Partial schedule generation

Partial Schedule Generation

- Goals:
  - Greatly simplify constraints
  - Compromise between full schedule generation and no schedule generation
    - No schedule generation: really complex constraints
    - Full employee schedule generation: Infeasibly exponential number of schedules.

Difficult "ugly" constraints

Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
					OR	OR							
	/	s	s	s	s	s	/						

- Weekends are counted Saturday **or** Sunday
- Consecutive (off) shift counts. Constraints between far away days.
- Not very elegant to represent as ILP
→ Divide into blocks to simplify these.

Schedule is divided into blocks

Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun

Employee 1 has minimum block size 5.

Each block has a set of allowed sub schedules within that block.

Schedule is divided into blocks

Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun

Employee 2 has minimum block size 6. => weekends must be included whole in a block

Schedule is divided into blocks

Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun

Employee 3 has minimum block size 3.

Schedule is divided into blocks

Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
						F							

Employee 4 has minimum block size 5.
Free days allow for smaller blocks.

Resulting constraints

- Generate all schedules for each block
  - Keep weekends whole

- Adjacent Block Constraints
  - Co-occurence allowed Matrix from difficult constraints
    - Consecutive shifts
    - Shift may follow

- Global Constraints
  - Translated from original constraints
    - Number of weekends
    - Total shifts
    - Max minutes
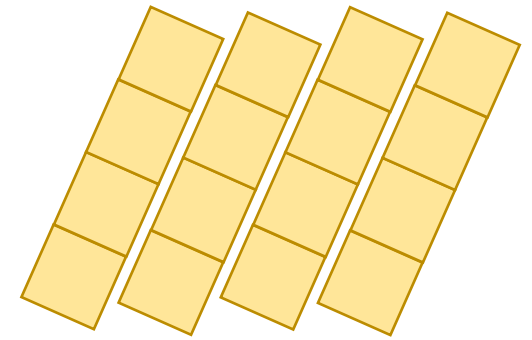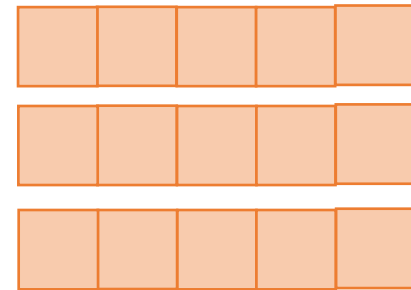
1	1	1	0
0	1	1	0
0	0	0	1

ILP Representation

- Block b of Employee e has possible schedules x_{ebs} :

    $\forall e \in E, b \in B_e: \sum_{s}^{S_{eb}} x_{ebs} = 1$

- Adapt Global Constraints from original constraints

- Local Constraints:

    $\forall e \in E, b \in B_e, s \in S_{eb}, r \in S_{e(b+1)}: x_{ebs} + x_{e(b+1)r} \leq 1$ iff s and r are not compatible

Maximal BiClique Optimization

- Fewer tighter constraints

1	1	1	0
0	1	1	0
0	0	0	1

Performance measurements

	Baseline Gurobi		
	Time	**LB**	**Best**
1	0,107	607	607
2	1,29	828	828
3	0,98	1001	1001
4	10,67	1716	1716
5	70,07	1143	1143
6	20,67	1950	1950
7	29,23	1056	1056
8	3586	1300	1300
9	3601	406	439
10	18,0	4631	4631
11	16,0	3443	3443

	Blocks Method		
	Time	**LB**	**Best**
1	0,08	607	607
2	0,26	828	828
3	0,46	1001	1001
4	1,12	1716	1716
5	3,16	1143	1143
6	4,25	1950	1950
7	15,45	1056	1056
8	640	1300	1300
9	3600	439	439
10	58,16	4631	4631
11	233,7	3443	3443