

Spring 3-23-2018

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Thomas L. Ngo-Ye

*Alabama State University, tngoye@alasu.edu*

Jae Choi

*Pittsburg State University, jchoi@pittstate.edu*

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## Recommended Citation

Ngo-Ye, Thomas L. and Choi, Jae, "Teaching Students Mainframe Skills for the Niche Market: An Exploratory Proposal" (2018). *SAIS 2018 Proceedings*. 15.

<https://aisel.aisnet.org/sais2018/15>

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# TEACHING STUDENTS MAINFRAME SKILLS FOR THE NICHE MARKET: AN EXPLORATORY PROPOSAL

**Thomas L. Ngo-Ye**  
Alabama State University  
[tngoye@alasu.edu](mailto:tngoye@alasu.edu)

**Jae Choi**  
Pittsburg State University  
[jchoi@pittstate.edu](mailto:jchoi@pittstate.edu)

## ABSTRACT

Contrary to the common belief, mainframe is here to stay in corporate Information Technology (IT) infrastructure. Many organizations find it more advantageous in leveraging the mainframe and are adding more workloads and exploiting new technologies. They increase the mainframe usage and leverage it to drive business value and become more successful. However, the mainframe industry faces the challenge of talent shortage because many older mainframe professionals are retiring. On the other hand, very few universities teach students mainframe skills. The high demand of mainframe jobs and the low supply of college graduates with mainframe skills present a unique opportunity for Information Systems (IS) programs to train students mainframe skills for job placement in the niche market. Therefore, we propose the idea of exploring teaching students mainframe skills in IS curriculum. Several excellent programs and resources to prepare students with mainframe skills are also reported in this paper.

## Keywords

Mainframe computing, mainframe job opportunity, teaching mainframe skills, IS education

## INTRODUCTION

Last few years have witnessed the explosive advancements in cloud computing, smart phone, and tablet technologies. These technologies have been widely adopted by organizations as well as individuals. Our current generation of college students are used to smartphone, tablet, and cloud service. These technologies are regarded as the contemporary mainstream technologies and trend of future. Because most people are only exposed to these front-end users' technologies, other technologies such as mainframe are perceived as marginal, legacy, old, and out-of-date. Mainframes are predominantly used by big organizations for critical applications; bulk data processing; enterprise resource planning; and transaction processing (Wikipedia, 2018). Mainframes are larger and have more processing power than some other types of computers: Minicomputers, Servers, Workstations, and PCs (Wikipedia, 2018). Unaware of the important role played by mainframe and career opportunities associated with mainframe, most college students and Information Systems (IS) faculty would conveniently discard the notion of learning and teaching mainframe technologies. In most computer science programs in universities, mainframe skills are no longer taught (Florentine, 2017). Similarly, in fact, since mid-90s, most business schools in the U.S.A. discontinued offering COBOL programming and other mainframe courses. In this paper, we investigate today's reality of mainframe computing, likely trend in the near future, job opportunities in mainframe area, and relevant educational and internship programs. By identifying the unique niche opportunity for students and faculty, we intend to add value to IS programs and help students get on the path of a secure and rewarding career in mainframe computing.

## CURRENT STATE OF MAINFRAME COMPUTING

Contrary to the conventional wisdom, mainframe computing technology is not disappearing. Instead it is thriving in the cloud computing era (BMC, 2017). In 1964 the first mainframe computer was introduced by IBM. Both mainframe and COBOL programming language are more than 50 years old. Mainframe has been the backbone of corporate IT for the last 50+ years (ThinkComputing, 2015). However, mainframe technology has been changed for these past 50+ years. It keeps evolving with continuous innovations, which push the boundaries of mainframe technology to the next level with each and every new mainframe generation (Dickens, 2016). Nowadays IBM's new mainframe computing offerings (IBM z Systems, z13, z/OS, zCloud, z/VM, z/TPF) are very powerful workhorse of many large scale enterprise computing. For the latest generation of mainframe, its MIPS (millions of instructions per second) surpasses 110,000, its clock speed is up to 5 Ghz, and its memory is in the range of terabytes (Dickens, 2016).

While mainframe and COBOL are more than 50 years old, they continue ruling the world of enterprise Information Technology (IT). Billions of transactions that are executed every day are often powered by mainframe behind the scenes and many aspects

of people's daily lives are touched by COBOL systems (Kelly, 2017). According to IBM Mainframe Academic Initiative (IBM, 2017a), with only 6% of IT spending, mainframes account for 68% of enterprise computing workloads. IBM Mainframe Academic Initiative also finds the following facts: 1) Today about 80% of the world's company data resides or originates on mainframes. 2) Around 55% of all enterprise applications require a mainframe to finish transactions. 3) Every day about 30 billion business transactions are handled on mainframes. 4) Mainframe not only continues representing the lion's share of the world's business transactions and data processing, but also remains to be the backbone of the world's leading businesses. 5) 92 of the top 100 worldwide banks run on mainframe. 6) 23 out of 25 world's largest airlines run on mainframe. 7) 23 of the top 25 US retailers run on mainframe. 8) All 10 of the world's largest insurers run on mainframe (IBM, 2017a).

Opposite to the common belief that mainframe is fading away as a sunset technology, mainframe remains to be the most important computing technology due to the fact that businesses and people behind mainframe computing keep on evolving and enhancing the technology to confront new challenges (Dickens, 2016). Moreover, businesses today continue choosing mainframe computing because it continues to evolve to support business computing demands and offers the overall best business value (BMC, 2017; Dickens, 2016).

While a lot of businesses rely on mainframes to run their core applications, mainframe hardware is often coming to its end of life (Dickens, 2017b). To address this issue, IBM offers the Mainframe-as-a-Service (zCloud) solution. Using a cloud-based financial model, zCloud enables organizations to maintain and keep up with the modernization of mainframes with a more agile and flexible infrastructure (Dickens, 2017b). zCloud offering can be either off-premises or on-premises in any data center hosting facility. zCloud helps businesses convert their mainframe costs from a capital budget expense into an operational expense (Dickens, 2017b).

In 2017 BMC conducted an annual mainframe survey to gather input from more than 1,000 mainframe executives and professionals. The 2017 mainframe survey results shed new light on the strategic importance and future of the mainframe, its workloads, and its workforce (BMC, 2017). Overall, the survey results provide key indicators of the future health and viability of the mainframe, as well as busting five common myths about mainframe. The myths busted by the 2017 mainframe survey are as following.

1. Businesses have already fully optimized their mainframes for maximum availability.
2. The mainframes are in maintenance mode, and no organization is modernizing them.
3. Executives are planning to substitute the mainframes with other technology.
4. Younger IT professionals are pessimistic about future careers on the mainframe.
5. Only older IT professionals work on the mainframe nowadays.

The 2017 mainframe survey found that the mainframe technology is changing, and businesses are taking advantage of advanced technologies to streamline their operations. Executives hold a more positive view of the future of the mainframe platform, with 91% of survey participants expecting long-term viability, up from 89% in 2016 (BMC, 2017). 71% of large shops (defined as more than 10,000 MIPS) witnessed MIPS growth in 2017 and forecast more growth in 2018. The survey also found that participants regard mainframe as a long-term, strategic asset that helps organizations meet their digital business needs.

From our conversation with a local Fortune 500 company X, a large mainframe shop, we learned that it has a lot of COBOL applications and still relies on those very complicated COBOL functions to run its business. It is just too expensive for company X to replace all existing COBOL applications by rewriting them in a new programming language such as Java. Company X expects to maintain its COBOL applications for many years to come.

### **MAINFRAME WORKFORCE AND ITS CHALLENGE**

According to the Mainframe Skills Special report in IBM Systems Magazine (IBM, 2015), majority of enterprise mainframe workloads are growing, or staying steady, and within the next five years, 21% reported that up to 25% of their firm's mainframe staff will be retiring. Not surprisingly, the right staffing and skills are a critical part of modernizing the mainframe environment, and mainframe staffing/skills shortage is regarded as one of the top three challenges for the mainframe industry (BMC, 2017). Since many IT professionals with mainframe knowledge are approaching retirement age, the industry is facing the danger of losing critical mainframe technical know-hows (Florentine, 2017). Recently, baby boomers who are proficient in mainframe skills are starting to retire and the gruesome prognosis is being realized. The 2017 BMC mainframe survey found that only 7% of mainframe workforce is under age 30. Among these small group of young millennial mainframe workforce, 70% anticipate the mainframe as a platform to grow and attract new workloads industry-wide and 54% believe the mainframe platform to grow within their own organization (BMC, 2017). Because most universities are not teaching students mainframe skills, it is very

rare for employers to be able to find new graduates with mainframe-specific training and skills (Florentine, 2017). The mainframe talent shortage issue continues on and only becomes worsened as time goes by.

### **MAINFRAME JOB OPPORTUNITY FOR STUDENTS**

Due to the mainframe skill shortage, even service firms like Ensono, which maintains and manages clients' mainframe workloads, are struggling to find workers with right mainframe experience and skills (Florentine, 2017). Therefore, training high-potential millennial students mainframe skills becomes a win-win proposition for both employers and college students. In the U.S.A., there are more than 1,700 open mainframe positions at some of the world's most respected and largest firms and the average starting salary for mainframe developers is \$113,000 (ThinkComputing, 2015). There are a wide variety of mainframe projects needed to be executed for client businesses, ranging from reworking legacy program code to developing new features and applications on top of existing mainframe technologies (Florentine, 2017). Recognizing the mainframe skill shortage problem, IBM initiated a strategic program for filling the enterprise skills pipeline (IBM, 2017a). Given that industries continue relying on mainframe technology and most universities do not teach students mainframe skills, mainframe specialty represents a guaranteed career path (Florentine, 2017). Acknowledging this unique opportunity, teaching and training millennial students these highly in-demand mainframe skills will provide students a major competitive edge in a tight job market (Florentine, 2017). Therefore, squeezing in a double major or minor concentrated on mainframe skills is a rewarding investment that will help college students pay off student debt in a shorter time (ThinkComputing, 2015).

### **PROGRAMS AND RESOURCES TO PREPARE STUDENTS MAINFRAME SKILLS**

After identifying mainframe specialization is an attractive and unique career possibility for students, the next natural question is how to get started with preparing students for the appropriate mainframe skills. In this section, we highlight several useful mainframe training resources and college mainframe programs.

#### **IBM Mainframe Academic Initiative**

IBM undertakes the Academic Initiative (IBM, 2017a). IBM is filling the mainframe talent pipeline through assisting and enabling schools to teach z Systems. All the IBM z Systems teaching and learning materials, curriculum, courses, workshops, and access to z Systems are totally free for faculty and students. IBM provides free worldwide access to enterprise systems for every college student enrolled in its mainframe courses. Moreover, IBM also offers mainframe contests including annual zEnterprise Mastery Test, certifications, and awards to college students. In 2015, IBM Master the Mainframe Contest had over 10,000 participants. IBM also provides free online z/OS Introduction and Workshop class to faculty (<http://ibm.biz/zOSclass>). Marist College/IBM Joint Studies and Academic Initiative sponsored the Open Mainframe Summer Internship Program in 2017, where each of eight student interns received \$2,500 and got the exposure to mainframe professionals (Dickens, 2017a).

IBM's Master the Mainframe hands-on program (IBM, 2017b) presents a "sampler platter" of mainframe and enterprise computing to students and introduces students to the topics instructors are not able to cover in classroom. The Master the Mainframe program helps students build stronger resume because employers value the experience on resumes. There are three parts in this program. Part 1 is comprised of a simple homework assignment. Part 2 is for credit and is a bit more significant. Part 3 is worth even more significant extra credit. Most students finishing Part 2 get interviews, and close to 100% of students completing Part 3 get internship offers at IBM. IBM maintains the Master the Mainframe system and answer student questions, and IBM even grades it for faculty. Many faculty make Master the Mainframe a required classroom assignment for grade point. There are three different options to use Master the Mainframe in classroom teaching. First, Master the Mainframe topic(s) can be incorporated into an existing IT course as a module. Currently, Master the Mainframe modules include "z/OS Introduction" and "Spark Analytics on z". Second, Master the Mainframe can be included in an existing curriculum as a new independent course. Many Master the Mainframe courses are now available including "Intro to z Systems" and "DB/2 Databases". Third, a new minor or certificate program can be created with content of Master the Mainframe. The mainframe program offers multiple courses towards an Enterprise Systems Minor or certificate program. It is recommended to work closely with local mainframe employers to design the mainframe program.

#### **University Mainframe Programs and Other Resources**

In addition to IBM's mainframe academic initiative, several universities are leading the mainframe education (ThinkComputing, 2015). Some established mainframe education programs are as following.

- North Carolina A&T University in Winston-Salem, NC (<http://www.ncat.edu/divisions/academic-affairs/bulletin/2014-2015/academic-info-and-regs/sot/dept-of-computer-systems-technology.html>)
- Marist College in Poughkeepsie, NY (<https://www.marist.edu/>)
- The iSchool at Syracuse University (<http://ischool.syr.edu/>)

There are also some free online mainframe courses. For example, IBM and Syracuse University jointly offer “Enterprise Computing Strategies” (<http://ischool.syr.edu/contact/forms/ecsmooc.aspx>). IBM and Marist College jointly offer “Introduction to Enterprise Computing” (<https://mooc.marist.edu/web/ecc>).

Online mainframe communities include SHARE zNextGen (<http://www.share.org/znextgen>) and Mainframe Debate (<https://mainframedebate.com/>).

Online Job Boards for mainframe positions include the following.

- zSystems Jobs [http://www.systemzjobs.com/home/index.cfm?site\\_id=11677](http://www.systemzjobs.com/home/index.cfm?site_id=11677)
- Indeed (Mainframe) <http://www.indeed.com/jobs?q=mainframe+developer&l=>
- Monster (Mainframe) <http://jobsearch.monster.com/jobs/?q=Mainframe>

## CONCLUSION

Mainframe computing has been a critical part of enterprise IT infrastructure in the past 50 years and will continue playing an important role in the years to come. As the mainframe workforce is aging and retiring, there is a clear shortage for talents with mainframe skills. Because mainframe uses a different technology than the other types of computers, mainframe is unique and requires a dedicated education path. Given the high demand for such skills and low supply of college graduates with mainframe skills, we identify the unique opportunity for higher education institutions to partner with industry to train our students these skills. Leading students on this niche career path will help students land a secure, rewarding, and high-paying job. We also present several useful programs and resources to prepare students mainframe skills. As we are just embarking on the journey to experiment offering mainframe content in our IS curriculum, we expect challenges ahead. We will report our first-hand observations and lessons learned in the next study. We do believe that this paper contributes the field of IS education by pointing out an unconventional IT career path, for which IS faculty and students should seriously consider. We recommends IS programs take incremental approach to introduce mainframe topics into curriculum. First, some mainframe modules can be incorporated to an existing course. Second, a standalone mainframe elective course can be offered. Finally, a mainframe concentration can be developed with several mainframe courses. Nevertheless, we also need to caution readers the risk associated with the big-bang approach of creating a full-fledged mainframe degree program. An incremental approach of first introducing mainframe as a module seems to be safer. Faculty also need to consider local employment condition and available resources (faculty time to learn mainframe skills) before undertaking this mainframe education endeavor.

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