

The R package *trioClasses* for definition of the class *SNPTrioExperiment*, an extension of *SummarizedExperiment*, for use in trio based analyses of genetic data.

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1 Packages

```
> library("trioClasses")
```

2 Sample Data

```
> data("sample")
> se <- SummarizedExperiment(assays = SimpleList(geno = t(sm)),
  colData = col.DF, rowData = gr)
> ped <- PedClass(ped.DF)
> ste <- SNPTrioExperiment(se, pedigree = ped)

> ste
```

```
class: SNPTrioExperiment
dim: 511 968
exptData(0):
assays(1): geno
rownames(511): chr14:54383433 chr14:54383470 ...
  chr14:54444385 chr14:54444750
rowData values names(0):
colnames(968): H_ME-CSc175_1-CSc175_1_a.1
  H_ME-CSc175_2-CSc175_2 ... H_ME-DS11418_2-DS11418_2
  H_ME-DS11418_3-DS11418_3
colData names(28): vcfid jb_famid ... id ped
pedigree(4139): famid id fid mid sex dx
```

3 Methods

Now create a list of three SnpMatrices for trio analyses using `GenoTrio()`.

```
> gtrio <- GenoTrio(ste)
```

Now we can do things easily, such as count transmissions.

```
> trans.011 <- with(gtrio, sum(F == 0 & M == 1 & O == 1,
  na.rm = TRUE))
```

Or run Holger's functions.

```
> geno <- ctcbind(gtrio)
> aTDT(geno[, 1:10])
```

```
$stat
[1]      NaN  5.0000000  0.3333333 15.0912548 10.3142857  1.0000000
[7]  3.0000000  4.1666667 32.0512821 12.6420233
```

```
$pval
[1]      NaN 2.534732e-02 5.637029e-01 1.024367e-04 1.320044e-03
[6] 3.173105e-01 8.326452e-02 4.122683e-02 1.501560e-08 3.771715e-04
```

```
$transMinor
[1]  0  5  2 100  8  0  0  7 14 100
```

```
$transMajor
[1]  0 15  1 163 27  1  3 17 64 157
```

4 Classes

4.1 SnpMatrix, DataFrame, GRanges

The four key ingredients are the SNP matrix, the pedigree information as a `DataFrame`, position of the SNPs given by a `GRanges` object, and covariate data given as a `DataFrame`.

```
> sm
```

```
A SnpMatrix with 968 rows and 511 columns
Row names: H_ME-DS10776_2-DS10776_2 ... H_ME-DS11313_1-DS11313_1
Col names: chr14:54383433 ... chr14:54444750
```

```
> ped.DF
```

```
DataFrame with 4139 rows and 6 columns
```

	famid	id
	<character>	<character>
1	4778	H_ME-4778_1-4778_1.2
2	4778	H_ME-4778_2-4778_2.2
3	4778	H_ME-4778_3-4778_3.2
4	4783	H_ME-4783_1-4783_1.1
5	4783	H_ME-4783_2-4783_2.1
6	4783	H_ME-4783_3-4783_3.1
7	20000492	H_ME-20000492_1-20000492_1.1
8	20000492	H_ME-20000492_2-20000492_2.a.1
9	20000492	H_ME-20000492_3-20000492_3.1
...
4131	DS12332	H_ME-DS12332_1-DS12332_1

4132	DS12332	H_ME-DS12332_2-DS12332_2	
4133	DS12332	H_ME-DS12332_3-DS12332_3	
4134	DS99998	H_ME-DS10193_5-DS10193_5.2	
4135	DS99998	H_ME-DS10193_6-DS10193_6	
4136	DS99998	H_ME-DS10193_7-DS10193_7	
4137	DS99999	H_ME-DS10707_4-DS10707_4.2	
4138	DS99999	H_ME-DS10707_5-DS10707_5	
4139	DS99999	H_ME-DS10707_6-DS10707_6	
		fid	mid
		<character>	<character>
1		H_ME-4778_2-4778_2.2	H_ME-4778_3-4778_3.2
2		NA	NA
3		NA	NA
4		H_ME-4783_2-4783_2.1	H_ME-4783_3-4783_3.1
5		NA	NA
6		NA	NA
7	H_ME-20000492_2-20000492_2_a.1	H_ME-20000492_3-20000492_3.1	
8		NA	NA
9		NA	NA
...	
4131		H_ME-DS12332_2-DS12332_2	H_ME-DS12332_3-DS12332_3
4132		NA	NA
4133		NA	NA
4134		H_ME-DS10193_6-DS10193_6	H_ME-DS10193_7-DS10193_7
4135		NA	NA
4136		NA	NA
4137		NA	NA
4138		H_ME-DS10707_4-DS10707_4.2	H_ME-DS10707_6-DS10707_6
4139		NA	NA
	sex	dx	
	<numeric>	<numeric>	
1	1	1	
2	1	0	
3	2	0	
4	2	1	
5	1	0	
6	2	1	
7	2	1	
8	1	0	
9	2	0	
...	
4131	1	1	
4132	1	0	
4133	2	0	
4134	2	1	
4135	1	0	
4136	2	0	
4137	1	0	
4138	1	1	
4139	2	0	

> gr

GRanges with 511 ranges and 0 elementMetadata cols:

	seqnames	ranges	strand
	<Rle>	<IRanges>	<Rle>
chr14:54383433	chr14	[1, 1]	*
chr14:54383470	chr14	[2, 2]	*
chr14:54383819	chr14	[3, 3]	*
chr14:54383945	chr14	[4, 4]	*
chr14:54384030	chr14	[5, 5]	*
chr14:54384232	chr14	[6, 6]	*
chr14:54384251	chr14	[7, 7]	*
chr14:54384291	chr14	[8, 8]	*
chr14:54384382	chr14	[9, 9]	*
...
chr14:54443495	chr14	[503, 503]	*
chr14:54443499	chr14	[504, 504]	*
chr14:54443514	chr14	[505, 505]	*
chr14:54443831	chr14	[506, 506]	*
chr14:54443880	chr14	[507, 507]	*
chr14:54444016	chr14	[508, 508]	*
chr14:54444124	chr14	[509, 509]	*
chr14:54444385	chr14	[510, 510]	*
chr14:54444750	chr14	[511, 511]	*

```
seqlengths:
chr14
NA
```

4.2 SummarizedExperiment

We combine three of the key ingredients when we create the SummarizedExperiment object.

```
> se <- SummarizedExperiment(assays = SimpleList(geno = t(sm)),
  colData = col.DF, rowData = gr)
```

4.3 SNP TrioExperiment

Now, we include the pedigree information as an object of class PedClass. We keep PedClass independent of SNP TrioExperiment for flexibility.

```
> ped <- PedClass(ped.DF)
> ste <- SNP TrioExperiment(se, pedigree = ped)
```

Here is the show method.

```
> ste

class: SNP TrioExperiment
dim: 511 968
exptData(0):
assays(1): geno
rownames(511): chr14:54383433 chr14:54383470 ...
  chr14:54444385 chr14:54444750
```

```
rowData values names(0):
colnames(968): H_ME-CSc175_1-CSc175_1_a.1
               H_ME-CSc175_2-CSc175_2 ... H_ME-DS11418_2-DS11418_2
               H_ME-DS11418_3-DS11418_3
colData names(28): vcfid jb_famid ... id ped
pedigree(4139): famid id fid mid sex dx
```

And now we verify that it is indeed an extension of SummarizedExperiment.

```
> getClass("SNPTrioExperiment")
```

```
Class "SNPTrioExperiment" [package "trioClasses"]
```

Slots:

Name:	pedigree	exptData
Class:	PedClass	SimpleList

Name:	rowData	colData
Class:	GenomicRangesORGRangesList	DataFrame

Name:	assays
Class:	SimpleList

```
Extends: "SummarizedExperiment"
```

4.4 PedClass

Now we investigate the pedigree slot of the SNPTrioExperiment object.

```
> class(pedigree(ste))
```

```
[1] "PedClass"
attr("package")
[1] "trioClasses"
```

```
> getClass("PedClass")
```

```
Class "PedClass" [package "trioClasses"]
```

Slots:

Name:	rownames	nrows	listData
Class:	characterORNULL	integer	list

Name:	elementType	elementMetadata	metadata
Class:	character	DataTableORNULL	list

Extends:

```
Class "DataFrame", directly
Class "DataTable", by class "DataFrame", distance 2
Class "SimpleList", by class "DataFrame", distance 2
```

```

Class "DataTableORNULL", by class "Dataframe", distance 3
Class "List", by class "Dataframe", distance 3
Class "Vector", by class "Dataframe", distance 4
Class "Annotated", by class "Dataframe", distance 5

```

```
> pedigree(ste)
```

```
PedClass with 4139 rows and 6 columns
```

	famid		id
	<factor>		<factor>
1	4778	H_ME-4778_1-4778_1.2	
2	4778	H_ME-4778_2-4778_2.2	
3	4778	H_ME-4778_3-4778_3.2	
4	4783	H_ME-4783_1-4783_1.1	
5	4783	H_ME-4783_2-4783_2.1	
6	4783	H_ME-4783_3-4783_3.1	
7	20000492	H_ME-20000492_1-20000492_1.1	
8	20000492	H_ME-20000492_2-20000492_2_a.1	
9	20000492	H_ME-20000492_3-20000492_3.1	
...	
4131	DS12332	H_ME-DS12332_1-DS12332_1	
4132	DS12332	H_ME-DS12332_2-DS12332_2	
4133	DS12332	H_ME-DS12332_3-DS12332_3	
4134	DS99998	H_ME-DS10193_5-DS10193_5.2	
4135	DS99998	H_ME-DS10193_6-DS10193_6	
4136	DS99998	H_ME-DS10193_7-DS10193_7	
4137	DS99999	H_ME-DS10707_4-DS10707_4.2	
4138	DS99999	H_ME-DS10707_5-DS10707_5	
4139	DS99999	H_ME-DS10707_6-DS10707_6	
	famid		mid
	<factor>		<factor>
1	H_ME-4778_2-4778_2.2	H_ME-4778_3-4778_3.2	
2	NA	NA	
3	NA	NA	
4	H_ME-4783_2-4783_2.1	H_ME-4783_3-4783_3.1	
5	NA	NA	
6	NA	NA	
7	H_ME-20000492_2-20000492_2_a.1	H_ME-20000492_3-20000492_3.1	
8	NA	NA	
9	NA	NA	
...	
4131	H_ME-DS12332_2-DS12332_2	H_ME-DS12332_3-DS12332_3	
4132	NA	NA	
4133	NA	NA	
4134	H_ME-DS10193_6-DS10193_6	H_ME-DS10193_7-DS10193_7	
4135	NA	NA	
4136	NA	NA	
4137	NA	NA	
4138	H_ME-DS10707_4-DS10707_4.2	H_ME-DS10707_6-DS10707_6	
4139	NA	NA	
	sex	dx	
	<factor>	<factor>	

1	1	1
2	1	0
3	2	0
4	2	1
5	1	0
6	2	1
7	2	1
8	1	0
9	2	0
...
4131	1	1
4132	1	0
4133	2	0
4134	2	1
4135	1	0
4136	2	0
4137	1	0
4138	1	1
4139	2	0

4.5 geno accessor

```
> class(geno(ste))
```

```
[1] "SnpMatrix"
attr(,"package")
[1] "snpStats"
```

```
> getClass("SnpMatrix")
```

```
Class "SnpMatrix" [package "snpStats"]
```

```
Slots:
```

```
Name: .Data
Class: matrix
```

```
Extends:
```

```
Class "matrix", from data part
```

```
Class "array", by class "matrix", distance 2
```

```
Class "structure", by class "matrix", distance 3
```

```
Class "vector", by class "matrix", distance 4, with explicit coerce
```

```
Known Subclasses: "XSnpMatrix"
```

```
> geno(ste)
```

```
A SnpMatrix with 968 rows and 511 columns
```

```
Row names: H_ME-CSc175_1-CSc175_1_a.1 ... H_ME-DS11418_3-DS11418_3
```

```
Col names: chr14:54383433 ... chr14:54444750
```

4.6 RowData

```
> rowData(ste)
```

GRanges with 511 ranges and 0 elementMetadata cols:

	seqnames	ranges	strand
	<Rle>	<IRanges>	<Rle>
chr14:54383433	chr14	[1, 1]	*
chr14:54383470	chr14	[2, 2]	*
chr14:54383819	chr14	[3, 3]	*
chr14:54383945	chr14	[4, 4]	*
chr14:54384030	chr14	[5, 5]	*
chr14:54384232	chr14	[6, 6]	*
chr14:54384251	chr14	[7, 7]	*
chr14:54384291	chr14	[8, 8]	*
chr14:54384382	chr14	[9, 9]	*
...
chr14:54443495	chr14	[503, 503]	*
chr14:54443499	chr14	[504, 504]	*
chr14:54443514	chr14	[505, 505]	*
chr14:54443831	chr14	[506, 506]	*
chr14:54443880	chr14	[507, 507]	*
chr14:54444016	chr14	[508, 508]	*
chr14:54444124	chr14	[509, 509]	*
chr14:54444385	chr14	[510, 510]	*
chr14:54444750	chr14	[511, 511]	*

seqlengths:

chr14
NA

4.7 ColData

5 Validity