Unit 4: Digital Media Processing

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Computer Science Principles

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Computer Science Principles, Grades 9-12

Digital Media Processing

Belleville Board of Education

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Unit Overview

Use of a coding environment to programmatically manipulate digital images and audio.

Digitalization, is the process of converting information into a digital (i.e. computer-readable) format, in which the information is organized into bits. The result is the representation of an object, image, sound, document or signal (usually an analog signal) by generating a series of numbers that describe a discrete set of its points or samples. The result is called digital representation or, more specifically, a digital image, for the object, and digital form, for the signal. In modern practice, the digitized data is in the form of binary numbers, which facilitate computer processing and other operations, but, strictly speaking, digitizing simply means the conversion of analog source material into a numerical format; the decimal or any other number system that can be used instead.

Enduring Understanding

- Programs developed for creative expression, to satisfy personal curiosity, or to create new knowledge may have visual, audible, or tactile inputs and outputs.
- A computer program or the results of running a program may be rapidly shared with a large number of users and can have widespread impact on individuals, organizations, and society.
- Advances in computing have generated and increased creativity in other fields.
- Innovations enabled by computing raise legal and ethical concerns.

Essential Questions

- How does abstraction help us in writing programs, creating computational artifacts, and solving problems?
- How can computational models and simulations help generate new understanding and knowledge?
- Why are some languages better than others when used to implement algorithms?

Exit Skills

- Students will be able to use appropriate terminology when describing the size of digital files.
- Identify and compare the size of familiar digital media.
- Explain why the optimal amount of compression is impossible or "hard" to identify.
- Explain factors that make compression challenging.
- Describe the purpose and rationale for lossless compression.
- Explain how images are encoded with pixel data.
- Describe a pixel as an element of a digital image.
- Encode a B&W image in binary representing both the pixel data (intensity) and metadata (width, height).
- Explain why image width and height are metadata for a digital image.
- Use the Pixelation Tool to encode small color images with varying bits-per-pixel settings.
- Explain the color encoding scheme for digital images.
- Determine the benefits of using hexadecimal numbers for representing long streams of bits
- Explain the difference between lossy and lossless compression.
- Explain the relative benefits or drawbacks of different file formats, particularly in terms of how they compress information.
- Explain the difference between open source and licensed software.

New Jersey Student Learning Standards (NJSLS-S)

- 8.2.12.E.1
- 8.2.12.C.2
- 9.3.IT.7
- 9.3.IT.10
- 9.3.IT-PRG.1
- 9.3.ST.2
- 9.3.ST-ET.3
- 9.3.ST-SM.4

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
TECH.8.1.12	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A	Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.2.12	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.A	Technology systems impact every aspect of the world in which we live.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.2.12.A.CS1	The characteristics and scope of technology.

Interdisciplinary Connections

- English
- Math
- Science

Learning Objectives

Procedural Programming:

- Compare and contrast the programming capabilities of a visual programming language with those of a text-based programming language.
- Write programs in a text-based programming language that make use of parameterized methods to invoke specific behaviors.

- Understand the importance of using proper punctuation and syntax when coding in a text-based programming language.
- Use event handlers to respond to mouse and keyboard input.
- Write code using common programming constructs like conditional statements for selection and loops for iteration.

Image Manipulation:

- Examine the structure of images as compositions of pixels.
- Explore methods of representing color, including the various colors that can be produced by the combination of different ratios of red, green, and blue light.
- Modify the color channels of pixels in an image to produce a variety of effects.
- Design algorithms for modifying the pixels in an image in prescribed ways to create custom image filters.
- Explore encoding schemes of common image file formats.

Audio Manipulation:

- Analyze the differences between analog and digital sound.
- Investigate the roles that sampling rate and bit depth play in determining the quality of digitized sound.
- Explore methods of programmatically generating digital audio as well as altering and modifying digital audio by adjusting volume, pitch, and sampling rate.
- Evaluate the effects of compression algorithms in reducing the amount of data needed to represent an audio sample.

Global Impact:

- Evaluate the positive and negative consequences of digitally altering images.
- Discuss the ethics of digitally manipulating images.
- Discuss the issues related to intellectual property.
- Explore the limitations and rights associated with a number of common licenses, including Creative Commons.

Suggested Activities & Best Practices

In this project based learning unit students will learn on the Edhesive simulator that:

Students will use various problem solving strategies to collect input, store information, and generate outputs.

Students will learn to read and write information to data files.

This unit also investigates various ethical issues arising in computer science.

Students will also explore and learn how to create arrays, and how to write programs that declare, initialize, modify and access these arrays.

Students will write algorithms with nested structures, and sub-programs, and algorithms that perform simple data management tasks.

Evidence of Student Learning - Checking for Understanding (CFU)

Minor exercises and short formative assessments addressing specific unit topics and objectives
Formally assessed, multiple-choice test addressing unit objectives (single- and multiple- select questions) in preparation for advanced placement exam
Rubric-assessed, individual and/or collaborative unit project demonstrating mastery of unit objectives

Some of the **Evidence of Student Learning with Checking for Understanding (CFU)** techniques used during the lesson and/or for Closure (Madeline Hunter), listed below.

- Admit Tickets
- Anticipation Guide
- Common benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite

- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit tests

Primary Resources & Materials

Edhesive online computer science simulater, Code.Org website.

Ancillary Resources

General Resources:

- Computers and Internet Access
- AP Central at Collegeboard.org
- Massive Open Online Course
- Code.org
- Multimedia Applications Tools
- Abelson, H., Ledeen, K., and Lewis, H. R. Blown to Bits: your life, liberty, and happiness after the digital explosion. Upper Saddle River, N.J.: Addison-Wesley, 2008.

AP Approved Programming Resources:

(may choose one or more)

- Alice - This 3-D modeling environment allows students to create and animate 3-D worlds. This environment lends itself well to creating stories and games.
- App Inventor - This open-source Web application allows students to create their own applications on mobile devices. App Lab - This is a programming environment for creating web applications with JavaScript. It allows students to develop programs and toggle back and forth between block-based and text-based programming modes.
- EarSketch - This browser-based application allows students to create their own music using either JavaScript or Python. Greenfoot - This Java IDE is designed for use in education to create two-dimensional graphic applications, such as simulations and interactive games.
- Java - There are several IDEs that can be used to write in Java. The Java language allows students to create and solve problems that vary widely in difficulty.
- JavaScript - This language is commonly used to create interactive effects within Web browsers.

- Lego Mindstorms NXT - This product integrates programming with Lego bricks and sensors to create and program robots. The instructions are assembled by linking together function blocks.
- Processing - This programming language was initially created to serve as a software sketchbook, and it can be used to teach programming using a visual context.
- Python - This language has the benefit of readability that might be helpful to new programmers.
- Scratch - This blocks-based programming language allows students to build scripts to run animations. This product can be downloaded and installed on a computer or run in the browser.
- Snap! - This Scratch-style programming language is block-based and allows users to define new primitives in JavaScript. Users can read and write information from the Internet using server-defined APIs and make mobile applications.
- Swift - This programming language is designed for use with iOS, OS X, tvOS and watchOS. This environment allows students to create their own Apple apps and includes interactive environments that allow students to see the effects of changes or additions to code as they type.

Design and Development Process:

- "What Is the Software Development Life Cycle?" Official Blog Airbrake Bug Tracker. https://airbrake.io/blog/insight/what-is-the-software-development-life-cycle
- "Engineering Design Process." https://www.teachengineering.org/ engrdesignprocess.php
- "The Engineering Design Process." http://www.eie.org/overview/engineeringdesign-process Mohammed, Nabil, Ali Munassar, and A. Govardhan.
- "A Comparison Between Five Models of Software Engineering." IJCSI International Journal of Computer Science 7.5 (2010): 94-101.
- Open Source:
- "What Is Open Source?" Opensource.com. https://opensource.com/resources/whatopen-source
- Open Source Initiative. http://opensource.org/

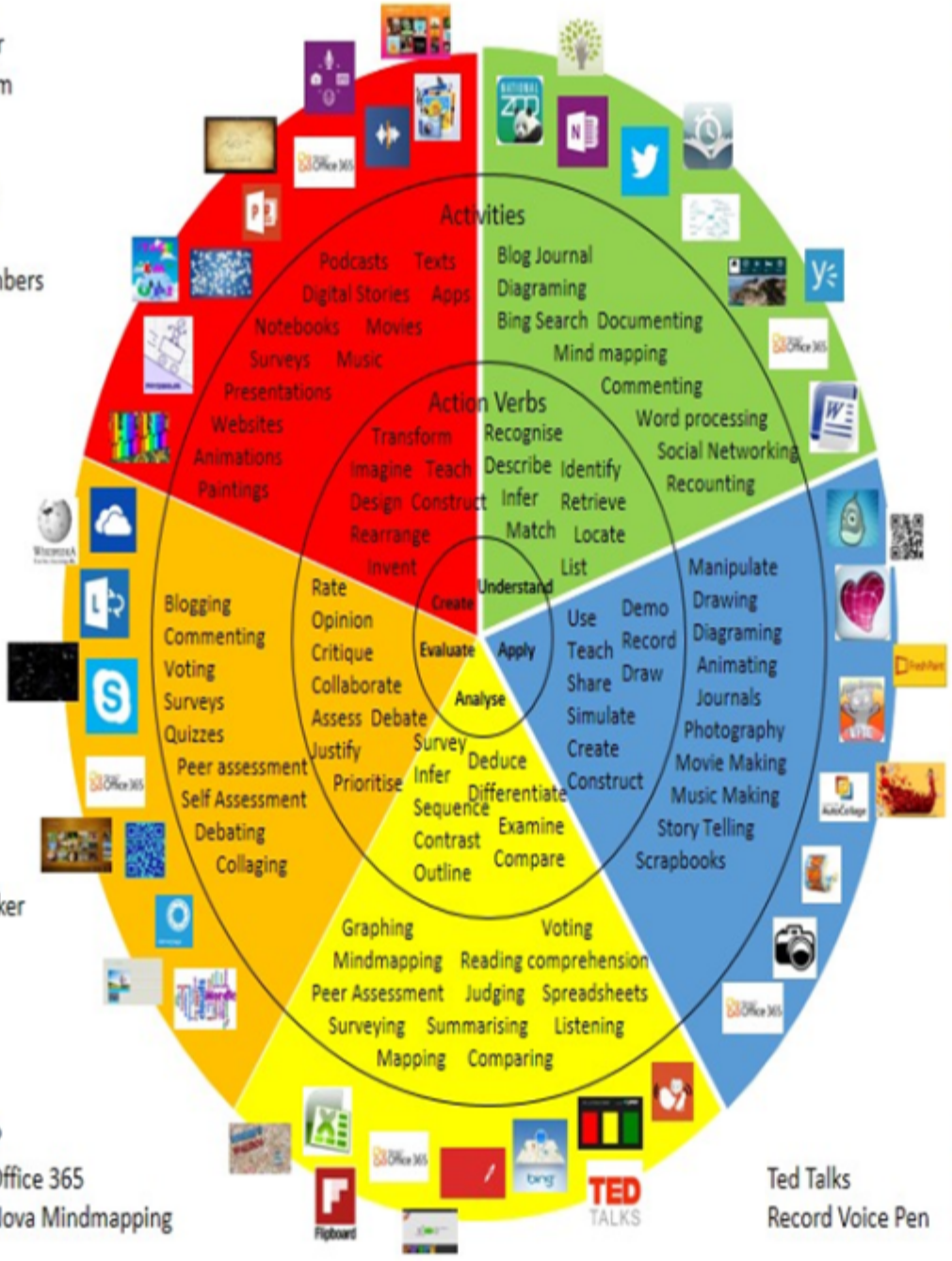
Technology Infusion

Technology Infusion and/or strategies are integrated into this unit to enhance learning, please the the below list for some of the strategies used.

Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker



Where's Waldo?
MS Excel
Flipboard
Office 365
Nova Mindmapping

Ted Talks
Record Voice Pen

Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

Alignment to 21st Century Skills & Technology

21st Century Skills & Technology skills that could be included in this unit are:

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

21st Century Skills/Interdisciplinary Themes

21st Century/Interdisciplinary Themes that could be incorporated into this unit.

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

21st Century Skills

21st Century Skills that could be incorporated into this unit.

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

Differentiation

Some of the **Differentiation** that will be employed in this unit as seen below.

Differentiations:

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning

- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

Intervention Strategies

Some of the Intervention Strategies that will be employed in this unit, are identified below.

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test

- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Special Education Learning

Some of the **Special Education Learning** adaptations that will be employed in this unit, are identified below.

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multiple test sessions
- multi-sensory presentation
- preferential seating
- preview of content, concepts, and vocabulary
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

Some of the **English Language Learning** adaptations that will be employed in this unit, are identified below.

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

Sample Lesson