Lecture 7
Running Assignment

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Loading Data

```
> F <- read.table("/home/marco/Teaching/Fall2009/DM811/GCP/results.txt")
> G1 <- read.table("/home/marco/Teaching/Fall2009/DM811/GCP/Task1.res")
> names(F) <- c("alg", "inst", "col", "time")
> names(G1) <- c("alg", "inst", "run", "col", "time")
> G <- G1[, c(1, 2, 4, 5)]
> Fqueen <- F[grep("queen", F$inst), ]
> Gqueen <- G[grep("queen", G$inst), ]
> FDSJC <- F[grep("DSJC", F$inst), ]
> GDSJC <- G[grep("DSJC", G$inst), ]
> DSJC <- rbind(FDSJC, GDSJC)
> queen <- rbind(Fqueen, Gqueen)
```


Experimental Set Up

- 12 instances divided into two sets

Queen	Random
queen11_11	DSJC1000.1
queen12_12	DSJC1000.5
queen13_13	DSJC1000.9
queen14_14	DSJC500.1
queen15_15	DSJC500.5
queen16_16	DSJC500.9

- Same computational environment to all algorithms on Intel(R) Celeron(R) CPU 2.40GHz, 1GB RAM
- ROS, RLF and DSATUR added
- Problem: some algorithms are single-pass heuristics, other metaheuristics with time limit 30 seconds.
  Thought this should not be, analyzed together due to limited number of submissions!

Experimental Set Up

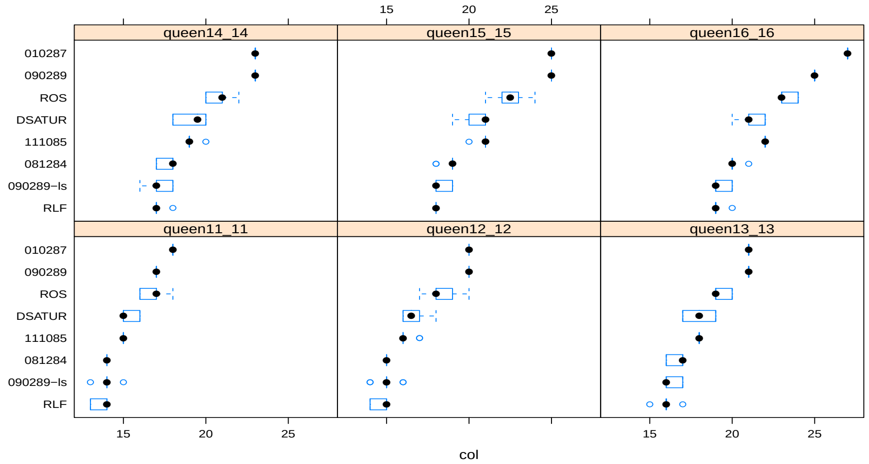
- Each algorithm run 10 times on each of the 12 instances

```
> all <- rbind(DSJC, queen)
> table(all$alg, all$inst)

           DSJC1000.1 DSJC1000.5 DSJC1000.9 DSJC500.1 DSJC500.5 DSJC500.9 queen11_11
010287             10         10         10        11        10        10         10
081284              0          0          0         0         0         0         10
090289             10         10         10        10        10        10         10
090289-ls          10         10         10        10        10        10         10
111085             10         10         10        10        10        10         10
DSATUR             10         10         10        10        10        10         10
RLF                10         10         10        10        10        10         10
ROS                10         10         10        10        10        10         10
           queen12_12 queen13_13 queen14_14 queen15_15 queen16_16
010287             10         10         10         10         10
081284             10         10         10         10         10
090289             10         10         10         10         10
090289-ls          10         10         10         10         10
111085             10         10         10         10         10
DSATUR             10         10         10         10         10
RLF                10         10         10         10         10
ROS                10         10         10         10         10
```

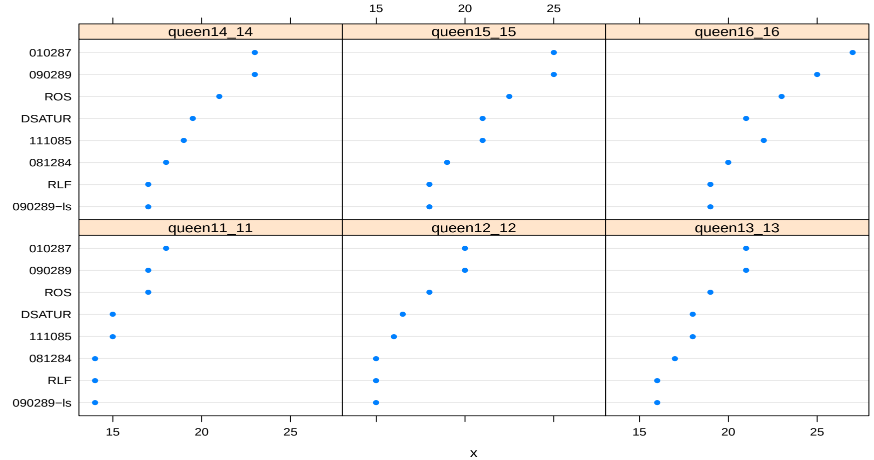
Comparative Analysis

```
> print(bwplot(reorder(alg, col) ~ col | inst, data = queen, layout = c(3,
+     2)))
```



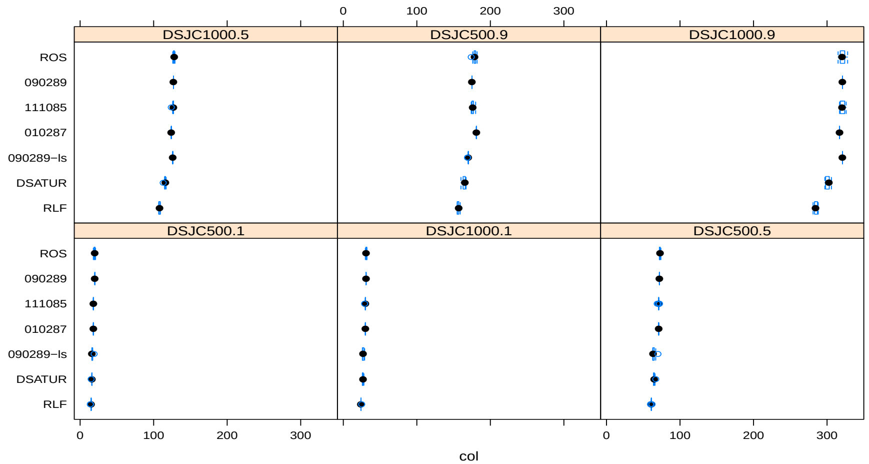
Comparative Analysis

```
> K <- aggregate(queen$col, list(alg = queen$alg, inst = queen$inst),
+     median)
> print(dotplot(reorder(alg, x) ~ x | reorder(inst, x), data = K, layout = c(3,
+     2), scales = list(y = list(relation = "same"))))
```



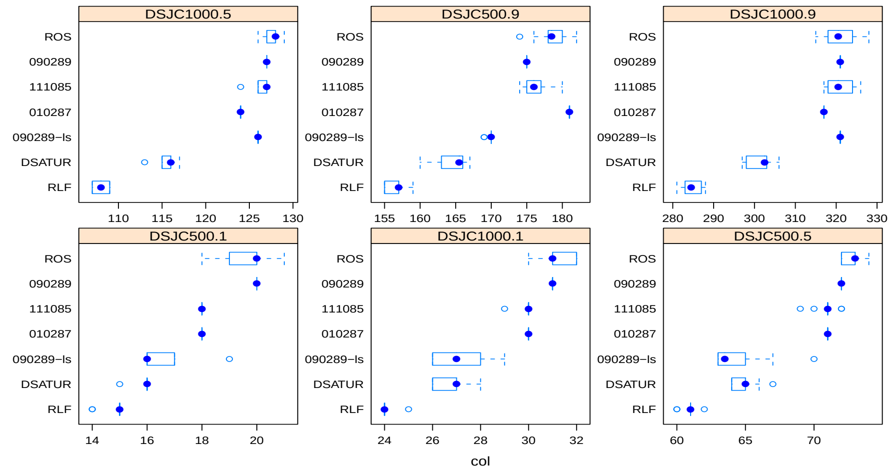
Comparative Analysis

```
> print(bwplot(reorder(alg, col) ~ col | reorder(inst, col), data = DSJC,
+     layout = c(3, 2)))
```



Comparative Analysis

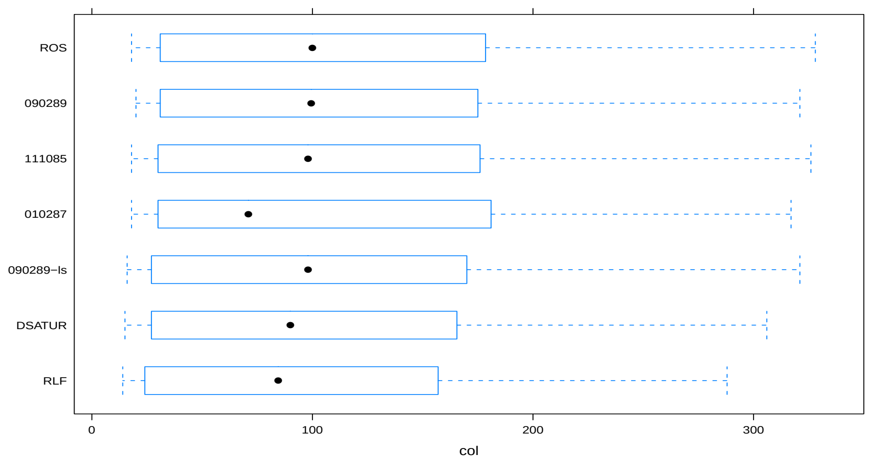
```
> print(bwplot(reorder(alg, col) ~ col | reorder(inst, col), data = DSJC,
+     layout = c(3, 2), col = "blue", scales = (x = list(relation = "free"))))
```



Comparative Analysis

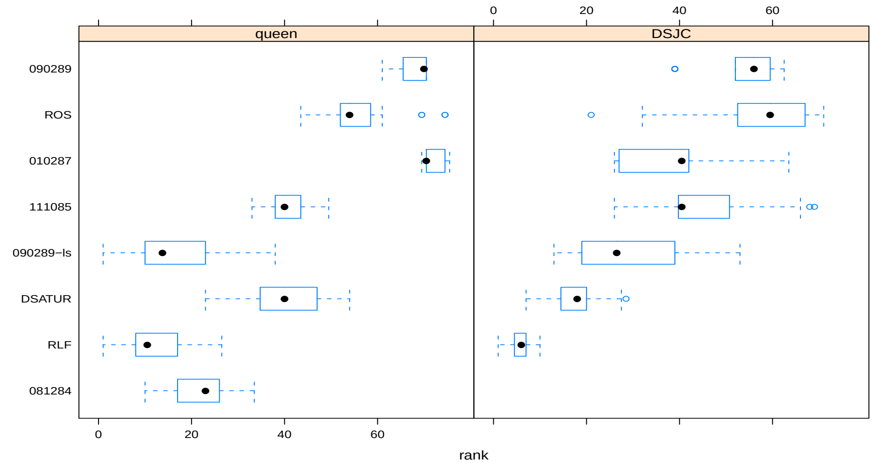
Aggregating raw data on the random graphs

```
> print(bwplot(reorder(alg, col) ~ col, data = DSJC))
```



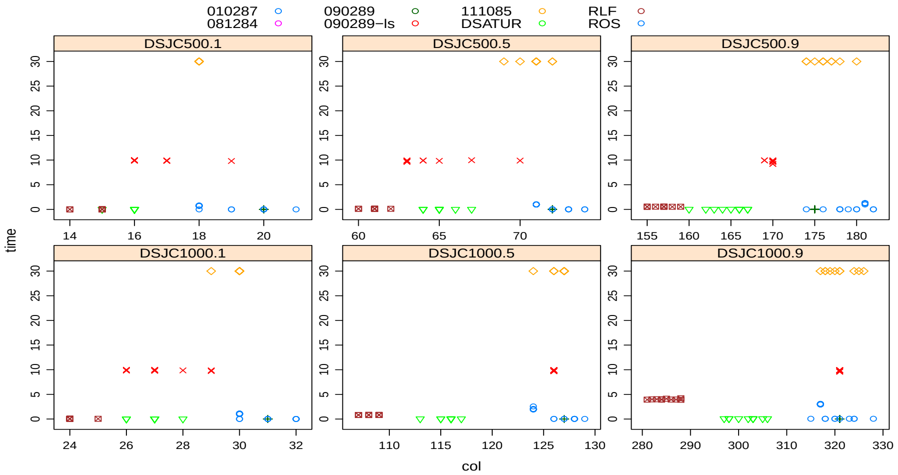
Comparative Analysis

View of raw data ranked within instances and aggregated between



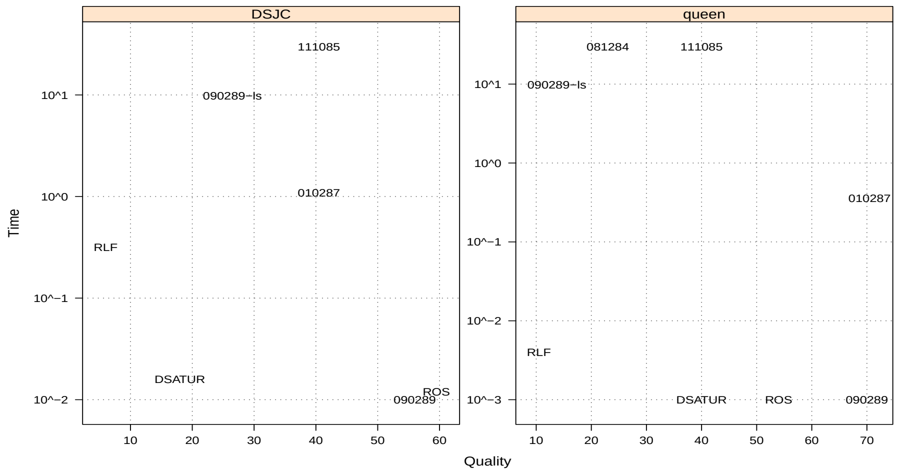
Trade off Solution Quality vs Run Time

```
> print(xyplot(time ~ col | inst, groups = alg, data = DSJC, pch = c(1:7),
+     scales = list(relation = "free"), auto.key = list(pch = c(1:7),
+         columns = 5)))
```



Trade off Solution Quality vs Run Time

Solution quality ranked within instances
Data aggregated by median value between instances



Numerical Results

Best Solutions

inst	x.010287	x.081284	x.090289	x.090289-ls	x.111085	x.DSATUR	x.RLF	x.ROS
DSJC1000.1	30		31	26	29	26	24	30
DSJC1000.5	124		127	126	124	113	107	126
DSJC1000.9	317		321	321	317	297	281	315
DSJC500.1	18		20	16	18	15	14	18
DSJC500.5	71		72	63	69	64	60	72
DSJC500.9	181		175	169	174	160	155	174
queen11_11	18	14	17	13	15	15	13	16
queen12_12	20	15	20	14	16	16	14	17
queen13_13	21	16	21	16	18	17	15	19
queen14_14	23	17	23	16	19	18	17	20
queen15_15	25	18	25	18	20	19	18	21
queen16_16	27	20	25	19	22	20	19	23

Median Time (sec.)

inst	x.010287	x.081284	x.090289	x.090289-ls	x.111085	x.DSATUR	x.RLF	x.ROS
DSJC1000.1	1.06		0.01	9.87	30.00	0.01	0.04	0.01
DSJC1000.5	2.01		0.02	9.85	30.00	0.04	0.82	0.04
DSJC1000.9	3.02		0.02	9.87	30.00	0.07	3.98	0.06
DSJC500.1	0.74		0.00	9.91	30.00	0.00	0.01	0.00
DSJC500.5	0.99		0.01	9.87	30.00	0.01	0.12	0.01
DSJC500.9	1.25		0.01	9.77	30.00	0.02	0.54	0.02
queen11_11	0.23	30.00	0.00	9.88	30.00	0.00	0.00	0.00
queen12_12	0.27	30.00	0.00	9.88	30.00	0.00	0.00	0.00
queen13_13	0.31	30.00	0.00	9.76	30.00	0.00	0.00	0.00
queen14_14	0.36	30.00	0.00	9.82	30.00	0.00	0.00	0.00
queen15_15	0.39	30.00	0.00	9.89	30.00	0.00	0.00	0.00
queen16_16	0.49	30.00	0.00	9.71	30.00	0.00	0.00	0.00

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3. Choose the next vertex to be the one with largest saturation degree, that is, the number of differently colored adjacent vertices.
   (break ties preferring vertices with the maximal number of adjacent, still uncolored vertices; otherwise randomly).

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4. Color the vertex according to greedy heuristic.
5. If still vertices to color, goto 3. Else stop.

RLF
Recursive Largest First

Key idea: iteratively extract independent sets.

1. Let $\{C_1, \dots, C_k\}$, $k = |V|$, be a set of empty color classes. Set $i = 1$.
Let $V' = V$ be a set of of still uncolored vertices.

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4. Remove from V' all vertices that are adjacent to v and insert them into U.

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3. Assign to C_i a vertex $v \in V'$ with maximal degree in V'
4. Remove from V' all vertices that are adjacent to v and insert them into U.
5. while V' is not empty:
   - add to C_i the vertex $v' \in V'$ with largest number of edges $[v', u]$, with
   - $u \in U$; (break ties randomly)
   - remove v' from V'
   - move into U all vertices in V' adjacent to v'.

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   - $u \in U$; (break ties randomly)
   - remove v' from V'
   - move into U all vertices in V' adjacent to v'.
6. Set $V' = U$. If V' not empty $i = i + 1$ and goto 2. Else stop.