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**06 – Non-Numeric Data**

**Activities**

COMP256 – Computing Abstractions

Dickinson College

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**Name:**

**Introduction:**

Today’s class introduced the idea of using unsigned integer values to represent other types of data including characters and colors. The activities that follow give you some more experience and practice with these representations and moving between them. In addition, you will gain exposure to a few other common representations.

**ASCII Character Encoding:**

🔑 1. Find an ASCII table on-line. The tables come in many forms, so you’ll want to be sure you find one that you are able to read correctly. You can do that by reviewing the examples from class and checking that you get the same results using your table. Use the table that you found to answer the following questions:

a. What is the URL of the ASCII table that you are using?

b. Give the decimal values of the ASCII codes for the characters in the string: “Comp-256”

c. Decode the following sequence of decimal ASCII codes into a string of characters:

68 105 99 107 105 110 115 111 110 32 49 55 56 51

🏆 2. If you look at the ASCII table you will see that the characters that we are used to seeing on a keyboard begin at ASCII code 32 (space) and continue up through 127 (delete).

a. The first 32 ASCII codes (0 – 31) are special characters reserved for other purposes. Explain in a sentence or two of your own words what is the overall purpose of the first 32 special ASCII characters is? Use your favorite search engine and read a few pages to help you answer this question. **Finally, provide the URL(s) of the page(s) that you used in formulating your answer.**

b. Research a few of these first 32 ASCII characters. Pick one of these special characters for which its purpose makes sense to you. For that one character, give its decimal ASCII character code, the symbol associated with that code (e.g. STX) and describe in a sentence or two of your own words what it was used for. **Finally, provide the URL(s) of the page(s) that you used in formulating your answer.**

🏆 3. Before ASCII each computer manufacturer had their own encoding for assigning unsigned binary values to characters. IBM defined the EBCDIC (Enhanced Binary Coded Decimal Interchange Code) for use on its mainframe computers. EBCDIC works a lot like the ASCII encoding that you have been working with, but the codes are different. Find an EBCDIC table on-line that makes sense to you. Then use that table to answer the following questions:

a. What is the URL of the EBCDIC table that you are using?

b. Decode the following sequence of EBCDIC codes into a string of characters:

196 137 131 146 137 149 162 150 149

**Hexadecimal Values and Binary Strings:**

Hexadecimal (hex or base 16) values provide a compact and convenient way to represent binary strings with each hex “digit” corresponding to a nibble in binary. You’ll get a little practice converting between these representations in this section.

🔑 4. Give the binary string represented by the hex value: 0x3C7D

🔑 5. Express the following binary string as a hex value:

1110 0101 1101 0110 1010 1001

**Unicode Character Encoding:**

🏆 6. To learn more about Unicode, its importance and the group that manages it watch the video *The Unicode Consortium Overview* and use its contents to answer the questions below.

* <https://www.youtube.com/watch?v=-n2nlPHEMG8> (5:50)

a. In a few sentences of your own words, describe the problem that UNICODE was designed to solve.

b. How many languages are covered by the Unicode standards?

c. Why were Emoji’s added to Unicode?

🔑 7. Use the Unicode Table: <https://unicode-table.com/> to answer the following questions:

a. What character has the code point U+2836?

b. What is the code point for the Myanmar letter ‘shan tha’ (ႀ)

🔑 8. Use the Emojipedia (<https://emojipedia.org/>) to find your favorite emoji and answer the following questions:

a. Paste your favorite emoji here:

b. What is the official name of your favorite emoji?

c. What is the Unicode code point for your favorite emoji?

**Colors and Color Models:**

There are a variety of different color models that are used in computer graphics applications. This section will have you experiment with a few of them and emphasizes that they are all able to represent essentially the same colors, just using different encodings.

🔑 9. The following binary string is the representation of a color in the RGB color model:

0101 1100 0111 1011 0010 1100

a. What is the hex representation of this color?

b. What are the decimal values for the Red, Green and Blue components of this color?

Red = Green = Blue =

c. What color is represented by the values in parts a and b? To find out, use an on-line RGB converter to find out. Paste a small screen shot of the color here.

d. RGB is not the only color model that is used to encode colors. The CMYK (cyan, magenta, yellow, black) color model is another. Find a CMYK color chooser on-line and produce a color that is very similar to the one in b. Paste a screen shot of the CMYK color chooser here showing the color and the C, M, Y and K values you used.

e. HSB (Hue, Saturation and Brightness) is another commonly used color model. Repeat part d using the HSB color model.

🔑 10. In computer graphics the term *color depth* refers to the number of bits used to represent colors in the images being displayed. For example, in the previous question the color depth was 24 bits (8 bits for Red, 8 bits for Green and 8 bits for Blue).

a. If the color depth is 6 bits (2 bits for R, 2 bits for G and 2 bits for B), how many different colors could be displayed? Give you answer both as a whole integer and as a power of two. Hint: How many different patterns of 1’s and 0’s can be formed with 6 bits? This is the same as asking how many rows there would be in a truth table with 6 inputs?

b. The term *Hi-color* was used to describe the first computers to display rich color images. They used a color depth of 15 bits with 5 bits for each of Red, Green and Blue. How many different colors could a Hi-color system display? Give you answer both as a whole integer and as a power of two.

c. Most current graphics systems are called *True Color* and have a 24-bit color depth. How many different colors can a True Color system display? Give you answer both as a whole integer and as a power of two.

🔑 11. Explain in a few sentences of your own words how the colors we see and use in our computers are an abstraction. Be sure to identify what information is relevant (i.e. visible to someone using a color) and what information is being ignored (i.e. hidden from someone using a color). Be as specific as you can based on the activities above.

**Moving Between Representations:**

Recall from the prior class that binary strings do not have meaning on their own. That is, we cannot not know what a binary string means unless we are told what representation to use to interpret it. The same can be said about a hex value when it is used to represent a binary string. The questions in this section play around with that idea a little bit by having you interpret values using different representations. Feel free to use on-line converters or calculators to do the unsigned binary to decimal conversions in this section.

🔑 12. In question #9 you considered the following binary string.

0101 1100 0111 1011 0010 1100

In that question you were told that it represented a color in the RGB color model, and thus you were able to interpret it as a color. This same string, in other contexts could have different meanings.

a. If the binary string above is interpreted using ASCII, what character string does it encode?

b. If the binary string above is interpreted using unsigned binary, what base 10 value does it encode?

🏆 13. What color do you get if you interpret your favorite emoji using the RGB color model? Give the following as your answer:

* The hex value for the code point of your favorite emoji.
* A screen shot showing an RGB color chooser that shows:
  + The values for the Red, Green and Blue components of the color.
  + The color in an RGB color chooser here.

🏆 14. Hexadecimal, in addition to being a convenient way to represent binary strings, is a standard base 16 number system with the 16 “digits” 0…9 and A…F. Thus, it is possible to convert back and forth directly between unsigned whole numbers (0 and positive) in base 10 and hexadecimal (base 16). The processes are analogous to what we used in the last assignment to convert back and forth between unsigned base 10 and binary (base 2). The following questions ask you to apply that process to hexadecimal values.

a. Convert the hexadecimal value 0xAF2B directly to base 10 assuming we are using unsigned binary representation. Do not convert the hex to binary first. Show your work in a format similar to what we did in the prior class. There are lots of decimal to hex converters on-line you can use to check your results. But note that **correct answers showing insufficient work will not receive full credit.**

b. Convert the decimal number 17210 directly to a two-digit hex value assuming we are using unsigned binary representation. Do not convert the decimal to binary first. Show your work in a format similar to what we did in the prior class. There are lots of decimal to hex converters on-line you can use to check your results. But note that **correct answers showing insufficient work will not receive full credit.**

🏆 15. Watch the short clip below from the 1999 thriller and smash hit movie “The Sixth Sense:

* <https://www.youtube.com/watch?v=ZSNyiSetZ8Y> (0:36)

When the boy tells his secret, how many people does he see? Briefly explain your answer. Hint: This is kind of a geeky CS joke and is related to the previous question!

Optional: To help me improve and scope these activities for future semesters please consider providing the following feedback.

a. Approximately how much time did you spend on this activity outside of class time?

b. Please comment on any particular challenges you faced in completing this activity.