

## CUE-T: EducateAI: Revolutionizing Business Curricula by Incorporating Computational Logic with Generative AI Tools

### Overview

The overarching objective of this project's is to addresses the critical need for cultivating computing and logical communication skills among business students by developing and integrating the *Business AI ChatBot (BI-Bot)*, a cloud-based, Generative AI-powered educational tool, into the business core curriculum. The aim is to transform students' computing mindset through a structured pathway: *natural domain language (ex ante) → structured mindset → computing logic → code or worksheet (ex post)*. By enhancing computational literacy, the project seeks to improve employability, foster critical thinking, and ensure equitable access to advanced AI-driven learning tools, particularly for underrepresented and underserved student populations.

The initiative will be piloted with *Financial Management (FM)* courses, which are mandatory for all business students. Following successful implementation, the platform can be expanded to other courses such as *Money and Banking* and *Financial Data Analytics*. Unlike traditional methods, *BI-Bot* provides interactive logical guidance rather than direct answers, fostering deep understanding, cultivating computing mindset and enhancing problem-solving skills.

Rigorous tests will be conducted at three collaborating institutions: the University of Arkansas, Tuskegee University, and McNeese State University. This multi-institutional approach ensures *BI-Bot*'s scalability, adaptability, and effectiveness across diverse educational settings. Incorporating feedback from these institutions, the project aims to meet the needs of a wide range of students, particularly those from underrepresented and underserved groups, ensuring equitable access to advanced AI-driven learning tools. The team is committed to serving at least 100 undergraduate students from underserved and disadvantaged populations and conducting a workshop targeted at minority faculty.

This initiative aligns with the goals of NSF 24-553 by re-envisioning computing education and broadening participation. It also supports the objectives of NSF 24-025: EducateAI by preparing an AI-ready workforce in business schools, educating students in computational logic, and enhancing their ability to communicate effectively with computing systems through the AI tool.

### Intellectual Merit

This project integrates computational literacy into business education, bridging the gap between business and computing. The *Business AI ChatBot (BI-Bot)* offers several key advantages:

1. **Accessibility:** The *BI-Bot* provides students with continuous access to learning resources, ensuring they can study and practice computational skills anytime, anywhere.
2. **Frontier Technology:** Utilizing the latest OpenAI API, the *BI-Bot* leverages state-of-the-art AI capabilities to deliver a adaptive, interactive learning experience.
3. **Scalability:** Hosted on cloud services, the *BI-Bot* is designed to scale easily, accommodating a growing number of users and institutions without compromising performance.
4. **Traceability:** The chat history data allows for tracking student progress and provides a valuable resource for future research aimed at improving computing education.
5. **Future Extensions:** The *BI-Bot*'s framework can be extended to other fields by developing additional knowledge bases (KBs) in various domains.

### Broader Impacts

The *BI-Bot* will be deployed across the collaborating institutions to ensure equitable access for students from diverse backgrounds, especially underserved populations. Key impacts include enhanced employability and workforce readiness through improved computational literacy and problem-solving skills. Extensive data collection from anonymized chat histories will provide valuable insights for educational research. The *BI-Bot*'s scalable and adaptable design allows for expansion to other disciplines and institutions, creating a versatile educational model. Additionally, the project will generate ancillary educational products, promote outreach and community engagement through workshops and hackathons, and offer professional development for educators. Insights from this project will inform educational policy and practice, advocating for the integration of AI and computational thinking into business education, thereby contributing to a more equitable and innovative computing education. The team also plans to initiate *AI for Business Center* in the future.

# **CUE-T: EducateAI: Revolutionizing Business Curricula by Incorporating Computational Logic with Generative AI Tools**

## **1 Background and Rationale**

The overarching objective of this project's is to addresses the critical need for cultivating computing and logical communication skills among business students by developing and integrating the *Business AI ChatBot (BI-Bot)*, a cloud-based, Generative AI-powered educational tool, into the business core curriculum. The aim is to transform students' computing mindset through a structured pathway: *natural domain language (ex ante) → structured mindset → computing logic → code or worksheet (ex post)*. By enhancing computational literacy, the project seeks to improve employability, foster critical thinking, and ensure equitable access to advanced AI-driven learning tools, particularly for underrepresented and underserved student populations.

In today's business landscape, the necessity for computing skills among business students is more critical than ever. A study by the Federal Reserve Bank of Atlanta revealed that 92% of job postings in 2021 required digital skills, with nearly half demanding advanced digital competencies ([1]). This highlights the pervasive need for digital literacy across all job markets, emphasizing the importance of integrating computing skills into business education.

Insights from the team, two business school deans, two department chairs, and a founding faculty member of a data analytics for business program, reveal a consistent struggle among business students. These students often feel unprepared due to a lack of opportunities and appropriate methodologies to acquire necessary computing skills. This struggle highlights the need for a reformed educational framework to better prepare students for future demands.

Despite this clear demand, the United States lags behind other nations in mandating computer science education. Unlike countries such as Korea, Japan, China, Australia, and England, the U.S. has not implemented national computer science mandates ([2]). This lack of a national requirement places U.S. students at a disadvantage, impacting their competitiveness in the global job market.

The issue is even more pronounced for underserved and disadvantaged student populations. Historic underinvestment and structural inequities have resulted in a significant portion of the U.S. workforce lacking foundational digital skills. About one-third of workers do not possess the digital skills needed to thrive in today's job market ([3]). Addressing this digital skill divide could generate substantial economic benefits for businesses, workers, and the broader economy. This gap in digital literacy underscores the urgent need for public investment to prepare a workforce capable of meeting modern technological demands.

Traditional methods of teaching technology are also proving inadequate. These methodologies are not conducive to retaining students, indicating a pressing need for modernized, engaging, and interactive approaches. The same problem is presented in business education and is even more critical for the education of business computing.

In response to these challenges, we propose an innovative solution: the BI-Bot learning partner. The BI-Bot is an adaptive and personalizable tool available 24/7, designed to help business students acquire computing skills alongside their business courses. It offers extensive domain knowledge and unlimited patience, providing a supportive learning environment that traditional classroom settings often lack. By leveraging such technology, we can bridge the digital skill gap and ensure that business students are well-prepared for the demands of the modern workforce.

## **2 Sample Use Case: Gamified Risk and Return with BI-Bot Guidance**

### **2.1 Learning Objective**

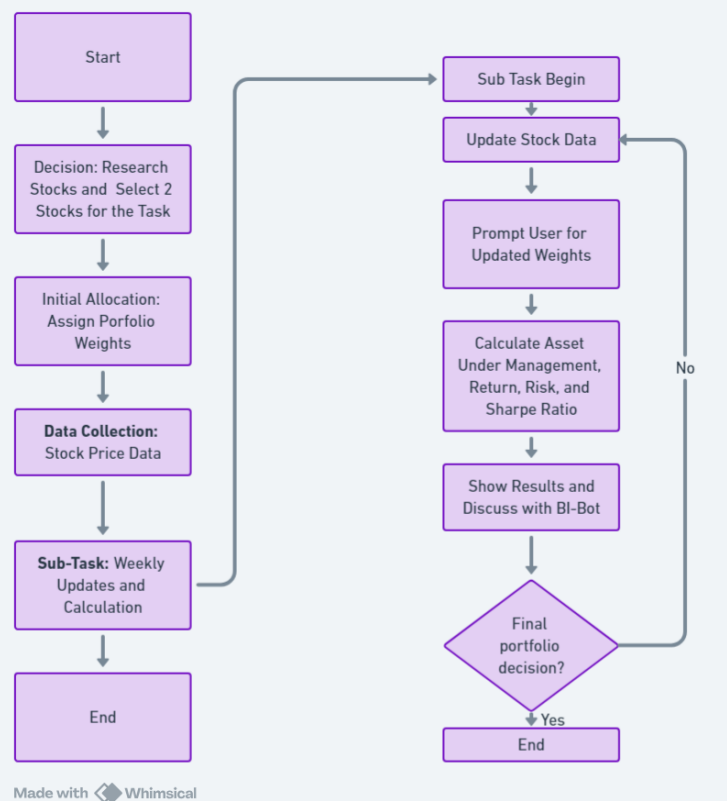
Learning Computing and programming thinking logic by guide students to create flowchart and then either use Python or Excel to update and perform calculation pragmatically.

### **2.2 Initial Setup**

With Python or Excel, students will manage a portfolio of 2 stocks, using the Sharpe ratio to evaluate performance in terms of risk-adjusted returns. *The BI-Bot will facilitate the learning process by providing guide to set up Python or Excel logic.* It also provides real-time hints, checking calculations, guiding students to find the optimal portfolio weights, and encouraging thorough research. The leaderboard will track performance based on the lowest risk, highest return, and highest Sharpe ratio.

**Overview:** The objectives, rules, and learning outcomes of the simulation are explained, with a specific focus on the Risk-Return Trade off measured with Sharpe ratio. The duration is the semester.

**BI-Bot Demonstration:** A live demonstration of how to use the BI-Bot for selecting stocks, managing portfolios, calculating the Sharpe ratio, and accessing research sources. Very importantly, The ***BI-Bot and the instructor work together*** and guide students to create a flowchart for the game plan similar to the *Figure 1* below.



**Figure 1: Portfolio Management Flowchart**

## 2.3 Portfolio Creation

**Stock Selection:** Students choose 2 stocks from a predefined list provided by the BI-Bot. The list includes stocks with varying levels of risk and return.

**Initial Allocation:** Students allocate their virtual budget (\$100,000) across the 2 (or more) chosen stocks. BI-Bot challenge the students of their allocation by telling students that are alternative portfolio weights and the risk and return trade-off.

**Research Source Suggestions:** The BI-Bot suggests reliable sources for market research, such as Seeking Alpha, Finviz, Yahoo Finance, and The Wall Street Journal (WSJ). The BI-Bot reminds students to research information on each stock, including historical performance, volatility, and expected returns.

### 2.3.1 Investment Decisions

**Decision Points:** At regular intervals, the BI-Bot prompts students to review their portfolios and make investment decisions (buy, sell, or hold) based on the latest research. Remind the students, by doing so, they are changing the portfolio weights.

**Interactive Analysis:** The BI-Bot works together with the students for analyzing potential investment changes, including historical performance, risk metrics, and forecasts.

## **2.4 Gamification Elements**

### **2.4.1 Leaderboards**

**Performance Tracking:** The BI-Bot tracks each student's portfolio performance, focusing on the following key measures: Lowest Risk (Portfolio with the lowest standard deviation), Highest Return (Portfolio with the highest overall return) and Highest Sharpe Ratio (Portfolio with the best risk-adjusted return).

### **2.4.2 Achievement Badges**

**Milestones:** Students earn digital badges for reaching milestones such as highest Sharpe ratio bi-weekly, lowest portfolio volatility, and best stock picks.

## **2.5 Rewards for Leaders**

At the end of the simulation, students with the lowest risk, highest return, and highest Sharpe ratio portfolios receive rewards such as gift cards, extra credit points, or certificates of achievement.

## **2.6 Performance Review**

**Weekly Review:** The BI-Bot generates performance reports for each student, highlighting their Sharpe ratio, investment decisions, and portfolio performance.

**Instructor Feedback:** Feedback is provided based on the BI-Bot's analytics, discussing common strategies, mistakes, and learning points.

### **2.6.1 Interactive Debrief**

**Group Discussions:** Students form small groups to discuss their strategies, outcomes, and lessons learned. The BI-Bot provides prompts and guiding questions for these discussions.

**Class Reflection:** A full-class debrief session where students share insights and reflections. The BI-Bot summarizes key points and provides additional context and analysis.

## **2.7 Advanced Features with BI-Bot Guidance**

### **2.7.1 Hint System**

**Portfolio Weights:** The BI-Bot reminds students about the importance of portfolio weights and provides brief explanations.

**Risk and Return Calculation:** The BI-Bot checks the student's calculations for risk and return, providing hints and step-by-step guidance to correct them if necessary.

**Sharpe Ratio Calculation:** The BI-Bot guides students through calculating the Sharpe ratio, explaining each step.

### **2.7.2 Optimal Portfolio Guidance**

**Efficient Frontier:** The BI-Bot encourages students to find the optimal portfolio weights that maximize the Sharpe ratio and explains the concept of the efficient frontier.

**Interactive Tools:** The BI-Bot provides interactive tools for students to adjust their portfolio weights and see the impact on risk, return, and Sharpe ratio in real-time.

## **2.8 Robust Learning Interactions with BI-Bot**

### **2.8.1 Interactive Tutorials and Reviews**

**Concept Reinforcement:** The BI-Bot offers interactive tutorials on key concepts such as portfolio diversification, risk management, and the efficient frontier.

**Immediate Feedback:** Students receive immediate feedback on quizzes, helping them identify areas where they need further study.

**Review along the Learning:** Students review their actions, consequences and what they have achieved on the way.

**Workshops:** Periodic workshops are led with the BI-Bot assisting in organizing activities and ensuring all students are engaged.

### 3 Feasibility

The project's feasibility is strongly supported by the PIs' extensive experience and expertise in relevant areas. The PIs have a proven track record in:

- Python coding and data analysis: They have successfully implemented Retrieval Augmented Generation (RAG) applications and supervised students in similar projects, demonstrating their technical proficiency.
- Cloud-based application development: Their experience piloting projects on Microsoft Azure ensures they have the necessary skills to develop and deploy the BI-Bot effectively.
- Business and computing domains: The PIs are recognized experts in their respective fields of finance, information systems, computing, and energy. This domain knowledge is crucial for developing accurate and relevant knowledge bases for the BI-Bot.
- Educational innovation: Dr. Xinde Zhang's recognition for innovative teaching approaches, such as being the runner-up for the Teaching Innovation Award at the Financial Management Association International, demonstrates the team's commitment to educational excellence. Dr. Koong and Dr. Wu has been the driver for many NSF education grants on computing education (13).

In addition to the PIs' expertise, the project benefits from:

- Dedicated team: The project team includes department chairs and college deans, indicating a high level of commitment and support from the participating institutions.
- Strong institutional support: The collaboration between three AACSB-accredited institutions (University of Arkansas, Tuskegee University, and McNeese State University) ensures access to diverse resources and a wide range of student demographics for testing and implementation.
- Existing infrastructure: The availability of Microsoft Azure for hosting the BI-Bot simplifies the technical implementation and ensures scalability.

The combination of the PIs' expertise, institutional support, and existing infrastructure provides a solid foundation for the successful development, implementation, and evaluation of the BI-Bot. The project's well-defined timeline and clear milestones further enhance its feasibility.

### 4 Innovation and Plan

Innovations in our project include:

- I. **Interactive AI Learning Partner:** The Azure-hosted, AI powered chatbot, BI-Bot, provides a dynamic, adaptive learning experience. BI-Bot brings down the communication barriers between business students and computer. Therefore, it cultivates logical and computational mindset for student's life time learning. It also enforces and clarifies the business domain knowledge as the students learning with it as a partner.
- II. **Creation of domain knowledge base:** The PIs will develop and upload the knowledge bases (KB) for the business students. Our team members are all leading experts in their domain of business, accounting, finance, energy, operation, data analysis, cybersecurity, machine learning and more. The domain expertise allow the team to build the tailored KBs which help the diversified students' learning needs.
- III. **Innovation on Course Content Delivery:** Instructors can delivery their context more efficiently. By utilizing the BI-Bot together with the students, the instructors will be able to ensure the understanding of knowledge in the classroom in realtime because the students can ask their questions in their own words. It will make the students fully digest the course context in and out of the classroom.
- IV. **Detailed Learning Experience Data:** The BI-Bot keeps all the conversation between the bot and the students. The data will be analyzed anonymously. Such detailed data is super valuable for the learning and teaching developments.

## 4.1 Incentivizing Participation

### 4.1.1 Monetary Incentives

#### I. Mid-Term Awards

- **Description:** Recognize students who demonstrate the highest interaction rates and engagement with the BI-Bot by the mid-term of the course.
- **Categories:**
  - **Most Interactive User:** Awarded to the student with the highest number of meaningful interactions.
  - **Most Improved User:** Recognizes the student who shows the greatest improvement in interaction with the BI-Bot.
  - **Peer Mentor:** Voted by classmates, this award is given to the student who provides the most help to peers through the BI-Bot platform.

#### II. End of Course Awards

- **Description:** Acknowledge students who consistently used the BI-Bot throughout the course and excelled in various aspects.
- **Categories:**
  - **Top User:** Awarded to the student with the highest overall interaction throughout the course.
  - **Most Improved User:** Recognizes the student who shows the greatest improvement throughout the semester.

### 4.1.2 Gamification Elements

#### I. Leaderboards

- **Description:** Implement leaderboards to display the top users of the BI-Bot, fostering a competitive environment.
- **Visibility:** Leaderboards will be updated weekly and displayed on the BI-Bot dashboard.

#### II. Achievement Badges

- **Description:** Award digital badges for achieving specific milestones, such as completing a certain number of interactions, mastering a topic, or helping peers.
- **Recognition:** Badges will be visible on student profiles and can be shared on social media or included in digital portfolios.

## 4.2 BI-Bot: the personal learning partner

The PI will design and implement an interactive chatbot, BI-Bot, on Microsoft Azure, enabling personalized learning and providing one-on-one learning assistance on finance, financial data analysis, and Python coding. Multiple learning styles and reasoning frameworks will be offered to fit students' personal learning styles. The development plan is shown in Figure 2. The key features of the BI-Bots includes:

- Cloud Service:** The BI-Bot will be hosted by Microsoft Azure cloud service. The BI-Bot will be available for students and instructor to access 24/7.
- OpenAI API Powered:** The BI-Bot will be implemented with OpenAI API most up-to-date generative AI model.
- Personalization:** The BI-Bot will allow students to personalize based on their own learning style, topic and level.
- Domain Knowledge Base:** The BI-Bot will have the specific domain knowledge base (KB) created by the proposing team.

- V. **Tracking Student Progress:** The BI-Bot allows educators and students check individual progress through the detailed chat data. The BI-Bot provides function including: review chat history, summarize chat history, review KBs, revisit certain sections or key points.
- VI. **Detailed Dataset:** The team will keep the chat history data privately. The datasets will be used for future studies on how to inspiring computing mindset and skills in business community.

The team also has the following development and implementation plan:

- I. **Build the BI-Bot:** The lead PI will build the BI-Bot in the University of Arkansas.
- II. **Distribution and Testing:** The BI-Bot will be distributed and tested in all three collaborating institutions.
- III. **Feedback and Update:** The feedback from the students and instructors will be collected and addressed by updating the BI-Bot. Additional revision and updates will be conducted continuously.
- IV. **Workshops:** Tuskegee University will host the first workshop in year 2. The University of Arkansas will host the second workshop in year 3.
- V. **Adoption Beyond the Collaborating Institutions:** The BI-Bot will be available for other institutions and instructors who willing to use the BI-Bot by year 2.

#### 4.3 Knowledge Base (KB)

The knowledge base for the BI-Bot includes lecture notes, textbook materials, and other helpful contents. Each KB item will detail the associated computational tools, logical thinking tools and skills, learning objectives, and expected computational learning outcomes.

The following demos the modules for *Financial Management* Knowledge Bases, tools and the objectives. Note that in all of the course modules, BI-Bot plays the essential role of providing real-time feedback and assistance, encourages learning and records the progress.

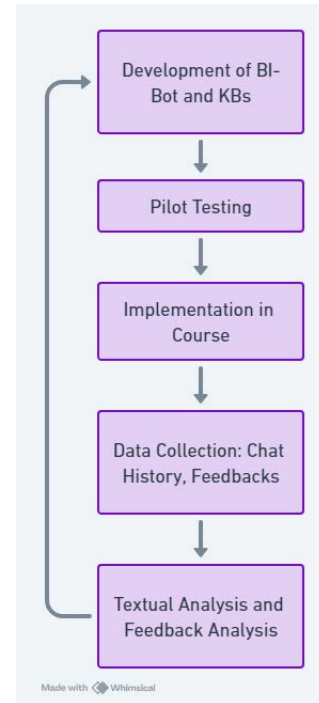
##### 4.3.1 Sample KB: Financial Management

###### I. Time Value of Money

- **Computational Tool:** BI-Bot, Excel and Python
- **Logical Thinking Tool and Skill:**
  - Use of timelines for visual learning
  - Real-life examples such as purchasing decisions or retirement planning
- **Learning Objectives:**
  - Understand the concept of present value and future value
  - Learn to apply discounting and compounding techniques
- **Expected Computational Learning Outcome:**
  - Ability to convert word problems into logical and numerical charts
  - Mastery of backward deduction: identifying the objective, analyzing given information, setting up the computing system, and using appropriate tools and knowledge to solve problems

###### II. Risk and Return

- **Computational Tool:** BI-Bot, Flowchart, Excel and Python
- **Logical Thinking Tool and Skill:**



**Figure 2:** BI-Bot Development Plan.

- Scenario analysis and probability distributions and Real-life applications in investment decision-making

- **Learning Objectives:**

- Understand the relationship between risk and return
- Learn to calculate expected returns and measure risk using standard deviation and variance

### III. Capital Budgeting

- **Computational Tool:** BI-Bot, Flowchart, Excel and Python

- **Logical Thinking Tool and Skill:**

- Use of decision trees and sensitivity analysis
- Examples in project evaluation and capital investment decisions

- **Learning Objectives:**

- Understand different capital budgeting techniques such as NPV, IRR, and Payback Period
- Learn to evaluate and compare investment projects

- **Expected Computational Learning Outcome:**

- Ability to perform capital budgeting analysis and make informed investment decisions
- Develop skills in financial modeling and scenario analysis

### IV. Capital Asset Pricing Model (CAPM)

- **Computational Tool:** BI-Bot, Excel and Python

- **Logical Thinking Tool and Skill:**

- Use of regression analysis to estimate beta and Understand the process of obtaining and processing data

- **Learning Objectives:**

- Understand the principles of CAPM and the security market line and Learn to calculate the expected return of an asset using CAPM

### V. Portfolio Analysis

- **Computational Tool:** BI-Bot, Flowchart, Excel and Python

- **Logical Thinking Tool and Skill:**

- Diversification and portfolio optimization techniques
- Constructing and managing investment portfolios for a given set of securities

- **Learning Objectives:**

- Understand the principles of portfolio theory, including diversification and the efficient frontier
- Learn to optimize portfolios to achieve desired risk-return profiles
- Learn how to download stock price and calculate returns
- Learn how to apply on investments with real datasets

#### 4.3.2 Process for Creating Knowledge Bases (KBs)

The team creates KBs by the following procedure and merits.

##### I. Gather Materials

- Collect relevant and authoritative materials from various sources, including lecture notes, textbooks, research papers, industry publications, online courses, and reputable financial websites.

##### II. Develop Original Content

Fill any gaps identified during the material gathering phase and create new content that focuses on computing and communication mindset and skills with a particular emphasis on Flowchart, Python and Excel.



- **Computing and Communication Skills**

- Translate between the coding in Python and natural language, with logic and procedure, to solve financial problems.
- Practices for collaborating and communicating in groups or individually with BI-Bot.

### III. Organize Content

- Structure the content logically to make it easily searchable and navigable for the BI-Bot. Convert and save the content to a vector database.

### IV. Peer Review

- Engage subject matter experts in the team, address all feedback and make necessary revisions.

### V. Update KBs

- Continuously monitor industry trends, academic research, and changes in educational standards to ensure the KB remains up-to-date.

## 5 Evaluation Plan and Measure of Success

### 5.1 Evaluation Plan

The project will be evaluated continuously through various methods to ensure the effectiveness and improvement of the BI-Bot platform. Key milestones include:

- **Textual Analysis on Chat History:** From the beginning to the end of the courses, textual analysis will be performed on the chat history data. This analysis will help the team track the development of students' communication and computing skills. Examples of textual analysis include:
  - Analyzing the complexity of questions asked by students over time to gauge their understanding and confidence.
  - Evaluating the accuracy and relevance of student responses to BI-Bot prompts to measure their learning progress.
  - Identifying common misconceptions or frequently asked questions to improve the BI-Bot's knowledge base.
- **Student and Instructor Evaluation and Feedback:** Surveys will be distributed to students and instructors at regular intervals throughout the courses. These surveys will gather quantitative and qualitative data on the platform's usability, effectiveness, and areas for improvement. Comments from the surveys will be summarized and integrated into the iterative development process of the platform.
- **Educator Workshop Feedback:** Workshops will be held for educators to familiarize them with the BI-Bot and gather their feedback. Evaluation forms will be collected from participating professors to gain insights into the platform's educational value and usability. This feedback will be analyzed to guide future enhancements.
- **Focus Groups and Interviews:** Periodic focus groups and one-on-one interviews will be conducted with a subset of students and instructors. These sessions will provide deeper insights into user experiences and identify specific challenges and successes not captured in surveys.
- **Performance Metrics:** Key performance metrics such as student engagement levels, frequency of BI-Bot usage, and time spent on the platform will be monitored. These metrics will help assess the overall adoption and impact of the BI-Bot in the learning process.
- **Academic Performance Tracking:** Students' academic performance in the courses utilizing the BI-Bot will be compared to their performance in previous terms without the BI-Bot. This comparison will provide data on the platform's impact on learning outcomes.

## 5.2 Measure of Success

Success of the project will be measured through multiple dimensions:

- **Development of Communication and Computing Skills:** The primary measure of success will be the improvement in students' communication and computing skills, as evidenced by textual analysis of chat history. The progression in the complexity, accuracy, and frequency of student interactions with the BI-Bot will indicate skill development.
- **Feedback and Evaluation Scores:** The secondary measure of success will be the feedback and evaluation scores from students, instructors, and workshop participants. High satisfaction and positive comments will reflect the platform's effectiveness and user acceptance.
- **Engagement and Usage Metrics:** The number of students participating, frequency of BI-Bot usage, and the duration of interactions will be the third measure of success. High engagement levels will indicate the platform's relevance and usefulness in the educational process.
- **Academic Performance Improvements:** Improvements in students' academic performance in the BI-Bot integrated courses compared to previous terms will be another critical success measure. This will demonstrate the platform's impact on educational outcomes.
- **Scalability and Adoption:** The successful adoption of the BI-Bot across multiple institutions and its scalability to different courses and educational settings will be evaluated. Widespread adoption and positive feedback from diverse institutions will validate the platform's broader applicability.

By continuously evaluating and iterating on the BI-Bot platform, we aim to create a robust educational tool that significantly enhances students' learning experiences and outcomes in business computing courses.

## 6 Data Privacy and Accuracy

The team underlines the following to guide privacy and accuracy concerns. The team will consult with university legal counsel for guidance.

### 6.1 Data Privacy Protocols

#### I. Data Collection and Storage:

- All data collected through the BI-Bot, including chat histories, learning progress, and usage metrics, will be stored securely on Microsoft Azure, utilizing its robust data protection features. Data used for research will be anonymized to protect student identities. Identifiable information will be separated from educational data and stored in encrypted databases.

#### II. Access Control:

- Access to student data will be restricted to authorized personnel only, including the project team and relevant institutional staff. Access will be granted based on role-specific needs and subject to strict authentication protocols.

#### III. Data Retention and Deletion:

- Student data will be retained only for the duration necessary to fulfill the educational and research objectives of the project. After this period, data will be securely deleted in accordance with institutional data retention policies and applicable regulations. Students will have the right to request the deletion of their data at any time, and such requests will be honored promptly.

### 6.2 Obtaining Student Consent

#### I. Informed Consent Process:

- Before participating in the BI-Bot project, students will be provided with detailed information about the nature and purpose of the data collection, how their data will be used, and their rights regarding data privacy. An informed consent form will be provided, outlining these details clearly and concisely.

#### II. Voluntary Participation:

- Participation in the BI-Bot project will be entirely voluntary. Students will have the option to opt-in or opt-out of the data collection process without any academic penalties or repercussions.

### 6.3 Ethical Considerations

#### I. Use of AI and Bias Mitigation:

- The BI-Bot's AI algorithms will be regularly evaluated for potential biases. Efforts will be made to ensure that the AI provides equitable support to all students, regardless of background or demographics. Training data for the AI will be curated to include diverse scenarios and perspectives to minimize biases.

#### II. Accuracy of Information:

- Users will be informed that the BI-Bot may occasionally provide inaccurate information. It is the responsibility of the users to verify the information provided by the BI-Bot. The BI-Bot will include prompts reminding users to cross-check important information and provide resources or references when possible to aid in verification.

## 7 The Team, Qualification, and Synergy

### 7.1 PI and Team Expertise

The team comprises two deans, two department chairs, and the founding faculty for business computing education. This team's extensive experience, the urgency and dedication of the schools and departments, and the tremendous support from both school and department levels guarantee the delivery and success of the project. The collective expertise and knowledge from the PIs also ensure the development of the platform and course curriculum.

**PI, Dr. Xinde Zhang:** Dr. Xinde Zhang is an award-winning educator specializing in financial data analytics and machine learning. He was the runner-up for the prestigious Teaching Innovation Award at the Financial Management Association International-*ONLY 3 educators being selected globally* to be the finalist each year, highlighting his global recognition in innovative educational approaches. His panel and talk at the Southwest Finance Association Annual Meeting, titled "Bridging Finance and Data Analytics: The Transformative Role of Generative AI in Education," underscore his expertise in integrating cutting-edge AI technologies into financial education.

As the founder of the Financial Analytics Concentration at the University of Arkansas, Dr. Zhang has developed six courses from the ground up, tailored to modern financial industry demands for machine learning and artificial intelligence. With 81 students currently enrolled in this specialty, his student-centric approach and first-hand knowledge of teaching computational courses in business ensure the vision and success of this project. His research, which extensively utilizes big data to uncover arbitrage opportunities in the fixed-income market, has been published in top-tier journals including *the Journal of Financial and Quantitative Analysis*, *Journal of Banking and Finance*, and *Journal of Corporate Finance*. Dr. Zhang holds a bachelor's degree in Computer Science and a doctoral degree in Finance, blending technical prowess with financial acumen.

**Senior Personnel, Dr. Alexey Malakhov:** Dr. Alexey Malakhov, the interim chair of the Finance Department at the University of Arkansas. He will help to distribute the BI-Bot to courses in the University of Arkansas.

### 7.2 Collaborating Institution Team Expertise

The team from collaborating institutions will ensure the adoption and execution of the modules and the app in their respective institutions.

**Dr. Kai S. Koong:** Dr. Kai S. Koong is the Dean of the Andrew F. Brimmer College of Business and Information Science at Tuskegee University, where he also serves as a Professor of Business Administration. With over 20 years of experience in academic leadership and a strong background in minority education, Dr. Koong is particularly suited to the project's focus on broadening participation. His expertise in e-commerce, health information technology, and business analytics aligns directly with the project's aim to integrate advanced technological tools into financial education. Dr. Koong has been recognized for his contributions to academia and leadership with awards such as the Decision Sciences Institute Southwest Chapter Outstanding Educator of the Year and the Shaanxi Province Outstanding Foreign Educator Award.

**Dr. Fan Wu:** Dr. Fan Wu is the head of the Computer Sciences department at Tuskegee University, where he has been a faculty member since 2009. He received his Ph.D. in Computer Science from Worcester Polytechnic Institute. Dr. Wu's research interests include Mobile Security, Data Science, and High-Performance Computing, areas pivotal to the technological foundation of this project. He has authored over 40 peer-reviewed papers and received numerous

research grants from agencies such as NSF, DHS, NASA, DoD, and NIH. Dr. Wu's commitment to technological advancement in education is also evident in his editorial role at the *International Journal of Mobile Devices, Wearable Technology, and Flexible Electronics*.

**Dr. Shuming Bai:** Dr. Shuming Bai is Dean of the College of Business and Professor of Finance at McNeese State University. She is well published and serves on several peer-review journal Editorial Boards. She is known for her contributions in the development of energy programs, including creating the first Certificate in Liquefied Natural Gas Business program in Louisiana and the Certificate in Energy Business program in Texas. Dean Bai also serves as a Peer Review Team member for AACSB International, the premier accreditation agency for business schools around the globe. Her research interests span finance, energy markets, financial fraud, and risk management. She has also been a panel reviewer for the U.S. Nuclear Regulatory Commission Scholarships and Fellowships Grant.

### **7.3 Synergy and Collaborative Potential**

The combined strengths of these AACSB-accredited institutions, coupled with the PIs' leadership and innovative teaching practices, create a powerful synergy uniquely positioned to advance AI in financial education. This collaborative effort leverages diverse institutional resources and integrates complementary expertise to address the project's goals effectively, making our team exceptionally suited to undertake this transformative educational initiative.

The student bodies of the collaborating institutions represent a diverse cross-section of the population. *The University of Arkansas*, Walton College of Business currently serves over 8,500 undergraduate students, with around 2,000 majoring in Finance. *Tuskegee University*, a minority serving institution, with its deep integration into the local rural economy and strong connections to major employers like Amazon, Apple, Meta, and Boeing, brings a unique perspective. As a member of the University of Louisiana System in EPSCoR, *McNeese State University* serves rural and economically disadvantaged population. It excels in financial education and maintains strong ties to local industries. All three institutions serve significant numbers of underserved and disadvantaged students. This collaboration provides a representative sample for future development and dissemination of the project nationwide.

### **7.4 Institutional Support**

A \$150,000 funding has been approved at the University of Arkansas to build a GPU cluster with 24 GPUs for the Financial Data Analytics Concentration. Both Business School IT team and the university central IT team are support the project. The cluster will be deployed in Summer 2024 for the concentration.

## 8 Time Line

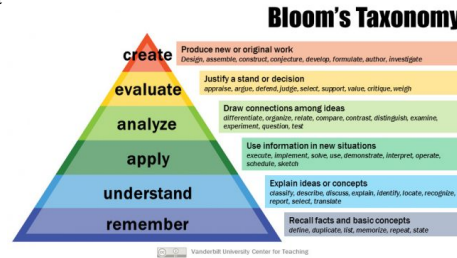
All three institutions host workshops for involved and interested faculties.

Activity	Personnel	Time Frame
Develop and deliver the BI-Bot V0.1	P1, GS	1st half of Y1 and continuous
Build KB for FM	P1, GS	1st half of Y1
Use BI-Bot in FM	All PIs, US	Starting at 2nd half of Y1
Update and deliver BI-Bot V0.2	P1, GS	Y2
Build KB for <i>Money and Banking</i>	P1, GS	1st half of Y2
Use BI-Bot in <i>Money and Banking</i>	P3, P4, P5 US	Starting at Y2
Update and deliver BI-Bot V0.3	P1, US	Y3
Develop KB for <i>Financial Data Analytics</i>	P1, GS	Y2 and Y3
Use BI-Bot in <i>Financial Data Analytics</i>	P1, US	Y3
Analyze the results and write reports	All PIs	Y1, Y2, Y3
Workshop at McNeese State University	P1, P5	Y2 or Y3
Workshop at Tuskegee	P1, P3, P4	Y2 or Y3
Workshop at U of Arkansas	P1, P2, GS	Y1 and Y2 or Y3
Present findings at scientific meetings and publish results in peer-reviewed journals	All PIs, GS	Y1, Y2, Y3

**Table 1:** Project schedule. PIs are Xinde Zhang (P1), Alexey Malakhov (P2), Kai Koong (P3), Fan Wu (P4) and Shuming Bai (P5). Graduate student is GS, and the undergraduate student is US. The proposed time frame is 3 years. *Financial Management* is tested in all three institutions. *Money and Banking* is tested in Tuskegee University and McNeese State University. *Financial Data Analytics* is tested in the University of Arkansas.

## 9 Scientific Merit

The proposed project demonstrates significant scientific merit by integrating advanced AI technologies into business education. The BI-Bot, a Generative AI-powered educational tool, is designed to enhance computational literacy and problem-solving skills among business students. This initiative aligns with contemporary educational research and pedagogical frameworks, ensuring a robust and evidence-based foundation for the project.



**Figure 3:** Bloom's Taxonomy

The integration of the BI-Bot into business courses leverages AI to provide personalized learning pathways, adapt to individual student needs, and offer real-time feedback. These features are supported by educational theories such as Constructivist Learning, which posits that learners construct knowledge through experiences and reflections [4, 5]. Additionally, Vygotsky's Zone of Proximal Development (ZPD) emphasizes providing learning opportunities that are within the learner's capabilities but still challenging enough to require assistance. The BI-Bot's adaptive learning algorithms tailor interactions to each student's ZPD, ensuring optimal learning progression [5]. Bloom's Taxonomy ([6]) further supports the BI-Bot's design by encouraging higher-order skills of all levels in Figure 3 .

### 9.1 Project Design and Implementation

The BI-Bot will be integrated into the pilot business courses such as Financial Management (FM), a core requirement for all business students. This course will serve as the pilot for the initial deployment. The project will subsequently extend to other courses, including Money and Banking, Financial Data Analytics, and Energy Finance. In the future, the BI-Bot can be further expanded with alternative knowledge bases in accounting, finance, and coding, personalized to adapt to each student's learning style and level.

## 9.2 Key Features and Innovations

- **Cloud-Based AI Tool:** The BI-Bot will be hosted on Microsoft Azure, ensuring 24/7 accessibility for students and instructors. This cloud-based approach facilitates scalability and continuous updates.
- **Utilization of OpenAI API:** The BI-Bot leverages the latest OpenAI API to deliver a sophisticated, interactive learning experience, utilizing state-of-the-art AI capabilities.
- **Personalization and Adaptivity:** The BI-Bot allows for personalization based on individual learning styles, topics, and levels, ensuring a tailored educational experience for each student.
- **Domain-Specific Knowledge Bases:** The BI-Bot will have specialized knowledge bases created by the project team, covering key areas such as finance, accounting, and data analytics. This ensures that the content is relevant and accurate.
- **Tracking Student Progress:** Detailed chat histories will be maintained to track student progress and provide a valuable resource for future research aimed at improving computing education.
- **Data-Driven Improvements:** The project will continuously analyze data collected from student interactions to identify areas for improvement and implement iterative enhancements to the BI-Bot.

The effectiveness of the BI-Bot will be evaluated through continuous data collection and analysis. Key performance metrics include student engagement levels, frequency of BI-Bot usage, and academic performance improvements. Textual analysis of chat histories will help track the development of students' communication and computing skills. Feedback from students and instructors will be gathered through surveys and focus groups, ensuring that the platform evolves based on user needs and experiences.

The project will be tested across three collaborating institutions: the University of Arkansas, Tuskegee University, and McNeese State University. This multi-institutional testing ensures the tool's scalability, adaptability, and effectiveness in diverse educational settings. By incorporating feedback from these varied institutions, the project aims to meet the needs of a wide range of students, particularly those from underrepresented and underserved groups.

## 10 Broader Impacts

The proposed project has significant broader impacts, addressing key educational and societal challenges by integrating advanced AI technologies into business education. The BI-Bot, a Generative AI-powered educational tool, is designed to enhance computational literacy and problem-solving skills among business students, thus preparing them for the demands of the modern workforce. This initiative aligns with NSF's goals of broadening participation in computing education and fostering an AI-ready workforce.

### 10.1 Enhancing Employability and Workforce Readiness

One of the primary broader impacts of the BI-Bot project is the enhancement of employability and workforce readiness among business students. By improving computational literacy and problem-solving skills, the project equips students with the necessary tools to succeed in a technology-driven business environment. The demand for digital skills is increasing across all job markets, as highlighted by the Federal Reserve Bank of Atlanta, which found that 92% of job postings in 2021 required digital skills. By integrating computing skills into business education, this project ensures that graduates are well-prepared to meet these demands, thereby improving their job prospects and career advancement opportunities.

### 10.2 Equitable Access and Inclusion

The project will be implemented across three diverse institutions: the University of Arkansas, Tuskegee University, and McNeese State University. These institutions serve a wide range of students, including those from underrepresented and underserved groups. By incorporating feedback from these varied institutions, the BI-Bot is designed to meet the needs of a diverse student body, ensuring equitable access to advanced AI-driven learning tools. This approach addresses historic underinvestment and structural inequities that have left a significant portion of the workforce lacking foundational digital skills. By closing the digital skill divide, the project can generate substantial economic benefits for businesses, workers, and the broader economy.

### **10.3 Scalable and Adaptable Educational Model**

The BI-Bot's scalable and adaptable design allows for expansion to other disciplines and institutions, creating a versatile educational model. The cloud-based architecture ensures that the platform can accommodate a growing number of users without compromising performance. This scalability is crucial for extending the benefits of the project beyond the initial implementation, making it a valuable tool for a wide range of educational settings. The adaptability of the BI-Bot also means that it can be customized to fit the specific needs of different courses and student populations, further enhancing its impact.

### **10.4 Data-Driven Insights for Educational Research**

The project will generate extensive data from anonymized chat histories, providing valuable insights for educational research. This data will be used to understand how students interact with AI-driven educational tools, identify common challenges and misconceptions, and develop strategies for improving computing education. The detailed dataset collected by the BI-Bot can inform future studies on how to inspire computational thinking and skills in the business community, contributing to the broader field of educational research.

### **10.5 Community Engagement and Professional Development**

The project will also promote outreach and community engagement through workshops and hackathons. These events will provide opportunities for students, educators, and industry professionals to collaborate, share knowledge, and develop new skills. Additionally, the project will offer professional development for educators, helping them integrate AI and computational thinking into their teaching practices. By fostering a community of practice around the BI-Bot, the project aims to create a sustainable impact on business education and beyond.

### **10.6 Informing Educational Policy and Practice**

Insights from the project will inform educational policy and practice, advocating for the integration of AI and computational thinking into business education. By demonstrating the effectiveness of the BI-Bot in enhancing computational literacy and problem-solving skills, the project can influence curriculum development and teaching strategies at a broader level. This advocacy is crucial for ensuring that business students are equipped to thrive and innovate in a rapidly evolving technological landscape.

### **10.7 Conclusion**

In conclusion, the BI-Bot project has the potential to make significant contributions to business and the broader field of computing education. By enhancing employability and workforce readiness, ensuring equitable access and inclusion, providing a scalable and adaptable educational model, generating data-driven insights for research, promoting community engagement and professional development, and informing educational policy and practice, the project aligns with NSF's goals and addresses critical societal needs. This comprehensive approach ensures that the BI-Bot will have a lasting impact on students, educators, and the broader community.

## **11 Dissemination Plan**

To ensure broad dissemination of our project results, we will employ a multi-faceted approach combining academic, digital, and community engagement strategies. Our findings and methodologies will be shared through peer-reviewed journal publications and online platforms. Additionally, we will host workshops and webinars to demonstrate the use of the BI-Bot, providing hands-on training to educators and researchers.

We will create a dedicated project website and utilize social media platforms to share updates, resources, and interactive tools. Our educational materials will be developed as Open Educational Resources (OER) under Creative Commons licenses to ensure wide accessibility. Furthermore, we will engage with schools and community organizations to promote AI literacy and business education, particularly targeting underrepresented groups. Collaborations with industry partners will also be pursued to explore real-world applications and extend our reach.

## **12 Sustainability Plan**

To maintain the project outcomes post-funding, we have secured commitments from our participating institutions for ongoing support. This includes resource allocation for personnel and infrastructure to keep the BI-Bot and its

knowledge base updated. We will pursue additional funding opportunities through grant applications to NSF and other agencies, as well as seek corporate sponsorships from the business and technology sectors. We plan to initiate Business AI Education Center based on this project.

Our BI-Bot and educational materials are designed to be scalable and easily adaptable to various educational contexts. We will develop training programs for new instructors and institutions adopting the BI-Bot, ensuring its effective use. Continuous feedback from users will be collected to regularly update and improve the tool. By maintaining an active research agenda, we aim to explore new applications and enhancements, ensuring the project's long-term impact and sustainability in AI-driven business education.

### **13 Results from Prior NSF Support**

PI: Dr. Xinde Zhang: No NSF support in the past five years

Senior Personnel: Dr. Alexey Malakhov: No NSF support in the past five years

#### **13.1 Collaborators in Collaborating Institutions**

Dr. Kai Koong:NSF S-STEM Award # DUE-2221115, \$1,499,963, 10/01/2022-09/30/2028, PI: Xiao Chang, Co-PI: Kai Koong. Improving Retention Rate and Success in Computer Science Scholars in a Historical Black University. Intellectual Merit: The project has the following intellectual merits. (a) Introduction to coding seminars will help TU students without coding background overcome the barrier and succeed in their entry-level computer science courses, which will increase students' self-confidence in computer science. (b) Peer tutoring and peer-cooperative learning will be implemented to assist S-STEM scholars to become independent learners and learn course material in a deeper and more concrete way. (c) Retention risk early-alert will be studied and implemented to guide the targeted retention intervention. (d) Peer mentoring and living learning community will be implemented to support S-STEM scholars' academic and personal engagement and development. Broader impact: The proposed project will make the following impacts. (a) 24 scholars will be enrolled in this project. 100% of the scholars will be low-income and academically talented underrepresented minority students (African Americans) at a historically black university. More than 50% of the scholars will be female African American students. (b) Student retention risk early-alert and targeted retention intervention program will be implemented and cover all freshmen (>30 students per year) in TU computer science programs. (c) The computer science research meetings planned to guide and engage S-STEM scholar professional development will be open to all computer science students in TU computer science programs (200 registered students). In addition, As Co-PIs, Koong is also currently Co-leading other NSF-sponsored research or education projects (#2306141, #2209637, #2100134, #2048884).

Dr. Fan Wu:NSF CyberCorps SFS Award # DGE-2234911, \$2,863,511, 06/01/2023-05/31/2028, PI: Fan Wu. Collaborative Research: CyberCorps Scholarship for Service (Renewal): Strengthening the National Cybersecurity Workforce with Integrated Learning of AI/ML and Cybersecurity. Intellectual Merit: The intellectual merit of this renewal collaborative project lies in its strong and innovative program content built on the existing program's track record and accumulated experiences in recruitment and retention, academic and professional training, and placement supported by experienced and committed faculty, AI enhanced curriculum, comprehensive support, as well as diversity aware cohort experience plan. Broader impact: The SFS program will increase diversity of cybersecurity professionals and workforce as well as their awareness of inclusiveness through the collaboration between University of Tennessee at Chattanooga and Tuskegee University. And the SFS scholars will promote cybersecurity awareness through community service (e.g., visit K-12 schools with a large population of underrepresented students). In addition, As PI or Co-PI, Wu is also currently leading other NSF-sponsored research or education projects (#2306141, #2245879, #2221115, #2209637, #2131228, #2110788, #2100134, #2048884)

Dr. Shuming Bai: Even though Dr. Bai does not have NSF support in the last 5 years, she is the sole PI of a recently completed national non-profit grant on financial literacy and a current state grant on energy finance.



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