Group A2

Research Report I

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Definitions

- **Vertex:**

  A vertex is a special point of a mathematical object, and usually a location where two or more lines or edges meet

- **Graph Edge:**

  For an *undirected graph*, an unordered pair of nodes that specify a line joining these two nodes are said to form an edge. For *directed graph*, the edge is an ordered pair of nodes

- **Directed graph:**

  A graph in which each graph edge is replaced by a directed graph edge

- **Graph–Walk:**

  A walk is a sequence v_0 ,e_1,v_1..... v_k of graph vertices v_i and graph edges e_i such that for $1 \le i \le k$, the edge e_i has endpoints v_{i-1} and v_i.

- **Graph–Trail:**

  A trail is a walk v_0 ,e_1,v_1..... v_k with no repeated edges. The length of a trail is its number of edges.

- **Graph–Circuit:**

  A *closed trail* is called a circuit when it is specified in cyclic order but no first vertex is explicitly identified.

- **Euler Trail:**

  A trail is called an Euler trail if it includes each edge of the graph exactly once.

- **Euler Circuit:**

  A closed *Euler trail* is called an Euler circuit.

- **Euler Graph:**

  A graph which has an *Euler circuit* is called an Euler graph.

Provided Question To Solve

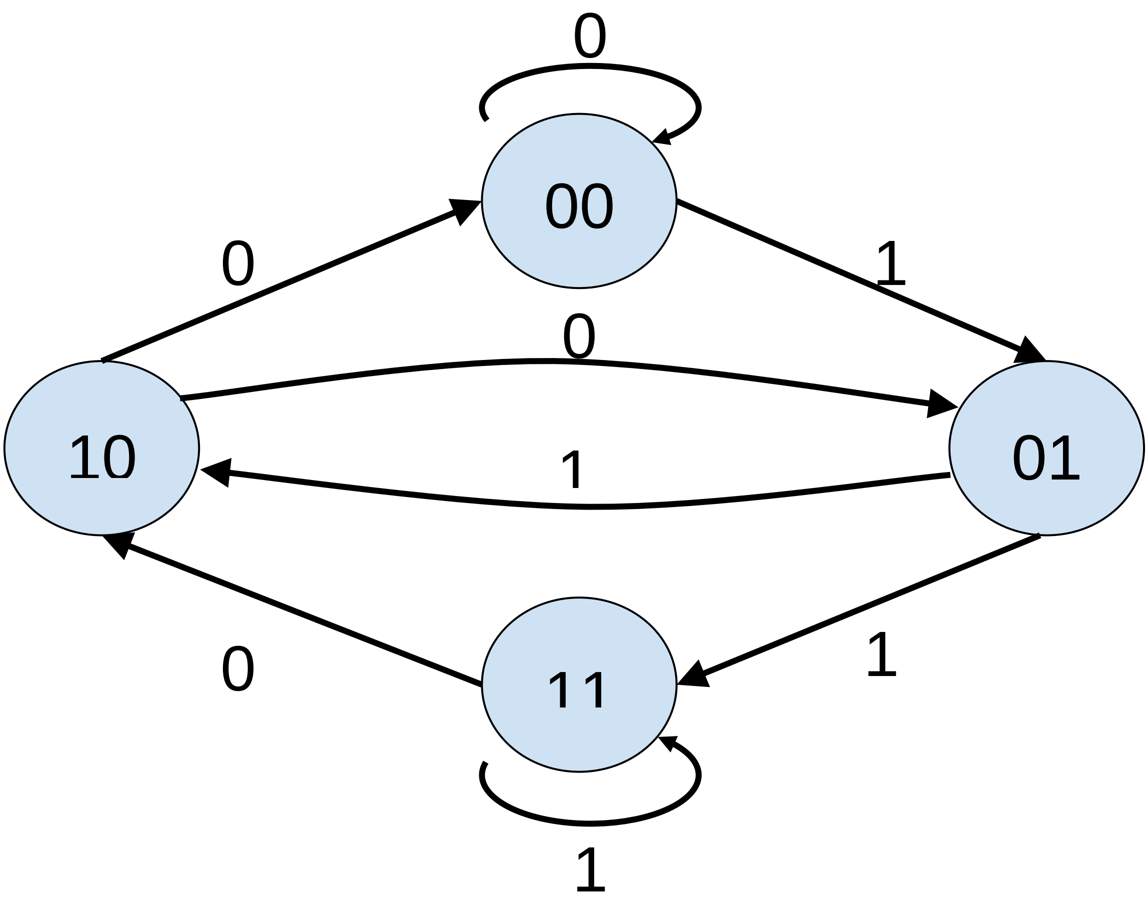
Create a sequence of 1s and 0s such that when the digits are arranged in a cycle, each possible binary triple appears exactly once in the cycle.

(Hint: how many digits would be in the sequence? If you were to try and represent the problem graphically, what parts of a binary triple might be represented by the vertices or arcs of the graph? What graph theoretical idea might relate to appearing exactly once?)

Answer For The Provided Questions

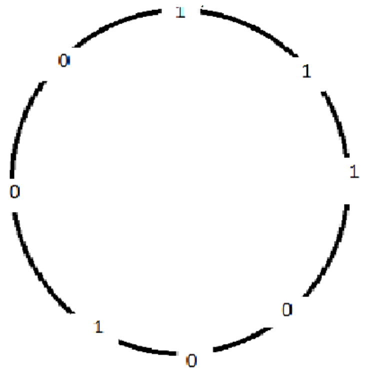
There are 8 possible binary triples:000,001,010,011,100,101,110,111.

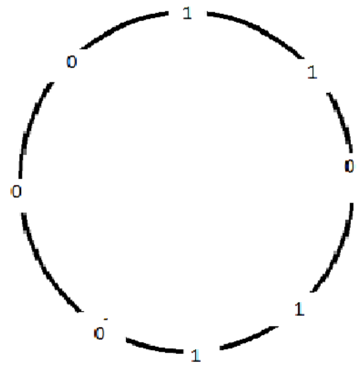
To arrange them in a cycle we must have 8 ones or zeros in the cycle. Consider the graph below. It is a graph with four vertices, each labeled with one of the possible pairs of binary digits. Imagine that each vertex represents the last two digits of the pattern so far. The arrows are weighted by either 0 or 1 (the two possible values) values that can be added to the pattern as the next digit of the pattern.



To achieve every possible three-digit combination, we need to traverse the graph with an Eulerian cycle. There are two possible orders of digits to represent this cycle.

- 01110010
- 01101100

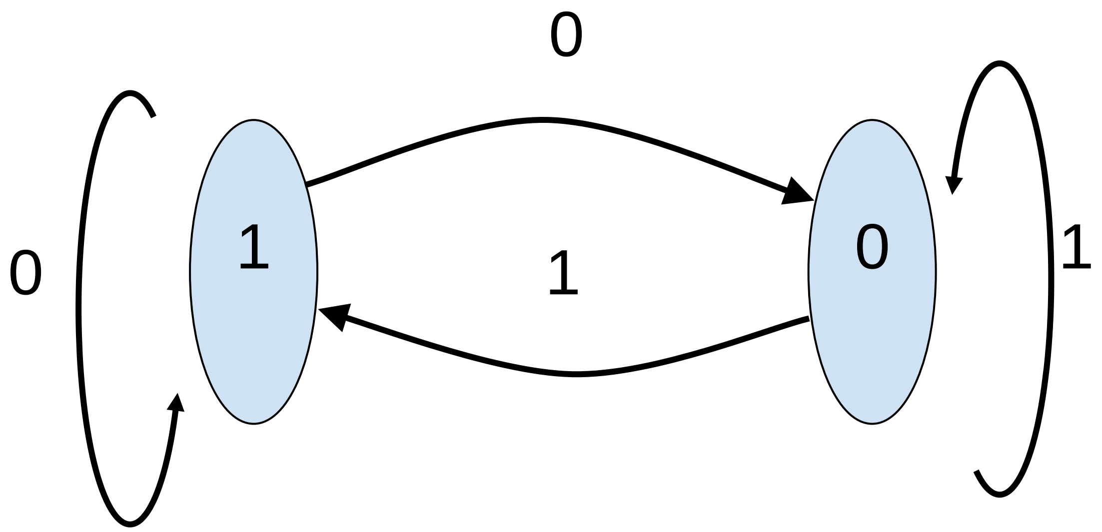




We can get all the binary triples without repeating them in a cycle like this.

Problems With Answers (Related to Graph Theory)

1. **How all the possible binary doubles can be shown in a cycle without repeating the same one? Show it in a graph?**



2. **How many way are there to represent the order of the previous question?**

   One way only

3. **Will it be possible to solve for four digit numbers in the same way of the graph representation. True or False?**

   True. There will be eight vertices instead of four (000,001,010,011,100,101,110,111).

List Of References

1. WolframMathWorld(2017, Jan 26). Vertex [Online]. Available: http://mathworld.wolfram.com/Vertex.html

2. WolframMathWorld(2017, Jan 26). Graph - Edge [Online]. Available: http://mathworld.wolfram.com/GraphEdge.html

3. WolframMathWorld(2017, Jan 26). Graph - Edge [Online]. Available: http://mathworld.wolfram.com/DirectedGraph.html

4. WolframMathWorld(2017, Jan 26). Graph - Trail [Online]. Available: http://mathworld.wolfram.com/Trail.html

5. WolframMathWorld(2017, Jan 22). Graph - Walk [Online]. Available: http://mathworld.wolfram.com/Walk.html

6. WolframMathWorld(2017, Jan 22). Graph - Circuit [Online]. Available: http://mathworld.wolfram.com/Circuit.html

Additional Bibliography List

1. WolframMathWorld(2017, Jan 21). Euler Graph[Online]. Available: http://mathworld.wolfram.com/EulerGraph.html