

Mar 6th, 10:15 AM - 11:00 AM

Can Computational Thinking Predict Academic Performance?

Rami Haddad

Georgia Southern University, rhaddad@georgiasouthern.edu

Youakim Kalaani

Georgia Southern University, yalkalaani@georgiasouthern.edu

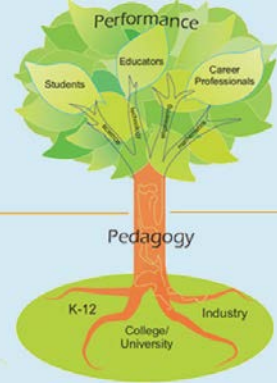
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Can Computational Thinking Predict Academic Performance?

Dr. Rami Haddad, Dr. Youakim Kalaani

Department of Electrical Engineering

Georgia Southern University

Outline

- Motivation
- What is Computational Thinking?
- Computational Thinking Misconceptions
- Problem Solving vs. Computational Thinking
- Proposed Hypothesis
- Study and Results
- Conclusion

Motivation



We do not acquire technical skills simply from the use of technology any more than engineering skills evolve from using automobiles or aeronautical engineering skills from flying.



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Robert Tinker, Alvaro Galvis, and Andrew Zucker

The Concord Consortium

What is Computational Thinking?

- Computational Thinking is a fundamental analytical skill that everyone can use to help solve problems, design systems, and understand human behavior.



Modeling a problem involves:

- formulating the problem,
- defining its inputs and outputs,
- dividing it into its basic components using Computational Thinking modalities.

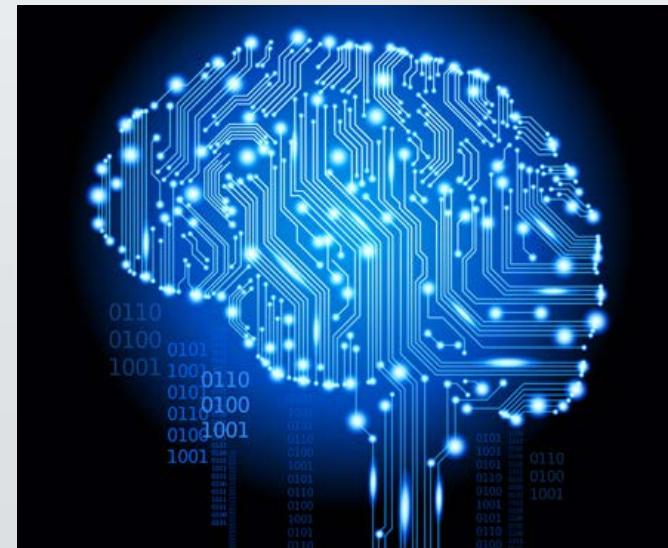


Computational Thinking Misconception

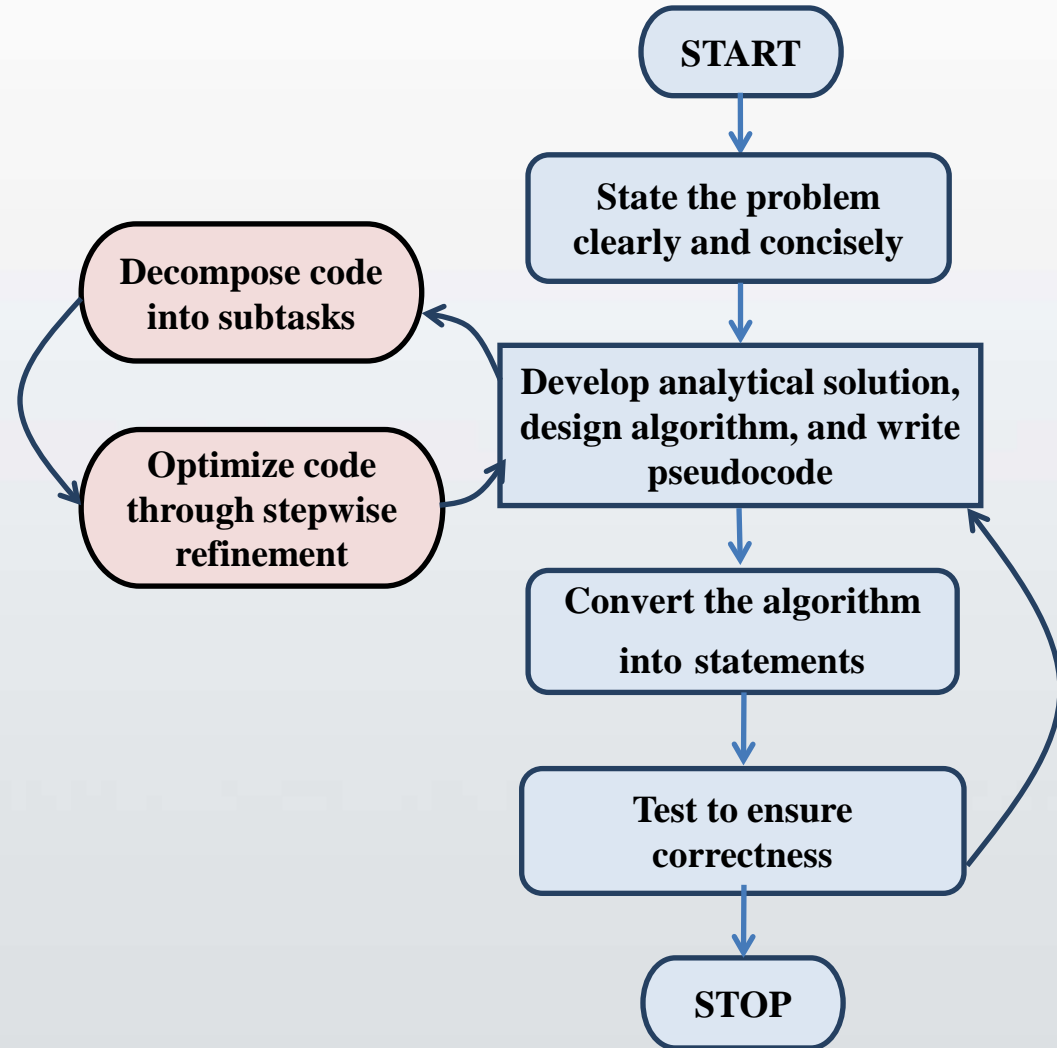
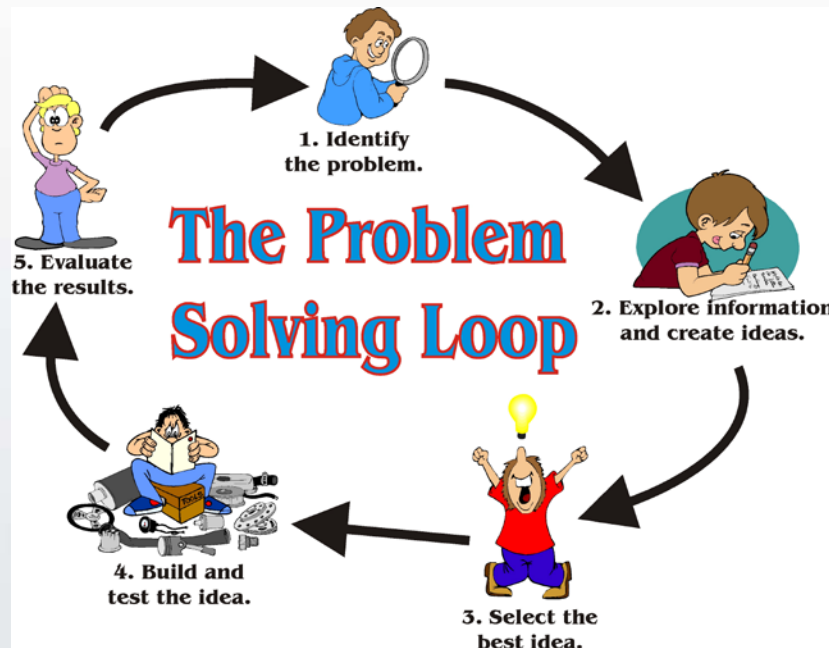
- It's not just more technical details for using software.
- It's not thinking like a computer.
- It's not programming (necessarily).
- It doesn't always require a computer.



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Problem Solving vs. Computational Thinking



Proposed Hypothesis

If engineering is very dependent on creative problem solving and Computational Thinking is a structured process that facilitates this, therefore, Computational Thinking is a vital skill set for engineers which can help predict the future success of engineering students.



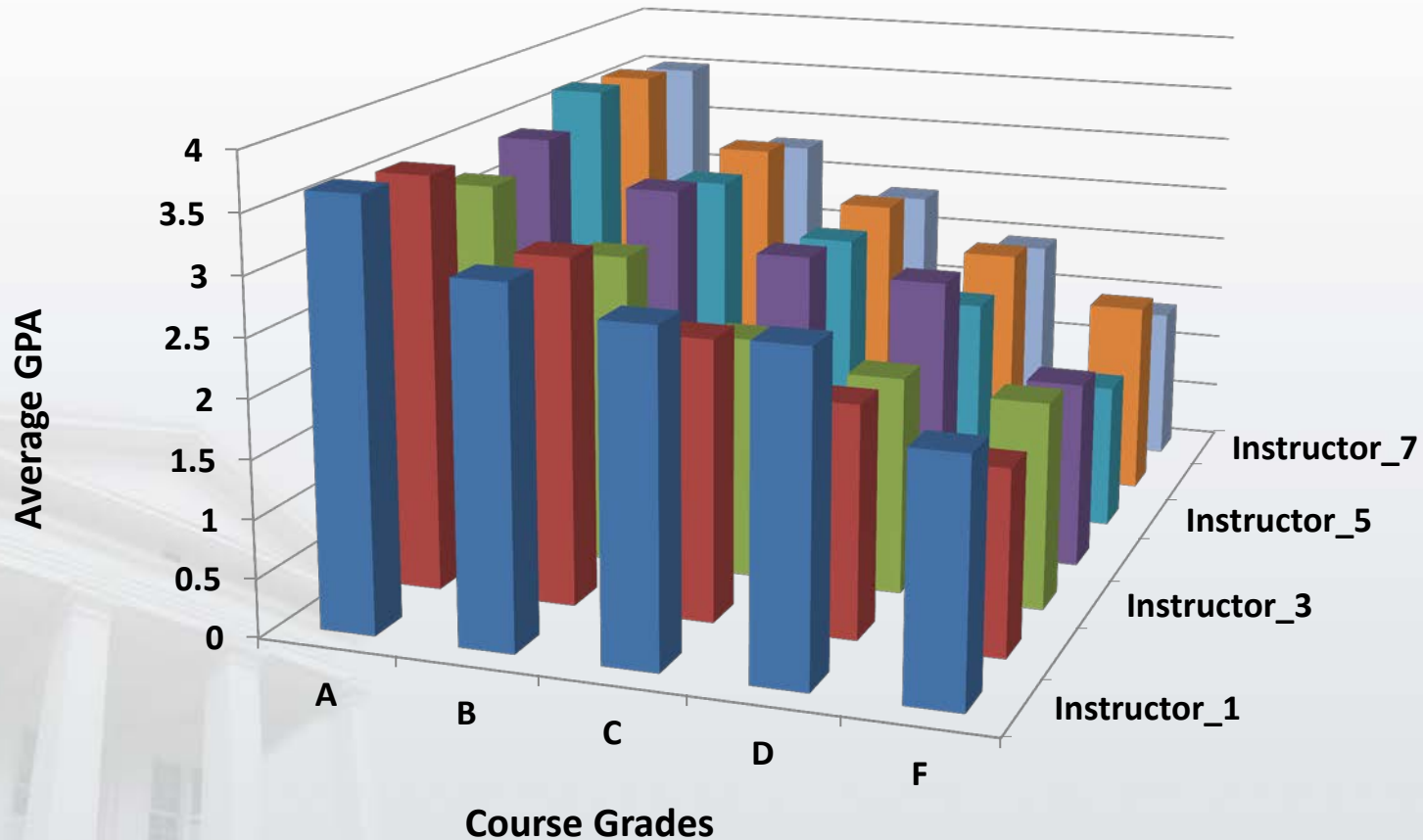
Study Details

To test our hypothesis,

- a quantitative analysis was conducted in over 40 different sections of this Computing for Engineers course offered between Fall 2012 and Spring 2014.
- Our sample consisted of 982 students (15% Civil, 50% Mechanical, 25% Electrical, and 10% from other Engineering disciplines)

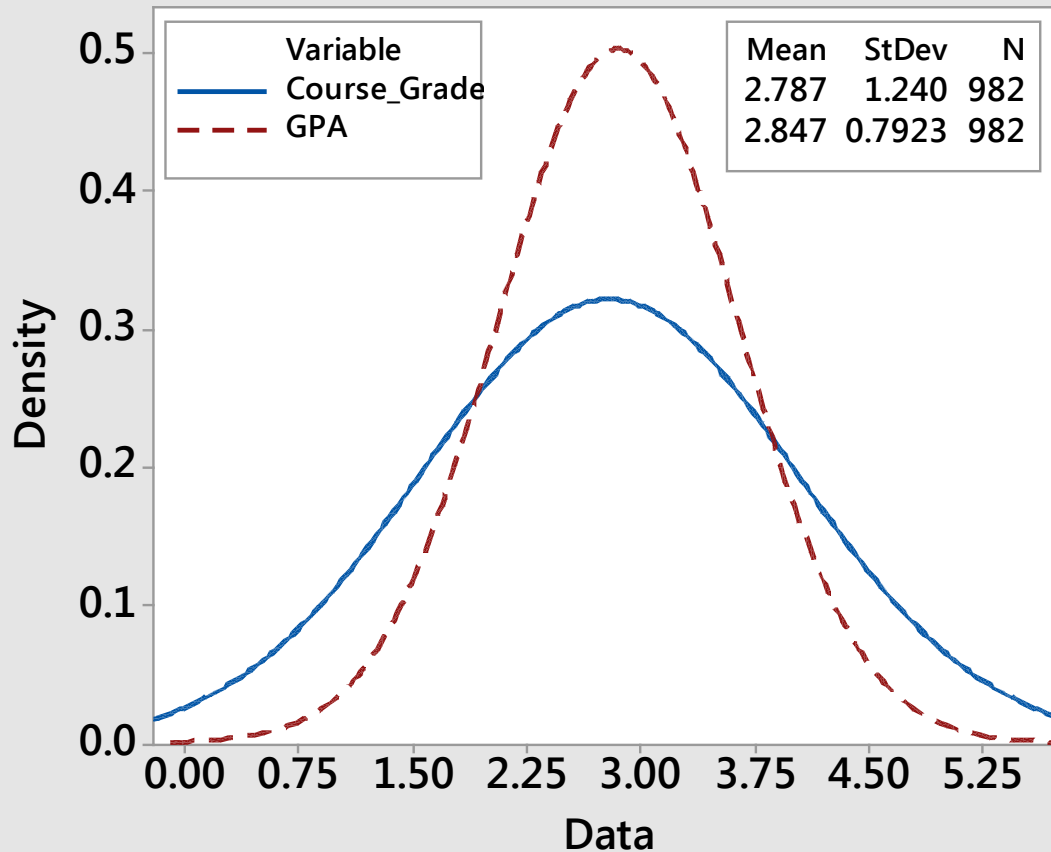


Overall GPA of Students vs. CT Grades & Instructor



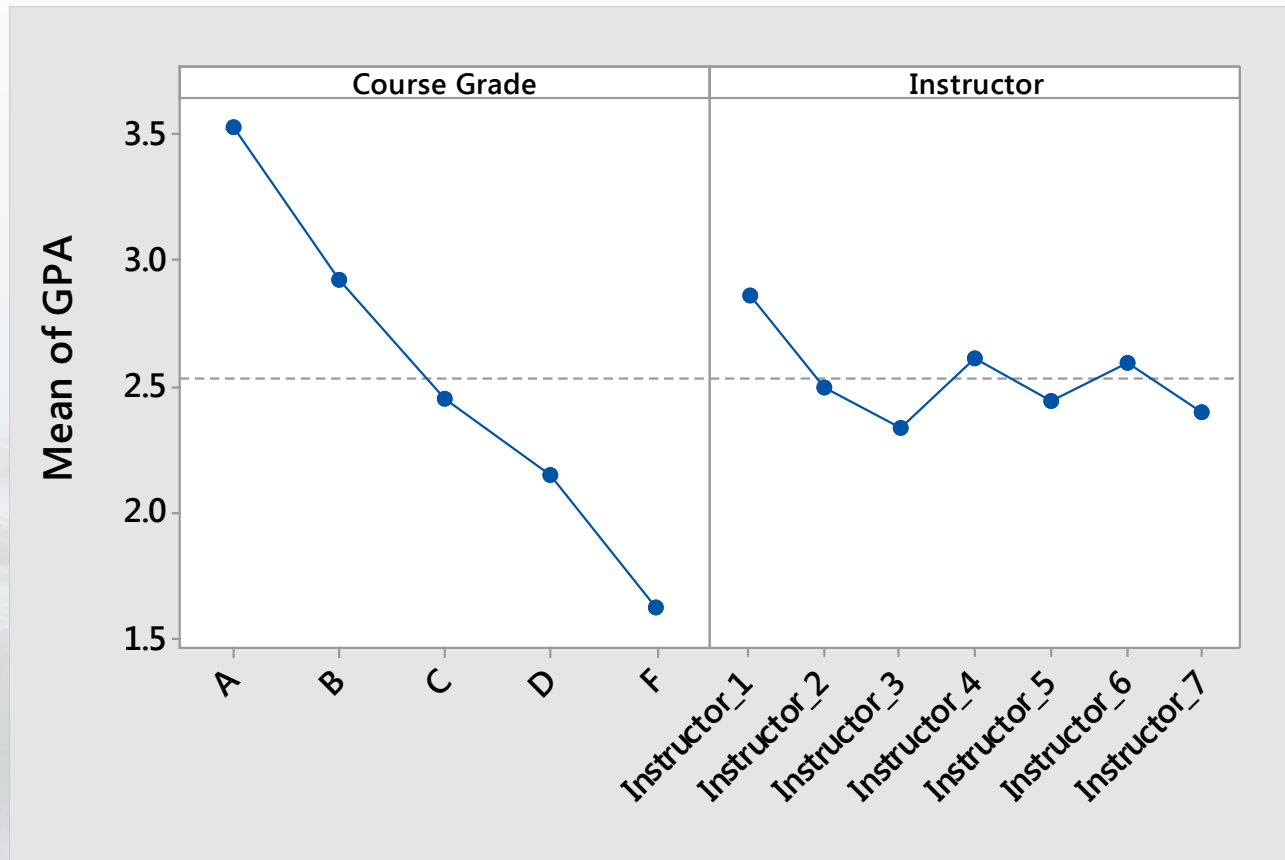
Academic success of students, as represented by their average GPA, correlates with their CT performance.

Normal Fit of Data



**Students' overall GPA & CT grades
have the same mean.**

Main Factors Effects



Statistical Analysis Results

General Linear Model: GPA versus Course Grade, Instructor

Method

Factor Information

Factor	Type	Levels	Values
Course Grade	Fixed	5	A, B, C, D, F
Instructor	Fixed	7	Instructor_1, Instructor_2, Instructor_3, Instructor_4, Instructor_5, Instructor_6, Instructor_7

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Course Grade	4	14.7863	3.69657	139.60	0.000
Instructor	6	0.8987	0.14978	5.66	0.001
Error	24	0.6355	0.02648		
Total	34	16.3205			

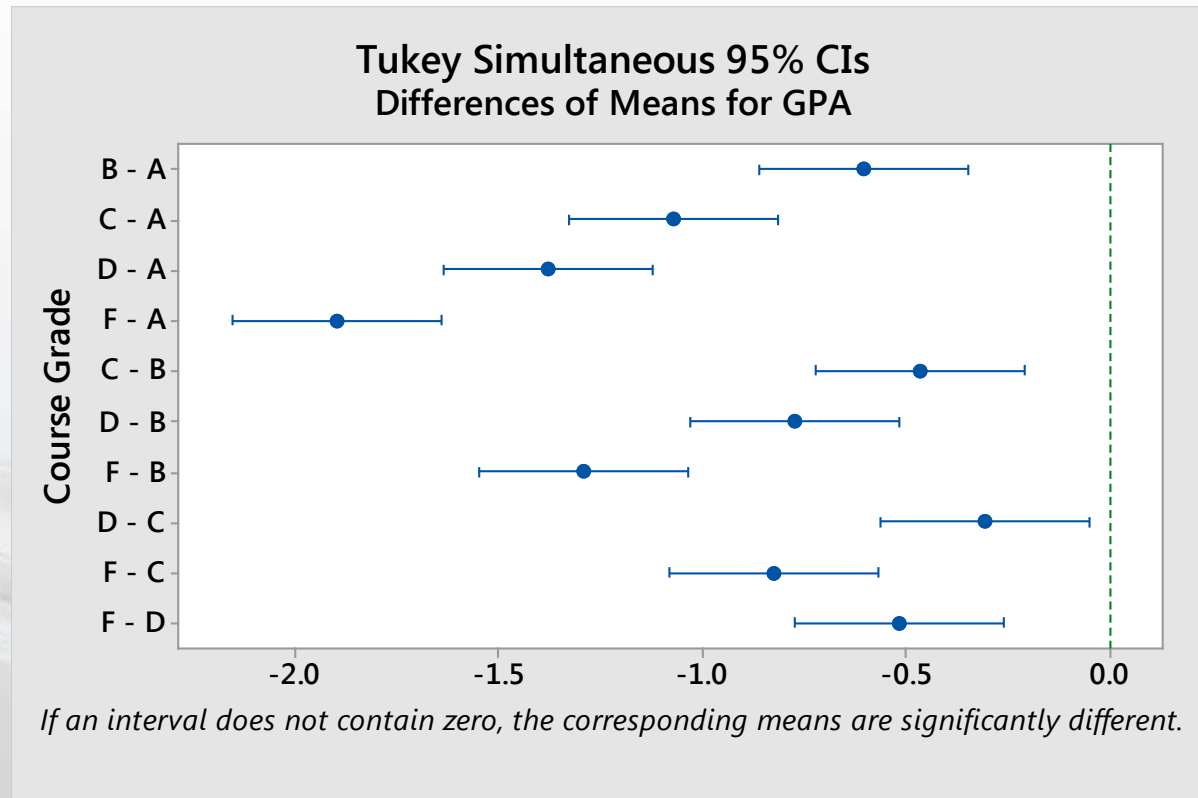
Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.162723	96.11%	94.48%	91.72%

We achieved statistical significance with a confidence level of **99.9%**

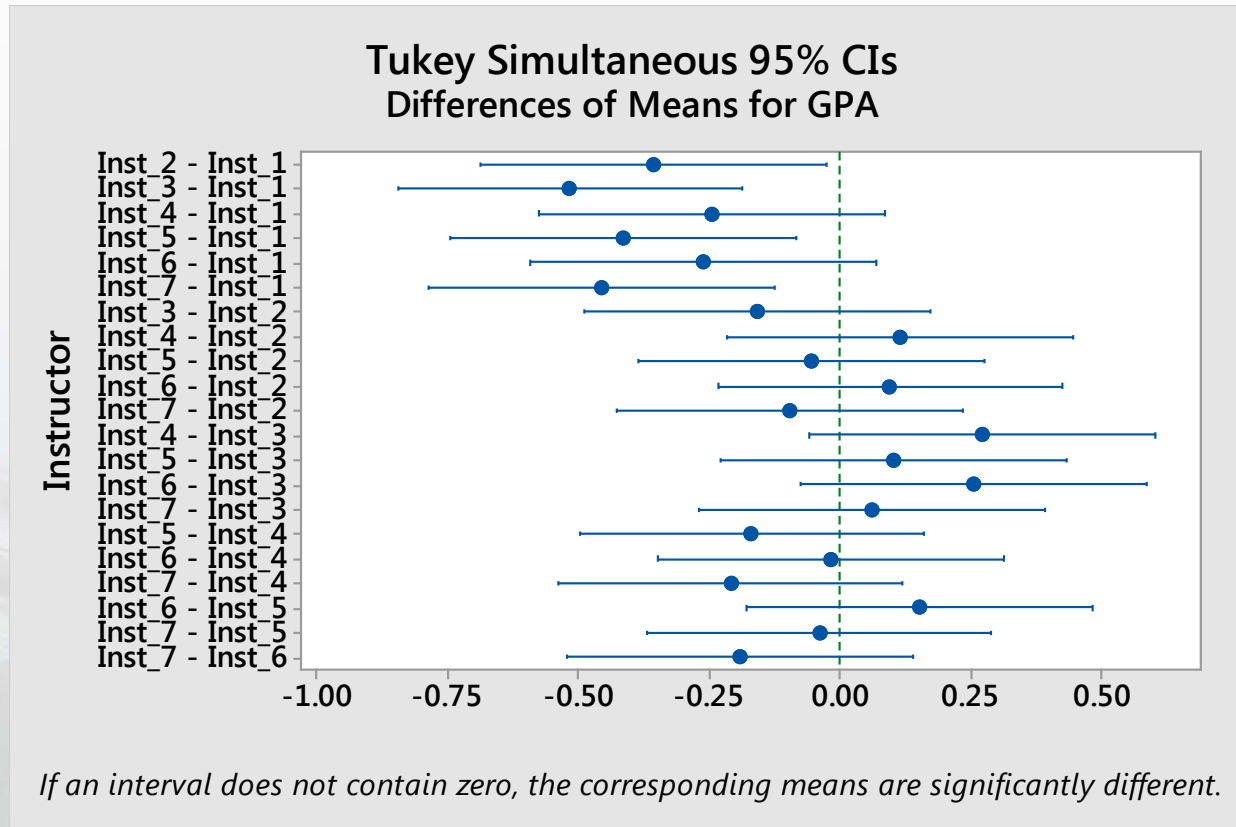


Pairwise Comparisons - Course Grades

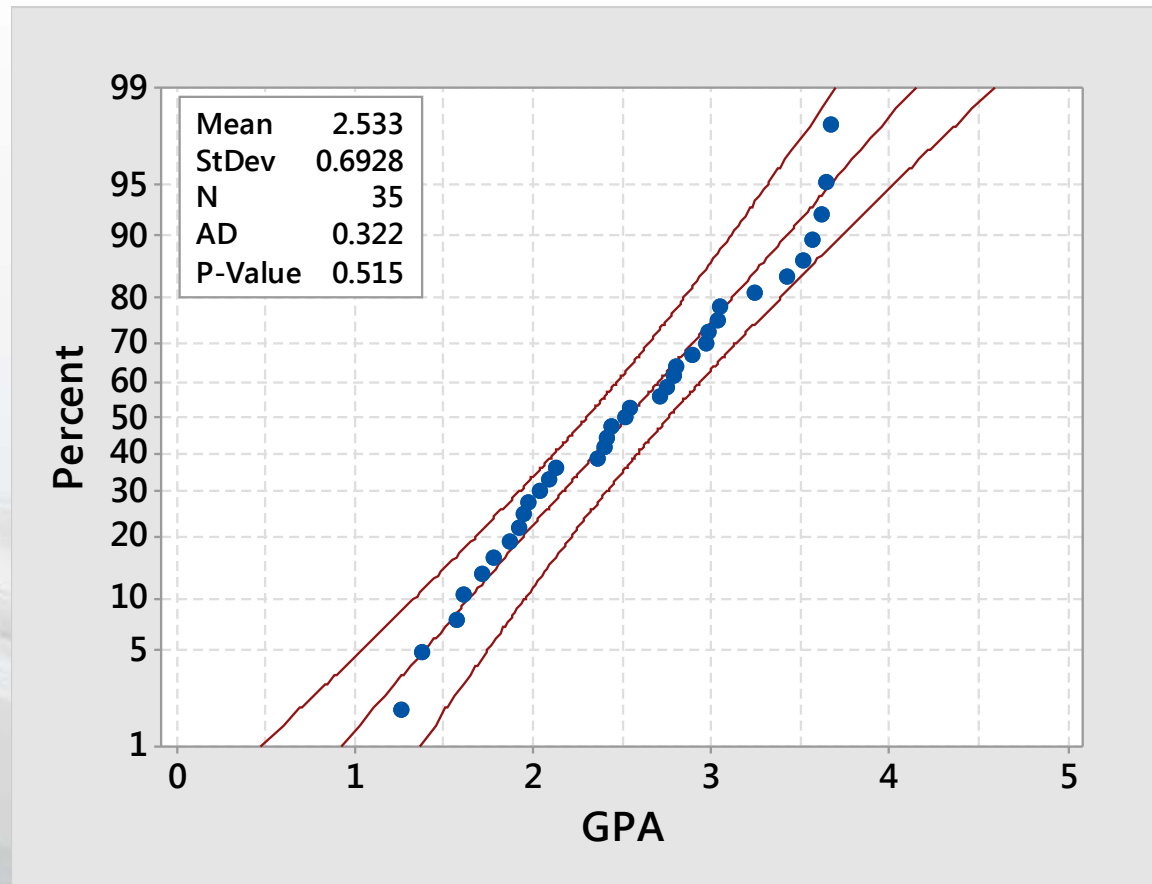


Engineering students' academic achievement represented by their average GPA can be predicted based on their performance in this course

Pairwise Comparisons - Instructors



Data Goodness-of-Fit



Conclusion

- The notion of predicting academic performance using Computational Thinking skills was presented.
- Performance in Computational Thinking freshman courses can predict the student future academic success.
- We concluded that is statistical difference in the overall students' GPA based on their CT grades with over 99.9% confidence level.
- Finally, assessment of CT can be used as an early intervention indicator to increase the students' retention, progression, and graduation rates.



Questions?

