Textbook Transformation Grants, Round Twelve (Fall 2018-2019)

Proposal Form and Narrative

Applicant, Team, and Sponsor Information

The **applicant** is the proposed Project Lead for the grant project. The **submitter** is the person submitting the application (which may be a Grants Officer or Administrator). The submitter will often be the applicant – if so, leave the submitter fields blank.

Institution(s)	**Kennesaw State University**
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Applicant Position/Title	Associate Professor of Computer Science
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Submitter Position	Associate Professor of Computer Science

Please provide the first/last names and email addresses of all team members within the proposed project. Include the applicant (Project Lead) in this list. Do not include prefixes or suffixes such as Ms., Dr., Ph.D., etc.

Team	**Name**	**Email Address**
Team Member 1	Yong Shi	yshi5@kennesaw.edu
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Team Member 3	Selena He	she4@kennesaw.edu
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Team Member 6		
Team Member 7		
Team Member 8		

If you have any more team members to add, please enter their names and email addresses in the text box below.

Please provide the sponsor's name, title, department, and institution. The sponsor is the provider of your Letter of Support.

Dr. Dan Lo, Chair of Department of Computer Science, Kennesaw State University Dr. Jon Preston, Dean of College of Computing and Software Engineering

Project Information and Impact Data

Title of Grant Project	*An effort to build affordable Modern Computing Systems courses in undergraduate and graduate Computer Science programs (BSCS and MSCS)*
Type of Grant	*No-or-Low-Cost-to-Students Learning Materials*
Requested Amount of Funding	$30,000
Course Names and Course Numbers	CS 4524 (undergraduate) / CS 7125 (graduate) - Cloud Computing CS 4322 (undergraduate) / CS 7455 (graduate) - Mobile Software Development CS 3503 - Computer Organization and Architecture CS 4712 - User Interface Engineering CS 7267 - Machine Learning
Final Semester of Project	***Fall 2019***
Average Number of Students Per Course Section Affected by Project	27
Average Number of Sections Affected by Project in One Academic Year	29
Total Number of Students Affected by Project in One Academic Year	780
Average Number of Students	94

Affected per Summer Semester	
Average Number of Students Affected per Fall Semester	422
Average Number of Students Affected per Spring Semester	264
Title/Author of Original Required Materials	Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press, ISBN 0956355609, by John Rhoton,2009. $23 Introduction to Android Application Development: Android Essentials, 4/E, Joseph Annuzzi, Jr., Lauren Darcey, and Shane Conder, ISBN-13: 9780321940261, 2014, Addison-Wesley Professional. $38 Android for Programmers: An App-Driven Approach by Paul J. Deitel, Harvey M. Deitel, Abbey Deitel and Michael Morgano. $29 Dan Lo and Kai Qian, Fundamentals of Computer Systems, 4rd edition, 2014, Linus Publications, Inc., ISBN 13: 978-1-60797-590-8. $68 Interaction Design: Beyond Human - Computer Interaction (4th ed.), by Jenny Preece, Yvonne Rogers, Helen Sharp. Wiley publisher Company, 2015. ISBN-13: 978-1119020752. $63 Data Algorithms-Recipes for Scaling up with Hadoop and Spark. Mahmoud Parsian O'Reily Media, 2014.ISBN-13: 978-1491906187. $56
Original Total Cost Per Student	*For the BSCS program, suppose a student takes one required course (CS 3503 @ $68) and two major electives (the average cost of major electives CS 4524, CS 4322 and CS 4712 is $51). The total cost for a student will be $68+$51+$51 = $170.* *For the MSCS program, the average cost of the three major elective courses (CS 7125, CS 7455, CS 7267) is $48.67. The total cost for a student taking two major elective courses will be $48.67+$48.67 = $97.34.*
Post-Project Cost Per Student	*$0*
Post-Project Savings Per Student	*$170 for a BSCS student and $97.34 for an MSCS student*
Projected Total Annual Student	*$46,041*

Savings Per Academic Year	
Using OpenStax Textbook?	*No.*

Table 1 Projected Student Enrollment in 2019

Course	**Spring 2019**	**Summer 2019**	**Fall 2019**	**Total sections**	**Total Number**
CS 4524 / CS 7125	35/16	No offering/ 32	27/9	5	**119**
CS 4322 / CS 7455	15/ No offering	No offering / 7	59/ No offering	3	**81**
CS 3503	154 (01(27); 03(28); 04(9); 05(34); 06(19); 07(37)).	16	194 (01(33); 03 (23); 04(21); 05 (22); 06 (24); 07(18); 08(15); 09 (38)).	15	**364**
CS 4712	No offering	39	108 (01(34); 02(32); W01(42)).	4	**147**
CS 7267	44	No offering	25	2	**69**
Total	**264**	**94**	**422**	**29**	**780**

Notes: 1) Spring, summer and fall 2019 enrollment numbers are projected numbers based on preceding enrollment of our programs in 2018 cited from the school enrollment system, owlexpress.kennesaw.edu. 2) If there are multiple sections in a semester, we put a total number of students followed by a parenthesis that includes the section id and enrollment number of each section.

Table 2. Summary of Savings with No-Cost Learning Material

Course	**Textbook Used (complete textbook information including title, authors, ISBN, etc.)**	**Cost per Student (textbook price)**	**Projected Enrollment (from table 1)**	**Projected Costs (multiplication of previous two columns)**
CS4524 / CS 7125	Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press, ISBN 0956355609, by John Rhoton, 2009.	$23	119	**$2,737**
CS 4322 / CS 7455	Introduction to Android Application Development: Android Essentials, 4/E, Joseph Annuzzi, Jr., Lauren Darcey, and Shane Conder, ISBN-13: 9780321940261, 2014, Addison-Wesley Professional. Android for Programmers: An App-Driven Approach by Paul J. Deitel, Harvey M. Deitel, Abbey Deitel and Michael Morgano.	$38 $29	81	**$5,427**
CS 3503	Dan Lo and Kai Qian, Fundamentals of Computer Systems, 4rd edition, 2014, Linus Publications, Inc., ISBN 13: 978-1-60797-590-8.	$68	364	**$24,752**
CS 4712	Interaction Design: Beyond Human - Computer Interaction (4th ed.), by Jenny Preece, Yvonne Rogers, Helen Sharp. Wiley	$63	147	**$9,261**

	publisher Company, 2015. ISBN-13: 978-1119020752			
CS 7267	Data Algorithms-Recipes for Scaling up with Hadoop and Spark. Mahmoud Parsian O'Reily Media, 2014. ISBN-13: 978-1491906187	$56	69	**$3,864**
Total		**$300**	**780**	**$46,041**

Note: The prices of the textbooks are referenced from authors' websites as well as Amazon.com

Narrative Section

1. Project Goals

The Department of Computer Science is one of the largest departments in Kennesaw State University and currently has over 40 faculty and 1600 students in various programs, including Bachelor of Science in Computer Science (BSCS), Bachelor of Arts in Applied Computer Science (BAACS), Minor in Computer Science, Master of Science in Computer Science (MSCS), Graduate Certificate in Computer Science Foundations and Certificate in High Performance Cluster Computing, and Ph.D. in Analytics and Data Science. In this project, we propose to make a department-wide effort to replace the textbooks used in seven BSCS and MSCS courses related to science and technology in Modern Computing Systems with no-cost-to-students learning materials to greatly reduce student cost and improve student success rates.

We expect this textbook transformation project to have a profound impact. In the past 7 years, more than 1,133 students have graduated from our undergraduate programs and more than 257 students have graduated from our graduate programs. These graduates have become a major workforce for the local community in the State of Georgia and nationwide. Programs from our department also advocate and promote student diversity and multiculturalism. For example, of the students currently enrolled in the BSCS program, 55% are minority students; of the students graduated from the MSCS program, 57% of the students are females and 71% are minority students; of the students currently enrolled in the MSCS program, over 50% entered our MSCS program without a CS background. Over the years, we are continuously improving the quality of our programs while endlessly seeking ways to make our programs more affordable so that more good-quality, underrepresented, and career-changing students will be encouraged to apply for and enter our programs. The proposed transformation project is consistent with our department goal to not only improve the quality of our programs to better prepare students for today's competitive job market, but also to reduce students' financial burden and increase our programs' affordability.

2. Statement of Transformation

Modern Computing Systems is an important branch of CS curriculum, and it includes various aspects such as how computers are organized (CS 3503 Computer Organization and Architecture), how software and tools are designed for mobile communication and transactions (CS 4322/7455 Mobile Software Development), how resources are shared and allocated in efficient and effective ways (CS 4524/7125 Cloud Computing), how we use state-of-the-art technologies to automate the decision-making process (CS 7267 Machine Learning) and how systems provide information to users (CS 4712 User Interface Engineering). CS 4322 (Undergraduate Mobile Software Development) provides students with real-world relevant mobile app development and improve their knowledge and skills on mobile application development such as Android GI and Android building block components, while CS 7455 (Graduate Mobile Software Development) covers more advanced topics such as 3D graph and multimedia mobile apps, resource management for mobile apps, sensor apps, and android security issues. Similarity, CS 4524 (Undergraduate Cloud Computing) provides students with basic knowledge and application of Cloud Computing such as Cloud SPI model, Amazon EC2 and Google App Engine, while CS 7125 (Graduate Cloud Computing) discusses more advanced topics such as Hadoop HDFS, MapReduce and tasking scheduling in Cloud.

To keep up with the ever-increasing pace of Computer Science and Technology, it is mandatory for us to update the curriculum of CS programs frequently. However, traditional textbooks used in the courses mentioned above are not only expensive, but also insufficient to convey adequate and up-to-date knowledge to students. For example, CS 4524 and CS 7125 cover knowledge, practice and tools in the Cloud Computing area. The original textbook used to be a good fit explaining Cloud Computing from the implementation perspective when the courses were designed a few years ago. However, with the rapid development in the field of Cloud Computing, that textbook can provide neither adequate nor up-to-date knowledge for students, especially at the graduate level. Similarly, in CS 4322 and CS 7455, we use the android studio and android SDK in assignments and projects which are updated frequently every year, and the hardcopy textbook cannot reflect those changes in time. Also, CS courses normally cover numerous topics, and it is hard to find one textbook that can include all the essential contents, thus students are required to purchase multiple textbooks. For example, CS 3503 combines a wide range of topics including computer architecture and organization, computer arithmetic, computer logic, assembly language programming, Instruction Set Architecture (ISA), design of single-cycle CPU, and hardware security. Therefore, it covers topics from multiple textbooks. Another example is CS 7267 that covers a number of machine learning models and methods such as Restricted Boltzmann Machine, Deep Believe Network, Neural Networks, and Convolutional Neural Network that one textbook cannot cover all together. Furthermore, an increasing numbers of new models and technologies (e.g., just looking at only deep learning related works) are being proposed every year. In order to reduce/eliminate textbook costs, it would be great to compile one single, online free and open-sourced learning material.

Also, with regard to the pedagogical aspects, textbooks generally fail to include the following significant pedagogical principles and concepts:

1) Introducing new topics by purposefully referencing prior knowledge of students,

2) Encouraging independent study experiences to enhance metacognition,

3) Promoting distributed or spaced practices (exposure of content/topics multiple times throughout a course),

4) Interleaving or alternating different but related topics and skills, and

5) Lacking of hands-on learning materials.

Hence, we need to design and implement no-cost-to-students learning materials to eliminate the textbook costs in the proposed BSCS and MSCS courses in the field of Modern Computing Systems. The feasibility of this textbook transformation project is reflected in the following aspects:

1) As an important feature of today's Computer Science fields, many leaning materials that are part of the essential content of the proposed BSCS and MSCS courses are open-source and free of charge. For example, in CS 4524 we use a toolkit called CloudSim that helps students study and analyze simulated activities in the Cloud, such as datacenter creation, task scheduling and network topology. Using CloudSim greatly helps students learn how Cloud systems work, and it provides a relatively short learning curve. CloudSim is open-source, and students can easily download the package written in Java from its official website and import it in IDEs such as Eclipse.

2) Enriched with various forms of multimedia with engaging interactional technologies, web-based learning materials provide flexible ways for the students to have two-way communications with tools related to the courses they take. Furthermore, interactive online laboratories are available through many educational institutions for free use. For example, there are many available interactive web-based materials used for CS 4712, including Unity 3D, VRML (Virtual Reality Modeling Language), DJI Phantom Drones with Microsoft Goggles, Microsoft HoloLens, EPOC+, a High-resolution multiple channel EEG designed by Emotive, and HTC VIVE Virtual Reality Headset System. These technologies will work seamlessly for both online and face-to-face classes. In CS 7267, interactive and graphical explanation provides easy methods to understand complex concept intuitively, and online resources can efficiently support the interactive materials. Also, discussion for case study in CS 7267 (e.g., data cleaning, preprocessing, experimental setting, and model interpretation) is essential. Students can discuss with each other via online interactive forums and share their ideas efficiently.

3) The nature of Computer Science determines that the knowledge it involves is always continuously and quickly updated, and free resources available online are more advantageous than traditional textbooks in keeping up with the fast-changing Computer Science and Technology. In fact, our instructors have already been researching and identifying appropriate and related no-cost web content to be used in the BSCS and MSCS courses involved in this project. For example, in CS 7267, we use free online textbooks with good quality such as "Deep Learning" by Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016 and books in data science from websites such as https://www.kdnuggets.com/2015/09/free-data-science-books.html and https://www.oreilly.com/data/free/archive.html.

4) By designing our own lecture notes, study guides, PowerPoint presentations, instructional/tutorials content videos, online and offline reading materials, assignments and exercises and assessment tools, we gain the capability to dynamically adjust our courses so they will be always consistent with the outcomes of our BSCS and MSCS programs.

Furthermore, the majority of our team members have more than 7 years of teaching experience, and we are the experts in searching through the unorganized mass of data on Internet and in organizing the state-of-the-art techniques. As the first team in the Department of Computer Science, we are fully committed to the development of no-cost-to-students learning materials for the proposed BSCS and MSCS courses in the Modern Computing Systems field. We also hope this project will serve as a pioneer for the many more future textbook transformation projects in the Department of Computer Science of Kennesaw State University.

3. Transformation Action Plan

Here is a table that shows the responsibilities of each investigator involved in this project:

Table 3. PIs' Roles and Responsibilities

Primary Investigator	**Course**	**Responsibilities**
Dr. Yong Shi	CS 4524 / CS 7125	Project Lead. Subject Matter Expert and developer; course coordinator; instructor of record
Dr. Dan Lo	CS 3503	Subject Matter Expert and developer; course coordinator; instructor of record
Dr. Selena He	CS 4322 / CS 7455	Subject Matter Expert and developer; course coordinator; instructor of record
Dr. Sarah North	CS 4712	Subject Matter Expert and developer; course coordinator; instructor of record
Dr. Mingon Kang	CS 7267	Subject Matter Expert and developer; course coordinator; instructor of record

All investigators are the coordinators of their corresponding course(s). To achieve our goal of textbook transformation for the seven BSCS and MSCS courses involved in this project, we will plan our textbook transformation process in three stages:

Stage1: Initial preparation

- Analyze and complete the modification of course syllabi
- Analyze the consistency between no-cost-to-students learning materials, course learning outcomes, and BSCS and MSCS program outcomes

Stage2: Implementation

- Map and design no-cost-to-students learning materials to learning modules of each course
- Design PowerPoints and video recordings for all learning modules of each course using no-cost-to-students learning materials
- Design assignments, labs and projects using no-cost-to-students learning materials
- Design exams that are consistent with no-cost-to-students learning materials.

- Reconstruct the proposed seven BSCS and MSCS courses on the KSU official D2L Brightspace site

Stage3: Evaluation and promotion

- Evaluate and measure our textbook transformation project using student surveys, official course evaluations and student performance data of spring, summer and fall semesters in 2019 and compare the results with those from 2018
- Continuously update course learning modules using no-cost-to-students materials based on evaluation and feedback
- Evaluate the change of retention rate compared to previous academic year of 2018
- Present our work to a wide range of audiences through conference and workshop presentations

4. Quantitative and Qualitative Measures

We plan to assess our project both quantitatively and qualitatively, including comparisons of students' performance before (student performance data from the academic year of 2018 will be collected) and after the adoption of no-cost-to-students learning materials, surveys, comparison of course-level retention, etc.

Table 4. Quantitative and Qualitative Measures

Source	Description
Midterm student survey on no-cost-to-students learning materials (Qualitative Measures)	We will conduct a survey of students' opinions on using the no-cost-to-students learning material in the middle of each semester. This is to gather students' feedback so we can dynamically adjust our course content according to students' suggestions and recommendations. The questions involved in this survey will include but not be limited to: 1. What do you think of the new no-cost-to-students learning material we used so far for this course? 2. Do you prefer the new way of using no-cost-to-students learning material or the traditional way of using hardcopy textbooks? 3. What improvements would you suggest we can make regarding our no-cost-to-students learning material delivery? 4. Do you think you will learn more or less knowledge using no-cost-to-students learning materials? 5. Do you think your grade will be improved using no-cost-to-students learning materials?
End-of-term student survey on no-cost-to-students learning	We will also conduct a survey of students' opinions on using the no-cost-to-students learning material again by the end of each semester. Feedback gathered in this survey will be used to adjust the course content

materials (Qualitative Measures)	and arrangement of no-cost-to-students learning material for the following semester. The questions involved in this survey will include but not be limited to: 1. What changes of no-cost-to-students learning material would you suggest if this course is offered again? 2. What is your expected grade for this course? 3. Would you prefer we redesign more courses in BSCS (MSCS) using no-cost-to-students learning material? What would you say the impact to the program will be if we do so?
Official student evaluation (Quantitative and Qualitative Measures)	The official student evaluation provided by KSU will also be used to gather information of students' opinions on using no-cost-to-students learning materials as well as the way instructors are teaching no-cost-to-students learning materials.
Comparison of student performance before and after using no-cost-to-students learning materials (Quantitative Measures)	We use the grades to analyze the change of student performance in the following categories: 1. Homework grades 2. Project grades 3. Presentation grades 4. Lab grades 5. Individual questions in midterm and final exams
Retention (Quantitative Measures)	We will compare the drop rate, fail rate, and withdrawal rate before and after using no-cost-to-students learning materials to see how the new method impacts course retention.

5. Timeline

The table below shows the detailed step-by-step progress of this project including a list of major milestones aligned with the Transformation Action Plan.

Table 5. Timelines and Milestones

Milestone dates	Milestone
11/1/2018	1) Attend the Kickoff Meeting in Middle Georgia State University Hatcher Conference Center (10/29) 2) Complete the modification of course syllabi, analyze the consistency between no-cost-to-students learning materials, course learning outcomes, and BSCS and MSCS program outcomes 3) Progress report 1
12/1/2018	1) Map and design no-cost-to-students learning materials to learning modules of each course, design assignments, labs and projects using no-cost-to-students learning materials, redesign exams that are consistent with no-cost-to-students learning materials. 2) Progress report 2
12/20/2018	1) Complete the update of course learning modules, assignments, labs, projects, PowerPoints, etc. on the official KSU D2L Brightspace. 2) Complete the design of midterm and end of term survey for students' feedback 3) Progress report 3
03/01/2019	1) Conduct the midterm survey for spring 2019, gather students' feedback 2) Adjust the course content with no-cost-to-students learning materials based on the midterm survey 3) Attend ACM-SIGCSE 2019 and present our research work (tentative) 4)Progress report 4
05/15/2019	1) Conduct the end of term survey for spring 2019, gather students' feedback 2) Conduct the official student evaluation for spring 2019 3) Compare student performance before (spring 2018) and after using no-cost-to-students learning materials 4) Adjust the course content with no-cost-to-students learning materials based on 1) 2) and 3)
06/01/2019	1) Conduct the midterm survey for summer 2019, gather students' feedback 2) Adjust the course content with no-cost-to-students learning materials based on the midterm survey 3)Progress report 5
07/26/2018	1) Conduct the end of term survey for summer 2019, gather students' feedback 2) Conduct the official student evaluation for summer 2019 3) Compare student performance before (summer 2018) and after using no-cost-to-students learning materials 4) Adjust the course content with no-cost-to-students learning materials based on 1) 2) and 3) 5) Progress report 6
10/15/2019	1) Conduct the midterm survey for fall 2019, gather students' feedback 2) Adjust the course content with no-cost-to-students learning materials based on the midterm survey 3) Attend IEEE-FIE 2019 and present our research work (tentative) 4)Progress report 7
12/10/2019	1) Conduct the end of term survey for fall 2019, gather students' feedback 2) Conduct the official student evaluation for fall 2019 3) Compare student performance before (fall 2018) and after using no-cost-to-students learning materials 4) Adjust the course content with no-cost-to-students learning materials based on 1) 2) and 3) 5) Complete and submit research work to education conferences.

12/12/2019	Submit the final project report

6. Budget

The table below lists the responsibility and compensation for each investigator in our team. We estimate that each investigator (the coordinator of corresponding course(s)) will spend more than 100 hours in designing the no-cost-to-students learning materials, designing mid-term and end-of-term student surveys, updating and maintaining course curricula using no-cost-to-students learning materials, assessing course outcomes, and coordinating the work progress of instructors teaching different sections of the same course using the new no-cost-to-students learning materials.

Table 6. Budget and Justification

Team Member	**Role**	**Investigator's compensation**
Dr. Yong Shi	Developer and instructor for CS 4524 / CS 7125	$5000
Dr. Dan Lo	Developer and instructor for CS 3503	$5000 to be allocated to his department of Computer Science to be used for Professional Development
Dr. Selena He	Developer and instructor for CS 4322 / CS 7455	$5000
Dr. Sarah North	Developer and instructor for CS 4712	$5000
Dr. Mingon Kang	Developer and instructor for CS 7267	$5000

Budget for Investigators Compensation

Total investigators compensation will be $5000 *5 = $25,000.

Travel & Other Expense will be $2500, of which $800 is the expense for two team members to attend the Kickoff Meeting at Middle Georgia State University Hatcher Conference Center, and the remaining $1700 is budgeted for attending another conference related to the course development involved in this project such as ACM-SIGCSE 2019 and IEEE-FIE 2019.

Equipment (computers and tablets): $2500, of which $2000 will be used for purchase of computers, webcams and microphones for the team to build and test no-cost-to-students learning materials, and $500 will be used for purchase of tablets for the team to experiment on mobile teaching environment.

Total Budget: $30,000.

There is no cost for online textbooks, software and online tools, because they are all open-source and free of charge.

7. Sustainability Plan

Our sustainability plan aligns with our college's and department's effort to continuously improve the quality of teaching. For each course taught in the Department of Computer Science at KSU, a coordinator is assigned who is responsible for the course content maintenance and updates, course teaching, and coordinating instructors teaching different sections of the same course in a semester. All of our team members are coordinators of the corresponding course(s) in this textbook transformation project. We will not only design and develop the no-cost-to-students learning materials and be the first ones to teach the course(s), but we will also monitor the course teaching for following semesters to make sure the course teaching is consistent. Each of us will write a course related tutorial which describes the arrangement of course content using no-cost-to-students learning materials for future instructors. All course related materials will be available at the official KSU D2L Brightspace site as well as the department depository to make sure that any future instructor for a course has access to the no-cost-to-students learning materials.

In addition to the coordinator arrangement and course related no-cost-to-students learning materials availability within the Department of Computer Science, each semester, our department also organizes a day-long event for course assessment. The purpose of this assessment is to evaluate the student learning outcomes of each course and update course content using no-cost-to-students learning materials according to the evaluation. This is to make sure that we continuously improve our courses using no-cost-to-students learning materials.

At the end of each semester, we also invite industry experts to our student project presentation meetings, and ask them to evaluate the student projects and presentations from the courses using no-cost-to-students learning materials.

We will use the comparison of student performance data before and after using no-cost-to-students materials, student feedback, and evaluation from the industry experts to continuously improve the no-cost-to-students learning materials in our BSCS and MSCS courses. As the first textbook transformation project in the Department of Computer Science, we hope this project will serve as a pioneer and that the success of this project will encourage many more future textbook transformation projects in the Department of Computer Science at KSU. We also plan to submit research work based on our textbook transformation project to education conferences such as ACM-SIGCSE and IEEE-FIE and present our work to a wide range of audiences.

Our textbook transformation project is also supported by our department chair and the dean of our colleges as shown in their support letters to further ensure the sustainability of our transformation plan.

Note: Letter of Support

We attach two support letters here. One is from the Dean of the College of Computing and Software Engineering, and the other is from the chair of the Department of Computer Science.