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## Fundamental Algorithms

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### Problem 1 (10 Points)

Explain the four different types of edges in a graph with a figure.

### Problem 2 (10 Points)

What are the variables  $DFSNum$  and  $FinishNum$  in topological sorting?

### Problem 3 (10 Points)

How can one classify an edge of a graph if the values of  $DFSNum$  and  $FinishNum$  of the nodes connected by it are known?

### Problem 4 (10 Points)

Show that in an undirected graph, there are neither Forward nor Cross edges.

### Problem 5 (10 Points)

Disprove the conjectures:

1. If there is a path from  $u$  to  $v$  in a directed graph, and if  $u.DFSNum < v.DFSNum$  then  $v$  is a descendant of  $u$ .
2. If there is a path from  $u$  to  $v$  in a directed graph, then any DFS must result in  $v.DFSNum \leq u.FinishNum$ .