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UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Department of Computer Science

201 North Goodwin Avenue
Urbana, IL 61801-2302   USA

To: Prof. Bettina Francis,
      Chair, Senate Educational Policy Committee

The Department of Computer Science intends to deploy a specialization of its online Masters of Computer Science (MCS) degree focusing on Data Sciences ("DS"). This MCS-DS specialization will be delivered in an online format that follows the model of the iMBA. It will use Coursera MOOC video lessons for lecture delivery and an LMS (e.g., Compass) to manage the assignments, exams, projects and office hours. As it does with our current online MCS, the LMS provides a platform restricted to registered students only, and provides them access to faculty and TAs for advice and assessment commensurate with a credit-bearing online course. Given the visibility of the Coursera MOOC platform and the high demand for Computer Science and Data Science education, the scalable nature of this new program delivery option will allow us to better meet market demand and enrollments, and will likely increase enrollments more than 25% per cohort as the program scales up to its potential over the coming years. The initial enrollment target will be 150 students, and growth will be regulated by the CS Department to ensure it maintains proper academic rigor and avails itself of adequate staffing and support.

Background

The Computer Science Department is consistently ranked among the top 5 CS programs in the nation, and the top 15 CS programs in the world. Its programs have some of the highest entrance requirements on campus, and its classes are notoriously overbooked. Its online MCS program was originally developed over 15 years ago to deliver the MCS to students in India, but is now a rather standard online masters degree and is largely unknown due to lack of attention in this highly competitive field.

The online MCS was reviewed by CEEED (the Committee on Extended Education and External Degrees) in April 2014. The CEEED review found that the program was healthy with good levels of student satisfaction (20%/57%/23% moderately/very/extremely satisfied). One of the most common complaints was the use of classroom video capture for lecture delivery.

The CEEED review noted that the program only enrolls about 31 students each year, which is quite small given the high demand for skilled professionals in the computer sciences, and well below the CS Department's desired enrollment targets for this program. CS has hired a marketing specialist, contracted with an advertising agency for $18K/year, contributes $600/year to Engineering in support of their college-wide online degree marketing activities, and has also paid for an MBA marketing class study to develop new online MCS marketing strategies.

The CEEED review also noted the diversity challenges of the program. Over the previous three years, the program enrollment was only 4.2% female and 4.2% underrepresented minorities. At this same time, the CS campus graduate program has grown female enrollment from 15% to 20% and doubled its URM enrollment to 22 students.

In the meantime, Georgia Tech has offered a MOOC-based OMSCS (Online Masters of Science degree in Computer Science). The program immediately benefited from the press in the form of free advertising in

nearly 700 articles, growing to a single cohort enrollment of 2,841 in just two years. Of its students, 13% are female, 16% URM and 79% domestic (US citizen or permanent resident). The Georgia Tech CS PhD program recruits the strongest candidates from its online Master's program to improve the diversity of its campus population.

A New Delivery Format for the Online MCS

We propose to offer a version of the online MCS degree that utilizes MOOC components similar to the Georgia Tech OMSCS and our campus's iMBA, and similarly benefits from the accompanying marketing and recruiting opportunities.,

The Computer Science Department currently provides a variety of MOOC courses in partnership with Coursera. These MOOCs consist of lecture video organized into short lessons (15-20 minutes) with embedded quizzes to improve learner attention. Students are assessed via several mechanisms supported on the platform: auto-graded quizzes, homeworks and exams; auto-graded software programming assignments; and peer-graded homework and project assignments. CS offers sequences of these MOOC courses that can be completed as Coursera specializations for certificates in Data Mining and in Cloud Computing.

While these MOOCs in their current form can result in certificates, they do not suffice alone to meet the requirements of university course credit that can be applied toward a degree. To meet university credit requirements, the assessment of students must be properly overseen by qualified faculty and TA's, who can provide verifiable assessment and feedback to students to ensure the satisfactory completion of course requirements.

The iMBA refers to the additional requirements above those of a MOOC as "high engagement." The iMBA offers 8-week high-engagement sessions that are synchronized with MOOC offerings to meet the requirements of course credit.

The MCS-DS instead consists of semester-long courses. The lecture material for each course is provided by two or more MOOCs offered during the semester. These MOOCs are the standard Coursera MOOCs available to Coursera students. In addition to the MOOC lecture material, an MCS-DS course will also include access to an LMS that will manage assignments, exams and projects, and support TA grading, feedback and guidance, that is restricted to UIUC students registered for the course.

The assessment of the proposed MCS will combine multiple existing and new assessment elements. The existing online MCS is LMS-based and includes assessment procedures that ensure the effective education of students. The program will also continue to be assessed through these and other standard periodic campus review procedures. In addition to these existing assessments, the proposed MCS-DS delivery format includes a MOOC portion, and Coursera provides ample, detailed, quantitative and qualitative assessment and feedback for all of its MOOCs.

The Data Sciences Specialization

Our initial offering of this MOOC-supported MCS degree is a specialization in the new field of Data Sciences. Data Science has emerged as a "fourth approach to scientific discovery, in addition to experimentation, modeling and computation," as reported by U. Michigan [press release, Sep. 8, 2015] when they initiated their $100M Data Science program by announcing 35 new faculty positions. They are joined by Stanford, NYU, USC and others that have introduced similarly innovative master's degrees in Data Science, and online versions of these degrees have been designed and offered by UC Berkeley, Wisconsin and others.

In cooperation with the Statistics Department and our I-School, the Computer Science Department approved, in a 3/4/16 faculty meeting, to proceed with this new online delivery format, starting with a new departmental specialization in Data Science for the MCS program. This MCS Data Sciences (MCS-DS) specialization satisfies all of the requirements of the MCS program while covering the key areas of Data Science across Computer Science, Information Science and Statistics. In particular, its courses in four areas of Data Science satisfy the MCS's coursework requirements in four core areas of computer science.

Data Science Subject	Computer Science Core Area
Data Mining	Database, Information Systems and Bioinformatics
Data Visualization	Graphics, Visualization and Human-Computer Interaction
Applied Machine Learning	Artificial Intelligence
Cloud Computing	Systems and Networking

The proposed curriculum of courses available for the MCS-DS is attached. With it is attached the MCS program of study, and shows that the proposed MCS-DS curriculum provides sufficient coursework to satisfy the requirements of the MCS degree. Hence the MCS-DS does not represent a new program nor a new degree. Instead it is a selection of courses available in a new online delivery format.

We are well poised to launch the courses for the MCS-DS for Fall 2016. The CS department already has infrastructure, expertise and experience in developing online LMS-based courses from its existing online MCS program. MOOCs have already been developed for the data mining, data visualization and cloud computing courses for the department's certificate programs. The I-School courses are already part of their online masters degree offerings, and will require converting the lectures to MOOC format. The remaining courses will be produced on a timeline so they can be offered in the coming three semesters.

Once launched, the format can readily support the integration of additional CS courses. The MCS-DS supports only a minimum four core areas of CS. The addition of courses in other core areas will enable the later delivery of an MCS without the constraint of the Data Sciences specialization. The MCS-DS supports a Data Science curriculum that includes significant Computer Science element, and could be broadened into a more fundamental Data Science masters degree program that does not require four core areas of Computer Science. Or the MCS-DS might not live up to its potential in which case the MOOCs could continue individually or as part of certificate sequences. The 32-hour coursework masters degree provides as flexible a platform as possible for such evolution. Students can complete the program within a single academic year, allowing the curriculum and course offerings to evolve annually, and students taking longer to complete can be transitioned to adapt to changes in course offerings and delivery formats as needed.

Sincerely,

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Rob A. Rutenbar
Bliss Professor and Head, Department of Computer Science

MCS – Data Sciences Specialization

Course	Title	Instructor	Hrs
Data Mining			
Must take four credit hours to satisfy MCS core requirement in databases			
CS 410	Text Information Systems	Zhai	4
CS 412	Introduction to Data Mining	Han/Chang	4
Data Visualization			
Must take Data Visualization course to satisfy MCS core requirement in visualization			
CS 498 DV	Data Visualization	Hart	4
Machine Learning			
Must take Applied Machine Learning course to satisfy MCS core requirement in AI			
CS 498 AML	Applied Machine Learning	Forsyth/Brunner	4
STAT 542	Practical Statistical Learning	Liang/Douglas	4
Cloud Computing			
Must take four credit hours to satisfy MCS core requirement in networking			
CS 498 CCA	Cloud Computing Applications	Campbell/Farivar	4
CS 425 C3	Cloud Computing Concepts	Gupta	4
CS 498 CN a	Cloud Networking	Godfrey/Farivar	4
Statistical Analysis			
STAT 400	Statistics and Probability	Dalpiaz/Zhu/Simpson	4
STAT 420	Methods of Applied Statistics	Unger/Dalpiaz/Zhao	4
STAT 571	Multivariate Analysis	Marden/Douglas/Simpson	4
Information Science			
IS 531	Foundations of Data Curation	Renear	4
IS 590 DCL	Theory & Practice of Data Cleaning	Ludaescher	4
Capstone			
CS 590 DMC	Data Mining Capstone	Zhai	4
CS 590 CC	Cloud Capstone	Gupta/Farivar	4
Total Required for MCS			**32**
Credit hours required at the 500 level			*12*

Master of Computer Science

This degree is offered as an on-campus program or via the Internet through the I2CS program.

Breadth Requirement: four different courses, each from a different core area out of the eight core areas.	12-16
Advanced courses – chosen from CS 500 - CS 590 and CS 598; CS 597, or an approved non-CS 500-level course may satisfy 4 credit hours of this requirement.	12
Elective courses (subject to Other Requirements and Conditions below)	4-8
Total Hours	**32**

Other Requirements and Conditions[1]

Other Requirements and Conditions may overlap

A minimum of 24 CS credit hours must be taken from the University of Illinois at Urbana-Champaign campus.

A minimum of 12 500-level credit hours overall.

A maximum of 4 hours of CS 591 and CS 491 may be applied toward the degree.

A grade of B- or higher is required for Breadth course work.

At most, 12 semester credit hours of previous graduate course work may be transferred and applied to the M.C.S. degree requirements and 12 credit hours of non-degree graduate courses completed in the Department of Computer Science at the University of Illinois at Urbana-Champaign campus may be transferred and applied to the M.C.S. degree requirements.

All degree requirements must be completed within three consecutive semesters (only fall and spring semesters are counted).

Off-campus students have 5 years in which to complete this degree.

The minimum program GPA is 3.0.

[1] *For additional details and requirements refer to the department's Graduate Degree Requirements and the Graduate College Handbook.*

Breadth Requirement: 12-16 credit hours
Must complete four different courses, each from a different area, from the following eight core areas with a grade of B- or higher.

- *Architecture, Compilers, Parallel Computing*: CS 426, 431, 433, 435, 462, 483, 484, 526, 533, 536
- *Artificial Intelligence*: CS 440, 443, 446, 543, 546, 548, 549
- *Database, Information Systems, Bioinformatics*: CS 410, 411, 412, 466, 511, 512
- *Formal Methods, Programming Languages, Software Engineering*: CS 421, 422, 427, 428, 476, 477, 522, 528, 524, 527, 576
- *Graphics/HCI*: CS 417, 418, 419, 465, 467, 519, 565
- *Systems and Networking (includes real-time systems and security)*: CS 414, 423, 424, 425, 438, 439, 461, 463, 523, 525, 538, 541, 545, 563
- *Scientific Computing*: CS 450, 457, 482, 554, 555, 556, 558
- *Theoretical Computer Science*: CS 475, 571, 573, 574, 579, 583

Department of Statistics
101 Illini Hall
725 South Wright Street
Champaign, IL 61820
USA

February 29, 2016

John C. Hart
Department of Computer Science and
The Graduate College
University of Illinois at Urbana-Champaign

Subject: Support for MCS-DS

Dear Professor Hart,

The Department of Statistics supports the proposed Data Sciences specialization of the MCS degree, using the Coursera MOOC platform for lecture delivery and our existing online educational systems to grade assignments, exams and projects, following the template of the iMBA. In addition, we plan to offer the following courses in this format for use by students in the Data Sciences specialization of the MCS:

STAT 400 a/b – Statistics and Probability I/II
STAT 420 a/b – Methods of Applied Statistics I/II
STAT 448 a/b – Advanced Data Analysis I/II
STAT 542 a/b – Statistical Machine Learning I/II
STAT 571 a/b – Multivariate Analysis I/II

Thank you for the opportunity to review this excellent proposal. I look forward to working with your and colleagues on this program.

Sincerely,

Douglas G. Simpson
Professor and Chair

February 25, 2016

Professor John Hart
Department of Computer Science
201 N. Goodwin Ave.
Urbana, IL 61801

Dear Professor Hart:

The Graduate School of Library and Information Science supports the proposed Data Sciences specialization of the MCS degree, using the Coursera MOOC platform for lecture delivery and our existing online educational systems to grade assignments, exams and projects, following the template of the iMBA. In addition, we plan to offer the following courses in this format for use by students in the Data Sciences specialization of the MCS:

LIS 531 a/b – Foundations of Data Curation I/II
LIS 590DCL a/b – Data Cleaning I/II

If you have any questions, please don't hesitate to let me know.

Sincerely,

Allen H. Renear
Dean and Professor