# Minimizing Working-Group Conflicts in Conference Session Scheduling Through Maximum Satisfiability

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# Plan

# Preliminaries

## literal

A literal is a variable $x$, or its negation $\overline{x}$

## Clause

A clause is a disjunction of literals $(l_1 \vee l_2 \vee \cdots \vee l_m)$

## Conjunctive Normal Form (CNF)

A CNF formula is a conjunction of clauses $C_1 \wedge C_2 \wedge \cdots \wedge C_n$

$\phi = (x_1 \vee x_2) \wedge (\overline{x_1} \vee x_3) \wedge (\overline{x_2} \vee \overline{x_3})$
The formula $\phi$ is satisfied by $\alpha = \{x_1, \overline{x_2}, x_3\}$

# Maximum Satisfiability (Max-SAT)

## Definition

Given a CNF formula $\phi$, Max-SAT consists in determining the maximum (resp. minimum) number of clauses that can be satisfied (resp. falsified) by an assignment of the variables :

$$opt(\phi) = \min_{\alpha} \ cost_{\alpha}(\phi)$$

where $cost_{\alpha}(\phi)$ denotes the number of clauses falsified by $\alpha$.

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where $cost_{\alpha}(\phi)$ denotes the number of clauses falsified by $\alpha$.

$\phi = (x_1 \vee x_2) \wedge (\overline{x_1} \vee x_3) \wedge (\overline{x_2} \vee \overline{x_3})$

- For $\alpha_1 = \{x_1, x_2, \overline{x_3}\}$, $cost_{\alpha}(\phi) = 1$
- For $\alpha_2 = \{x_1, \overline{x_2}, x_3\}$, $cost_{\alpha}(\phi) = opt(\phi) = 0$

# Partial Max-SAT

## Partial CNF Formula

A partial CNF formula is a bipartite set of clauses $\phi = S \cup H$ where $H$ denotes the set of hard clauses and $S$ the set of soft clauses

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A partial CNF formula is a bipartite set of clauses $\phi = S \cup H$ where $H$ denotes the set of hard clauses and $S$ the set of soft clauses

## Partial Max-SAT

Given a partial CNF formula $\phi = H \cup S$, Partial Max-SAT consists in determining the minimum number of soft clauses that can be falsified by an assignment while satisfying all the hard clause in $\phi$:

$$opt(\phi) = \min_{\alpha \text{ s.t H satisfied}} cost_\alpha(S)$$

# Partial Max-SAT

$\phi = H \cup S$ with $H = \{(x_1 \vee x_2)\}$ and $S = \{(\overline{x_1} \vee x_3), (\overline{x_2} \vee \overline{x_3})\}$

- $\alpha_1 = \{\overline{x_1}, \overline{x_2}, x_3\}$ is not a feasible solution because the hard clause is not satisfied
- $\alpha_2 = \{x_1, x_2, \overline{x_3}\}, cost_{\alpha_2}(S) = 1$ is a feasible solution
- $\alpha_3 = \{\overline{x_1}, x_2, \overline{x_3}\}, cost_{\alpha_3}(S) = 0$ is an optimal solution !

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## Pseudo-Boolean Constraints

$(\sum_{i=1}^{h} a_i * l_i) \circ k$ where $a_i, k \in \mathbb{N}$ and $\circ \in \{\leq, =, \geq\}$.

# Plan

# ROADEF Conference


ROADEF

SOCIÉTÉ FRANÇAISE DE RECHERCHE OPÉRATIONNELLE ET D'AIDE À LA DÉCISION

- Largest french-speaking conference dedicated to combinatorial optimisation and operations research.
- Annual event, with around 600 participants
- Comprises plenary sessions, **multiple parallel sessions**, industrial feedback sessions, ROADEF general assembly, ...
- Aims to train young researchers and to promote exchanges and collaborations with industrial partners

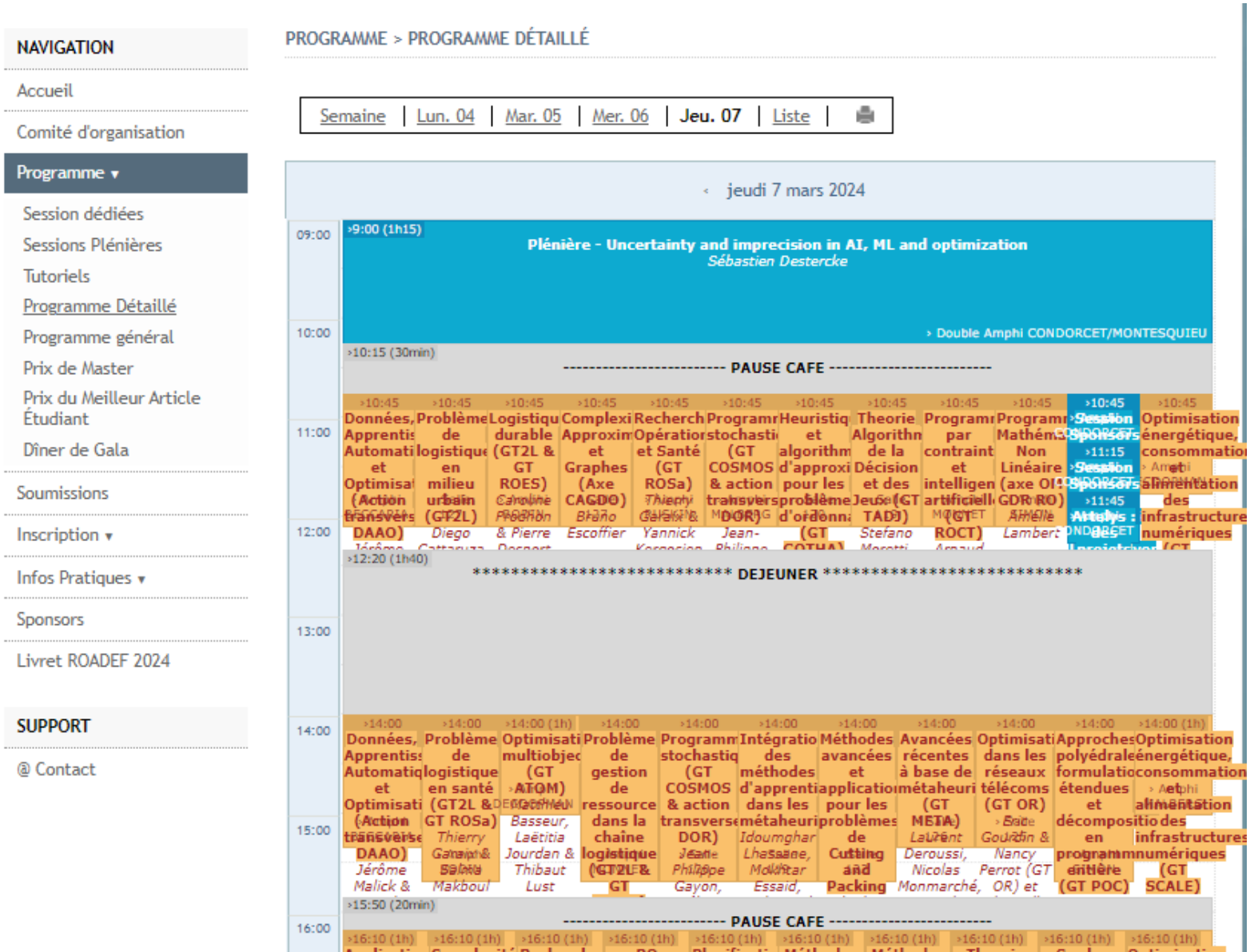
# ROADEF Scheduling

| Mercredi 6 mars | | |
|---|---|---|
| 9h – 10h15 | Plénière Nadia Brauner | Amphis |
| 10h15 – 10h45 | Pause café | Hall |
| 10h45 – 12h05 | Sessions Parallèles #5 (4) | |
| 12h – 14h | Pause déjeuner | Restaurant Universitaire |
| 14h – 14h30 | AG GdR RO | Amphi |
| 14h45 – 15h45 | Tutoriels I | Petit Amphi |
| 14h45 – 15h45 | Tutoriels II | Petit Amphi |
| 14h45 – 15h45 | Prix Master (3) | |
| 16h05 – 16h45 | Prix Master (2) | |
| 14h45 – 15h45 | Sponsors | Petit Amphi |
| 15h45 – 16h05 | Pause café | Hall |
| 17h – 18h30 | AG de la ROADEF | Amphis |

| Mardi 5 mars | | |
|---|---|---|
| 8h – 8h45 | Accueil | |
| 8h45 – 9h15 | Session d'ouverture | Amphis |
| 9h15 – 10h30 | Plénière Carola Doer | Amphis |
| 10h30 – 11h | Pause café | Hall |
| 11h – 12h20 | Sessions Parallèles #1 (4) | |
| 12h – 14h | Pause déjeuner | Restaurant Universitaire |
| 14h – 16h | Prix Etudiant I (4) | |
| 14h – 16h | Sessions Parallèles #2 (6) | |
| 16h30 – 18h30 | Sessions Parallèles #3 (3-6) | |
| 16h – 16h30 | Pause café | Hall |
| 16h30 – 18h | Prix Etudiant II (3) | |
| ~~17h10 – 18h30~~ | ~~Sessions Parallèles #4 (4)~~ | |

| Jeudi 7 mars | | |
|---|---|---|
| 9h – 10h15 | Plénière Sébastien | Amphis |
| 10h15 – 10h45 | Pause café | Hall |
| 10h45 – 12h20 | Sessions Parallèles #6 (4) | |
| 12h – 14h | Pause déjeuner | Restaurant Universitaire |
| 14h – 15h40 | Sessions Parallèles #7 (5) | |
| 15h50 – 16h10 | Pause café | Hall |
| 16h10 – 17h30 | Sessions Parallèles #8 (4) | |
| 18h | Départ repas de Gala | |

# ROADEF Scheduling



# Working Groups & Sessions

## Working Groups

Group of researchers / Research field

## Sessions

- A session is organised in one or several parallel session slots
- A session is generally organised by one or several working groups

# Problem

Overlaps prevent researchers from participating in their group sessions.

## Objective

Avoid overlaps (conflicts) between working groups in available time slots, in order to allow optimal participation of researchers in their sessions.

**Manuel Solution by the organising committee:**

| | | | | Mardi | | | Mercredi | Jeudi | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| fr | CASID | NB papiers | | 1 (4) | 2(6) | 3 (3-6) | 5 (4) | 6(4) | 7(5) | 8(4) | |
| Sessions ParallV®les | NB Sessions // | | | 11 | 11 | 11 | 11 | 11 | 11 | 11 | |
| Theorie Algorithmique de la DV©cision et des Jeux (GT TADJ) | 1453676 | 14 | | 4 | | 3 | | 4 | | 3 | 14 |
| DonnV©es, Apprentissage Automatique et Optimisation (Action transverse DAAO) | 1453676 | 23 | | | 6 | 4 | 4 | 4 | 5 | | 23 |
| Prix du Meilleur Article VâtudiantT | 1453676 | | | | | | | | | | 0 |
| Prix du Master | 1453676 | | | | | | | | | | 0 |
| Approches exactes basV©es sur l'apprentissage pour l'optimisation des systV®mes logistiques | 1453676 | 2 | | | | | | | | | 0 |
| Recherche OpV©rationnelle et SantV© (GT ROSA) | 201292 | 12 | | 3 | | 3 | | 3 | | 3 | 12 |
| MV©thodes avancV©es et applications pour les problV®mes de Cutting and Packing | 148991 | 9 | | | | | 4 | | 5 | | 9 |
| IntV©gration des mV©thodes d'apprentissage dans les mV©taheuristiques | 190261 | 9 | | | 6 | | | | 3 | | 9 |
| RO et V©thique (GT ROET) | 120058 | 2 | | | | | | | | | 0 |
| RO Environnement & SociV©tV© (GT ROES) + GT ROET | 50035 | 4 | 6 | | | 3 | | | | 3 | 6 |
| Optimisation bi-niveaux et applications | 1453676 | 6 | | | 6 | | | | | | 6 |

# Plan

# Formalisation

1. **Sessions ($S$)**
2. **Working Groups ($G$)**
3. **Available Slots ($C$)**
4. **Amount of authorized papers per session ($L$)**

# Formalisation

6. $n$: **maximal number of parallel sessions**
7. $np(s)$: **number of papers accepted in session** $s \in S$
8. $npMax(c)$: **maximal number of papers per slot** $c \in C$
9. $WG(s) \subseteq G$: **Working Groups for session** $s \in S$

# Case study: ROADEF 2024

- $25^{th}$ edition organised in Amiens by the MIS lab
- 40 sessions, 20 groups, 7 slots.

## Constraints

- 20 minutes per presentation
- Each parallel session should last between 1 and 2 hours
- A maximum of 15 sessions in parallel

# Case study: ROADEF 2024

- $S = \{1, \ldots, 40\}$ : Sessions
- $G = \{1, \ldots, 20\}$ : Groups
- $C = \{1, \ldots, 7\}$ : Slots
- $L = \{3, 4, 5, 6\}$ : amount of papers per session
- $n \leq 15$ : maximal number of parallel sessions (per slot)

307 papers accepted in the conference distributed over the sessions.

# Case study: ROADEF 2024

| Session s | Label | np(s) | Groups | WG(s) |
|---|---|---|---|---|
| 1 | Theorie Algorithmique de la Décision et des Jeux | 14 | TADJ | {1} |
| 2 | Données, Apprentissage Automatique et Optimisation | 23 | DAAO | {2} |
| ..... | ..... | .... | ..... | ..... |
| 39 | Problème de logistique en milieu urbain | 6 | GT2L, P2LS | {8,12} |
| 40 | Programmation par contraintes et intelligence artificielle | 8 | ROCT, META | {7,15} |

| **Slot (c)** | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| **npMax(c)** | 4 | 6 | 6 | 4 | 4 | 5 | 3 |

# Case study: ROADEF 2024

| Session s | Label | np(s) | Groups | WG(s) |
|---|---|---|---|---|
| 1 | Theorie Algorithmique de la Décision et des Jeux | 14 | TADJ | {1} |
| 2 | Données, Apprentissage Automatique et Optimisation | 23 | DAAO | {2} |
| ..... | ..... | .... | ..... | ..... |
| 39 | Problème de logistique en milieu urbain | 6 | GT2L, P2LS | {8,12} |
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| **Slot (c)** | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| **npMax(c)** | 4 | 6 | 6 | 4 | 4 | 5 | 3 |

## Specific Constraints

Session 34 must be programmed in the last day (slots 5, 6, 7)

# Variables

- **Assignment Variables** $x_{(s,c,l)}$

  True if session $s$ is allocated to slot $c$ with $l$ papers.

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- **Assignment Variables** $x_{(s,c,l)}$

  True if session $s$ is allocated to slot $c$ with $l$ papers.

- **Conflict Variables** $y_{(s_1,s_2,c,g)}$

  True if there is a conflict for group $g$ between sessions $s_1$ and $s_2$ in slot $c$.

# Soft Clauses

## Targeted Objective

Minimise the number of conflicts, i.e. the number of satisfied $y$ variables

$$\phi_{soft} = \bigwedge_{\substack{(s_1,s_2,c,g)\in S\times S\times C\times G \\ s1<s2 \\ g\in W(s_1)\cap W(s_2)}} \overline{y_{(s_1,s_2,c,g)}}$$

# Hard Constraints

## Constraints 1 & 2:

- At most one quantity of papers for each (session,slot) pair:

$$\sum_{l \in L} x_{(s,c,l)} \leq 1 \qquad \forall (s,c) \in S \times C \tag{1}$$

# Hard Constraints

## Constraints 1 & 2:

- At most one quantity of papers for each (session,slot) pair:

$$\sum_{l \in L} x_{(s,c,l)} \leq 1 \qquad \forall (s,c) \in S \times C \tag{1}$$

- Cover all the papers in a session:

$$\sum_{\substack{c \in C \\ l \in L}} x_{(s,c,l)} \times l = np(s) \qquad \forall s \in S \tag{2}$$

# Hard Constraints

## Constraints 3 & 4 & 5 :

Enforce the maximal number of papers per slot:

$$\bigwedge_{\substack{l \in L \\ l > npMax(c)}} \overline{x(s,c,l)} \qquad \forall (s,c) \in S \times C \tag{3}$$

# Hard Constraints

## Constraints 3 & 4 & 5 :

Enforce the maximal number of papers per slot:

$$\bigwedge_{\substack{l \in L \\ l > npMax(c)}} \overline{x(s,c,l)} \qquad \forall (s,c) \in S \times C \tag{3}$$

Enforce the maximal number of parallel sessions:

$$\sum_{\substack{s \in S \\ l \in L}} x_{(s,c,l)} \leq n \qquad \forall c \in C \tag{4}$$

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$$\bigwedge_{\substack{l \in L \\ l > npMax(c)}} \overline{x(s,c,l)} \qquad \forall (s,c) \in S \times C \tag{3}$$

Enforce the maximal number of parallel sessions:

$$\sum_{\substack{s \in S \\ l \in L}} x_{(s,c,l)} \leq n \qquad \forall c \in C \tag{4}$$

Session 34 must be programmed in the last day of the conference:

$$\bigwedge_{\substack{c \in C \setminus \{5,6,7\} \\ l \in L}} \overline{x_{(34,c,l)}} \tag{5}$$

# Hard Constraints - Conflict Management

Two sessions associated to the same group and assigned to the same slot generate a conflict:

$$(\sum_{l \in L} x_{(s_1,c,l)} \geq 1 \bigwedge \sum_{l \in L} x_{(s_2,c,l)} \geq 1) \implies y_{(s_1,s_2,c,g)}$$

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$$(\bigwedge_{l \in L} \overline{x_{(s_1,c,l)}}) \bigvee (\bigwedge_{l \in L} \overline{x_{(s_2,c,l)}}) \bigvee y_{(s_1,s_2,c,g)} \quad (6)$$

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$$(\bigwedge_{l \in L} \overline{x_{(s_1,c,l)}}) \bigvee (\bigwedge_{l \in L} \overline{x_{(s_2,c,l)}}) \bigvee y_{(s_1,s_2,c,g)} \quad (6)$$

**Introduction of new variables**

- $z_{(s,c)}$ is true if the session $s$ is not allocated to slot $c$.

# Hard Constraints - Conflict Management

## Constraints 6 & 7 :

- Enforce the semantic meaning of the z variables:

$$z_{(s,c)} \Leftrightarrow \bigwedge_{l \in L} \overline{x_{(s,c,l)}} \qquad \forall (s,c) \in S \times C \tag{7}$$

# Hard Constraints - Conflict Management

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- Enforce the semantic meaning of the z variables:

$$z_{(s,c)} \Leftrightarrow \bigwedge_{l \in L} \overline{x_{(s,c,l)}} \qquad \forall (s,c) \in S \times C \tag{7}$$

- Two sessions associated to the same group and assigned to the same slot generate a conflict:

$$z_{(s_1,c)} \vee z_{(s_2,c)} \vee y_{(s_1,s_2,c,g)} \tag{6'}$$

$$\forall (s_1, s_2, c, g) \in S \times S \times C \times G \text{ s.t } s1 < s2 \text{ and } g \in WG(s_1) \cap WG(s_2)$$

# Hard Constraints - Reformulations

## Reformulation of Constraints 4 & 5 :

- Enforce the maximal number of parallel sessions:

$$\sum_{s \in S} \overline{z_{(s,c)}} \leq n \qquad \forall c \in C \tag{4'}$$

# Hard Constraints - Reformulations

## Reformulation of Constraints 4 & 5 :

- Enforce the maximal number of parallel sessions:

$$\sum_{s \in S} \overline{z_{(s,c)}} \leq n \qquad \forall c \in C \tag{4'}$$

- Session 34 must be programmed in the last day of the conference:

$$\bigwedge_{c \in C \setminus \{5,6,7\}} z_{(34,c)} \tag{5'}$$

# Plan

# Experimental Protocol

- Model(s) implemented in PySAT[1] with sorting-network encoding for Pseudo-Boolean constraints[2].
- 84 generated instances extracted from 2021-2024 data, with 12 UNSAT
- Timeout set to 3600s per instance.
- Solvers : RC2, OpenWBO, MaxCDCL and MaxHS
- Comparison with CP-SAT of OR-Tools (CP Approach)

[1] `https://pysathq.github.io/`

[2] $O(m \times \log^2(m))$ where m is the sum of weights

# Results : Model vs Handmade Solutions

| **Year** | 2024 | 2023 | 2022 | 2021 |
|---|---|---|---|---|
| **Sessions** | 40 | 47 | 42 | 27 |
| **Groups** | 20 | 24 | 24 | 17 |
| **Slots** | 7 | 7 | 8 | 11 |
| **Papers** | 307 | 358 | 311 | 182 |
| **Conflicts** | 4 (6) | 9 (35) | 29 (38) | 0 (3) |
| **Parallel Sessions** | 10 (11) | 13 (14) | 11 (11) | 5 (5) |

# Results : Formulations

| | | Without Z | | | | | With Z | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **n** | **RC2** | **WBO** | **Max-CDCL** | **Max-HS** | **CP-SAT** | **RC2** | **WBO** | **Max-CDCL** | **Max-HS** | **CP-SAT** |
| 2024 | 15 | **3.428** | 7.811 | 5.358 | 16.086 | 26.800 | 1.259 | 1.180 | **0.989** | 17.933 | 7.683 |
| | 14 | **3.054** | 12.095 | 5.716 | 46.308 | 26.291 | 1.300 | 1.130 | **0.818** | 14.633 | 6.677 |
| | 13 | **3.288** | 6.989 | 5.591 | 46.206 | 20.622 | 1.199 | 1.404 | **0.992** | 18.585 | 7.713 |
| | 12 | **3.540** | 6.036 | 5.147 | 95.241 | 22.691 | 1.315 | 1.742 | **0.805** | 20.607 | 10.056 |
| | 11 | **3.652** | 12.384 | 8.746 | 153.335 | 22.594 | 1.287 | 2.472 | **1.100** | 71.655 | 10.390 |
| | 10 | **9.902** | 1398.111 | 511.043 | 869.119 | 88.831 | **9.707** | 341.225 | 150.416 | 271.440 | 35.460 |
| 2023 | 17 | 197.515 | **119.674** | T (-) | 1187.325 | T (-) | **9.687** | 17.769 | T (9) | 357.906 | T (9) |
| | 16 | 355.627 | **71.472** | T (-) | 755.975 | T (9) | **12.602** | 20.701 | 3058.418 | 395.716 | T (9) |
| | 15 | 139.625 | **99.332** | T (-) | 1106.281 | T (9) | **23.467** | 41.042 | T (9) | 408.854 | T (9) |
| | 14 | 107.202 | **102.947** | T (-) | 1036.948 | T (9) | **14.011** | 22.683 | T (9) | 413.160 | T (9) |
| | 13 | 250.308 | **199.549** | T (-) | 853.876 | T (9) | **8.006** | 14.962 | 3136.008 | 439.812 | T (9) |
| | 12 | T [10] | T (-) | T (-) | T (28)[8] | T (-) | T (-)[10] | T (-) | T (-) | T (23)[8] | T (10) |
| 2022 | 16 | T (-)[24] | T (127) | **T (29)** | 385.625 (46)[18] | **T (29)** | T (-)[25] | T (146) | **T (29)** | 496.061 (42)[22] | **T (29)** |
| | 15 | T (-)[24] | T (161) | **T (29)** | 380.048 (37)[26] | **T (29)** | T (-)[24] | T (134) | **T (29)** | 322.627 (51)[18] | **T (29)** |
| | 14 | T (-)[25] | T (196) | **T (29)** | T (37)[26] | **T (29)** | T (-)[27] | T (132) | **T (29)** | 473.504 (38)[23] | **T (29)** |
| | 13 | T (-)[24] | T (222) | **T (29)** | 392.299 (53)[18] | **T (29)** | T (-)[27] | T (146) | **T (29)** | 348.256 (56)[17] | **T (29)** |
| | 12 | T (-)[24] | T (324) | **T (29)** | 856.923 (50)[24] | **T (29)** | T (-)[26] | T (135) | **T (29)** | 980.692 (30)[25] | **T (29)** |
| | 11 | T (-)[25] | T (543) | **T (29)** | T (40)[27] | **T (29)** | T (-)[27] | T (436) | **T (29)** | 713.466 (56)[18] | **T (29)** |
| 2021 | 10 | 0.670 | 1.397 | **0.503** | 0.653 | 1.356 | 0.656 | 0.748 | 0.179 | **0.132** | 1.307 |
| | 9 | 1.210 | 1.380 | **0.276** | 0.685 | 1.324 | 0.309 | 0.812 | 0.170 | **0.155** | 1.316 |
| | 8 | 1.232 | 1.352 | **0.437** | 0.682 | 1.327 | 0.654 | 0.775 | **0.278** | 0.454 | 1.272 |
| | 7 | 1.189 | 1.364 | **0.262** | 0.619 | 1.333 | 0.649 | 0.791 | **0.256** | 0.448 | 1.276 |
| | 6 | 0.646 | 1.384 | **0.414** | 0.695 | 1.307 | 0.350 | 0.776 | **0.281** | 0.470 | 1.274 |
| | 5 | 1.142 | 1.724 | **0.425** | 0.696 | 1.347 | 0.661 | 0.885 | **0.279** | 0.459 | 1.280 |

# Results : Encodings

| | | SortN | | | | CardN+PBbest | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Année** | **n** | **RC2** | **WBO** | **Max-CDCL** | **Max-HS** | **RC2** | **WBO** | **Max-CDCL** | **Max-HS** |
| 2024 | 15 | 1.259 | 1.180 | **0.989** | 17.933 | 0.767 | **0.300** | 0.467 | 9.925 |
| | 14 | 1.300 | 1.130 | **0.818** | 14.633 | 0.716 | 0.301 | **0.290** | 11.236 |
| | 13 | 1.199 | 1.404 | **0.992** | 18.585 | 0.770 | **0.279** | 0.353 | 12.476 |
| | 12 | 1.315 | 1.742 | **0.805** | 20.607 | 0.718 | **0.309** | 0.313 | 5.972 |
| | 11 | 1.287 | 2.472 | **1.100** | 71.655 | 0.707 | 0.392 | 0.395 | 26.609 |
| | 10 | **9.707** | 341.225 | 150.416 | 271.440 | **1.544** | 411.766 | 213.257 | 500.964 |
| 2023 | 17 | **9.687** | 17.769 | T (9) | 357.906 | 10.370 | **6.136** | 3371.304 | 353.515 |
| | 16 | **12.602** | 20.701 | 3058.418 | 395.716 | 12.145 | **4.792** | 2866.853 | 426.965 |
| | 15 | **23.467** | 41.042 | T (9) | 408.854 | 15.247 | ***6.696*** | 2686.484 | 405.923 |
| | 14 | **14.011** | 22.683 | T (9) | 413.160 | 19.751 | **6.706** | T (9) | 417.693 |
| | 13 | **8.006** | 14.962 | 3136.008 | 439.812 | 8.733 | **4.162** | T (9) | 438.877 |
| | 12 | T (-)[10] | T (-) | T (-) | T (23)[8] | T [10] | T (-) | T (-) | T (30)[9] |
| 2022 | 16 | T (-)[25] | T (146) | **T (29)** | 496.061 (42)[22] | T (-)[22] | T (83) | **T (29)** | 1024.785 (40)[25] |
| | 15 | T (-)[24] | T (134) | **T (29)** | 322.627 (51)[18] | T (-)[24] | T (58) | **T (29)** | 1059.200 (33)[25] |
| | 14 | T (-)[27] | T (132) | **T (29)** | 473.504 (38)[23] | T (-)[24] | T (47) | **T (29)** | **448.613 (29)[23]** |
| | 13 | T (-)[27] | T (146) | **T (29)** | 348.256 (56)[17] | T (-)[25] | T (50) | **T (29)** | 330.284 (59)[18] |
| | 12 | T (-)[26] | T (135) | **T (29)** | 980.692 (30)[25] | T (-)[24] | T (71) | **T (29)** | 328.658 (59)[18] |
| | 11 | T (-)[27] | T (436) | **T (29)** | 713.466 (56)[18] | T (-)[24] | T (287) | **T (29)** | 650.517 (48)[18] |
| 2021 | 10 | 0.656 | 0.748 | 0.179 | **0.132** | 0.178 | 0.139 | 0.050 | **0.027** |
| | 9 | 0.309 | 0.812 | 0.170 | **0.155** | 0.133 | 0.136 | 0.038 | **0.026** |
| | 8 | 0.654 | 0.775 | **0.278** | 0.454 | 0.132 | 0.148 | 0.039 | **0.030** |
| | 7 | 0.649 | 0.791 | **0.256** | 0.448 | 0.126 | 0.132 | 0.035 | **0.030** |
| | 6 | 0.350 | 0.776 | **0.281** | 0.470 | 0.135 | 0.146 | 0.035 | **0.031** |
| | 5 | 0.661 | 0.885 | **0.279** | 0.459 | 0.142 | 0.200 | 0.035 | **0.027** |

# Results

- Timeout for $n = 9$ (2024), $n = 11$ (2023), $n = 10$ (2022), $n = 4$ (2021) by all Max-SAT solvers
- These $n$ values correspond to **UNSAT** instances
- For example, in 2024

$$\sum_{c \in C} n \times npMax(c) = 288 < 307$$

# Plan

# Conclusion

- Solving a conference scheduling optimisation problem through Max-SAT
- Simplifying the planning task, streamlining logistics and optimizing resources for subsequent editions of the conference.
- A Set of hard UNSAT instances for Max-SAT

- Improve our model and enlarge our benchmark to other editions/conferences
- Take into consideration other constraints

# Minimizing Working-Group Conflicts in Conference Session Scheduling Through Maximum Satisfiability

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