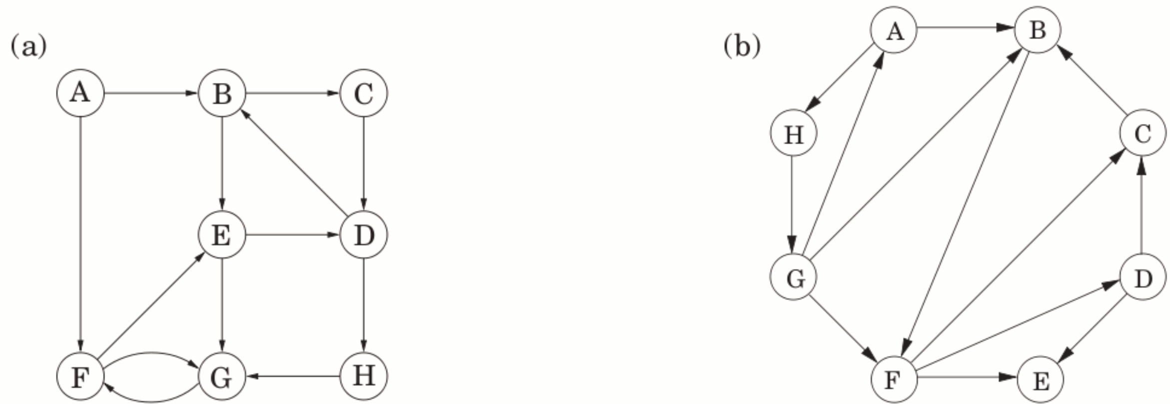
COT5405 - Homework I

Out date: **09/08/2010** (Wednesday), due date: **09/14/2010** (Wednesday)
15 points each problem.
You need to turn in the solutions for **all four** problems. But we will select **two** problems and **only** grade these two.

3.2. Perform depth-first search on each of the following graphs; whenever there's a choice of vertices, pick the one that is alphabetically first. Classify each edge as a tree edge, forward edge, back edge, or cross edge, and give the `pre` and `post` number of each vertex.



Problem (a)

Vertices	Pre number	Post number
A		
B		
C		
D		
E		
F		
G		
H		

Edges	Tree Edge	Cross Edge	Back Edge	Forward Edge
A-->B				
A-->F				
B-->C				
B-->E				
C-->D				

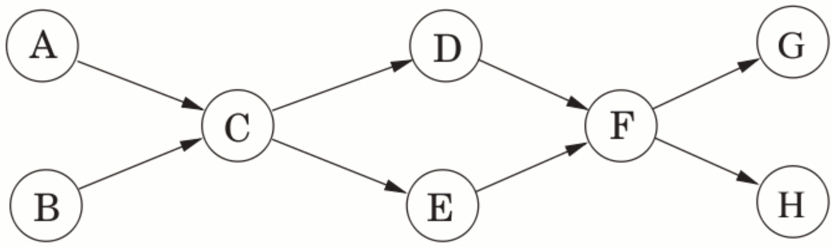
D-->B				
D-->H				
E-->D				
E-->G				
F-->E				
F-->G				
G-->F				
H-->G				

Problem (b)

Vertices	Pre number	Post number
A		
B		
C		
D		
E		
F		
G		
H		

Edges	Tree Edge	Cross Edge	Back Edge	Forward Edge
A-->B				
A-->H				
B-->F				
C-->B				
D-->C				
D-->E				
F-->C				
F-->D				
F-->E				
G-->A				
G-->B				
G-->F				
H-->G				

3.3. Run the DFS-based topological ordering algorithm on the following graph. Whenever you have a choice of vertices to explore, always pick the one that is alphabetically first.



(a) Indicate the `pre` and `post` numbers of the nodes.

(b) What are the sources and sinks of the graph?

(c) What topological ordering is found by the algorithm?

(d) How many topological orderings does this graph have?

Problem (a)

Vertices	Pre number	Post number
A		
B		
C		
D		
E		
F		
G		
H		

Problem (b)

Sources	
Sinks	

Problem (c)

Topo ordering								

Problem (d)

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3.5. The *reverse* of a directed graph $G = (V, E)$ is another directed graph $G^R = (V, E^R)$ on the same vertex set, but with all edges reversed; that is, $E^R = \{(v, u) : (u, v) \in E\}$.

Give a linear-time algorithm for computing the reverse of a graph in adjacency list format.

3.6. In an undirected graph, the *degree* $d(u)$ of a vertex u is the number of neighbors u has, or equivalently, the number of edges incident upon it. In a directed graph, we distinguish between the *indegree* $d_{in}(u)$, which is the number of edges into u, and the *outdegree* $d_{out}(u)$, the number of edges leaving u.

(a) Show that in an undirected graph, $\sum_{u \in V} d(u) = 2|E|$.

(b) Use part (a) to show that in an undirected graph, there must be an even number of vertices whose degree is odd.

(c) Does a similar statement hold for the number of vertices with odd indegree in a directed graph?