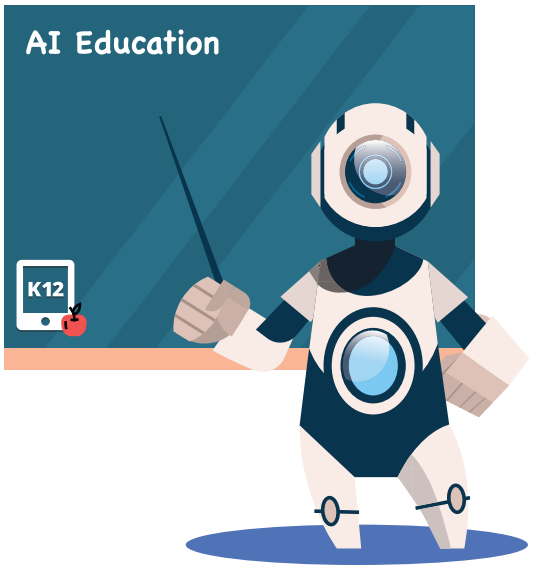

A Year in K–12 AI Education

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■ *The time is ripe to consider what 21st-century digital citizens should know about artificial intelligence (AI). Efforts are under way in the USA, China, and many other countries to promote AI education in kindergarten through high school (K–12). The past year has seen the release of new curricula and online resources for the K–12 audience, and new professional development opportunities for K–12 teachers to learn the basics of AI. This column surveys the current state of K–12 AI education and introduces the work of the AI4K12 Initiative, which is developing national guidelines for AI education in the USA.*

Today's children are growing up with artificial intelligence (AI). By the time children enter kindergarten, they have likely been conversing with Amazon's Alexa for years. AI is a disruptive technology, promising social and economic changes our society needs to wrestle with. As current users of AI and future decision-makers, children must be AI literate to engage in meaningful discourse about its effects. Due to the widespread impacts of AI, we want to foster a diverse population of AI developers. In this context, we need to engage students throughout their education starting as early as kindergarten through high school (K-12) and encourage early consideration of AI-related careers.

There are national efforts under way to make computing a core fixture in K–12 classrooms. While there are national

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standards for K–12 computing instruction developed by the Computer Science Teachers Association, the 2017 version contains only two sentences about AI (CSTA 2017). A growing number of teachers want more guidance in this area, but this is a significant challenge, given that most K–12 educators do not have a background in computer science or AI.

In May 2018, the Association for the Advancement of Artificial Intelligence and the Computer Science Teachers Association launched a joint initiative to develop national guidelines for teaching AI in K–12. The AI4K12 Initiative (AI4K12.org) is a National Science Foundation-funded project led by a four-person steering committee (Touretzky, Gardner-McCune, Martin, and Seehorn 2019). The AI4K12 Working Group is composed of practicing K–12 teachers and AI subject-matter experts. In its first year, the working group published a list of five big ideas in AI that serve as the organizing framework for the guidelines (figure 1). Each big idea is unpacked into a set of concepts and subconcepts that are further expanded for each grade band (K–2, 3–5, 6–8, and 9–12) and then summarized in a progression chart. Completing this progression chart by mid-2020 is currently the major focus of the AI4K12 Working Group. The chief aim of this initiative is to support teachers as they engage students in AI, and to provide guidelines that curriculum developers will choose to align their work with.

There are a number of K–12 curriculum development efforts occurring worldwide in academia, nonprofits, and for-profit companies. Some significant milestones in the last year were from Exploring Computer Science, Microsoft TEALS, ReadyAI, AI4All, the Massachusetts Institute of Technology, and the Finnish Center for Artificial Intelligence. For example, the Massachusetts Institute of Technology recently released an AI + ethics curriculum for middle school students that uses a combination of online and unplugged activities (Payne 2019). The curriculum not only helps students learn about the technical aspects of AI, but also helps them engage with its social and ethical implications. One activity in the curriculum introduces students to machine learning by having them develop a visual classifier using Google's Teachable Machine and then experiment with bias in training. This activity fosters discussion about sources of bias and the ethical implications of technologies. This curriculum has been accessed over 500 times and is being translated into multiple languages by the broader community.

The range of AI topics students are able to explore is closely tied to the availability of developmentally appropriate tools for K–12. Many K–12 AI curricula make use of materials that run the gamut from traditional textbooks to interactive media such as Jupyter notebooks and online courseware and project-based learning opportunities that leverage student-friendly coding platforms such as Scratch, App Inventor, and Snap!. A number of these platforms integrate commercial cognitive services, AI tools, and datasets developed by university or corporate research laboratories to provide user-friendly tools for K–12 students. Cognimates and Machine Learning for Kids combine IBM Watson's AI services with Scratch. Teachable Machine by Google's Creative Lab trains custom visual classifiers. The Massachusetts Institute of Technology's App Inventor leverages the Amazon Alexa Toolkit to provide conversational AI tools for mobile app development. In addition to these hands-on computer-based activities, unplugged activities such as Socratic seminar, team-based paper prototyping, and creative writing exercises also have value for promoting AI literacy.

Given the impact of AI technologies on different industries and society at large, future AI curricula and tools need to incorporate curricular goals of science, mathematics, social studies, humanities, and the arts. To ensure that AI instruction is accessible and developmentally appropriate for all students, curriculum and tool development efforts need to be iterative, collaborative processes that involve active participation among all stakeholders, including developers, teachers, and the students themselves.

Since the launch of AI4K12, we are seeing the growth of a new K–12 AI Education Community consisting of AI researchers, computer science education researchers, K–12 teachers, and curriculum developers. The biggest factor in the growth of the US K–12 teacher community has been the rollout of a teacher professional development course on AI from the International Society for Technology in Education. Joseph South, International Society for Technology in Education's chief learning officer, reports that as of September 2019, over 560 K–12 educators have completed the course. We anticipate similar growth globally as we are aware of parallel efforts to develop capabilities in K–12 AI Education in numerous other countries, including China, Finland, the United Kingdom, Canada, Turkey, Portugal, South Korea, and Argentina. We hope to see continued growth of this community and to leverage the expertise of AI researchers in collaboration with teachers to produce much-needed resources for K–12 AI education.

Looking to become involved in K–12 AI education? Join the AI4K12 mailing list (see AI4K12.org for the subscription link). Develop online tools and demos for making AI concepts accessible to the K–12 audience. Volunteer at your local school to help teachers and students explore AI.

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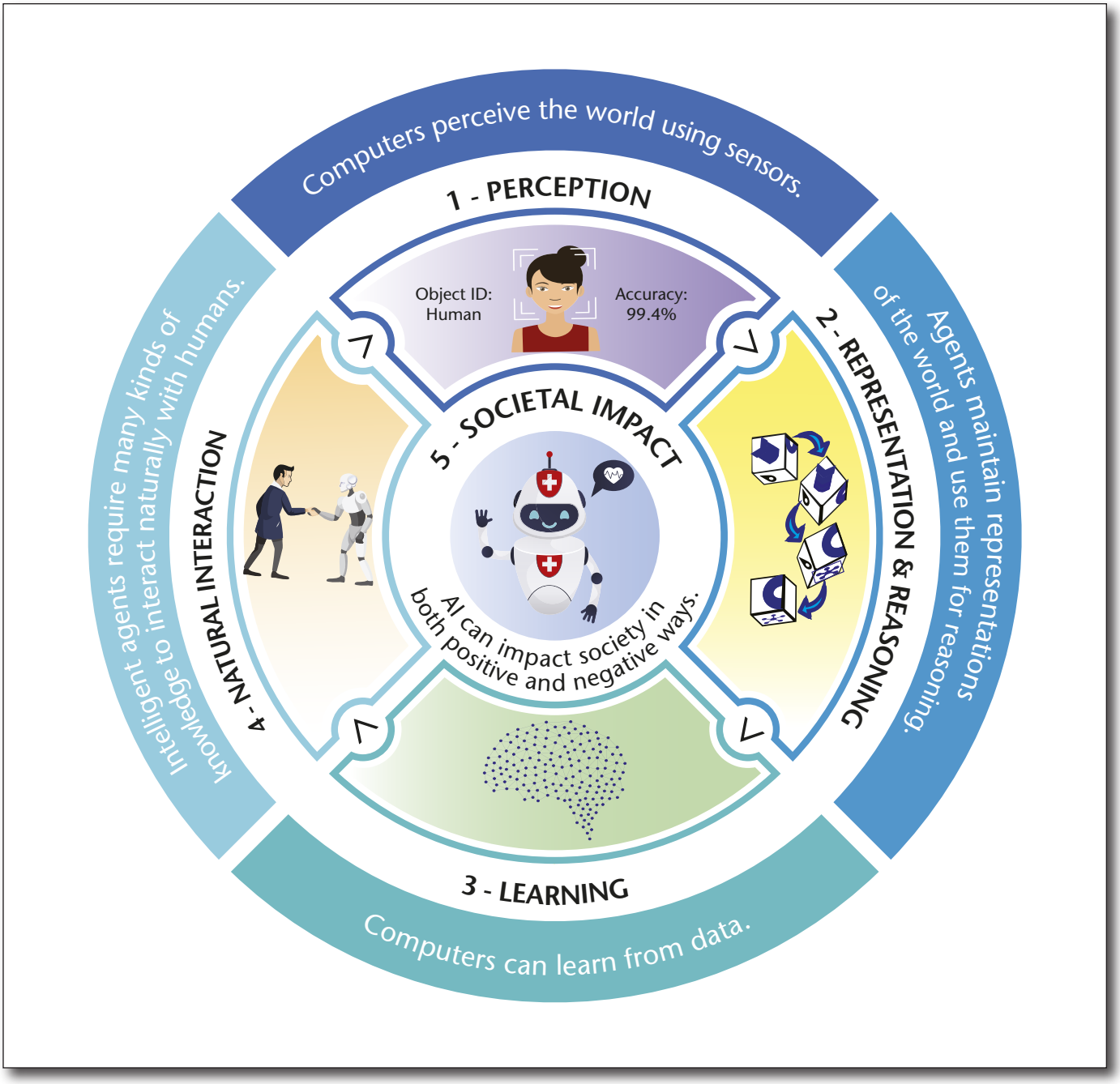

Figure 1. Five Big Ideas in AI.

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