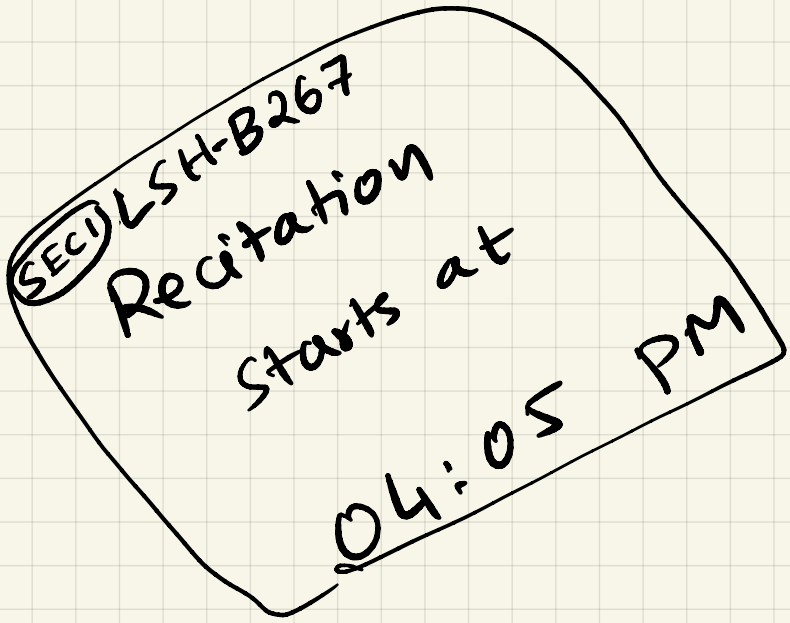
Spring 2025

CS440: Intro to AI

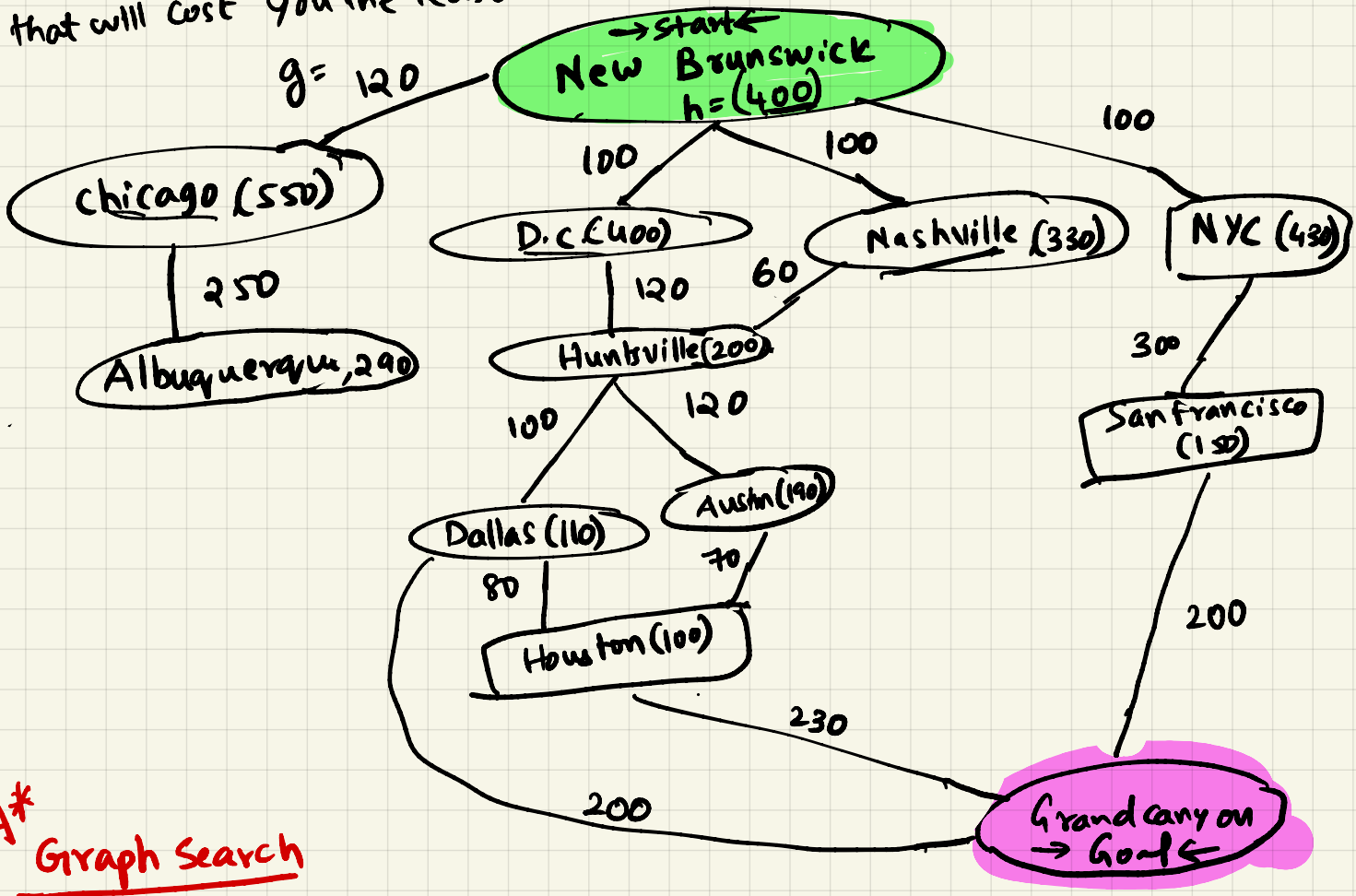


TA: Kowndinya Boyalakuntla

Office Hours: Tuesdays 11:00 AM to 12:00 PM

Zoom Link is on Canvas Course page.

Theme: You want to travel to Grand Canyon from New Brunswick. There are multiple routes to reach the goal, but can you plan a route that will cost you the least money?



A* Graph Search

Fringe/open list (Priority Queue)

closed set (Hashset)

n: node, g(n): path cost from start to node 'n'

h(n): heuristic/estimated cost from node 'n' to goal node

f(n) = g(n) + h(n): Estimated cost from start to goal through 'node n'

	open list (Node, g(n), h(n), f(n))	closed set: node 'n'
Step 1:	(New Brunswick, 0, 400, 400)	{ }
step 2:	(Chicago, 120, 550, 670)	{ New Brunswick }
	(D.C., 100, 400, 500)	
	(Nashville, 100, 330, 430)	
	(NYC, 100, 430, 530)	

Step 3: (Chicago, 120, 550, 670)
(D.C., 100, 400, 500)
(NYC, 100, 430, 530)
(Huntsville, 160, 200, 360)

{ Nashville, New Brunswick }

Step 4: (Chicago, 120, 550, 670)
(D.C., 100, 400, 500)
(NYC, 100, 430, 530)
(Dallas, 260, 110, 370)
(Austin, 280, 190, 470)

{ Huntsville, Nashville, New Brunswick }

Step 5: (Chicago, 120, 550, 670)
(D.C., 100, 400, 500)
(NYC, 100, 430, 530)
(Austin, 280, 190, 470)
(Houston, 340, 100, 440)
(GrandCanyon, 460, 0, 460)

{ Dallas, Huntsville, Nashville, New Brunswick }

Step 6: (Chicago, 120, 550, 670)
(D.C., 100, 400, 500)
(NYC, 100, 430, 530)
(Austin, 280, 190, 470)
(GrandCanyon, 460, 0, 460)
~~GrandCanyon, 510, 0, 510~~ → Do not update as node GrandCanyon has a lower f' value in the fringe already

{ Houston, Dallas, Huntsville, Nashville, New Brunswick }

Step 7: (Chicago, 120, 550, 670)
(D.C., 100, 400, 500)
(NYC, 100, 430, 530)
(Austin, 280, 190, 470)

{ Grandcanyon, Houston, Dallas, Huntsville, Nashville, New Brunswick }

"Goal Reached"

New Brunswick → Grandcanyon : $C^*(\text{Grandcanyon}) = 460$

A* Path: New Brunswick → Nashville → Huntsville → Dallas → Grandcanyon

$f(n) < C^*(n)$

A* search will find the optimal path to the goal as long as the heuristic $h(n)$ is admissible

that is $h(n) \leq$ the true path cost from node 'n' to goal 'G'.

A* will expand all nodes 'n' with $f(n) <$ Optimal cost to goal.

A* won't expand any node 'n' with $f(n) > C^*$

A* Tree search: We do not maintain a closed list here.

Step 1: (New Brunswick, 0, 400, 400)

Step 2: (Chicago, 120, 550, 670)
(D.C., 100, 400, 500)
(Nashville, 100, 330, 430)
(NYC, 100, 430, 530)

Step3: (Chicago, 120, 550, 670)
(D.C., 100, 400, 500)
(NYC, 100, 430, 530)
(Huntsville, 160, 200, 360)
(New Brunswick, 200, 400, 600)

Step 4: (Chicago, 120, 550, 670) (New Brunswick, 200, 400, 600)
(D.C., 100, 400, 500) (D.C., ~~260~~, 400, 680)
(NYC, 100, 430, 530) (Nashville, 220, 330, 550)
(Dallas, 260, 110, 370)
(Austin, 280, 190, 470)

Step 5: (Chicago, 120, 550, 670) (New Brunswick, 200, 400, 600)
(D.C., 100, 400, 500) (Nashville, 220, 330, 550)
(NYC, 100, 430, 530) (Huntsville, 360, 200, 560)
(Austin, 280, 190, 470)
(Houston, 340, 100, 440)
(GrandCanyon, 460, 0, 460)

Step6: (Chicago, 120, 550, 670) (New Brunswick, 200, 400, 600)
(D.C., 100, 400, 500) (Nashville, 220, 330, 550)
(NYC, 100, 430, 530) (Huntsville, 360, 200, 560)
(Austin, 280, 190, 470) (~~Austin, 430, 190~~, 620)
(GrandCanyon, 460, 0, 460) (Dallas, 420, 110, 530)
~~GrandCanyon, 510, 0, 510~~

Step 7: (Chicago, 120, 550, 670) (New Brunswick, 200, 400, 600)
(D.C., 100, 400, 500) (Nashville, 220, 330, 550)
(NYC, 100, 430, 530) (Huntsville, 360, 200, 560)
(Austin, 280, 190, 470) (Dallas, 420, 110, 530)

" Goal Reached: "

New Brunswick → Grandcanyon : $c^*(\text{Grandcanyon}) = 460$