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**CS 540 HW4**

Q1:

1. h(b) can be from $0$ to $\frac{1}{2}$
2. iteration 1:

   Pop A

   OPEN: {B g(b) = $\frac{1}{2}$ ; h(b) = 100 ; f(b) =$100\frac{1}{2}$ ; parent = A }

   { C1 g(C1) = 1 ; h(C1) = $0$ ; f(C1) = 1 ; parent = A }

   CLOSE: A{ f(A) = $0$ ; parent = null }

   iteration 2:

   Pop C1

   OPEN: {B g(b) = $\frac{1}{2}$ ; h(b) = 100 ; f(b) =$100\frac{1}{2}$ ; parent = A }

   { C2 g(C2) = $1\frac{1}{2}$ ; h(C2) = $0$ ; f(C2) = $1\frac{1}{2}$ ; parent = C1 }

   CLOSE: { A f(A) = $\frac{1}{2}$ ; parent = null }

   { C1 g(C1) = 1 ; h(C1) = $0$ ; f(C1) = 1 ; parent = A }

   iteration 3:

   Pop C2

   OPEN: {B g(b) = $\frac{1}{2}$ ; h(b) = 100 ; f(b) =$100\frac{1}{2}$ ; parent = A }

   { C3 g(C3) = $1\frac{3}{4}$ ; h(C3) = $0$ ; f(C3) = $1\frac{3}{4}$ ; parent = C2 }

   CLOSE: { A f(A) = $\frac{1}{2}$ ; parent = null }

   { C1 g(C1) = 1 ; h(C1) = $0$ ; f(C1) = 1 ; parent = A }

   { C2 g(C2) = $1\frac{1}{2}$ ; h(C2) = $0$ ; f(C2) = $1\frac{1}{2}$ ; parent = C1 }

   iteration 4:

   Pop C3

   OPEN: {B g(b) = $\frac{1}{2}$ ; h(b) = 100 ; f(b) =$100\frac{1}{2}$ ; parent = A }

   { C4 g(C4) = $1\frac{7}{8}$ ; h(C4) = $0$ ; f(C4) = $1\frac{7}{8}$ ; parent = C3 }

   CLOSE: { A f(A) = $\frac{1}{2}$ ; parent = null }

   { C1 g(C1) = 1 ; h(C1) = $0$ ; f(C1) = 1 ; parent = A }

   { C2 g(C2) = $1\frac{1}{2}$ ; h(C2) = $0$ ; f(C2) = $1\frac{1}{2}$ ; parent = C1 }

   { C3 g(C3) = $1\frac{3}{4}$ ; h(C3) = $0$ ; f(C3) = $1\frac{3}{4}$ ; parent = C2 }

   iteration 5:

   Pop C4

   OPEN: {B g(b) = $\frac{1}{2}$ ; h(b) = 100 ; f(b) =$100\frac{1}{2}$ ; parent = A }

   { C5 g(C5) = $1\frac{15}{16}$ ; h(C4) = $0$ ; f(C4) = $1\frac{15}{16}$ ; parent = C3 }

   CLOSE: { A f(A) = $\frac{1}{2}$ ; parent = null }

{ C1 g(C1) = 1 ; h(C1) = 0 ; f(C1) = 1 ; parent = A }

{ C2 g(C2) = $1\frac{1}{2}$ ; h(C2) = 0 ; f(C2) = $1\frac{1}{2}$ ; parent = C1 }

{ C3 g(C3) = $1\frac{3}{4}$ ; h(C3) = 0 ; f(C3) = $1\frac{3}{4}$ ; parent = C2 }

{ C4 g(C4) = $1\frac{7}{8}$ ; h(C4) = 0 ; f(C4) = $1\frac{7}{8}$; parent = C3 }

3. Based on the results from part be, we can see that the formula is $f(C_{n)} = 1 + \frac{2^{n-1}-1}{2^{n-1}}$, therefore $\lim_{i\to\infty} f(Ci) = 2$
4. Because f(Ci) will never exceed 2 in this case so if h(B) is greater or equal to 2, the search algorithm will never pop B and therefore never be able to find an answer.
5. Yes. The range is $1 < \mathrm{h(B)} < 2$ . Because the f(Ci) will never exceed 2, so if h(B) is less than 2, the algorithm will be able to find an answer. Depend on the value of h(b), it may take a long time for the algorithm to find the answer.
6. It is a necessary condition for A* to be able to ALWAYS find an optimal goal.

Q2:

| Iteration Number | Current Point | Temperature | Probability |
|---|---|---|---|
| 1 | 2 | 1.8 | 0.5738(100% because successor is greater) |
| 2 | 3 | 1.62 | 0.2906 |
| 3 | 3 | 1.458 | 0.2537 |
| 4 | 1 | 1.312 | 0.1061(100% because successor is greater) |
| 5 | 4 | 1.181 | 0.1839 |
| 6 | 4 | 1.063 | 0.3903 |
| 7 | 4 | 0.957 | 1 |
| 8 | 4 | 0.861 | 0.313 |

Q3:

1. There are n! trees.
2. Its neighborhood cover $\frac{n-1}{n!}$ of the total number of states
3. $1 \times 10^{519455}$
4. $112511 \times 10 \div 384402 \approx 3\ \mathrm{LD}$
5. $112511 \times 10 \div 1000 = 1125.11\ \mathrm{km}$
6. 25 miles = 40.2336 km

   $1125 \div 25 = 45\ \mathrm{hours}$

   The inspector cannot finish the job in one day.