Book Review

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Dennis Shasha' Six Pack.

1. *The Puzzling Adventures of Doctor Ecco*, 0-486-29165-6
   Dover, Mineola, 1998; reprinted from W. H. Freeman, 1988.
2. *Dr. Ecco Mathematical Detective*, 0-486-43552-0
   Dover, Mineola, 2004; reprinted from W. H. Freeman, 1992.
3. *Dr. Ecco's Cyberpuzzles*, 0-393-05120-X
   W. W. Norton, New York, 2002.
4. *Puzzling Adventures*, 0-393-32663-2
   W. W. Norton, New York, 2005.
5. *The Puzzler's Elusion*, 1-56025-831-4
   Thunder's Mouth Press, New York, 2006.
6. *Puzzles for Programmers and Pros*, 0-470-12168-9
   Wiley, Indianapolis, 2007.

Dennis Shasha is the leading problemist of the day. He was the last person to edit the monthly puzzle column in *Scientific America* made famous by the long tenure of **Martin Gardner**, before the column disappeared from the printed pages into cyberspace. He still has a monthly puzzle column in *Dr. Dodd's Journal*, in addition to a full time job as a professor of computing sicence at the Courant Institute in New York University.

What makes a good puzzle? First of all, it must be *interesting*. If it is also *instructive*, that adds to its value. On rare occasions, a puzzle may be *important*, in that it introduces the solver to deeper concepts. In **Dennis Shasha's Six Pack**, the reader will find plenty of examples of important, instructive and interesting puzzles. For illustrations, I will take a part of the very first puzzle from each of his most recent three books.

Example 1. (from *Puzzling Adventures*)
Five witnesses are asked to give evidence against ten suspects, but some of them sometimes lie. In the following chart, Y means that the witness claims the suspect is guilty, and N means that the witness claims the suspect is innocent. Given that the total number of lies is 8 or 9, and there are more incorrect Ns than incorrect Ys. Which suspects are guilty?

Suspects	A	B	C	D	E	F	G	H	I	J
Witness 1	Y	N	Y	Y	Y	N	Y	Y	N	Y
Witness 2	Y	N	Y	Y	Y	N	Y	Y	N	N
Witness 3	Y	N	N	Y	Y	N	Y	Y	N	N
Witness 4	Y	N	N	Y	Y	N	N	Y	N	N
Witness 5	Y	N	N	Y	N	N	N	Y	N	N

Example 2. (from *Puzzles for Programmers and Pros*)
Jeremy and Marie are sharing three identical cakes. Jeremy cuts the first cake into two pieces. Empty pieces are allowed. Marie decides to choose first or let Jeremy choose first. Naturally, whoever chooses first will take the larger piece if the pieces are unequal. Once the pieces have been taken, the process is repeated with the second cake, and then the third cake. However, Marie must let Jeremy choose first once. How much of the three cakes can Jeremy guarantee of getting?

Example 3. (from *The Puzzler's Elusion*)
Harout wants to send 10 valuable coins from Yerevan to Zurich. For each coin, the regular shipping company charges him one half of its value. Michael can smuggle the coins for Harout, and they come to the following argument. Harout will divide the ten coins into a number of shipments. For each shipment, Michael will keep one of the coins, and smuggle the rest for Harout. Michael will not cheat if he can get just as many coins by being honest, and Harout will not change the arrangment unless Michael has cheated. If he uses the regular shipping company, Harout will essentially end up with five coins. Can he do better using Michael?

Give these a try before reading on.

Solution to Example 1.
At least 2 lies are made against each of C and G, and at least 1 lie against each of E and J. Hence the unanimous conclusions are all valid. If the total number of lies is 8, they must be 3 against each of C and G and 1 against each of E and J. However, the number of incorrect Ns must be the same as the number of incorrect Ys. Hence the total number of lies is 9, and they must be 2 against each of C and G, 4 against one of E and J and 1 against the other of E and J. Since there are more incorrect Ns than incorrect Ys, there are 4 lies against J and 1 against E. It follows that the guilty ones are A, D, E, G, H and J.

Solution to Example 2.
This is an instructive puzzle on recurrence and induction. Let a_n denote the maximum amount of cakes Jermey can get from n cakes under the rules. Note that $a_1 = 1$ since Marie must let Jeremy choose first once, and there is no reason why Jermey should leave anything for Marie. For $n \geq 1$, let Jeremy cut the cake into two pieces of respective amount b and s, with $b \geq s$. If Marie let him choose first, Jereme will cut all subsequent cakes in halves, and get $b + \frac{n-1}{2}$ cakes. If Marie chooses first, Jermey can get at most $s + a_{n-1}$ cakes. One of these two amounts increases if and only if the other decreases. Since Marie can dictate which amount Jeremy gets, he can maximize his take by making them equal, so that $a_n = \frac{1}{2}(b + \frac{n-1}{2} + s + a_{n-1}) = \frac{n+1}{4} + \frac{a_{n-1}}{2}$. It follows that $a_2 = \frac{5}{4}$ and $a_3 = \frac{13}{8}$.

Solution to Example 3.
Harout should divide the 10 coins into four shipments of respective sizes 4, 3, 2 and 1. Michael can get 4 coins by being honest. If he cheats on the first shipment, he will get 4 coins. If he cheats on the second shipment, he will get 1+3=4 coins. If he cheats on the third shipment, he will get 1+1+2=4 coins. He does not have to cheat on the fourth shipment since he gets the lone coin anyway. It follows that Michael will not cheat and Harout can keep six coins by using Michael. *This puzzle is an excellent introduction to Dynamic Programming.*