2025 AIChE ANNUAL MEETING
NOVEMBER 2 - 6, 2025
BOSTON, MA

LSU College of Engineering
Cain Department of Chemical Engineering

How Shall Language Model Apply to University Lab Teaching?

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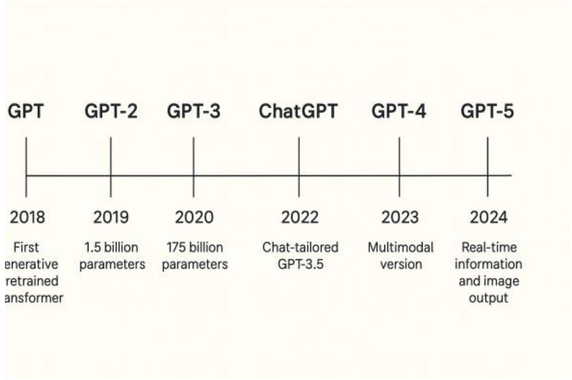
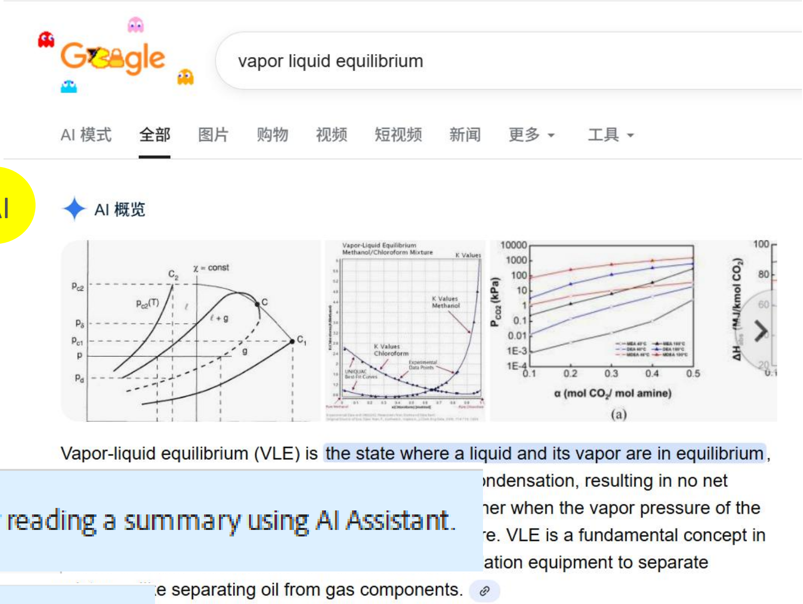
Cain Department of Chemical Engineering
Louisiana State University

- Motivation: Ubiquitous AI and stressful undergraduate study
- ChE 3104, LSU Engineering Measurement Lab
- Survey and Volunteer activities
- Observation and Conclusion

Ubiquitous AI and stressful undergraduate study



AI



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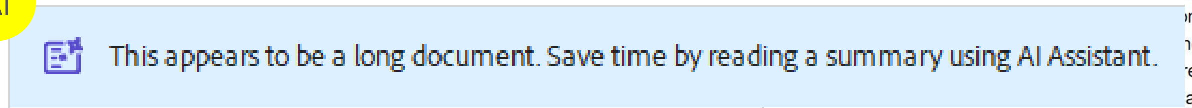

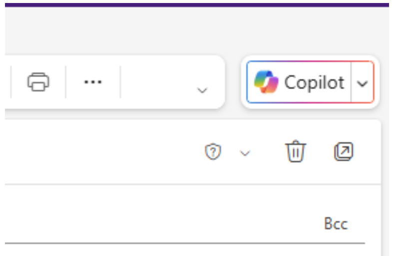

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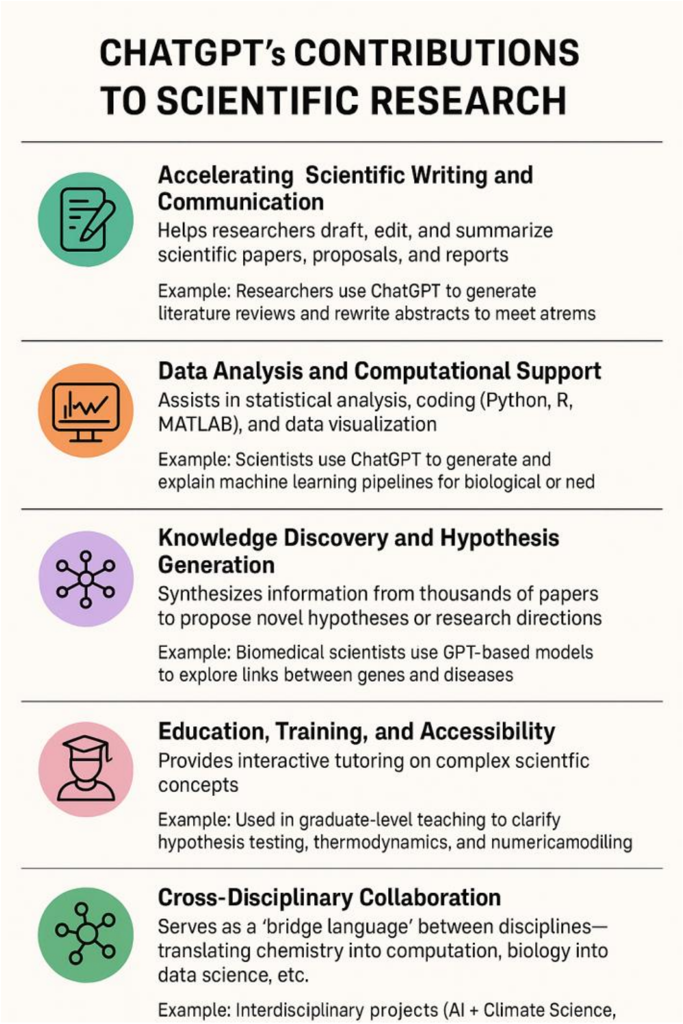
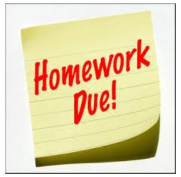


Ubiquitous AI and stressful undergraduate study

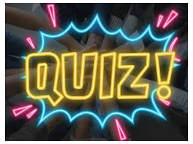
A brief survey on senior student regarding his/her daily schedule

12 hours on campus



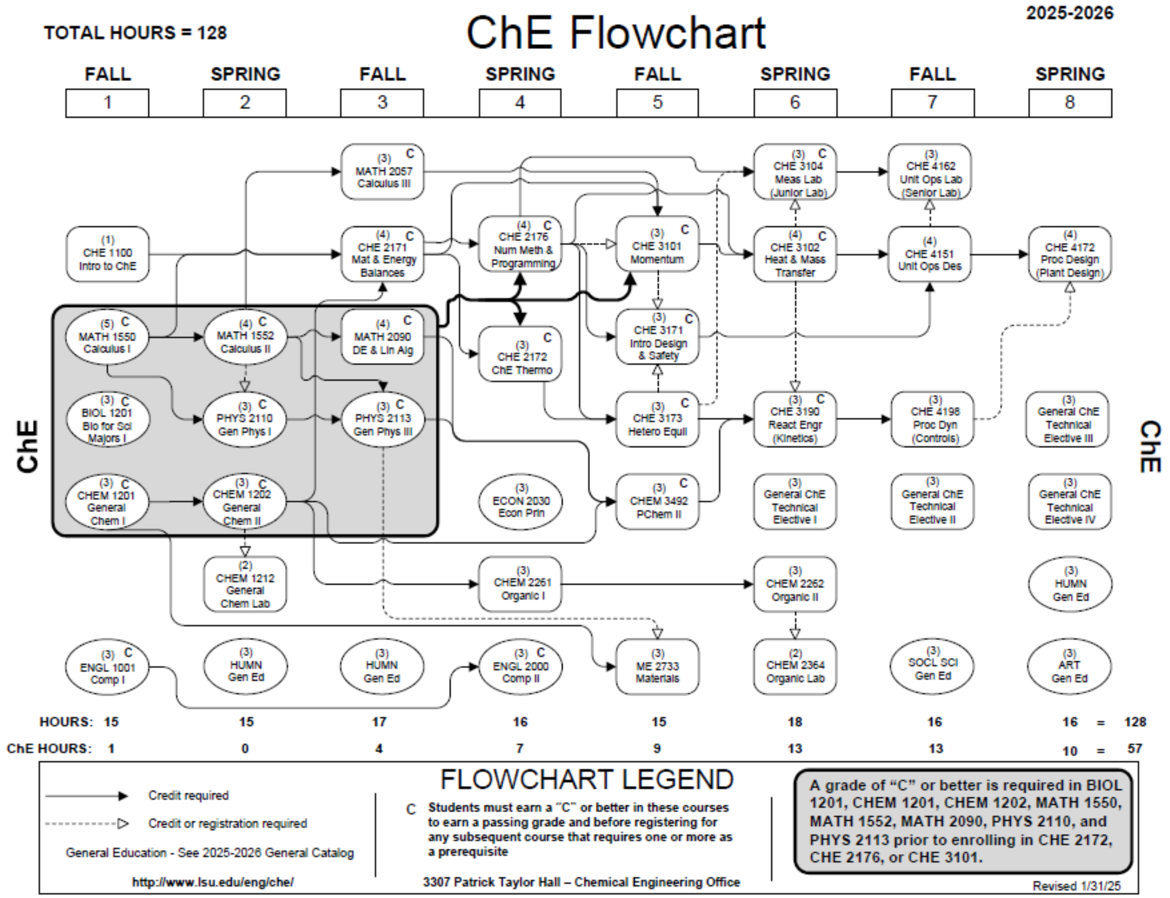
1 for each lecture

1 for each week



6 per course

2-3 per course



Ubiquitous AI and stressful undergraduate study

- ❑ Shall we introduce or encourage students to learn with the assistance of AI?
- ❑ Does AI really help?
- ❑ How can we know whether AI help?

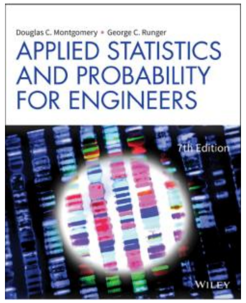
Let’s try and see…

- Motivation: Ubiquitous AI and stressful undergraduate study
- ChE 3104, LSU Engineering Measurement Lab
- Survey and Volunteer activities
- Observation and Conclusion

ChE 3104, LSU Engineering Measurement Lab

Two hour lecture:

- homework per lecture
- 6 quizzes
- 2 midterms
- I final

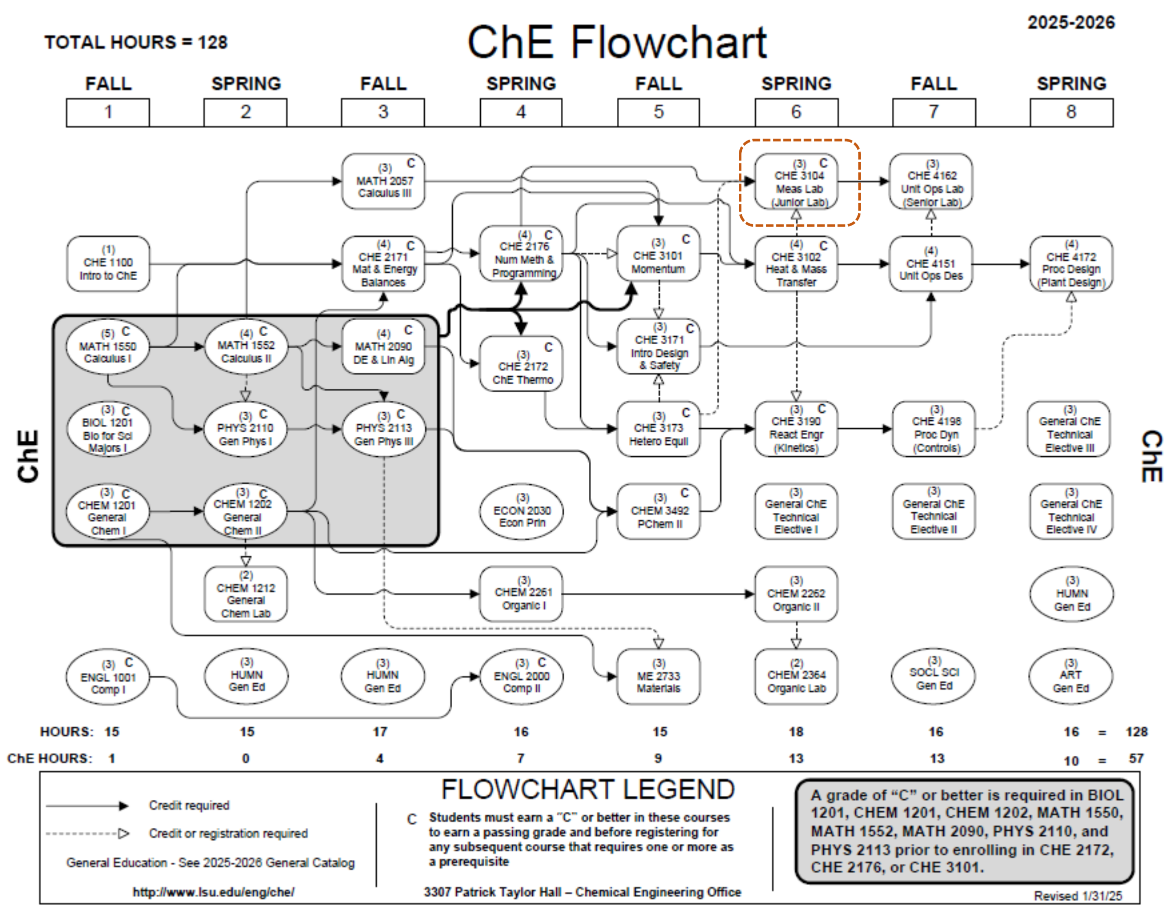


3 hour lab:

- 3 labs for each students;
- 4 weeks for one experiment;
  - 3 weeks for experiment
  - 1 week for presentation

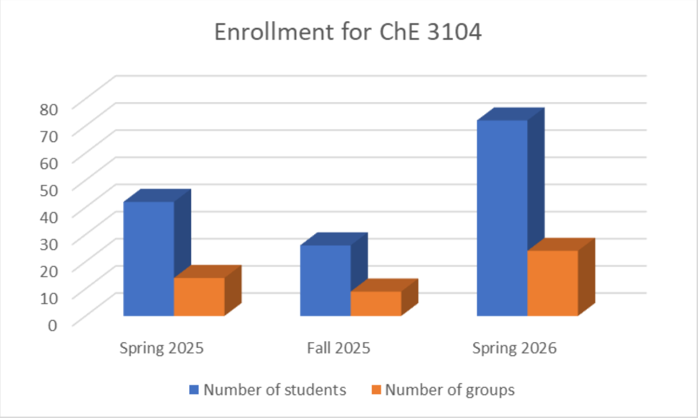
Lab deliveries:

- 1 project status outline per week during week 1 to 3
- 1 preliminary report at week 2
- 1 update report at week 3
- 1 written report at week 4
- 1 presentation at week 4
- 1 manual revision at week 4



ChE 3104, LSU Engineering Measurement Lab

- Six experiments are offered and randomly assigned to each student group
- Number of students enrolled changes by semester,



- Vapor-liquid equilibrium
- Heat Exchanger Network
- Pump Network
- Chiller
- Dryer
- Viscometer

CHE 3104 - Spring 2025

Laboratory Session Schedule

January 2025

Tuesday		Wednesday		Thursday	
14	WS	15	WS	16	WS
21	WS	22	WS	23	WS
28	Day 1	29	Day 1	30	Day 1

February 2025

Tuesday		Wednesday		Thursday	
4	Day 2	5	Day 2	6	Day 2
11	Day 3	12	Day 3	13	Day 3
18	Day 4	19	Day 4	20	Day 4
25	Day 1	26	Day 1	27	Day 1

March 2025

Tuesday		Wednesday		Thursday	
3	Mardi Gras	4	(no lab)	6	(no lab)
11	Day 2	12	Day 2	13	Day 2
18	Day 3	19	Day 3	20	Day 3
25	Day 4	26	Day 4	27	Day 4

April 2025

Tuesday		Wednesday		Thursday	
1	Spring Break	2	Spring Break	3	Spring Break
8	Day 1	9	Day 1	10	Day 1
15	Day 2	16	Day 2	17	Day 2
22	Day 3	23	Day 3	24	Day 3
29	Day 4	30	Day 4		

May 2025

Tuesday		Wednesday		Thursday	
				1	Day 4

Legend

- No laboratory session
- LSU holiday
- Workshop session ** incl. WS oral
- Laboratory session - Cycle 1
- Laboratory session - Cycle 2
- Laboratory session - Cycle 3

(SUBJECT TO CHANGE PENDING ADD / DROP DAY ADJUSTMENTS)

Tuesday groups (Sections 1-3)	Team Number	Team Member Assignments		
Acosta, Gavin Anthony	1	GL	WR	OR
Hymel, Sidney R		OR	GL	WR
Nyiam, Deborah N		WR	OR	GL
Aucoin, Zachary David	2	GL	WR	OR
Garrett, William Edward		OR	GL	WR
Reinhardt, Jacob Duggan		WR	OR	GL
Avant, Austin Gregory	3	GL	WR	OR
Mooney, John J		OR	GL	WR
Songy, Ethan A		WR	OR	GL
Sorrel, Lucas Taylor	4	GL	WR	OR
Stratton, Thomas A		OR	GL	WR
York, Mason		WR	OR	GL

Experiment Cycle 1	Experiment Cycle 2	Experiment Cycle 3
Heat exchanger (Griffin)	VLE (Sun)	Pump network (Balhoff)
Pump network (Balhoff)	Heat exchanger (Griffin)	VLE (Sun)
VLE (Sun)	Pump network (Balhoff)	Heat exchanger (Griffin)
Tray dryer (Griffin)	Viscometer (Sun)	Chiller (Balhoff)
Chiller (Balhoff)	Tray dryer (Griffin)	Viscometer (Sun)

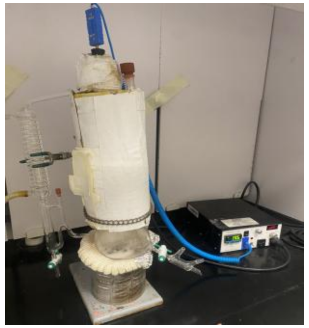
Wednesday groups (Sections 4-6)	Team Number	Team Member Assignments		
Brown, Leo Thomas	5	GL	WR	OR
Hanchey, Henry L		OR	GL	WR
Rikhoff, Cody Brandt		WR	OR	GL
Jenning, Trent Michael	6	GL	WR	OR
Nguyen, Timothy D		OR	GL	WR
Rikhoff, Cullen Brock		WR	OR	GL
Cromwell, Andrew Michael	7	GL	WR	OR
Larpenter, Matthew James		OR	GL	WR
Simon, Sarah Claire		WR	OR	GL
Fournier, Payton Katherine	8	GL	WR	OR
LeJeune-Bolivar, Isabella M		OR	GL	WR
White, Kayden		WR	OR	GL
Angers, Reagan	9	GL	WR	OR
Gernon, Patrick George III		OR	GL	WR
Punkay, Karleigh Ortego		WR	OR	GL

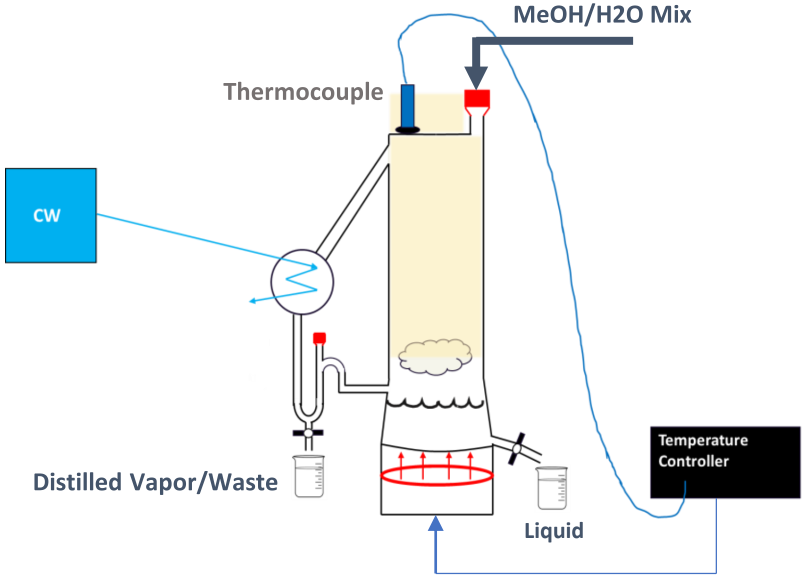
Experiment Cycle 1	Experiment Cycle 2	Experiment Cycle 3
Heat exchanger (Griffin)	VLE (Sun)	Pump network (Balhoff)
Pump network (Balhoff)	Heat exchanger (Griffin)	VLE (Sun)
VLE (Sun)	Pump network (Balhoff)	Heat exchanger (Griffin)
Tray dryer (Griffin)	Viscometer (Sun)	Chiller (Balhoff)
Viscometer (Sun)	Chiller (Balhoff)	Tray dryer (Griffin)

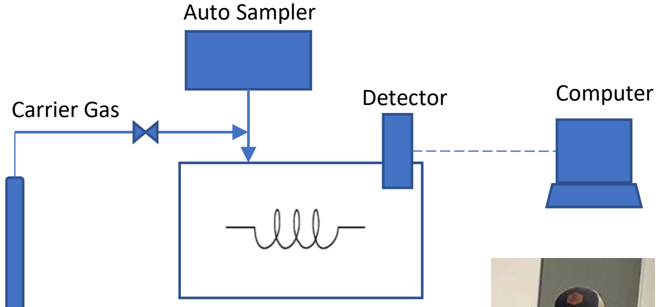
Thursday groups (Sections 7-9)	Team Number	Team Member Assignments		
Afenkhena, Edward Aina	10	GL	WR	OR
DeQueiroz, Alexis Aita		OR	GL	WR
Sutton, Jordan		WR	OR	GL
Cupit, Trevor Grayson	11	GL	WR	OR
Diaz, Abigail Elizabeth		OR	GL	WR
Perez, Pedro Alberto		WR	OR	GL
Bonilla, Gino Salvatore	12	GL	WR	OR
Gage, Gracie Kate		OR	GL	WR
Prejean, Nicole		WR	OR	GL
Bruni, Colton Luke	13	GL	WR	OR
Habib, Mohamad Emad		OR	GL	WR
Rome, Mason Paul		WR	OR	GL
Nemitt, Tyler R	14	GL	WR	OR
Miller, Taylor Nicole		OR	GL	WR
Roppolo, Mia		WR	OR	GL

Experiment Cycle 1	Experiment Cycle 2	Experiment Cycle 3
Heat exchanger (Griffin)	VLE (Sun)	Pump network (Balhoff)
Pump network (Balhoff)	Heat exchanger (Griffin)	VLE (Sun)
VLE (Sun)	Pump network (Balhoff)	Heat exchanger (Griffin)
Tray dryer (Griffin)	Viscometer (Sun)	Chiller (Balhoff)
Chiller (Balhoff)	Tray dryer (Griffin)	Viscometer (Sun)
Viscometer (Sun)	Chiller (Balhoff)	Tray dryer (Griffin)

ChE 3104, LSU Engineering Measurement Lab --- VLE







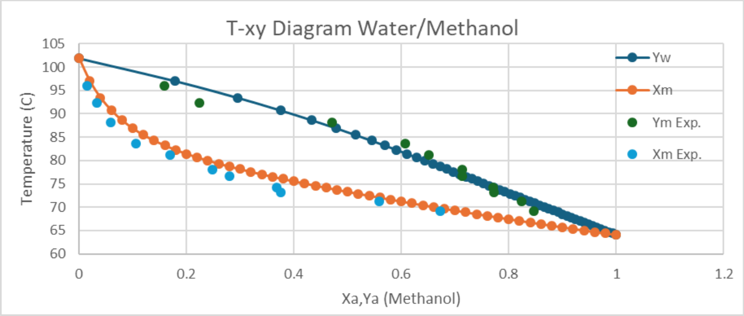
Assignment:

- GC calibration
- Equilibrium data
- Two-suffix Margules Coefficients
- Comparation with literature data

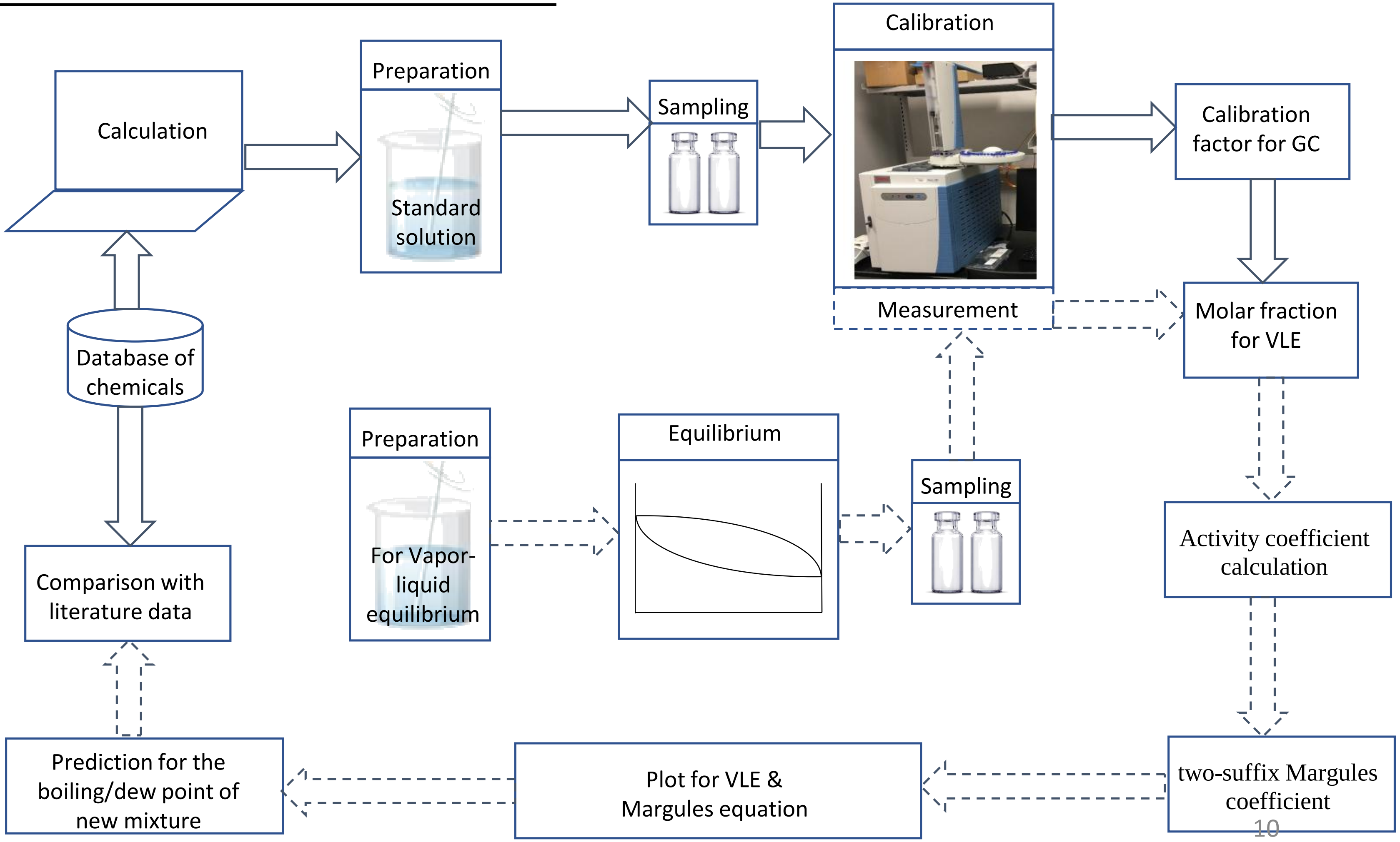
LSU College of Engineering
Cain Department of Chemical Engineering

ChE 3104, LSU Engineering Measurement Lab --- VLE

- ❖ Standard liquid mixture for GC calibration



- ❖ Equilibrium data collection at different temperature



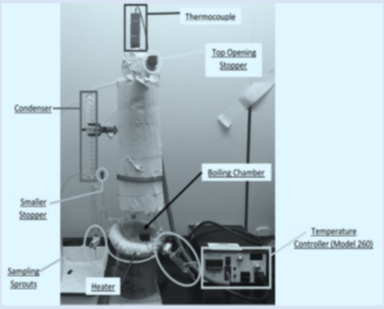
ChE 3104, LSU Engineering Measurement Lab --- VLE

To prepare

- Theories behind
  - Vapor liquid equilibrium
  - Distillation
- Fundamental data to know
  - Components to study
  - Physical properties for each component
    - Density
    - Molar mass
    - Boiling point/dew point
    - Azeotropic point
- Numbers to calculate before the experiment
  - Volume for each component based on the expected molar ratio
- Apparatus
  - Unit
  - Gas Chromatograph(GC)
- What and how to measure
  - measuring device
  - GC
- Safety protocol
  - Glove
  - Fume hood
  - mask

To implement

- Procedure
  - Mixture preparation
  - Start up
  - Establish the equilibria
  - Shut down
- Measurements
  - Temperature
  - Molar ratio from GC
- Data record
  - Table
- Problems exist



implementation

To analysis and summarize

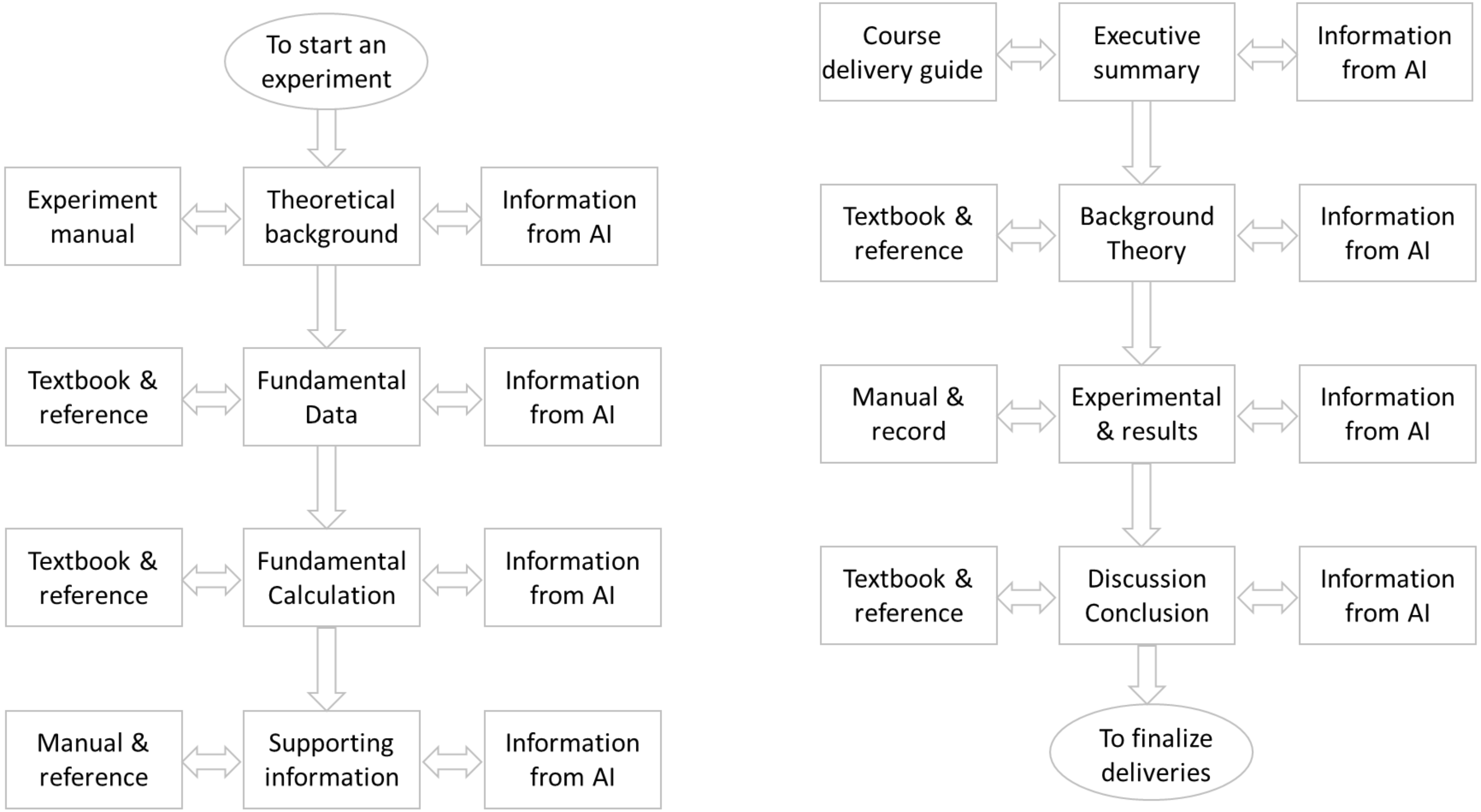
- Data summary
  - From literature
  - From pre-calculation
  - From measurements
- Data analysis
  - Data validation
  - Curve fitting
  - Result validation
- Knowledge revisit
- Conclusion
- Suggestions for next session
- Deliveries and report

To use AI

- Concept
  - Equilibrium
  - Physical property
- User guide
  - GC
  - Curve fitting and error statistics
- Others
  - Safety information

ChE 3104, LSU Engineering Measurement Lab --- VLE

AI for preparation by question and answer



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Survey and Volunteer activities

Category 1: Basic Understanding

VLE Fundamentals and Othmer Still Use

- What skills should students master after a VLE lab?
  Students should be able to measure and analyze how the compositions of vapor and liquid phases change at equilibrium for mixtures, understand the use of lab apparatus such as the Othmer still, and perform data analysis including GC calibration and error checks.[1][2]

- "If you had to describe vapor-liquid equilibrium to a friend, what would you say?"
  Vapor-liquid equilibrium means the point at which both vapor and liquid phases of a mixture coexist stably at a set temperature and pressure, and their compositions no longer change over time.[3][4]

- "Ever used an Othmer still? What does it do?"
  The Othmer still enables separation and analysis of binary liquid-vapor mixtures by repeated condensation and reflux cycles, helping keep the system at total reflux for equilibrium studies.[5][1]

- "How would you explain the working principle behind the Othmer still?"
  You heat a liquid mixture until it boils, then the vapor condenses and cycles back into the boiling flask, ensuring the vapor and liquid phases repeatedly mix and align their compositions before you sample them.[1][5]

Survey and Volunteer activities

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Gas Chromatography Basics and Data Handling

- "What does GC stand for in the lab?"
  GC stands for Gas Chromatography, a technique used to separate and analyze volatile compounds in your samples.[1]
- "If you see a GC output plot, how do you match peaks to components?"
  Identify each component by running pure standards; the peak with the earliest retention time is usually the compound with the lowest boiling point (in methanol-water, methanol elutes before water).[2][1]
- "Which comes out first in GC: methanol or water?"
  Methanol's peak appears first since it travels faster in the GC due to its lower boiling point.[1]
- "How does the GC distinguish different chemicals?"
  The GC separates mixture components by how quickly they pass through a column; their speed depends on boiling points and their interaction with the column's coating.[2][1]
- "What is the purpose of running a GC test?"
  GC measures the relative concentrations of different volatile substances in your vapor and liquid samples.[2][1]

Survey and Volunteer activities

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Category 2: Practical Knowledge

- **Othmer Still Components & Sampling Choices**
- "What makes up an Othmer still, and why?"
  Key parts: boiling chamber (heating), condenser (cooling vapor), reflux return (ensures equilibrium), sampling ports (for collecting phase samples). Each part ensures equilibrium and lets you sample both vapor and liquid.[2]
- "Why choose a methanol-water binary mix?"
  The methanol-water system is a textbook example because its components' volatility differences make equilibrium data more pronounced and easier to analyze for educational experiments.[2]
- "What's the point of cycling vapor and liquid in the still?"
  Repeated cycling allows the vapor and liquid compositions to gradually adjust and reach equilibrium for accurate VLE measurement.[1][2]

Survey and Volunteer activities

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Data Reliability, Sampling, and Error Checking

- "How do you spot unreliable or contaminated GC results?"
  ıconsistent retention times, or irregular baselines may indicate
  ıipment error. Re-run pure standards and compare.[1][2]

  GC response factor consistency?"
  ntrations; consistency in their

  ıe system stabilizes to collect

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Data Reliability, Sampling, and Error Checking

- "How do you spot unreliable or contaminated GC results?"
Unexpected peaks, inconsistent retention times, or irregular baselines may … contamination or equipment error. Re-run pure standards and compare.[1][2]
- "How do you verify GC response factor consistency?"
Prepare and run several standard solutions at different concentrations; cons… response factors suggests reliable calibration.[1]
- "How do you take samples from vapor or liquid phases?"
Use designated sampling ports in the apparatus right after the system stabilizes to collect small amounts of each phase for GC analysis.[2]

Category 3: Theory, Laws, and Calculations

- "Which scientific laws are essential for your VLE equilibrium calculations/graphs?"
Raoult's Law (for ideal binary mixing), Dalton's Law (partial pressures), and definitions from thermodynamics (activit…
- "How is linear regression used…
Linear regression fits your exp… estimates. Compute by least sq…
- "What counts as a "good fit" i…
A good fit is indicated by sma… points follow the predicted tre… …nol elutes

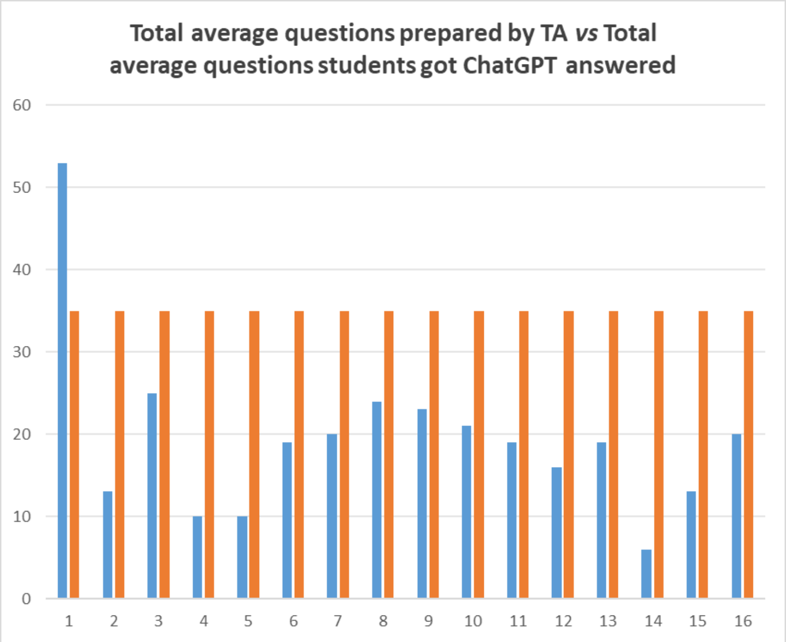
Experimental Choices and Mixing Decisions

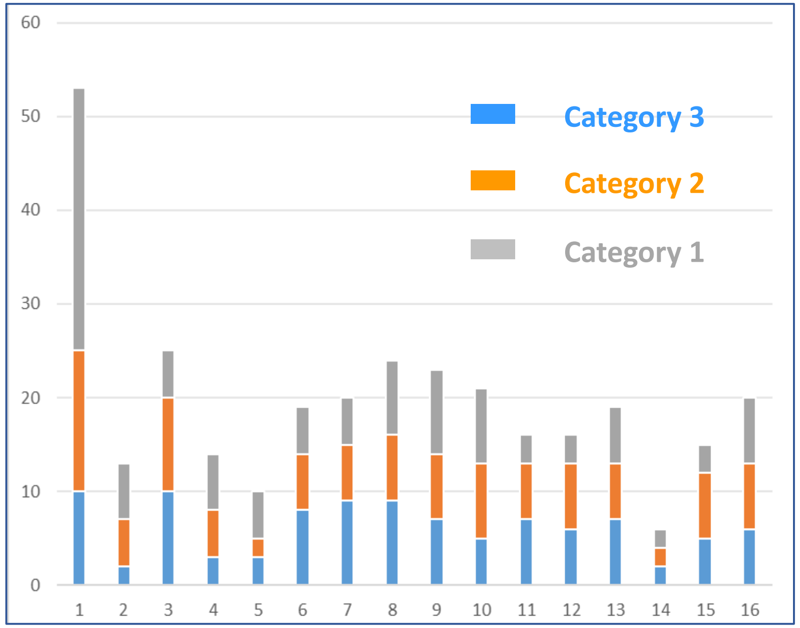
- "Why a 90/10 molar ratio instead of by volume?"
Mole ratio is chosen bec… and match theoretical m…
- "Will mixing methanol…
There can be a slight vo… especially because the i… mixtures.[3][2]
- "Do you add methanol t…
Usually, methanol is ad… release or splashing.[2]
- "Are we assuming ideal…
Often initial calculation… coefficients or Margules…
- "How do equilibrium co… mixtures?"
The equilibrium compos… pressure, then analyzed… liquid.[1][2]

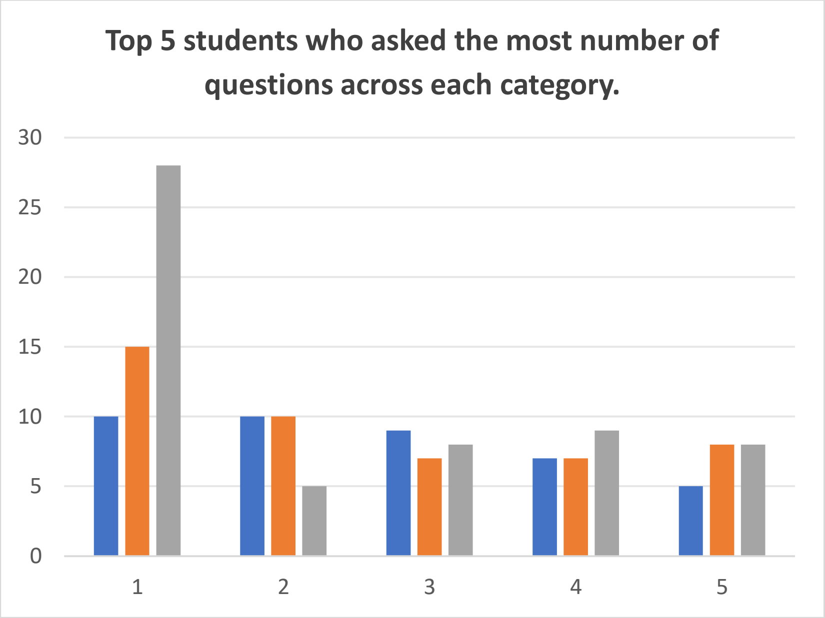
Standard Solutions, Peak Assignment, and Data Choice

- "Best way to prepare a GC calibration standard?"
Accurately weigh or pipette components, dilute to a known volume, and mix thoroughly before analysis.[2]
- "How to decide which GC peak is which?"
Run pure standards first, then match their retention times to the peaks in your sample runs.[2]
- "Why use mole fraction over weight or volume fractions?"
Mole fraction allows direct use in equilibrium models and thermodynamic formulas, which require molecules counts, not volume or mass.[3][2]
- "Explain "activity coefficient" simply."
Activity coefficient measures how far a real mixture's behavior deviates from the ideal case, influencing phase equilibrium.[3]
- "Physical meaning of Margules coefficients?"
Margules coefficients quantify how strongly two substances in a binary mixture deviate from ideal mixing, affecting the activity coefficient.[3]
- "Common sources of composition measurement error?"
Sample contamination, temperature fluctuations, incomplete equilibrium, or instrumental calibration drift.[1][2]
- "How do temperature fluctuations affect equilibrium?"
They change the volatility and equilibrium compositions, introducing error into your measurements.[5][3]
- "Correct experimental data for non-ideal behavior?"
Use activity coefficients and models such as Margules or van Laar to correct experimental data for observed non-idealities.[3]
- "How do you know if the system reached equilibrium?"
The boiling temperature should stop drifting and repeated measurements should give the same results for both phases.[5][2]

Survey and Volunteer activities

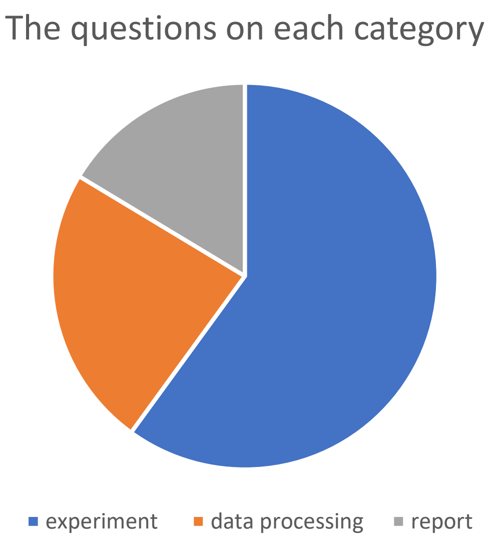




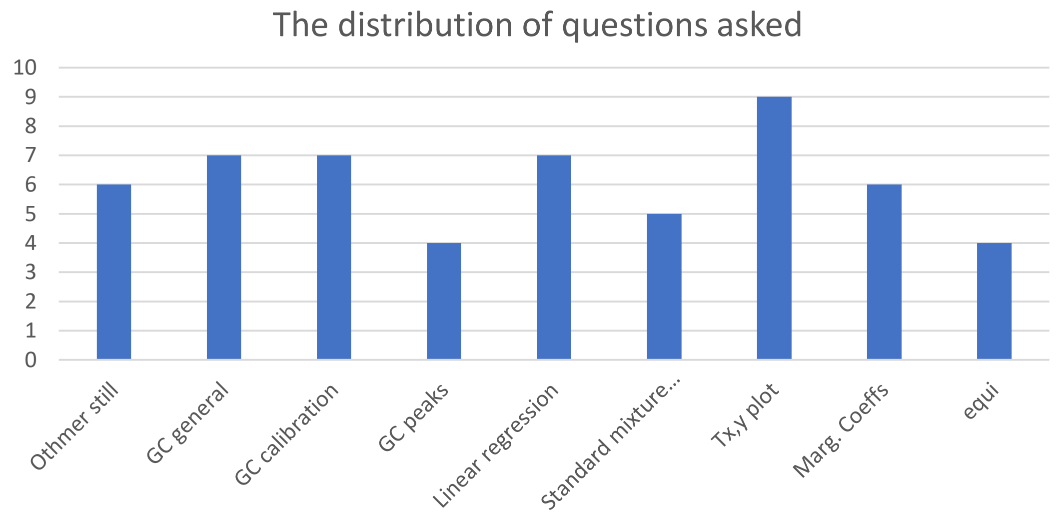


Questions in each category asked by different students

Survey and Volunteer activities



More questions in preparation stage



Equipment, operation and reporting

- Motivation: Ubiquitous AI and stressful undergraduate study
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Observations and Conclusions

More questions *vs* **Better performance**

One group leader prepared herself and her team very well with ChatGPT

im doing a VLE experiment in my junior lab for chemical engineering using an othmer still and GC to integrate. I've watched youtube videos but can you explain to be how it works and what equations i may need and anything else important you think ill need to know?

1. How the Othmer Still Works

The Othmer still is a **simple batch distillation apparatus** used to measure **vapor–liquid equilibrium (VLE)** data for binary (sometimes ternary) mixtures.

- **Basic setup:**
  - You charge the still with a known liquid composition.
  - Heat brings the mixture to boiling.
  - Vapor rises and is condensed.
  - A portion of condensate is returned (reflux) to maintain equilibrium, while another portion is withdrawn for sampling.
  - You can sample both the **vapor condensate** and the **liquid phase** inside the still.
- **Key idea:** After equilibrium is established, the liquid in the boiling pot and the vapor leaving the system represent one data point on the VLE curve:

2. Where the GC Fits In

The **gas chromatograph** (GC) is used to determine the **composition of each phase** by separating the components and integrating peak areas.

- The **area under each peak** is proportional to the molar amount of that species.
- A **response factor** (RF) is needed if detector sensitivity differs between species.

Equation for mole fraction from GC data:

3. Equations You'll Likely Need

Here are the key ones that usually come up in a junior VLE lab:

a) Raoult's Law (ideal mixtures)

$$y_i P = x_i P_i^{sat}(T)$$

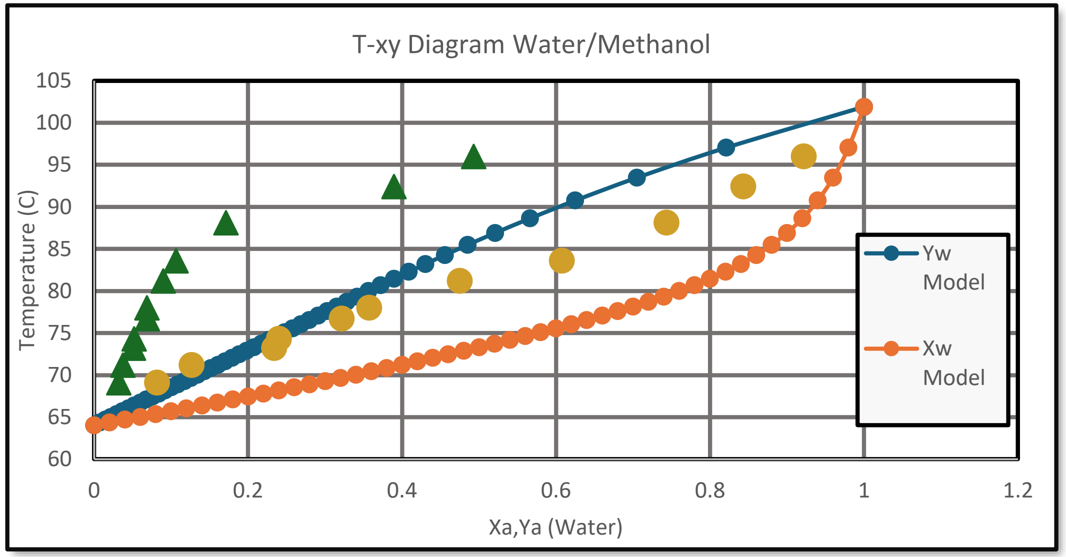
where

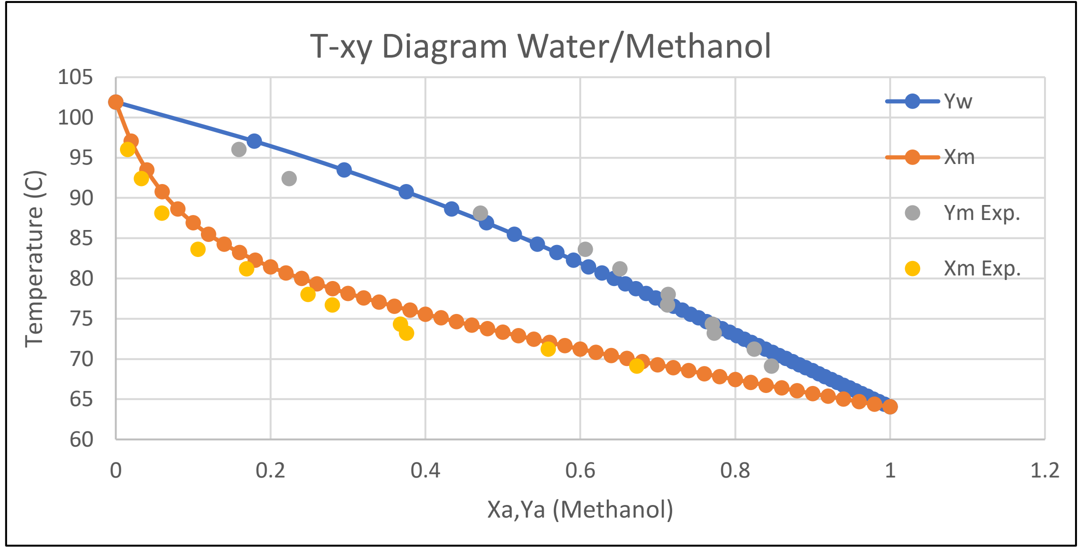
- y_i = vapor mole fraction
- x_i = liquid mole fraction
- P = total system pressure (usually 1 atm in Othmer still)
- $P_i^{sat}(T)$ = vapor pressure of pure component i at temperature T (from Antoine equation)

Observations and Conclusions

More questions *vs* Better performance

Other group leader asked significant number of questions, but made a terrible mistake





Observations and Conclusions

A two-member group only asked total six questions and did a very good job.

Based on the study on the calculation result and further investigation, the group addressed as following:

By taking the calculated activity coefficients from Equation 1, the Margules Coefficient can be solved in the Two-Suffix Margules Equation (Equation 3). After proceeding with these calculations, asymmetrical behavior was observed. It was then decided that calculating the Margules Coefficients for the Three-Suffix Margules Equation could depict the behavior of the mixture more accurately (Equation 4).

Observations and Conclusions

1. It is always good to start and ask --- with the help of AI, well established scientific and engineering questions can be properly answered.
2. A guide can be provided for specific questions, instead of the exact answers.
3. AI can help, but may not be able to learn for students.
4. The acceptance for new tool is different by persons.
5. More samples needed to have a solid conclusion.

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