A Current Situation Analysis of Data Science-related Programs in North American iSchools in the Big Data Age

WT. Han  
School of Information Management,  
Nanjing University  
P.O. Box 210023  
PRC  
wthexo@163.com

YT. Guo  
School of Information Management,  
Nanjing University  
P.O. Box 210023  
PRC  
njuguoyt@outlook.com

1 INTRODUCTION

Data science as an academic field is relatively new. It originally arises out of the “big data/cloud computing” world and complexity science [1]. And by 2010, the term “data science” had been more prominent than “data analysis” [2]. Now, Data science is defined as that using the statistics and other mathematical knowledge and computer technology, to reason and explore the data which is massive, disordered, heterogeneous and unstructured, in order to tap the valuable knowledge hidden in the original data, and then solve the specific business cases.

McKinsey estimated that by 2018, in order to take full advantage of big data in the United States, the US market would need more deep analytical talent positions which would reach to 190,000, and the shortage of data-savvy managers would reach 1.5 million [3]. Therefore, opening a set of curriculum related to data science, has attracted the attention of the universities worldwide, including iSchools definitely. Tang R. and Sae-Lim W. [4] conducted an exploratory content analysis to Data Science-related Programs (DSPs) in U.S. higher education, samples including 5 iSchools. Comparing DSPs of iSchools and other seven disciplines, they focused on three levels of analytical skills which these programs could provide. In our research, we selected all 37 iSchools in North America to make an overall situation analysis on Data Science-related Programs from the perspective of curriculum and program settings.

2. DATA SCIENCE-RELATED PROGRAMS IN NORTH AMERICAN ISCHOOLS

There have been 20 North American iSchools opening up Data Science-related Programs or Specializations until now. According to the information on their websites, six of them offer Bachelor Degree or Specialization in Data Science and fifteen of them offer Master Degree or Specialization in Data Science. One of the iSchools, University of Washington: The Information School, provides both B. S. and M. S. degrees with Data Science Option. 2.1 Bachelor Degree or Specialization in Data Science

Table 1 displays the specific degree & major in 6 Bachelor Programs of iSchools: four have B. S. in Data Science or equivalent and two have B. S. in Information Studies or Informatics with Data Science Concentration or Option.

<table>
<thead>
<tr>
<th>iSchool</th>
<th>Degree &amp; Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drexel University: CC&amp;I</td>
<td>B. S. in Data Science</td>
</tr>
<tr>
<td>The Pennsylvania State University: CS&amp;T</td>
<td>B. S. in Data Science</td>
</tr>
<tr>
<td>Simmons, Boston: SL&amp;IS</td>
<td>B. S. in Data Science And Analytics</td>
</tr>
<tr>
<td>University of California, Irvine: DBSI&amp;CS</td>
<td>B. S. in Data Science</td>
</tr>
<tr>
<td>University of South Florida: SI</td>
<td>B. S. in Information Studies with Data Science &amp; Analytics Concentration</td>
</tr>
<tr>
<td>University of Washington: IS</td>
<td>B. S. in Informatics with Data Science Option</td>
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</tbody>
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In the aspect of curriculum structure, DSPs of B. S. are made of ample courses and students have more freedom to choose elective courses. It is noteworthy that the curriculum in different programs is similar with each other. Showing in the following figures, we choose two representative programs to display their curriculum structure.

Fig. 1. Curriculum Structure of BSDS in Drexel University: CC&I

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1 DSPs refers to Data Science-related Programs in this paper.
2 B. S. refers to Bachelor of Science Degree.
3 M. S. refers to Master of Science Degree.
2.2 Master Degree or Specialization in Data Science

On the basis of degree, major, study form and credit requirement, three types of mode can be concluded among 15 DSPs of M. S. in North American iSchools. One third of these programs belong to Mode 1, one fifth pertaining to Mode 2, and others belong to Mode 3.

Mode 1: setting up M. S. / M. P. S. 4 degree in Data Science or equivalent;
Mode 2: setting up M. S. / M. P. S. degree in IT/IS with Data Science or equivalent specializations, designated course requirements;
Mode 3: setting up M. S. / M. P. S. degree in IT/IS with Data Science or equivalent specializations, recommending elective courses but no requirements.

| Table 2: Example of Mode 1—University of California, Berkeley: SI |
| Degree | Major with Specialization | Study Form | Credit Requirement |
| M. P. S. | Information and Data Science | Online | 27-unit (15 Foundational+ 15 Advanced+ 3 Capstone) |

| Table 3: Example of Mode 2—University of Pittsburgh: SIS |
| Degree | Major with Specialization | Study Form | Credit Requirement |
| M. S. | Information Science | On Campus | 36-credit (15 Required + 15 Recommended+ 6 Elective) |

Table 4: Example of Mode 3—University of Washington: IS

| Degree | Major with Specialization | Study Form | Some Highly Recommended Elective Courses |
| M. S. | Information Management— Data Science | On Campus | Theoretical Foundations; Machine Learning and Econometrics; Scaling, Applications, and Ethics; |

In summary, due to the properties of DSPs, such as late start and interdiscipline, most of iSchools prefer the Mode 3. The iSchools which own abundant and mature resources in Math and Computing have the ability and potential to establish DSPs in Mode 1 or Mode 2.

3 CONCLUSION

Based on the data and analysis shown in Part 2, the features of curriculum and program settings of Data Science-related Programs in North American iSchools are as follows.

3.1 DSPs of B. S.

Credit Requirement: The total credit hours required by Bachelor Programs are more than those of Master Programs, generally between 100 hours and 200 hours, e.g. the total credit hours required by BDS& in Drexel University: CC&I are 188 hours.

Course Category: Curriculum can be divided into General Courses, Prescribed Courses, Core Courses and Elective Courses, etc. Some programs also set up the Capstone Courses, such as BDS in University of California, Irvine: DBISLCS, which provides Data Science capstone team-based project courses for students.

Subject Cross: Some programs are opened up cooperatively by several Colleges or Schools, not only by iSchools. Meanwhile students in some programs must minor in courses from other Colleges or Schools, not only from iSchools, e.g. BDSA in Simmons, Boston: SL&IS requires a 5-course minor in recommended disciplines, such as Biology, Chemistry, Management-Finance and so on.

Curriculum Similarity: Courses are similar in these programs, such as Math (especially Statistics), Computer Science, Data Management & Processing, Visualization and Social Science, which provide skills that are necessary to data scientists.

3.2 DSPs of M. S.

Compared to Bachelor Programs, Master Programs in Data Science are more flexible and diverse.

Degree Awarding: Majority of DSPs provide M. S., while 4 programs provide M. P. S., such as Master of Data Science provided by UC-Berkeley. Especially, University of Wisconsin provides M. A. 5 degree for students studying in School of Library and Information Studies.

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3 M. P. S. refers to Master of Professional Studies.

5 M. A. refers to Master of Arts Degree.
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**Study Form:** Many programs provide online or blend mode for students off-campus and working professionals. Data Science Master Program in Indiana University Bloomington: SIC can be completed with three options: Online, Residential or Hybrid.

**Credit Requirement:** The credits required by most of the programs are between 30 and 40 credits, and students must finish it in 1 to 2 years. In addition to the Required Courses and Elective Courses, some programs also require credits of Capstone or Practicum Courses.

**Curriculum Feature:** Compared to Bachelor Programs, DSPs of M. S. pay more attention to advanced data processing skills, and therefore, provide more advanced courses (such as Data Mining, Visualization) than basic courses (such as Mathematics, Programming). Meanwhile M. P. S. programs focus more on large-scale data or big data projects, such as MPS in Applied Statistics (Option II) in Cornell University: CIS.

**REFERENCES**