

**CIS681 – Extra-Credit Homework 1 – Search & Game Trees**  
**Due: Friday, March 21, 2008, 9:00pm – 25 points**

**SOLUTIONS**

1.  $bv(A) = 12$

not examined: S, I, V, W, X, J, Y, Z, d1, e1, N, i1, j1

2. (a) steepest-ascent hill climbing

expl = S, children =  $A^{13} J^7$

expl = J, children =  $I^3 F^2$

expl = F, children =  $E^4$

nothing better

**Goal Not Found**

(b) best-first strategy

expl = S, OPEN =  $A^{13} J^7$

expl = J, OPEN =  $A^{13} I^3 F^2$

expl = F, OPEN =  $A^{13} I^3 E^4$

expl = I, OPEN =  $A^{13} E^4 C^2 H^0$

expl = H, \*\*\* GOAL!

**S-J-I-H cost=13**

(c) uniform cost

expl = S, OPEN =  $A^7 J^4$

expl = J, OPEN =  $A^7 I^6 F^7$

expl = I, OPEN =  $A^7 F^7 C^{10} H^{13}$

expl = A, (or F) OPEN =  $F^7 C^9 H^{13} B^8$

expl = F, OPEN =  $C^9 H^{13} B^8 E^9$

expl = B, OPEN =  $C^9 H^{13} E^9 D^9$ ,

expl = C, (or E) OPEN =  $H^{13} E^9 D^9 G^{13}$

expl = E, (or D) OPEN =  $H^{13} D^9 G^{13}$

expl = D, OPEN =  $H^{11} G^{13}$

expl = H, \*\*\* GOAL

**S-A-B-D-H cost = 11**

Final properties on nodes for above search are below. Note, only g is used since this is a uniform cost search.

S: parent: ()

g: 0

h:  
f:  
children: (A J)  
A: parent: S  
g: 7  
h:  
f:  
children:  
B: parent: A  
g: 8  
h:  
f:  
children: (D)  
C: parent: A  
g: 9  
h:  
f:  
children: (D G I)  
D: parent: B  
g: 9  
h:  
f:  
children: (H)  
E: parent: F  
g: 9  
h:  
f:  
children: (J)  
F: parent: J  
g: 7  
h:  
f:  
children: (E)  
G: parent: C  
g: 13  
h:  
f:  
children:  
H: parent: D  
g: 11  
h:

f:  
 children:  
 I: parent: J  
 g: 6  
 h:  
 f:  
 children: (C H)  
 J: parent: S  
 g: 4  
 h:  
 f:  
 children: (I F)

(d) alg A

expl = S OPEN =  $A^{20} J^{18}$   
 expl = J OPEN =  $A^{20} I^9 F^9$   
 expl = I (or F) OPEN =  $A^{20} F^9 H^{13} C^{12}$   
 expl = F OPEN =  $A^{20} H^{13} C^{12} E^{13}$   
 expl = C OPEN =  $A^{20} H^{13} E^{13} D^{12} G^{14}$   
 expl = D OPEN =  $A^{20} H^{13} E^{13} G^{14}$   
 expl = H (or E) \*\*\* GOAL

**S-J-I-H cost = 13**

Final properties on Nodes for above search:

S: parent: ()  
 g: 0  
 h: 11  
 f: 11  
 children: (A J)  
 A: parent: S  
 g: 7  
 h: 13  
 f: 20  
 children:  
 B: parent:  
 g:  
 h:  
 f:  
 children:  
 C: parent: I  
 g: 10  
 h: 2

f: 12  
 children: (D G)  
 D: parent: C  
 g: 11  
 h: 1  
 f: 12  
 children: (H)  
 E: parent: F  
 g: 9  
 h: 4  
 f: 13  
 children:  
 F: parent: J  
 g: 7  
 h: 2  
 f: 9  
 children: (E)  
 G: parent: C  
 g: 14  
 h: 0  
 f: 14  
 children:  
 H: parent: I  
 g: 13  
 h: 0  
 f: 13  
 children:  
 I: parent: J  
 g: 6  
 h: 3  
 f: 9  
 children: (H C)  
 J: parent: S  
 g: 4  
 h: 7  
 f: 11  
 children: (I F)

- (e) No, because  $h(A)$  is not an underestimate. Consider that  $h(A) = 13$  but cost of optimal path from A to a goal is 4.
- (f) Note: do a depth first search as long as f values are low enough. Assume here that doing left-to-right depth-first search (open list kept to pick next f value).

f = 11

expl = S OPEN =  $A^{20} J^{11}$

expl = J OPEN =  $A^{20} I^9 F^9$

expl = I OPEN =  $A^{20} F^9 C^{12} H^{13}$

expl = F OPEN =  $A^{20} C^{12} H^{13} E^{13}$

f = 12

expl = S OPEN =  $A^{20} J^{11}$

expl = J OPEN =  $A^{20} I^9 F^9$

expl = I OPEN =  $A^{20} F^9 C^{12} H^{13}$

expl = C OPEN =  $A^{20} F^9 H^{13} D^{12} G^{14}$

expl = D OPEN =  $A^{20} F^9 H^{13} G^{14} H^{13}$

expl = F OPEN =  $A^{20} H^{13} G^{14} H^{13} E^{13}$

f = 13

expl = S

expl = J

expl = I

expl = C

expl = D

expl = H \*\*\* GOAL

**S-J-I-C-D-H**