Why Early Coding Education is important?

Taehee Jung is a vice president and senior developer at PIMCO, focused on client-facing technologies. Prior to joining PIMCO in 2010, he was with 20th Century FOX as a senior consultant, and National Bankers Group Inc as a computer information system director. In addition, he has many years of experience in teaching various computer science courses for undergraduate and master students at private institutes. He received an undergraduate and master degree in computer science from the University of Southern California. He has 20 years of professional and educational experience, holds an Oracle Certified Java Developer, and a Chartered Financial Analyst (CFA).

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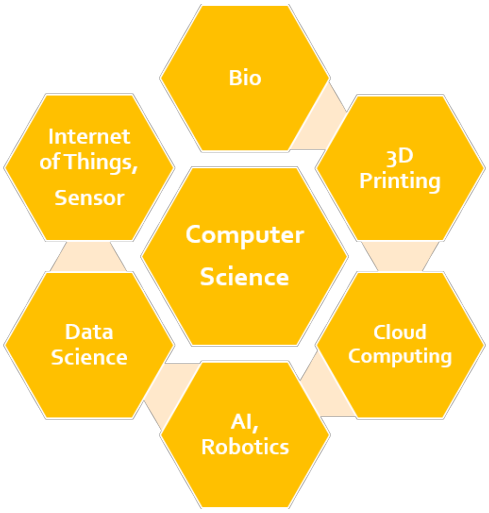
I. Industrial Revolution and Trend

The 4th Industrial Revolution

A new era of the 4th Industrial Revolution is imminent. It refers to the integration of advanced information technologies, such as Artificial Intelligence(AI), Internet of Things(IoT), Cloud Computing, Big Data into technologies in existing industries, which will bring about innovative changes to all aspects of society. In other words, all things will be connected by networks, all actions will be recorded as data, and AI with self-learning capability will make important decisions based on accumulated Big Data. Such advancement will inevitably lead to elimination or replacement of current workforce with AI, all the while increasing the desperate need for competent professionals in advanced information technologies. We are already witnessing this “future” in the case of self-driving automobiles and unmanned shops.



Integration of Computer Science (CS + X)

We can also see that Computer Science(CS) is being integrated with other disciplines. Google calls these transdisciplinary trends as “CS + X," where “X” can be anything. For example, animation could be "CS + art," and smart lenses could be "CS + medicine." In addition, many universities are offering "CS + X" degrees in order to enable their students to innovate in this time of change. Stanford University has been offering "Joint Major" degree in CS and a number of humanities disciplines since 2014. With this kind of convergence, computer science with the software technology will be indispensable knowledge regardless of occupations and fields.

Early Coding Education Trend

The world has recognized the necessity of early coding education for young children so that the children will not only stay abreast of changes but also lead and affect these changes themselves. Currently, many countries are implementing early coding education. England mandated coding classes for all children between the ages of 5 and 16, and South Korea enforced mandatory coding education in middle school and high school curriculum. In the United States, President Obama started a nationwide campaign called "Hour of Code" to interest children in computer science. Mark Zuckerberg, Facebook founder and Bill Gates, Microsoft founder provided free tutorials for this “Hour of Code” campaign.

II. What do you teach in coding?

Fundamentals of Programming Language

Early coding education teaches children the "fundamental concepts of programming language." Coding refers to making commands using a programming language so that the computer can execute. Just like human languages, there are many

programming languages, such as low-level languages called machine languages as well as high-level languages like C ++, Java, Python, and Scratch. By using programming languages with the most similarity to human languages and good visual expressions, proper early coding education should teach the fundamental concepts of language in a fun and effective way, so that children can easily learn any language in the future.

Computational Thinking

Early coding education also teaches children "Computational Thinking." Computational thinking refers to the thinking process of identifying problems and finding solutions so that computer can execute the commands efficiently. Algorithm is the formalization of this process. With various algorithmic problems, proper early coding education should teach children to naturally understand the computational thinking process.

III. What can you learn by coding?

Logical Problem Solving Skills

Children can learn "Logical Problem Solving Skills" through various algorithm training. In other words, children can learn how to logically solve a large and difficult problem by dividing them into small problems and sequentially solving them. This is very helpful for math, science, and logical writing.

Creative Thinking Skills

Children can also learn "Creative Thinking Skills" by making various computer application programs. In other words, children can learn creative ways of thinking by developing what they only imagined via use of websites, mobile apps, animations, and games. This is very helpful in art, creative writing, and various project preparation. Furthermore, Children can experience a sense of accomplishment and a boost in self-esteem from sharing their creations with family and friends.

IV. How can we learn coding?

The First Programming Language

One of the most common questions parents ask is what kind of programming language children should learn first. I would recommend Scratch, a block coding platform developed by MIT for elementary school students. It is a great tool to build a foundation in programming language, especially for those students with weaker mathematical skills and typing skills. As for middle school and high school students, I would recommend Python, which has excellent visual expression and high applicability in many fields.

Websites / Mobile Apps / Games

All areas of society require computer applications. I would recommend learning how to develop websites, mobile apps, animations, and games. Children will acquire an ability to realize what is needed in real life creatively and moreover, by providing their own capabilities to meet the needs of the communities, they will be able to create many opportunities for the future.

Computing Olympiad / Coding Contest

USA Computing Olympiad (USACO) and middle/high school coding contests presented by colleges require resolution of various levels of algorithmic problems. Especially, many university research centers and industry-leading companies, such as Facebook, Amazon and Google also pose interview questions based on algorithmic issues. I would recommend participating various coding contest. Children will develop an ability to logically solve more complex problems in the real world and, furthermore with the achievement, they will be able to seize more opportunities in the future.

V. Conclusion

In 2017, over 200 million students around the world learned coding, and over 90% of US parents wished to include coding in the school curriculum. In this age, coding should be a core subject to learn, just like math and reading. In this time of great change, I hope that our children become logical and creative leaders in any field through proper early coding education.

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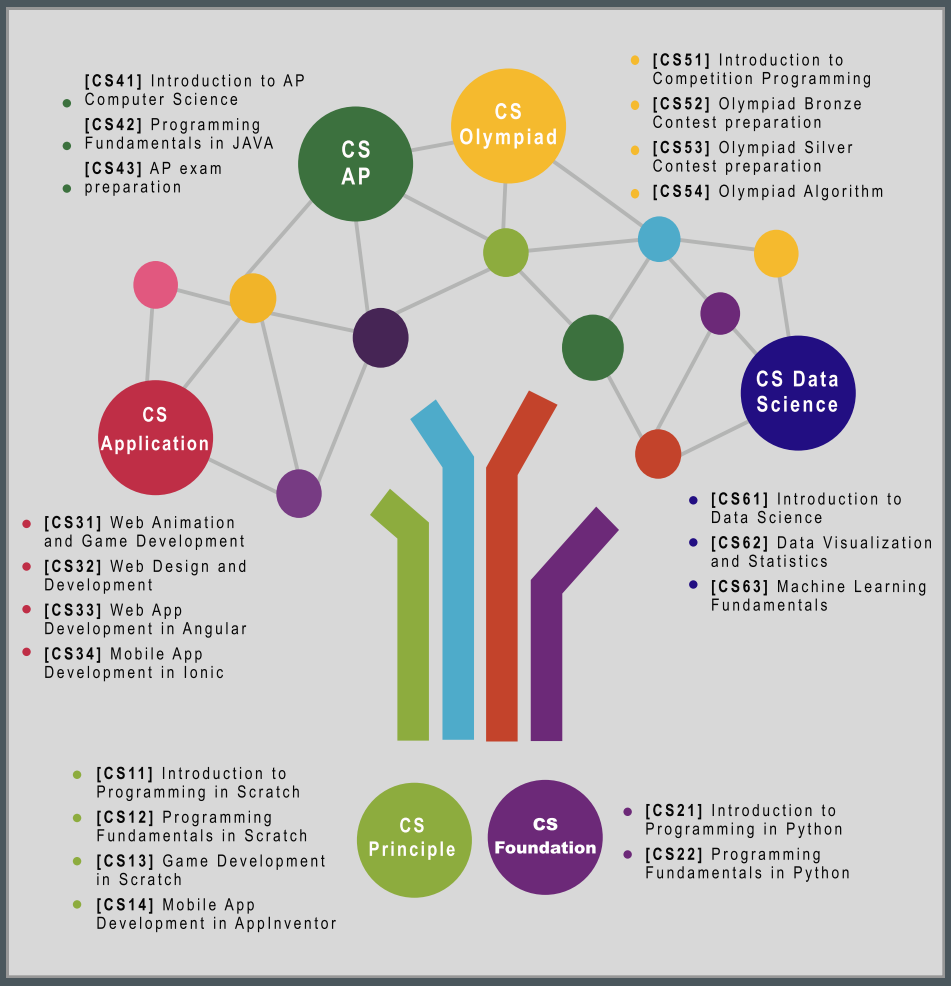
TAE Coding Tracks



2017-2018 Session
USA Computing Olympiad

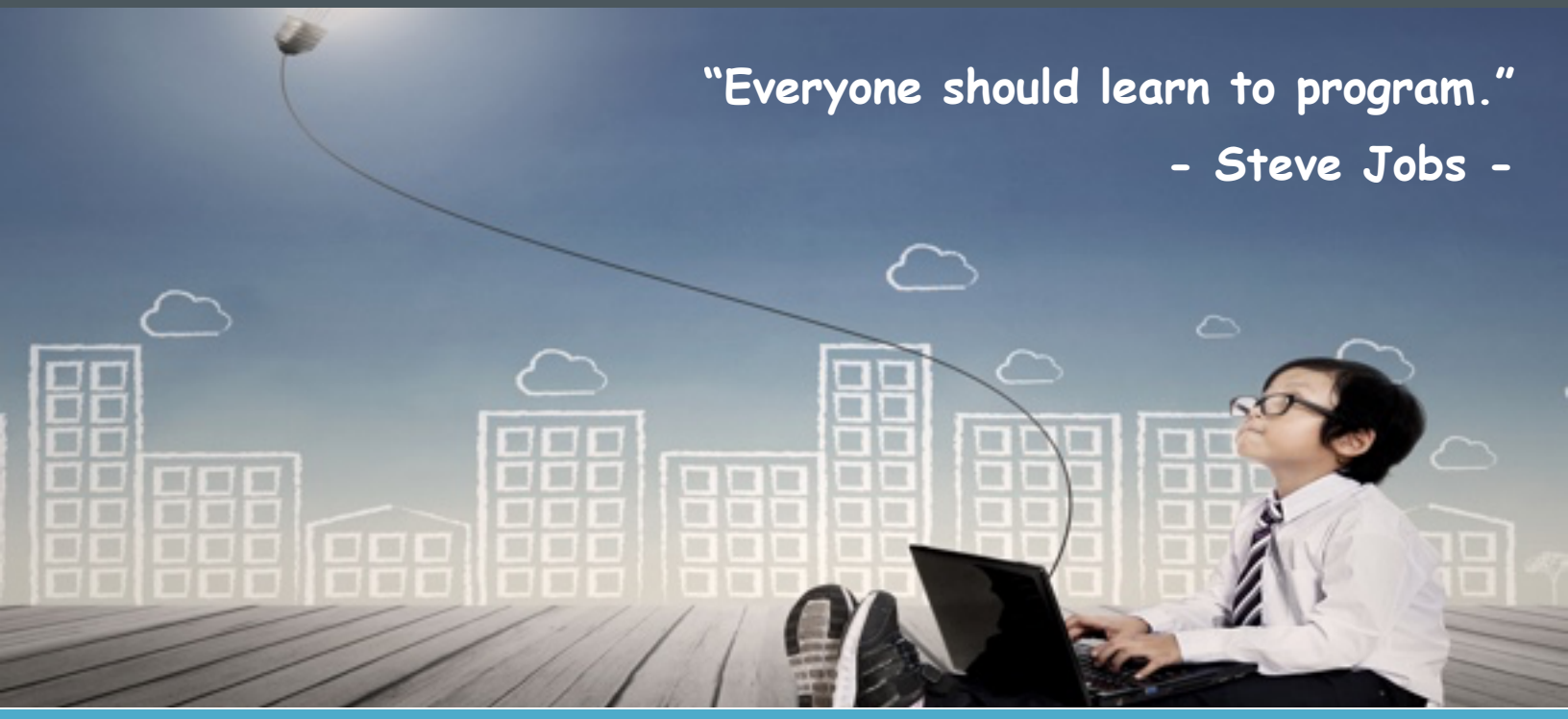
TAE Coding Achievement

Gold / Silver Winners

Jaden Lee	Sage Hill High	9th

Bronze Winners

Jeremy Koo	University High	12th
Jae Hwan Lee	Northwood High	11th
Kangyeon Lee	University High	11th
Junha Kim	Troy High	9th
Justin Chung	Northwood High	9th
YoonSeong Roh	Irvine High	9th
Jaden Lee	Sage Hill High	9th
Andrew Chung	Sierra Vista Mid	8th
Minseo Kim	Pioneer Middle	8th
Shaun Baek	Jeffrey Trail Mid	8th



EARLY CODING EDUCATION

TAE coding Technology Applied Edaucation COURSE CATALOG

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A new era of the 4th Industrial Revolution is imminent. We are already witnessing advancements in technology, such as artificial intelligence, the Internet of Things(IoT) and Big Data rapidly changing every aspect of our society. Preparing our children for these unprecedented changes is critical and imperative.

We at TAE Coding believe that learning coding is as important as learning to read and write for today's students. Through programming education, the students will develop logical thinking and creative algorithmic problem-solving skills. Quality coding education can empower them to be creative leaders in any field in this new era of change.

TAE Coding is a specialist in early coding education. We have designed various learning tracks to accommodate and foster different interests and goals. Each track provides a streamlined guide for our students to learn not only the fundamentals but also advanced programming through systematic curriculum.

TRACKS OFFERED

CS PRINCIPLE TRACK [GRADES: 4TH – 6TH]

- **[CS11]** Introduction to Programming in Scratch
- **[CS12]** Programming Fundamentals in Scratch
- **[CS13]** Game Development in Scratch
- **[CS14]** Mobile App Development in App Inventor

CS FOUNDATION TRACK [GRADES: 7TH AND UP]

- **[CS21]** Introduction to Programming in Python
- **[CS22]** Programming Fundamentals in Python

CS APPLICATION TRACK [GRADES: 7TH AND UP]

- **[CS31]** Web Animation and Game Development
- **[CS32]** Web Design and Development
- **[CS33]** Web App Development in Angular
- **[CS34]** Mobile App Development in Ionic

CS AP TRACK [GRADES: 7TH AND UP]

- **[CS41]** Introduction to AP Computer Science
- **[CS42]** Programming Fundamentals in JAVA
- **[CS43]** AP Exam Preparation

CS OLYMPIAD TRACK [GRADES: 7TH AND UP]

- **[CS51]** Introduction to Competition Programming
- **[CS52]** Olympiad Bronze Contest Preparation
- **[CS53]** Olympiad Silver Contest Preparation
- **[CS54]** Olympiad Algorithm

CS DATA SCIENCE TRACK [GRADES: 7TH AND UP]

- **[CS61]** Introduction to Data Science
- **[CS62]** Data Visualization and Statistics
- **[CS63]** Machine Learning Fundamentals

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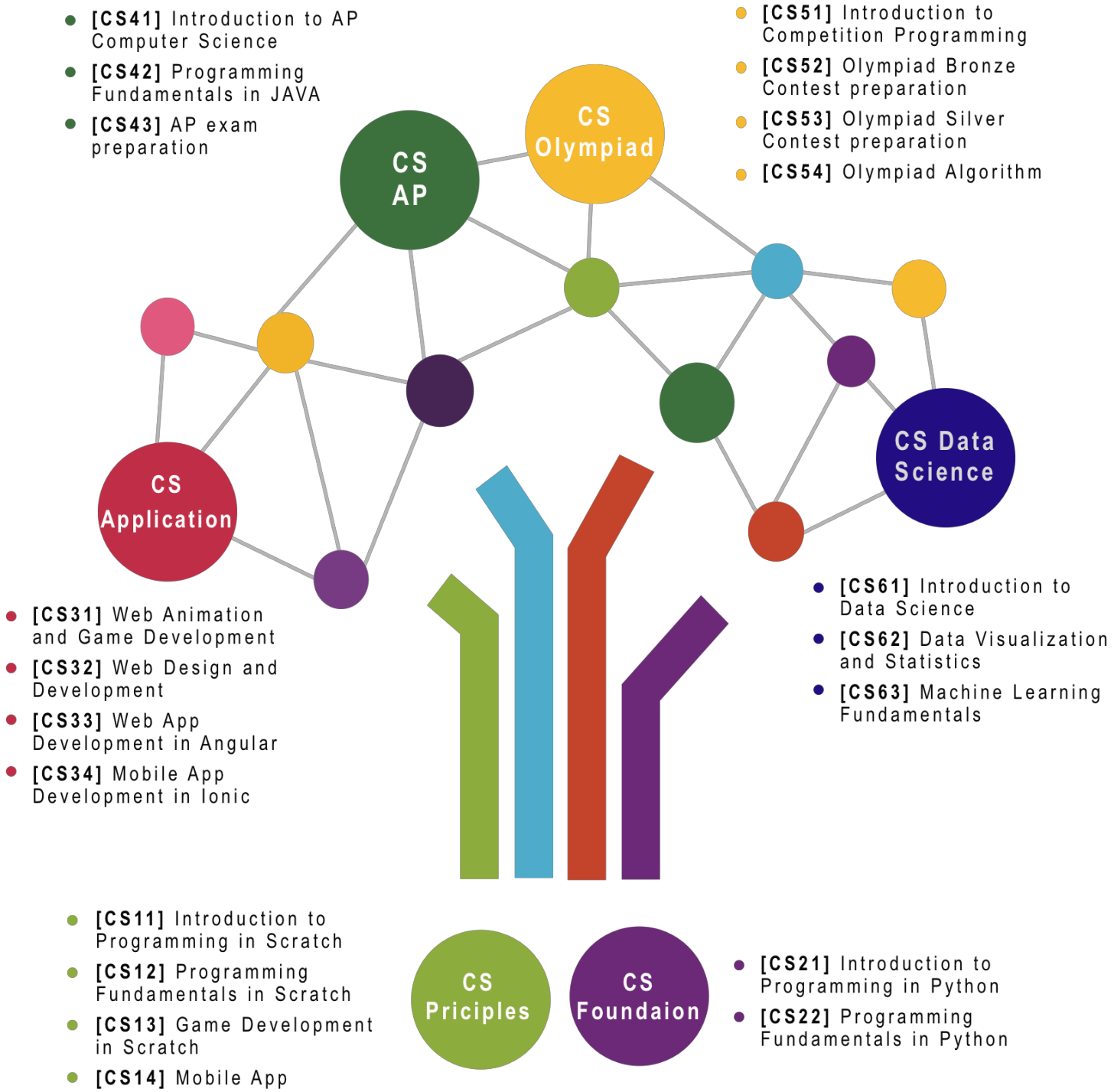
COURSE TRACK TREE



TAE coding Technology Applied Education CS PRINCIPLE TRACK

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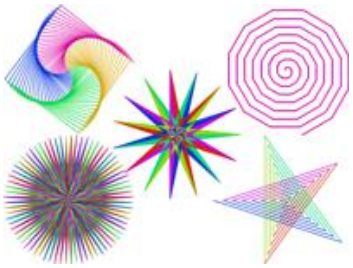
In this Computer Science Principle Track, students will learn essential concepts for programming principles by learning Scratch and App Inventor. Both Scratch and App Inventor are block-based programming languages developed by MIT. Scratch and App Inventor are visually powerful to facilitate the learning of complex programming principles. Students will also learn how to create interactive data-oriented animations and games and how to share their creations with others. By the end of this track, students will have a strong foundation for programming principle and logical computational thinking to move on to more advanced tracks.

Length: 4 Courses
Recommended Grades: 4^{th} – 6^{th}
Prerequisites: None

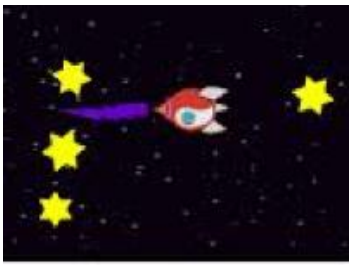
[CS11] INTRODUCTION TO PROGRAMMING IN SCRATCH

This is the first course in Computer Science Principle Track. Students will learn essential programming concepts, such as variables, operators, expressions, conditional statements, loops, and functions. Also, students will learn how to create basic interactive animations and games. Quizzes and homework will be assigned on a weekly basis.



[CS12] PROGRAMMING FUNDAMENTALS IN SCRATCH

This is the second course in Computer Science Principle Track. On top of the essential programming concepts, students will learn more advanced programming concepts, such as string, list manipulation, and recursions. Also, students will learn how to create more advanced data-oriented animations and games. Quizzes and homework will be assigned on a weekly basis.



[CS13] GAME DEVELOPMENT IN SCRATCH

This is the third course in Computer Science Principle Track. With all the programming concepts, students will focus on developing more complicated and interactive games. Also, students will learn how to publish and share their creations with others in the world. By working through projects, students will also learn the basic life cycle of computer science. Quizzes and homework will be assigned on a weekly basis.

[CS14] MOBILE APP DEVELOPMENT IN APP INVENTOR

This is the last course in Computer Science Principle Track. Students will learn the essential constructs of App Inventor and how to design and develop functional mobile apps for smartphones and tablets. Quizzes and homework will be assigned on a weekly basis.

TAE coding Technology Applied Edaucation CS FOUNDATION TRACK

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In this Computer Science Foundation Track, students will learn essential concepts for programming principles by using Python. Python is an expressive programming language to facilitate the learning of complex programming principles and, also a popular versatile language even suitable for data science. By the end of this track, students will have a strong foundation of programming principles and logical computational thinking to move on to learn how to develop the advanced applications.

Length: 2 Courses
Recommended Grades: 7th and up
Prerequisites: None

[CS21] INTRODUCTION TO PROGRAMMING IN PYTHON

This is the first course in Computer Science Foundation Track. By learning Python programming, students will learn essential programming concepts, such as variables, constants, operators, expressions, conditional statements, loops, and functions. Quizzes and homework will be assigned on a weekly basis.

[CS22] PROGRAMMING FUNDAMENTALS IN PYTHON

This is the second course in Computer Science Foundation Track. Students will learn string, list, range sequences, the power of list iteration, string and list methods. Also, students will learn the data structures and other practical tasks of Python programming. Quizzes and homework will be assigned on a weekly basis.

TAE coding CS APPLICATION TRACK

Technology Applied Education

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In this Computer Science Application Track, students will learn how to develop the advanced applications for desktop, web and mobile with the latest industry standard technologies and tools, including JavaScript, HTML5 and CSS, VSCODE IDEA, Typescript, Angular, Ionic and Node.js. By working through fun projects, students will also learn the core software development principles. More importantly, they will learn the common structures in applications and how to apply them to learn new technologies more quickly. By the end of this track, students will have a strong foundation of developing applications and move on to more advanced applications.

Length: 4 Courses
Recommended Grades: 7th and up
Prerequisites: CS Foundation Track

[CS31] WEB ANIMATION AND GAME DEVELOPMENT

This is the first course in Computer Science Application Track. Students will learn the constructs of JavaScript programming and how to build animations, interactive art and games in Typescript. Also, students will learn how to publish websites with animations and interactive games. Quizzes and homework will be assigned on a weekly basis.

[CS32] WEB DESIGN AND DEVELOPMENT

This is the second course in Computer Science Application Track. Students will learn the constructs of HTML5 and CSS for web designing and styling. Students will also learn how to integrate CSS and JavaScript to give a professional look and feel. Quizzes and homework will be assigned on a weekly basis.

[CS33] WEB APP DEVELOPMENT IN ANGULAR

This is the third course in Computer Science Application Track. Students will learn Google Angular framework, which is the latest application development technology. By learning Angular framework, student will be able to build applications suitable for all platforms, such as web, mobile web, native mobile, and native desktop. Quizzes and homework will be assigned on a weekly basis.

[CS34] MOBILE APP DEVELOPMENT IN IONIC

This is the fourth course in Computer Science Application Track. Students will learn Ionic 2, one of the most popular open source frameworks especially for building mobile applications. Students will learn how to develop their own mobile applications and how to publish it. Quizzes and homework will be assigned on a weekly basis.

TAE coding CS DATA SCIENCE TRACK

Technology Applied Edaucation

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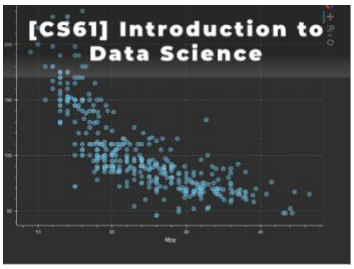
DS TRACK DESCRIPTION

Data Science is an interdisciplinary study of mathematics, statistics, information science, and computer science to extract valued insights through big data. The term "data science" was initially used as new technology enabling companies to target marketing with vast amounts of data about consumers. But now every field including economists, lawyers, engineers and medical researchers use data science to find solutions for their challenging issues. The New York Times emphasized that this hot new field promises to revolutionize industries from business to government, health care to academia.

Now the demand for skilled data science practitioners is significantly growing. According to Glassdoor, the job search website, a data scientist is the best job in the U.S 2016, 2017 and 2018 in a row. Also, Harvard Business Review called the profession of data scientist as the "Sexiest Job of the 21 Century".

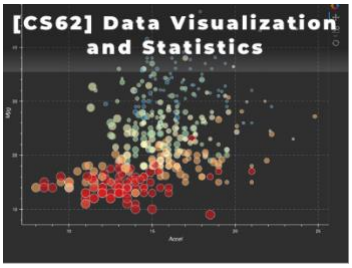
Our one-year Data Science Track is designed for high school and college students to learn fundamental knowledge and research skills necessary for the research-related internship as well as job opportunities in any field. Professional data scientists will teach data processing, data visualization with statistics, and predictive machine learning models with motivating case studies. In the end, students will participate in data science research projects with challenging real-world issues. Students can have an opportunity to participate in data science competitions with mentorship and can receive a letter of recommendation from instructors.

Length: 4 Courses
Recommended Grades: 9th and up
Prerequisites: CS Foundation Track



[CS61] INTRODUCTION TO DATA SCIENCE

This is the first course of CS Data Science Track. This course introduces a collection of powerful tools for data analysis such as Jupiter Notebook, Numpy, Pandas, Matplotlib, Git and more. Students will learn hands-on knowledge on data processing. This course also provides the foundation for the later courses in the data visualization and machine learning.



[CS62] DATA VISUALIZATION AND STATISTICS

Visualization is one key approach to gaining insight from this mountain of data. It enables the trends and patterns, to be examined and assessed. Data Visualization tools in the Python (Matplotlib) platforms will be covered in the course. Students will also learn the foundation of statistics, probability. They will be given many opportunities to apply theories they've learned.

[CS63] Machine Learning Fundamentals

This course is the third course of CS Data Science Track. There is heavy and growing demand for computer scientists who have 'Machine Learning' skills. This course will cover the underlying mathematical concepts for a wide variety of Machine Learning methods and algorithms, plus various procedures used to assess the value and validity of them. .

[CS64] Machine Learning Research Projects

This course is the final course of CS Data Science Track. This course is designed to challenge students with real-world machine learning problems. The instructor will introduce several open dataset competitions on real world issues that current data scientists are trying to solve in the areas of government, health, and science. Instructors will guide students to explore and build predictive models.

Instructor Information

Dr. Ash Pahwa

Ash Pahwa, Ph.D., is an educator, author, entrepreneur, and technology visionary with three decades of industry and academic experience. Dr. Pahwa currently teaches a data science course, "Advanced Analytics: Machine Learning Using R and Python." at California Institute of Technology.

Dr. Pahwa earned his doctorate in Computer Science from the Illinois Institute of Technology in Chicago. He is listed in ***Who's Who in the Frontiers of Science and Technology***. He is also a Google Certified Analytics Consultant.

In Industry, Dr. Pahwa has worked for General Electric, AT&T Bell Laboratories, Xerox Corporation, and Oracle. He founded CD-Gen, Inc. and DV Studio Technologies, LLC., which introduced successful products for CD-Recording (CDR), MPEG encoding, and videotape-to-DVD archiving. His book, ***CD-Recordable Bible***, has been published in English, Japanese, and German.

Taehee Jung, CFA

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