

## 14 Magical Reindeer Breeding

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### Challenge

To deliver Christmas gifts around the world, Santa uses his enchanted sledge. Each year, the sledge is dragged by a herd of magical reindeer. Due to the heavy load, the reindeer can only drag the sledge once and need to retire afterwards. So Santa is required to breed a new herd of reindeer every year.

For that purpose, Santa uses a special enclosure in which the current population magically doubles its current size after each day. The enclosure is surrounded by a fence. This fence currently possesses a length of 112 meters and cannot be enlarged, because all elves in the workshops have to craft presents until Christmas. Furthermore, due to new regulations on reindeer-appropriate husbandry, Santa has to arrange the enclosure in the shape of a rectangle (see Fig. 1) and has to ensure that reindeer each are given space of at least 3 square meters. These regulations are enforced by the Department of Reindeer Welfare, and inspections can happen at *any time*.

The breeding process itself cannot be interrupted once it has been started, and Santa begins the breeding with Rudolph, his most famous and beloved reindeer.

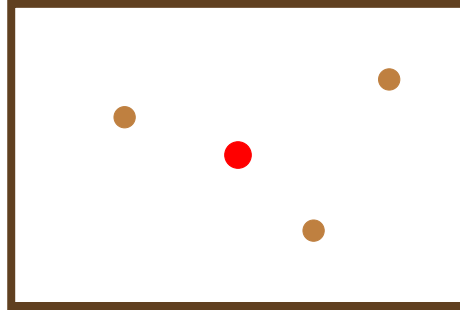


Figure 1: The rectangular enclosure, Rudolph (red), and three of his offspring (brown).

At which day should Santa start the breeding process to maximize the number of reindeer on the 24 December while abiding all the above regulations at any time?

**Possible answers:**

1. 1 December
2. 6 December
3. 10 December
4. 12 December
5. 14 December
6. 16 December
7. 18 December
8. 20 December
9. 22 December
10. 24 December

**Project reference:**

The move towards sustainable energy networks, with due consideration of the complexities arising from the integration of rather unsteady renewable resources, causes major operational challenges for network providers. The research agenda of project AA 4-7 *Decision-Making for Energy Network Dynamics* tackles fundamental questions concerning control and optimization in context of this application. The above challenge is an example of a constrained optimization problem.