

# Professional Opportunities for Existing and New Students at CU Boulder

## Opportunities and challenges identified by Earth Lab's Earth Analytics Professional Program

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Growth of professional programs is exploding in the United States. It is predicted that by 2022 one third of all masters degrees acquired will be professional<sup>1,2</sup>. In tandem, demand for data intensive programs is exploding given increases in both job availability and salary<sup>3</sup>. However, despite a strong market for these skills, many jobs are still not being filled given a shortage of workers with data science skills and domain science knowledge. For example, in 2015, there were 4.4 million data scientist job openings and only 30 percent of those positions were filled. In a market analysis, which included surveys of employers, we found a consistent demand for employees that have coupled data science and science skills.

*"[An ideal job candidate has] science and technology understanding with demonstrated programming skills." -Hiring Manager, Northrup Grumman*

There is a tremendous opportunity for CU Boulder to be a leader in innovative professional programs that provide in demand skills to both a new body of professional students and to existing CU Boulder students. These programs will:

1. Increase the number and diversity of students enrolled at CU Boulder.
2. Provide new revenue streams to the University - if organized and run properly.
3. Enhance existing CU student's education with new, innovative courses that teach career specific skills.
4. Capitalize on CU's extensive institutional expertise in the space, earth, computer and data science realms.

Given the demand for technical professional programs, an Earth Lab Grand Challenge goal is to develop a Professional Masters and Certificate in Earth Analytics. This innovative program, capitalizes on intellectual strengths at CU blending data science with Earth systems science. We are one of the first

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<sup>1</sup> "Understanding the Changing Market for Professional Master's ...."  
<https://www.eab.com/research-and-insights/academic-affairs-forum/studies/2015/understanding-the-changing-landscape-for-professional-masters-programs>. Accessed 9 Jan. 2018.

<sup>2</sup> "Does a Professional Science Master's Degree Pay Off? | Science | AAAS." 30 Mar. 2012,  
<http://www.sciencemag.org/careers/2012/03/does-professional-science-masters-degree-pay>. Accessed 9 Jan. 2018.

<sup>3</sup> "Beyond the Talent Shortage - Indeed Blog."  
<http://blog.indeed.com/hiring-lab/beyond-the-global-talent-shortage/>. Accessed 9 Jan. 2018.

universities to launch such a program, with Earth Lab's certificate in Earth Data Analytics - Foundations starting in August 2018. However, other universities are not far behind (e.g. Bren School - University of California, Santa Barbara, University of Wisconsin). In the next six months we need to stake our claim to this fast-growing market of professional students who seek big data skills coupled with Earth science expertise. Below we outline our vision for professional programs and the key challenges inhibiting program development at CU Boulder.

## A Vision for Professional Programs at CU

Our vision includes new, cutting edge courses that are delivered in rich, online and in person teaching environments to an interdisciplinary mix of existing CU students and professionals. This blended learning environment simulates professional interdisciplinary environments, enriches the learning experience and provides flexibility to students with demanding schedules.

### Interdisciplinary Classes for Professionals, Undergraduate and Graduate Students

The professional and academic worlds are becoming increasingly interdisciplinary and team-oriented given the broad nature of the issues that society needs to address. Interdisciplinary programs are thus critical in addressing 21<sup>st</sup> century science challenges. Professional students need interdisciplinary experiences to be marketable. However, existing CU undergraduate and graduate students also often need applied interdisciplinary experience, which is not always fulfilled in traditional courses. Professional programs like Earth Data Analytics enrich the education experience of CU students by offering applied skills that are directly applicable to job placement.

*"[I want to see] discipline specific skills, i.e. geology, geophysics, geochemistry, remote sensing, coupled with varying degrees of computing/data skills. [Moving] forward more experience manipulating large datasets, scripting, programming via Python for example will be important."*  
-Brian Krzys, Exploration R&D, Newmont Mining

In our two semesters of teaching Earth Analytics at CU, we have had a mix of students from eight different departments including geography, geology, applied math, environmental studies, biology, computer science, sociology and anthropology. Each student had a unique experience in the course. Students from applied math and computer science have been particularly enthusiastic about understanding the science applications of techniques learned in their department courses, whereas the social and natural science students have focused more on learning the technical approaches for science.

*"After taking Earth Analytics...] I am able to list proficiency with R and analyzing large data sets as a skill that I have, giving me an edge on the competition." -- Leah Bollin, CU Boulder Graduate, Earth Analytics Student - Spring 2017*

### Innovative Online Program Development

If time and resources are invested properly, CU Boulder can become a leader in online education. Many successful professional programs have a strong online component (e.g. [Penn State GIS Program](#)). Online

programs support flexible schedules which are often required by non-traditional students. They provide documentation of lecture materials that can be challenging to absorb during a class period. Further, CU Boulder has invested significantly in distance classroom technology which allows students to connect synchronously to a class using Zoom. For some students, synchronous distance learning is the perfect blend of flexibility in attending class remotely with direct participation in class.

Online programs also enable students across the world to take CU courses, further increasing program visibility. The Earth Lab publishes its courses online: (see <https://earthdatascience.org/courses/earth-analytics>). We have seen significant increases in site traffic with a current user base of 4,600 unique users a month from countries across the world.



## New Career Development Opportunities Through Career-Focused Course Development

It is no surprise that rapid advances in technology and big data change the technical skills and knowledge required to solve pressing environmental problems. A successful professional program is founded in market research and driven by an advisory board that identifies marketable skills. Further, professional programs should offer students applied experience<sup>4</sup>.

*"I also want someone who can speak broadly about the industry and its challenges, not just repeat textbook examples or show code they've developed in a class." -Dr. Jordan Winkler, Hiring Manager, Digital Globe.*

The Earth analytics professional program brings agility to the CU curriculum as it needs to be current to attract professional students. Program courses will also provide valuable career specific tracks for existing CU students who are not on an academic path. Further, if the University incentivized program support of existing CU students, students could seek professional certificates to complement a traditional degree.

<sup>4</sup> Earth Lab Industry Survey 2016

## CU Faculty Expertise Enriches Professional Program Content

Professional students will benefit from the intellectual capital at CU Boulder. We envision current CU faculty developing courses for and teaching professional students. We further envision hiring faculty from industry who are explicitly targeted to contribute to professional teaching. Similarly professional students, particularly those participating in masters programs, could find research and applied opportunities in faculty labs and institutes to build experience. Integrating professionals into current CU structures will yield strong, future university-industry partnerships as students graduate and move into the private or federal sector.

## Challenges

Despite the growing opportunity of professional programs, there are significant challenges faced by faculty and staff when proposing, developing and running these programs at CU Boulder, including:

### 1. Faculty have no incentive to contribute to professional programs

While students can benefit from faculty teaching in professional programs, this type of teaching is currently not encouraged through existing faculty teaching obligations. Professional teaching that supports professional programs must be undertaken as an additional activity that does not contribute to tenure and is often discouraged.

### 2. University silos present barriers to developing interdisciplinary professional programs

While interdisciplinary experiences for both professionals and existing students are critical to career development, there is no clear path for proposing, building and running an interdisciplinary program at CU. Further an interdisciplinary program needs to sit in an interdisciplinary space rather than a single department. Mechanisms for creating interdisciplinary programs thus need to be developed at CU to support innovative program development.

### 3. Professional program models do not incentivize innovative course development

While there is significant opportunity to build cutting-edge online courses, current program models do not incentivize innovative, course development that supports both online offerings and interdisciplinary audiences. Designing an online course requires significant resources and additional start-up program costs. Further, creating online courses requires knowledge and skills that instructors and faculty don't always have. Yet, given this challenge, there is little instructional design support for programs that wish to develop courses and teach online. Our Earth Analytics course (which was taught both online and in person in the Fall 2017) demonstrated that online approaches are highly valuable to students. However, the online format took time and expertise to develop and implement successfully.

#### 4. University tuition fees during the startup years hinder program innovation and increase program financial liability

Currently there is a \$300 fee per credit taken from professional programs. This fee does not consider the program's initial startup costs, support innovative course development or fund program administration - particularly in the critical start-up years when programs may not generate profit. Further, during those same startup years, programs need to consider savings that accommodate years of low enrollment, when the liability is high as some program costs such as instruction, will be consistent regardless of whether 3 students or 15 students enroll. Considering these start-up challenges, it would be ideal if the University considered allocating some of that \$300 to program development and initial administration costs.

#### 5. Unclear financial models make sustainable program development challenging

Financial models for professional programs are unclear. Currently, each program develops a financial model independently. There is no structure for revenue sharing between a professional program and a department that offers a course that is also available to professional students. Further, there is no clear path for how revenue flows through the University system and is transferred back to the program. Ideally CU-Boulder would assist programs in developing sustainable financial models that consider:

1. Startup costs associated with course development and staffing.
2. Resource flows back to the program.
3. Interdepartmental MOU's that incentivize participation but also account for program costs to obtain new students, including marketing, courses development and staff.

#### 6. Professional programs are not incentivized to teach existing CU students

Currently, there is no incentive for professional programs to teach existing CU students even though program courses are of interest and great value to this audience. In the Spring and Fall 2017 we taught 41 existing undergraduate and graduate students from eight departments representing a total of 123 graduate and undergraduate credit hours in 2017 through its Earth Analytics Course (GEOG 4563 / 5563). The program supported a TA for each semester as well as course development and instruction. Yet the program received no tuition assistance to support its efforts. To sustainably continue to offer these valuable courses to CU students, such programs need core financial assistance. We would like to teach an additional 25 or more professional students in the course beginning in Fall 2018. The current University financial model does not make teaching existing students financially sustainable over time.

#### 7. Redundant program administration is not efficient

In the current model, each professional program is administered independently. This means that programs need to determine their administration approach individually. Thus, valuable resources and institutional knowledge are not pooled, captured and shared. Many programs spend significant time "learning the hard way" to run a professional program on the CU Campus when resources and knowledge could be shared. This challenge slows down program development and increases costs. It

would be ideal if the University could support program administration to increase efficiency and support development of new programs.

## What We Need

Professional programs will play a significant role in future University revenue models, increasing enrollment and bringing a diverse new body of students to CU Boulder. As such, we hope that the University will consider supporting professional programs as follows:

1. Incentivize existing CU Faculty to teach in professional programs.
2. Provide a clear path and associated financial model that supports development of interdisciplinary programs at CU.
3. Incentivize and support development of new, innovative online courses.
4. Develop clear financial models that programs can use that consider program startup costs, resource flows back to the program and revenue sharing between departments.
5. Incentivize programs that teach existing CU students through financial support.
6. Consider allocating some of the \$300 tuition fee to professional program startup costs and administration during the critical startup years.
7. Provide program administration support to consolidate resources and knowledge.