Student Performance Q & A:

2016 Pilot AP® Computer Science Principles Performance Tasks

November 2016

Task: Explore — Impact of Computing Innovations
Percentage of AP Score: 16%

What were students expected to demonstrate in their response to this performance task?

Students are expected to:

- Investigate and analyze a computing innovation that has had or has the potential to have both beneficial and harmful effects on society, economy, or culture. The computing innovation should consume, produce, and/or transform data and raise a data concern.
- Create a computational artifact that represents a computing innovation's purpose, function, or effect.
- Determine and justify, with evidence, beneficial and harmful effects of a computing innovation.
- Analyze the data a computing innovation uses, manipulates, or produces as well as any storage, privacy, or security concerns that is connected to the computing innovation.

What were some computing innovations and computational artifacts students submitted during this pilot year's reading?

- Some computing innovations included, but were not limited to:
  - Google Self-driving Car, Oculus Rift, iPay, Ekso Skeleton, PulsePoint App, Body Camera, Brain Computing Interface.
- Some computational artifact included, but were not limited to:
  - Video, pod cast, video presentation, infographic, animated video, photo collage.

How well did students address the course content related to this question? How well did students perform on the skills required on this question?

- Students were asked to investigate a computing innovation and create a computational artifact to represent its intended purpose, function or effect. With the use of video and video presentations, students were able to create computational artifacts that conveyed a computing innovation's purpose, function, or effect. Some students struggled to convey a computing innovation's purpose, function, or effect when using other mediums.
- Students were asked to identify and describe both a beneficial and harmful effect of a computing innovation. While most students were able to **identify** beneficial effects of a computing innovation, many struggled to fully describe the effect and provide specific evidence tying it to society, economy, or culture. Additionally, many students did not include a harmful effect of a computing innovation.
- Students were asked to identify the data used in a computing innovation and describe how a computing innovation used or transformed this data. Additionally, students were asked to describe in detail a data storage, privacy, or security concern. While most students were able to **identify** the

data being used or stored by a computing innovation, many struggled to describe in detail how a computing innovation used or transformed this data. Students were also able to **identify** a data concern, but many did not connect this concern to a computing innovation.

What common student misconceptions or gaps in knowledge were seen on this question?

Criteria	**Common Misconceptions/Knowledge Gaps**	**Exemplary Answers**
Criteria 1: The computational artifact identifies the **computing innovation** and provides an illustration, representation, or explanation of the computing innovation's intended purpose, function or effect.	• Confusion between technology innovations, such as a car, with computing innovations, such as the computers and sensors used in a self-driving car. **A computing innovation is an innovation that includes a computer or program code as an integral part of its functionality.** • Use of images and videos taken from the Internet to create a computational artifact without providing any acknowledgement that they were not the student's work. This is considered plagiarism, and will result in a score of 0 on the entire performance task.	• High scoring submissions included descriptions of physical computing innovations such as Google glasses, non-physical computing software, such as cell phone applications, and eCommerce, which relies on transactions conducted on the Internet. • All submissions must include acknowledgement of the source or author of any and all information or evidence taken from the work of someone else. Acknowledgements can be done by adding a citation to the computational artifact itself, by adding a credits page to a video, or by including these with the references included in submission requirement 2e.
Criteria 2: States a plausible fact about the **computing innovation's** intended purpose or function.	• Confusion between facts and opinions regarding the computing innovation. • Confusion between conjecture about a possible effect of the computing innovation and facts stated about the actual known effects of a computing innovation.	• Submissions that clearly stated the function of the computing innovation received this point. An example of a fact about a computing innovation is: "Drones are used in the military to fire missiles and other weapons, and are also used to map sea ice in Antarctica, survey damage after natural disasters, and find signs of crop damage." • Submissions that include inline citations learned through investigating the computing innovation received this point. For example, "According to the Association of Unmanned Vehicle Systems International (AUVSI), the cost of a car crash is $576M and 42 lives daily." [3]
Criteria 3: Identifies at least ONE effect of the **computing innovation.**	• Confusion between a direct effect of a computing innovation and an outside influence that might serve to break the innovation. Some examples of harmful effects that wouldn't be considered direct effects of a computing innovation include the cost of a computing innovation (e.g., being too expensive), or the ability of a computing innovation to be hacked.	• High scoring submissions included a clear and detailed analysis of harmful and beneficial effects of a computing innovation including the consequences of using a computing innovation and tying this to society, economy, or culture. These submissions included evidence to support their claims. For example, a submission claiming the benefits to our economy of self-driving cars could support the economic impact by including the following statement,

Criteria	Common Misconceptions/Knowledge Gaps	Exemplary Answers
	• Stating a fact about a computing innovation, without making a claim as to whether it is a beneficial or harmful effect. For example, stating that eCommerce encourages people to shop at home rather than going to a store is not enough to determine whether this is a beneficial or harmful effect.	"According to the Association of Unmanned Vehicle Systems International (AUVSI), the cost of a car crash is $576M and 42 lives daily." [3] Since self-driving cars are designed to obey traffic laws, the response can further explain how the self-driving car avoids these types of fatalities and losses. Therefore, the self-driving car impacts the economy by saving the user from unforeseen financial hardship in the form of car repairs, medical expenses, and legal expenses.
Criteria 4: Identifies a beneficial effect AND a harmful effect of the **computing innovation**. Explains how ONE of the identified effects impacts or has the potential to impact society, economy, or culture.	• Stating a fact about a computing innovation being beneficial or harmful, without explicitly tying this claim to the impact on society, economy, or culture. for example, stating that eCommerce is harmful because it encourages people to shop at home rather than going to a store where they can be more social is not enough to connect the effect to the impact on society.	• High scoring submissions explicitly tied their claim to society, economy, or culture, and support the claims by providing evidence. For example, eCommerce has a negative impact on society by encouraging shoppers to become addicted. This addiction happens because "features that emphasize attractive product stimuli … may make shoppers less attentive to their purchasing behavior by generating a sense of excitement about the product that banishes reasoned self-observation of the damage to one's credit card balance."[2]
Criteria 5: Identifies the data that the **computing innovation** uses. Explains how that data is consumed, produced, OR transformed.	• Neglecting to demonstrate understanding of how a computing innovation uses and transforms data. For example, a submission might identify that a computing innovation stores video, but neglects to explain how this video is being used.	• High scoring submissions identified the type of data being used by a computing innovation, and demonstrated the understanding of how a computing innovation stores and processes this information. Submissions used evidence to support the analysis of how a computing innovation used the data. For example, a submission might identify that a computing innovation stores video of car license plates, and further explains that "the number and letter images on license plates are scanned and matched with on-board, real-time databases" [4] to match current police bulletins for wanted criminals.
Criteria 6: Identifies one storage, privacy, OR security concern. Explains how the concern is related to the **computing innovation**.	• Stating a data privacy concern, such as hacking, without an analysis that connects the concern to a computing innovation and a description of how the obtained data might be used to violate privacy rights.	• High scoring submissions incorporated an analysis of data storage, privacy, or security aspects of a computing innovation. For example, these submissions went beyond stating the data security concern, such as an app meant to help first responders and stores patient information which is protected under HIPAA, and provided the consequence of a security breach, such as patient information being "passed on to a lender who could then deny the patient's application for a home mortgage…". [1]

Criteria	Common Misconceptions/Knowledge Gaps	Exemplary Answers
Criteria 7: Provides inline citations of at least 3 attributed sources within the written response. The citations must be used to justify the response.	• Neglecting to provide inline citations either by using statements such as, "According to…", including the name of a source and/or link, or quoting and putting a numeral to the citation.	• High scoring submissions substantiated their claims with evidence from their research and included at least 3 inline citations from attributed sources.

Based on your experience of student responses at the AP® Reading, what advice would you offer to teachers to help them improve the performance of their students on the exam?

- Criteria 1: The computational artifact identifies the **computing innovation** and provides an illustration, representation or explanation of the computing innovation's intended purpose, function or effect.
    - Students must use a computing tool to create a computational artifact. Some examples of computing tools used in the creation of a computational artifact include, but were not limited to, Screencast-O-Matic, Movie Maker, Word, PhotoShop, cell phone video recording, cell phone audio recordings. Taking a digital picture of a non-computational artifact is not considered computational.
    - After a student uploads their final submission, teachers will be able to review the submission to ensure appropriate acknowledgements of image(s), video, music, written works, and code segment(s) created by someone else and used in the creation of the computational artifact or written responses. Rather than reporting this as plagiarism, teachers will be able to return the submission to the student to add the necessary acknowledgements before submitting to College Board for AP Scoring.
- Criteria 7: Provides inline citations of at least 3 attributed sources within the written response. The citations must be used to justify the response.
    - Students must provide attributions for the sources of information in their written responses. Either by saying, "According to…," including the name of a source and/or link, or quoting and putting a numeral to the citation.

References

[1] "188-Why is the HIPAA privacy rule needed," HHS.gov, 2015. [Online]. Available: http://www.hhs.gov/hipaa/for-professionals/faq/188/why-is-the-privacy-rule-needed/index.html. Accessed: Sep. 8, 2016.

[2] R. LaRose Ph.D., *Journal of Computer-Mediated Communication*, 2001. [Online]. Available: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.116.2169&rep=rep1&type=pdf. Accessed: Sep. 8, 2016.

[3] H. Logic, "Daily impact of self driving cars in the United States - association for unmanned vehicle systems international," in *AUVSI All Things Unmanned*. [Online]. Available: http://www.auvsi.org/auvsiresources/knowledge/dailylossesinaworldwithoutselfdrivingcars. Accessed: Sep. 8, 2016.

[4] D. Matson, "Automatic license plate recognition (ALPR) scanning systems," in *Experienced Criminal Lawyers*, Experienced Criminal Lawyers, 2010. [Online]. Available: http://www.experiencedcriminallawyers.com/articles/automatic-license-plate-recognition-alpr-scanning-systems/. Accessed: Sep. 8, 2016.