### 1. Representing Venn Diagrams as Binary Numbers…

a) In our last class we let **U** be the universe of all RSGC students, the set **A** stand for the set of all Grade 5 students and **B** be set of students that like *Brussels sprouts*. A really simple way to create a binary number from a Venn Diagram is to let **1** stand for whether someone is in the set and **0** if they are not in the set. Using this strategy the diagram from Question 2 in our previous worksheet can be coded in Binary shown below.

|  |  |
| --- | --- |
| **Venn Diagram of Two Sets** | **Binary Representation of Venn Diagram** |
|  | |  |  | | --- | --- | | **Base 10** | **A B** | | **0** | **0 0** | | **1** | **0 1** | | **2** | **1 0** | | **3** | **1 1** | |

b) In this next exercise you are asked to extend your understanding of the previous question to include **three** sets.

You might start by filling in the counting sequence of binary numbers in the **second** column of the table below right, before filling in the equivalent base 10 (decimal) number in the **first** column.

Finally, use your understanding of the previous question to place the correct decimal number in the appropriate coloured region in the Venn Diagram.

|  |  |
| --- | --- |
| **Venn Diagram of Three Sets** | **Binary Representation of Venn Diagram** |
|  | |  |  | | --- | --- | | **Base 10** | **A B C** | | **0** | **0 0 0** | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |

**Reference**: <https://github.com/lawrancej/COMP278-2014/blob/master/lectures/lecture3.adoc>

### 2. Double Dabble I: Convert Binary to Decimal

Convert 101101012 to decimal using the *double dabble* algorithm (show evaluation)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **3. Complete the table of Gray Codes**   |  |  | | --- | --- | | **Binary BCD** | **Gray Code** | | 0000 | 0000 | | 0001 |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | | 1111 |  | | **4. Convert Binary to Gray Code (show work).**  1001101112 |
| **5. Convert Gray Code to Binary (show work)**  100110111g |

### 6. Double Dabble II: Convert 8-bit Binary to 3-byte Packed BCD

**Reference:** <https://en.wikipedia.org/wiki/Double_dabble>

Convert 101101012 to 3-bit packed BCD using the *double dabble* algorithm (show evaluation)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **BCD** | | | **Original** | **Comment** |
| **Hundreds** | **Tens** | **Ones** |  |  |
| 0000 | 0000 | 0000 | 111100112 | Initialization |
| 0000 | 0000 | 0001 | 111001102 | Shift |
| 0000 | 0000 | 0011 | 110011002 | Shift |
| 0000 | 0000 | 0111 | 100110002 | Shift |
| 0000 | 0000 | 1010 | 100110002 | Add 3 |
| 0000 | 0001 | 0101 | 001100002 | Shift |
| 0000 | 0001 | 1000 | 001100002 | Add 3 |
| 0000 | 0011 | 0000 | 011000002 | Shift |
| 0000 | 0110 | 0000 | 110000002 | Shift |
| 0000 | 1001 | 0000 | 110000002 | Add 3 |
| 0001 | 0010 | 0001 | 100000002 | Shift |
| **0010** | **0100** | **0011** | **000000002** | **Shift** |
| **2** | **4** | **3** |  |  |