

# IE 303 Modelling and Methods in Optimization

Fall 2022

MCP

First Project Assignment to be completed individually or in groups of two, due date: October 25, 2022, Midnight. For questions about the assignment consult the TAs. Send your reports to the TAs by email (ecenur.oguz and selim.aktas followed by @bilkent.edu.tr)

## 1 Making Riches with Ali Baba

After keeping Ali Baba in the cave for a few days, the thieves decide to release him. Ali Baba tells the thieves that he wants to get some gold coins from the cave. In response, the thieves give Ali Baba an assignment and say that he can get a certain number of gold coins from the cave, according to the result of this assignment. In the beginning, the thieves give Ali Baba a  $7 \times 7$  chessboard without any coins on it. According to the rules of the assignment, Ali Baba will leave as many unit squares of this chessboard as he wants empty, and place either a gold or a bronze coin in each of the remaining unit squares. According to the rules of the assignment, any  $3 \times 3$  square of unit squares of the chessboard must contain an equal number of gold and bronze coins after all the coins have been placed. According to the agreement, after the coins are properly placed by Ali Baba, the thieves allow Ali Baba to take away all the gold coins from the  $7 \times 7$  chessboard.

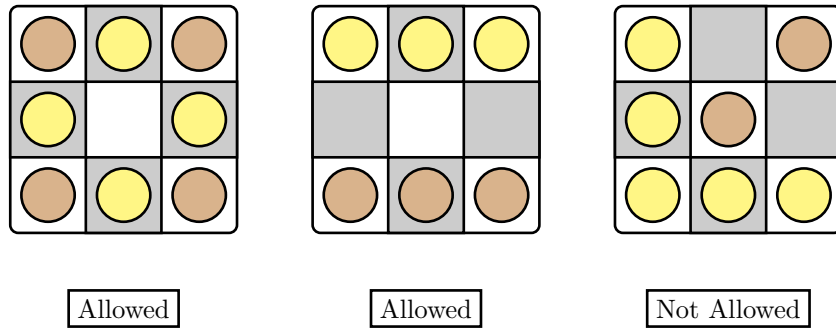


Figure 1: Example  $3 \times 3$  grids

## 2 Questions

1. Formulate an IP-Model for Ali Baba's assignment to maximize his profit.
2. Solve your model using XPress-MP. Briefly explain your results.
3. (Bonus) How would you solve the same problem if instead of  $7 \times 7$ ,  $90000 \times 90000$  chess board was given? What is the guarantee that your approach will be optimal ?