GUROBI SOLVING OF ②

- **Attempt 1:**

$C(i,j)$ → Completion time of operation $i \in [1,2,3]$ → $[0,1,2]$ of job $j \in [1,2,\dots N]$ → $[0,1,\dots N-1]$

$OR(j)$ → Binary variable, 1 if patient j answers in the OR

$PREC(j_1,j_2)$ → Binary matrix, each entry = 1 if job j_1 precedes j_2 in the schedule

DEFINITION OF PRECEDENCE OF j_1 ON j_2: $A(j_1)$ BEGINS BEFORE $A(j_2)$

O.F. $\min(\max(C(3,j)))$

CONSTRAINTS:

① $C(1,j) - P(1,j) \geq 0$	$\forall j$	Initialization of first job (whichever it is)
② $C(2,j) - P(2,j) - C(1,j) = 0$	$\forall j$	No time between operations of each job
③ $C(3,j) - P(3,j) - C(2,j) = 0$	$\forall j$	
④ $C(2,j_1) - P(2,j_1) - C(1,j_2) + M \cdot PREC(j_1,j_2) \geq 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	Ordering of patients
⑤ $C(2,j_2) - P(2,j_2) - C(2,j_1) + P(2,j_2) + M \cdot PREC(j_2,j_1) \geq 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	
Wrong ⑥ $C(3,j_1) - P(3,j_1) - C(3,j_2) + M \cdot PREC(j_1,j_2) \geq 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	
⑦ $C(2,j_1) - P(2,j_1) - C(2,j_2) - P(3,j_2) \cdot OR(j_2) + M \cdot PREC(j_1,j_2) \geq 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	No overlapping in the OR
⑧		
Wrong ⑨ $C(3,j_2) - P(3,j_2) - C(1,j_1) + M \cdot OR(j_2) + M \cdot PREC(j_1,j_2) \geq 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	No overlapping of $A(j_1)$ and $A(j_2)$

- **Attempt 2:**

$C(i,j)$ → Completion of operation $i \in [1,2,3]$ of job $j \in [1\dots N]$

$OR(j)$ → Binary variable = 1 if job j answers in the OR.

$PREC(i_1,j_1,i_2,j_2)$ → Binary matrix (4 dimensions, $3 \times N^2$ elements), 1 if operation (i_1,j_1) precedes (i_2,j_2)

O.F. $\min(\max(C(3,j)))$ ⇝ $\min(F)$ (F → Int, support variable to express $\max(3,j)$)

CONSTRAINTS:

① $C(1,j) - P(1,j) \geq 0$	$\forall j$	Initialization of first job (whichever it is)
② $C(2,j) - P(2,j) - C(1,j) = 0$	$\forall j$	No time between operations of each job
③ $C(3,j) - P(3,j) - C(3,j) = 0$	$\forall j$	
④ $C(2,j_1) - P(2,j_1) - C(2,j_2) + M \cdot PREC(2,j_1,2,j_2) \geq 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	SURG and SURG — No overlapping
⑤ $C(2,j_2) - P(2,j_2) - C(3,j_1) + M \cdot PREC(2,j_1,3,j_2) + M \cdot (1 - OR(j_2)) \geq 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	SURG and AW
⑥ $C(3,j_2) - P(3,j_2) - C(2,j_1) + M \cdot PREC(3,j_1,2,j_2) + M \cdot (1 - OR(j_1)) \geq 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	AW and SURG
⑦ $C(1,j_1) - P(1,j_1) - C(1,j_2) + M \cdot PREC(1,j_1,1,j_2) \geq 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	A and A
⑧ $C(1,j_1) - P(1,j_1) - C(3,j_2) + M \cdot PREC(1,j_1,3,j_2) + M \cdot OR(j_2) \geq 0$	$\forall j_1,j_2 \mid j_2 \neq j_1$	A and AW
⑨ $C(3,j_1) - P(3,j_1) - C(1,j_2) + M \cdot PREC(3,j_1,1,j_2) + M \cdot OR(j_1) \geq 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	AW and A
⑨.1 $C(3,j_1) - P(3,j_1) - C(3,j_2) + M \cdot PREC(3,j_1,3,j_2) + M \cdot (OR(j_1) + OR(j_2))$	$\forall j_1,j_2 \mid j_1 \neq j_2$	AW and AW — Only in AM the two can overlap
⑩ $F - C(3,j) \geq 0$	$\forall j$	$F = \max(C(3,j))$
⑪ $PREC(1,j_1,1,j_2) + PREC(1,j_2,1,j_1) - 1 = 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	A and A
⑫ $PREC(2,j_1,2,j_2) + PREC(2,j_2,2,j_1) - 1 = 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	S and S
⑬ $PREC(3,j_1,3,j_2) + PREC(3,j_2,3,j_1) - 1 = 0$	$\forall j_1,j_2 \mid j_2 \neq j_1$	AW and AW
⑭ $PREC(2,j_1,3,j_2) + PREC(3,j_2,2,j_1) - 1 = 0$	$\forall j_1,j_2 \mid j_1 \neq j_2$	S and AW
⑮ $PREC(1,j_1,3,j_2) + PREC(3,j_2,1,j_1) - 1 = 0$	$\forall j_1,j_2 \mid j_2 \neq j_1$	A and AW