

Classes Used in the Oligo Package

Benilton Carvalho

March, 2007

1 Introduction

This document describes the classes used in the `oligo` package. The `oligo` package uses essentially two groups of classes:

- Static data classes: these are chip-specific information. Each chip contains its own annotation, which is shared across experiments that used that array. These are generated by the `makePlatformDesign` and `pdInfoBuilder` packages.
- Experimental data classes: these classes refer to the experimental data, ie. CEL and XYS files that the user has. All the experimental data classes derive from `eSet` defined in `Biobase`.

The *platformDesign* is one of the static data classes and is generated by the `makePlatformDesign` package. It is a container for the chip-specific information. We are transitioning the creation of the chip-specific packages to the `pdInfoBuilder`, which makes more efficient use of memory (via SQLite) and is much more flexible than the environment approach used by `makePlatformDesign`.

2 *platformDesign* Class

The *platformDesign* class is the container for information on the expression (NimbleGen), tiling (Affymetrix, NimbleGen) and exon (Affymetrix) arrays. It contains the following slots:

- **manufacturer**: lower case string containing the name of the manufacturer of the array (eg., `■affymetrix■` or `■nimblegen■`).
- **genomebuild**: lower case string containing the genome release information using the USCS notation, as described at <http://genome.ucsc.edu/FAQ/FAQreleases#release1>.
- **featureInfo**: an environment containing vectors of same length which fully characterizes the array being used. See details below.

Slot	Type
<code>manufacturer</code>	<i>character</i>
<code>genomebuild</code>	<i>character</i>
<code>featureInfo</code>	<i>enviroment</i>
<code>featureTypeDescription</code>	<i>list</i>
<code>type</code>	<i>character</i>
<code>nrow</code>	<i>numeric</i>
<code>ncol</code>	<i>numeric</i>
<code>nwells</code>	<i>numeric</i>
<code>lookup</code>	<i>data.frame</i>
<code>indexes</code>	<i>list</i>
<code>platforms</code>	<i>character</i>

Table 1: Description of the *platformDesign* class

- `type`: a string describing the type of the array (eg., `expression`, `tiling`, `exon`, `SNP`).
- `nrow` and `ncol`: array dimensions.
- `nwells`: number of wells (specific for NimbleGen data).
- `lookup`: *data.frame* used to map features in complex NimbleGen designs.
- `indexes`: not used anymore. To be removed.
- `platform`: not used anymore. To be removed.

2.1 Details on the `featureInfo` slot

The `featureInfo` is the home for the majority of the information used by *oligo*. `featureInfo` is an *environment* containing the following vectors:

- `X` and `Y`: X/Y coordinates on the array. Class: *integer*.
- `feature_set_name`: name of the featureset (probeset). Class: *character*.
- `feature_ID`: match ID between PM and MM. *integer*.
- `feature_type`: type of the feature. Class: *factor*. (PM/MM)
- `target_strand`: target strandness. Class: *factor*. (antisense/sense)
- `sequence`: probe sequence. Class: *character*.
- `length`: probe length. Class: *integer*.
- `chromosome`: chromosome. Class: *character*. (chr1/chr22/chrX)
- `ambiguous_feature`: indicator if sequence is mapped to more than one genomic location. *logical*

Field	Expression	Tiling	Exon
X and Y	✓	✓	✓
feature_set_name	✓	✓	✓
feature_ID	✓	✓	✓
feature_type	✓	✓	✓
target_strand	✓	✓	✓
sequence	✓	✓	✓
order_index	✓	✓	✓
length		✓	✓
chromosome		✓	
ambiguous_feature		✓	
position		✓	
location	✓		✓
atomID			✓
gc_count			✓

Table 2: Fields in `featureInfo`

- **position**: genomic location within chromosome. *numeric*
- **location**: genomic location within chromosome. To be removed and merged with **position**.
- **atomID**: pairing key between PM-MM.
- **gc_count**: number of GC bases. To be removed, as this can be obtained from the sequence information.

2.1.1 Particularities of Tiling Arrays

For tiling arrays, I have been using the genomic position as `feature_set_name`, but it is not uncommon to have a probe sequence matching $k > 1$ genomic positions. In situations like this, the `feature_set_name` is set as the concatenation of the k genomic positions using ■;■ as separator and `ambiguous_feature` is set TRUE. For example:

sequence	position	feature_set_name	ambiguous_feature
AAATC...GCCAT	12345	■12345■	FALSE
CCACG...ATTCC	34567 / 87654	■34567;87654■	TRUE

Table 3: Naming convention for tiling arrays

An even more effective naming convention would be `CHRnnPmmmmmm`, which would be more robust on designs that involve multiple chromosomes.

2.1.2 Particularities of Exon Arrays

A basic support of Exon Arrays is offered by `oligo`.

2.1.3 Particularities of SNP Arrays

The data packages for SNP arrays are now built via `pdInfoBuilder` package. The packages for the Affymetrix 100K and 500K sets are available via BioConductor.

2.1.4 About `order_index`

In the final version of the data packages, the fields described on Table 2 are ordered by `feature_set_name`, `feature_type` and `target_strand`. Note that this breaks the link between the intensity file (which is often ordered by X/Y location) and the annotation available in the *platformDesign* object.

In order to keep this link, we initially order the *platformDesign* object by X/Y location, so it matches the intensities files. Then we add the field `order_index`, which is only the row number. Later, the *featureInfo* object is re-ordered by `feature_set_name`, `feature_type` and `target_strand`. But with the presence of `order_index`, we can correctly map the intensities to their probe-level annotations.

3 *DBPDInfo* Class

The *DBPDInfo* class is the database approach for the *platformDesign* class. Table 3 describes the class structure.

Slot	Type
<code>getdb</code>	<code>function</code>
<code>tableInfo</code>	<code>data.frame</code>
<code>geometry</code>	<code>integer</code>
<code>manufacturer</code>	<code>character</code>
<code>genomebuild</code>	<code>character</code>

Table 4: Description of the *DBPDInfo* class

- `getdb`: function that accesses the external database (we use SQLite, via RSQLite);
- `tableInfo`: a `data.frame` with two columns (`tbl` and `row_count`). This `data.frame` contains the name and number of rows of each table available in the database.
- `geometry`: an integer vector of length 2, containing the number of rows and columns of the array;
- `manufacturer`: a string with the manufacturer's name;
- `genomebuild`: a string with the genome build information.

4 *FeatureSet* Class

The *FeatureSet* class is a virtual class to be used with the feature-level data and is created from the *eSet* class. Different classes are created from this:

- *ExpressionFeatureSet*: for expression arrays;
- *SnpFeatureSet*: for SNP arrays;
- *ExonFeatureSet*: for exon arrays;
- *TilingFeatureSet*: for tiling arrays.

5 *SnpQSet* Class

The *SnpQSet* class is created by the `snprma()` method. It contains four matrices, which contain the summarized information for SNP data. The four matrices are:

- **antisenseThetaA**: summarized data at the SNP-level for the antisense strand and allele A;
- **antisenseThetaB**: summarized data at the SNP-level for the antisense strand and allele B;
- **senseThetaA**: summarized data at the SNP-level for the sense strand and allele A;
- **senseThetaB**: summarized data at the SNP-level for the sense strand and allele B;

This is the expected input to the genotyping algorithm, `cr1mm()`.

6 *SnpCallSet* Class

The *SnpCallSet* class is a container for the output of genotyping algorithm, eg. `cr1mm()`. It contains two matrices: **calls** and **callsConfidence**, which hold respectively the genotype calls and associated measures of confidence.

7 *SnpCopyNumberSet* Class

The *SnpCopyNumberSet* class is a container for the output of copy number analysis. It contains two matrices: **copyNumber** and **copyNumberConfidence**, which hold respectively the copy number estimates and associated measures of confidence.