

# Constraint Programming

*Practical Exercises*

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Constraint Modelling

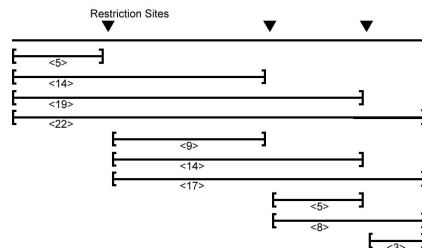
Toaster

- Propose a constraint model describing the toaster problem – the task is to minimize the number of toaster usages. Two toasts can be toasted together, but only one side of each toast is baked. The input to the model is the number of toasts.



Partial Digest Problem

- DNA is cut at several locations by an application of enzyme. We know distances between all the cuts and we look for the exact positions of the cuts. Propose a constraint model to solve the problem.



Double Digest Problem

- Assume that DNA is cut by an enzyme and we know distances between neighboring points  $a_i - a_{i-1}$ . Now a different enzyme cuts DNA at different points  $b_j$  and again we know the distances  $b_i - b_{i-1}$ . Finally, both enzymes are applied together and DNA is cut in all points  $a_i$  and  $b_i$  so we get points  $c_i$  and again, we know the distances  $c_i - c_{i-1}$  (note that some points  $a_i$  and  $b_j$  may overlap so the number of points  $c_k$  may be smaller than the sum of the numbers of points  $a_i$  and  $b_j$ ). From the multisets of distances  $\Delta a$ ,  $\Delta b$ , and  $\Delta c$ , find the all the cutting points  $a_i$ ,  $b_j$ ,  $c_k$ .

