1. Ignore the heuristic

F	V	Expanded
~~A~~	A	A → B, C
B	A, B	B → D, E
		E → Done.

Path is E → B → A or A > B > E

Optimality is fewest nodes.

2.

F	V	Expanded
A	A	A → B(3+1), C(2+2)
~~B(4)~~, C(4)	B, A	B → D(3+3+1), E(3+7+0)
~~C(4)~~, D(7), E(10)	A, B, C	C → ~~D(2+4+1)~~ 7, X F(2+6+1)
~~D(7)~~, F(9), E(~~10~~ 7)	A, B, C, D	D → E(~~3+3~~+1) 7, F(~~2+6+1~~) 9 No.

~~E(7)~~, F(9) E → DONE

PATH E → D → C → A or A > C > D > E.

WITH PATH LEN = 7

NOTE: There is a tie at E. I chose one path, but the other is valid. We could have PATH A > B > D > E

OPTIMALITY is minimum path cost

BFS optimizes for Nodes while A* optimizes for path cost.

3. Using conditional probabilities

$$P(A) = \sum_b \sum_e P(A, B, E)$$

$$= \sum_b \sum_e P(A \mid B, E) \cdot P(B \mid E) \cdot P(E)$$

assume conditional independence

$$= \sum_b \sum_e P(A|B,E) \cdot P(B) \cdot P(E)$$

$b = T, E = T$

$$= 0.95 \times 0.001 \times 0.002$$

$b = T, E = F$

$$+ \ 0.94 \times 0.001 \times (1 - 0.002)$$

$b = F, E = T$

$$+ \ 0.29 \times (1 - 0.001) \times 0.002$$

$b = F, E = F$

$$+ \ 0.001 \times (1 - 0.001) \times (1 - 0.002)$$

$$\boxed{\simeq 0.0025}$$

$$P(\bar{J}) = 1 - P(J)$$

$$= 1 - P(J, A, E, B)$$

$$= 1 - \sum_a \sum_e \sum_b P(J, A, E, B)$$

$$\approx 1 - \sum_a \sum_e \sum_b P(J|A) \cdot P(A|B,E) \cdot P(B) \cdot P(E)$$

Assumes conditional independence

<u>$J=T, E=F$</u> :

WANT $P(B=T \mid J=T, E=F)$

$$P(B|J=T, E=F) = \frac{P(B=T, J=T, E=F)}{P(J=T, E=F)}$$

$$= \frac{\sum_a P(J=T, E=F, B=T, A)}{\sum_a \sum_b P(J=T, E=F, B, A)}$$

$P(J=T, E=F, B=T, A)$

$P(J, A, E, B) = P(J|A) \cdot P(A|E,B) \cdot P(E) \cdot P(B)$

$$P(J=T, E=F, B=T, A)$$

$$= P(E=F) \cdot P(B=T) \cdot \sum_a P(J=T \mid A) \cdot P(A \mid E=F \cdot B=T)$$

$$= (1-0.002) \times 0.001 \times$$

$a=T$ $\qquad\qquad$ $a=F$

$$[0.9 \times 0.94 + 0.05 \times (1-0.94)]$$

$$= 0.000847302$$

WTF: $\sum_a \sum_b P(J=T, E=F, B, A)$

$$= P(J=T \mid A) \cdot P(A \mid B, E=F) \cdot P(B) \cdot P(E=F)$$

$$= P(E=F) \cdot \left[\sum_a \sum_b P(J=T \mid A) \cdot P(A \mid B, E=F) \cdot P(B) \right]$$

$$= (1-0.002) \times$$

$a=T,\ b=T$:

$$[0.90 \times 0.94 \times 0.001$$

$a = T,\ b = F$

$+\ 0.90 \times 0.001 \times (1 - 0.001)$

$a = F,\ b = T$

$+\ 0.05 \times (1 - 0.94) \times 0.001$

$a = F,\ b = F$

$+\ 0.05 \times (1 - 0.001) \times (1 - 0.001)]$

$= 0.05154548537$

$P(D \mid J = T, E = F)$

$$= \frac{0.000847302}{0.05154548537} = \boxed{0.0164}$$

A = T WANT $P(E \mid A=T)$

$$P(E \mid A) = \frac{P(A \mid E) \cdot P(E)}{P(A)}$$

$$= \frac{\sum_b P(A \mid E, B) \cdot P(E)}{P(A)}$$

$$= P(E) \cdot P(A) \sum_b P(A \mid E, B)$$

$$\begin{array}{lll} & B=T & B=F \\ = 0.002 \times 0.002516 & \Big[\, 0.95 + 0.29 & \Big] \end{array}$$

$$\simeq 6.2 \times 10^{-6} \quad \text{(RARE)}$$