# A Hybrid Google Computer Science for High School Workshops

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Mingyu Lu received the B.S. and M.S. degrees in electrical engineering from Tsinghua University, Beijing, China, in 1995 and 1997 respectively, and the Ph.D. degree in electrical engineering from the University of Illinois at Urbana-Champaign in 2002. From 1997 to 2002, he was a research assistant at the Department of Electrical and Computer Engineering in the University of Illinois at Urbana-Champaign. From 2002 to 2005, he was a postdoctoral research associate at the Electromagnetics Laboratory in the University of Illinois at Urbana-Champaign. He was an assistant professor with the Department of Electrical Engineering, the University of Texas at Arlington from 2005 to 2012. He joined the Department of Electrical and Computer Engineering, West Virginia University Institute of Technology in 2012, and he is currently an associate professor. His current research interests include wireless power transmission, radar systems, microwave remote sensing, antenna design, and computational electromagnetics. He was the recipient of the first prize award in the student paper competition of the IEEE International Antennas and Propagation Symposium, Boston, MA in 2001. He served as the chair of Antennas and Propagation Society of IEEE Fort Worth Chapter from 2006 to 2011.

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Currently, I am a third-year student enrolled at WVU Institute of Technology, studying for a B.S. in Computer Science and a B.S. in Information Systems. Before coming to WVU Institute of Techonology, I graduated suma cum laude from both Midland Trail High School and from Fayette Institute of Technology in the Aries Computer Maintenance course. I taught a 12-week night class at Fayette Institute of technology on smartphones and tablets on three separate occasions. After coming to WVU Institute of Technology, I began working under Dr. Afrin Naz in a work-study arrangement. In this work-study, I researched implementing low-cost high-performance computing (HPC) clusters. Additionally, I assisted in research on using the Scratch programming language as a tool for STEM education in the K-12 fields.

# A Google Computer Science for High School Workshop with Hybrid Format


## Abstract

In the summer of 2016, a Google Computer Science for High School workshop was organized by West Virginia University Institute of Technology. Its objective is to provide professional development training for high school teachers in several remote counties of West Virginia to offer introductory Computer Science course. West Virginia University Institute of Technology offered two Google Computer Science for High School workshops in 2013 and 2014, respectively. The 2013 workshop was in face-to-face format, and the 2014 workshop was completely online. In 2016, we employed a "hybrid format," including both face-to-face and online, which was tailored for the needs of West Virginia teachers. Based on the feedback collected from the workshop participants, the hybrid format enables the workshop to be more effective than our previous workshops.


## Introduction

Computer Science education in West Virginia high schools is fairly underdeveloped; for instance, only a few public high schools of West Virginia offer AP Computer Science courses. During the past four years, several Computer Science for High School workshops were organized by West Virginia University Institute of Technology, with sponsorship from Google. Our workshop in 2013 took the traditional face-to-face format, whereas our workshop in 2014 was completely online. In 2016, we employed a "hybrid format," including both face-to-face and online. More than 30 high school and middle school teachers registered for the workshop in 2016, and majority of them fulfilled the requirements of the workshop. Some of them have started applying what they learned from the workshop to their teaching. According to the data and feedback we have collected to date, the hybrid format is well received by the participating teachers.

## Previous Work

Initiated in 2009, Google Computer Science for High School program [1] aims to provide professional development opportunities for high school teachers in the discipline of computer science. We organized a two-day face-to-face Google Computer Science for High School workshop at West Virginia University Institute of Technology in the summer of 2013 [2]. A total of fourteen high school teachers attended the two-day workshop. In 2014, we organized Google Computer Science for High School workshop once again with the workshop's format changed to be "completely online." 123 high school teachers from USA and Canada registered for the four-week workshop [3,4].

## Implementation of 2016 Computer Science for High School Workshop

Our 2016 Computer Science for High School project employs a "hybrid format" including both face-to-face and online. This hybrid format is tailored for the needs of West Virginia high school

teachers. Computer Science education in West Virginia high schools is fairly underdeveloped; for instance, only a few public high schools of West Virginia offer AP Computer Science courses. As a result, it is very necessary to initiate the Computer Science for High School project by visiting the teachers and holding face-to-face interactions with them. After the initial face-to-face phase, rigorous instructions were delivered online. Based upon the above strategy, our 2016 Computer Science for High School project consists of three phases, which are elaborated below separately.

Phase 1 constitutes several one-day workshops in the summer of 2016. We made visits to high schools of four school districts. All the four school districts were very supportive, and all the facilities were offered to us for free. During the one-day workshops, high school teachers learned how to log onto our university servers remotely. Also during the face-to-face workshops, training sessions were offered on several software tools such as Google Course Builder, Google Hangouts, Scratch, and Piazza Discussion Board, as Phase 2 and Phase 3 heavily rely on these software tools. More importantly, personal relationships were established between the participating teachers and us, which greatly facilitated the next two phases. Two photos taken during Phase 1 are shown in Fig. 1.

Figure 1: Two photos taken when we visited high schools in Phase 1 of this project.

Phase 2 was entirely online. It was offered as a four-week online course. Specifically, fundamental hardware and software content knowledge of Computer Science was delivered to the participating teachers systematically. The contents of the four-week online course are detailed in the next section.

In Phase 3, year-round online and on-site support was provided for the participating teachers to incorporate Computer Science into their teaching. Two university students are in charge of online support, and they also travel to high school classrooms to provide assistance. Every participating teacher had remote access to resources over Google Drive and over our university server. In addition, an online forum was created for the participating teachers to share their resources. This phase aims to reinforce the outcome of the summer workshop as well as to maintain a long-term community of practice among high school teachers and us. The two photos in Fig. 2 were taken when our students visited high schools in Phase 3.

The three-phase design described above intends to provide the maximum resources and support to high school teachers, and in turn, to minimize the difficulty/barrier when high school teachers

start teaching Computer Science from little foundation. Feedback from the participating teachers indicates that our three-phase format is well received and appreciated.

Figure 2: Two photos taken when we visited high schools in Phase 3 of this project.

**Contents of Four-week Online Course in Phase 2**

The four-week online course held in the summer of 2016 covers the following topics, all of which are mapped to the Big Ideas of Computer Science.

- Binary number and data structure (Big Idea #3: Data and Information)
- A simple tour in programming (Big Idea #4: Algorithms, Big Idea #5: Programming)
- Construct a simple website (Big Idea #1: Creativity)
- Computer hardware organization in a regular desktop computer (Big Idea #2: Abstraction)
- Different types of operating systems (Big Idea #2: Abstraction)
- Cutting-edge computing technologies such as Cloud Computing and Internet of Things (Big Idea #6: The Internet)
- Ethics in Computer Science (Big Idea #7: Global Impact)

Our online course is divided into eight units. Each unit includes three theoretical sessions and one hands-on session. The course also includes four online discussion sessions. The four-week online course schedule is shown in Table I. Fig. 3 displays two snapshots of our online course.

The online course has three types of sessions: theoretical, hands-on, and discussion. In the following, the three types of sessions are described individually.

Theoretical sessions intend to educate the audience about the fundamental knowledge related to computer software and hardware. The theoretical sessions include both PowerPoint slides and video tutorials. The video tutorials for each unit include one introductory video and two lecture videos. The lesson materials were posted through Google Course Builder and Google Drive, so that the audience could access them any time.

Two types of hands-on sessions were offered: activity sessions and pedagogical tool training sessions. To be specific, activity sessions supplement the theoretical sessions and pedagogical tool training sessions provide training on how to employ modern software tools such as Piazza. The hands-on sessions were delivered using Google Hangouts.

Table I: Schedule of four-week online course in the summer of 2016

| | | |
|---|---|---|
| Week 1 | Unit 1 Intro | Introduction to Computer Science |
| | Unit 1 Part 1 | Algorithms |
| | Unit 1 Part 2 | Computer number systems |
| | Activity 1 | Warm up exercise: Post a comment on discussion board |
| | Unit 2 Intro | Computer hardware |
| | Unit 2 Part 1 | Memory |
| | Unit 2 Part 2 | CPU |
| | Activity 2 | Open up a computer |
| | Discussion Session 1 | Popularizing Computer Science in West Virginia |
| Week 2 | Unit 3 Intro | Computer software |
| | Unit 3 Part 1 | Different types of operating systems |
| | Unit 3 Part 2 | More on Linux |
| | Activity 3 | Linux project |
| | Unit 4 Intro | Computer networking |
| | Unit 4 Part 1 | World Wide Web and the Internet |
| | Unit 4 Part 2 | Using HTML for website |
| | Activity 4 | HTML website project |
| | Discussion Session 2 | Involving minority and parents |
| Week 3 | Unit 5 Intro | Introduction to Scratch |
| | Unit 5 Part 1 | Events |
| | Unit 5 Part 2 | Motion |
| | Activity 5 | Events and motion project |
| | Unit 6 Intro | Working with sounds and costumes |
| | Unit 6 Part 1 | Sounds |
| | Unit 6 Part 2 | Costumes |
| | Activity 6 | Sounds and costumes project |
| | Discussion Session 3 | Ethics in computing |
| Week 4 | Unit 7 Intro | Having fun with looks |
| | Unit 7 Part 1 | Looks |
| | Unit 7 Part 2 | More on looks |
| | Activity 7 | Looks project |
| | Unit 8 Intro | Playing with controls |
| | Unit 8 Part 1 | Controls |
| | Unit 8 Part 2 | More on controls |
| | Activity 8 | Controls project |

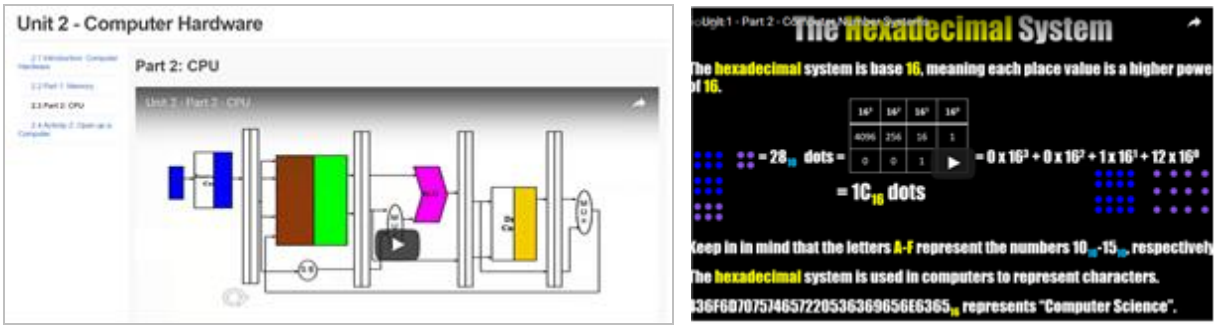


Figure 3: Two snapshots of our online workshop held in the summer of 2016.

Our online course had several discussion sessions. In Session "Popularizing Computer Science in West Virginia," the participants exchanged their teaching experience and discussed how to prepare high school students for college majors related to computer. Another session "Involving Minority and Parents" was devoted to inspiring students from minority groups (including females) to choose computer/computing as their college major and how to involve West Virginia parents. In "Ethics in Computing" session, the issues related to computing ethics were discussed.

**Results**

More than 30 teachers participated in our Google workshop. None of them has degree in Computer Science. 8% of taught Computer Science courses before participating in the workshop. The participants took pre-workshop and post-workshop online surveys, which were administered by Google. Some of the survey results are presented in this section.

Fig. 4 shows the participants' answers in response to a statement "I am confident in my ability to teach Computer Science effectively." Fig. 5 displays the participants' answers in response to a statement "I have the knowledge and skills I need to teach Computer Science effectively." The participants' answers to a question "How would you rate your overall knowledge of Computer Science teaching before and after this professional development opportunity?" are depicted in Fig. 6. Comparison between the pre-workshop answers and post-workshop answers clearly demonstrates that the workshop succeeds in improving the participants' knowledge and confidence significantly.

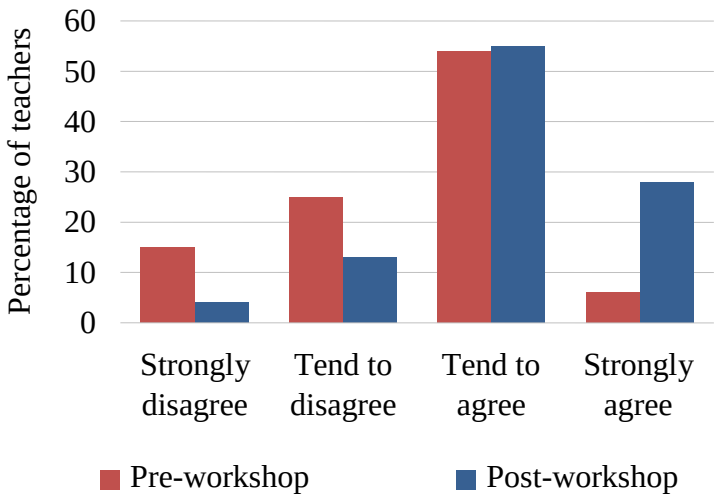


Figure 4: Participants' answers in response to statement "I am confident in my ability to teach Computer Science effectively."

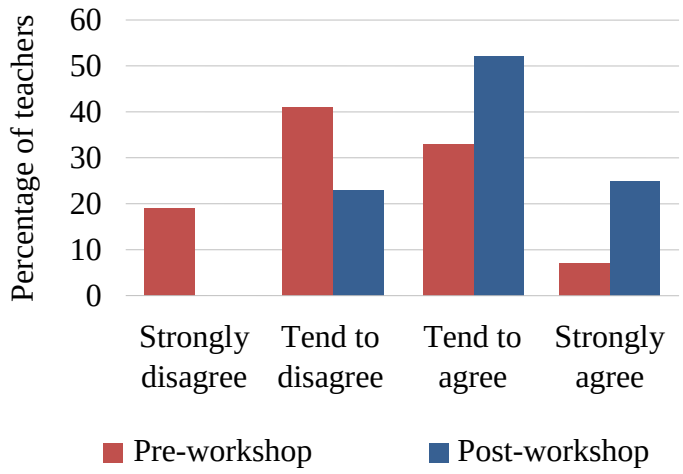


Figure 5: Participants' answers in response to statement "I have the knowledge and skills I need to teach Computer Science effectively."

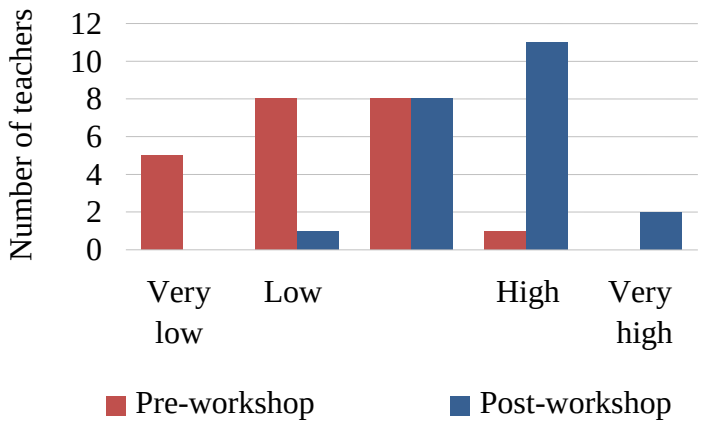


Figure 6: Participants' answers to question "How would you rate your overall knowledge of Computer Science teaching?"

When the participants were asked to rate "How successful was your implementation of Computer Science for High School professional development content?" on a scale from 1 to 5 after the workshop, 22% of them rated 5, 73% rated 4, and 5% rated 1.

The participants were also asked "Would you recommend this professional development opportunity to other colleagues?" One participant answered "maybe," nobody answered "no," and all the others answered "yes."

**Conclusions**

This Computer Science for High School project accomplishes the following three outcomes.

First, more than thirty high school teachers registered our workshop. Majority of them have fulfilled the workshop's requirements. Five teachers have received certificates from West Virginia University's CEHS 930 course, Continuing Professional Development for Educators. Most of the participating teachers have applied what they learned from our workshop to their teaching. Particularly, 10% of the participants have initiated elective Computer Literacy courses.

Second, solid partnership relationships have been established between local school districts and us. The participants of this Computer Science for High School project are from public and private schools of four counties of West Virginia, including Kanawha County, Nicholas County, Raleigh County, and Marion County. We received solid support from the administrators of all the four school districts. As a matter of fact, teachers are unable to develop new courses or modify existing courses without the support of their administrators.

Third, more than thirty teachers learned the fundamental knowledge and skills of Computer Science in this project, and we consider them as the core members of Computer Science community in West Virginia. Computer Science education has weak foundation in K-12 schools of West Virginia. Starting with thirty core members, we hope the Computer Science community in West Virginia will grow steadily.

**Acknowledgement**

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