

Proposal for: Undergraduate Certificate Program in Computer Game Development

Department of Mathematics and Computer Science
College of Science and Technology
Lincoln University
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I. Program Overview

The Lincoln University currently offers a Bachelor's degree in Computer Science. The Department of Mathematics and Computer Science seeks approval to initiate a new certificate program in Computer Game Development. This new certificate program will be housed in the Department of Mathematics and Computer Science within the College of Science and Technology and overseen by Computer Science Program.

The certificate program will be developed for undergraduate students who are majoring in Computer Science or related fields and want to intensively study Computer Game Development. The certificate is ideal for a student planning for an advanced degree in gaming, or to enter gaming industry.

The curriculum for the certificate consists of 18 hours of coursework(6 courses). The sequence of courses is linear in content. The certificates will be awarded to students who complete the required courses with grades of C or better, and graduate with a Bachelor's degree in Computer Science or related fields such as Mathematics, Information Technology.

The program will enlist current STEM students interested in gaming. It will also promote our computer science program to potential students in other disciplines, employers and graduate school recruiters.

II. Introduction and Justification

The study of games and game production is important to developments in education, training, and medicine. Given the relative youth of the discipline, the potential of serious games is immense. As a tool for training and education in general, games have proven to be an effective addition to traditional methods, especially in simulation.

Clear evidence that games are more than just for entertainment can be found everywhere. As more public and private entities seek out and use this innovative approach, a focus on the development of games will be necessary. A certificate program in game development will turn out the kind of professionals and future scholars that can lead the way forward.

The proposed certificate program in Computer Game Development responds to current job creation needs in the commonwealth of Pennsylvania. Contemporary game design is a multi-billion dollar component of the entertainment industry, and serious game design and production is becoming ubiquitous in our daily lives. Games also play an increasing role in education and training, in areas as diverse as management, healthcare, law enforcement, and defense. The proposed program will allow Pennsylvania to contribute to this important industry and to have positive impacts in the delivery of essential public services.

Serious-game design is already having an impact in Pennsylvania. Some examples of the expanding applications of serious games are listed below:

- Neurosensory Center of Eastern Pennsylvania is using computer games to treat visual system dysfunction and strengthen visual skills of the patients diagnosed with autism, brain injury, stroke or a variety of other conditions.¹
- Northgate School District at Pittsburgh uses games to educate students on Math, Science, Reading and Social Study².
- Every year, Grassroots Game Conference hosts “K12 Game Creation for STEM”. They use games to introduce kids to the creative use of technology, in a manner that embraces programming to design and music to writing³.

Additional justification and rationale to offer the certificate program in Computer Game Development include:

1. Additional certificate option for undergraduate students in the Commonwealth of Pennsylvania, the Philadelphia and Washington Metropolitan region with majors in Computer Science or related field;
2. To increase the Lincoln computer science undergraduate retention and graduation rate;
3. Industry options to partner with our students on cutting-edge gaming and simulation, and interactive design research projects; and
4. Increased research and funding potential by establishing collaboration.

The Lincoln University, like many other historically black colleges and universities (HBCUs), is looking to offer certificate both as a way to expand its enrollment and because it believes that it can provide more effective and culturally responsive education to the students it was designed to serve than is typically provided by large for-profit universities. It also will support one of the university’s goals, which states that the University faculty will develop new curricula that are driven by student needs and tested by feedback from students, employers, professional associations and alumni.

¹ NeuroSensory Center of Eastern Pennsylvania. Retrieved from <http://www.keystonensc.com/services/OMT.html>

² Northgate School District. Retrieved from <http://www.northgate.k12.pa.us/students.aspx>

³ K12 Game Creation for STEM. Retrieved at <http://grassrootsgameconference.com/k12-game-creation-for-stem/>

III. The Undergraduate Certificate In Computer Game Development

A. Objectives, Goals and Student Learning Outcomes

The purpose of the Computer Game Development certificate is to provide undergraduate students with the opportunity to reach a demonstrated level of competence in game development. The certificate will provide set of competencies for students who want to advance their knowledge of modern game design and development techniques. The educational objectives of the program are:

- To provide the students with the knowledge and skills to create and develop games and simulation in the industry,
- To prepare the students for their first and subsequent positions, as they are independent learners, including learning new, rapidly-changing technologies and applying them in their game systems development.
- To train the students to work effectively in team environment and demonstrate effective oral and written communication skills.
- To prepare the students for graduate study in game related fields.

The goals of the proposed certificates in Computer Game Development are to:

- Develop the basic competencies needed by computer science graduates to contribute quickly and effectively to the technical and research needs of the game industry and the government agencies, and
- Create a benchmark educational program that can serve as a model for other programs.

Computer Game Development Certificate Student Learning Outcomes (PSLOs) include the following knowledge, skills, and competencies:

1. Apply the principles of game design that make for a playable experience. (CSC454 and CSC490)
2. Describe the hardware and software components of a video game system. (CSC452)
3. Build and deploy characters and models. (CSC202)
4. Design and build a single user 2D and 3D video game and evaluate existing game engines, script games in those engines. (CSC458)
5. Create a proposal for a game including concept, design, game adaptation, gameplay elements, production plan, and story character elements documents. (CSC490 and CSC491)
6. Communicate ideas, information and intentions effectively and foster healthy working relationships within a team. (CSC491)

B. Program Curriculum

The Computer Game Development certificate is a transcript recognized program. Students who complete certificate requirements will receive recognition on the University transcript.

The Certificate in Computer Game Development will be awarded to students who complete the following courses, with grades of C or better, and graduate with a Bachelors degree in Computer Science or related fields including (but not limited to) Mathematics, Information Technology and Engineering:

• CSC 202 Introduction to Computer Animation	(3 credits)
• CSC 452 Computer Graphics	(3 credits)
• CSC 454 Software Engineering	(3 credits)
• CSC 458 Introduction to Game Programming	(3 credits)
• CSC 490 2D Games Development Capstone	(3 credits)
• CSC 491 3D Games Development Capstone	(3 credits)
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Total	18 credits

Course descriptions:

CSC 202 Introduction to Computer Animation (3 Credits)

Prerequisite: CSC-159 (Programming II). This course is a study of the art and science of computer animation. Both programming and utilization of animation software will be covered with an emphasis on the latter. The topics include NURBS and Polygon modeling, rendering techniques, motion path, and introductory applications of mathematics and algorithms in computer gaming.

CSC 452 Computer Graphics (3 Credits)

Prerequisite: CSC 254 (Data Structure), MAT 120 (Calculus). This course develops and applies the mathematical theory of computer graphics. The theory includes rotation, translation, perspective projection, and curve and surface description. Students will learn to use a graphic programming language, OpenGL.

CSC454 Software Engineering (3 Credits)

Prerequisite: CSC254 (Data Structure). This course will introduce the student to the principles and techniques involved in the generation of production quality software items. The emphasis will be on the specification, organization, implementation, testing and documentation of software products.

CSC 458 Introduction to Game Programming (3 Credits)

Prerequisite: CSC 202 (Introduction to Computer Animations). An introduction to the fundamental concepts of computer game programming. Students design and develop

original games for PCs applying proven game design and software engineering principles.

CSC 490 2D Games Development Capstone (3 Credits)

Prerequisite: CSC458 (Introduction to Game Programming). The Capstone Game Development course forms small teams in which student will contribute modeling, animation or programming skills to create of 2D games for mobile, online, and social technology platforms. Students will gain a thorough understanding of the 2D game development process, through modeling of the environment and practices that are used in game studios.

CSC 491 3D Game Development Capstone (3 Credits)

Prerequisite: CSC458 (Introduction to Game Programming). The Capstone Game Development course forms small teams in which student will contribute modeling, animation or programming skills to create 3D games. Students will gain a thorough understanding of the 3D game development process, through modeling of the environment and practices that are used in game studios.

Note: Admission to the Capstone Project will be competitive. Students will need to submit a resume and a portfolio of their game-related work. The portfolio may be software, designs, animations, 3D artwork, sound design examples, or game stories, anything that demonstrates exceptional skills in one or more areas of game development.

C. Admission Requirements

To be admitted into the Undergraduate Certificate in Computer Game Development, students must hold an undergraduate degree or admission to an undergraduate degree program at Lincoln University. Official transcripts for previous degree(s) and course work are required to be submitted together with an admission application. Course-work towards the certificate in Computer Game Development can be used for credit towards the Bachelor's degree in Computer Science at Lincoln University.

IV. Timeline For Course Development And Implementation

Table 1 shows sequence of course offerings for Computer Game Development Certificate in the past two years. The certificate courses have been offered to CSC students after CSC490 (2D Game Development) and CSC491 (3D Game Development) were approved by the curriculum committee in the spring of 2014. The certificate courses enrolled 96 students in total since fall of 2013. The courses have been appreciated and receiving good feedback from students, which are reflected by student evaluations and course assessment reports. Table 2 summarized this information. Among these courses, CSC452 (Computer Graphics) was only offered one time in the fall of 2015. Therefore we are anticipating the graduation of the first game certificate class this May of 2016.

Table1: Proposed Game Development Courses Offerings

<i>Fall of 2013, 2014, 2015</i>	<i>Spring of 2014, 2015, 2016</i>
CSC 202 Intro. To Computer Animation	CSC 458 Intro. To Game Programming CSC 454 Software Engineering
<i>Fall of 2014, 2015</i>	<i>Spring of 2015, 2016</i>
CSC 452 Computer Graphics (only offered in the fall of 2015) CSC 490 2D Games Development Capstone	CSC 491 3D Game Development Capstone

Table2: Course Enrollment and Student Evaluations

<i>Gaming Course</i>	<i>Enrollment (Total)</i>	<i>Student Evaluations</i>	
		<i>Course (Average)</i>	<i>Instructor (Average)</i>
CSC202	34	3.71/4.0	3.65/4.0
CSC458	32	3.64/4.0	3.64/4.0
CSC452	5	4.0/4.0	4.0/4.0
CSC490	13	3.75/4.0	3.75/4.0
CSC491	12	--	--

The Department of Math and Computer Science will oversee the certificate program in Computer Game Development. Dr. Claude Tameze (Associate Professor and Chair of the Department of Math and Computer Science) and Dr. Derrick Swinton (Professor and Dean of College of Science and Technology) will supervise and provide guidance for the Game Development Certificate Program. Both of them will be responsible for the evaluation aspects of this project.

VI. Projected Resource Needs

A. Lab Space and Computing

Infrastructure needs for the certificate program will use existing space and computational facilities. An additional computer lab with game design software needs to be identified for student research and study. This space will allow students to access any time to accomplish their capstone research projects. The program will also need a dedicated computer lab with game design software for teaching the proposed courses. It is anticipated that additional instructional equipment and software will cost roughly \$19,000. With funded Title III grant to enhance current Computer Science Infrastructure, Computer Science program has received funding support for the proposed equipment and software needs.

Table3. Infrastructure needs

Needs	Total Units	Remarks

Research Area -Computer Lab	1	This space will allow students to access any time to accomplish their capstone research projects
Teaching Space -Computer Lab	1	A dedicated computer lab with game design software for teaching

B. Library Resources

Library resources to support the certificate program will be available from three sources: Langston Hughes Memorial Library, The IVNCS Library, and remote access to UD Library and resources.

C. Faculty Line

The proposed courses in Computer Game Development have been offered by Dr. Bo Sun, associate professor of Computer Science, who has a Ph.D. in Modeling and Simulation. Dr. Sun has more than 8 years of R&D experiences in simulation by utilizing computer graphics and visualizations. Dr. Sun so far has 18 publications in journals and conference proceedings and also holds a U.S. patent. Her experiences in game development for simulation research are extensive. Prof. James Chikwem, adjunct professor of CSC, has also been helping to offer the courses. Prof. Chikwem holds a Master Degree in Computer Graphics and Game Technology from University of Pennsylvania and he has more than 5 years of project experiences on Game Development.

As displayed in Table 4, a total of 3/8 (0.375) FTE faculty (9-credits teaching load) is required to cover Dr. Sun's current teaching load in order to enable her to deliver the required courses for the Game Development Certificate, which includes directing the game research projects. Prof. Chikwem has been hired by the department to support this effort in the past two years.

Computer Science major enrollment has increased from approximately 54 to 72 students in year 2013 to 2016. This proposed certificate will contribute to promote and market Computer Science program at Lincoln University.

Table 4 Faculty line needed to support Game Certificate Program

Course currently not offered, Required by Game Certificates	Faculty Load
CSC 452 Computer Graphics	3
CSC 490 2D Games Development Capstone	3
CSC 491 3D Game Development Capstone	3
Total FTE	9

Request	Computer Science	Departments	Start date
$\frac{3}{4}$ FTE Game	0.375	AY14 search 37.5-62.5 joint appointment Game/Cybersecurity Computer Science	9/2014

VII. Financial Analysis, Program Assessment And Evaluation

Five-year budget projection (See Table 5) of the certificate estimates a profit for the University. The certificate program income will help to sustain faculty lines, addition of more computer science student resources, ongoing improvements and services, and student and faculty continuous development.

Table 5: Undergraduate Certificate Program in Computer Game Development

Estimated Revenues	Year1		Year2		Year3		Year4		Year5		Total
	In state	Out of State	In state	Out of State	In state	Out of State	In state	Out of State	In state	Out of State	
Enrollments	5	7	5	7	5	7	5	7	5	7	60
Tuitions	\$51,951.96		\$51,951.96		\$51,951.96		\$51,951.96		\$51,951.96		\$259,759.8
Estimated Expenses	Year1		Year2		Year3		Year4		Year5		
Faculty Salary and Benefit	\$30,000		\$30,000		\$30,000		\$30,000		\$30,000		\$150,000
Instructional Equipment	\$7,000		\$0		\$0		\$0		\$0		\$7,000

Software	\$12,000	\$0	\$0	\$0	\$0	\$12,000
Total	\$49,000	\$30,000	\$30,000	\$30,000	\$30,000	\$169,000
Difference	\$2,951.96	\$21,951.96	\$21,951.96	\$21,951.96	\$21,951.96	\$90,759.8

Estimated revenues are calculated based on the current Lincoln tuition rate for in-state (\$378.37/credit) and out-of state (\$554.37/credit) students. We project there are 5 in-state and 7 out-of-state students annually for game certificate class based on current Lincoln in-state and out-of-state student ration, which is 4:6. Students will need a total of additional 9 credits to gain the certificate.

Each year we will target a total of 12 students to enroll for the certificate program. A formal evaluation of the program will be conducted on an annual basis, focusing on the following criteria:

- Number of students enrolled in Game Development courses
- Number of students earning the Game Development certificate
- Quality of graduating students based on their GPA and class standing
- Student evaluation of each course offering
- Job placement opportunities including the companies hiring, starting salaries, etc.
- Employer satisfaction focusing on the strengths and weaknesses of students graduating with a certificate in Game Development.
- Budgetary factors, i.e. revenues and expenditures associated with the program; ability to attract outside funding.