Advanced Heuristics

Questions on "Where the really hard problems are"
by Cheeseman, Taylor & Kanefski

1. P ≠ NP ?

Cheeseman et al. write in the abstract "assuming P ≠ NP". This is an open and important issue.

1.1 What is P, and what is NP?

1.2 So what if the assumption "P ≠ NP" turns out to be wrong? Does it mean that every element of NP is actually in P, or that every element of P is actually in NP?

1.3 What is meant by "typical cases are easy to solve", and how does it correspond to being in NP? The answer is hidden in the first paragraph.

2. Hamilton circuits

2.1 What is a Hamilton circuit?

2.2 Do you expect the following random networks to have a Hamilton circuit?

a) a network with 21 vertices and 93 edges

b) a network with 419 vertices and 1377 edges

c) a network with 20789 vertices and 300145 edges

d) a network with 88 vertices and 263 edges

e) a network with 31 vertices and 34 edges

f) a network with 171 vertices and 587 edges

2.3 Which of the networks from 2.2 will take the most time to decide using Cheeseman's method? Sort the networks from 'shortest time' to 'longest time'. Also, try to motivate your answer.

2.4 What is the best predictor of whether some graph is easily decided on for having a Hamilton circuit? What does Cheeseman call this predictor?

2.5 Cheeseman also mentions a possible secondary predictor for the existence of a Hamilton circuit, what is it?

3. Graph Coloring

3.1 “Graph coloring is almost always easy” (p.333). What does that mean, and how does it compare to being NP-complete?

3.2 From page 333, reduction operators are discussed. What are the implications of such reduction operators in terms of running time?

3.3 How does Brelas’ algorithm work?

3.4 On the last paragraph of p.334, the authors write “these local minima make it hard to find a solution”. But this is not an optimization problem, so how can there be local minima?

3.5 Similar to Hamilton circuit detection, graph coloring might be characterized by a secondary indicator. How is it similar, and how is it different?

3.6 There is a paradox lurking in the last paragraph of section 4. What is it?

4. Traveling Salesman

4.1 “The cost of edges ... not symmetric.” Does this matter a lot for the algorithm and/or problem instance?

4.2 (p.336) “This cost matrix can be rescaled and a constant added, without changing the essential problem.” If this is true, why would you want to do that?

4.3 (p.336) “In the one regio ... At the other extreme .... difficult.” Is this true? Or: how true is this?

4.4 (p.336) Same line as in 4.3, now looking at figure 5 and again: how true is this? And in what sense?