attainment of ABET students' outcomes 1, 2, 4, 6, and 7, as shown in table Table3.

At the end of the academic year 2020-2021, the attainment of ABET student outcomes, 1, 2, 4, 6, and 7 have been assessed by FCY teachers for the three classes. Final projects, HW & Lab assignments, and exams were used for this assessment. The evaluation has shown a significant improvement in these ABET students' outcomes.

5. An example of the ABET assessment and results used in the Computational Thinking (CT) class

An example of the assessment method and results used in Computational Thinking class is shown in this section of the paper.

✓ **CT course learning objectives**:
  - Implement basic Python programs using computational thinking concepts
  - Apply Python programming constructs and libraries to solve relevant data science problems
  - Perform fundamental data analytics and basic visualization using Python script language

✓ **ABET Student outcomes**
- EAC SO (1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- EAC SO (6) an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions
- EAC SO (7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
- CAC SO (1) analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions
- CAC SO (2) design, implement and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program`s discipline.

✓ **Performance indicators and metrics:** Table 3 shows how labs1-23 are used as performance indicators to assess the ABET student outcomes.

Objective	EAC 1-7 (weight*)	CAC 1-6 (weight*)	Performance Indicator and Metrics (outcome met if at least 70% of students received > 70 % of the points on the item measured)
Implement basic Python programs using computational thinking concepts.	1 (4)	1 (4)	Lab 1: Variables, Operators, Expressions, Basic I/O, and String Manipulation Lab 2, 3: Data Structures and Conditional Statements Lab 4, 5: Loops and Functions Exam 1 - Take-home Problems
Apply Python programming constructs and libraries to solve relevant data science problems.	1 (4) 7 (3)	1 (4) 2 (3)	Lab 6, 7: Classes and Objects and NumPy Library Lab 10, 11: Pandas Library, Graphing using Matplotlib Library, Setting up Iterations Lab 12, 13: Probability and Descriptive Statistics Lab 14: Sampling and Empirical Distributions Exam 2 - Take-home Problems Project: 5 different Projects that has Linear Regression and Classification
Perform fundamental data analytics and basic visualization using Python script language.	1 (4)	1 (4) 2 (3)	Lab 15: Hypothesis Testing Lab 18: A/B Testing Lab 19: Bootstrap Algorithm Lab 20, 21: Interpreting and Using Confidence Intervals Lab 22, 23: Linear Regression Exam 3 - Take-home Problems

Table4: shows Performance indicators mapped to ABET student outcomes

✓ **Students' performance**

Figure 2 shows the students' performance on labs and exam questions used to evaluate student attainment to the mapped student`s ABET outcomes. An average of 70% and above shows the attainment of the students to the ABET outcome.

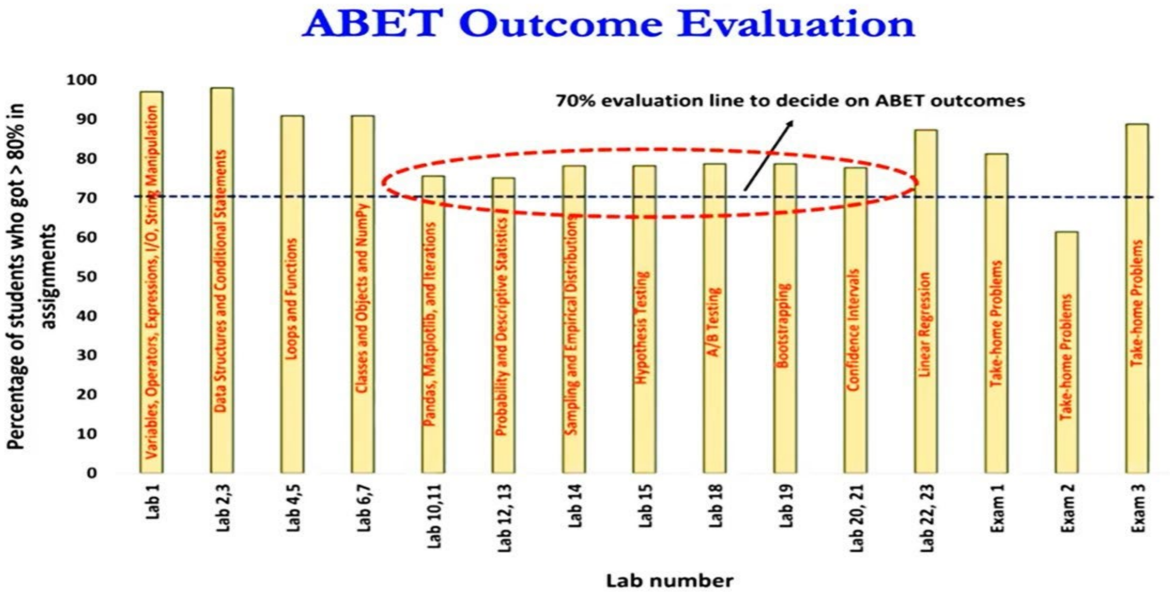

Figure2: Student performance in the lab assignment and exams

Table 5 shows the overall assessment results of the attainment of the mapped ABET student outcomes.

Objective	EAC 1-7 (weight*)	CAC 1-6 (weight*)	Performance Indicator and Metrics (outcome met if at least 70% of students received > 70 % of the points on the item measured)	Assessment Results (of students who passed the course)
Implement basic Python programs using computational thinking concepts.	1 (4)	1 (4)	Lab 1: Variables, Operators, Expressions, Basic I/O, and String Manipulation Lab 2, 3: Data Structures and Conditional Statements Lab 4, 5: Loops and Functions Exam 1 - Take-home Problems	37 of 37 (100%) 36 of 37 (97.3%) 35 of 37 (94.6%) 32 of 37 (86.5%)
Apply Python programming constructs and libraries to solve relevant data science problems.	1 (4) 7 (3)	1 (4) 2 (3)	Lab 6, 7: Classes and Objects and NumPy Library Lab 10, 11: Pandas Library, Graphing using Matplotlib Library, Setting up Iterations Lab 12, 13: Probability and Descriptive Statistics Lab 14: Sampling and Empirical Distributions Exam 2 - Take-home Problems Project: 5 different Projects that has Linear Regression and Classification	31 of 37 (83.7%) 30 of 37 (81.1%) 23 of 37 (62.2%) 27 of 37 (73.0%) 29 of 37 (78.4%) 37 of 37 (100%)
Perform fundamental data analytics and basic visualization using Python script language.	1 (4)	1 (4) 2 (3)	Lab 15: Hypothesis Testing Lab 18: A/B Testing Lab 19: Bootstrap Algorithm Lab 20, 21: Interpreting and Using Confidence Intervals Lab 22, 23: Linear Regression Exam 3 - Take-home Problems	27 of 37 (73.0%) 26 of 37 (70.3%) 26 of 37 (70.3%) 27 of 37 (73.0%) 25 of 37 (67.6%) 29 of 37 (78.4%)

Table 5: ABET outcomes evaluation results.

6. Assessment Summary

Using the defined metrics, the outcome is met if at least 70% of students received >70% of the points on the item measured) and the results in table 4 ➢ **CT course learning objectives**:

- Implement basic Python programs using computational thinking concepts **(Met)**
- Apply Python programming constructs and libraries to solve relevant data science problems **(weaknesses, partially Met)**
- Perform fundamental data analytics and basic visualization using Python script language **(weakness, possibly student Fatigue, Met)**

➢ **ABET Student outcomes**

- EAC SO (1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics **(Met)**
- EAC SO (6) an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions **(Met)**
- EAC SO (7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
- CAC SO (1) analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions **(Met)**
- CAC SO (2) design, implement and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program`s discipline **(Met).**

7. Integration of the FCY Courses to the Second-year Petroleum Engineering Curriculum.

The disciples of the PE department have planned to advance and integrate what is being learned in the FCY. as well to remeasure the student's attainment of the above-mentioned ABET students' outcomes, Table3. The metrics will be changed, the outcome is met if at least 75-80 % of students received > 80% of the points on the item measured) In this section of the paper, examples of how the FCY curriculum is being carried out and integrated into the petroleum engineering curriculum are shown. This is the plan of the Petroleum Engineering (PE) department to integrate and advance the common year courses into PE courses. The plan starts with selecting courses in each upper level to advance the FCY courses. The courses are usually taught by the selected PE disciples. There will be three main groups of courses based on each subject.

<u>Group 1: the Bio-Inspired group class.</u>

More specifically, in the sophomore year, we have designated three courses, reservoir I, Petroleum Methods, and petroleum Geology, to advance the programming/ data science, Bio-inspired engineering design, and humanities/social science classes. Here is the plan for all academic years.

- ➢ **Freshmen Year Spring 2021:** ENGR1320 Bio-inspired Design
- ➢ **Sophomore Year Spring 2022**: …Petroleum Geology & Petroleum Methods (drilling part)
- ➢ **Junior Year Fall 2022&spring 2023**: Drilling I & Core analysis
- ➢ **Senior Year Fall 2023 & Spring 2024**: mandating content related to Bio-inspired design in the final design I & II reports.

The definition of bio-inspired engineering and how it can be used in petroleum engineering design is being reintroduced to PE students and supported with PE-related design problems.

1. Petroleum Geology, Bio-inspired Design In-class Activity 1

In the sophomore year, students visit our oil technology center, consisting of oil and gas production systems and surface facilities used for separating produced oil and gas. They learn about how sour natural gas is being treated to meet commercial standards. In reservoir engineering, I class, separating oil, gas, and water, and flush calculation to separate hydrocodone components are covered as well. During the discussion hour in reservoir class, students will be divided into groups to think of a nature-inspired example that would represent the separation process of oil, gas, and water or the treatment of sour gases. At the end of the discussion hour, the kidney and liver will be shown as examples of bio-inspired systems that can be mimicked or learned from to design better separation or treatment systems.

2. **Petroleum Geology, Bio-inspired Design In-class Activity 2**

This example is used in petroleum geology class to advance the bio-inspired design topic. The raw measurement acquired by a monopole sonic tool is interval transit time (or delta-t), the time required for compressional energy to travel 1-ft through the reservoir. How that measurement is made is inspired by human hearing. Suppose one person stands at the corner of 19th and Quaker (a local address by the university), while a second stands at the corner of 19th and Slide (a local address by the university). An explosion occurs at the intersection of 19th and Avenue Q. Use the post-explosion experiences of both persons to explain interval transit time in mathematical terms. Assuming a compressional velocity of 1,100 feet/second through the air, calculate a value of interval transit time in microseconds/feet.

3. **Petroleum Geology, Bio-inspired Design HW problem**

- Explain how a piezoelectric transducer (i.e., sonic tool receiver) behaves exactly like the human ear. The solution is A piezoelectric transducer (i.e., sonic tool receiver) that behaves exactly like the human ear, in that it converts energy from one form to another. Analogize how a sonic transducer converts received energy into useable information using human hearing as an example.
- As a homework problem, we will ask students to look for another nature-inspired example that would represent the separation process of oil, gas, and water and the treatment of sour gases and write an essay about it.

Group 2: The Computational Thinking (CT) class.

Computational thinking involves three key constructs: Algorithms, Abstraction, and Automation. An algorithm is a step-by-step series of instructions. Abstraction involves generalizing and transferring the problem-solving process to similar problems. Finally, automation involves using digital and simulation tools to mechanize problem solutions. This question is asked to the reservoir engineering dissection hour class, why should you start using python and data analysis to solve petroleum engineering problems? Here is the plan for all academic years.

- **Freshmen Year Fall 2020:** ENGR1330 comp Thinking/Data Science
- **Sophomore Year Spring 2022**: Reservoir Engineering I: Using Python to estimate oil and gas properties.
- **Junior Year Fall 2022**: PETR4324 Statistical Analysis data (requiring students to solve Delice curve analysis, IPR& TPC, Oil and Gas MBE problems using Python. Fall 2023
- **Senior Year Fall 2023 & Spring 2024**: mandating the use of Python in analyzing the senior design Data. Senior electives Simulation methods

This is the faculty member's message to students at the end of the discussion "this will help you to get a job because the oil and gas industry moves more into the machine learning space, Python-conversant petroleum domain specialists will prove to be increasingly valuable to organizations."

1. **Reservoir Engineering I, First-in-class activity using programming to solve petroleum-related problems**

In reservoir Engineering I class, students will learn to solve petroleum engineering problems using numerical methods, such as iteration, which involve programming knowledge. An example is shown below, Figure3.

Step 1. Assume a trial value of p_d. A good starting value can be obtained by applying Wilson's equation for calculating K_i to Equation to give:

$$\sum_i \frac{z_i}{K_i} = \sum_i \left[\frac{z_i}{\frac{p_{ci}}{p_d} \exp\left[5.37(1+\omega_i)\left(1-\frac{T_{ci}}{T}\right)\right]} \right] = 1$$

Solving for p_d yields:

$$\text{initial } p_d = \frac{1}{\sum_i \left[\frac{z_i}{p_{ci} \exp\left[5.37(1+\omega_i)\left(1-\frac{T_{ci}}{T}\right)\right]} \right]}$$

Step 2. Using the assumed dew-point pressure, calculate the equilibrium ratio, K_i, for each component at the system temperature.

Step 3. Compute the summation of Equation

Step 4. If the sum is less than 1, steps 2 and 3 are repeated at a higher initial value of pressure; conversely, if the sum is greater than 1, repeat the calculations with a lower initial value of p_d. The correct value of the dew-point pressure is obtained when the sum is equal to 1.

Figure3: solving for dew point pressure using iteration

2. Reservoir Engineering I, Project assignment using programming

In reservoir engineering I class: students are required to use Python to estimate and plot oil and gas properties using available equations and correlations, an example shown in Figure4. This is a month-long project assignment. The project involves the three key computational thinking constructs: Algorithms, Abstraction, and Automation.

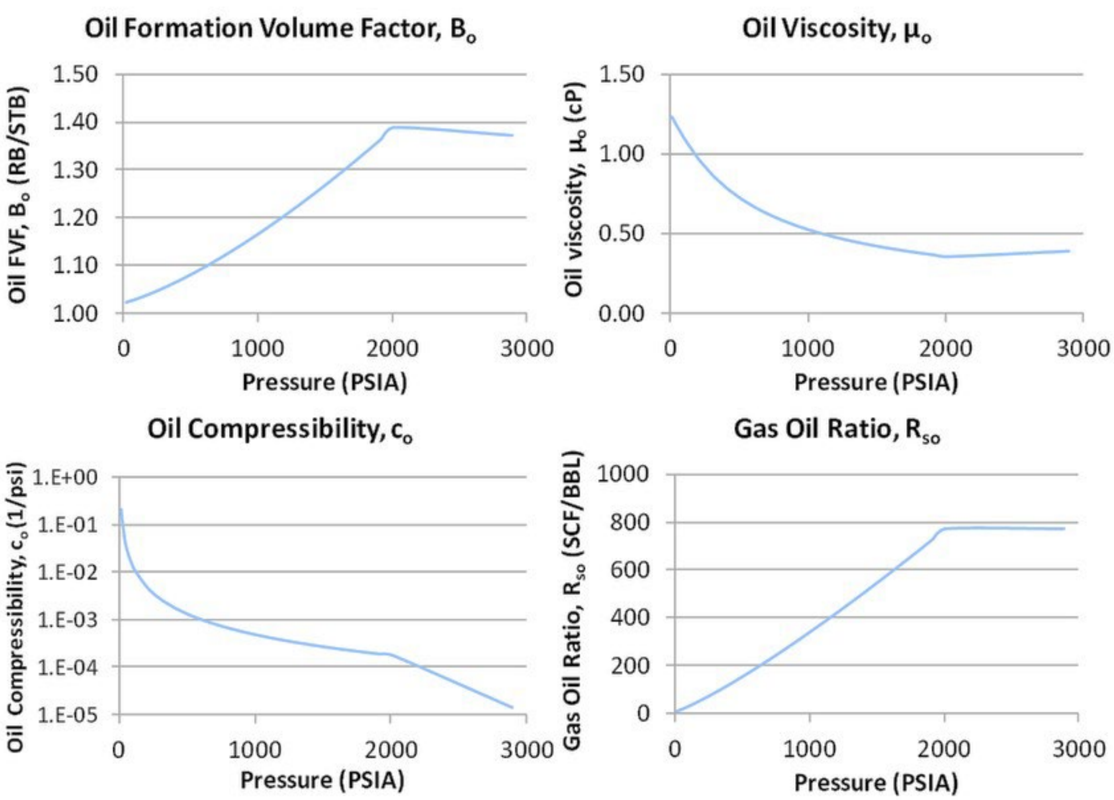

Figure4: oil properties calculation using Python

Group 3: the Ethics and Humanities class.

Engineering is the process of developing an efficient mechanism that quickens and eases the work using limited resources, with the help of technology. Ethics are the principles accepted by society, which also equate to the moral standards of human beings. An engineer with ethics can help society in a better way. Hence the study of Engineering ethics, where such ethics are implemented in engineering by the engineers, is necessary for the good of society. Engineering Ethics is the study of decisions, policies, and values that are morally desirable in engineering practice and research. To advance students' knowledge of professional ethics, these issues are being discussed in the petroleum methods dissection hour class. Here is the plan for all academic years.

- **Freshmen Year Spring 2021:** ENGR2392 engineering ethics
- **Sophomore** Year Spring 2022: Petroleum Methods
- **Junior Year** Spring 2023: Production methods
- **Senior Year Fall 2023 & Spring 2024**: mandating content related to Social Awareness & Ethics in the final design I & II reports.

1. Petroleum Methods class: Ethics in-class Activity 1

Your company is planning to drill several 100's horizontal wells in an area of the field where there has not been any significant oil and gas development. the only urban center in the area is a small town of approximately 1500 people. The town is a typical rural town with an economy based on ranching and farming few locally owned shops, no large hotel accommodations. you and a few other members of the company management team are going to meet with the local city management to discuss the upcoming programs.

b. should your company have done a detailed analysis of the impact of the influx of people, services, and changes in the economy on the community (positive and negative) and shared these findings openly with city management to develop a plan to address short term these issues.

c. present a version of the study that emphasizes only the positive aspects of the project, more $ to the city, and minimizes the impact on the local people

d. be willing to invest long term into the city's future, as per infrastructure, services to the town`s people, and training for better job opportunities. this will require a significant expenditure of time, money, and resources for your company beyond the industry standards, but it will have the most beneficial impact on the community

2. Petroleum Methods class: Ethics in-class Activity 2

You are responsible for paying royalty owners the payments are based on actual sales volumes and for a given period and posted oil prices by the company that purchases your product. On the payment statement, dates of production and price are shown together with volumes for the period in question these values can fluctuate by a few days over a given year. You have been made aware that the company that is buying your oil the next day will drop the posted price. Would you pay the royalty owners a few days earlier to take advantage of this situation? the estimated savings for the given month amount to approximately $1.5M.

3. Petroleum Methods class: Ethics HW Assignment

you are part of a team evaluating a prospect, your area of responsibility is not a reservoir, specifically fluid properties. you are the completion specialist the team has used some standard techniques on a few fluid samples and some typical correlations to determine the crude gravity, a key factor in determining the actual price of the product. you were doing some research on unusual details of previous completions issues have done some additional work and have come up with the conclusion that there is a strong probability that based on this information you have come up with conclusion that there is a strong probability that the crude gravity is significantly lower than what has been estimated by the team, this fact will decrease the value of the product by up to 40%. What would you do?

a) present your finding and most likely make the project uneconomical
b) make the team aware of these issues and request additional data to verify your findings all your team members will be unhappy since this will require additional work
c) given the fact that it is not your area of expertise and goes against the standard results, keeps the information to yourself and go along with the team

8. Conclusion

1. Whitacre College of Engineering (WCE) at TTU, adopted the importance of having excellent and skilled-based experience in the first year of engineering students and added three new courses, computational thinking and data science, Bio-inspired engineering design, and ethics & humanities.
2. Newly added First-year curriculum, adopted by WCE, adds value to students by helping the attainment of ABET students' outcomes 1, 2, 4, 6, and 7 at an early stage of their education.
3. Following up with the changes made to the college`s curriculum and the intergradation of first-year experiences into upper-level courses is significant, hence, a group of disciples was selected to ensure that.

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