GSOE9210 Engineering Decisions

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Trees

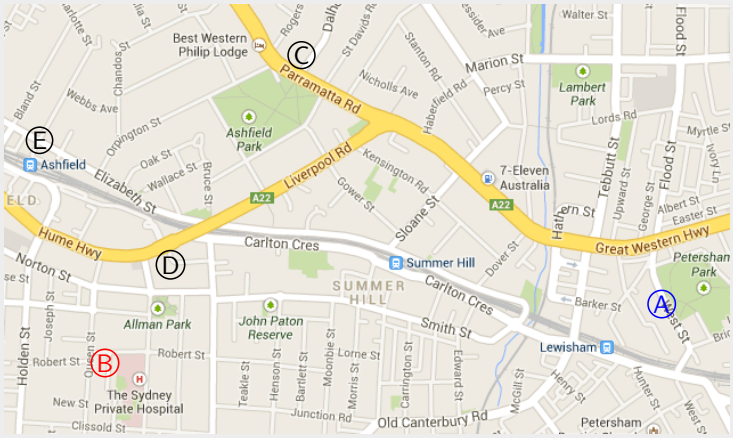
1. Tree: definitions
2. Tree properties

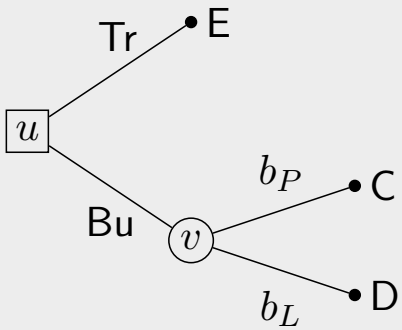
Outline

1 Tree: definitions

2 Tree properties

Problem representation: decision trees

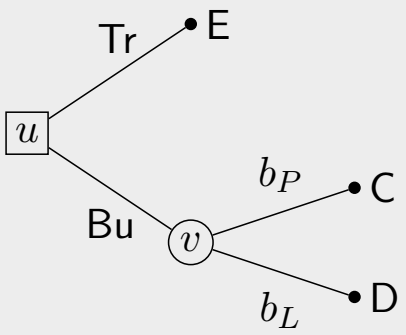




- a *tree* is a *connected graph* with no *circuits/cycles*
- node connections are called *branches*
- a unique node may be designated as the tree's *root*; then we have a *rooted tree*

Tree definitions

- a *path* is a sequence of nodes connected by branches
- the first node on a node's path to the root is called the node's *parent*; all other adjacent nodes are the node's *children*
- a node with no children is called a *leaf node*; a non-leaf node is called an *internal node*

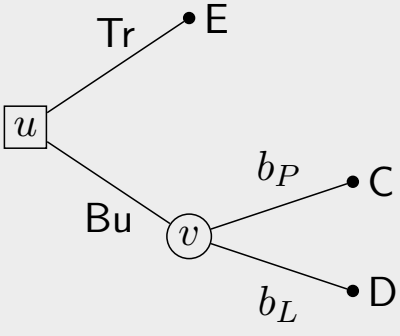


Exercises

- Which nodes are the leaves? The internal nodes?
- Which nodes are the parents/children of node v? D? u?

Tree definitions

- a node u is an *ancestor* of node v if u lies on the path from the root to v (excluding v itself)
- the *descendants*, or *successors*, of a node v are all the nodes that have v as an ancestor
- The *subtree* with root v is the tree comprising only v and all its descendants



Exercises

- Which nodes are the ancestors of C? v? u?
- Which nodes are the descendants of E? v? u?
- Draw the subtrees of with respective roots: v, C, u

Outline

1 Tree: definitions

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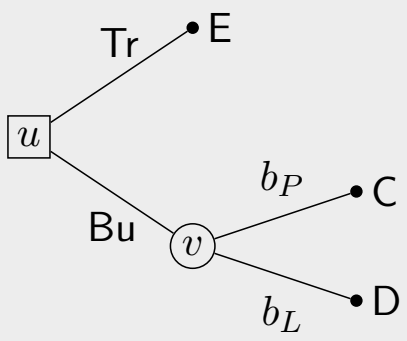
Tree properties

Theorem (Tree characterisation)

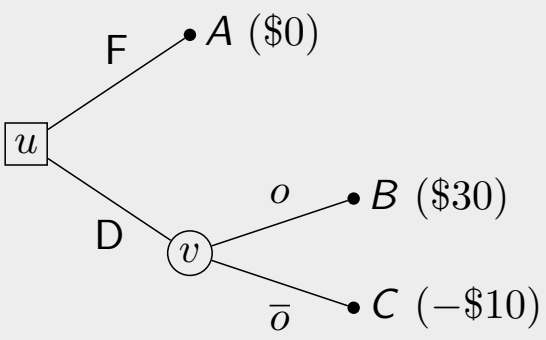
A graph is a tree if and only if there is a unique path between any two of its nodes.



Therefore, in a rooted tree:

- there is a unique path from every node to the root
- each node (except the root) has a unique parent, but may have multiple children

Decision trees



In a decision tree:

- each leaf node represents an outcome
- each branch represents either an action or an (chance) event
- internal nodes can be *decision nodes* (boxes) or *chance nodes* (circles)

Exercises

- What type of node is u? v? B?
- What does the branch labelled D represent?
- What does the branch labelled $\overline{o}$ represent?