Assignment 2 – Extended Mine Planning

This assignment is due by 11:59pm on Friday, April 22nd and is worth 20% of your final grade. You can do each assignment in pairs, with a single submission.

BigAlCo were so satisfied with your work on Assignment 1 that they have come back to you with a larger, more difficult problem.

They still need to meet the demands of several customers, while minimising mining cost. However, now each customer requires a specified tonnage of bauxite for each of 6 months with the tonnage required in each month potentially varying. The minimum content of aluminium and silicon varies by customer, but is constant from month to month.

To meet the demands of their customers, BigAlCo can mine bauxite from a number of different bauxite mine blocks. Each mine block is of a specified size (in tonnes), has a known cost per tonne of mining and known content of aluminium and silicon.

The mine blocks are laid out roughly as follows:

Mine Face				
Block(0,0)	Block(0,1)	Block(0,2)	…	Block(0,6)
Block(1,0)	Block(1,1)	Block(1,2)	…	Block(1,6)
Block(2,0)	Block(2,1)	Block(2,2)	…	Block(2,6)
Block(3,0)	Block(3,1)	Block(3,2)	…	Block(3,6)

BigAlCo need to decide which how much ore from which blocks to supply to each customer each month from July to December this year. There are mining access rules as follows:

- The two "columns" of blocks on the left most side of the mining area (columns 0 and 1 above) cannot be used at all in November and December as it is not accessible in the rainy season.
- A block cannot be used in a month unless the block immediately closer to the Mine Face is completely mined by the end of the same month (i.e. its entire tonnage used). For example, if Block(0,0) is partially mined in July and then fully mined in August, we can't mine Block(1,0) at all in July, but can mine any amount from August onwards.

Create a general mathematical formulation of BigAlCo's problem.

Implement your model in Python and solve it using the data generated by the stub provided on Blackboard.

BigAlCo are concerned that the algorithm may produce solutions which mine very unevenly – with deep channels leading from the mine face. Therefor they ask you to consider the impact of the following additional access rule:

- A block cannot be used in a month unless the block immediately closer to the Mine Face, and the blocks on either side of that block are completely mined by the end of the same month. For example, we can't mine Block(2,1) in September unless Block(1,0), Block(1,1) and Block (1,2) are all completely mined out by the end of September. For those blocks on the edge of the mining area, only two other blocks need to be mined out to gain access.

You will need to submit the following:

1. A general mathematical formulation of the problem with the additional/alternative constraints for the additional access rule clearly marked (8 marks)
2. A Python file with the problem modelled for Gurobi. This should be easy to relate back to the formulation and should have a binary global variable which can be set to "True" to turn on the additional access rules. We will attempt to execute this model. (8 marks)
3. A short report discussing the solution and the impact of the additional access rule (4 mark)

Submit your files via Blackboard, using PDF for the report (items 1 and 3 above). The PDF can be saved from Word or created in LaTeX. Only one submission per pair is necessary but make sure both names are clearly shown.