Testimony Presented to the
Senate Education, Energy, and the Environment Committee

SB 0980 (EDUCATION - COMPUTER SCIENCE - CONTENT STANDARDS AND REQUIREMENTS)

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Position: Support
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Thank you, Chair Senator Feldman, Vice Chair Senator Kagan, and members of the Education, Energy, and Environment Committee for the opportunity to support Senate Bill 980. My name is Kathy Benson. I am a program manager for the non-profit Tequity4all. I have lived and worked in Maryland for my entire life. I am a former software engineer turned elementary school teacher. I've teamed up with the Maryland Center for Computing Education and the Maryland State Department of Education to push computer science education into the spotlight.

What is the vision?
Imagine Maryland, where there is:

- Equitable Computing Education. Throughout their schooling, all students receive standards-aligned, high-quality, and hands-on instruction in computer science (CS) and computational thinking (CT).
- Broader Participation in Computing: All students understand the basics of CS and see themselves as able to use and apply it in a wide range of fields and disciplines.
- Workforce Development: More students develop confidence in their abilities and pursue higher-level CS courses; these students reflect the population's demographics and are poised to fill high-wage jobs.

How do we get there?
Maryland is already a national leader in computing education at the secondary level. Building upon the accomplishments of the Maryland State Department of Education (MSDE) and the Maryland Center for Computing Education (MCCE), Maryland is poised to advance computing education across P-20 education. Moving forward, Maryland should:

- Maintain the requirement that high schools offer at least one high-quality CS course and continue to strive for enrollment demographics commensurate with the school's demographics.
- Maintain existing state funding to MCCE of at least $1M annually. (Most of this funding supports secondary CS instruction and incorporates CS into pre-service teacher programs at Institutions of Higher Education.)
- Require that all Kindergarten through 8th-grade students receive developmentally

appropriate CS education.
- Increase funding to allow school systems to meet the new K-8 requirement in every public K-8 school within five years.
- Align K-12 CS instruction to broaden participation in CS and CS-related pathways to satisfy the Blueprint for Maryland's Future - Pillar 3: College and Career Readiness.

Where are we now?

In the percentage of high schools offering a high-quality CS course, Maryland is leading the nation. Despite our accomplishments, we have more work to do. Only 37% of 2022 Maryland high school graduates have taken at least one high-quality CS course[1]. More than offering CS courses is required; we want to increase enrollment. At the same time, Maryland has increased the diversity of enrolled students, but we have yet to match the state's demographics.[14] To broaden participation in computing, we need to retain the language which states, "in each public elementary and middle school in the county; and (2) Increase the enrollment in middle and high school computer science courses of: (i) Female students; (ii) Students with disabilities; and (iii) Students of ethnic, racial, and other demographic groups that are underrepresented in the field of computer science as identified by the U.S. Equal Employment Opportunity Commission."[2] Maryland is seen as a leader in doing this important work, and this legal language has been shared with other states as a way to specify students who have been historically marginalized.

For all students to be better informed and opt into additional CS courses in high school, we need to advance CS in K-8. Maryland has already begun preparing to advance CS education K-8.

- Maryland has K-12 CS standards.[3] (These standards include Cyber and were adopted in 2018).
- Every school system has a Strategic CSforALL Planning Tool (SCRIPT) plan for CS education K-12.[4]
- MCCE has provided professional development for at least one teacher in 47% of all elementary schools in Maryland.
- MCCE has trained over 100 Maryland Elementary School Ambassadors across almost every Maryland school system to be advocates, mentors, and trainers.
- MSDE with MCCE has developed a nationally used toolkit that includes a lesson repository, annotated standards, skill progressions, and a unit evaluation tool.

What are the next steps?

Maryland school systems are already implementing computing education models of instruction

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[1] Garvin, M. & Koerner, M. (2021). Dashboards: Participation in Maryland high quality computing courses and post-graduation outcomes.

[2] Maryland Code, Education, § 4-111.4

[3] Maryland State Department of Education. (2018). Maryland's K-12 Computer Science Standards.

[4] DeLyser, L. & Wright, L. 2019. A systems change approach to CS education: Creating rubrics for school system implementation. In Proceedings of the 2019 *ACM Conference on Innovation and Technology in Computer Science Education*. ACM, 492–498.

in some elementary schools. Some school systems incorporate lessons in their related arts rotation with School Library Media Specialists, Technology Teachers, or STEM teachers. Others have integrated lessons into the content areas (i.e. English Language Arts, Mathematics, Science, or Social Studies). Research has shown that the effectiveness of short-term in-school educational robotics instruction was significant for primary students' measured outcomes.[5] Our vision for schools involves a framework that builds on a foundation of computation thinking, extends it to blend computer science and engineering, especially through roboticis, and culminates in rich problem-based learning.

Over the next five years, we propose to build upon the successes from the last five years of the elementary CS ambassador program and state-level workshops, which have provided state-level professional development to at least one elementary school teacher from 47% of the Maryland public elementary schools.[6] We will provide evidence-based practices and data from the current implementations to the decision-makers at the other school systems to select how they intend to implement CS in each grade level. We will continue to support each school system to bring CS in each grade level to full-scale implementation and alignment with the Maryland K-12 CS Standards.

So What?

Computing occupations are the best-paying, fastest-growing, most extensive source of all new wages in the U.S.[7] According to the United States Bureau of Labor Statistics, "Overall employment in computer and information technology occupations is projected to grow much faster than the average for all occupations from 2022 to 2032. On average, about 377,500 openings are projected each year in these occupations due to employment growth and the need to replace workers who leave the occupations permanently. The median annual wage for this group was $100,530 in May 2022, which was higher than the median annual wage for all occupations of $46,310." CS knowledge and skills pay off both for those who specialize in CS and those who do not.[8] Artificial Intelligence and Machine Learning jobs will grow by 40%.[9] There are over 30,000 job openings in Cyber per year in Maryland. These Cyber jobs are at all levels of responsibility and across all business sectors.[10] CS education promotes prosperity and equity.

There is more than just an economic imperative for this work. We can not overstate the significance of early exposure to CS. Research has shown that introducing CS in the early years

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[5] Zhang, Y., Luo, R., Zhu, Y., & Yin, Y. (2021). Educational robots improve K-12 students' computational thinking and STEM attitudes: Systematic review. *Journal of Educational Computing Research*, *59*(7), 1450-1481.

[6] Garvin, M. (2023). Securing the Future of Maryland: Computer Science for All Annual Report 2022-2023. Maryland Center for Computing Education.

[7] Code.org. (2024). Computing occupations are now the #1 source of new wages in America.

[8] Vegas, E., Hansen, M., & Fowler, B. (2021). Building Skills for Life: How to expand and improve computer science education around the world.

[9] Di Battista, A., Grayling, S., & Hasselaar, E. (2023). Future of Jobs Report 2023. World Economic Forum, Geneva, Switzerland.

[10] Cyber Seek U.S. (2024). Cyber Seek Interactive Map.

has a profound and lasting impact on a student's creative thinking, mathematical skills[11], metacognitive skills, reasoning skills, spatial skills, student achievement[7], executive functioning[12], and literacy[13]. Early childhood CS learning opportunities, especially with robotics, are essential to building the foundational knowledge needed by all students.[14] By providing this foundation, we are setting the stage for lifelong learning.

The post-pandemic landscape has unveiled glaring inequities in education along racial and economic lines. Early access to CS education is essential to combat disparities.[15] [16] By investing in early and comprehensive CS education; we can level the playing field, ensuring that every student, regardless of their background, has access to the skills and knowledge needed to thrive in the 21st-century workforce.

There is also a civic responsibility to provide high-quality CS education. Emerging technologies such as artificial intelligence, cybersecurity, and quantum computing have ethical implications. A firm foundation early on will pave the way for students to apply computing ethically, practice cybersecurity, and be empowered to innovate. An informed citizenry is a must. The current reality is that technology permeates all aspects of society.. Our responsibility is to ensure that all students are literate in technology in the same way that they are literate in reading, writing, and mathematics.

[11] Scherer, R., Siddiq, F., & Sánchez Viveros, B. (2019). The cognitive benefits of learning computer programming: A meta-analysis of transfer effects. *Journal of Educational Psychology*, *111*(5), 764.
[12] Arfé, B., Vardanega, T., Montuori, C., & Lavanga, M. (2019). Coding in primary grades boosts children's executive functions. *Frontiers in psychology*, *10*, 2713.
[13] Strawhacker, A. (2021). Supporting Literacy with Coding.
[14] Simonsmeier, B. A., Kampmann, K., Staub, J., & Scherer, R. (2023). The Effects of Programming Interventions in Early Childhood: A Systematic Review and Meta-Analysis.
[15] Coughlin, S. (2019). Career ambitions 'already limited by age of seven'. BBC News.
[16] Marken, S & Crabtree, A. (2021). U.S. Students' Computer Science Participation Lags Interest. Gallup.