

1 Some simulations

```
> library(resper)
```

First of all, let's check if the algorithm samples the permutations with similar frequencies. To that end, we build a tridiagonal matrix, which would correspond to a run of equidistant numbers and a lag that covers up to three numbers at once.

```
> m <- toeplitz(c(rep(1, 2), rep(0, 5)))
```

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]
[1,]	1	1	0	0	0	0	0
[2,]	1	1	1	0	0	0	0
[3,]	0	1	1	1	0	0	0
[4,]	0	0	1	1	1	0	0
[5,]	0	0	0	1	1	1	0
[6,]	0	0	0	0	1	1	1
[7,]	0	0	0	0	0	1	1

```
> print(m)
```

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]
[1,]	1	1	0	0	0	0	0
[2,]	1	1	1	0	0	0	0
[3,]	0	1	1	1	0	0	0
[4,]	0	0	1	1	1	0	0
[5,]	0	0	0	1	1	1	0
[6,]	0	0	0	0	1	1	1
[7,]	0	0	0	0	0	1	1

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]
[1,]	1	1	0	0	0	0	0
[2,]	1	1	1	0	0	0	0
[3,]	0	1	1	1	0	0	0
[4,]	0	0	1	1	1	0	0
[5,]	0	0	0	1	1	1	0
[6,]	0	0	0	0	1	1	1
[7,]	0	0	0	0	0	1	1

A nice result is that the permanent of an $n - dimensional$ tridiagonal matrix is the $n+1$ th Fibonacci number. The algorithm therefore should sample from 21 realizations of the permutation with probability $1/21$ each. Let's sample with the classical algorithm:

```
> anziter <- 1000  
> byrow.times <- NULL  
> byrow.perms <- NULL
```

```

> byrow.rejects <- NULL
> for (i in 1:anziter) {
+   byrow.times <- rbind(byrow.times, system.time(p <- ResperByrow(m)))
+   byrow.perms <- rbind(byrow.perms, p$perm)
+   byrow.rejects <- c(byrow.rejects, p$reject)
+ }

```

Now let's look at the result. The permutations are first mapped to single elements that are distinguished between one another. As no number is greater than 9, one can simply convert the permutations into eight-digit numbers.

```

> pn <- apply(t(byrow.perms) * 10^(6:0), 2, sum)

```

```

[1] 1234567 1235476 1325476 2134657 1243576 2143576 2143567 1324567 1325476
[10] 1324576 2135476 2143567 1235467 1234657 1234576 1243657 1324576 1324567
[19] 2143657 2134567 2135467 1235467 1243567 2135476 1235476 1234657 2134567
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[1000] 1324657

```

```
> table(pn)
```

```

pn
1234567 1234576 1234657 1235467 1235476 1243567 1243576 1243657 1324567 1324576
      51      40      42      30      53      48      43      53      54      66
1324657 1325467 1325476 2134567 2134576 2134657 2135467 2135476 2143567 2143576

```

```

42      36      59      68      47      48      40      43      41      42
2143657
54

```

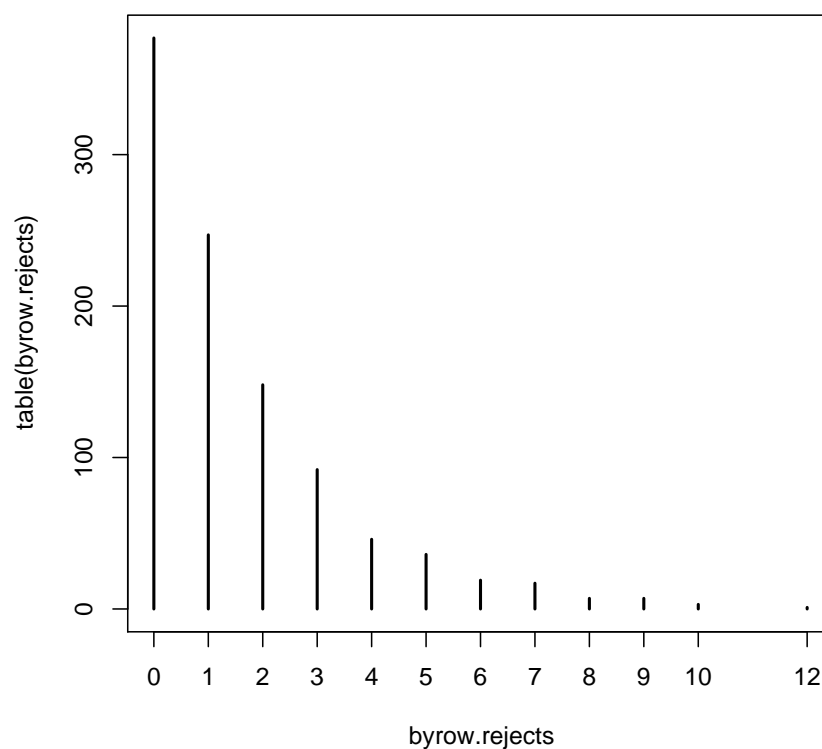
The computation times that this has taken are logged by attempt. Obviously, the distribution of times is very skewed.

```
> summary(byrow.times)
```

X1		X2		X3		X4		X5	
Min.	:0.02000	Min.	:0.00000	Min.	:0.02000	Min.	:0	Min.	:0
1st Qu.:	0.02000	1st Qu.:	0.00000	1st Qu.:	0.03000	1st Qu.:	0	1st Qu.:	0
Median	:0.03000	Median	:0.01000	Median	:0.04000	Median	:0	Median	:0
Mean	:0.04369	Mean	:0.00588	Mean	:0.05845	Mean	:0	Mean	:0
3rd Qu.:	0.05000	3rd Qu.:	0.01000	3rd Qu.:	0.07000	3rd Qu.:	0	3rd Qu.:	0
Max.	:0.18000	Max.	:0.03000	Max.	:0.34000	Max.	:0	Max.	:0

This is caused by the roughly geometrical distribution of the number of rejections.

```
> plot(table(byrow.rejects))
```



Let's see if the clotting algorithm performs better.

```

> anziter <- 1000
> clot.times <- NULL
> clot.perms <- NULL
> clot.rejects <- NULL
> for (i in 1:anziter) {
+   clot.times <- rbind(clot.times, system.time(p <- ResperClot(m)))
+   clot.perms <- rbind(clot.perms, p$perm)
+   clot.rejects <- c(clot.rejects, p$reject)
+ }

```

The tabulation of the permutation samples:

```

> pn <- apply(t(clot.perms) * 10^(6:0), 2, sum)

```

[1]	2134657	1243567	1324567	1324576	2143657	1234576	1324657	1234567	2135467
[10]	1234567	1325467	1243657	1324576	1234576	1243567	1325467	1235467	1324576
[19]	1324657	1325476	1325476	1234657	2134657	1243657	1243567	1243576	2143657
[28]	1234657	1324567	1243567	2135476	1234576	2135467	2135467	2143657	2134567
[37]	2134657	1243567	1234567	2135476	1325476	2135476	1324657	2134657	1234576
[46]	1324576	2143567	2135467	1243567	2143657	2134657	2134576	1324657	2134576
[55]	2143576	1324567	2135467	2135467	1243657	1234576	2135467	2134657	2135467
[64]	2134657	2134576	2143567	2143657	1234576	1325476	2135467	2135476	1234576
[73]	2134657	1324576	2135467	2143657	1234576	1234657	1234657	2134576	2143576
[82]	2135476	2134657	1234567	1234657	1234657	1234567	1234657	1324567	2134567
[91]	1324567	1234657	2143657	1234576	2135467	2135467	1234576	1234576	2135476
[100]	1324567	1243576	2143567	1234657	1325467	1234567	2134576	2143657	1243567
[109]	2143657	1325467	1324576	1325476	1243576	1243657	1324567	1324567	1243567
[118]	2143657	1234657	1234657	1234576	1324576	1235467	1234567	1234576	1234576
[127]	1235476	1325467	1324567	2143657	1234657	2135467	2143657	1243567	1324657
[136]	1243576	2134657	1324576	1324657	1234576	1243567	1324576	1234576	1234576
[145]	1234657	1234657	1235476	1235467	2134576	1234567	1234657	1324576	2134576
[154]	2135467	1324657	1235476	2134576	2134567	1324567	1235467	2135467	1324657
[163]	2134576	1234576	1235467	1243576	1324657	1235467	1235476	2134576	1325476
[172]	2134657	2135476	1235467	1324567	2143657	1324576	2134657	2135467	1325476
[181]	1235467	2135476	2134657	1243567	1243567	1324567	1243567	1325467	1234657
[190]	2143576	1324567	1243657	2134576	2143576	2135467	1234657	1324657	2143567
[199]	2134567	1324657	2134567	2135476	2135467	1234576	1234657	2143576	1325467
[208]	1325467	1235467	1234567	1234657	1243567	2135476	2135467	1235476	2134567
[217]	2134567	1234567	1324576	1235476	1325476	1234576	2134576	1243576	1243576
[226]	2134567	2143576	1324657	2135476	2143567	1325476	1325467	1243657	1234657
[235]	1243567	1325467	2143657	1235476	1324657	1324576	1235476	1234567	1234576
[244]	1243576	1243576	2134657	1243567	2143657	1234576	1324657	1324567	2134576
[253]	2134657	2134657	1243576	2134657	1243567	1243567	1235467	2143567	1235476
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[739] 1234567 1234576 2143567 1324576 1235467 1234567 2134576 1325476 2143576
[748] 1325476 1235467 1235476 2134576 2134657 2134657 2134657 1234657 2134576
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[784] 2134576 2135476 2134576 1243567 1235476 2135476 1325467 1243576 2143657
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[802] 1324576 1243576 1235476 1324567 1234576 1325467 1234657 1324657 1234657
[811] 1235476 2143567 1234567 1243657 2134576 1324567 2134657 1234576 2134576
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[829] 1325467 1234576 1324657 1234657 1235467 2134567 2143657 1325467 1234576
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[973] 2135476 1243567 2134576 1243576 1324567 2135467 1234567 1324567 1243576
[982] 1325467 1325476 1235476 2143657 2134657 1234576 1243657 2135467 1234567
[991] 2135476 1243576 1324657 1243657 2135467 1324657 1324567 2135476 1324657
[1000] 1243576

```

```
> table(pn)
```

```
pn
```

```

1234567 1234576 1234657 1235467 1235476 1243567 1243576 1243657 1324567 1324576
      54      66      59      40      48      52      46      30      55      45

```

```

1324657 1325467 1325476 2134567 2134576 2134657 2135467 2135476 2143567 2143576
      50      42      41      47      60      60      48      41      25      38
2143657
      53

```

The summary of the computing time:

```
> summary(clot.times)
```

	X1	X2	X3	X4	X5
Min.	:0.02000	Min. :0.00000	Min. :0.0200	Min. :0	Min. :0
1st Qu.:	0.03000	1st Qu.:0.00000	1st Qu.:0.0300	1st Qu.:0	1st Qu.:0
Median :	0.04000	Median :0.01000	Median :0.0400	Median :0	Median :0
Mean :	0.04136	Mean :0.00548	Mean :0.0559	Mean :0	Mean :0
3rd Qu.:	0.05000	3rd Qu.:0.01000	3rd Qu.:0.0600	3rd Qu.:0	3rd Qu.:0
Max. :	0.13000	Max. :0.02000	Max. :0.4700	Max. :0	Max. :0

And finally, the bar chart of the rejections:

```
> plot(table(clot.rejects))
```

