



Computer Science Principles

Performance-Based Assessment

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Computer Science Principles is a pilot course and exam under development. It is not an Advanced Placement® (AP) course currently being offered by the College Board. The official AP Computer Science Principles (CSP) course will launch in fall 2016. The first AP CSP exam is scheduled to be administered in May 2017



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The following pages provide updated versions of the performance-based tasks developed as part of the upcoming new Advanced Placement Computer Science Principles (AP CSP) course scheduled to launch in fall 2016. A first set of tasks was piloted in academic year 2012-13 at four high schools and two universities. The CSP project team then developed the following revised versions for piloting in 2013-14 based on explicit feedback from teachers who used the tasks in the classroom, discussions with experts well-versed in high-stakes assessments, and discussions with the CS Education community.

These revised tasks are called "Performance-Based (PB) Tasks" rather than "Portfolio Tasks" as they were called previously. This change better reflects the purpose of the assessment, which is to use student performance on the tasks as part of determining an overall score on the AP assessment. This is not a portfolio in the sense of a student choosing her best work from a collection of work— rather, these items require students to complete specific tasks in three different areas.

Many of the changes in this version of the PB tasks are in place to make clear the requirements and expectations for student work. We have worked to make the instructions clearer, to make it simple to determine what is expected in terms of length and format for each part of the PB tasks, and to facilitate collection of the artifacts and writing that students will do in completing the tasks.

Performance-Based Task - Data

Task

There are two parts to this performance-based task. The first part includes working in a group. The second part is done individually, but is related to the first part.

1. **Collaborative portion:** Working with your group, identify and describe a significant area in which you will collaborate to conduct an investigation to gain insight and knowledge from publicly available data. Develop a set of 3 to 5 questions that will be the focus of the investigation, find one or more large data sets that will allow you to obtain answers to your questions, and then apply computational tools and techniques to answer your questions, e.g., by finding patterns in the data, by transforming or translating the data, or by finding connections between the data and other sources of knowledge.

Produce an artifact and write-up that will allow someone else to understand your investigation, including the area you chose to explore, the set of questions you posed, the data set(s) used to explore the questions, the answers you obtained, and how those answers contributed to the development of insight and knowledge. Your artifact will include non-textual representations of any or all of these components, as appropriate.

2. **Individual portion:** Working on your own, create a document in which you describe your investigation in detail. You must describe the computational tools and techniques you used, explain why you chose them, and justify why they are appropriate for your investigation. The description of your investigation, in terms of tools, techniques, and their use with the data and other sources of knowledge, should be detailed enough that a skilled reader could verify and reproduce your results. This document must make it clear that, without the aid of you partner, you can use the computational tools and techniques described in your collaborative portion to verify the answers obtained collaboratively in your group.

The individual portion will include a section for reflection in which you will describe and analyze the collaborative aspects of the investigation.

Prepare and submit the following

1. A collaboratively developed artifact that communicates a detailed description of your group's investigation, questions, and your collective findings, as described in the *Collaborative Artifact* section. Each member of your group will submit the same artifact.
2. A collaboratively written description of your group's investigation as described in the *Collaborative Write-up* section. Each member of your group will submit the same write-up.

3. An individually written description of how your group achieved its results as described in the *Individual Write-up* section.
4. An individually written reflection on the group investigation as described in the *Reflection* section.

Requirements

- You must work in a group of two on the collaborative part of this task. Groups of three are allowed at the college level or if the number of students in the class is odd. You will collaboratively conduct the investigation: formulating the area to be investigated, developing the questions, finding data set(s) to address those questions, and developing answers to your questions. After conducting your investigation, each group will create an Artifact and Write-up. Your Collaborative Artifact is a detailed way to communicate the results of your investigation. The Collaborative Write-up is a less detailed, though comprehensive summary of the results presented in your Artifact.
- You must work by yourself on the individual part of this task. This individual portion will be created after your collaborative data investigation is complete. Working alone, you will create a write-up that includes a detailed description and justification of the tools and techniques your group used in your investigation. This description must be detailed enough that someone else can understand and recreate your investigation.
- You must use a data set with at least 5000 entries (you may use more than one data set). You must use a publicly available, permanent data set(s) from a credible source that supports a meaningful investigation.
- You must use computing tools and techniques to analyze the data and answer your questions and answering the questions must require such tools and techniques.

Collaborative Artifact

In your collaboratively developed artifact you must include each of the following components.

1. Charts, tables, graphs, visualizations, videos, or other non-textual representations as appropriate to help communicate the details of your investigation. These non-textual representations should augment or otherwise clarify your questions, analysis, and answers, and should be explicitly related to the textual components described below.
2. Textual components that synthesize the details of your investigation with the information communicated in your non-textual representations, explained above. These textual components should include the following:
 - a. An in-depth overview and explanation of your investigation. This should include a review of why your group is interested in your chosen area of investigation,

the questions you chose to answer, why you think the questions you posed are important, and how the questions could help you gain insight and knowledge.

- b. A comprehensive explanation of the data and other sources (if any) used in your investigation. This should include why you chose them as well as why they are appropriate for answering the questions and conducting the investigation. Your explanation should include advantages and limitations of the data and other sources.
- c. A thorough description of the answers to your questions and how the answers help gain insight and knowledge in the area of your investigation.

Collaborative Write-up

In your collaboratively developed write-up, respond directly to each of the following prompts. This write-up is a summary of the results expressed in your artifact.

1. State the area your group chose to explore in this data investigation. Your answer should be approximately 200 to 300 words.
2. Enumerate the set of 3 to 5 questions you sought to answer in your investigation.
3. Identify the permanent data set(s) you used in this project. For each set you must:
 - a. Give the permanent URL.
 - b. Give a brief description of the data set. Each description should be approximately 75 to 100 words.
 - c. Give the date on which you accessed this data set.
 - d. Give a reference from a written work (e.g., an article, book, or blog post) that cites or uses this data set.
4. Clearly present a summary of answers to the questions you investigated. Each answer should be approximately 200 to 300 words.
5. Explain how your questions and answers contribute to the development of insight and knowledge in your chosen area of inquiry. Your explanation should be approximately 200 to 300 words.

Individual Write-up

In your individually developed write-up, respond directly to each of the following prompts.

1. Describe and justify the specific computational tools and techniques your group used in your investigation (e.g., Many Eyes, Excel, Fathom, etc.). Your description should be approximately 250 to 300 words.

2. Explain why your questions are rich enough and your data set(s) are large enough to require the use of computation to analyze the data and answer the questions. Your explanation should be approximately 300 to 400 words.
3. Explain why your group selected the data set(s) used in your investigation. Your explanation should be approximately 250 to 300 words.
4. Provide a detailed description of how your group processed the information in the data set(s) to conduct the investigation and how this enabled you to meet your objective of gaining insight and knowledge. This description should be sufficiently detailed to make it clear that you could conduct the investigation on your own. It should also include sufficient detail such that a reasonably skilled reader could use the tools and techniques and verify the results by replicating the investigation. Your description should be approximately 500 to 700 words.

Reflection

Working on your own, develop a written reflection that addresses the following prompt.

Develop a short essay in which you reflect on the collaborative portion of this performance-based task. Describe the collaborative process you used to create your artifact and your collaborative write-up. Answer the following questions in your essay, keeping your answers at a strategic level rather than an operational level. For example, talk about how you divided the tasks, but not what time and for how long you met with your group. Your answer should be approximately 200 to 300 words.

- a. How did you share or divide the work?
- b. How did you coordinate your efforts?
- c. What worked well and what did not work well in your collaboration?
- d. How did you benefit from working with a partner?

Learning Objectives

The Data Performance-Based Task addresses the following CS Principles Learning Objectives (LOs):

LO 1: The student can use computing tools and techniques to create artifacts.

LO 2: The student can collaborate in the creation of computational artifacts.

LO 4: The student can use computing tools and techniques for creative expression.

LO 10: The student can use models and simulations to raise and answer questions.

LO 11: The student can use computers to process information to gain insight and knowledge.

LO 12: The student can collaborate when processing information to gain insight and knowledge.

LO 13: The student can communicate how computer programs are used to process information to gain insight and knowledge.

LO 14: The student can use computing to facilitate exploration and the discovery of connections in information.

LO 15: The student can use large datasets to explore and discover information and knowledge.

Performance-Based Task - Internet

Task

Identify and describe a *contemporary* social, economic, or cultural issue on which the Internet has considerable influence and impact. The issue should concern a significant population. Then, drawing from two high-quality references that provide context for the issue you chose, create a document describing the social, economic, or cultural contexts; Internet characteristics; cybersecurity concerns; potential beneficial and harmful effects the Internet has on the issue you investigated; and one field other than computing that contributed to or is affected by the issue you investigated.

Prepare and submit the following

A single written document that addresses the task as described above and in the *Requirements* and *Internet Document* sections below. The document should include a sequence of written paragraphs and can include illustrations and non-textual examples.

Requirements

- You must work alone on this performance-based task.
- The issue you investigate should concern a significant population (more than a few hundred people).
- Each of your references must be to a source of information that anyone can use to learn about the issue you investigated. Each reference must be to something written between May 2013 and April 2014.

Internet Document

Respond directly to each of the following prompts.

1. Identify a contemporary social, economic, or cultural issue on which the Internet has significant influence and impact. Your answer should be approximately 100 to 200 words.
2. Describe the population that is affected by the issue and explain why that population is significant. Your answer should be approximately 100 to 200 words.
3. Identify two high-quality references that provide context for the issue you investigated. Each source might be a newspaper article, a book, or an online source, and should conform to the specifications in the *Requirements* section. Provide the full citation for each reference, e.g., author, title, and source. Include the permanent URL when appropriate and the date on which you accessed the reference if the reference is online.

4. Connect each of your references to the issue you investigated. Your description must make explicit connections to your references and have a clear relationship to the issues you investigated. Your answer should be approximately 200 to 300 words.
5. Address the specific characteristics of the Internet relevant to this issue and how the Internet influences and impacts the issue. You may include many characteristics of the Internet, but you must at least select those characteristics from the list below that are *most* relevant to the issue studied and explicitly connect them to the issue.
 - a. Evolving Internet standards and abstractions (e.g., addresses and names)
 - b. Hierarchy and redundancy in the Internet
 - c. Interfaces and protocols of the Internet that enable widespread use
 - d. The trust model of the Internet and its role in cybersecurity
 - e. How cryptography affects cybersecurity.

Your answer should be approximately 300 to 500 words.

6. Identify and describe how one cybersecurity concern is connected to the issue you investigated. Describe the cybersecurity concern and explain how it relates to the issue you investigated. Your answer should be approximately 200 to 300 words.
7. Describe one potentially beneficial effect the Internet has on the issue you investigated. Your answer should be approximately 100 to 200 words.
8. Describe one potentially harmful effect the Internet has on the issue you investigated. Your answer should be approximately 100 to 200 words.
9. Identify one field other than computing that contributed to or is affected by the issue you investigated. Describe how the field contributes to or is changed in some way by the issue you investigated. Your answer should be approximately 200 to 300 words.

Learning Objectives

The Internet Performance-Based Task addresses the following CS Principles Learning Objectives (LOs):

LO 27: The student can explain the abstractions in the Internet and how the Internet functions.

LO 28: The student can explain characteristics of the Internet and the systems built on it.

LO 29: The student can analyze how characteristics of the Internet and systems built on it influence their use.

LO 30: The student can connect the concern of cybersecurity with the Internet and systems built on it.

LO 31: The student can analyze how computing affects communication, interaction, and cognition.

LO 33: The student can connect computing with innovations in other fields.

LO 34: The student can analyze the beneficial and harmful effects of computing.

LO 35: The student can connect computing within economic, social, and cultural contexts.

Performance-Based Task - Programming

Task

There are two parts to this performance-based task. The first part is a group collaboration. The second part is done individually, but is related to the first part.

1. **Collaborative portion:** Collaborate in your group to identify an area of focus in which you will develop programs and then write about the programs. The area of focus and programs should be personally relevant to you. With your group, develop a written description of how your program works, what it does, and the program development process by responding to the prompts listed in the *Collaborative Write-up* section.
2. **Individual portion:** Working on your own and after you have completed the collaborative portion, write another program related to the area of focus you chose collaboratively. Working alone, develop a written description of how this individually written program works, what it does, and the program development process by responding to the prompts in the *Individual Write-up* section. Finally, develop a written reflection about the collaborative program development process by responding to the prompts listed below in the *Reflection* section.

Prepare and submit the following:

1. The program you developed collaboratively with your group. Each member of your group will submit this same program.
2. A collaboratively written description of your group's program as described in the *Collaborative Write-up* section.
3. The program you developed individually.
4. An individually written description of your individual program as described in the *Individual Write-up* section.
5. An individually written reflection on the group programming process as described in the *Reflection* section.

Requirements

- You must work in a group of two on the collaborative portion of this project. Groups of three are allowed at the college level or if there are an odd number of students in the class. Your group will identify an area of focus, collaboratively develop a program within that area, and prepare a collaborative write-up.

- You must work alone on the individual portion of this project. You must write both the program and the associated write-up by yourself, without consulting those in your group. This includes the reflection part of the individual portion.

Programs

You are free to determine the area of focus and the purpose of your programs, but the programs must meet the following requirements:

1. Each program must include the basic programming elements of the language you use, must demonstrate the use of abstraction in the programming language, and must represent significant work.
2. Each program must have an intended purpose that relates to the area of focus; you must describe this purpose in the collaborative write-up.
3. Each program should be reasonably complex in demonstrating both the power of the language and environment you use and the significance of the effort you apply to creating the program.
4. The program you produce individually must be significantly different from the one you write collaboratively and from your partner's individually produced program.
5. The program you write independently does not have to be written in the same programming language as the program that you write collaboratively.

Collaborative Write-up

In your collaborative write-up, respond directly to each of the following prompts.

1. State the area your group chose to explore in this programming project. Your answer should be approximately 75 to 100 words.
2. Describe the purpose of your collaborative program and how it relates to your area of focus. Your answer should be approximately 100 to 200 words.
3. Identify the platform and environment in which you developed and tested your program. Include the programming environment (and which version you used) and the hardware and operating system on which you developed and tested your program.
4. Describe how a user runs and interacts with your program. Provide details that allow a novice user to experience the full functionality of the program. This must include sufficient detail for a novice user to do things like click on buttons or fill in text boxes and in general be able to run your program from beginning to end. Your answer should be approximately 300 to 400 words.

5. Select a part or parts of code in the program that illustrate abstraction. Cut-and-paste your code here (either as text or a screenshot). Your answer should be no more than one page of code.
6. Explain how the code above illustrates the use of abstraction, and explain how the code fits into the overall program you wrote. Your answer should be approximately 200 to 300 words.
7. Explain how your program demonstrates the power of the language and environment used in developing it. Your answer should be approximately 200 to 300 words.
8. Discuss one significant run-time error or bug you encountered while writing the program by answering the following questions. Your answer should be approximately 200 to 300 words.
 - a. What was the error or bug?
 - b. What process did you use to discover it?
 - c. What modifications did you make to the code to fix it?

Individual Write-up

In your individual write-up, respond directly to each of the following prompts.

1. How does your individual program relate to the collaborative program and how is it different? Your answer should be approximately 100 to 200 words.
2. Describe the purpose of your individually developed program and how it relates to your area of focus. Your answer should be approximately 100 to 200 words.
3. Identify the platform and environment in which you developed and tested your program. Include the programming environment (and which version you used) and the hardware and operating system on which you developed and tested your program.
4. Describe how a user runs and interacts with your program. Provide details that allow a novice user to experience the full functionality of the program. This must include sufficient detail for a novice user to do things like click on buttons or fill in text boxes and in general be able to run your program from beginning to end. Your answer should be approximately 300 to 400 words.
5. Select a part or parts of code in the program that illustrate abstraction. Cut-and-paste your code here (either as text or a screenshot). Your answer should be no more than one page of code.
6. Explain how the code above illustrates the use of abstraction, and explain how the code fits into the overall program you wrote. Your answer should be approximately 200 to 300 words.
7. Explain how your program demonstrates the power of the language and environment used in developing it. Your answer should be approximately 200 to 300 words.

8. Discuss one significant run-time error or bug you encountered while writing the program by answering the following questions. Your answer should be approximately 200 to 300 words.
 - a. What was the error or bug?
 - b. What process did you use to discover it?
 - c. What modifications did you make to the code to fix it?

Reflection

Working on your own, develop a written reflection that addresses the following prompt.

Develop a short essay in which you reflect on the collaborative portion of this performance-based task. Describe the collaborative process you used to create your shared program and your collaborative write-up. Answer the following questions in your essay. Keep your answers at a strategic level rather than an operational level. For example, talk about how you divided the tasks, but not what time and for how long you met with each other. Your answer should be approximately 300 to 400 words.

- a. How did you share or divide the work?
- b. How did you coordinate your efforts?
- c. What worked well and what did not work well in your collaboration?
- d. How did you benefit from working with a partner?

Learning Objectives

The Programming Performance-Based Task addresses the following CS Principles Learning Objectives (LOs):

LO 1: The student can use computing tools and techniques to create artifacts.

LO 2: The student can collaborate in the creation of computational artifacts.

LO 3: The student can analyze computational artifacts.

LO 4: The student can use computing tools and techniques for creative expression.

LO 5: The student can use programming as a creative tool.

LO 8: The student can develop an abstraction.

LO 22: The student can use abstraction to manage complexity in programs.

LO 23: The student can evaluate a program for correctness.

LO 24: The student can develop a correct program.

LO 25: The student can collaborate to solve a problem using programming.