Лабораторная 2

Бинцаровский Леонид

Задача

ran12x21

Солвер

cbc

Стандартный запуск

cbc ran12x21.mps solve

```
Cbc0038I Full problem 285 rows 504 columns, reduced to 51 rows 64 columns
Cbc0010I After 18000 nodes, 2023 on tree, 3664 best solution, best possible 3624.5496 (52.54 seconds)
Cbc0010I After 19000 nodes, 2162 on tree, 3664 best solution, best possible 3629.7595 (55.99 seconds)
Cbc0010I After 20000 nodes, 2268 on tree, 3664 best solution, best possible 3633.4686 (59.23 seconds)
Cbc0010I After 21000 nodes, 2328 on tree, 3664 best solution, best possible 3637.2916 (62.46 seconds)
Cbc0010I After 22000 nodes, 2131 on tree, 3664 best solution, best possible 3637.2916 (64.33 seconds)
Cbc0010I After 23000 nodes, 2133 on tree, 3664 best solution, best possible 3641.2223 (67.70 seconds)
Cbc0010I After 24000 nodes, 2070 on tree, 3664 best solution, best possible 3644.7735 (70.78 seconds)
Cbc0010I After 25000 nodes, 1945 on tree, 3664 best solution, best possible 3648.3261 (73.49 seconds)
Cbc0038I Full problem 285 rows 504 columns, reduced to 32 rows 41 columns
Cbc0010I After 26000 nodes, 1597 on tree, 3664 best solution, best possible 3648.3261 (74.95 seconds)
Cbc0010I After 27000 nodes, 1330 on tree, 3664 best solution, best possible 3652.3289 (77.68 seconds)
Cbc0010I After 28000 nodes, 986 on tree, 3664 best solution, best possible 3656.2188 (79.80 seconds)
Cbc0010I After 29000 nodes, 561 on tree, 3664 best solution, best possible 3659.8118 (81.24 seconds)
Cbc0010I After 30000 nodes, 79 on tree, 3664 best solution, best possible 3659.9175 (82.11 seconds)
Cbc0001I Search completed - best objective 3664, took 727140 iterations and 30158 nodes (82.29 seconds)
Cbc0032I Strong branching done 53556 times (704365 iterations), fathomed 2562 nodes and fixed 14844 variables
Cbc0035I Maximum depth 83, 36835 variables fixed on reduced cost
Cuts at root node changed objective from 3157.38 to 3446.24
Probing was tried 26 times and created 1 cuts of which 0 were active after adding rounds of cuts (0.009 seconds)
Gomory was tried 7764 times and created 2947 cuts of which 0 were active after adding rounds of cuts (1.843 seconds)
Knapsack was tried 7764 times and created 949 cuts of which 0 were active after adding rounds of cuts (6.178 seconds)
Clique was tried 26 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.001 seconds)
MixedIntegerRounding2 was tried 7764 times and created 22244 cuts of which 0 were active after adding rounds of cuts (1.639 seconds)
FlowCover was tried 7764 times and created 20511 cuts of which 0 were active after adding rounds of cuts (1.885 seconds)
TwoMirCuts was tried 7764 times and created 110 cuts of which 0 were active after adding rounds of cuts (1.091 seconds)
ZeroHalf was tried 1 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)

Result - Optimal solution found

Objective value:                3664.00000000
Enumerated nodes:               30158
Total iterations:               727140
Time (CPU seconds):             82.30
Time (Wallclock seconds):       85.92

Total time (CPU seconds):       82.30   (Wallclock seconds):       85.93

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Отключение эвристик

cbc ran12x21.mps heuristics off solve

```
Cbc0004I Integer solution of 3664 found after 498259 iterations and 18318 nodes (55.16 seconds)
Cbc0010I After 19000 nodes, 1891 on tree, 3664 best solution, best possible 3618.5368 (56.73 seconds)
Cbc0010I After 20000 nodes, 2105 on tree, 3664 best solution, best possible 3625.1082 (60.36 seconds)
Cbc0010I After 21000 nodes, 2289 on tree, 3664 best solution, best possible 3630.1507 (63.87 seconds)
Cbc0010I After 22000 nodes, 2169 on tree, 3664 best solution, best possible 3630.1816 (65.54 seconds)
Cbc0010I After 23000 nodes, 2290 on tree, 3664 best solution, best possible 3634.5946 (68.59 seconds)
Cbc0010I After 24000 nodes, 2358 on tree, 3664 best solution, best possible 3638.2536 (71.42 seconds)
Cbc0010I After 25000 nodes, 2432 on tree, 3664 best solution, best possible 3641.5498 (74.31 seconds)
Cbc0010I After 26000 nodes, 2205 on tree, 3664 best solution, best possible 3641.5498 (76.07 seconds)
Cbc0010I After 27000 nodes, 2104 on tree, 3664 best solution, best possible 3645.0238 (79.16 seconds)
Cbc0010I After 28000 nodes, 1945 on tree, 3664 best solution, best possible 3648.1439 (82.04 seconds)
Cbc0010I After 29000 nodes, 1740 on tree, 3664 best solution, best possible 3651.233 (84.54 seconds)
Cbc0010I After 30000 nodes, 1390 on tree, 3664 best solution, best possible 3651.233 (85.95 seconds)
Cbc0010I After 31000 nodes, 1044 on tree, 3664 best solution, best possible 3655.3148 (88.16 seconds)
Cbc0010I After 32000 nodes, 619 on tree, 3664 best solution, best possible 3659.1288 (89.87 seconds)
Cbc0010I After 33000 nodes, 142 on tree, 3664 best solution, best possible 3663.0765 (90.95 seconds)
Cbc0001I Search completed — best objective 3664, took 862291 iterations and 33283 nodes (91.16 seconds)
Cbc0032I Strong branching done 53494 times (784119 iterations), fathomed 2570 nodes and fixed 15510 variables
Cbc0035I Maximum depth 131, 50468 variables fixed on reduced cost
Cuts at root node changed objective from 3157.38 to 3446.24
Probing was tried 26 times and created 1 cuts of which 0 were active after adding rounds of cuts (0.008 seconds)
Gomory was tried 8592 times and created 2824 cuts of which 0 were active after adding rounds of cuts (2.065 seconds)
Knapsack was tried 8592 times and created 1094 cuts of which 0 were active after adding rounds of cuts (7.073 seconds)
Clique was tried 26 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.001 seconds)
MixedIntegerRounding2 was tried 8592 times and created 28236 cuts of which 0 were active after adding rounds of cuts (1.919 seconds)
FlowCover was tried 8592 times and created 23420 cuts of which 0 were active after adding rounds of cuts (2.135 seconds)
TwoMirCuts was tried 8592 times and created 69 cuts of which 0 were active after adding rounds of cuts (1.191 seconds)
ZeroHalf was tried 1 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)

Result — Optimal solution found

Objective value:                3664.00000000
Enumerated nodes:               33283
Total iterations:               862291
Time (CPU seconds):             91.17
Time (Wallclock seconds):       96.41

Total time (CPU seconds):       91.17   (Wallclock seconds):       96.41

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Отключение предобработки

cbc ran12x21.mps presolve off solve

```
Cbc0010I After 28000 nodes, 2475 on tree, 3664 best solution, best possible 3638.4737 (103.04 seconds)
Cbc0010I After 29000 nodes, 2419 on tree, 3664 best solution, best possible 3641.7097 (106.69 seconds)
Cbc0010I After 30000 nodes, 2147 on tree, 3664 best solution, best possible 3641.7097 (108.64 seconds)
Cbc0010I After 31000 nodes, 2033 on tree, 3664 best solution, best possible 3645.1839 (112.22 seconds)
Cbc0010I After 32000 nodes, 1865 on tree, 3664 best solution, best possible 3648.2946 (115.34 seconds)
Cbc0038I Full problem 285 rows 504 columns, reduced to 60 rows 78 columns
Cbc0010I After 33000 nodes, 1597 on tree, 3664 best solution, best possible 3651.6728 (118.00 seconds)
Cbc0010I After 34000 nodes, 1200 on tree, 3664 best solution, best possible 3651.6728 (119.60 seconds)
Cbc0010I After 35000 nodes, 827 on tree, 3664 best solution, best possible 3655.9093 (121.96 seconds)
Cbc0010I After 36000 nodes, 394 on tree, 3664 best solution, best possible 3660.4021 (123.73 seconds)
Cbc0001I Search completed — best objective 3664, took 1327200 iterations and 36815 nodes (124.60 seconds)
Cbc0032I Strong branching done 56964 times (1075077 iterations), fathomed 2667 nodes and fixed 14140 variables
Cbc0035I Maximum depth 88, 456833 variables fixed on reduced cost
Cuts at root node changed objective from 3157.38 to 3446.01
Probing was tried 43 times and created 0 cuts of which 26 were active after adding rounds of cuts (0.015 seconds)
Gomory was tried 9984 times and created 3283 cuts of which 0 were active after adding rounds of cuts (2.830 seconds)
Knapsack was tried 9984 times and created 419 cuts of which 0 were active after adding rounds of cuts (7.062 seconds)
Clique was tried 43 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.001 seconds)
MixedIntegerRounding2 was tried 9984 times and created 36002 cuts of which 0 were active after adding rounds of cuts (2.406 seconds)
FlowCover was tried 9984 times and created 28811 cuts of which 0 were active after adding rounds of cuts (2.464 seconds)
TwoMirCuts was tried 9984 times and created 79 cuts of which 0 were active after adding rounds of cuts (1.419 seconds)
ZeroHalf was tried 1 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)

Result — Optimal solution found

Objective value:                3664.00000000
Enumerated nodes:               36815
Total iterations:               1327200
Time (CPU seconds):             124.62
Time (Wallclock seconds):       128.97

Total time (CPU seconds):       124.63  (Wallclock seconds):       128.97

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Отключение предобработки и эвристик

cbc ran12x21.mps presolve off heuristics off solve

```
Cbc0010I After 54000 nodes, 2962 on tree, 3664 best solution, best possible 3650.8229 (159.83 seconds)
Cbc0010I After 55000 nodes, 2679 on tree, 3664 best solution, best possible 3652.6234 (162.37 seconds)
Cbc0010I After 56000 nodes, 2378 on tree, 3664 best solution, best possible 3654.3151 (164.74 seconds)
Cbc0010I After 57000 nodes, 2010 on tree, 3664 best solution, best possible 3656.0906 (166.93 seconds)
Cbc0010I After 58000 nodes, 1556 on tree, 3664 best solution, best possible 3656.0906 (168.35 seconds)
Cbc0010I After 59000 nodes, 1138 on tree, 3664 best solution, best possible 3658.3681 (170.16 seconds)
Cbc0010I After 60000 nodes, 689 on tree, 3664 best solution, best possible 3660.5571 (171.72 seconds)
Cbc0010I After 61000 nodes, 204 on tree, 3664 best solution, best possible 3662.8761 (172.93 seconds)
Cbc0001I Search completed — best objective 3664, took 2197321 iterations and 61410 nodes (173.33 seconds)
Cbc0032I Strong branching done 48768 times (916816 iterations), fathomed 2921 nodes and fixed 11941 variables
Cbc0035I Maximum depth 93, 1221315 variables fixed on reduced cost
Cuts at root node changed objective from 3157.38 to 3444.01
Probing was tried 43 times and created 0 cuts of which 26 were active after adding rounds of cuts (0.014 seconds)
Gomory was tried 16926 times and created 5241 cuts of which 0 were active after adding rounds of cuts (4.591 seconds)
Knapsack was tried 16926 times and created 1078 cuts of which 0 were active after adding rounds of cuts (12.443 seconds)
Clique was tried 43 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.001 seconds)
MixedIntegerRounding2 was tried 16926 times and created 69435 cuts of which 0 were active after adding rounds of cuts (4.297 seconds)
FlowCover was tried 16926 times and created 52555 cuts of which 0 were active after adding rounds of cuts (4.242 seconds)
TwoMirCuts was tried 16926 times and created 90 cuts of which 0 were active after adding rounds of cuts (2.272 seconds)
ZeroHalf was tried 1 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)

Result — Optimal solution found

Objective value:                3664.00000000
Enumerated nodes:               61410
Total iterations:               2197321
Time (CPU seconds):             173.35
Time (Wallclock seconds):       178.50

Total time (CPU seconds):       173.35   (Wallclock seconds):       178.50

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Выводы

1. Отключение предобработки заметно увеличивает количество узлов и ите- раций, что замедляет процесс решения.

2. Отключение эвристик также приводит к росту узлов и времени, так как солвер не использует быстрые методы для поиска допустимых решений на ранних этапах.

3. В режиме одновременного отключения предобработки и эвристик рост времени становится более заметным, так как солвер решает исходную модель "в лоб".

Таким образом, предобработка играет ключевую роль в уменьшении размера задачи и ускорении решения, тогда как эвристики ускоряют на- хождение допустимых решений, что особенно полезно для больших задач.