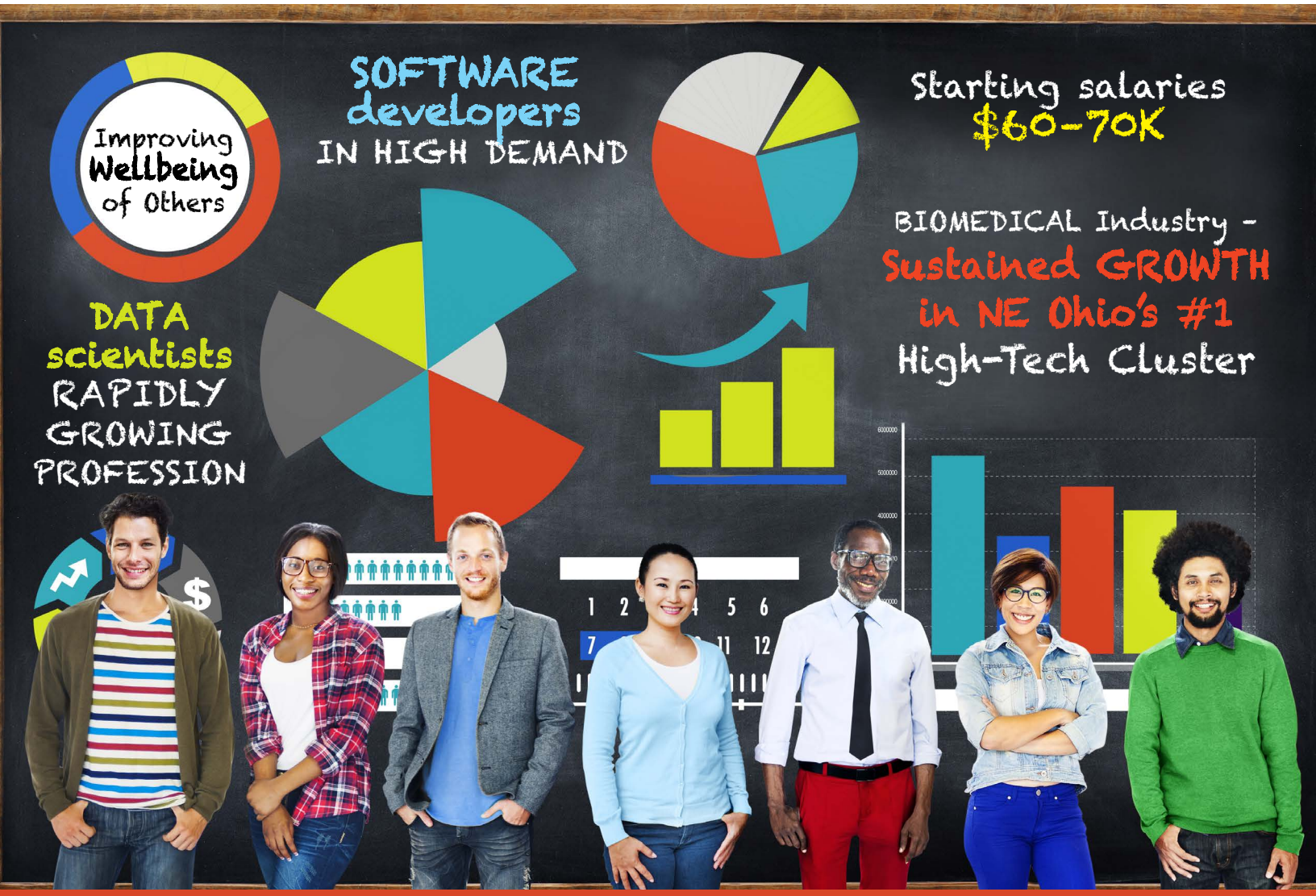
HIT in the CLE

SOFTWARE DEVELOPER AND DATA SCIENTIST EDUCATIONAL PATHWAYS FOR THE HEALTH IT SECTOR



A NORTHEAST OHIO HEALTH IT TALENT COLLABORATIVE

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The Health IT (HIT) industry in Northeast Ohio is one of the highest growth industries for our region and continues to outperform other areas of business. In order to provide enough talent for the demands of our vibrant local Health IT industry, our region must expand our Health IT talent pipeline.

We intended to improve student awareness of the two critical Health IT positions, **Software Developer** and **Data Scientist**. We will explain the necessary curriculum high school and college students need to take as well as experiential learning opportunities to compete for the well-paying, personally rewarding jobs. Most importantly, we will give those who might be considering a career in Health IT a framework for technical and soft skills that the Health IT industry values and requires of its entry-level talent.

Enjoy the following pages as you explore a career in the exciting entrepreneurial world of Health IT. If you have questions, go to www.hitinthecle.com for additional information and resources.

We wish you the best on your educational journey!

This publication made possible by grants from The Cleveland Foundation and PartsSource

Members of the **Northeast Ohio Health IT Talent** Collaborative:

BioEnterprise

Case Western Reserve University

Cleveland State University

CoverMyMeds

Cuyahoga Community College

IBM Watson Health

Hyland Software

John Carroll University

John Marshall School Of Information Technology

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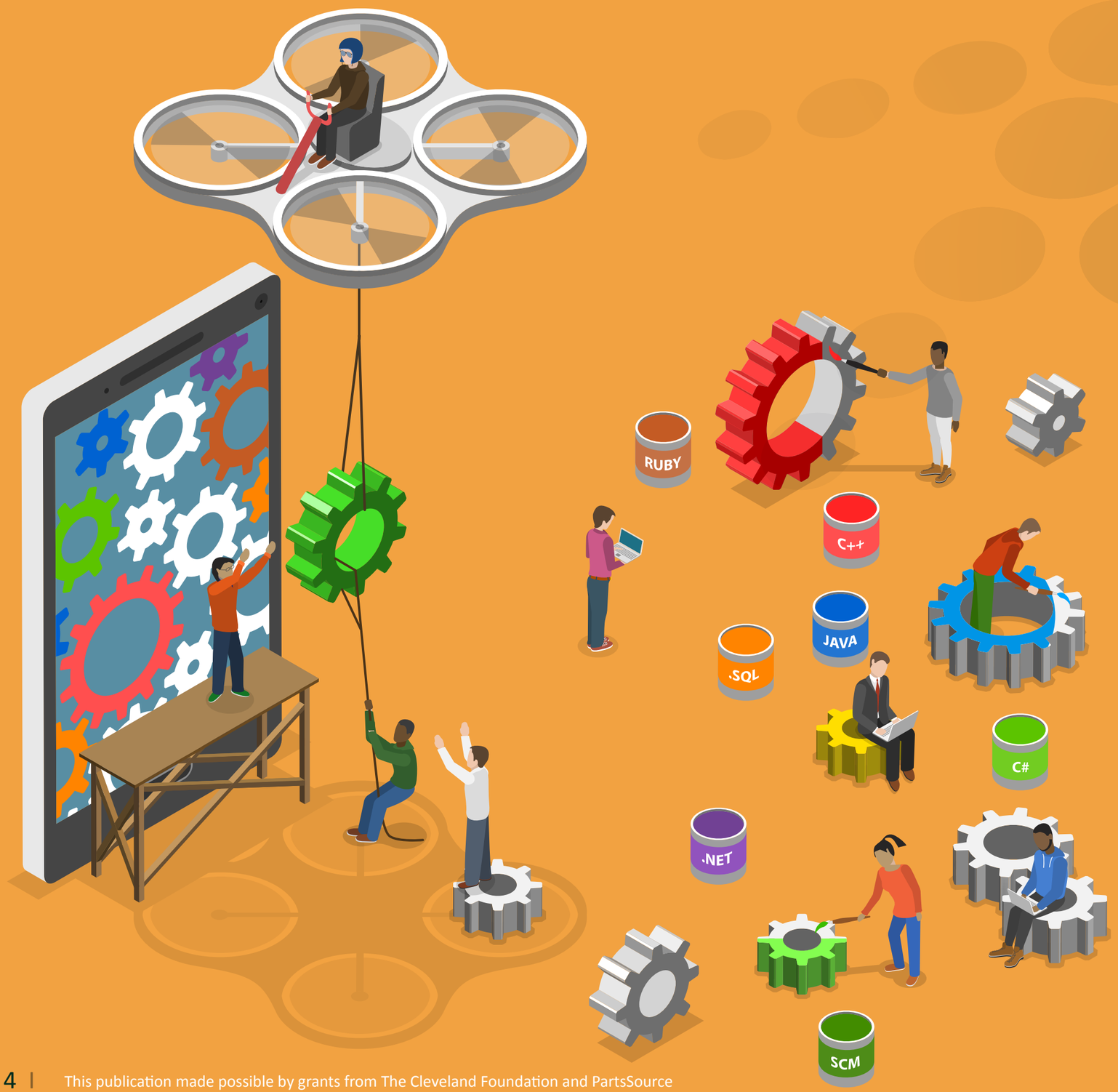
THE DOMINANT INDUSTRIES THAT SERVE THE **NORTHEAST OHIO REGION** HAVE SHIFTED WITH THE **BIOMEDICAL SECTOR EMERGING** WITH THE **HIGHEST-GROWTH** OPPORTUNITIES

- **Since 2002**, Cleveland's biomedical industry has **grown from 300** companies to **over 700 companies**
- **Investment** in Cleveland biomedical companies **increased** from **$30 million in 2001 to over $200 million in 2015**
- There are roughly **200—300 new Health IT jobs** created each year **in our region**
- **Software developers** and **data scientists** are the **skill sets most in demand** by Health IT companies **in our region**
- **Starting salaries** for software developers and data scientists for our regional Health IT industry range between **$60—70K for undergraduate degrees**

Health IT (HIT) Cluster

The **group of regional companies** committed to **developing IT-enabled** solutions and services to **support health** and **wellness** industries



HIT **Software Developer**

A professional who **understands healthcare challenges** and **produces code** in **collaborative environments** resulting in industry solutions**.** HIT software developers have a **deep understanding** of **Computer Science** concepts and think with an **entrepreneurial mindset.**

This publication made possible by grants from The Cleveland Foundation and PartsSource

High School HIT Software Developer Educational Path

Calculus*
Exposure in high school is key

Algebra*
A strong algebraic base is key to Computer Science success

Entrepreneurship
Build your knowledge of what it means to start a business or work in a startup environment

Computer Science Camp Or Competition

Extra Curriculars
Involvement in non-academic activities builds important skills

AP Computer Science (A)*
Programming language and higher order Computer Science concepts taught at an intro college level

Pursue Your Passions
Continue learning about a wide variety of interests. There are synergies that will be of value

Computer Science Principles*
Foundational Computer Science class intended for everyone

Work Experience
Take advantage of any opportunity to gain professional exposure and experience

Physics*
The lab science most often required by college programs

Communi-cation

*Critical Software Developer High School Coursework

This publication made possible by grants from The Cleveland Foundation and PartsSource

High School HIT Software Developer Educational Path

CRITICAL HIGH SCHOOL COURSES FOR SOFTWARE DEVELOPERS	DESCRIPTION
Algebra	• According to a National Science Foundation report, Algebra 1 is considered a "gateway" course leading to more advanced courses in mathematics and to higher levels of achievement (Loveless 2008; Tierney et al. 2009). • Algebra bolsters logic skills and introduces abstract thinking (EdSource) • Basic Algebra is a prerequisite for Computer Science Principles and AP Computer Science (A)
Calculus	• Taking Calculus in high school nearly doubles the success rate of graduating in Computer Science in college • Exposure to Calculus in high school makes the college Calculus experience less difficult and complex • Calculus is required to enhance Computer Science mathematical maturity and thinking (*Mathematical Reasoning In Software Engineering Education* – Peter B. Henderson)
Computer Science Principles	• An introductory course designed for all students • Intended to educate students on the fundamentals of Computer Science and the applications of the discipline • Leverages computational thinking and applies it to problem solving via technology. Computational thinking is the process of using math and logic to solve problems.
AP Computer Science (A)	• Designed for students who intend to be Computer Science or other STEM majors in college • Mirrors first college introductory Computer Science—a major course • This class is very important for student success in college. Exposure to this material in high school significantly increases the likelihood of success in the intro college Computer Science class.
Physics	• The lab science class most frequently required by college Computer Science programs. An overwhelming majority of Computer Science majors are required to take Physics, so like Calculus, taking Physics in high school makes the content more familiar when students see it again in college. • Physics and Computer Science are interconnected on many levels as computers are used to prove a majority of the concepts in the physical world (Prof. Charles H. Bennett, IBM Fellow)

ELECTIVE HIGH SCHOOL COURSES FOR SOFTWARE DEVELOPERS	DESCRIPTION
Pursue Your Passions	Your passions can be instrumental in the development of the foundations that can support a long career in Computer Science: • Have fun with your coursework outside of your formal educational track. Your high school years should fuel your passions and support your growth as a person. • In addition to STEM, subjects like art, history, music, etc., can play an important role in building skills that are high in demand. HIT employers look for well-rounded candidates and colleges look to admit the best potential students. • Problem solving is a large part of Computer Science. Those who are able to solve problems in areas outside of Computer Science often find that they are able to transfer this skillset to technical areas.

HIGH SCHOOL EXPERIENTIAL COMPONENTS FOR SOFTWARE DEVELOPERS	DESCRIPTION
Communication	Effective communication is an important workplace competency for software developers. As high school students, this skill can be practiced in a number of different settings. Some examples are: • Take a creative writing class or maintain a blog of your choice • Participate on the debate team or Model United Nations • Serve as the communications chairperson for a club or activity
Extra Curriculars	Take advantage of extra curricular opportunities, picking a few that you can really commit to. Quality participation vs. résumé stuffing is key. Demonstration of leadership, initiative taking and flexibility are very important skill sets. Examples of extracurricular activities are: • Varsity sports • Scouting, religious organizations, civic organizations • Participation in the arts (music, visual arts, dance, drama) • Summer enrichment (intensives, college emersion programs, etc.) • Traveling abroad • Volunteering in an industry or with an organization for which you have a passion • Investigate and participate in a summer bridge program after high school graduation. If available, these programs give incoming college freshman exposure to curriculum and campus life, before the start of the academic year.
Entrepreneurship	An entrepreneurial mindset is a characteristic that is valued by HIT companies. This trait can be cultivated during the high school years in a number of ways: • Work or volunteer for an entrepreneurial venture to get first-hand experience • Take part in an entrepreneurial club (e.g., Junior Achievement) • Take an entrepreneurial class • Participate in a business plan pitch competition (e.g. Believe in Ohio, CoolTech Challenge, etc.) • Research, plan and start a business
Work Experience	Capitalize on the opportunity to gain work experience in a professional setting. • Get a job, internship or co-op in a professional setting. • Volunteer for a professional organization that shares your career interests or passion • Capitalize on shadowing opportunities as they present themselves
Computer Science Camp Or Competition	Participate in a Computer Science camp and/or competition that allows high school students who aspire to be software developers the opportunity to cultivate their development skills and increase hands-on experience. • Computer Science Camp (sponsored by the RITE Board @ CWRU, We Can Code IT, etc.) • Hack-a-thons (CLE – Teen Hack, Cleveland Medical Hackathon, etc.) • Participate in the National STEM Video Game Challenge

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College HIT Software Developer Educational Path

Communi-cation
Grow professional competency

Exposure To Clinical Settings

Entrepreneurship
HIT companies look for graduates who have entrepreneurial mindsets

Active Engagement In A Student Technical Organization
Added experiential value to undergraduate coursework

Extra Curriculars
Extra curricular activities provide an important vehicle to grow personal and workplace competencies

Core Computer Science Coursework*
Key college classes, integral to the software development profession

Health Informatics/ Bio Informatics

Design Thinking/ Ethno-graphy

Computer Science Support Network
Support is a key enabler for success

Bio-Ethics/ Health-Related Ethics

Computer Science Comp/ Hackathon

Developing Software In A Collaborative Environment

*Critical Software Developer Core College Coursework

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College HIT Software Developer Educational Path

CORE COLLEGE CURRICULUM FOR SOFTWARE DEVELOPERS	DESCRIPTION
Core Coursework	Diverse mixture of programming, modeling, and higher order math classes to prepare undergraduate students for a career as a software developer. Students are exposed to a broad array of programming languages and computing platforms. The ultimate goal of the coursework is not necessarily mastery of a particular language but the ability to learn new languages and concepts based on foundational preparation.

ELECTIVE COLLEGE CLASSES FOR SOFTWARE DEVELOPERS	DESCRIPTION
Communication	Communication is a vital workplace competency, integral to the success of entry-level developers within HIT organizations. Developers need to effectively communicate to peers, management and a host of other stakeholders. This skill can be refined in college by: • Taking a professional or technical communications class • Joining a club like Toastmasters or taking integral speaking roles during group presentations in core coursework
Entrepreneurship	Having an entrepreneurial mindset is an important business impact competency that HIT companies look for in new hires. New hires must have a strong tolerance for ambiguity and risk taking. This skill can be developed by: • Taking an entrepreneurship class or joining a similar type club in college • Working in an entrepreneurial company while in college • Starting an entrepreneurial venture while in college
Health Informatics/ Bioinformatics	Health Informatics/Bioinformatics is the application of computer technology to the management of biological information. These classes are becoming an integral part of many college programs and are deemed an ideal elective for HIT software developers.
Bio-Ethics or Health-Related Ethics	Integrity is a highly rated personal-effectiveness trait especially in the HIT industry. Health-related data has some of the strictest guidelines associated with its use. Some undergraduate bio/health-related ethics classes have certification components built into the coursework. At a minimum an appreciation of the importance of health data is vital.
Design Thinking–Ethnography	Empathy is the first step in the design-thinking process. Stanford University, and other educational institutions suggest good designs begin with the designer's ability to first empathize with aspects of a problem or business challenge before defining and building a solution. If software developers can empathize with patients, stakeholders, etc., first, their software is thought to be more robust and ultimately a better product. Software developers are part of dynamic teams and must engage people. Students can gain exposure to this process through: • Coursework at college that specifies design-thinking approach • Online, self-paced courses

COLLEGE EXPERIENTIAL COMPONENTS FOR SOFTWARE DEVELOPERS	DESCRIPTION
Active Engagement In A Student Technical Organization	Students benefit from greater exposure to professional applications of their education, professional development and exposure to potential job opportunities. Some of the technical organizations for software developers that exist on most campuses are: • ACM – Association for Computing Machinery • IEEE – Institute of Electrical and Electronic Engineers • HIMSS – Healthcare Information and Management Systems Society
Development Experience In Practical Industry Scenarios	Gaining real-world experience is an important goal during the undergraduate period. Working in development environments that accurately reflect the Health IT industry is important. • Intern/co-op with a HIT company, IT startup or within a clinical setting. Developing software in an environment that is relevant to the HIT industry is an experience sought out by HIT employers. • The ability to collaborate, learn and contribute with others in a professional setting is vital. Strive to get as much relevant experience outside the classroom as time permits.
Computer Science Support Network	With a 60% attrition rate nationally for Computer Science majors, plugging into support networks (peer, educational, mentor, faculty, etc.) can prove very important in increasing the chances of successfully graduating with a Computer Science degree. How college students can access support: • Attend the BioEnterprise HIT undergraduate 'Meet-Ups' sponsored by HIT companies • Leverage student technical organizations to take advantage of study tables, test files and peer social support
Extra Curriculars	Get involved in at least one non-technical-related group! There are many aspects of HIT software development like taking initiative, cross-cultural sensitivity, service projects and teamwork, that may be best developed in an activity or group outside of academic studies. Some of these opportunities may be presented in: • Student government • Intercollegiate or intramural athletics • Volunteer for a cause or in an area for which you have a passion
Computer Science Competition Or Hackathon	Computer Science competitions allow those who aspire to be software developers the opportunity to cultivate their development skills and to increase their collaboration and problem-solving opportunities. This type of experience is highly desired by HIT employers. Some examples are: • Challenges (ex. NASA Tournament Lab) • Competitions (ex. Student Contest on Software Engineering–SCORE) • Hackathons (ex. Cleveland Medical Hackathon)
Exposure To Clinical Settings	Gaining exposure to clinical settings greatly enhances the HIT skill set. • Spending time in clinical settings (hospitals, medical clinics and other patient care facilities) provides opportunities for developers to gain first-hand knowledge of healthcare delivery environments. This exposure leads to better solution designs. • Exposure comes in the form of volunteerism, class projects, or internships/co-ops

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HIT **Data Scientist**

A professional **skilled in the art of problem solving.** Data scientists **review** large **data sets**, draw **conclusions**, and **report** their findings. They are **good oral and visual communicators** and can get their message **across to a broad audience.**

This publication made possible by grants from The Cleveland Foundation and PartsSource

High School HIT Data Scientist Educational Path

Communication: Written & Oral/ Factual & Creative

Practice communicating using different methods with different groups of people

Computer Science Principles*

Foundational Computer Science class intended for everyone

Work Experience

Ideally in a professional setting

Calculus*

Advanced math is key to CS success

AP Stats*

Data scientists use a lot of statistics. Key to get exposure before college.

Kaggle (like) Competition

Experiential Data Science event

Algebra*

A strong algebraic base is key to Computer Science success

Extra Curriculars

Personal-effectiveness skill building

AP Computer Science (A)*

Programming language and higher order Computer Science concepts taught at an intro college level

Pursue Your Passions

Physics*

The lab science most requested by colleges

Graphic Arts*

Visual presentation of data is a key skill

*Critical Data Science High School Coursework

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High School HIT Data Scientist Educational Path

CRITICAL HIGH SCHOOL COURSES FOR DATA SCIENCE	DESCRIPTION
Algebra	• According to a National Science Foundation report, Algebra 1 is considered a "gateway" course leading to more advanced courses in mathematics and to higher levels of achievement (Loveless 2008; Tierney et al. 2009) • Algebra bolsters logic skills and introduces abstract thinking (EdSource) • Basic Algebra is a prerequisite for Computer Science Principles and AP Computer Science (A)
Calculus	• Taking Calculus in high school nearly doubles the success rate of graduating in Computer Science in college • Exposure to Calculus in high school makes the college Calculus experience less difficult and complex • Calculus is required to enhance Computer Science mathematical maturity and thinking (*Mathematical Reasoning In Software Engineering Education* – Peter B. Henderson)
AP Stats	• Statistics is used heavily in the study and execution of Data Science • Many statistical classes are taught in college. Early exposure in high school makes the college experience easier and less intimidating.
Computer Science Principles	• An introductory course designed for all students • Intended to educate students on the fundamentals of Computer Science and the applications of the discipline • Leverages computational thinking and applies it to problem solving via technology. Computational thinking is the process of using math and logic to solve problems.
AP Computer Science (A)	• Designed for students who intend to be Computer Science or other STEM majors in college • Mirrors first college introductory Computer Science—a major course • This class is very important for student success in college. Exposure to this material in high school significantly increases the likelihood of success in the intro college Computer Science class
Physics	• The lab science class most frequently required by college Computer Science programs. An overwhelming majority of Computer Science majors will be required to take Physics, so, like Calculus, taking Physics in high school makes the content much more familiar when students see it again in college. • Physics and Computer Science are interconnected on many levels as computers are used to prove a majority of the concepts in the physical world – *Prof. Charles H. Bennett (IBM Fellow)*
Graphic Arts	The ability to create visual presentations of information is an important skill set for a data scientist. Developing these skills early makes sense especially when there are classes offered at most high schools that can be leveraged. Some examples are: • General art class (concepts about color, shape and design are foundational) • Graphic art and design • Computer-aided design (CAD)

ELECTIVE HIGH SCHOOL COURSES FOR DATA SCIENCE	DESCRIPTION
Pursue Your Passions	Your passions can be instrumental in the development of the foundations that can support a long career in Computer Science: • Have fun with your coursework outside of formal school. Your high school years should fuel your passions and support your growth as a person. • Participation in the arts (music, visual arts, dance, drama) • In addition to STEM, subjects like art, history, music, etc., can play an important role in building skills that are high in demand. HIT employers look for well-rounded candidates and colleges are looking to admit the best potential students. • Problem solving is a large part of Computer Science. Those who can solve problems in areas outside of Computer Science, often find that they are able to transfer this skillset because they are able to think. • Traveling abroad to experience different cultures, languages and customs

HIGH SCHOOL EXPERIENTIAL COMPONENTS FOR DATA SCIENCE	DESCRIPTION
Communication: Written & Oral/Factual & Creative	Effective communication is an important workplace competency for Data Science. High School students should get lots of practice communicating ideas and thoughts to a wide range of people. Creative and factual communications should be practiced in high school. Examples are: • Take a speech class if offered in high school or participate on the debate team • Take a creative writing class
Work Experience	Focus on gaining work experience, ideally in professional environments. Examples are: • Get a job, internship/co-op. Exposure to professional settings can be very insightful • Seek opportunities that give exposure to technical environments and develop soft skills • Volunteer in an industry or with an organization for which you have a passion
Extra Curriculars	Take advantage of extra curricular opportunities, picking a few that you can really commit to. Quality participation vs. résumé stuffing is key. Demonstration of leadership, initiative taking and flexibility are very important skill sets. Examples of extracurricular activities are: • Being part of a competitive athletic or academic team • Scouting, religious organizations, civic organizations • Participation in the arts (music, visual arts, dance, drama) • Summer enrichment (intensives, college immersion programs, etc.) • Investigate and participate in a summer bridge program after high school graduation. If available, these programs give rising college freshman exposure to curriculum and campus life, before the start of academic year
Kaggle (like) Competition	A Kaggle (like) competition is an event where students are tasked with the opportunity to come up with the best solution for a problem definition that is based on a large data set. • Participation in the BioEnterprise High School Kaggle (like) competition gives students the opportunity to experience manipulation of large data sets, as well as to present their solutions to the problem definition in oral and visual formats. • The contest allows students to utilize the skill sets that are most important to data scientists in a fun and non-threatening environment. They will have the opportunity to work in teams and be coached by a professional data scientist, as well as undergraduate students.

College HIT Data Scientist Educational Path

Multi-Level Communication

Data scientists must be able to communicate with a diverse group of stakeholders

Computer Science Support Network

Support is a key enabler for success

Active Engagement In Student Technical Organization

Added experiential value to undergraduate coursework

Health Informatics/ Bioinformatics

The combination of biological data with technology for analysis

Core Data Science Coursework* (including data visualization)

Key college classes, integral to the Data Science curriculum
** Data privacy and security integral to degree

Design Thinking/ Ethno-graphy

Kaggle Competition

Experiential Data Science event

Solving Problems Working With Real-World Data Sets

Bio-Ethics or Health-Related Ethics

Ethics are an important part of the HIT industry, especially due to data protection issues

Extra Curriculars

Extracurricular involvement builds key skills

Business Acumen

*Critical Data Science Core College Coursework
** Data Privacy And Security Is An Integral Part Of The Data Science Core

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College HIT Data Scientist Educational Path

CORE COLLEGE CURRICULUM FOR DATA SCIENTISTS	DESCRIPTION
Core Coursework	The core curriculum for the study of Data Science has a Computer Science foundation, but is also rich and is complemented with higher order statistics, machine learning and data visualization. Undergraduate programs stress the importance that data scientists need to be proficient at articulating and visually presenting their findings to a broad spectrum of stakeholders. To that end: • Data Visualization is a core class offered in the majority of Data Science programs. This course develops graphical skills for presentation of data analysis and reporting. This is a vital skill set, given the fact that many people are visual learners, and data scientists need to be able to convey their findings by means of visual presentations. • Verbal skills is the other key tool in the tool box vital to a data scientist's effective communication. Interdisciplinary communication skills are best achieved through numerous educational course offerings. The curriculum should do an exceptional job of preparing students academically, as well as provide tools and experiences to make undergraduates great communicators in the process.

ELECTIVE COLLEGE CLASSES FOR DATA SCIENTISTS	DESCRIPTION
Multi-Level Communication	As a data scientist, one of the key functions will be to communicate to a wide group of people who may represent different perspectives or backgrounds. Undergraduate Data Science students will benefit from a communications class outside of the engineering curriculum that pushes the interdisciplinary envelope of communication. Relevant classes may be found in: • The Business School • College of Arts and Sciences • Other non-traditional undergraduate communication offering
Business Acumen	Solid business knowledge is an important and valuable competency for data scientists. Understanding how one's role adds value to the HIT organization and makes a difference to the bottom line is desired by employers. This skill may be developed by: • Taking an introductory business class while in college • Participating in a business plan competition • Joining a business club or affinity group on campus
Health Informatics/ Bioinformatics	Health Informatics/Bioinformatics is the application of computer technology to the management of biological information. These classes are becoming an integral part of many college programs and are deemed an ideal elective for the HIT data scientist.
Bioethics or Health-Related Ethics	Integrity is a highly rated personal-effectiveness trait identified by the HIT industry. There are strict data regulatory requirements around patient data protection. Health-related data has some of the strictest guidelines associated with its use. Some undergraduate bio/ health-related ethics classes have certification components built into the coursework. At a minimum, an appreciation of the importance of health data is vital.
Design Thinking—Ethnography	It is essential for data scientists to display empathy in the interpretation and communication of their solutions to relevant stakeholders. Research conducted by Stanford University stresses the importance of starting from an empathetic perspective. Data scientists need to be empathetic as they engage in a variety of settings and circumstances in gaining greater insight and understanding of the data samples. Data scientists are part of dynamic teams and must engage people. Students gain exposure to this process through: • College coursework that specifies 'design-thinking approach' • Online, self-paced courses

COLLEGE EXPERIENTIAL COMPONENTS FOR DATA SCIENTISTS	DESCRIPTION
Active Engagement In Student Technical Organization	Students benefit from greater exposure to professional applications of their education, professional development and exposure to potential job opportunities. Some of the technical organizations for data scientists that exist on most campuses are: • DSA – The National Data Science Association • IEEE – Institute of Electrical and Electronic Engineers • HIMSS – Healthcare Information and Management Systems Society
Real World Experiences	Making the most of time outside the classroom during the undergraduate years is very important. Gaining relevant work experience when the time permits should be a priority. • Get an internship/co-op with an HIT company, IT startup or within a clinical setting. Gaining relevant work experience regarding one's major is important. • Work experience should show growth and increased responsibilities, leading to increased professional exposure
Support Network	With a 60% national attrition statistic for Computer Science majors, plugging into support networks (peer, educational, mentor, etc.) can prove very important in increasing the chances of successfully graduating with a Computer Science degree. College students can experience support by: • Attending the BioEnterprise HIT undergraduate 'Meet-Up' sponsored by HIT companies • Leveraging a student technical organizations to take advantage of study tables, test files and peer social support
Extra Curricular	Involvement in at least one non-technical related group during the undergraduate experience is wise. There are many aspects of HIT software development like taking initiative, cross-cultural sensitivity and teamwork, that may be best developed in an activity or group outside of academic studies. Some of these opportunities may be presented in: • Student government • College sport or athletic endeavor • Volunteer for a cause or in an area that you have a passion
Kaggle Competition	Building on the high school experience, participate in the Kaggle competition, with more complex problem definitions and data sets. Compete on a global stage to improve Data Science skill set.

For more information visit:
www.hitinthecle.com

Growing HIT companies in **our region:**

covermymeds®	www.covermymeds.com
IBM Watson Health	www.ibm.com/watson/health
OnBase® by Hyland	www.onbase.com
OniShift	www.onshift.com
PARTSSOURCE®	www.partssource.com

Health IT Talent Collaborative Leader:

BioEnterprise

www.bioenterprise.com

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