PROBLEM SET 1

C.S. 440: INTRO TO A.I.

Rutgers University

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* Disclosure *

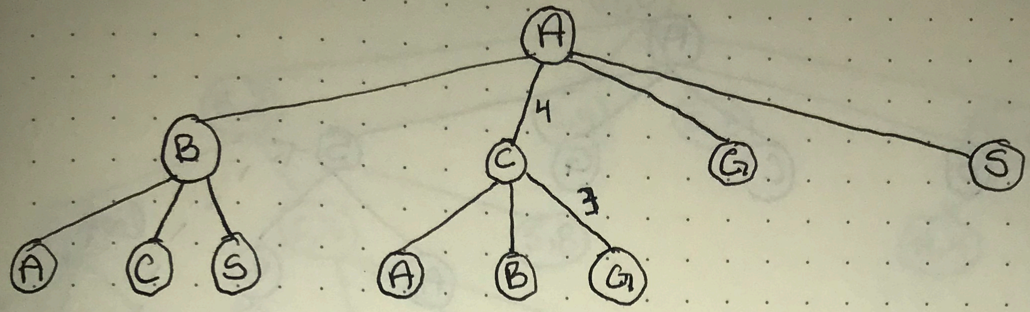
I, Michael Saunders, mistakenly began ~~my search~~ the BFS, DFS, and Uniform-Cost search-trees from node A instead of node S.

It was too late to revise these by the time the mistake was caught.

I included them anyway, but am requesting CHEESE instead of Ø points.

Thank you, and I apologize to Zain Ali.

BFS Tree-search

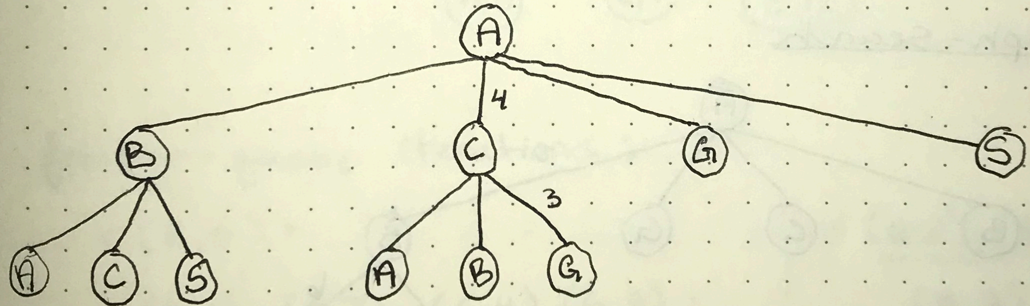


frontier-queue iterations:

< A >
< B, C, G, S >
< C, G, S, A, C, S >
< G, S, A, C, S, A, B, G >

goal (G) found ; cost = 7

BFS Graph-search

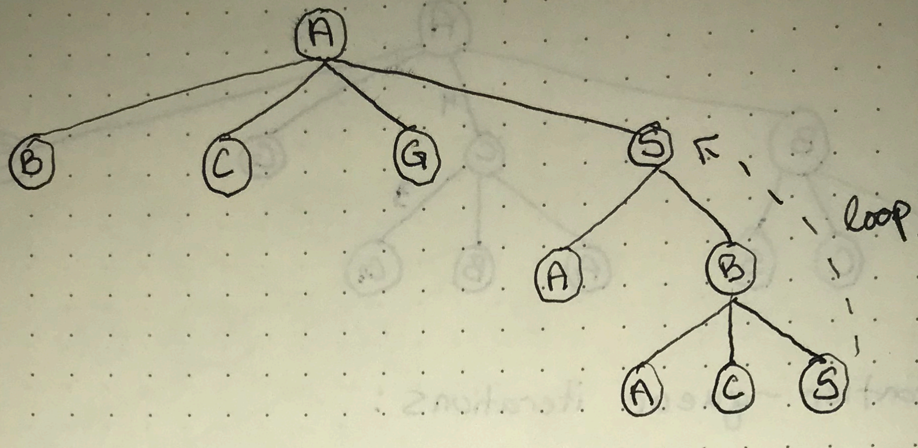


frontier-queue iterations:

< A >
< B, C, G, S >
< C, G, S, C, S >
< G, S, C, S, G >

goal (G) found ; cost = 7

DFS Tree-Search

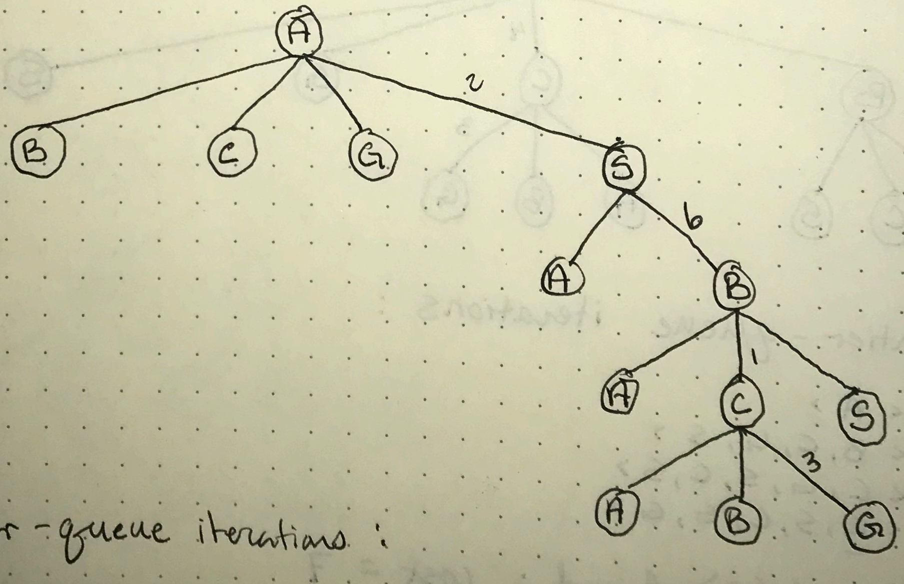


frontier-queue iterations :

< A >
< S,G,C,B >
< B,A,G,C,B >
< S,C,A,A,G,C,B >

goal (G) Not found ; caught in infinite loop.

DFS Graph-Search

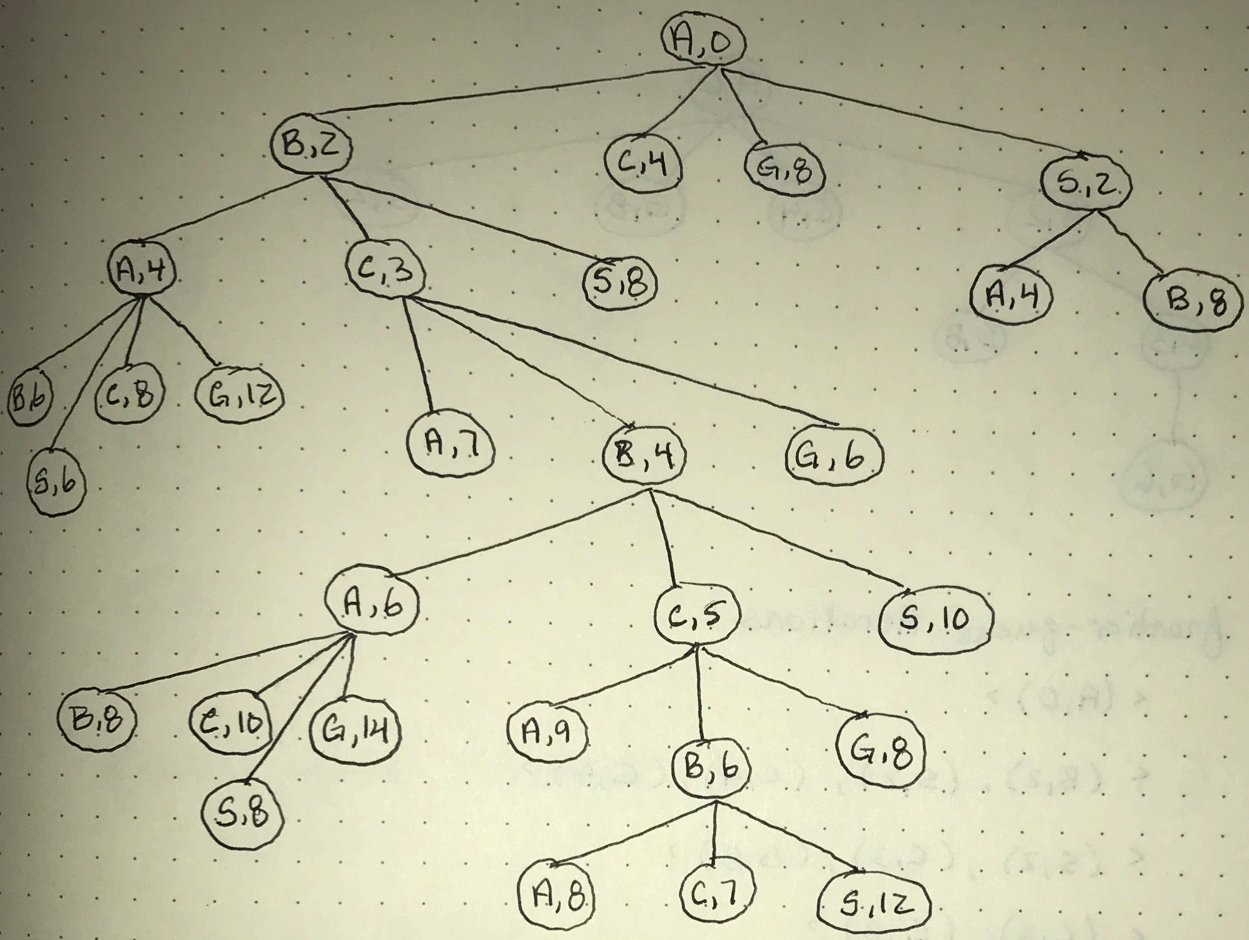


frontier-queue iterations :

< A >
< S,G,C,B >
< B,G,C,B >
< C,G,C,B >
< G,G,C,B >

goal (G) found ; cost = 12

Uniform - Cost Tree - Search



frontier - queue iterations:

< (A,0) >

< (B,2), (S,2), (C,4), (G,8) >

< (S,2), (C,3), (A,4), (G,8) >

< (C,3), (A,4), (B,8), (G,8) >

< (A,4), (B,4), (G,6) >

< (B,4), (G,6), (S,6) >

< (C,5), (A,6), (G,6), (S,6) >

< (A,6), (B,6), (G,6), (S,6) >

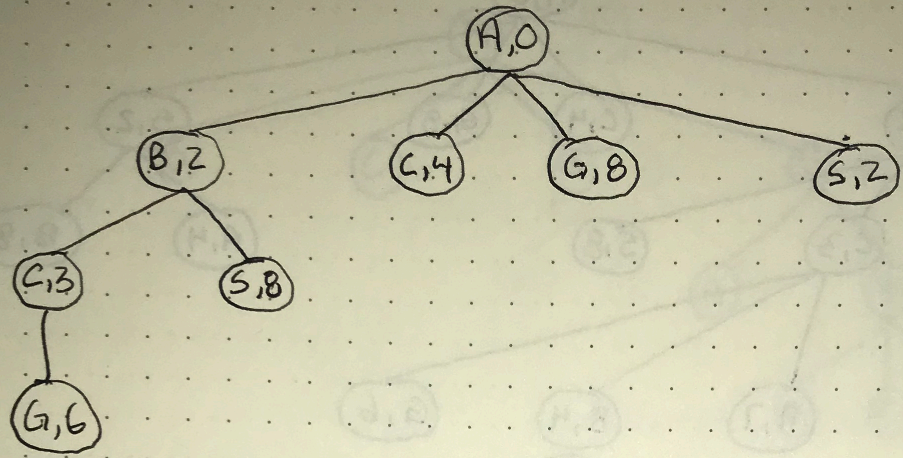
< (B,6), (G,6), (S,6) >

< (G,6), (S,6), (C,7), (A,8) >

goal (G) found;

cost = 6

Uniform - cost Graph - Search



frontier-queue iterations :

< (A,0) >

< (B,2), (S,2), (C,4), (G,8) >

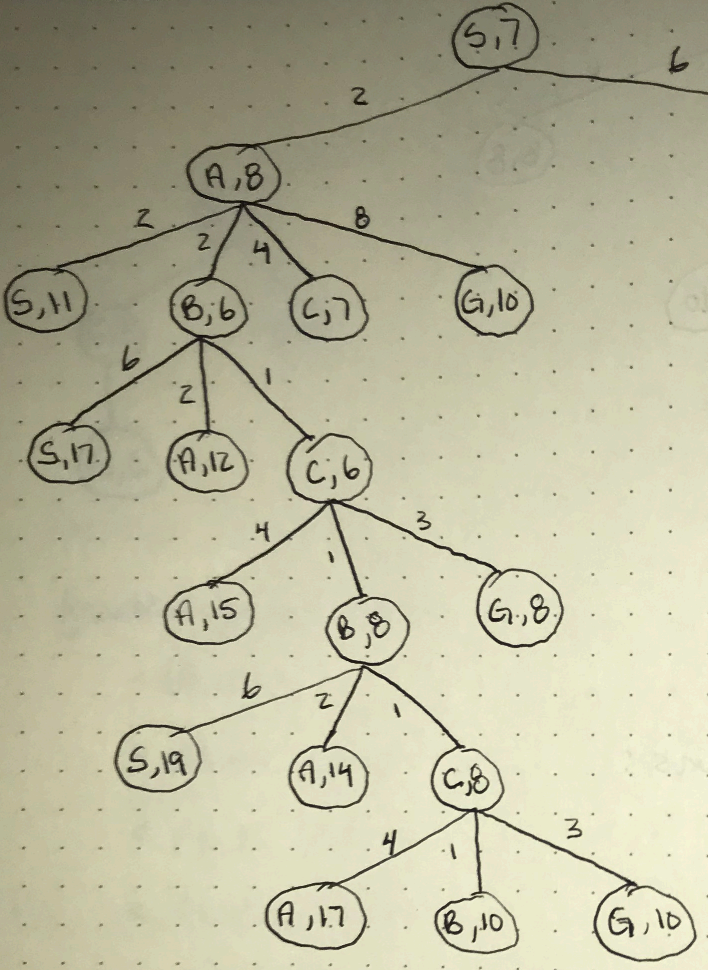
< (S,2), (C,3), (G,8) >

< (C,3), (G,8) >

< (G,6) >

goal (G) found ; cost = 6

A* Tree - Search



frontier-queue iterations:

< (S,7) >

< (A,8), (B,8) >

< (B,6), (C,7), (G,10), (S,11) >

< (C,6), (G,10), (A,12), (S,11) >

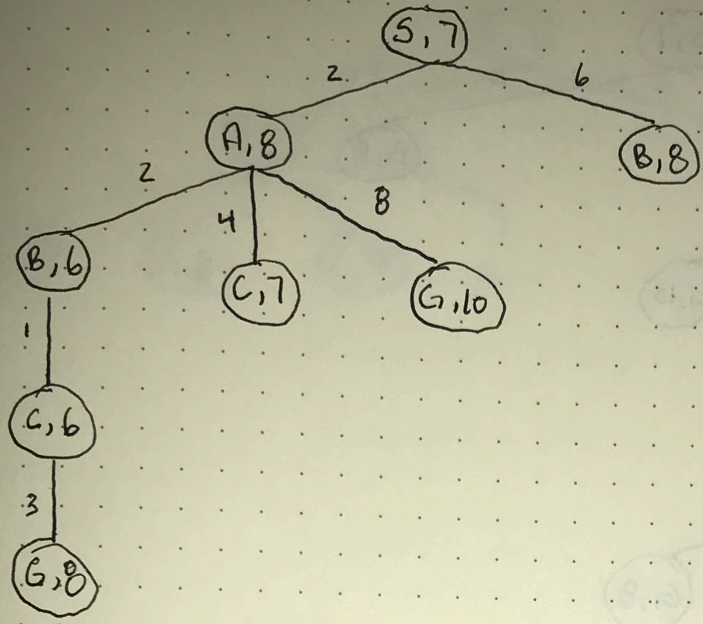
< (B,8), (G,8), (A,12), (S,11) >

< (C,8), (G,8), (A,12), (S,11) >

< (G,8), (B,10), (A,12), (S,11) >

goal(G) found; cost = 8

A* Graph-Search



frontier - queue iterations :

< (S, 7) >

< (A, 8), (B, 8) >

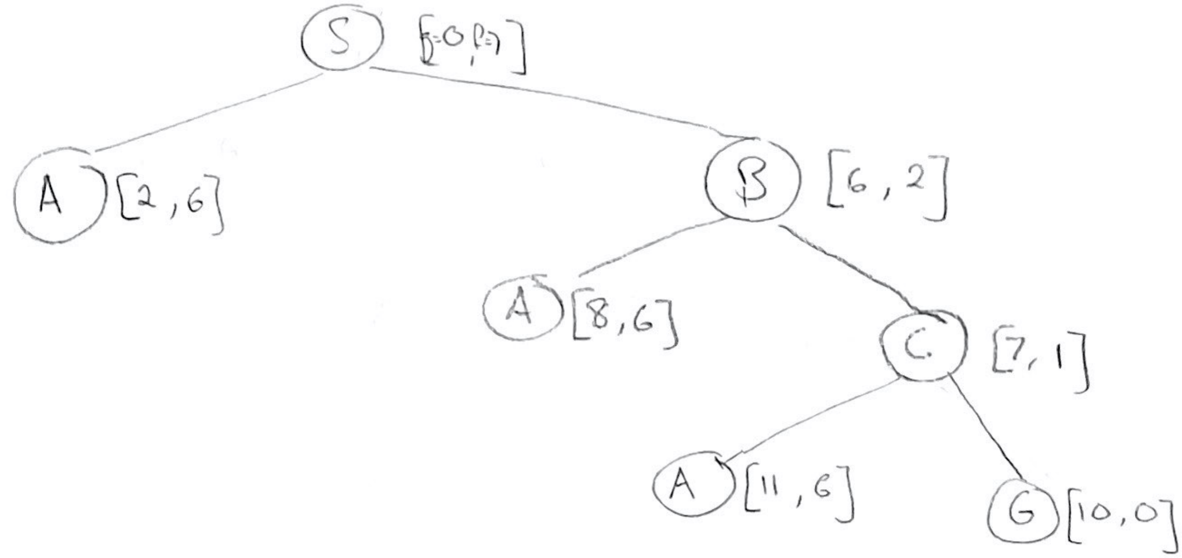
< (B, 6), (C, 7), (G, 10) >

< (C, 6), (G, 10) >

< (G, 8) >

goal (G) found ; cost = 8

Greedy Best - First Tree Search



frontier

< (S,7) >

< (B, 2), (A, 6) >

< (C, 1), (A, 6), (A, 6) >

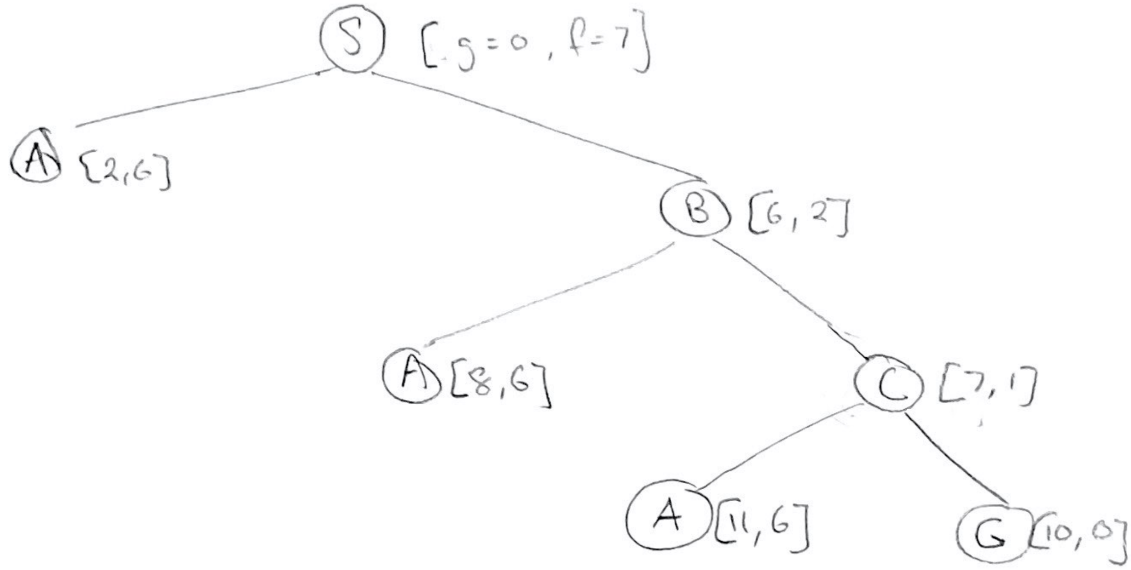
< (G, 0), (A, 6), (A, 6), (A, 6) >

END < (A, 6), (A, 6), (A, 6) >

goal g

cost = 10

Greedy Best-First Graph Search



Frontier

< (S,7) >

< (B,2), (A,6) >

< (C,1), (A,6), (A,6) >

< (G,0), (A,6), (A,6), (A,6) >

END < (A,6), (A,6), (A,6) >

goal g

cost = 10

Problem 2

1) $h(n) = \min\{h_1(n), h_2(n)\}$

admissible)

$h_1(n) \leq h^*(n)$ and $h(n) \leq h^*(n)$

if $h_1(n) \leq h_2(n) \leq h^*(n)$

then $h(n) = h_1(n) \leq h^*(n)$

else $h_2(n) \leq h_1(n) \leq h^*(n)$

then $h(n) = h_2(n) \leq h^*(n)$

is admissible

consistent)

$$h(n) = \min\{h_1(n), h_2(n)\} \leq \min\{c(n,a,n') + h_1(n'), c(n,a,n') + h_2(n')\} \leq$$

$$\leq c(n,a,n') + \underbrace{\min\{h_1(n'), h_2(n')\}}_{h(n')} \rightarrow$$

$$\rightarrow h(n) \leq c(n,a,n') + h(n')$$

is consistent

2) $h(n) = wh_1(n) + (1-w)h_2(n)$, where $0 \leq w \leq 1$

admissible)

Since $h_1(n)$ and $h_2(n) \leq h^*(n)$

we can say $h_3(n) \leq h^*(n)$ where

$h_3(n) = h_1(n)$ or $h_2(n)$

Since $wh_3(n)$ and $(1-w)h_3(n)$ are compliments of eachother, we can say

$wh_3(n) = A$ and $(1-w)h_3(n) = \bar{A}$

$A + \bar{A} = U = h_3(n) \leq h^*(n)$ is admissible

2)

Consistent)

$h(n) \le c(n,a,n') + h(n')$

$w\left(c(n,a,n') + h_1(n')\right) + (1-w)\left(c(n,a,n') + h_2(n')\right) \le$

$\le c(n,a,n') + h(n')$

Since $w(c(n,a,n') + h_1(n'))$ and

$(1-w)(c(n,a,n') + h_2(n'))$ are compliments of

eachother AND are both $\le c(n,a,n') + h(n')$

iff $0 \le w \le 1$, we can say

$w(c(n,a,n') + h_1(n')) + (1-w)(c(n,a,n') + h_2(n')) \le$

$\le c(n,a,n') + h(n')$ which is $\geq h(n)$

is consistent

3) $h(n) = \max\{h_1(n), h_2(n)\}$

admissible)

if $h_1(n) \le h_2(n) \le h^*(n)$

then $h(n) = h_2(n) \le h^*(n)$

else $h_2(n) \le h_1(n) \le h^*(n)$

then $h(n) = h_1(n) \le h^*(n)$

is admissible

3)

Consistent)

$$h(n) = \max\{h_1(n), h_2(n)\} \leq$$

$$\leq \max\{c(n,a,n') + h_1(n'), c(n,a,n') + h_2(n')\} \leq$$

$$\leq c(n,a,n') + \underbrace{\max\{h_1(n_1), h_2(n_2)\}}_{h(n')} \rightarrow$$

$$\rightarrow h(n) \leq c(n,a,n') + h(n')$$

is consitstent.

Problem 3

Hill Decending

Iteration 1   * = location of Queen

6*	4	5	4
4	6*	4	5
5	4	6*	4
4	5	4	6*

Iteration 2

6	2	3	2
4*	4*	3	5
5	3	4*	3
4	3	3	4*

Iteration 3

4	2*	2	2
2*	4	2	3
2	3	2*	3
2	3	3	2*

END: No lower values