

Data Structures G5029

Lecture 9

Kingsley Sage
Room 5C16, Pevensey III
khs20@sussex.ac.uk

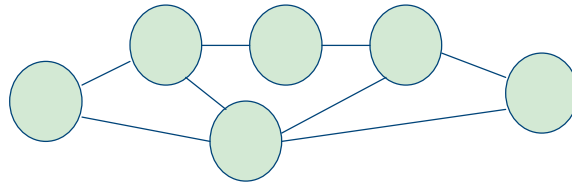
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Lecture 9

- Weighted graphs ...

Graphs

- Graphs occur everywhere and can be used to represent a wide range of relationships.
- In fact, we have already such examples of graphs in binary trees.
- Graphs can be represented pictorially ...

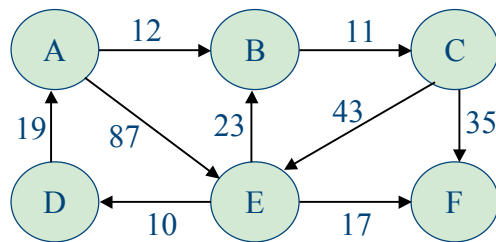


Graphs

- Examples of things graphs can represent:
 - Binary trees
 - Family relationships (complex graphs if you watch EastEnders ...)
 - Relationships between facts in a police investigation
 - Maps
 - Cause and effect maps
 - The list goes on ...

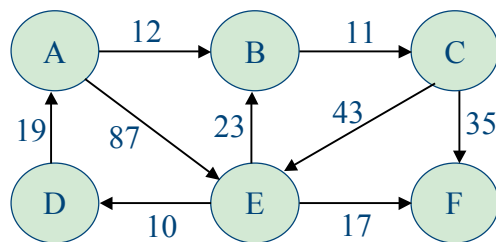
Terminology

- Graphs consist of a collection of nodes connected by various arcs.
- Node is sometimes called a vertex and an arc is sometimes called an edge.



Terminology

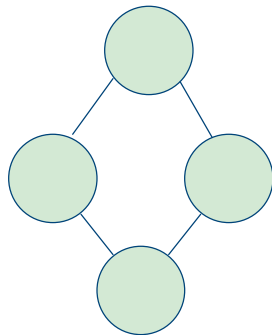
- Information may be attached to the nodes or arcs of the graph, or both. In the latter case, the nodes are labelled and the arcs are weighted.
- Numerical weights are sometimes referred to as costs.
- Weights could, for example, represent the cost of getting between airports (money, fuel, distance etc.).



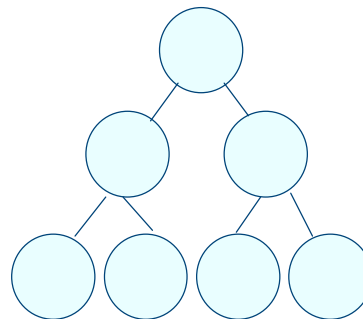
Topological properties

- Graphs are characterised in a number of ways:
 - Cyclic or acyclic
 - Fully connected or not fully connected (localised connections)
 - Directed or undirected
- The topological properties associated with any graph will depend on what the graph is being used to represent.

Cyclic and acyclic

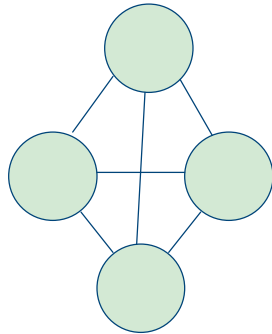


CYCLIC

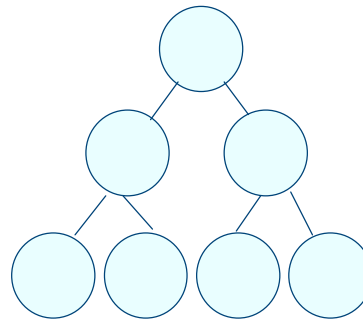


ACYCLIC

Connected and locally connected



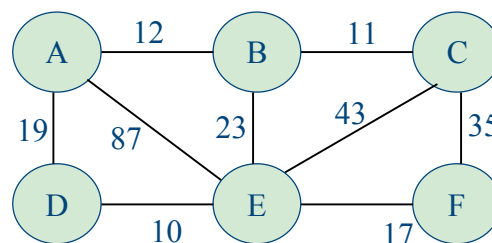
FULLY CONNECTED



LOCALLY CONNECTED

Directed and undirected

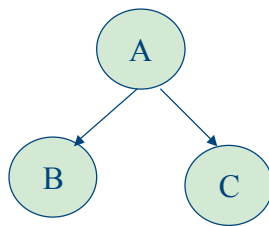
- For some applications (and the graphs that represent them) it does not matter whether what direction we travel along the arc.
- If this is a graph describing the cost of moving between airports, is the cost of going from A to B, the same as going from B to A?
- What might the significance be if we add arrows to the arcs?



UNDIRECTED

Directed and undirected

- Directed arcs (and thus directed graphs) imply that a relationship only works one way around.
- Occurs in, for example, logic. If $A \rightarrow B$, then $B \rightarrow A$ is not true.

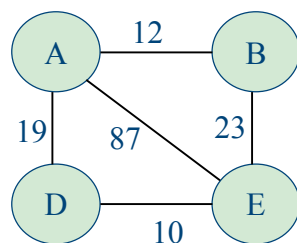


DIRECTED

Basis of belief networks

Adjacency matrix

- An alternative and sometime convenient representation of a graph is the adjacency matrix ...

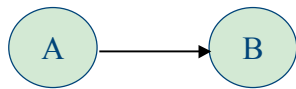


	A	B	D	E
A		12	19	87
B	12			23
D	19			10
E	87	23	10	

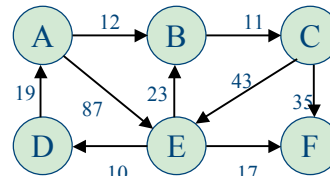
Notice anything about this matrix?
What would be the effect if the arcs were directed?

Adjacency lists

- An alternative representation uses just the collection of arcs in the graph ...



We say that A is the tail of the arc and B is the head (think of the arrow). We say that node B is adjacent to node A when there is an arc having B as its head and A as its tail (this is a directed arc).



A → {B,E}
B → {C}
C → {E,F}
D → {A}
E → {B,D,F}
F → {}

Next time ...

- Lots of stuff on implementing graphs can be found in the on-line course notes on the course web site.
- Finding paths through weighted graphs, or we can look at assignment 2 (class chooses) ...