# 3- Data

Content Area: **Technology**
Course(s):
Time Period: **Marking Period 2**
Length: **22 blocks**
Status: **Published**

## Course Description & Instructional Notes

**Exam Weighting: 17-22%**

Because essentially everything we do with a computer is being broken down into some form of data, it is important for students to develop a breadth of understanding of how computers handle data and how students can use those same data to solve problems such as raising awareness for a cause, using census data to determine which state will gain seats in the House of Representatives, or using traffic and cost data to determine the ideal location for prom. In this big idea, students will gain a deep understanding of how information is stored on a computer in binary and seamlessly translated into what is seen on the screen or heard through speakers. Students will also learn how data are processed to learn something new.

**Prior Knowledge**

none

**Instructional Notes**

Building Computational Thinking Practices:

On the end-of-course exam, students will be presented with the way data for text or media, such as color, are represented by a computer and will be asked to convert values from binary to decimal or vice versa. The idea that there are number systems other than the decimal system is often new to students. Connecting the foundational principles of how number systems operate to the decimal number system is likely to help students lean on their prior knowledge when asked to work with binary numbers.

Some real-world problems and simulations involve the use of large data sets that cannot be easily analyzed by hand and require a programming solution that manipulates or combines the data with other sources to generate new knowledge and find a solution. When working with large data sets, programmers use data abstraction to write programs that can be flexible enough to handle a change in the number of data entries. Providing students with practice using data sets that are too large to manipulate by hand will motivate them to develop more general solutions and data abstractions. Because the solution is generalized, an explanation of the solution through documentation within the program may be necessary.

Preparing for the AP Exam:

Data compression algorithms are often used to maximize storage space or to transmit data over the Internet, but sometimes at a cost to the quality of the data. Students will need to compare data compression algorithms and determine which one would be best to use in a given situation. Providing students with examples of different compression algorithms along with how each might work may deepen students' understanding. Examples of how data might be restored to their uncompressed state—or may be unable to be restored— may

improve students' ability to distinguish between compression algorithms.

When presented with scenarios that describe data and metadata for analysis on the end-of-course exam, students will be asked to determine what information can be found, as well as a potential programming process that can be used to extract information or modify the existing data. Students might benefit from practice identifying a problem they could solve using data, such as the best route to take to school, gathering the necessary data to analyze—either by using a public data set or developing a survey to gather the data—and then implementing a program that will manipulate the data to find an answer.

**Technology Integration:** Computer Science naturally integrates technology on a daily basis.

## Enduring Understandings

The way a computer represents data internally is different from the way the data are interpreted and displayed for the user.

Programs are used to translate data into a representation more easily understood by people.

Programs can be used to process data, which allows users to discover information and create new knowledge.

## Essential Questions

How can we use 1s and 0s to represent something complex like a video of the marching band playing a song?

How can you predict the attendance at a school event using data gathered from social media?

When is it more appropriate to use a computer to analyze data than to complete the analysis by hand?

## Student Learning Objectives

Students will be able to…

- Explain how data can be represented using bits.
- Explain the consequences of using bits to represent data.
- For binary numbers: Calculate the binary (base 2) equivalent of a positive integer (base 10) and vice versa and compare and order binary numbers.
- Compare data compression algorithms to determine which is best in a particular context.
- Describe what information can be extracted from data.
- Describe what information can be extracted from metadata.

- Identify the challenges associated with processing data.
- Extract information from data using a program.
- Explain how programs can be used to gain insight and knowledge from data.

## Vocabulary & Learning Experiences

**Essential Academic Vocabulary**: binary, bit, byte, abstraction, analog data, sampling techniques, samples, data compression, lossless data compression, lossy data compression, information, metadata, cleaning data, software library, application program interfaces (APIs), simulation, problem, instance of a problem, decision problem, efficiency, optimization problem, reasonable/unreasonable amount of time, heuristic, decidable/undecidable problem

**Planned Learning Experiences**

Look for a pattern

Provide students with a sentence or paragraph of compressed lossless text and a key. Have them look for patterns in their process of retrieving the original text and evaluate whether this is the best compression algorithm to use. Have them write down the patterns they see along with their evaluation and share these in a large group.

Diagramming

Give students a question and a list of data. Have them diagram a process that could be used to answer the question using the data, making sure to include the input(s) of information and the output of the transformed data. Have students include an explanation of how the process represented in their diagram would work to find

the solution.

## Resources

CodeHS
Code.org
MobileCSP
Google Classroom
AP Classroom

## Assessments

**Formative**

Quizzes embedded in CodeHS Modules and Code Review

Draw a Barcode

Students write a program to draw a barcode on the screen given an array that represents the data in the barcode. The array will contain a boolean in it, and if the boolean is `true`, the program will need to draw a vertical line in that position that runs from the top to the bottom of the screen. If not, the program will not draw a line. This program development requires students to use data generated from their bit array and loops and conditionals to determine where lines are drawn and where they are not drawn.

Guess the Passcode

Students first imagine they forgot their 4-digit passcode for their phone, and need to guess the correct passcode. They develop a program to guess passcodes for them to speed up the process. Once the correct passcode has been guessed, the program should print out how many guesses it took to reach the correct one. This activity encourages students to consider security issues which can be expanded to how we create a safer computing culture.

Students discuss the following questions with a partner:

1. How many possible passcodes will you need to guess before you've guessed every possible passcode?

2. Why is this dangerous for the security of your phone?

3. Imagine a hacker had access to your phone and had written a program to guess every possible passcode until they had broken in. What defenses could we build into the phone to keep this guess and check strategy from working? (What happens when you guess incorrectly over and over again?)

4. Can you think of any guessing strategies that might be faster than starting at 0000 and iterating all the way up to 9999?

**Summative**

Data Unit Assessment on CodeHS

Practice PT Secret Image: Steganography

Students use a form of cryptography called steganography to hide a secret image inside of a cover image. They need to develop two functions that create filters, with one encoding and the other decoding. They are required to use a solid degree of abstraction since several functions will be required for each part of the encoding and decoding process. This also continues their consideration and discussions of privacy issues in computing.

Create an Image Filter

In this activity, students work with a partner to develop functions for creating unique mage filters. They share their creative solutions designs with others and incorporate feedback for improvement.

## NJSLS Standards

*NJSLS Standards Copied and Pasted as well as linked.*

**NJSLS Computer Science and Design Thinking**

8.2.12.ITH.1: Analyze a product to determine the impact that economic, political, social, and/or cultural factors have had on its design, including its design constraints.
8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.
8.2.12.ITH.3: Analyze the impact that globalization, social media, and access to open source technologies has had on innovation and on a society's economy, politics, and culture.
8.2.12.NT.1: Explain how different groups can contribute to the overall design of a product.
8.2.12.NT.2: Redesign an existing product to improve form or function.
8.2.12.ETW.1: Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.
8.2.12.ETW.2: Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
8.2.12.ETW.3: Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.

## Additional NJSLS Standards

*NJSLS Standards Copied and Pasted as well as linked.*

***Interdisciplinary Connections***

***NJSLS Career Readiness, Life Literacies, and Key Skills***

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas

9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice

9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving

9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society

9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem

**NJSLS Companion Standards Grades 9-12 (Reading & Writing in Science & Technical Subjects)**

## Modifications/Accommodations

GENERAL CONSIDERATIONS FOR DIVERSE LEARNERS

| English Language Learners | Students Receiving Special Education Services | Advanced Learners |
|---|---|---|
| - Personal glossary | - Small group/One to one | - Use of high level academic vocabulary/texts |
| - Text-to-speech | - Additional time | - Problem-based learning |
| - Extended time | - Review of directions | - Pre assess to condense curriculum |
| - Simplified / verbal instructions | - Student restates information | - Interest-based research |
| - Frequent breaks | - Space for movement or breaks | - Authentic problem-solving |
| WIDA Can Do Descriptors for Grade 9-12 | - Extra visual and verbal cues and prompts | - Homogeneous grouping opportunities |
| WIDA Essential Actions | - Preferential seating | |
| | - Follow a routine/schedule | |
| | - Rest breaks | |

Handbook

FABRIC Paradigm

Wall Township ESL Grading Protocol

- Verbal and visual cues regarding directions and staying on task

- Checklists

- Immediate feedback

Knowledge and Skill Standards in Gifted Education for All Teachers

Pre-K-Grade 12 Gifted Programming Standards

Gifted Programming Glossary of Terms

*Use WIDA Can Do Descriptors in coordination with Student Language Portraits (SLPs).

Students receiving Special Education programming have specific goals and objectives, as well as accommodations and modifications outlined within their Individualized Education Plans (IEP) due to an identified disability and/or diagnosis. In addition to exposure to the general education curriculum, instruction is differentiated based upon the student's needs. The IEP acts as a supplemental curriculum guide inclusive of instructional strategies that support each learner.

Considerations for Special Education Students 6-12

National Center on Universal Design for Learning - About UDL

UDL Checklist

UDL Key Terms

Students with 504 Plan

Teachers are responsible for implementing designated services and strategies identified on a student's 504 Plan.

At Risk Learners / Differentiation Strategies

| | | |
|---|---|---|
| Alternative Assessments | Independent Research & Projects | Jigsaw |
| Choice Boards | Multiple Intelligence Options | Think-Tac-Toe |
| Games and Tournaments | Project-Based Learning | Cubing Activities |
| Group Investigations | Varied Supplemental Activities | Exploration by Interest |
| Learning Contracts | Varied Journal Prompts | Flexible Grouping |
| Leveled Rubrics | Tiered Activities/Assignments | Goal-Setting with Students |
| Literature Circles | Tiered Products | Homework Options |
| Multiple Texts | Graphic Organizers | Open-Ended Activities |
| Personal Agendas | Choice of Activities | Varied Product Choices |

| | | |
|---|---|---|
| Homogeneous Grouping | Mini-Workshops to Reteach or Extend | Stations/Centers |
| | Think-Pair-Share by readiness or interest | Work Alone/Together |
| | Use of Collaboration of Various Activities | |