

## SUPPLEMENTARY MATERIAL

# Results for the Branch-And-Cut using the original and the updated parameters

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### **Abstract**

In this document we show supplementary results of part of the experiments for the paper *An efficient evolutionary algorithm for the orienteering problem*. We compare the performance of B&C algorithm when it is implemented with the original parameter values and with the updated values, both of which use the new LP solver CPLEX 12.5.

Table 1: Generation 1,  $n \leq 400$ 

instance	d0	$\alpha$	opt	Branch-&-Cut (Updated)			Branch-&-Cut (Original)		
				best	gap	time	best	gap	time
att48	5314	0.50	31	<b>31</b>	*	<b>0.00</b>	<b>31</b>	*	<b>0.00</b>
gr48	2523	0.50	31	<b>31</b>	*	<b>0.00</b>	<b>31</b>	*	<b>0.00</b>
hk48	5731	0.50	30	<b>30</b>	*	<b>0.00</b>	<b>30</b>	*	<b>0.00</b>
eil51	213	0.50	29	<b>29</b>	*	<b>0.00</b>	<b>29</b>	*	<b>0.00</b>
berlin52	3771	0.50	37	<b>37</b>	*	<b>0.00</b>	<b>37</b>	*	<b>0.00</b>
brazil58	12698	0.50	46	<b>46</b>	*	<b>0.00</b>	<b>46</b>	*	<b>0.00</b>
st70	338	0.50	43	<b>43</b>	*	<b>0.10</b>	<b>43</b>	*	<b>0.10</b>
eil76	269	0.50	47	<b>47</b>	*	0.10	<b>47</b>	*	<b>0.00</b>
pr76	54080	0.50	49	<b>49</b>	*	<b>0.10</b>	<b>49</b>	*	<b>0.10</b>
gr96	27605	0.50	64	<b>64</b>	*	<b>0.10</b>	<b>64</b>	*	<b>0.10</b>
rat99	606	0.50	52	<b>52</b>	*	<b>0.40</b>	<b>52</b>	*	<b>0.40</b>
kroA100	10641	0.50	56	<b>56</b>	*	<b>0.40</b>	<b>56</b>	*	<b>0.40</b>
kroB100	11071	0.50	58	<b>58</b>	*	95.40	<b>58</b>	*	<b>72.80</b>
kroC100	10375	0.50	56	<b>56</b>	*	<b>0.40</b>	<b>56</b>	*	0.50
kroD100	10647	0.50	59	<b>59</b>	*	<b>0.10</b>	<b>59</b>	*	0.20
kroE100	11034	0.50	57	<b>57</b>	*	<b>159.20</b>	.	.	.
rd100	3955	0.50	61	<b>61</b>	*	<b>0.20</b>	<b>61</b>	*	<b>0.20</b>
eil101	315	0.50	64	<b>64</b>	*	<b>0.10</b>	<b>64</b>	*	<b>0.10</b>
lin105	7190	0.50	66	<b>66</b>	*	<b>0.30</b>	<b>66</b>	*	<b>0.30</b>
pr107	22152	0.50	54	<b>54</b>	*	<b>0.30</b>	<b>54</b>	*	<b>0.30</b>
gr120	3471	0.50	75	<b>75</b>	*	<b>0.10</b>	<b>75</b>	*	<b>0.10</b>
pr124	29515	0.50	75	<b>75</b>	*	<b>0.30</b>	<b>75</b>	*	0.40
bier127	59141	0.50	103	<b>103</b>	*	<b>0.30</b>	<b>103</b>	*	<b>0.30</b>
pr136	48386	0.50	71	<b>71</b>	*	<b>1.40</b>	<b>71</b>	*	1.70
gr137	34927	0.50	81	<b>81</b>	*	<b>1.50</b>	<b>81</b>	*	<b>1.50</b>
pr144	29269	0.50	77	<b>77</b>	*	<b>1.30</b>	<b>77</b>	*	1.70
kroA150	13262	0.50	86	<b>86</b>	*	<b>175.40</b>	<b>86</b>	*	204.60
kroB150	13065	0.50	87	<b>87</b>	*	<b>1.20</b>	<b>87</b>	*	1.40
pr152	36841	0.50	77	<b>77</b>	*	<b>1.40</b>	<b>77</b>	*	1.60
u159	21040	0.50	93	<b>93</b>	*	<b>3.40</b>	<b>93</b>	*	3.60
rat195	1162	0.50	102	<b>102</b>	*	<b>2.60</b>	<b>102</b>	*	3.10
d198	7890	0.50	123	<b>123</b>	*	<b>3.20</b>	<b>123</b>	*	4.90
kroA200	14684	0.50	117	<b>117</b>	*	<b>1.20</b>	<b>117</b>	*	1.50
kroB200	14719	0.50	119	<b>119</b>	*	<b>14.10</b>	.	.	.
gr202	20080	0.50	145	<b>145</b>	*	<b>12.70</b>	<b>145</b>	*	12.80
ts225	63322	0.50	124	<b>124</b>	*	<b>10216.30</b>	.	.	.
tsp225	1958	0.50	129	<b>129</b>	*	<b>94.40</b>	<b>129</b>	*	151.40
pr226	40185	0.50	126	<b>126</b>	*	<b>166.20</b>	<b>126</b>	*	433.30
gr229	67301	0.50	176	<b>176</b>	*	<b>0.90</b>	<b>176</b>	*	<b>0.90</b>
gil262	1189	0.50	158	<b>158</b>	*	<b>0.90</b>	<b>158</b>	*	1.10
pr264	24568	0.50	132	<b>132</b>	*	<b>21.20</b>	<b>132</b>	*	25.20
a280	1290	0.50	147	<b>147</b>	*	<b>13.60</b>	<b>147</b>	*	14.10
pr299	24096	0.50	162	<b>162</b>	*	<b>111.50</b>	<b>162</b>	*	129.50
lin318	21015	0.50	205	<b>205</b>	*	<b>22.40</b>	<b>205</b>	*	24.60
rd400	7641	0.50	239	<b>239</b>	*	<b>37.40</b>	<b>239</b>	*	40.70

Table 2: Generation 1,  $n > 400$ 

instance	d0	$\alpha$	opt	Branch-&-Cut (Updated)			Branch-&-Cut (Original)		
				best	gap	time	best	gap	time
fl417	5931	0.50	228	<b>228</b>	*	-	.	.	.
gr431	85707	0.50	350	<b>350</b>	*	139.90	<b>350</b>	*	<b>138.10</b>
pr439	53609	0.50	313	<b>313</b>	*	<b>833.30</b>	.	.	.
pcb442	25389	0.50	251	<b>251</b>	*	<b>14.90</b>	<b>251</b>	*	18.60
d493	17501	0.50	320	<b>320</b>	*	347.30	<b>320</b>	*	<b>203.80</b>
att532	13843	0.50	363	<b>363</b>	*	<b>593.00</b>	.	.	.
pa561	1382	0.50	356	<b>356</b>	*	<b>2103.60</b>	.	.	.
u574	18453	0.50	354	<b>354</b>	*	<b>61.40</b>	<b>354</b>	*	63.80
rat575	3387	0.50	322	<b>322</b>	*	<b>59.50</b>	<b>322</b>	*	72.60
p654	17322	0.50	327	<b>327</b>	*	-	<b>327</b>	*	-
d657	24456	0.50	386	<b>386</b>	*	<b>715.70</b>	<b>386</b>	*	763.30
gr666	147179	0.50	503	<b>503</b>	*	<b>634.20</b>	<b>503</b>	*	696.70
u724	20955	0.50	439	<b>439</b>	*	<b>1077.10</b>	.	.	.
rat783	4403	0.50	438	<b>438</b>	*	<b>594.30</b>	.	.	.
pr1002	129523	0.50	604	<b>604</b>	*	-	449	25.66	-
vm1084	119649	0.50	777	<b>777</b>	*	<b>4927.40</b>	.	.	.
rl1323	135100	0.50	811	<b>811</b>	*	-	.	.	.
fl1400	10064	0.50	922	909	1.41	-	<b>922</b>	*	-
d1655	31064	0.50	798	.	.	-	<b>798</b>	*	-
vm1748	168278	0.50	1168	873	25.26	-	<b>1168</b>	*	-
rl1889	158268	0.50	890	<b>890</b>	*	-	<b>890</b>	*	-
pr2392	189016	0.50	1140	<b>1140</b>	*	-	<b>1140</b>	*	-
fl3795	14386	0.50	1470	.	.	-	<b>1470</b>	*	-

Table 3: Generation 2,  $n \leq 400$ 

instance	d0	$\alpha$	opt	Branch-&-Cut (Updated)			Branch-&-Cut (Original)		
				best	gap	time	best	gap	time
att48	5314	0.50	1717	<b>1717</b>	*	<b>0.00</b>	<b>1717</b>	*	0.10
gr48	2523	0.50	1761	<b>1761</b>	*	<b>0.20</b>	<b>1761</b>	*	<b>0.20</b>
hk48	5731	0.50	1614	<b>1614</b>	*	<b>0.10</b>	<b>1614</b>	*	<b>0.10</b>
eil51	213	0.50	1674	<b>1674</b>	*	<b>0.40</b>	<b>1674</b>	*	<b>0.40</b>
berlin52	3771	0.50	1897	<b>1897</b>	*	93.40	<b>1897</b>	*	<b>92.10</b>
brazil58	12698	0.50	2220	<b>2220</b>	*	<b>0.10</b>	<b>2220</b>	*	<b>0.10</b>
st70	338	0.50	2286	<b>2286</b>	*	<b>19.40</b>	<b>2286</b>	*	21.40
eil76	269	0.50	2550	<b>2550</b>	*	<b>0.10</b>	<b>2550</b>	*	<b>0.10</b>
pr76	54080	0.50	2708	<b>2708</b>	*	<b>0.40</b>	<b>2708</b>	*	<b>0.40</b>
gr96	27605	0.50	3396	<b>3396</b>	*	<b>1.70</b>	<b>3396</b>	*	<b>1.70</b>
rat99	606	0.50	2944	<b>2944</b>	*	<b>0.90</b>	<b>2944</b>	*	<b>0.90</b>
kroA100	10641	0.50	3212	<b>3212</b>	*	0.90	<b>3212</b>	*	<b>0.80</b>
kroB100	11071	0.50	3241	<b>3241</b>	*	<b>6.70</b>	<b>3241</b>	*	7.50
kroC100	10375	0.50	2947	<b>2947</b>	*	85.60	<b>2947</b>	*	<b>77.20</b>
kroD100	10647	0.50	3307	<b>3307</b>	*	<b>45.00</b>	<b>3307</b>	*	48.00
kroE100	11034	0.50	3090	<b>3090</b>	*	<b>230.10</b>	<b>3090</b>	*	327.10
rd100	3955	0.50	3359	<b>3359</b>	*	<b>0.20</b>	<b>3359</b>	*	<b>0.20</b>
eil101	315	0.50	3655	<b>3655</b>	*	153.00	<b>3655</b>	*	<b>63.50</b>
lin105	7190	0.50	3544	<b>3544</b>	*	<b>67.30</b>	<b>3544</b>	*	71.00
pr107	22152	0.50	2667	<b>2667</b>	*	<b>0.60</b>	<b>2667</b>	*	<b>0.60</b>
gr120	3471	0.50	4371	<b>4371</b>	*	<b>35.80</b>	<b>4371</b>	*	72.30
pr124	29515	0.50	3917	<b>3917</b>	*	<b>0.50</b>	<b>3917</b>	*	0.70
bier127	59141	0.50	5383	<b>5383</b>	*	<b>58.80</b>	<b>5383</b>	*	59.40
pr136	48386	0.50	4309	<b>4309</b>	*	<b>2.10</b>	<b>4309</b>	*	<b>2.10</b>
gr137	34927	0.50	4286	<b>4286</b>	*	196.90	<b>4286</b>	*	<b>82.60</b>
pr144	29269	0.50	4003	<b>4003</b>	*	<b>90.40</b>	<b>4003</b>	*	93.20
kroA150	13262	0.50	4918	<b>4918</b>	*	241.40	<b>4918</b>	*	<b>172.80</b>
kroB150	13065	0.50	4869	<b>4869</b>	*	<b>24.80</b>	<b>4869</b>	*	29.00
pr152	36841	0.50	4279	<b>4279</b>	*	<b>2.20</b>	<b>4279</b>	*	2.30
u159	21040	0.50	4960	<b>4960</b>	*	192.20	<b>4960</b>	*	<b>97.50</b>
rat195	1162	0.50	5791	<b>5791</b>	*	128.80	<b>5791</b>	*	<b>63.60</b>
d198	7890	0.50	6670	<b>6670</b>	*	74.20	<b>6670</b>	*	<b>54.30</b>
kroA200	14684	0.50	6547	<b>6547</b>	*	<b>68.70</b>	<b>6547</b>	*	72.60
kroB200	14719	0.50	6419	<b>6419</b>	*	<b>34.70</b>	<b>6419</b>	*	74.60
gr202	20080	0.50	7789	<b>7789</b>	*	<b>85.70</b>	.	.	.
ts225	63322	0.50	6834	<b>6834</b>	*	<b>6.60</b>	<b>6834</b>	*	8.10
tsp225	1958	0.50	6987	<b>6987</b>	*	<b>174.50</b>	.	.	.
pr226	40185	0.50	6662	<b>6662</b>	*	<b>74.10</b>	<b>6662</b>	*	265.20
gr229	67301	0.50	9177	<b>9177</b>	*	<b>182.60</b>	.	.	.
gil262	1189	0.50	8321	<b>8321</b>	*	89.60	<b>8321</b>	*	<b>75.40</b>
pr264	24568	0.50	6654	<b>6654</b>	*	<b>23.00</b>	<b>6654</b>	*	27.10
a280	1290	0.50	8428	<b>8428</b>	*	<b>103.80</b>	<b>8428</b>	*	105.80
pr299	24096	0.50	9182	<b>9182</b>	*	<b>426.50</b>	.	.	.
lin318	21015	0.50	10923	<b>10923</b>	*	<b>862.40</b>	.	.	.
rd400	7641	0.50	13652	<b>13652</b>	*	<b>293.50</b>	.	.	.

Table 4: Generation 2,  $n > 400$ 

instance	d0	$\alpha$	opt	Branch-&-Cut (Updated)			Branch-&-Cut (Original)		
				best	gap	time	best	gap	time
fl417	5931	0.50	11894	<b>11894</b>	*	-	.	.	.
gr431	85707	0.50	18318	<b>18318</b>	*	<b>969.50</b>	.	.	.
pr439	53609	0.50	16171	<b>16171</b>	*	<b>1298.30</b>	.	.	.
pcb442	25389	0.50	14484	<b>14484</b>	*	<b>6259.10</b>	.	.	.
att532	13843	0.50	19598	<b>19598</b>	*	-	.	.	.
ali535	101170	0.50	21954	<b>21954</b>	*	<b>2099.70</b>	.	.	.
pa561	1382	0.50	19576	<b>19576</b>	*	<b>1487.10</b>	.	.	.
u574	18453	0.50	19351	<b>19351</b>	*	<b>612.50</b>	.	.	.
rat575	3387	0.50	18251	<b>18251</b>	*	<b>931.10</b>	18250	0.01	1311.50
p654	17322	0.50	17224	17160	0.37	-	<b>17224</b>	*	-
d657	24456	0.50	21503	<b>21503</b>	*	<b>2682.40</b>	.	.	.
u724	20955	0.50	24223	<b>24223</b>	*	<b>5830.50</b>	.	.	.
dsj1000	9329844	0.50	35772	<b>35772</b>	*	-	.	.	.
pr1002	129523	0.50	27066	<b>27066</b>	*	-	<b>27066</b>	*	-
vm1084	119649	0.50	40687	<b>40687</b>	*	-	.	.	.
rl1304	126474	0.50	42181	.	.	.	<b>42181</b>	*	-
rl1323	135100	0.50	43347	<b>43347</b>	*	-	43216	0.30	-
fl1400	10064	0.50	54255	53222	1.90	-	<b>54255</b>	*	-
d1655	31064	0.50	44528	.	.	.	<b>44528</b>	*	-
vm1748	168278	0.50	62925	.	.	.	<b>62925</b>	*	-
rl1889	158268	0.50	52047	<b>52047</b>	*	-	<b>52047</b>	*	-
u2152	32127	0.50	53976	<b>53976</b>	*	-	<b>53976</b>	*	-
u2319	117128	0.50	72790	<b>72790</b>	*	-	<b>72790</b>	*	-
pr2392	189016	0.50	64577	<b>64577</b>	*	-	<b>64577</b>	*	-
pcb3038	68847	0.50	83951	<b>83951</b>	*	-	<b>83951</b>	*	-
fl3795	14386	0.50	89089	.	.	.	<b>89089</b>	*	-

Table 5: Generation 3,  $n \leq 400$ 

instance	d0	$\alpha$	opt	Branch-&-Cut (Updated)			Branch-&-Cut (Original)		
				best	gap	time	best	gap	time
att48	5314	0.50	1049	<b>1049</b>	*	<b>38.50</b>	<b>1049</b>	*	41.30
gr48	2523	0.50	1480	<b>1480</b>	*	<b>0.20</b>	<b>1480</b>	*	<b>0.20</b>
hk48	5731	0.50	1764	<b>1764</b>	*	<b>0.00</b>	<b>1764</b>	*	<b>0.00</b>
eil51	213	0.50	1399	<b>1399</b>	*	<b>0.20</b>	<b>1399</b>	*	<b>0.20</b>
berlin52	3771	0.50	1036	<b>1036</b>	*	<b>124.70</b>	<b>1036</b>	*	139.40
brazil58	12698	0.50	1702	<b>1702</b>	*	<b>0.00</b>	<b>1702</b>	*	<b>0.00</b>
st70	338	0.50	2108	<b>2108</b>	*	<b>0.40</b>	<b>2108</b>	*	0.50
eil76	269	0.50	2467	<b>2467</b>	*	<b>0.40</b>	<b>2467</b>	*	<b>0.40</b>
pr76	54080	0.50	2430	<b>2430</b>	*	<b>0.20</b>	<b>2430</b>	*	0.30
gr96	27605	0.50	3170	<b>3170</b>	*	61.50	<b>3170</b>	*	<b>39.90</b>
rat99	606	0.50	2908	<b>2908</b>	*	4.90	<b>2908</b>	*	<b>4.40</b>
kroA100	10641	0.50	3211	<b>3211</b>	*	<b>63.30</b>	<b>3211</b>	*	68.50
kroB100	11071	0.50	2804	<b>2804</b>	*	<b>0.60</b>	<b>2804</b>	*	0.90
kroC100	10375	0.50	3155	<b>3155</b>	*	<b>1.50</b>	<b>3155</b>	*	1.80
kroD100	10647	0.50	3167	<b>3167</b>	*	<b>10.70</b>	<b>3167</b>	*	11.90
kroE100	11034	0.50	3049	<b>3049</b>	*	<b>1.50</b>	<b>3049</b>	*	1.70
rd100	3955	0.50	2926	<b>2926</b>	*	113.20	<b>2926</b>	*	<b>105.30</b>
eil101	315	0.50	3345	<b>3345</b>	*	<b>29.80</b>	<b>3345</b>	*	31.50
lin105	7190	0.50	2986	<b>2986</b>	*	<b>51.90</b>	<b>2986</b>	*	56.00
pr107	22152	0.50	1877	<b>1877</b>	*	660.90	<b>1877</b>	*	<b>294.60</b>
gr120	3471	0.50	3779	<b>3779</b>	*	<b>1.50</b>	<b>3779</b>	*	1.80
pr124	29515	0.50	3557	<b>3557</b>	*	<b>1021.50</b>	.	.	.
bier127	59141	0.50	2365	<b>2365</b>	*	<b>79.90</b>	<b>2365</b>	*	122.10
pr136	48386	0.50	4390	<b>4390</b>	*	<b>86.70</b>	<b>4390</b>	*	95.20
gr137	34927	0.50	3954	<b>3954</b>	*	<b>8.60</b>	<b>3954</b>	*	8.80
pr144	29269	0.50	3745	<b>3745</b>	*	<b>112.60</b>	<b>3745</b>	*	337.30
kroA150	13262	0.50	5039	<b>5039</b>	*	<b>330.70</b>	.	.	.
kroB150	13065	0.50	5314	<b>5314</b>	*	107.60	<b>5314</b>	*	<b>61.90</b>
pr152	36841	0.50	3905	<b>3905</b>	*	<b>1122.40</b>	.	.	.
u159	21040	0.50	5272	<b>5272</b>	*	<b>52.20</b>	<b>5272</b>	*	62.10
rat195	1162	0.50	6195	<b>6195</b>	*	<b>49.90</b>	<b>6195</b>	*	51.10
d198	7890	0.50	6320	<b>6320</b>	*	<b>286.10</b>	.	.	.
kroA200	14684	0.50	6123	<b>6123</b>	*	<b>122.30</b>	<b>6123</b>	*	133.70
kroB200	14719	0.50	6266	<b>6266</b>	*	<b>40.10</b>	<b>6266</b>	*	43.10
gr202	20080	0.50	8616	<b>8616</b>	*	<b>224.80</b>	.	.	.
ts225	63322	0.50	7575	<b>7575</b>	*	171.20	<b>7575</b>	*	<b>110.80</b>
tsp225	1958	0.50	7740	<b>7740</b>	*	<b>150.30</b>	.	.	.
pr226	40185	0.50	6993	<b>6993</b>	*	<b>32.60</b>	<b>6993</b>	*	36.80
gr229	67301	0.50	6328	<b>6328</b>	*	<b>10.20</b>	<b>6328</b>	*	15.90
gil262	1189	0.50	9246	<b>9246</b>	*	133.40	<b>9246</b>	*	<b>57.40</b>
pr264	24568	0.50	8137	<b>8137</b>	*	<b>20.70</b>	<b>8137</b>	*	21.40
a280	1290	0.50	9774	<b>9774</b>	*	213.30	<b>9774</b>	*	<b>192.90</b>
pr299	24096	0.50	10343	<b>10343</b>	*	<b>363.60</b>	.	.	.
lin318	21015	0.50	10368	<b>10368</b>	*	534.80	<b>10368</b>	*	<b>507.20</b>
rd400	7641	0.50	13223	<b>13223</b>	*	293.20	<b>13223</b>	*	<b>266.00</b>

Table 6: Generation 3,  $n > 400$ 

instance	d0	$\alpha$	opt	Branch-&-Cut (Updated)			Branch-&-Cut (Original)		
				best	gap	time	best	gap	time
f417	5931	0.50	14220	<b>14220</b>	*	<b>6227.60</b>	.	.	.
gr431	85707	0.50	10911	<b>10911</b>	*	<b>1046.90</b>	.	.	.
pr439	53609	0.50	15160	<b>15160</b>	*	-	.	.	.
pcb442	25389	0.50	14819	<b>14819</b>	*	-	.	.	.
d493	17501	0.50	25167	<b>25167</b>	*	-	.	.	.
att532	13843	0.50	15498	<b>15498</b>	*	933.20	<b>15498</b>	*	<b>849.50</b>
pa561	1382	0.50	14482	<b>14482</b>	*	<b>10543.80</b>	.	.	.
u574	18453	0.50	20064	<b>20064</b>	*	<b>1409.30</b>	.	.	.
rat575	3387	0.50	20109	<b>20109</b>	*	<b>1426.50</b>	.	.	.
p654	17322	0.50	24492	<b>24492</b>	*	-	.	.	.
d657	24456	0.50	24562	<b>24562</b>	*	<b>4053.30</b>	.	.	.
gr666	147179	0.50	17020	<b>17020</b>	*	-	.	.	.
u724	20955	0.50	28348	<b>28348</b>	*	<b>5870.60</b>	.	.	.
rat783	4403	0.50	27566	<b>27566</b>	*	<b>7232.30</b>	.	.	.
pr1002	129523	0.50	39508	39449	0.15	-	<b>39508</b>	*	-
vm1084	119649	0.50	37653	<b>37653</b>	*	-	.	.	.
d1291	25401	0.50	30106	<b>30106</b>	*	-	<b>30106</b>	*	-
rl1304	126474	0.50	41385	40478	2.19	-	<b>41385</b>	*	-
rl1323	135100	0.50	44458	<b>44458</b>	*	-	40948	7.90	-
nrw1379	28319	0.50	39435	.	.	-	<b>39435</b>	*	-
f1400	10064	0.50	54792	<b>54792</b>	*	-	54293	0.91	-
d1655	31064	0.50	51168	<b>51168</b>	*	-	<b>51168</b>	*	-
vm1748	168278	0.50	68979	<b>68979</b>	*	-	67905	1.56	-
u1817	28601	0.50	52186	<b>52186</b>	*	-	<b>52186</b>	*	-
rl1889	158268	0.50	43374	<b>43374</b>	*	-	<b>43374</b>	*	-
d2103	40225	0.50	76035	<b>76035</b>	*	-	<b>76035</b>	*	-
u2152	32127	0.50	52091	<b>52091</b>	*	-	<b>52091</b>	*	-
u2319	117128	0.50	79351	<b>79351</b>	*	-	79221	0.16	-
pr2392	189016	0.50	60225	<b>60225</b>	*	-	<b>60225</b>	*	-
pcb3038	68847	0.50	96356	<b>96356</b>	*	-	<b>96356</b>	*	-

Table 7: Generation 4,  $n \leq 400$ 

instance	d0	$\alpha$	opt	Branch-&-Cut (Updated)			Branch-&-Cut (Original)		
				best	gap	time	best	gap	time
att48	6909	0.65	1870	<b>1870</b>	*	<b>106.00</b>	<b>1870</b>	*	167.20
gr48	4037	0.80	2264	<b>2264</b>	*	<b>22.40</b>	<b>2264</b>	*	23.20
hk48	9169	0.80	2177	<b>2177</b>	*	<b>0.20</b>	<b>2177</b>	*	<b>0.20</b>
eil51	384	0.90	2490	<b>2490</b>	*	82.10	<b>2490</b>	*	<b>64.60</b>
berlin52	4526	0.60	2089	<b>2089</b>	*	<b>115.00</b>	<b>2089</b>	*	124.50
brazil58	11428	0.45	2070	<b>2070</b>	*	132.00	<b>2070</b>	*	<b>74.60</b>
st70	574	0.85	3316	<b>3316</b>	*	<b>127.70</b>	.	.	.
eil76	458	0.85	3646	<b>3646</b>	*	45.10	<b>3646</b>	*	<b>41.50</b>
pr76	75712	0.70	3361	<b>3361</b>	*	<b>1047.70</b>	.	.	.
gr96	52449	0.95	4851	<b>4851</b>	*	<b>212.30</b>	.	.	.
rat99	727	0.60	3502	<b>3502</b>	*	16.00	<b>3502</b>	*	<b>8.00</b>
kroA100	20218	0.95	4999	<b>4999</b>	*	<b>187.10</b>	.	.	.
kroB100	9964	0.45	2935	<b>2935</b>	*	<b>34.40</b>	<b>2935</b>	*	37.10
kroC100	7263	0.35	1962	<b>1962</b>	*	<b>261.60</b>	<b>1962</b>	*	283.10
kroD100	4259	0.20	1212	<b>1212</b>	*	<b>11.80</b>	<b>1212</b>	*	13.40
kroE100	17655	0.80	4635	<b>4635</b>	*	<b>203.40</b>	.	.	.
rd100	4747	0.60	3815	<b>3815</b>	*	<b>164.60</b>	<b>3815</b>	*	164.90
eil101	409	0.65	4308	<b>4308</b>	*	<b>90.80</b>	<b>4308</b>	*	110.50
lin105	5033	0.35	2455	<b>2455</b>	*	<b>1020.60</b>	.	.	.
pr107	13291	0.30	2072	<b>2072</b>	*	159.00	<b>2072</b>	*	<b>158.20</b>
gr120	5901	0.85	5830	<b>5830</b>	*	<b>236.70</b>	.	.	.
pr124	17710	0.30	2036	<b>2036</b>	*	<b>163.80</b>	.	.	.
bier127	53227	0.45	5068	<b>5068</b>	*	278.40	<b>5068</b>	*	<b>168.80</b>
pr136	33871	0.35	2860	<b>2860</b>	*	<b>6303.60</b>	.	.	.
gr137	55883	0.80	6523	<b>6523</b>	*	<b>203.10</b>	.	.	.
pr144	40976	0.70	5641	<b>5641</b>	*	357.90	<b>5641</b>	*	<b>230.10</b>
kroA150	19893	0.75	6858	<b>6858</b>	*	<b>415.90</b>	.	.	.
kroB150	20904	0.80	7023	<b>7023</b>	*	<b>303.00</b>	.	.	.
pr152	51578	0.70	5823	<b>5823</b>	*	<b>483.60</b>	.	.	.
u159	14729	0.35	3147	<b>3147</b>	*	<b>1145.20</b>	.	.	.
rat195	2207	0.95	9753	<b>9753</b>	*	<b>205.40</b>	.	.	.
d198	6312	0.40	4661	<b>4661</b>	*	<b>492.70</b>	.	.	.
kroA200	26432	0.90	9892	<b>9892</b>	*	<b>340.30</b>	.	.	.
kroB200	26494	0.90	9849	<b>9849</b>	*	<b>253.20</b>	.	.	.
gr202	6025	0.15	1071	<b>1071</b>	*	<b>376.10</b>	.	.	.
ts225	113979	0.90	11002	<b>11002</b>	*	<b>3524.60</b>	.	.	.
tsp225	3525	0.90	10972	<b>10972</b>	*	<b>706.70</b>	.	.	.
pr226	32148	0.40	4893	<b>4893</b>	*	<b>1183.10</b>	.	.	.
gr229	121142	0.90	11482	<b>11482</b>	*	<b>563.10</b>	.	.	.
gil262	357	0.15	2031	<b>2031</b>	*	<b>1770.50</b>	.	.	.
pr264	34395	0.70	10253	<b>10253</b>	*	<b>277.50</b>	.	.	.
a280	1935	0.75	12064	<b>12064</b>	*	351.80	<b>12064</b>	*	<b>214.70</b>
pr299	45782	0.95	14986	<b>14986</b>	*	<b>7771.90</b>	.	.	.
lin318	35725	0.85	15132	<b>15132</b>	*	-	.	.	.
rd400	14517	0.95	20107	<b>20107</b>	*	<b>5093.10</b>	.	.	.



Table 8: Generation 4,  $n > 400$ 

instance	d0	$\alpha$	opt	Branch-&-Cut (Updated)			Branch-&-Cut (Original)		
				best	gap	time	best	gap	time
fl417	10082	0.85	20496	<b>20496</b>	*	-	.	.	.
gr431	51425	0.30	13976	<b>13976</b>	*	-	.	.	.
pr439	75052	0.70	19613	<b>19613</b>	*	<b>3936.10</b>	.	.	.
pcb442	10156	0.20	5839	<b>5839</b>	*	-	.	.	.
d493	24502	0.70	21745	21740	0.02	-	<b>21745</b>	*	-
att532	26302	0.95	26728	<b>26728</b>	*	-	.	.	.
ali535	40468	0.20	13520	<b>13520</b>	*	<b>15739.60</b>	.	.	.
pa561	2487	0.90	27712	<b>27712</b>	*	-	.	.	.
u574	35060	0.95	28823	<b>28823</b>	*	-	.	.	.
rat575	6096	0.90	28364	<b>28364</b>	*	-	.	.	.
p654	27715	0.80	31814	<b>31814</b>	*	-	.	.	.
d657	44021	0.90	32548	<b>32548</b>	*	<b>13485.10</b>	.	.	.
gr666	103026	0.35	21013	<b>21013</b>	*	-	.	.	.
u724	35624	0.85	34988	<b>34988</b>	*	-	.	.	.
rat783	1321	0.15	7829	<b>7829</b>	*	-	.	.	.
dsj1000	6530891	0.35	27357	<b>27357</b>	*	-	.	.	.
pr1002	90666	0.35	23551	23527	0.10	-	<b>23551</b>	*	-
u1060	190480	0.85	51768	<b>51768</b>	*	-	.	.	.
vm1084	107684	0.45	38678	<b>38678</b>	*	-	.	.	.
pcb1173	48359	0.85	55954	<b>55954</b>	*	-	.	.	.
d1291	5081	0.10	4029	<b>4029</b>	*	<b>2335.60</b>	<b>4029</b>	*	2929.10
rl1304	189711	0.75	57782	<b>57782</b>	*	-	57643	0.24	-
rl1323	243180	0.90	65476	<b>65476</b>	*	-	.	.	.
nrw1379	53807	0.95	69119	<b>69119</b>	*	-	.	.	.
fl1400	18115	0.90	70476	<b>70476</b>	*	-	.	.	.
u1432	91783	0.60	54540	<b>54540</b>	*	-	.	.	.
fl1577	7788	0.35	22191	<b>22191</b>	*	-	.	.	.
d1655	21745	0.35	29920	<b>29920</b>	*	-	.	.	.
vm1748	252417	0.75	82216	81778	0.53	-	<b>82216</b>	*	-
u1817	20021	0.35	31800	<b>31800</b>	*	-	<b>31800</b>	*	-
rl1889	237402	0.75	71527	<b>71527</b>	*	-	<b>71527</b>	*	-
d2103	24136	0.30	31045	<b>31045</b>	*	-	31029	0.05	-
u2152	28914	0.45	48472	<b>48472</b>	*	-	<b>48472</b>	*	-
u2319	187405	0.80	111472	110995	0.43	-	<b>111472</b>	*	-
pr2392	132312	0.35	45407	<b>45407</b>	*	-	.	.	.
pcb3038	75732	0.55	91831	<b>91831</b>	*	-	<b>91831</b>	*	-
fl3795	11509	0.40	71328	<b>71328</b>	*	-	<b>71328</b>	*	-
fnl4461	54770	0.30	84098	<b>84098</b>	*	-	<b>84098</b>	*	-
rl5915	480701	0.85	279116	<b>279116</b>	*	-	.	.	.
pla7397	5815182	0.25	106131	<b>106131</b>	*	-	<b>106131</b>	*	-