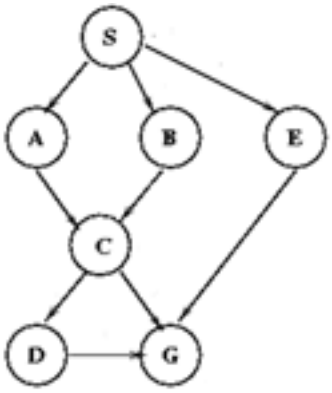
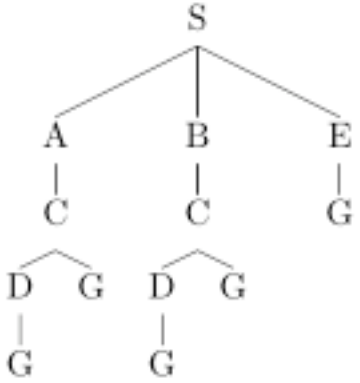
6.034 Recitation 3: Search Exercise Solutions (9/18-19/03)

R. Berwick

1. Draw the graph at left as a tree.
   (Hint: use this tree for parts 2 and 3.)





2. In the graph above, assuming *no enqueued* list, enumerate the order in which all nodes are expanded starting from S for each of the search strategies listed below. In other words, assume that the goal is a node not found in the graph. Also assume that nodes are expanded by delineating descendents left to right, and that the search strategies include backup.

Depth-first: S A C D G G B C D G G E G

Breadth-first: S A B E C C G D G D G G G

3. Now search the above graph using an *enqueued* list and each of the search strategies listed below. Assume that we're looking for a path from S to G, and that our search strategy checks for having reached the goal when a partial path is taken off the queue (and about to be expanded). Assume all search strategies except breadth-first include backup. When heuristics are needed, assume these for each node: S 1, A 5, B 3, E 7, C 6, D 2, G 0. For each strategy enumerate the order in which nodes are expanded and give the path found from S to G.

Strategy	Node expansion order	Path S→G
Depth-first	S A C D G	S A C G
Breadth-first	S A B E C G	S E G
Hill-Climbing	S B C G	S B C G
Best-first	S B A C G	S B C G

Note: Be careful not to generalize from this example that hill-climbing and best-first will always find the same path. Breadth-first, however, will always find the path with the fewest number of nodes.

The charts below show the derivation of the above node expansion orders and paths.

	Queue	Enqueued list	Next node to expand	Not added
Depth-first	(S)	S	(**S**)	
	(A S) (B S) (E S)	A,B,E,S	(**A** S)	
	(C A S) (B S) (E S)	C,A,B,E,S	(**C** A S)	
	(D C A S) (G C A S) (B S) (E S)	D,G,C,A,B,E,S	(**D** C A S)	
	(G C A S) (B S) (E S)	D,G,C,A,B,E,S	(**G C A S**)	(G D C A S)
	(B S) (E S)	D,G,C,A,B,E,S	done, path = (**S A C G**)	
Breadth-first	(S)	S	(**S**)	
	(A S) (B S) (E S)	A,B,E,S	(**A** S)	
	(B S) (E S) (C A S)	C,A,B,E,S	(**B** S)	
	(E S) (C A S)	C,A,B,E,S	(**E** S)	(C B S)
	(C A S) (G E S)	G,C,A,B,E,S	(**C** A S)	
	(G E S) (D C A S)	D,G,C,A,B,E,S	(**G E S**)	(G C A S)
	(D C A S)	D,G,C,A,B,E,S	done, path = (**S E G**)	
Hill-climbing	(1 S)	S	(1 **S**)	
	(3 B S) (5 A S) (7 E S)	A,B,E,S	(3 **B** S)	
	(6 C B S) (5 A S) (7 E S)	C,A,B,E,S	(6 **C** B S)	
	(0 G C B S) (2 D C B S) (5 A S) (7 E S)	D,G,C,A,B,E,S	(0 **G C B S**)	
	(2 D C B S) (5 A S) (7 E S)	D,G,C,A,B,E,S	done, path = (**S B C G**)	
Best-first	(1 S)	S	(1 **S**)	
	(3 B S) (5 A S) (7 E S)	A,B,E,S	(3 **B** S)	
	(5 A S) (6 C B S) (7 E S)	C,A,B,E,S	(5 **A** S)	
	(6 C B S) (7 E S)	C,A,B,E,S	(6 **C** B S)	(6 C A S)
	(0 G C B S) (2 D C B S) (7 E S)	D,G,C,A,B,E,S	(0 **G C B S**)	
	(2 D C B S) (7 E S)	D,G,C,A,B,E,S	done, path = (**S B C G**)	