EN.520.650 Midterm

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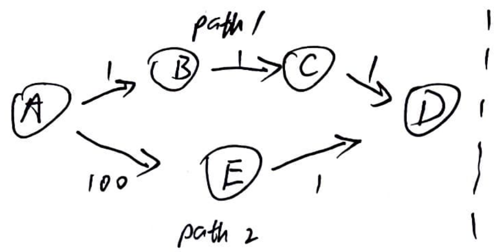
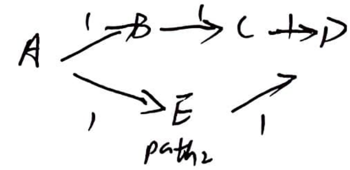
1\. a) BFS travels the path level by level. It will check all path that are one edge away then check the two edges away path, until it find the sink node. So it's guarantee to find shortest solution.

b) example



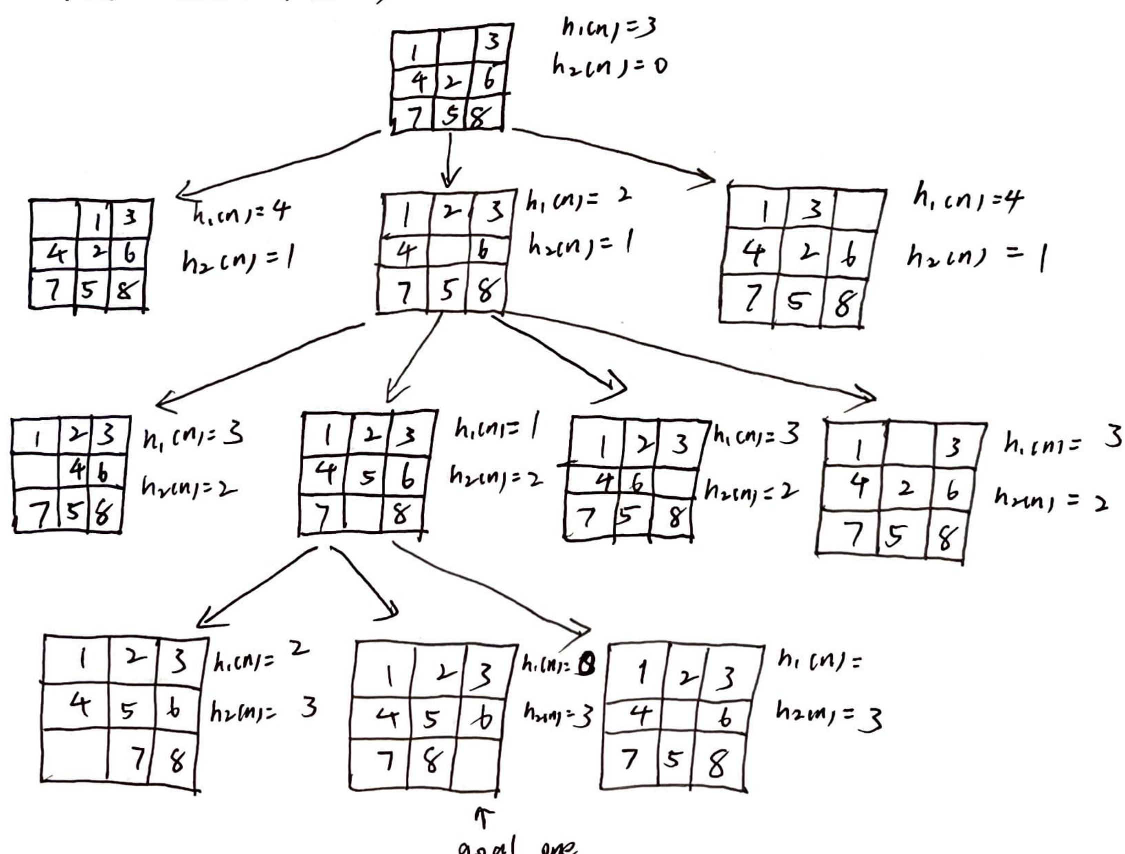


it will find path 2 as the answer.

In this example, in path 1, the length is 3 but in path 2 the length is 101. However, the path 2 has 2 edge, the path 1 has 3 edge. The BFS will find which path can first get the sink node. So BFS will find D first on path 2. It means it doesn't work for varying cost edge.

2\. For given in the question

$f(n) = h_2(n) + h_1(n)$



3.

B	E	A	$P(B,E,A) = P(a\mid B,E) * P(B) * P(E)$
T	T	T	$0.95 \times 0.01 \times 0.02 = 1.9\times10^{-6}$
T	T	F	1×10^{-7}
T	F	T	9.381×10^{-4}
T	F	F	5.988×10^{-5}
F	T	T	5.794×10^{-4}
F	T	F	1.418×10^{-3}
F	F	T	9.97×10^{-4}
F	F	F	0.996

$P(A) = P(A\mid B,E)\,P(B)\,P(E) + P(A\mid B,-E)\,P(B)\,P(-E) + P(A\mid -B, E)\,P(-B)\,P(E)$

$+ P(A\mid -B,-E) + P(A\mid -B,E)\,P(-B)\,P(-E) = 0.0025\mid$

$P(J) = 0.9$ $\qquad P(M) = 0.7$

$P(B\mid j,m) = \alpha\, P(B,j,m)$

$= \alpha \sum_{e,a} P(B,e,a,j,m)$

$= \alpha \sum_{ea} P(B)\,P(e)\,P(a\mid B,e)\,P(j\mid a)\,P(m\mid a) = \alpha\,(0.00059224,\ 0.0014919)$

$= (0.284,\ 0.716)$

$P(M\mid B) =$

$P(B\mid M) =$

$P(A\mid j,m) = \alpha\, P(A,j,m) = P(A,J) \times P(A,B)$

$= (0.003,\ 0.0018)$

4. a) O_1 = Green $\quad O_2$ = Blue, O_3 = Yellow

$\alpha_1(1) = \pi_1 b_1(O_1) = 0.3 \times 0.2 = 0.06$

$\alpha_1(2) = \pi_2 b_2(O_1) = 0.4 \times 0.6 = 0.24$

$\alpha_1(3) = \pi_3 b_3(O_1) = 0.3 \times 0.1 = 0.03$

$\alpha_2(1) = \sum_{i=1}^{3} \alpha_1(i) a_{i1} b_1(O_2) = (0.06 \times 0.4 + 0.24 \times 0.2 + 0.03 \times 0.3) \times 0.2 = 0.0162$

$\alpha_2(2) = \sum_{i=1}^{3} \alpha_1(i) a_{i2} b_2(O_2) = (0.06 \times 0.3 + 0.24 \times 0.7 + 0.03 \times 0.2) \times 0.2 = 0.0384$

$\alpha_2(3) = \sum_{i=1}^{3} \alpha_1(i) a_{i3} b_3(O_2) = (0.06 \times 0.3 + 0.24 \times 0.1 + 0.03 \times 0.5) \times 0.2 = 0.0114$

$\alpha_3(1) = \sum_{i=1}^{3} \alpha_2(i) a_{i1} b_1(O_3) = (0.0162 \times 0.4 + 0.0384 \times 0.2 + 0.0114 \times 0.3) \times 0.1 = 1.758 \times 10^{-3}$

$\alpha_3(2) = \cancel{\sum_{i=1}} = (0.0162 \times 0.3 + 0.0384 \times 0.7 + 0.0114 \times 0.2) \times 0.1 = 3.402 \times 10^{-3}$

$\alpha_3(3) = (0.0162 \times 0.3 + 0.0384 \times 0.1 + 0.0114 \times 0.5) \times 0.3 = 4.32 \times 10^{-3}$

$P(O|\lambda) = \alpha_3(1) + \alpha_3(2) + \alpha_3(3) = 9.48 \times 10^{-3}$

b)

$\delta_1(1) = 0.06$

$\delta_1(2) = 0.24$

$\delta_1(3) = 0.03$

$\delta_2(1) = \max(0.06 \times 0.4,\ 0.24 \times 0.2,\ 0.03 \times 0.3) \times 0.2 = 0.048 \times 0.2 = 9.6 \times 10^{-3}$ $\quad \psi_2(1) = 2$

$\delta_2(2) = \max(\delta_1(i) a_{i2}) b_2(O_2) = 0.0336$ $\quad \psi_2(2) = 2$

$\delta_2(3) = \max(\delta_1(i) a_{i3}) b_2(O_3) = 4.8 \times 10^{-3}$ $\quad \psi_2(3) = 2$

$\delta_3(1) = 0.1 \times 0.0384 \times 0.2 = 7.68 \times 10^{-4}$ $\quad \psi_3(1) = 2$

$\delta_3(2) = 0.1 \times 0.0384 \times 0.7 = 2.688 \times 10^{-3}$ $\quad \psi_2(2) = 2$

$\delta_3(3) = 0.3 \times 0.0114 \times 0.5 = 1.71 \times 10^{-3}$ $\quad \psi_3(3) = 3$

$q_3^* = 3$

$q_2^* = \psi_3(q_3^*) = 3$

$q_1^* = \psi_2(q_2^*) = 2$

sequence $3 \to 3 \to 2$

5. a) variables: { large rectangle width W, height H; small rect width x, heigh y }

~~domain~~ domain: i for Small rectangle R_i

constraints: $R_{i,x} > 0$

$R_{i,x} + R_{i,w} \leq W$

$R_{i,y} \geq 0$

$R_{i,y} + R_{i,h} \leq H$

b) variables: { Teacher T, Subjects S, classroom C, Time t }

domain: i, j in constraint T, S

$T_{ij} \neq T_{kj}$, $k \neq i$

$C(T_{ij}, S_{ij}) = \{ (t, s) \mid t$ for subjects $\}$.

c) variables: { each stop: such as stop: A B C D ... }

domain: neighbour city connect, such as X, Y, Z

costraint: in A = X, B = Y situation

each stop connect to a city and all different.