

Question 1

For each of the following simplified scenarios, determine if it comprises a combinatorial optimization problem and if so whether a KR-based approach like Answer Set Programming (ASP) may in principle be suitable. There may be multiple interpretations and multiple correct answers. See this as a prompt for discussion with your tutor.

1.1 Building a mobile app that can play chess against the user.

The chess engine part of the app is a combinatorial optimization problem: how to find a strategy. However, ASP is not the right approach here because the adversarial element of the game prevents having a concise way of expressing chess strategies.

1.2 A new start-up offers chess clubs a software product that can propose a rotation of regular Sunday matches between the club members and automatically email the participants reminders when they have a match the next day.

Yes, there is a combinatorial optimization problem here and it could be addressed with ASP. The combinatorial problem is to determine a schedule of matches such that no player plays against themselves, no player plays twice on the same day, and possibly avoiding having any pair of players face each other more than once. The automated emailing part of the program is not relevant.

1.3 A Sydney non-profit wants to collect fresh produce discarded by supermarkets and redistribute them to local charity groups in different suburbs. The non-profit only has a single truck but a lot of good will.

Yes, there is a combinatorial optimization problem here and it could be addressed with ASP. The combinatorial problem is to find an efficient itinerary for the truck pick-ups and drop-offs. The route should visit as many supermarkets and charity groups as possible. The route needs to be such that the capacity of the truck for holding food is never exceeded. The travel time needs to be minimized because the groceries are perishable. The route should not visit a charity group more than once.

1.4 A political party wants to improve its image in view of the next election. Its strategy is to carefully write the next public speech so that the audience is thrilled and votes for it.

Depending on interpretation, we could see a combinatorial problem hiding in there. For instance, the speech could announce a series of investments that will be appealing to the audience without going over budget. Determining which items to fund and which ones to discard is a combinatorial optimization problem that could be tackled with ASP.

1.5 A car manufacturing company wants to improve the energy-efficiency of the next vehicle it designs. This involves adjusting the shape of the car body so as to minimize air friction.

Determining the ideal surface to minimize friction is a continuous optimization problem, it's not clear how one could approach with logic-based formalisms such as ASP.