

## 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] 1235467 2135467 2135476 1234576 1243567 1234567 1235476 1325467 1234576
[10] 1324657 1324567 1243567 2135476 1234657 2135476 1325467 1243567 1324567
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[991] 1243576 1243567 1243567 2135476 2143657 2135476 1243567 1243567 1235476
[1000] 2134567

```

```
> table(pn)
```

```

pn
1234567 1234576 1234657 1235467 1235476 1243567 1243576 1243657 1324567 1324576
      44      42      54      47      52      59      42      47      51      50
1324657 1325467 1325476 2134567 2134576 2134657 2135467 2135476 2143567 2143576

```

```

      48      60      48      53      40      48      39      50      38      40
2143657
      48

```

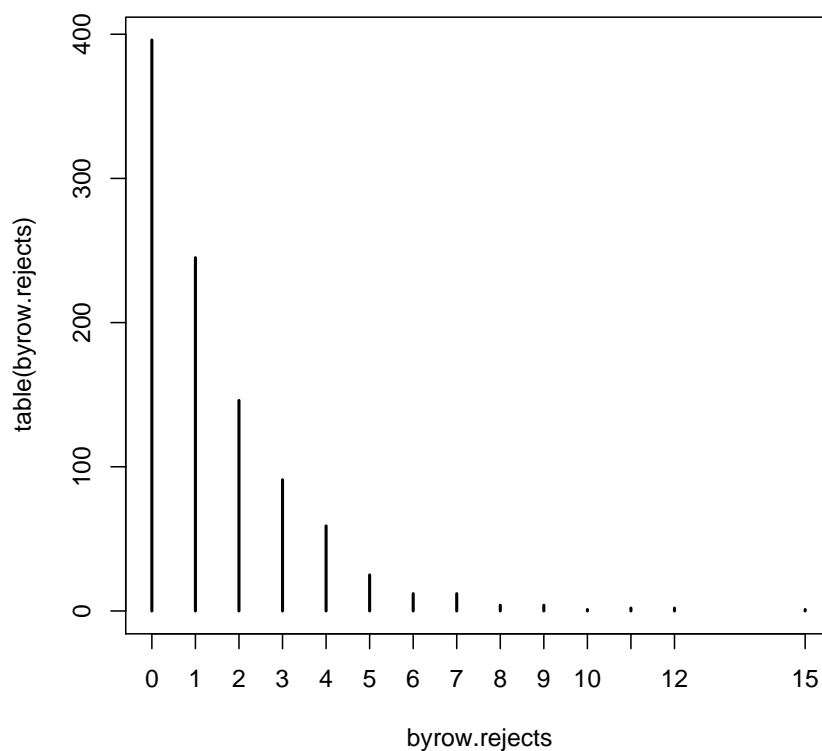
The computation times that this has taken are logged by attempt. Obviously, the distribution of times is very skewed.

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

X1		X2		X3		X4		X5	
Min.	:0.01000	Min.	:0e+00	Min.	:0.01000	Min.	:0	Min.	:0
1st Qu.:	:0.02000	1st Qu.:	:0e+00	1st Qu.:	:0.02000	1st Qu.:	:0	1st Qu.:	:0
Median	:0.03000	Median	:0e+00	Median	:0.02000	Median	:0	Median	:0
Mean	:0.03253	Mean	:6e-05	Mean	:0.03234	Mean	:0	Mean	:0
3rd Qu.:	:0.04000	3rd Qu.:	:0e+00	3rd Qu.:	:0.04000	3rd Qu.:	:0	3rd Qu.:	:0
Max.	:0.17000	Max.	:1e-02	Max.	:0.20000	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]	1325476	1243567	1234567	2134576	2135476	1234567	2143576	1243567	1234567
[10]	1234657	2134657	1324576	1235467	1235467	1235467	2143657	2143567	2135467
[19]	1243657	2134567	1235476	1234567	2143657	1234657	1325476	1234657	2134567
[28]	1235467	1235467	2143567	1234576	2143576	1324567	1324576	1325476	2134657
[37]	1234576	1234657	2135467	1243576	1234576	1243567	1243657	2134576	1324657
[46]	1324567	1235476	1235467	2143567	1243576	1324576	1235476	1234657	2143567
[55]	1234576	2134567	1234567	1324576	1235476	2134576	2143567	1243567	1325476
[64]	2134576	1243657	1234576	1324657	1324567	2134576	1325467	1243576	1243567
[73]	2134567	2143657	1234567	2135467	1324657	1325467	2143576	1324576	1234657
[82]	1325476	1243576	1243657	1324576	1324576	1234567	1243576	2134567	1234576
[91]	1234576	1234567	1324657	1243576	1325467	2143657	1243576	1234576	1234576
[100]	1235467	1243576	2134576	1324567	2143567	1324567	2135476	2143576	2134657
[109]	1235467	1243576	2134576	1324657	1324576	1234576	1324567	1324567	1235467
[118]	1243567	1324657	1234657	1324657	2134567	1235467	1324576	2143567	2143657
[127]	1243657	2143567	1235476	2134576	1235467	2135476	2134567	1235476	2134657
[136]	2143657	2134657	1234576	2135467	1324657	1234657	1234576	1243576	2135467
[145]	1235476	2135467	2134567	2143657	1234657	1234657	2134576	1324567	1234567
[154]	1235467	1235476	1243567	1235467	1243567	2135467	1324567	1324657	1234567
[163]	1243657	1234576	1234567	2135476	1234576	2143567	1324657	2134567	1324576
[172]	1243567	1234576	1234567	1324567	2134657	1234657	2143576	2134576	2134567
[181]	1234567	1243567	1243576	1235467	1235467	1235467	1324657	2134657	1235467
[190]	1324567	1243657	1243567	1234576	2143567	2135476	2143567	2134657	2143576
[199]	2143657	1325476	1234567	1325476	1324657	1324567	1235467	1235476	2135467
[208]	1324567	2134576	1234567	1324576	1324567	1234567	1325467	1235476	1234567
[217]	1324567	2135476	1234576	1324657	1325467	2143567	1234567	2135476	1235476
[226]	1235476	2143657	1243576	2143567	1235476	1324567	2134567	1243567	1325476
[235]	2143657	1235476	1235476	2134567	1235476	1324567	1325467	1324657	2135467
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[991] 1324567 2143567 2135467 1325476 2135467 2143657 1324657 2143657 2134576
[1000] 2135476

```

```
> table(pn)
```

```
pn
```

```

1234567 1234576 1234657 1235467 1235476 1243567 1243576 1243657 1324567 1324576
      59      55      52      45      42      48      50      42      68      37

```



```

1324657 1325467 1325476 2134567 2134576 2134657 2135467 2135476 2143567 2143576
      57      38      42      53      51      51      44      39      41      30
2143657
      56

```

The summary of the computing time:

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

	X1	X2	X3	X4	X5
Min.	:0.0100	Min. :0e+00	Min. :0.01000	Min. :0	Min. :0
1st Qu.	:0.0200	1st Qu.:0e+00	1st Qu.:0.02000	1st Qu.:0	1st Qu.:0
Median	:0.0300	Median :0e+00	Median :0.03000	Median :0	Median :0
Mean	:0.0309	Mean :8e-05	Mean :0.03107	Mean :0	Mean :0
3rd Qu.	:0.0400	3rd Qu.:0e+00	3rd Qu.:0.04000	3rd Qu.:0	3rd Qu.:0
Max.	:0.1000	Max. :1e-02	Max. :0.10000	Max. :0	Max. :0

And finally, the bar chart of the rejections:

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

