### **Binary Data**

### **Duration: 2 Weeks**

### **Summary**

This lesson explains how data used in computing is represented in binary. It introduces terminology such as *bit* and *byte*. It also introduces an aspect of *abstraction*, and how computing uses abstraction to represent data on computing devices. The reading summarizes how data is represented in binary and how the principle of abstraction is used. The video lectures first introduce binary data and the vocabulary, then cover how binary represents numbers (base 2 and base 16), text (ASCII and unicode), images (bitmap), and sound (WAV). A lecture then explains compressed file formats such as JPEG and MP3. Finally a video lecture demonstrates the use of a hex editor to look at the bytes of standard file formats such as .jpg, .docx, and others. The assignment has the students perform binary to decimal conversions using a fun binary game on the web, has them write some binary for text and for the pixels of an image, and has them write about how abstraction is used in representing data for computing.

### **Learning Objectives**

* Explain how binary sequences (e.g. bytes) are used to represent digital data (decimal numbers, text, images, sound, video, programs). [AP CSP P5, 2.1.2]
* Convert among binary and decimal number systems.
* Describe the combination of abstractions used to represent data including how bits are grouped to form digital data. [AP CSP P3, LO 2.1.1]
* Explain how the interpretation of a binary sequence in a device depends on how it is used (e.g. the same byte can be a sound when played to a speaker, or a number in a calculation).

### **Course Material**

* Read: [Data Representation for Computing](http://computing-concepts.cs.uri.edu/index.php/Data_Representation_For_Computing)
* Watch: [Digital Data](https://www.youtube.com/watch?v=GSnAeP4EIdQ&feature=youtu.be) [10:56]
  + [Slide PDF](http://homepage.cs.uri.edu/~thenry/csc414/04a_Digital_Data_TOC.pdf)
* Watch: [Numeric Data](https://www.youtube.com/watch?v=Tx1JakLuRfo&feature=youtu.be) [11:41]
  + [Slide PDF](http://homepage.cs.uri.edu/~thenry/csc414/04b_Numeric_Data_TOC.pdf)
* Watch: [Character Data and Programs](https://www.youtube.com/watch?v=z_fNRTRRJ8Q&feature=youtu.be) [10:26]
  + [Slide PDF](http://homepage.cs.uri.edu/~thenry/csc414/04c_Character_Data_TOC.pdf)
* Watch: [Raw Media (image, video, and sound data)](https://www.youtube.com/watch?v=_J6xdrYM9FU&feature=youtu.be) [12:43]
  + [Slide PDF](http://homepage.cs.uri.edu/~thenry/csc414/04d_Raw_Media_TOC.pdf)
* Watch: [Computer Science Concept: Abstraction](https://www.youtube.com/watch?v=0w_rla7GodI) [1:11]

### **In Class**

* Optional: [Binary Numbers Unplugged](http://csunplugged.org/binary-numbers/)

### **Assessments**

* Conceptual Quiz:
  + [Binary Data](https://docs.google.com/document/d/1FxD87-msaxlj5T8aIs2a1MKXIPetW12izbiO7byhZj8/edit?usp=sharing) (requires access)
* Practical Assignment:
  + [Binary Assignment](https://drive.google.com/open?id=1iH02A3CYeryuNLQgMzX4_Si9vrdLcZHVqhINaQFL7oU) | [Grading Rubric](https://drive.google.com/open?id=1_NtDH8JW17EmBuvN17cpSfK8cbtEcofigs-5VmQRTcM)