Tennessee Computer Science State Education Plan

Task Force Report & Recommendations

Tennessee Department of Education |April 2020

Table of Contents

Introduction

On May 22, 2019, Governor Bill Lee and the Tennessee General Assembly addressed the importance of computer science education for all Tennessee students when he signed into law **Public Chapter No. 454**. This legislation is designed to ensure all students are fully prepared for the jobs of today and the future. It charged the Tennessee Department of Education with developing a state plan for computer science in grades kindergarten through twelve (K-12).[1]

Focused on expanding computer science to all students in Tennessee, the state launched a Computer Science Task Force to explore and make recommendations regarding the goals outlined in Public Chapter 454. This report captures where we are as a state in computer science and recommendations for each goal.

By exposing Tennessee Students to computer science in their K-12 careers we are ensuring our kids have every chance to land a high-quality job.

Governor Bill Lee

Computer Science Task Force
Purpose

[Public Chapter No. 454](#) mandates the Tennessee Department of Education to develop a state plan for computer science in grades K-12.

The law outlines six strategic goals that must be included in the plan as part of the state's efforts to ensure students are fully prepared for the technology jobs of today and the future. This report outlines recommendations to achieve these strategic goals. Moreover, during discussions among members, the taskforce recognized the need for additional recommendations that should be considered by the legislature to make computer science accessible and sustainable in the state. Those are included in this plan for consideration.

The strategic goals, as required by **Public Chapter No. 454**, are:
  (1) Ensure public high school students have access to at least one (1) computer science course;
  (2) Integrate computer science into elementary education;
  (3) Allow computer science course completion to count as a core admission requirement at state institutions of higher education;
  (4) Develop educator preparation program standards and requirements for computer science;
  (5) Increase the number of underrepresented student groups earning college credit in computer science while still in high school; and
  (6) Ensure opportunities for educators who teach computer science to earn the computer science endorsement approved by the state board of education.

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[1] Public Chapter No. 454. on the internet at https://publications.tnsosfiles.com/acts/111/pub/pc0454.pdf (*visited October 1, 2019*)

On November 12, 2019, the department convened a task force to make recommendations on the strategic goals outlined above for developing a state plan for computer science. The task force included stakeholders from schools, districts, non-profit partners, institutions of higher education, and key industry leaders to provide diverse perspectives on the current landscape and future opportunities in expanding computer science in Tennessee.

Through discussions and feedback, the task force was ultimately charged with the primary goal of developing recommendations for the state's direction to support computer science.

By engaging key stakeholders, the department aims to ensure that its support captures the needs of Tennessee educators by creating a cohesive strategy across the identified priorities and utilizing and expanding on existing resources and successful strategies.

This report captures the state's current status regarding computer science education and the task force's recommendations for best preparing students to meet the challenges of a digital tomorrow .

Members

Recognizing the wide variety of stakeholders necessary to facilitate a comprehensive assessment on computer science, the task force represented diverse experiences and perspectives. Members contributed to robust discussions and ensured that strategies leveraged and connected resources from across the educational landscape in Tennessee. A full list of members is included below:

- Deborah Knoll, director, K-12 programs and STEM initiatives, Tennessee Dept. of Education
- Jean Luna, chief, college, career & technical education, Tennessee Dept. of Education
- Brandi Stroecker, director, Tennessee STEM Innovation Network (TSIN)
- Becky Ashe, manager of professional learning, Tennessee STEM Innovation Network (TSIN)
- Meka Egwuekwe, executive director, CodeCrew
- John Wark, CEO and founder, Nashville Software School
- Alexis Menocal Harrigan, director of state government affairs, Code.org
- Stacy Bassett, senior director state government relations, College Board
- Juan Navarro, associate director of K-12 Policy, College Board
- Catherine Johnson, policy coordinator, Tennessee State Board of Education
- Bryce Warden, senior postsecondary policy analyst, SCORE
- Robert Denn, associate vice chancellor for academic affairs, Tennessee Board of Regents
- Victoria Harpool, senior director for academic affairs and strategic alignment, Tennessee Higher Education Commission
- Annie Freeland, director of policy and engagement, University of Tennessee
- Jorge Perez, associate vice president for academic affairs and student success, University of Tennessee

- Julie Johnson, director of undergraduate studies in computer science, Vanderbilt University
- Chris Vanags, director of research initiatives, Vanderbilt University
- Brandon Johnson, vice president for enrollment and career placement, Tennessee Tech University
- Chelsey Guttery, 6-8 computer technology/science teacher and Code.org computer science discoveries facilitator, Lincoln Heights Middle School
- Keith Jackson, 9-12 math teacher and Code.org computer science principles and fundamentals facilitator, Oak Ridge High School
- Dinah Wade, 5-6 elementary library and Code.org fundamentals facilitator, Freedom Intermediate

Report Abbreviations and Definitions

The report contains commonly used language and agencies from the education landscape. Below is a summary for reference:

Department	Tennessee Department of Education
Board	Tennessee State Board of Education
STEM	Science, Technology, Engineering and Mathematics
STEAM	Science, Technology, Engineering, Mathematics, Arts and Music
EPSO	Early Postsecondary Opportunity. This includes opportunities for students to earn/take: industry certifications, Advanced Placement courses, IB courses, Cambridge courses, Dual Enrollment, and Dual Credit.
EPP	Educator Preparation Programs are designed for aspiring Tennessee educators as they must complete an approved educator preparation program. Approved preparation programs are available through a variety of levels, types, and pathways including undergraduate and post-baccalaureate, and with student teaching, internship, or job-embedded clinical practice. The requirements for educator preparation provider (EPP) eligibility and the approval of educator preparation programs are set by the State Board of Education (SBE) as outlined in Educator Preparation Policy 5.504 and rule Chapter 0520-02-04.
PLA	Prior Learning Assessments are used to evaluate credit for prior learning
TSIN	Tennessee STEM Innovation Network is a nonprofit whose mission is to promote and expand the teaching and learning of Science, Technology, Engineering, and Mathematics education in K-12 schools across Tennessee
SCORE	State Collaborative on Reforming Education is a nonprofit that works to ensure public education in Tennessee continues to deliver academic progress for students from kindergarten through career. SCORE informs and influences state policy, monitors progress to measure impact and identify challenges, and prioritizes Tennessee's education agenda.

Code.org	An international nonprofit dedicated to expanding access to computer science in schools and increasing participation by women and underrepresented youth.
CollegeBoard	A mission-driven not-for-profit organization that connects students to college success and opportunity. Each year, the College Board helps more than seven million students prepare for a successful transition to college through programs and services in college readiness and college success — including the SAT and the Advanced Placement Program. The organization also serves the education community through research and advocacy on behalf of students, educators and schools.

The State of Computer Science in Tennessee

Computer Science has been defined by different states in many ways. The department has utilized the K12 Computer Science Framework as resource to assist in crafting its K-8 Digital Readiness Computer Science Standards to help create a uniform definition. The department adopts the K12 Science Framework, computer science definition: "The study of computer and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society." The framework also established that "by applying computer science as a tool for learning and expression in a variety of disciplines and interests, students will actively participate in a world that is increasingly influenced by technology.[2]"

Computer science is one of the fastest growing industries, and computer programmers are needed within every field, including healthcare, engineering, manufacturing, and information technology.[3] Although not every Tennessee student will enter a STEM and/or STEAM field, all students will benefit from learning computer science concepts and practices. These concepts and practices allow students to better understanding the world around them, improve their logical reasoning and problem-solving skills, increase their creativity and collaboration, and refine their computational thinking skills using computational modeling and digital storytelling.

In 2017, 34,768 Tennessee students, or 46%, had an interest in STEM, but only 29% met the ACT STEM benchmarks. [4] While the number of students meeting the STEM benchmarks has improved by a few percentage points since 2016, Tennessee continues to see gaps between interest and aptitude for STEM. Additionally, STEM interest has remained the same since 2016, with minority and female interest particularly low. One way to shrink this gap is to explicitly focus on how STEM content is

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[2] K12 Computer Science Framework. (2016) Retrieved from https:/k12cs.org (*visited January 25, 2020)*
[3] Tennessee Department of Economic & Community Development. (2019) *2019 LEAP Report.* On the internet at https://tnecd.com/wp-content/uploads/2019/11/LEAP-2019-In-Demand-Occupations-FINAL-REPORT.pdf (*visited January 25, 2020)*
[4] ACT. The Condition of STEM 2017. (2017) On the internet at: http://www.act.org/content/dam/act/unsecured/documents/STEM/2017/Tennessee-State-of-STEM-2017.pdf (*visited January 25, 2020)*

applied in the classroom. Because computer science is an applied science, it encourages students to understand and engage in the "why" of science, technology, engineering and math, so they can begin to see connections to careers. This can serve as a needed inspiration as students learn science and math.[5]

In addition to the benefits for students, investing in computer science will directly benefit Tennessee's economy. Tennessee will experience significant growth in STEM occupations through 2026. In 2016 there were 138,100 STEM employees and is estimated to increase to 167,950 by 2026. These additional 29,850 STEM jobs will make up 8.44 percent of the jobs being added in the state through 2026. STEM occupations are also projected to grow nearly twice as rapidly as all occupations in Tennessee. Many of these are faster-growing, high- wage occupations for which significant shortages of job candidates exist and which are vital to the rapidly growing information economy. The majority of new STEM jobs will be in the computer, mathematical, architecture and engineering occupations. Of these core STEM occupations, more than half (53.8 percent) will be in the computer and mathematical occupational group.[6]

Best for All Strategic Plan

The development of the computer science education ecosystem in Tennessee is not being developed in a vacuum. There are multiple state stakeholders working to prepare students for success in college and career. In 2019, the department released its [Best for All Strategic Plan](#)[7] which includes priorities desinged to increase educaitonal outcomes for Tennessee students. There are two priorities within this plan that are closely aligned with supporting computer science education in the state. The task force's recommendations are directly aligned to the two priorities listed below.

Strategic Priority 1: Academics
All Tennessee students will have access to a high-quality education, no matter where they live.

- High-Quality Instructional Materials: Invest in high-quality materials, a tool for standards alignment training, and implementation support to districts.

- Career Exploration: Ensure every student has career exploration in middle school and a high school pathway that aligns to their interests and strengths.

[5] Tennessee Department of Education (2019) *Digital Readiness K-8 Computer Science Standards.* On the internet at https://www.tn.gov/content/dam/tn/stateboardofeducation/documents/2018_sbe_meetings/june-27,-2018-sbe-meeting/7-27-18%20III%20I%20K-8%20Computer%20Science%20Standards%20Clean%20Copy%202.pdf (*visited January 25, 2020*)

[6] Tennessee Department of Labor and Workforce Development. (2020)*The Demand for STEM Occupations in Tennessee 2019*. On the internet https://www.jobs4tn.gov/admin/gsipub/htmlarea/uploads/LMI/Publications/STEMReport2019Updated.pdf (*visited January 27, 2020*)

[7] Tennessee Department of Education. (2020) *Best for All Strategic Plan*. On the internet at https://www.tn.gov/education/news/2019/11/5/education-commissioner-unveils--best-for-all--strategic-plan.html (*visited January 25, 2020*)

Strategic Priority 3: Educators

Tennessee will set a new path for the education profession and be a top state to become and remain a teacher and leader.

- Preparation: Ensure educators are prepared to be successful in the classroom upon completion of their educator preparation program. This includes a strong understanding of the state standards, the use of high-quality instructional materials, and best practices for implementation.

Current Computer Science Funding

Governor Bill Lee has allocated the first dedicated funding stream to computer science education for Tennessee. Continued funding for teacher training, educator incentives, and equipment will be required to ensure growth and sustainability of computer science education in Tennessee.

Future Workforce Initiative

In February 2019, Governor Lee announced the **Future Workforce Initiative** to provide funding for the expansion of STEM programs statewide including computer science. The Tennessee Department of Education has committed to the following allocation of the funds identified in the STEM Expansion line item in the 2019-20 state budget to help expand computer science for all students in Tennessee.

Specific allocations identified for computer science for 2019-20 included:

- Code.org Regional Trainings (2019-20) $30,713.00
- Computer Science Grants to Educators (2019-20) $300,000.00
- K-8 Computer Science Standards Trainings (Summer 2020) $84,000.00

At the time of the writing, in the 2020-21 state budget, $1.8M was recommended for phase two of the Future Workforce Initiative is subject to change based on ongoing budget discussions. If the governor's Future Workforce Initiative funding is passed, the department will identify specific appropriation channels for computer science.

Perkins V

In 2018, the Carl D. Perkins Career and Technical Education Act of 2006 (Perkins IV) was reauthorized (Perkins V) to continue Congress's commitment to career and technical education (CTE) programs. The Perkins V offers states and local school districts a new way to expand access to computer science education by outlining the following:

- "Non-traditional fields" is defined to mean "occupations or fields of work, such as careers in computer science, technology, and other current and emerging high skill occupations, for

which individuals from one gender comprise less than 25% of individuals employed in each such occupation or field of work.

- Funds can be used for "programs and activities that increase access, student engagement, and success in science, technology, engineering, and mathematics fields (including computer science, coding, and architecture), support for the integration of arts and design skills, and support for hands-on learning, particularly for students who are members of groups underrepresented in such subject fields, and students who are members of special populations."

K-12 Current Computer Science Offerings

Students in Tennessee currently have several options to pursue computer science courses in the various grade levels. Courses are available for any district and school to offer and are reviewed by the department. Like all Tennessee course standards, every three or six years, standards are reviewed by the state board of education to ensure relevance and modernity of standards in fast-changing fields.

Additional information regarding teacher endorsement requirements, course type, appropriate grade levels, credit weight, attributes, and general notes can be found in the Tennessee Course Catalog.[8] For a complete look at board-approved computer science courses, please refer to: **Appendix B: Computer Science Courses in Tennessee**.

K-8 Digital Readiness Computer Science Standards
In July 2018, the board adopted Digital Readiness K-8 Computer Science Standards. Districts began implementing these during the 2019-2020 school year.

These standards arose from the increased demand and high job growth in computing professions in Tennessee. In the elementary grades, the standards introduce students to computing systems, digital citizenship, and privacy. In middle school the focus expands to career exploration in computer science fields, and safely interacting with people and content online. Computational thinking and informational processing are utilized throughout.

While the standards have five strands, only the "coding and computer programming" strand can be classified as computer science. This strand specifically addresses analytical and innovative problem-solving skills to decompose, identify patterns, generalize information, and formulate algorithmic processes to solve a problem or related set of problems with a variety of tools. The remaining

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[8] Tennessee Department of Education (2020) *Course Catalog*. On the internet https://www.tn.gov/content/tn/education/lea-operations/correlations-of-course-and-endorsment-codes.html (*visited January 17, 2020)*

strands focus on: fundamental technology skills, analytical and innovative thinking, information access and storage, communication and collaboration and digital citizenship.[9]

Elementary and Middle School Computer Science

The K-8 Digital Readiness Computer Science Standards are the primary source of computer science education in grades K-8. However, Code.org has free K-12 curricula for elementary: *Computer Science Fundamentals* and middle school: *Computer Science Discoveries*. Last year, both curricula were used in 18 percent of elementary and middle schools in Tennessee.
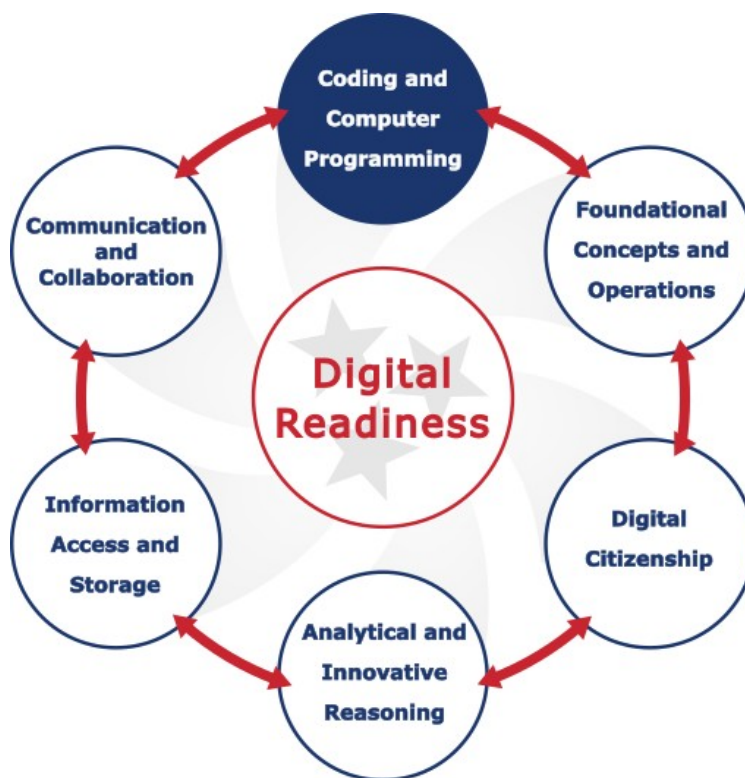
High School Computer Science

High school computer science options include a variety of courses that are described below. Courses are available for any district and school to offer and are reviewed, like all Tennessee course standards, by the department every three or six years and presented to the board for approval to ensure relevance and modernity of standards in fast-changing field. While the state does not currently require high schools to offer a computer science course, CTE, dual enrollment, IB, and AP computer science courses are available.10

[9] Tennessee Department of Education (2019) *Digital Readiness K-8 Computer Science Standards.* On the internet at https://www.tn.gov/content/dam/tn/stateboardofeducation/documents/2018_sbe_meetings/june-27,-2018-sbe-meeting/7-27-18%20III%20I%20K-8%20Computer%20Science%20Standards%20Clean%20Copy%202.pdf (*visited January 25, 2020*)
[10] Tennessee Department of Education. On the internet at https://www.tn.gov/education/instruction/academic-standards/computer-science.html (*visited January 25, 2020*)

AP Courses

The CollegeBoard, a non-profit organization that connects students to college success and opportunity, publishes the Advanced Placement program. According to CollegeBoard, the AP Program "gives students the chance to tackle college-level work while they're still in high school and earn college credit and placement." CollegeBoard also notes that they "strongly encourage educators to make equitable access a guiding principle for their AP programs by giving all willing and academically prepared students the opportunity to participate in AP." For a complete look at where AP courses are taught in Tennessee, please refer to **Appendix C: Maps of Schools Offering AP Computer Science Courses 2018-19.** Below are the two computer science advanced placement courses recognized in Tennessee.

- **AP Computer Science A**
  According to CollegeBoard, AP Computer Science A (AP CSA) is an introductory college-level computer science course that emphasizes object-oriented programming and design using the Java programming language. Additional information regarding AP CSA can be found here.[11]

- **AP Computer Science Principles**
  Per CollegeBoard, AP Computer Science Principles (AP CSP) is also an introductory college-level computing course. Students in this course have an opportunity to cultivate their understanding of computer science through working with data, collaborating to solve problems, and developing computer programs as they explore concepts like creativity, abstraction, data and information, algorithms, programming, the internet, and the global impact of computing. Additional information regarding AP CSP can be found here.[12]
  Cambridge Courses

The following course is considered "computer science" in high school under the Cambridge program.

- **IGCSE Computer Science**
  - This course is designed to provide students the foundational skills needed in learning how to problem solve using computers. This course will allow students to learn how to apply their understanding to develop computer-based solutions to problems using programming language and algorithms.

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[11] CollegeBoard. (2019) *AP Computer Science A Course Description*. On the internet https://apcentral.collegeboard.org/pdf/ap-computer-science-a-course-and-exam-description.pdf?course=ap-computer-science-a (*visited January 25, 2020*)
[12] CollegeBoard. (2017) *AP Computer Science Principles Course Description*. On the internet https://apcentral.collegeboard.org/pdf/ap-computer-science-principles-course-overview.pdf (*visited January 25, 2020*)

CTE Courses

There are currently four programs of study (POS) within the Information Technology career cluster. They include cybersecurity, networking systems, coding, and web design. These POS include four levels of courses that build on each other in rigor and in content and include options for students to earn industry certifications and take AP courses. CollegeBoard and Advance CTE both have highlighted the work the department has done to incorporate AP classes into CTE programs of study as a model for other states.[13] Students can earn industry certifications at all levels. For a complete look at CTE courses including aligned industry certification, please refer to **Appendix A: Information Technology CTE Career Cluster.**

Dual Enrollment

Students that are enrolled in dual enrollment have access the same courses offered by the college as do traditionally enrolled students. The following courses are some examples that can be taken by high school students with the opportunity to earn postsecondary credit through an agreement with the high school and the postsecondary institution:

- Computer Science
- Programming I Lab
- Introduction to Game Programming
- Java Programming I
- Beginning HTML & CSS
- Introduction to Programming Logic for Mobile Apps

Teacher Professional Development

As schools work toward the Governor's and General Assembly's goal of increasing the number of qualified computer science teachers by 2022, the department and Tennessee STEM Innovation Network (TSIN) are experiencing a corresponding increase in requests for professional learning support. The rising level of awareness around the Digital Readiness K-8 Computer Science Standards is leading schools to identify gaps in teacher and leader knowledge and practice that may be obstacles to implementing the required standards with fidelity by 2021. TSIN, in partnership with the department, has crafted a multi-pronged approach to meet educator needs across the state to develop and deliver innovative learning that brings computational thinking best practices to school staffs and districts. This initiative is consistent in rigor but customized in context to meet the diverse needs of the student populations.

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[13] CollegeBoard. (2018). *Advanced Placement and Career and Technical Education: Working Together*. On the internet https://cte.careertech.org/sites/default/files/files/resources/AP_CTE_Working_Together_Oct_2018.pdf. (*visited February 2, 2020)*

Code.org Professional Development Regional Partnership

TSIN serves as the regional partner in Tennessee for Code.org's [Professional Learning Programs](). The Code.org professional development program supports efforts to expand equitable access to computer science in K-12 schools through a one-year professional development program for teachers. Code.org has programs for all grade levels. All Code.org professional development opportunities require no prior knowledge. The Code.org professional development model in Tennessee is shifting to a regional strategy that allows twice the number of educators to be trained in computer science across the state. This regional strategy has shown promise as there is currently a waiting list for the 2020-21 cohort for teacher training.

Digital Readiness K-8 Computer Science Standards Summer Training Opportunities

TSIN, in partnership with department, has crafted rigorous standards training to be offered in eight geographically diverse locations across the state in summer 2020. Building off of the Code.org *Lead-Learner* concept, this training is designed to engage teachers in an age-appropriate activity for their respective grade band, discuss the relevance/importance of the [K12 Framework for Computer Science](), unpack the new computer science standard(s) that align to the learning experience, and identify additional aligned exemplar tasks. Administrators and school counselors will also be invited to participate in a leadership session at each training location to emphasize the importance of leadership support in computer science implementation and familiarize counselors with equitable computer science recruitment tools.

Tennessee STEM Innovation Summit

In partnership with department, the [Tennessee STEM Innovation Summit]() is the largest STEM-focused conference in the state. The continued emphasis and interest in STEM and STEAM pedagogy and instructional strategies has pushed TSIN to design a strong professional development conference with follow-up opportunities. This strategy uses a network of presenters across the state to develop and deliver innovative learning that brings STEM and/or STEAM best practices to school staffs and districts. The summit is targeted towards educators and building leaders and has been recognized with the ability to give TASL credit hours for administrators.

Regional STEM Hubs

There are seven geographically unique [STEM Innovation Hubs]() that each serve their immediate region. This is a local support team that provides additional professional development at the regional level and additional implementation support on strategies and practices. The STEM Innovation Hubs prioritize STEM/STEAM and computer science.

Postsecondary Computer Science

In the 21st century, more than half of Tennessee's jobs will require some type of postsecondary credential. To meet this demand, the state has set an ambitious [goal:](#) by 2025, 55 percent of the population will obtain a postsecondary certificate or degree.

Coupled with the workforce demand for postsecondary credentials, computer science is seen as a high-demand, high-wage career for Tennessee's students. Students must be afforded the opportunity to obtain a high-quality credential. Increased postsecondary participation in computer science policy provides one avenue for students to gain increased economic prosperity and success in life.

Computer Science Educator Opportunities

Educator Preparation Programs

Currently in Tennessee, only one approved teacher preparation provider - Tennessee Tech University - offers programming specifically designed to train new teachers in computer science instruction. Tennessee Tech trains future educator's to be proficient in most of the [International Society for](#) [Technology in Education](#) (ISTE). The state board of education has written policy to define what components need to be met for a program's educator candidates to qualify for licensure and endorsement in Computer Science K–12.

- Program Components:
  - Candidates shall complete field experiences in kindergarten through grade five (K-5), grades six through eight (6-8), and grades nine through twelve (9-12).
  - Candidates shall complete clinical practice in both kindergarten through grade eight (K–8) and in grades nine through twelve (9–12).

- Specialty Area Standards:
  - Educator preparation programs in computer science education shall be aligned to the International Society for Technology in Education (ISTE) Standards for Computer Science Education.

Endorsement 173

In 2017, *Public Chapter 105* required the state board of educaiton to create an endorsement in computer science for all teachers who demonstrate sufficient content knowledge in the course material. Endorsement 173 was designed to meet this requirement. An educator may earn this endorsement by passing the Praxis Computer Science (5652) exam. This exam is three hours long and contains 100 selected-response questions and assesses the knowledge, skills, and abilities in three major content categories: technology applications core, program design and development, and programming language topics.

Computer Science Employment Standard

The board allows the educators to earn [Computer Science Employment Standard](#)[14], with guidance on requirements to qualify to teach early post-secondary opportunities and/or career and technical education computer science courses. The computer science employment standard is achieved by completing the state sponsored middle and/or high school Code.org trainings. Participation in the Code.org Computer Science Discoveries and/or Advanced Placement (AP) Computer Science Principles trainings will be determined by submission of an application on a first-come, first-served basis. Completion of the training, resulting in the employment standard permits teachers to teach 15 different computer science courses, including cybersecurity, web design, coding, AP Computer Science A, and AP Computer Science Principles.

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[14] Tennessee Department of Education. (2020) *Computer Science Employment Standard*. On the internet
https://www.tn.gov/content/dam/tn/education/ccte/cte/ComputerScienceEmploymentStandard.pdf (*visited January 16, 2020)*

Public Chapter No. 454 Task Force Recommendations

On Nov. 12, 2019, the department convened a task force to make recommendations on the strategic goals below for developing a state plan for computer science. The task force included stakeholders from schools, districts, non-profit partners, institutions of higher education, and key industry leaders to provide diverse perspectives on the current landscape and future opportunities in expanding computer science in Tennessee. The plan must set strategic goals and make recommendations to:

(1) Ensure public high school students have access to at least one (1) computer science course;
(2) Integrate computer science into elementary education;
(3) Allow computer science course completion to count as a core admission requirement at state institutions of higher education;
(4) Develop educator preparation program standards and requirements for computer science;
(5) Increase the number of underrepresented student groups earning college credit in computer science while still in high school; and
(6) Ensure opportunities for educators who teach computer science to earn the computer science endorsement approved by the state board of education.

On Mar.10, 2020, the Task Force met a second time to finalize the report. The department will submit a copy of the plan to the speakers of the senate and house by May 1, 2020.

Vision Statement

Tennessee will ensure that every child in public school will have the opportunity to experience a seamless K-12 to career pathway of experiences in computer science and computational thinking that support their learning for today, as well as their capacity to contribute to the entrepreneurial community of tomorrow.

High School Access to Computer Science

In the process of developing recommendations and strategic goals to increase access to computer science courses, the task force reviewed available job data for the state. As part of its research, the task force also took into consideration Governor's Lee's 2019 State of the State address in which he noted that the state "must deliver a world-class education, and that education must be aligned with the needs of job creators of today and tomorrow."

Key Course Offering Points

- According to the department, in the 2019-2020 school year:
    - 34 high schools offered AP Computer Science A
    - 91 offered AP Computer Science Principles

- In 2019-2020, public high schools in Tennessee offered the following computer science CTE courses:

Course Code	Secondary Course Name	Sections Offered
C10H08	Coding Practicum	10
C10H14	Coding I	102
C10H15	Coding II	65
C10H19	Cybersecurity I	29
C10H20	Cybersecurity II	16
C10H22	Mobile App Development	6
	TOTAL	268

Key Job Points

- The majority of new STEM jobs will be in the computer and mathematical and architecture and engineering occupations. Of these core STEM occupations, more than half (53.8 percent) will be in the computer and mathematical occupational group.[15]

- Many computer science related occupations also had the greatest number of candidate shortages including: computer programmers, computer user support specialists, software developers, and computer systems analysts.[16]

- Computer professionals have some of the highest salaries in the state including[17]:
    - Computer and Information Systems Managers: $110,200
    - Computer and Information Research Scientists: $105,800

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[15] Tennessee Department of Labor and Workforce Development. (2020)*The Demand for STEM Occupations in Tennessee 2019*. On the internet https://www.jobs4tn.gov/admin/gsipub/htmlarea/uploads/LMI/Publications/STEMReport2019Updated.pdf (*visited January 27, 2020)*

[16] Tennessee Department of Labor and Workforce Development. (2020)*The Demand for STEM Occupations in Tennessee 2019*. On the internet https://www.jobs4tn.gov/admin/gsipub/htmlarea/uploads/LMI/Publications/STEMReport2019Updated.pdf (*visited January 27, 2020)*

[17] USAWage. (2020) *200 Highest Paying Jobs in Tennessee*. On the internet https://www.usawage.com/high-pay/jobs-state-tennessee.php (visited February 11, 2020)

Public Chapter No. 454 strategic goal:
Ensure public high school students have access to at least one (1) computer science course.

Recommendations:

1) Develop a law that requires each public high school to offer at least one computer science course using a wide array of computer science courses to within 2 years. See **Appendix B** for a list of approved courses.

2) Design an implementation plan for the computer science course policy so that schools have adequate time to comply with statutory requirements:

   • Within 1 year of policy adoption, each school district shall ensure that at least one high school in its school system shall offer at least one course in computer science.

   • Within 3 years of policy adoption, each school district shall ensure that at least 50% of high schools in the school district shall offer at least one computer science course.

   • Within 5 years of policy adoption, each school district shall ensure that all high schools in its school system offers at least one computer science course.

3) Create a policy requiring the department to collect and include computer science data in the district and school dashboard including:

   • the implementation of computer science related policies, including the course offering mandate;

   • the number and name(s) of computer science courses offered in each public secondary school; and

   • student participation in rigorous computer science broken down by course (e.g. virtual, AP, IB, dual enrollment, etc.) and disaggregated by demographics including but not limited to: gender, diverse races/ethnicities, rural students, low-income students, students taking exams for college credit, and students earning college credit while in high school for computer science.

4) Formulate targets within one year of policy adoption to increase the number of all students, especially for underrepresented groups, participating in computer science, particularly those opportunities that lead to college credit while in high school. The targets shall be achieved within five years of policy adoption.

5) Provide adequate funding to accelerate student access to at least one or more computer science courses in each public high school.

Elementary School Integration

It is necessary to integrate computer science into daily activities and instruction to make computer science fundamental in elementary school. Computer science clubs or afterschool programs only serve a small portion of the student population. Integration happens through offering independent enrichment rotations, similar to Music and Art, and integrating computer science concepts into other subjects such as reading, writing and math.

K-5 administrators have expressed concern that adding computer science into K-5 curricula will take away instructional time from other core subjects, such as math and reading. These are subjects for which testing results weigh heavily on school accountability and report cards. However, curricular integration of computer science fosters interdisciplinary study and mitigates competition for time and space resources.

In elementary school, computer science concepts like computational thinking, algorithms, and problem solving provide new and creative ways of learning. For example, computer science concepts provide a way to teach about the water cycle in science and angles and geometry in math.

Recently, a National Science Foundation funded research project investigated the effects of computer science integration in 3rd through 5th grade and the attitudes students had toward computer science and their academic achievement. Preliminary findings of the study show higher literacy scores, and higher scores on the state's ELA, Math and Science Assessments.[18]

A challenge of integrating computer science in K-5 curriculum is the additional professional development and the cost and time needed to train existing teachers, on top of very demanding schedules.

Public Chapter No. 454 Strategic Goal:
Integrate computer science into elementary education.

Recommendations:
1) Offer schools and districts grants providing professional development to teachers that incorporates tools and support after the training.
   - Cover the cost of teacher travel and lodging where applicable.

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[18] Time for CS: Integrating Computer Science into Elementary Literacy. (2020) Retrieved from http://outlier.uchicago.edu/TimeforCS/findings/ (*visited January 25, 2020*)

- Provide teachers with stipends for successfully completing professional development as identified by the department.

- Maintain a teacher community where educators can share ideas and challenges with one another. A teacher may often be the only person in their school teaching computer science. A network of support will help teachers build community and support one another.

2) Develop a central resource bank for elementary teachers to include computer science lesson plans, opportunities for additional professional development, research and best practices.

3) Design and implement a plan focused on messaging, outreach and engagement on the K-8 Digital Readiness Standards for computer science integration in grades K-5.

4) Provide financial incentives for teachers serving in distressed and/or low-income rural schools where computer science is not currently taught, and in schools with high percentage of underrepresented student subgroups in fields of computing, i.e. African-American, Hispanic/Latino, and Native American students.

5) Create a list of approved computer science courses for middle school. Such a list could help to create a pathway for students to continue their computer science development in middle and high school by providing computer science courses that build upon foundational concepts students mastered in elementary school.

Core Admissions Requirement

Currently in Tennessee, students can substitute Advanced Placement Computer Science for a fourth year of math. However, the state does not have a policy in place encouraging public institutions of higher education to assess computer science for admissions purposes when used to meet a core graduation requirement.

Public Chapter No. 454 Strategic Goal:
Allow computer science course competition to count as a core admission requirement at state institutions of higher education.

Recommendations:
1) Create a communication plan that explains how computer science courses can be used to meet core graduation requirements for math.

2) Recommend that the state board of education investigates allowing computer science courses to count as a graduation requirement for science or math.

3) Encourage public institutions of higher education to review admission requirements allowing secondary computer science courses for admission purposes.

4) Encourage public institutions of higher education to clearly articulate in their admissions and placement requirements regarding secondary computer science courses.

5) Develop a long-term, aspirational goal moving towards a stand-alone graduation requirement for computer science.

Educator Preparation Program Standards & Requirements

A major hurdle to expanding access to computer science education is a shortage of computer science teachers. The state has seen some positive outcomes in new course offerings and computer science integration by training existing K-12 teachers. Exposing future teachers to computer science during their pre-service training will help increase course offerings and provide basic knowledge of computer science for teachers continuing professional development.

The department and higher education institutions should review the existing computer science endorsement and the computer science employment standards as they begin to develop educator preparation program standards. The department of education and higher education institution should also determine district needs for teachers who hold the Computer Science endorsement. Alignment to existing endorsement and educator standards will make the transition into teaching easier and ensure state education agencies and stakeholders have common benchmarks for computer science education.

Public Chapter No. 454 Strategic Goal:

Develop educator preparation program standards and requirements for computer science.

Recommendations:

1) Request the state board of education include elements of foundational computer science concepts in standards for educator preparation providers for relevant specialty area programs.

2) Develop an incentive grant for institutions of higher education to develop a certification pathway creating a dual major program between computer science and teacher education.

3) Create a computer science course pathway option within the Educator Preparation Programs certification programs that individual programs would have the option to adopt.

4) Subsidize costs for current educators to become certified in computer science.

Underrepresented Students Earning College Credit

There are several pathways students can pursue to obtain college credit while in high school. The most common options include:

Advanced Placement

The Collge Board currently offers two different AP Computer Science courses that provide high school students the chance to earn college credit in computer science. These courses are traditionally open to all qualified students who wish to take the course, as long as the courses are available at the student's school. At the culmination of the course, studets may sit for the AP exam, which is scored on a 1-5 scale. Students who score at least a 3 on the exam aqualify for college credit at some postsecondary institutions.

- Tennessee provides a financial subsidy to assist students who qualify for free and reduced price lunch in covering the cost of AP and IB exams. This support helps increase access to college credit bearing opportunities for students from low-income backgrounds.

- Tennessee does not have a uniform AP credit policy, meaning that each public postsecondary institution sets its own policy to award credit for AP as shown below for the 2019-20 school year.

	Austin Peay University	Middle Tennessee State University	University of Memphis	East Tennessee State University	Tennessee State University	Tennessee Technological University	University of Tennessee - Chattanooga	University of Tennessee - Knoxville	University of Tennessee - Martin
AP Computer Science A	3	3	3	3	3	4	4	5	3
AP Computer Science Principles	3			3	4	3	4	5	

- Finally, research over time consistently shows that students who score a 3 or higher on AP Exams experience greater academic success in college and improved graduation rates compared to students who do not participate in AP examinations.

Dual Enrollment

All high schools in Tennessee provide a portfolio of early postsecondary opportunities (EPSO) for students, addressing a diversity of student interests, prior academic performance, needs, and postsecondary aspirations. High school students in Tennessee have the opportunity to earn postsecondary credits that are aligned with, and transferable to, postsecondary programs of study. Research shows that students who participate in early postsecondary courses are more likely to enroll and persist in postsecondary environments.

Public Chapter No. 454 Strategic Goal:

Increase the number of underrepresented student groups earning college credit in computer science while still in high school.

Recommendations:

1) Encourage public institutions of higher education to better communicate credit policies for all Prior Learning Assessments for students.

2) Leverage the department's existing efforts to document the existing needs and identify the barriers to success for students enrolled in computer science courses that lead to college credit while in high school.

3) Develop targets to increase the number of students, especially underrepresented groups, participating in computer science courses that lead to college credit while in high school.

4) Expand computer science opportunities that lead to college credit while in high school through increased access to dual credit, AP courses, and dual enrollment for underrepresented students.

5) Provide incentives for districts to develop a plan to offer computer science courses that lead to college credit for schools that do not currently offer those courses and increase participation in underrepresented groups in these courses.

Teacher Support

Tennessee can address the teacher pipeline in three ways:
- professional development for existing teachers;
- certification and licensure for ensuring qualified teachers are teaching computer science courses, and;
- development of educator preparation programs to maintain a supply of teachers over the long term.

Public Chapter No. 454 strategic goal:

Ensure opportunities for educators who teach computer science to earn the computer science endorsement approved by the state board of education.

Recommendations:

1) Provide multiple pathways for teachers to earn a Computer Science endorsement. Opportunities may include: educator preparation programs and post-secondary coursework. The board currently provides an endorsement contingent upon passage of the computer science Praxis exam.

2) Continue support for professional learning for both credentialed and non-credentialed computer science teachers to sustain and support the computer science teaching workforce. Opportunities include and are not limited to: covering the cost of professional learning (e.g., APSIs, CSTA memberships, state CS memberships).

In Conclusion

Commissioner Schwinn and participating staff from the department are grateful to the members of the Computer Science Task Force for offering their time and expertise to help shape the direction of computer science in Tennessee. As the state seeks to continuously improve its supports to students, educators and leaders, the feedback of stakeholders continues to provide invaluable insights into how strategies unfold at the local and district levels. Through the efforts of this task force, this report will influence the state's path forward which will continue to prioritize these key efforts in expanding computer science in Tennessee.

Appendix A: Information Technology CTE Career Cluster

For additional information click here

Program of Study	Level 1	Level 2	Level 3	Level 4
Coding	Computer Science Foundations (C10H11) -or- **Cambridge IGCSE** Computer Science (C10H07)	Coding I (C10H14) -or- AP Computer Science Principles (G02H44)	Coding II (C10H15) -or- Mobile App Development (C10H22) -or- AP Computer Science Principles (G02H44) -or- **Dual Enrollment** Coding (C10H01)	Coding Practicum (C10H08) -and/or- AP Computer Science A (G02H45) -and/or- AP Computer Science Principles (G02H44) -or- **Dual Enrollment** Coding (C10H01) -or- **Cambridge International AS Level** Computer Science (C10H25)
	Industry Certification: CompTIA IT Fundamentals		**Industry Certification:** Microsoft Technology Associate Software Development Fundamentals -and/or- CIW Web Foundation -and/or- JavaScript Specialist -and/or- Advanced HTML5/CSS3	
Networking Systems	Computer Science Foundations (C10H11)	Computer Systems (C10H10)	Networking (C10H13) -or- **Dual Enrollment** Networking Systems (C10H02)	Cabling and Internetworking (C10H09) -and/or- IT Clinical Internship (C10H12) -or- **Dual Enrollment** Networking Systems (C10H02)
	Industry Certification: CompTIA IT Fundamentals	**Industry Certification**: Comp TIA A+ -and/or- Cisco Certified Entry Network Tech (CCENT)	**Industry Certification**: CompTIA Network + -and/or- Microsoft Technology Associate Infrastructure -and/or- Cisco IT Essentials PC Hardware & Software Certification -and/or- Cisco Certified Network Associate (CCNA)	

Web Design	Computer Science Foundations (C10H11) -or- **Cambridge IGCSE** Information and Communication Technology (C10H26)	Web Design Foundations (C10H16) -and/or- AP Computer Science Principles (G02H44)	Web Site Development (C10H17) -and/or- AP Computer Science Principles (G02H44) -or- **Dual Enrollment** Web Design (C10H03)	Web Design Practicum (C10H18) -and/or- AP Computer Science Principles (G02H44) -or- **Dual Enrollment** Web Design (C10H03)
	Industry Certification: CompTIA IT Fundamentals		**Industry Certification**: CIW Web Design Specialist -and/or- CIW Web Foundation -and/or- JavaScript Specialist -and/or- Advanced HTML5/CSS3	
Cybersecurity	Computer Science Foundations (C10H11)	Cybersecurity I (C10H19) -and/or- AP Computer Science Principles (G02H44)	Cybersecurity II (C10H20) -and/or- AP Computer Science Principles (G02H44) -or- **Dual Enrollment** Cybersecurity (C10H24)	Cybersecurity Practicum (C10H21) -and/or- AP Computer Science Principles (G02H44) **Dual Enrollment** Cybersecurity (C10H24)
	Industry Certification: CompTIA IT Fundamentals	**Industry Certification**: CompTIA A+	**Industry Certification**: CompTIA Network +	**Industry Certification**: CompTIA Security + -and/or- Associate of ISC2

Appendix B: Computer Science Courses in Tennessee

## State Board Approved Department Computer Science Courses

Course Code	Primary Course Name *All listed courses use the K-8 Digital Readiness Standards*
G01S00	Multi-Grade Computer Science
G10K01	K- Computer Science
G10K00	K- Computer Science Self-Contained
G10101	1-Computer Science
G10100	1-Computer Science Self- Contained
G10201	2 -Computer Science
G10200	2-Computer Science Self- Contained
G10301	3-Computer Science
G10300	3-Computer Science Self- Contained
G10402	4-Computer Science
G10401	4-Computer Science Self- Contained
G10502	5 -Computer Science
G10501	5-Computer Science Self- Contained
Course Code	Middle School Course Name *All listed courses use the K-8 Digital Readiness Standards*
G25X40	Computer Science
G25X40	Computer Science: Flexible Scheduling
Course Code	Secondary Course Name *All Courses listed have standards approved by state board*
C10H08	Coding Practicum
C10H14	Coding I
C10H15	Coding II
C10H19	Cybersecurity I
C10H20	Cybersecurity II
C10H22	Mobile App Development
C10H21	Cybersecurity Practicum

Additional IB, Cambridge and Advanced Placement (AP) High School Approved Computer Science Courses

Course Code	Secondary Course Name
G02H44	AP Computer Science Principles
G02H45	AP Computer Science A
C10H07	IGCSE Computer Science
G02H66	Computer Science SL
G02H71	Computer Science II SL
G02H69	Computer Science I SL/HL
G02H70	Computer Science II SL/HL
G02H16	Computer Science I HL
G02H17	Computer Science II HL
C10H25	CIE Computer Science 1 AS Level

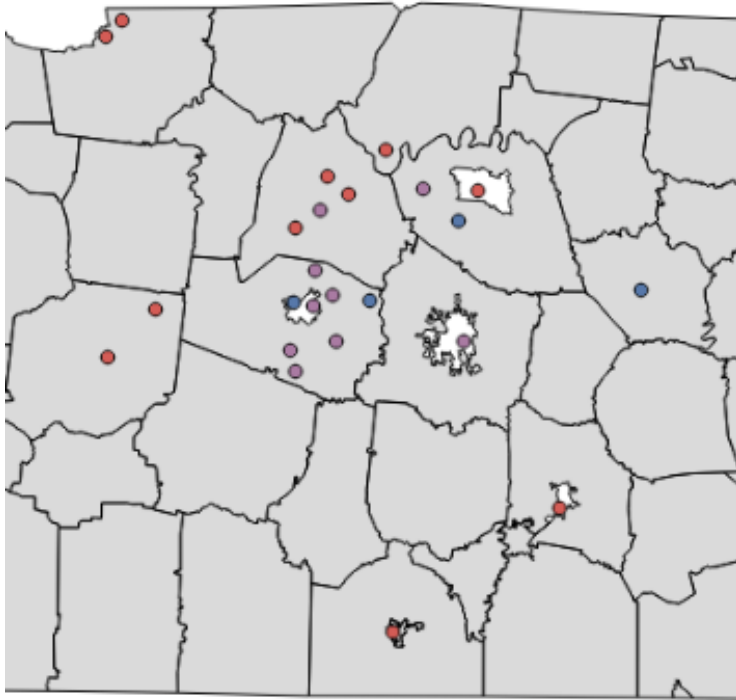# Appendix C: Maps of Schools Offering AP Computer Science Courses 2018-19

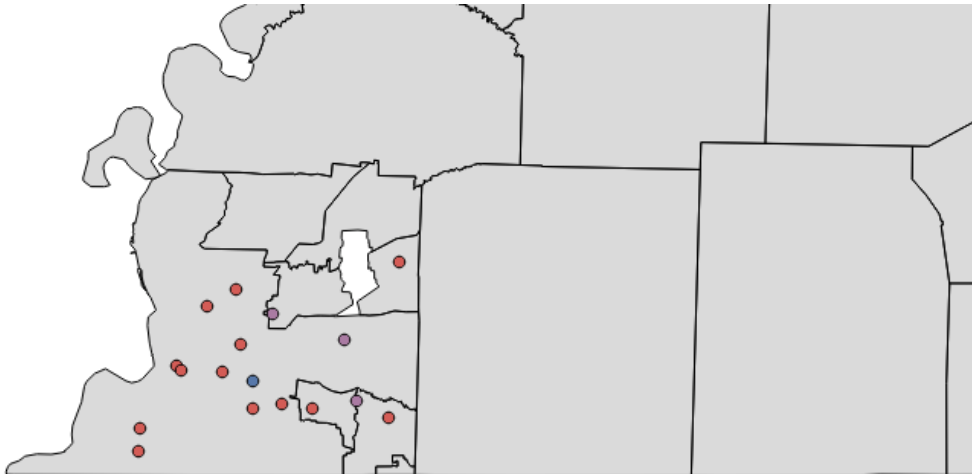● AP Computer Science A   ● AP Computer Science Principles   ● Both
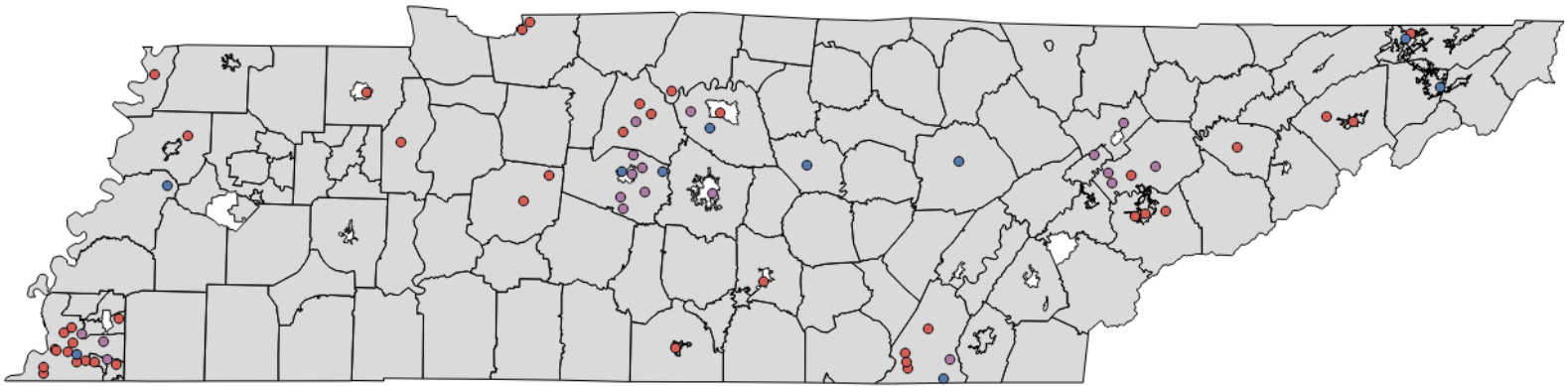
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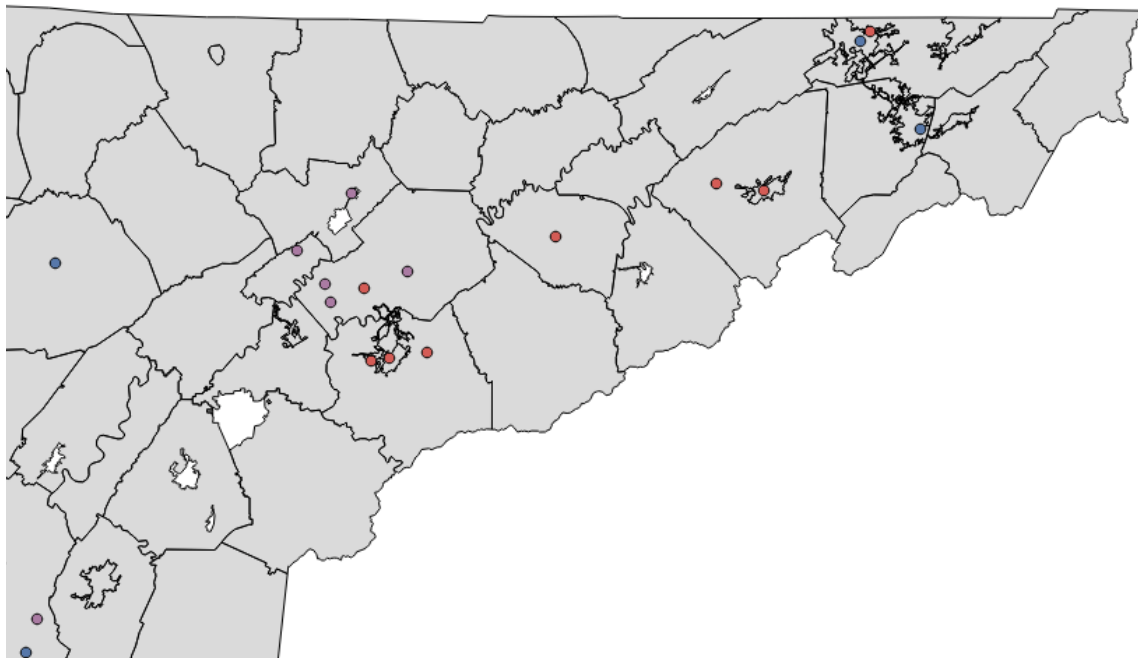
Middle Tennessee Area

Memphis Area

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