Information Technology

Comprehensive Career Cluster Review (C3R)

College, Career & Technical Education | Spring 2024

TN Department of Education

Comprehensive Career Cluster Review (C3R)

The comprehensive career cluster review (C3R) is the intentional review of career and technical education (CTE) programs and the course standards within each program to ensure students have up-to-date course standards aligned to postsecondary and career needs. Each career cluster is reviewed annually with input from the state-wide advisory councils comprised of postsecondary partners, industry partners, and secondary CTE teachers. Advisory council meetings allow the stakeholders to engage in dialogue and discuss current needs, emerging trends, and necessary course revisions to course standards. Advisory council input could potentially lead to new or retired programs of study, new courses or retired courses, or revised course standards within existing courses, if necessary. The collaborative engagement ensures students receive instruction on the most up-to-date and relevant course standards, so they are prepared for postsecondary and the workforce.

Information Technology

In Tennessee, the Information Technology career cluster is a vibrant and rapidly expanding field that encompasses the design, development, support, and management of hardware, software, multimedia, and systems integration services. This dynamic and entrepreneurial industry significantly impacts the economy and society, offering IT careers across all sectors, from Financial Services and Medical Services to Business, Engineering, and Environmental Services. The IT career cluster in Tennessee includes four key programs of study: Cybersecurity, Networking, Coding, and Web Design.

The Cybersecurity program is experiencing significant job growth as the demand for skilled professionals to protect sensitive information and defend against cyber threats increases across all industries. The Networking program also sees robust career growth, driven by the necessity for reliable and secure communication networks in today's interconnected world. The Coding program is expanding rapidly as businesses and organizations seek proficient programmers to develop software solutions and applications tailored to their needs. Similarly, the Web Design program is growing quickly, with a high demand for creative individuals who can design and maintain engaging and user-friendly websites. A strong foundation in math and science is essential for anyone preparing for a career in these IT fields, ensuring they are equipped with the critical thinking and problem-solving skills needed to thrive in this ever-evolving industry.

School Year	Information Technology Concentrators
2020-21	3,943
2021-22	3,903
2022-23	4,581

Coding

2023-24 Program of Study	Year 1	Year 2	Year 3	Year 4
Coding	Computer Science Foundations (C10H11) -or- **IGCSE** Computer Science (C10H07)	Coding I (C10H14)	Coding II (C10H15) -or- Mobile App Development (C10H22) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Coding I (C10H01) -or- **Dual Enrollment** Coding II [1] (C10H28)	Coding Practicum (C10H08) -or- **AP** Computer Science A (G02H45) -or- **Dual Enrollment** Coding III (C10H32) -or- **Dual Enrollment** Coding IV (C10H33) -or- **CIE** Computer Science 1 AS Level (C10H25) -or- **WBL** Coding Career Practicum (C10H40)

Description

The *Coding* program of study (POS) is designed for students interested in computer programming. Computer programming is either a stand-alone career or it can be used with other computer applications as a major aspect of broader computer science occupations. Students will develop standard programming techniques and learn the logic tools and methods typically used by programmers to create simple computer applications. Proficient students will be able to solve problems by planning multistep procedures: write, analyze, review, and revise programs, converting detailed information from workflow charts and diagrams into coded instructions in a computer language; and will be able to troubleshoot/debug programs and software applications to correct malfunctions and ensure their proper execution. This POS also challenges students to develop advanced skills in problem analysis, construction of algorithms, and computer implementation of algorithms as they work on programming projects of increased complexity. In doing so, they develop key skills of discernment and judgment as they must choose from among many languages, development environments, and strategies for the program life cycle. Course content is reinforced through

numerous short and long-term programming projects, accomplished both individually and in small groups. These projects are meant to hone the discipline and logical thinking skills necessary to craft error-free syntax for the writing and testing of programs.

This program of study is aligned with the SkillsUSA and the Technology Student Association (TSA) career and technical student organizations (CTSOs).

Job Outlook

As technology advances rapidly, there is a need for skilled professionals who can develop innovative software solutions. According to the Bureau of Labor Statistics, overall employment of Computer Programmers is declining nationally but remaining steady in Tennessee. Nationally computer programmers are projected to decline 11 percent from 2022 to 2032, faster than the average for all occupations[1]. Tennessee is expecting a 5 percent projected growth in the employment of computer programmers[2].

There are about 6,700 openings for computer programmers projected each year, on average, over the decade[3]. All these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

[1] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Computer Programmers], at https://www.bls.gov/ooh/computer-and-information-technology/computer-programmers.htm (Visited February 1, 2024)

[2] National Center for O*Net Development. O*NetOnLine. Retrieved February 1, 2024 from https://www.onetonline.org/

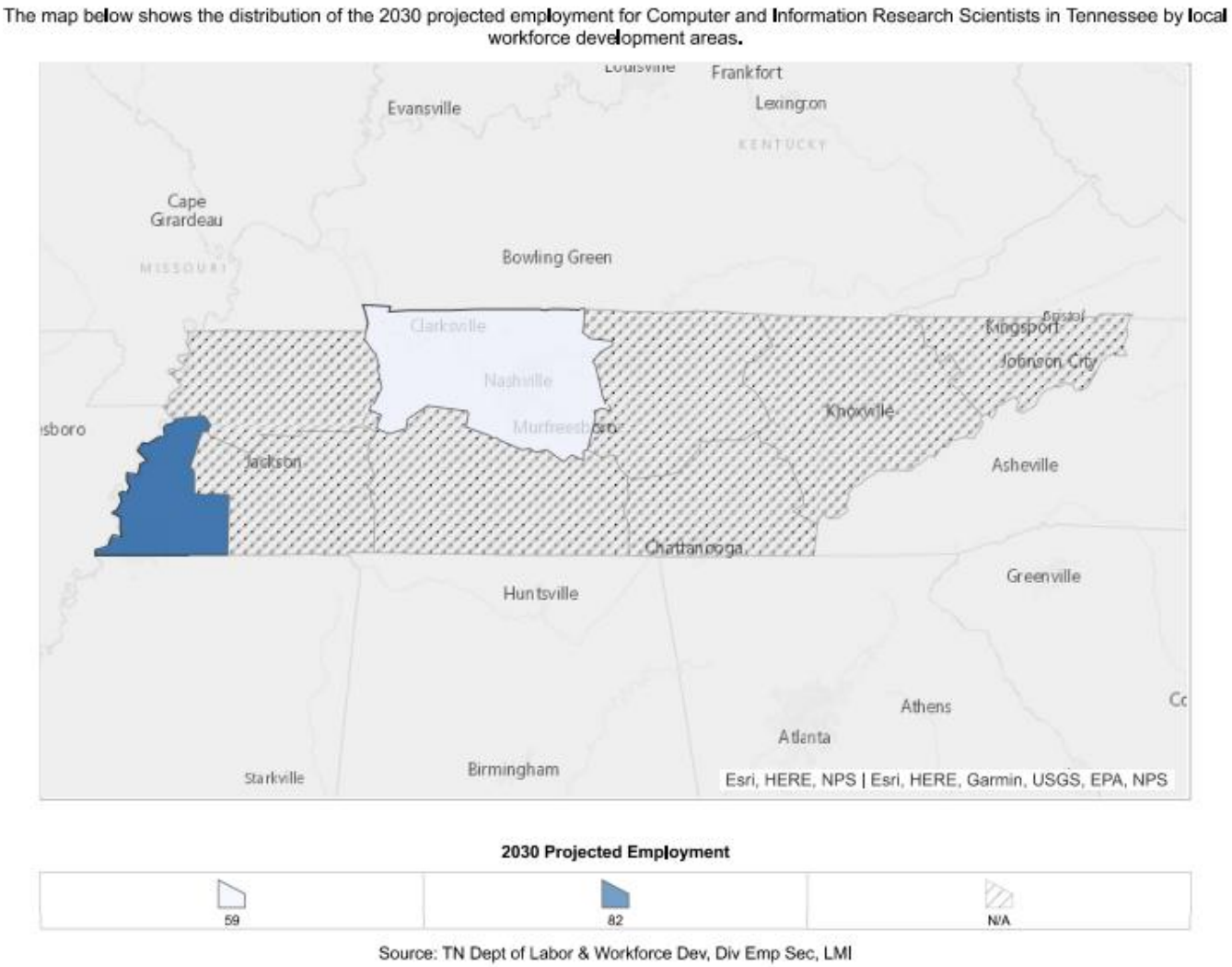
[3] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Computer Programmers], at https://www.bls.gov/ooh/computer-and-information-technology/computer-programmers.htm (Visited February 1, 2024)

Figure 2. Tennessee employment projections for Coding related occupations with positive job openings projected for 2020-2030 according to the Tennessee Higher Education Commission, Supply and Demand Report.[4]

Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
Health Informatics Specialists	15-1211	10,441	13,313	28%	1,103
Computer Systems Engineers/Architects	15-1299	6,813	8,307	22%	695
Management Analysts	13-1111	10,305	12,347	20%	1,220
Computer and Information Systems Managers	11-3021	7,256	9,247	27%	802
Computer Programmers	15-1251	3,274	3,453	5%	239
Information Security Analysts	15-1212	2,074	3,048	47%	279
Computer and Information Research Scientists	15-1221	276	372	32%	32

[4] Tennessee Higher Education Commission, Supply and Demand Report, Retrieved March 1, 2024, from https://www.tn.gov/thec/research/supply-and-demand.html

Figure 3. 2020-2030 projected employment for Computer and Information Research Scientists in Tennessee by region.[5]



[5] Jobs4Tn.gov. Occupation Profile. Retrieved (February 1, 2024), from https://jobs4tnwfs.tn.gov/vosnet/Default.aspx

Program of Study Level

The Tennessee Investment in Student Achievement (TISA) provides direct funding for student participation in career and technical education (CTE) programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student progression in coursework through the program

*The state budget keeps all programs funded at $5,000 for 2024-25 school year funding. See the CTE TISA Programs of Study Leveling Guide 2024-25 for the TISA funding formula for program of study levels.

Coding Program: Level 3

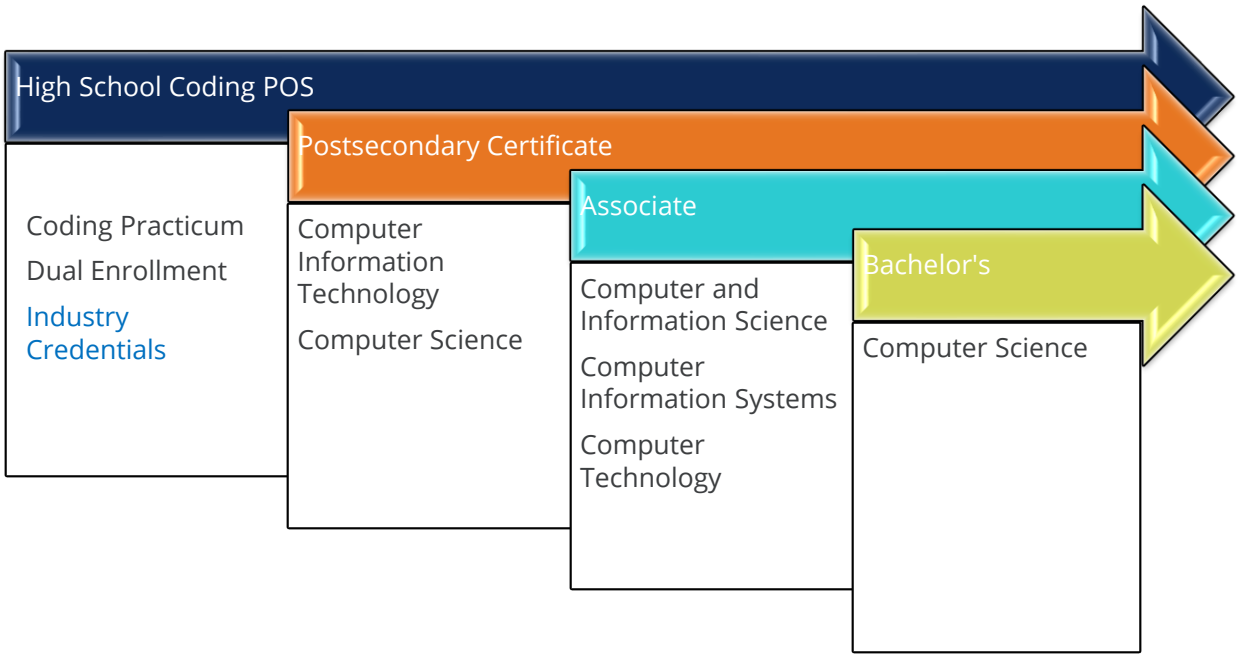
Postsecondary Pathways

An education in the coding and software development field is a great choice for students who are looking for a career field that is never stagnant. In fact, new advancements and innovative technology are almost constantly changing this field. Students who are interested in an occupation as a software developer should develop skills in critical thinking, operation analysis, systems analysis, systems evaluation, complex problem-solving, and programming. More specifically, they should demonstrate proficiency using software such as Microsoft SQL Server (database management), Microsoft Visual Basic (development environment software), C++ (object or component-oriented development software), Python (object or component-oriented development software), program testing software, and Hypertext markup language (HTML) (web platform development software), and JavaScript (web platform development software). Students should also be proficient in using tools such as computer servers, mainframe computers, and integrated circuit testers.

In Tennessee, students keen on forging a career in coding have an abundance of post-secondary opportunities to explore. The Tennessee College of Applied Technology (TCAT) stands out with specialized programs in coding and software development, providing hands-on training and industry-relevant certifications. Additionally, community colleges like Nashville State Community College and Pellissippi State Community College offer associate degree programs in computer science or information technology, with coursework covering programming languages, web development, and database management. For those seeking a deeper dive into the field, universities such as the University of Tennessee Knoxville and Middle Tennessee State University offer bachelor's degree programs in computer science or software engineering,

equipping students with the theoretical knowledge and practical skills needed to thrive in the rapidly evolving tech industry. With a range of educational pathways catering to different skill levels and career aspirations, Tennessee ensures that aspiring coders have ample opportunities to cultivate their talents and succeed in this dynamic field.

Figure 3. Outlines the related career opportunities and training necessary for each program of study. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions as indicated in the [Tennessee Department of Labor and Workforce Dashboard](#).

High School Diploma	Certificate	Associate	Bachelor's
• ComputerUser Support Specialist (**$47,960**)	• Computer User Support Specialist **($47,960)**	• Computer Programmers **($97,800)**	• Software Developer (**$103,270**) • Computer and Information Systems Manager **($164,070)**

Current Secondary Landscape

Over the past three years, the number of schools offering Coding has increased from 85 to 94. In the 2022-23 school year 12,042 students were enrolled in Coding which was an increase from previous years. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for the 2020-21 to the 2022-23 school year as well as the enrollment in Coding and student concentration in the Information Technology career cluster.

Figure 1. Open Enrollment Analysis

School Year	Schools Offering Coding
2020-21	85
2021-22	87
2022-23	94

Figure 5. Student Enrollment by Course

School Year	Computer Science	Coding I	Coding II	Mobile App Development	Coding Practicum
2020-21	6766	3034	908	95	113
2021-22	8034	3129	1033	41	109
2022-23	7914	2920	1071	43	94

Cybersecurity

2023-2024 Program of Study	Year 1	Year 2	Year 3	Year 4
Cybersecurity	Computer Science Foundations (C10H11)	Cybersecurity I (C10H19)	Cybersecurity II (C10H20) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Cybersecurity I (C10H24) -or- **Dual Enrollment** Cybersecurity II (C10H31)	Cybersecurity Practicum (C10H21) -or- **Dual Enrollment** Cybersecurity III (C10H34) -or- **Dual Enrollment** Cybersecurity IV (C10H35) -or- **WBL** Cybersecurity Career Practicum (C10H41)

Description

The *Cybersecurity* POS is tailored for high school students aspiring to explore the dynamic field of cybersecurity. Whether pursued as an independent career path or integrated into broader computer science occupations, this program equips students with essential skills for securing digital environments. Participants will delve into both theoretical concepts and practical applications, gaining proficiency in the fundamental principles of cybersecurity, project management, and teamwork. Emphasis is placed on honing troubleshooting and problem-solving abilities, fostering interpersonal skills, and replicating industry experiences through hands-on laboratory facilities. As students progress, they will tackle increasingly sophisticated projects, culminating in the development of practical cybersecurity solutions. Proficient graduates will be well-prepared for advanced coursework, setting a solid foundation for future success in the field of cybersecurity.

This program of study is aligned with SkillsUSA and the TSA CTSOs.

Job Outlook

With the growing volume and sophistication of cyber-attacks, ongoing attention is required to protect sensitive business and personal information, as well as safeguard national security. This has created a high demand for careers in Cybersecurity. According to the Bureau of Labor Statistics, overall employment of Information Security Analysts is strong both statewide and nationally. Nationally Information Security Analysts is projected to grow 32 percent from 2022 to 2032, much faster than the average for all

occupations[6]. Tennessee is expecting a 47 percent projected growth in employment of Information Security Analysts[7].

There are about 16,800 openings for information security analysts, projected each year, on average, over the decade[8]. Many of these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

Figure 2. Tennessee employment projections for Cybersecurity-related occupations with positive job openings projected for 2020-2030 according to the Tennessee Higher Education Commission, Supply and Demand Report.[9]

Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
Information Security Analysts	15-1212	2,074	3,048	47%	279
Computer System Analysts	15-1211	10,441	13,313	28%	1,103
Computer Occupations, All Other	15-1299	6,813	8,307	22%	695
Computer and Information Systems Managers	11-3021	7,256	9,247	27%	802
Computer Network Support Specialists	15-1231	4,048	5,042	24%	424
Management Analysts	13-1111	10,305	12,347	20%	1,220
Network and Computer Systems Administrators*	15-1244	5,250	6,247	19%	467

[6] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Information Security Analysts], at https://www.bls.gov/ooh/computer-and-information-technology/information-security-analysts.htm (Visited February 1, 2024)

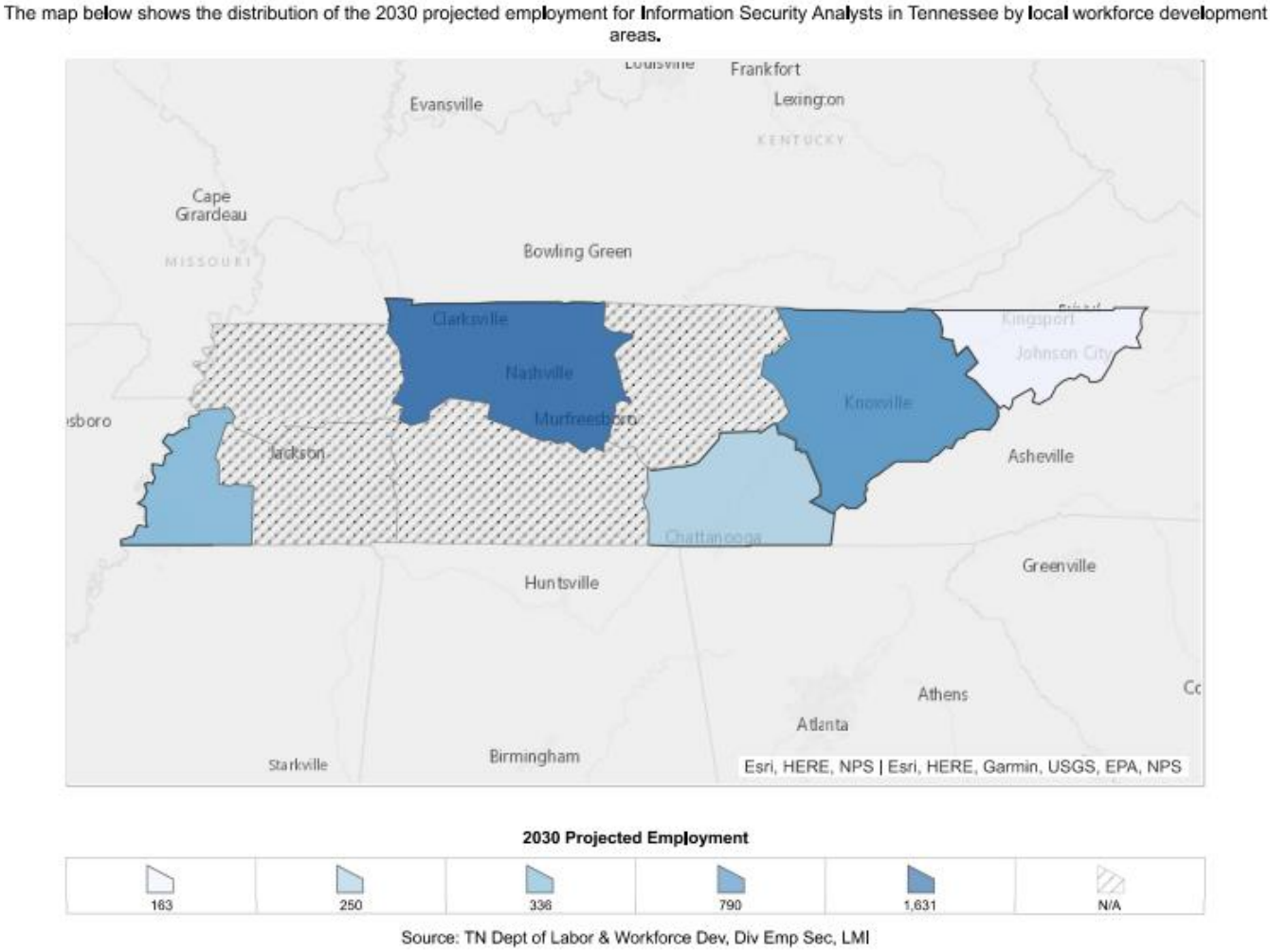
[7] National Center for O*Net Development. O*NetOnLine. Retrieved February 1, 2024 from https://www.onetonline.org/

[8] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Information Security Analysts], at https://www.bls.gov/ooh/computer-and-information-technology/information-security-analysts.htm (Visited February 1, 2024)

[9] Tennessee Higher Education Commission, Supply and Demand Report, Retrieved March 1, 2024, from https://www.tn.gov/thec/research/supply-and-demand.html

Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
Computer Programmers	15-1251	3,274	3,453	5%	239
Computer and Information Research Specialists	15-1221	276	372	32%	32

Figure 3. 2024 projected employment for Cybersecurity in Tennessee.[10]



[10] [10] Jobs4Tn.gov. Occupation Profile. Retrieved (February 1, 2024), from https://jobs4tnwfs.tn.gov/vosnet/Default.aspx

Program of Study Level

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2. The student's progression in coursework through the program

*The state budget keeps all programs funded at $5,000 for 2024-25 school year funding. See the CTE TISA Programs of Study Leveling Guide 2024-25 for the TISA funding formula for program of study levels.

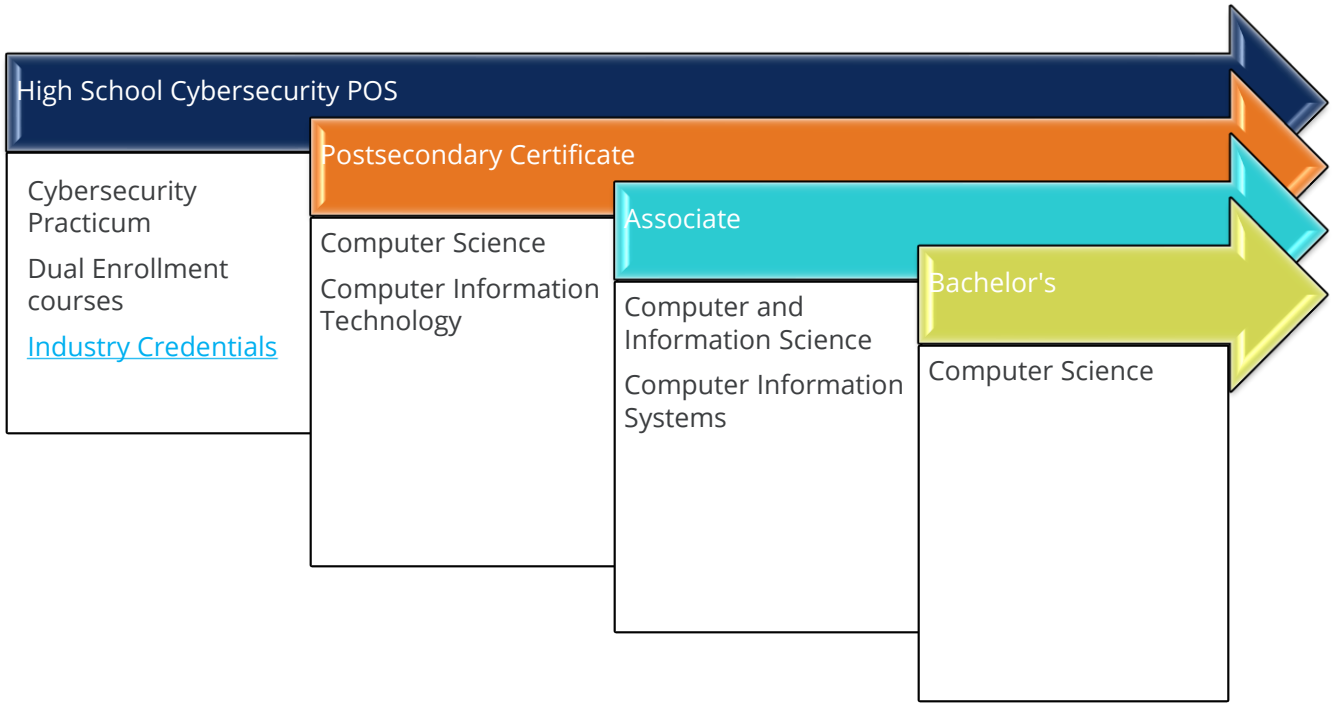
Cybersecurity Program: Level 3

Postsecondary Opportunities

An education in the cybersecurity field is a solid choice for students who are seeking job security and financial success in the future. As people's lives become more and more dependent upon technology, the need for cybersecurity professionals increases exponentially.

In Tennessee, students with a passion for cybersecurity have a multitude of post-secondary opportunities awaiting them. The Tennessee College of Applied Technology (TCAT) offers specialized programs in cybersecurity, providing hands-on training in network security, ethical hacking, and digital forensics, preparing students for entry-level positions in the field. Moreover, community colleges like Volunteer State Community College and Roane State Community College offer associate degree programs in computer information technology, covering topics such as cryptography, risk management, and cyber defense strategies. For those seeking advanced study and specialization, universities such as Middle Tennessee State University and the University of Tennessee Knoxville provide bachelor's and master's degree programs in cybersecurity, equipping students with the advanced technical knowledge and strategic thinking necessary to protect organizations from cyber threats. With a diverse range of educational pathways tailored to different skill levels and career aspirations, Tennessee ensures that aspiring cybersecurity professionals have the resources and support they need to succeed in this critical field.

Figure 3. Outlines the related career opportunities and training necessary for each program of study. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions as indicated in the Tennessee Department of Labor and Workforce Dashboard.

High School Diploma	Certificate	Associate	Bachelor's
• Computer User Support (**$47,960**)	• Computer Network Support Specialist (**$60,510**)	• Computer Systems Analyst (**$89,620**)	• Information Security Analysts (**$95,740**)

Current Secondary Landscape

Over the past three years, the number of schools offering Cybersecurity has increased from 33 to 38. In the 2022-23 school year, 958 students were enrolled, and 542 concentrated in Cybersecurity. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for the 2020-21 to the 2022-23 school year as well as the enrollment and student concentration in the Cybersecurity program.

Figure 2. Open Enrollment Analysis

School Year	Schools Offering Cybersecurity
2020-21	33
2021-22	33
2022-23	38

Figure 5. Student Enrollment by Course

School Year	Computer Science Foundations	Cybersecurity I	Cybersecurity II	Cybersecurity Practicum
2020-21	6764	691	235	13
2021-22	8034	750	213	39
2022-23	7914	742	194	18

Networking

2023-24 Program of Study	Year 1	Year 2	Year 3	Year 4
Networking Systems	Computer Science Foundations (C10H11)	Computer Systems (C10H10)	Networking (C10H13) -or- **Dual Enrollment** Networking Systems I (C10H02) -or- **Dual Enrollment** Networking Systems II (C10H29)	Cabling and Internetworking (C10H09) -or- IT Clinical Internship (C10H12) -or- **Dual Enrollment** Networking Systems III (C10H36) -or- **Dual Enrollment** Networking Systems IV (C10H37) -or- **WBL** Networking Systems Career Practicum (C10H42)

Description

The *Networking* POS is designed for students interested in occupations including computer support specialists, network and computer systems administrators, computer hardware engineers, and computer network architects. Networking systems is either a stand-alone career or it can be used with other computer applications as a major aspect of broader computer science occupations. This program of study provides students the opportunity to acquire knowledge in both theory and practical applications pertaining to hardware, operating systems, safe mode, command prompt, security, networking, printers, peripheral devices, laptops, mobile devices, troubleshooting, and customer service management. Upon completion of the course, proficient students will have acquired skills and knowledge to install, configure, and maintain computer systems. Students will also identify types of networks, understand the layers of the open systems interconnection (OSI) model, and apply troubleshooting theory to the successful execution of networking tasks. Course content covers transmission control protocol, internet protocol, wired and wireless topologies, switching and routing, network hardware, wireless networking, and network operating systems (NOS). Upon

completion of this POS, proficient students will be prepared to pursue many promoted IT industry-standard credentials.

This POS is aligned with the SkillsUSA and the TSA CTSOs.

Job Outlook

As a result of the increasing amount of data organizations are collecting the demand for data architects, those who design and develop data models, databases, and warehouses is also expanding. According to the Bureau of Labor Statistics, overall employment of computer network architects is strong statewide and average nationally. Nationally computer network architects are projected to grow four percent from 2022 to 2032, as fast as the average for all occupations[11]. Tennessee is expecting a 24 percent projected growth in employment of computer network architects[12].

There are about 10,200 openings for computer network architects, projected each year, on average, over the decade[13]. Many of these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

[11] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Computer Network Architects], at https://www.bls.gov/ooh/computer-and-information-technology/computer-network-architects.htm (Visited February 1, 2024)

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[13] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Computer Network Architects], at https://www.bls.gov/ooh/computer-and-information-technology/computer-network-architects.htm (Visited February 1, 2024)

Figure 2. Tennessee employment projections for Networking Systems-related occupations with positive job openings projected for 2020-2030 according to the Tennessee Higher Education Commission Supply and Demand Report.[14]

Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
Computer Network Support Specialists	15-1231	4,048	5,042	24%	424
Computer Network Architect	15-1241	2,381	2,953	24%	215
Network and Computer Systems Administrators	15-1244	5,250	6,247	19%	467
Computer Occupations, All Other	15-1299	6,813	8,307	22%	695
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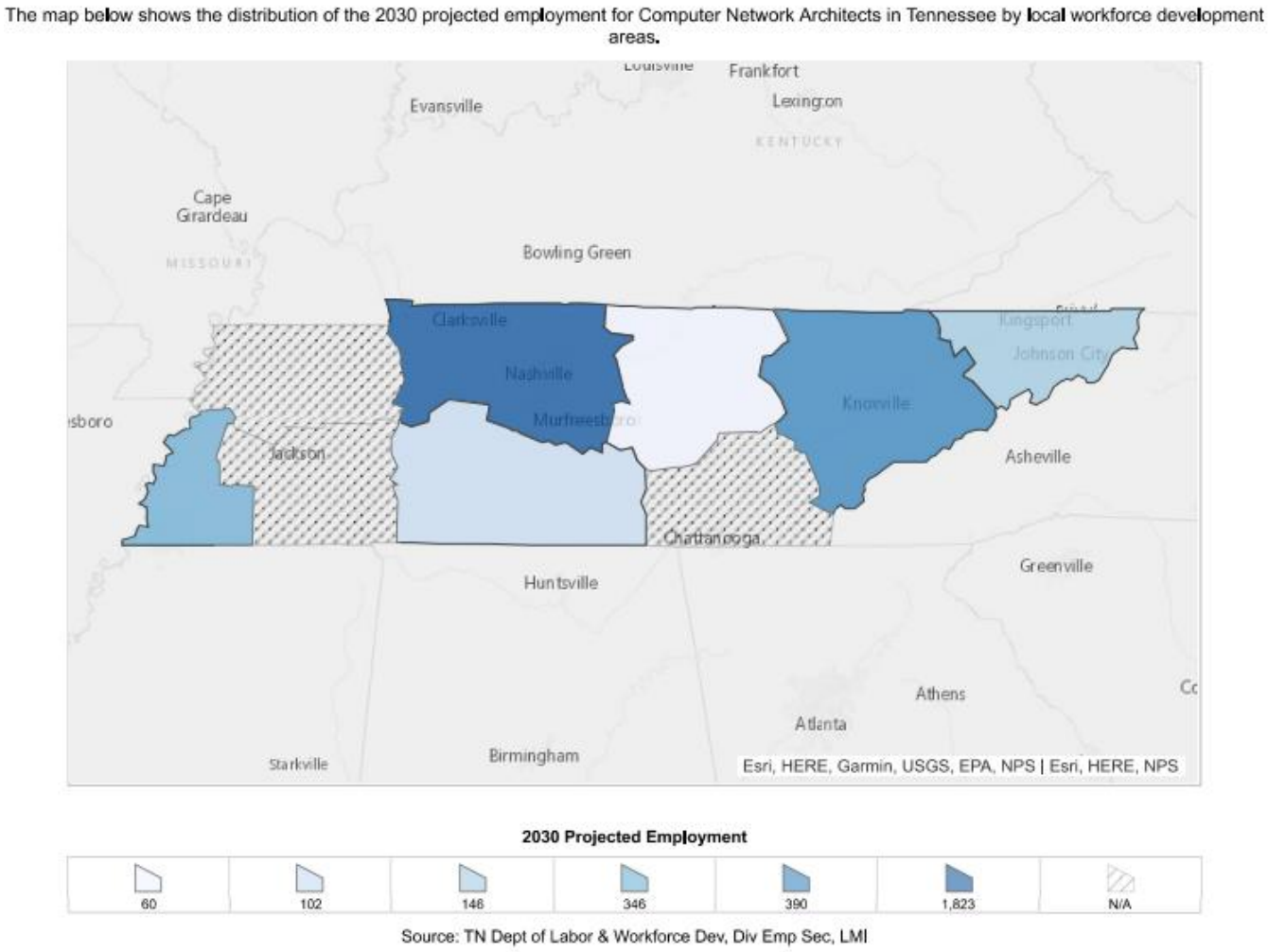
Management Analysts	13-1111	10,305	12,347	20%	1,220
Computer and Information Systems Managers	11-3021	7,256	9,247	27%	802
Installation, Maintenance, and Repair Workers, All Other	49-9099	7,096	8,283	17%	904
Telecommunications Equipment Installers and Repairers, Except Line Installers	49-2022	4,812	5,272	10%	608

[14] Tennessee Higher Education Commission, Supply and Demand Report, Retrieved March 1, 2024, from https://www.tn.gov/thec/research/supply-and-demand.html

Figure 2. 2020-2030 Projected employment for Computer Network Architects in Tennessee by region.[15]



[15] Jobs4Tn.gov. Occupation Profile. Retrieved (February 1, 2024), from https://jobs4tnwfs.tn.gov/vosnet/Default.aspx

Program of Study Level

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2. The student progression in coursework through the program

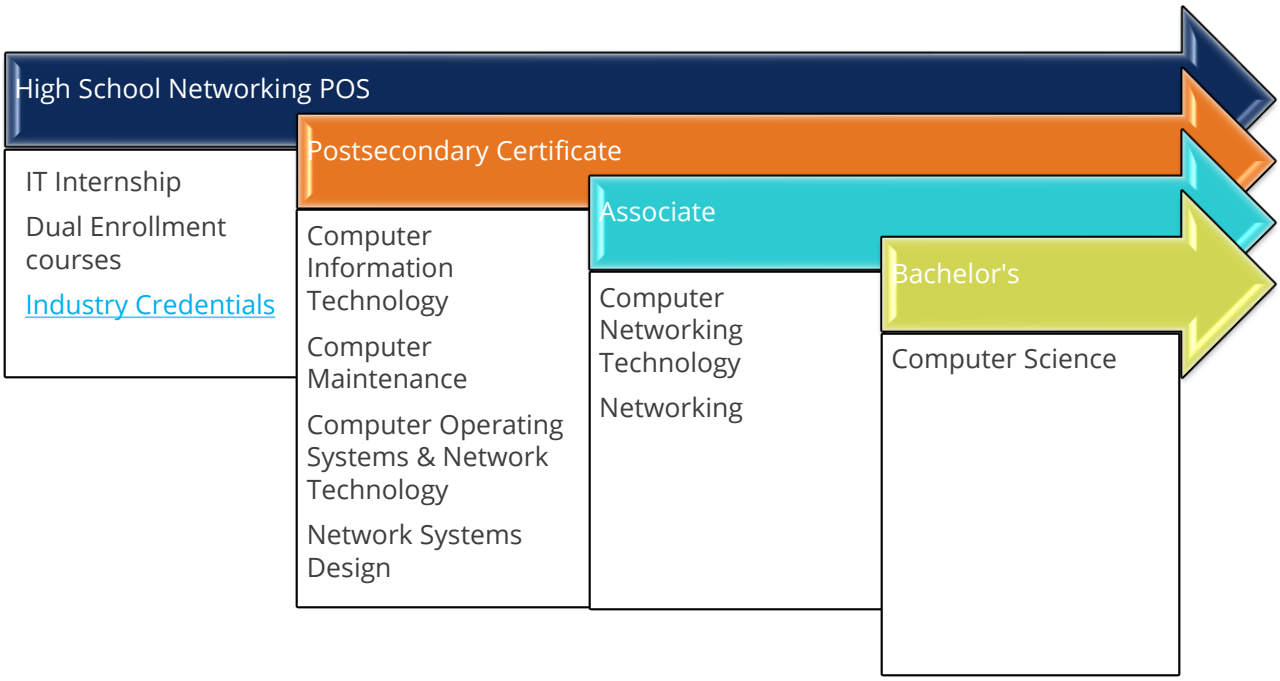
*The state budget keeps all programs funded at $5,000 for 2024-25 school year funding. See the CTE TISA Programs of Study Leveling Guide 2024-25 for TISA funding formula for program of study levels.

Networking Program: Level 3

Postsecondary Opportunities

In Tennessee, students aiming to pursue networking as a profession have a wealth of post-secondary opportunities available to them. The Tennessee College of Applied Technology (TCAT) offers specialized programs in networking, providing hands-on training in areas such as network administration, cybersecurity, and telecommunications, and preparing students for certifications like CompTIA Network+ and Cisco CCNA. Additionally, community colleges like Columbia State Community College and Pellissippi State Community College offer associate degree programs in information technology with concentrations in networking, covering topics such as routing and switching, network infrastructure, and wireless technologies. For those seeking further specialization and career advancement, universities such as Middle Tennessee State University and the University of Memphis offer bachelor's and master's degree programs in computer science or information systems with focuses on networking, providing students with in-depth knowledge and skills to excel in roles as network engineers, administrators, or architects. Tennessee's diverse educational pathways ensure that aspiring networking professionals have the necessary training and credentials to thrive in this critical field of technology.

Figure 3. Outlines the related career opportunities and training necessary for each program of study. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions as indicated in the Tennessee Department of Labor and Workforce Dashboard.

High School Diploma	Certificate	Associate	Bachelor's
• Customer Service Representative • **($36,630)**	• Computer Network Support Specialist • **($60,510)**	• Network and Computer Systems Administrator • **($79,710**.)	• Computer Network Architect (**$106,800)** • Computer and Information Systems Manager **($128,720)**

Current Secondary Landscape

Over the past three years, the number of schools offering Networking Systems has increased from 27 to 28. In the 2022-23 school year, 8,992 students were enrolled, and 425 concentrated in Networking Systems. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for the 2020-21 through the 2022-23 school year as well as the enrollment and student concentration in the Networking Systems program.

Figure 3. Open Enrollment Analysis

School Year	Schools Offering Networking Systems
2020-21	27
2021-22	27
2022-23	28

Figure 5. Student Enrollment by Course

School Year	Computer Science Foundations	Computer Systems	Networking	Cabling and Internetworking	IT Clinical Internship
2020-21	6,766	568	381	91	119
2021-22	8,036	563	237	94	76
2022-23	7,914	609	281	122	66

Web Design

2023-24 Program of Study	Year 1	Year 2	Year 2	Year 4
Web Design	Computer Science Foundations (C10H11) -or- **IGCSE** Information and Communication Technology (C10H26)	Web Design Foundations (C10H16)	Web Site Development (C10H17) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Web Design I (C10H03) -or- **Dual Enrollment** Web Design II (C10H30)	Web Design Practicum (C10H18) -or- **Dual Enrollment** Web Design III (C10H38) -or- **Dual Enrollment** Web Design IV (C10H39) -or- **WBL** Web Design Career Practicum (C10H43)

Description

The *Web Design* POS is designed for students interested in designing and creating websites. Web Design is either a stand-alone career or it can be used with other computer applications as a major aspect of broader computer science occupations. Students will develop fundamental skills in both theory and practical application of the basic web design and development process, project management and teamwork, troubleshooting and problem-solving, and interpersonal skill development. Laboratory facilities and experiences simulate those found in the web design and development industry where interaction with a "client" is indicated in the standards; it is expected that students' peers or the instructor may serve as mock clients in lieu of an actual relationship with an industry partner. Emphasis is also placed on applying the design process toward projects of increasing sophistication, culminating in the production of a functional, static website. As students work toward this goal, they will acquire key skills in coding, project management, basic troubleshooting and validation, and content development and analysis. Upon completion of this course, proficient students will be prepared for more advanced coursework in the Web Design program of study.

This program of study is aligned with the SkillsUSA and the TSA CTSOs.

Job Outlook

As a result of businesses seeking to enhance their online presence and offer seamless digital experiences to their customers, demand for computer and information systems managers has increased. These occupations play a critical role in crafting user interfaces that are not only visually appealing but also intuitive and user-friendly. According to the Bureau of Labor Statistics, overall employment of computer and information systems managers is strong both statewide and nationally. Nationally computer and information systems managers are projected to grow 15 percent from 2022 to 2032, much faster than the average for all occupations[16]. Tennessee is expecting a 27 percent projected growth in the employment of computer and information systems managers[17].

There are about 46,900 openings for computer and information systems managers, projected each year, on average, over the decade[18]. Many of these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

Figure 1. Tennessee employment projections for Web Design-related occupations with positive job openings projected for 2020-2030 according to the Tennessee Higher Education Commission, Supply and Demand Report.[19]

Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
Computer Occupations, All Other	15-1299	6,813	8,307	22%	695
Computer System Analysts	15-1211	10,441	13,313	28%	1,103
Management Analysts	13-1111	10,305	12,347	20%	1,220

[16] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Computer and Information Systems Managers], at https://www.bls.gov/ooh/management/computer-and-information-systems-managers.htm (Visited February 1, 2024)

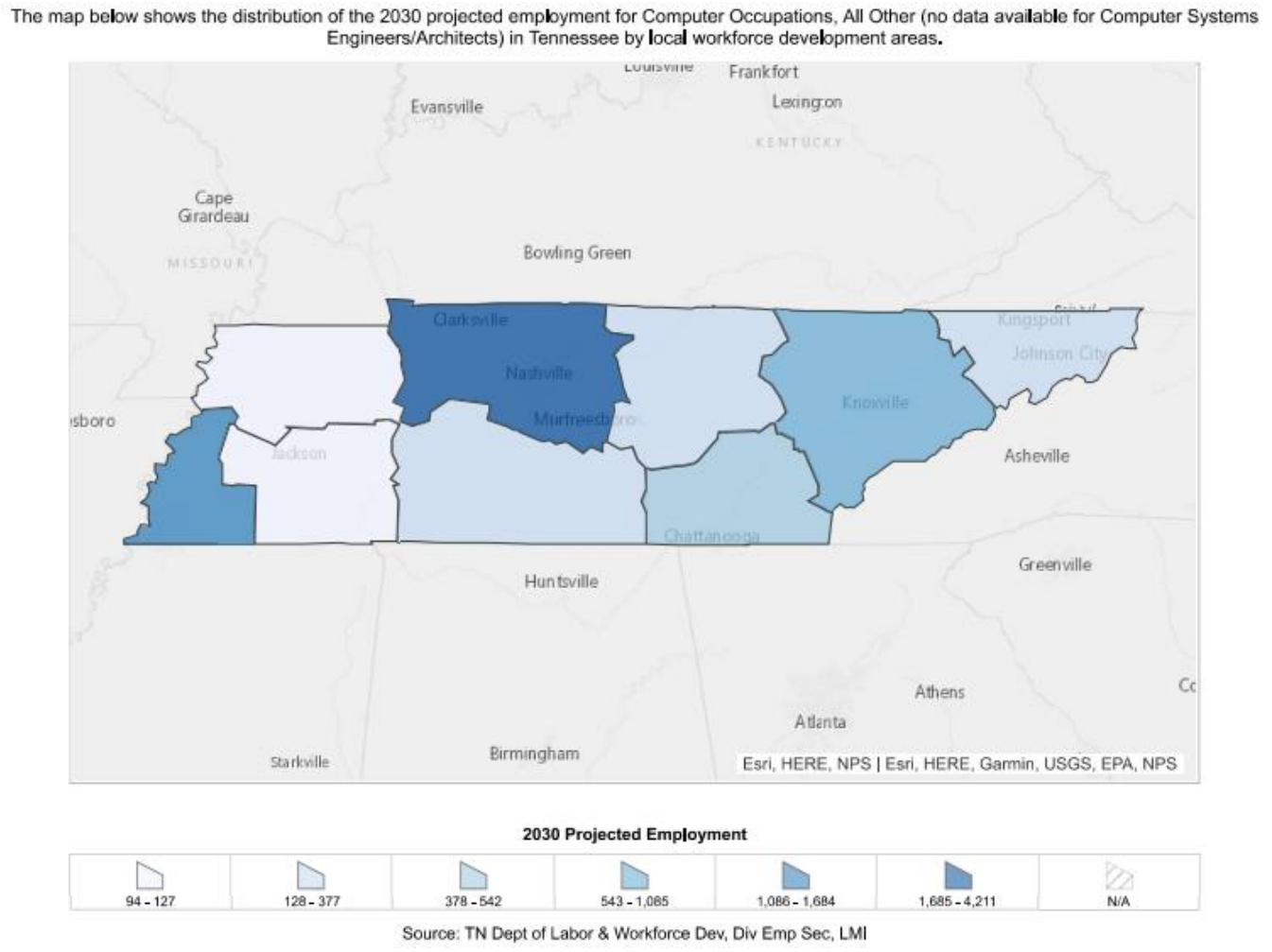
[17] National Center for O*Net Development. O*NetOnLine. Retrieved February 1, 2024 from https://www.onetonline.org/

[18] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Computer and Information Systems Managers], at https://www.bls.gov/ooh/management/computer-and-information-systems-managers.htm (Visited February 1, 2024)

[19] Tennessee Higher Education Commission, Supply and Demand Report, Retrieved March 1, 2024, from https://www.tn.gov/thec/research/supply-and-demand.html

Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
Computer and Information Systems Managers	11-3021	7,256	9,247	27%	802
Computer Programmers	15-1251	3,274	3,453	5%	239

Figure 2. Tennessee employment projections for Computer Systems Engineers/Architects-related occupations with positive job openings projected for 2020-2030.[20]



[20] Jobs4Tn.gov. Occupation Profile. Retrieved (February 1, 2024), from https://jobs4tnwfs.tn.gov/vosnet/Default.aspx

Program of Study Level

TISA provides direct funding for student participation in CTE programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student progression in coursework through the program

*The state budget keeps all programs funded at $5,000 for the 2024-25 school year funding. See the CTE TISA Programs of Study Leveling Guide 2024-25 for the TISA funding formula for program of study levels.

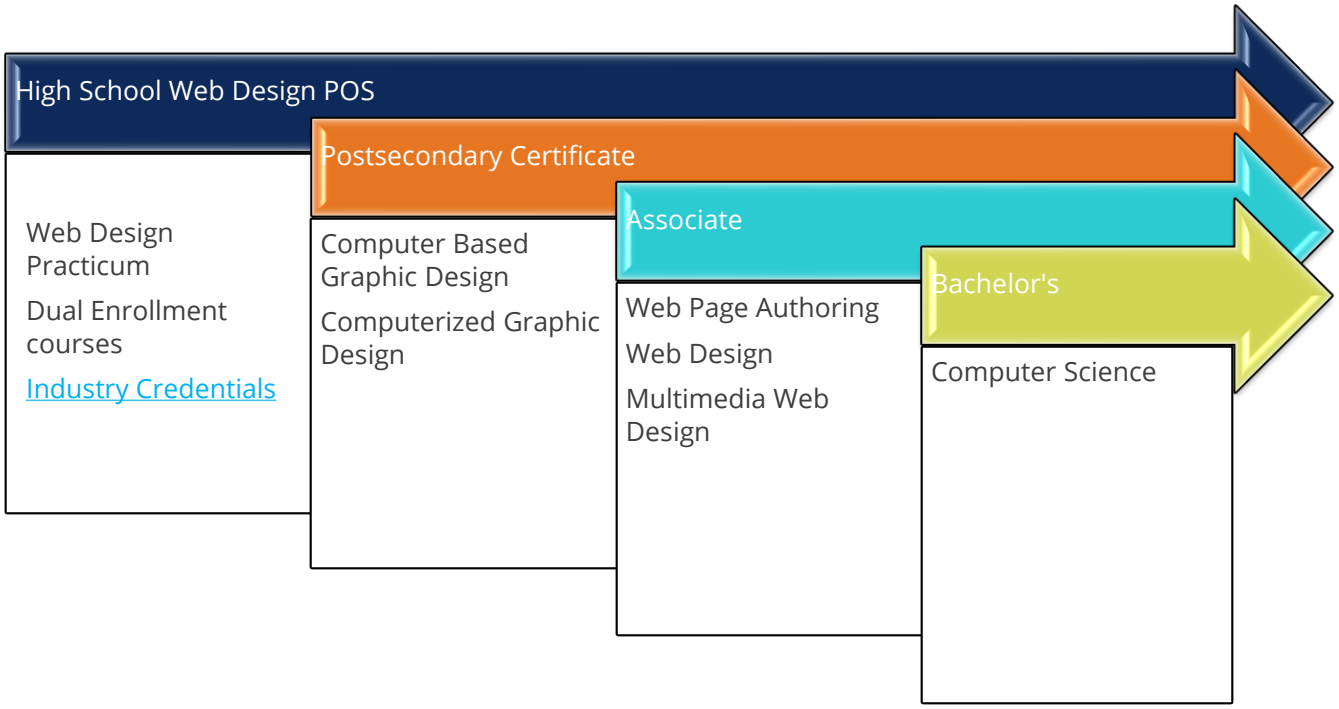
Web Design Program: Level 3

Postsecondary Opportunities

Web developers design, build, and maintain websites using authoring and scripting languages. As a result, they must have knowledge of programming and graphics design. Although an associate degree is the typical education level needed to enter the web developer occupation, 43 percent of adults attained a bachelor's degree. In addition, national growth in the web developer occupation is expected to be faster than the average at 27 percent through the year 2024. This growth is a direct correlation to the growth in the use of mobile devices and e-commerce.

In Tennessee, students with a passion for web design have numerous post-secondary opportunities to turn their interests into a profession. The Tennessee College of Applied Technology (TCAT) offers specialized programs in web design, providing hands-on training in coding languages like HTML, CSS, and JavaScript, as well as graphic design principles and user experience (UX) design. Community colleges such as Nashville State Community College and Pellissippi State Community College also offer associate degree programs in web development and design, covering topics like responsive design, web animation, and content management systems. Furthermore, universities like Middle Tennessee State University and the University of Tennessee Knoxville provide bachelor's degree programs in graphic design or computer science with concentrations in web design, allowing students to deepen their understanding of design theory while honing their technical skills to create engaging and functional websites. These diverse educational pathways in Tennessee ensure that aspiring web designers have the resources and training needed to succeed in this rapidly evolving field.

Figure 4. Outlines the related career opportunities and training necessary for each program of study. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions as indicated in the Tennessee Department of Labor and Workforce Dashboard.

High School Diploma	Certificate	Associate	Bachelor's
• Desktop Publisher (**$48,990**)	• Web Developer (**$71,680.**)	• Web Administrator (**$59,750**)	• Computer Programmer (**$97,800**)

Current Secondary Landscape

Over the past three years, the number of schools offering Web Design has decreased from 42 to 32. In the 2022-23 school year 8,936 students were enrolled, and 447 concentrated in Web Design. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for the 2020-21 through the 2022-23 school year as well as the enrollment and student concentration in the Web Design program.

Figure 4. Open Enrollment Analysis

School Year	Schools Offering Web Design
2020-21	42
2021-22	35
2022-23	32

Figure 5. Student Enrollment by Course

School Year	Computer Science Foundations	Web Design Foundations	Web Site Development	Web Design Practicum
2020-21	6,764	1248	608	37
2021-22	8,034	984	249	41
2022-23	7,914	804	201	16

References

Bureau of Labor Statistics, U.S. Department of Labor, Occupation Outlook Handbook, Online at https://www.bls.gov/ooh/ (Visited March 11, 2024)

O*NET OnLine, National Center for O*NET Development, www.onetonline.org/. Accessed 11 March 2024.

Jobs4Tn.gov. Occupation Data. Online at: https://jobs4tnwfs.tn.gov/vosnet/analyzer/drill/drill.aspx?enc=e7AKr7bjUGRBEdrMte14UU/yogJNLO8Pv84AeQ47o7RHYdO6bz/6xZJrhpqcrleAp8cmiHwwVz7Rx4EEfPLwSw==.(Visited March 11, 2024)

Tennessee Department of Labor & Workforce Development, JOBS4TN.GOV, Tennessee's In Demand Occupations to 2026, Online at https://www.tn.gov/content/dam/tn/workforce/documents/jobs-and-education/InDemandOccupationsto2026.pdf (Visited March 11, 2024)

Tennessee Higher Education Commission, Supply and Demand Report, Improving the Pipeline for Tennessee's Workforce: Academic Supply for Occupational Demand Report 2023, 2023

Recommendations

The following includes recommendations for course standards changes to be presented to the State Board of Education (SBE) for consideration in August 2024.

Program of Study	Course	Recommendations
• Coding • Cybersecurity • Networking Systems • Web Design	Computer Science Foundations	• Add a standard to highlight the importance and integration of CTSOs in the classroom. • Add a standard to emphasize the growing need for data analysis in all career areas. • Add a standard to point out the prominence of Artificial Intelligence.
• Coding • Cybersecurity • Computer Systems • Web Design	• Coding I • Cybersecurity I • Computer Systems • Web Design Foundations	• Add a Team Project standard with an emphasis on Data Analysis that incorporates the Engineering Design Project.
Web Design	Web Design Foundations	• Added standard 2.1 on AI-enhanced Client Interactions. • Added standard 5.3 on AI-enhanced imagery in Web Design. • Added standard 8.6 on AI and XR in Branding and Marketing

2025-26 Proposed Programs and Courses

Coding

2025-26 Program of Study	Year 1	Year 2	Year 3	Year 4
Coding	Computer Science Foundations (C10H11) -or- **IGCSE** Computer Science (C10H07)	Coding I (C10H14)	Coding II (C10H15) -or- Mobile App Development (C10H22) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Coding I (C10H01) -or- **Dual Enrollment** Coding II (C10H28))	Coding Practicum (C10H08) -or **AP** Computer Science A (G02H45) or **Dual Enrollment** Coding III (C10H32) -or- **Dual Enrollment** Coding IV (C10H33) -or- **Dual Enrollment** Coding V (C10H44) -or- **Dual Enrollment** Coding VI (C10H45) -or- **Dual Enrollment** Coding VII (C10H46) -or- **Dual Enrollment** Coding VIII (C10H47) or **Dual Enrollment** Coding IX (C10H48) -or- **Dual Enrollment** Coding X (C10H49) -or- **CIE** Computer Science 1 AS Level 1 (C10H25) -or- **WBL** Coding Career Practicum (C10H40)

Cybersecurity

2025-26 Program of Study	Year 1	Year 2	Year 3	Year 4
Cybersecurity	Computer Science Foundations (C10H11)	Cybersecurity I (C10H19)	Cybersecurity II (C10H20) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Cybersecurity I (C10H24) -or- **Dual Enrollment** Cybersecurity II (C10H31)	Cybersecurity Practicum (C10H21) -or- **Dual Enrollment** Cybersecurity III 1 (C10H34) -or- **Dual Enrollment** Cybersecurity IV (C10H35) -or- **Dual Enrollment** Cybersecurity V (C10H50) -or- **Dual Enrollment** Cybersecurity VI (C10H51) -or- **Dual Enrollment** Cybersecurity VII (C10H52) -or- **Dual Enrollment** Cybersecurity VIII (C10H53) -or- **Dual Enrollment** Cybersecurity IX (C10H54) -or- **Dual Enrollment** Cybersecurity X 1(C10H55) -or- **WBL** Cybersecurity Career Practicum (C10H41)

Networking Systems

2025-26 Program of Study	Year 1	Year 2	Year 3	Year 4
Networking Systems	Computer Science Foundations (C10H11)	Computer Systems (C10H10)	Networking (C10H13) -or- **Dual Enrollment** Networking Systems I (C10H02) -or- **Dual Enrollment** Networking Systems II (C10H29)	Cabling and Internetworking (C10H09) -or- IT Clinical Internship (C10H12) -or- **Dual Enrollment** Networking Systems III (C10H36) -or- **Dual Enrollment** Networking Systems IV (C10H37) -or- **WBL** Networking Systems Career Practicum (C10H42)

Web Design

2025-26 Program of Study	Year 1	Year 2	Year 3	Year 4
Web Design	Computer Science Foundations (C10H11) -or- **IGCSE** Information and Communication Technology (C10H26)	Web Design Foundations (C10H16)	Web Site Development (C10H17) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Web Design I (C10H03) -or- **Dual Enrollment** Web Design II	Web Design Practicum (C10H18) -or- **Dual Enrollment** Web Design III (C10H38) -or- **Dual Enrollment** Web Design IV (C10H39) -or- **Dual Enrollment** Web Design V (C10H62)

			(C10H30)	-or- **Dual Enrollment** Web Design VI (C10H63) -or- **Dual Enrollment** Web Design VII (C10H64) -or- **Dual Enrollment** Web Design VIII (C10H65) -or- **Dual Enrollment** Web Design IX (C10H66) -or- **Dual Enrollment** Web Design X (C10H67) -or- **WBL** Web Design Career Practicum (C10H43))