CSE232 Assignment 4

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1. $a = 6, b = 2, c = 3$. So, $6|(2 * 3), 6 \nmid 2, 6 \nmid 3$.

2. Because 7 and 123 are coprime, we have by Euler's Theorem:
   $\phi(7) = 6$ and $123^{456} \equiv 123^{456 \mod \phi(7)} \pmod 7$.
   So, $123^{456} \equiv 123^{456 \mod 6} \equiv 123^0 \equiv 1 \pmod 7$.

3. It's sufficient to check for 6 congruent clasess.
   For $n \equiv 0, 0^2 \mod 6 \equiv 0 \neq 2. \pmod 6$
   For $n \equiv 1, 1^2 \mod 6 \equiv 1 \neq 2. \pmod 6$
   For $n \equiv 2, 2^2 \mod 6 \equiv 4 \neq 2. \pmod 6$
   For $n \equiv 3, 3^2 \mod 6 \equiv 3 \neq 2. \pmod 6$
   For $n \equiv 4, 4^2 \mod 6 \equiv 4 \neq 2. \pmod 6$
   For $n \equiv 5, 5^2 \mod 6 \equiv 1 \neq 2. \pmod 6$

4. The strongly connected components are:
   $\{i\}$
   $\{a, b, c\}$
   $\{d, e, g, h\}$
   $\{f\}$

5. (a) Has an Euler path because it has exactly two vertices with odd degree. $\{d, f\}$
   (b) Doesn't have Euler circuit – not all vertices have even degree.
   (c) It has a Hamilton Path as: $\{a, b, e, f, g, c, d\}$

(d) By Dirac's Theorem we know that in a graph with $3 \leq n$ vertices, if each vertex has $n/2 \leq deg(v)$,
then the graph has a Hamilton circuit.
However, this theorem is not neccessary but it is sufficient.
A quick manual check gives us that this graph doesn't have a Hamilton circuit.

6. We know that every graph that doesn't have a cycle of odd length is bipartite.
All trees are acyclic so we might say that they have a cycle of length 0 which is even.
Thus, all trees are bipartite.