

# The SVM2CRM data User's Guide

Guidantonio Malagoli Tagliazucchi, Silvio Bicciato  
Center for genome research  
University of Modena and Reggio Emilia, Modena

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## 1 Overview

The SVM2CRMdata package contains ChIP-seq data of methylation and acetylation maps from CD4+ T-cells([1]). The package contains also a list of p300 binding sites and two matrix contains the signals of the histone marks in correspondance of genomic regions with enhancers or background sequences. This package is useful to perform the tutorial analysis of SVM2CRM. In this tutorial we load a matrix with the signal of ChIP-seq data preprocess using *cisREfindbed* function of SVM2CRM package and two matrices containing the signal of the histone marks at level of putative enhancers and random genomic regions.

## 2 CD4matrixInputSVMbin100window1000 object

This data.frame contains the signals of the histone modification from CD4+T-cells([1]) genome wide. In particular, this dataset contains 20 methylation and 17 acetylation ChIP-seq maps. We obtained this object using the function `cisREfindbed` from *SVM2CRM* package. For details about this function see the documentation in *SVM2CRM* package. Briefly, this function allowed the user to create one of the input required to perform the prediction of enhancers using *SVM2CRM*. In particular, this function reads external bed files of the histone modification (processed externally from R) and performed the smoothing of the signals genome-wide. When we processed this dataset we used `cisREfindbed` considering a `bin.size` of 100 bp, that is the values that we used to binarized the signals of the histone modification genome wide. Moreover the size of the window to perform the smoothing of the histone modification signals genome wide was set to 500, 1000, 2000 bp. This package contains the data.frame obtained using a window of 1000bp and considering only the chromosome 1. Before to perform the prediction of enhancers using your dataset and *SVM2CRM* we suggests to generate this data.frame using ad hoc script that contain only the code of `cisREfindbed` and that save the results of this analysis in a .RData. This can help the user to reduce the computational time to perform the prediction genome-wide and avoid to create the input each time that the user want launch a new analysis (for e.g. using different parameters).

```
> library(SVM2CRMdata)
> setwd(system.file("data", package="SVM2CRMdata"))
> load("CD4_matrixInputSVMbin100window1000.rda")
> #The column contains the signal. The rows contains the genomic coordinate, while the
> dim("CD4_matrixInputSVMbin100window1000")
```

NULL

## 3 trainpositive and trainnegative objects

The `trainpositive` and `trainnegative` objects were created using the function `getSignal` of *SVM2CRM* package. These data.frame contains the signals of the histone modification of 20 methylation and 17 acetylation ChIP-seq maps from ([1]) at p300 binding sites (train positive) and genomic random regions (train negative). In particular these data.frame contains the signals of the histone modifications in correspondence of p300 binding sites known

and genomic regions distant from TSSs of 1000bp. The creation of this matrices is mandatory because *SVM2CRM* require the presence of two datasets that contains the signals of the histone modification at level of putative enhancers (p300 binding sites) and in genomic regions different from distal *cis*-regulatory regions. Here we used `getSignal` from *SVM2CRM* to create respectively the `trainpositive` and `trainnegative` dataset. In particular, we download a list p300 binding sites and create a list of genomic-coordinates random regions using bedtools using a windows size of 1000. We used the same size of window (1000 bp) defined also to create the object described in the previously object (`CD4matrixInputSVMbin100window1000`).`getSignal` consider the signal of the histone marks around a particular windows (1000 bp) from the start of the genomic regions provided (e.g. the start of the p300 binding sites and background genomic regions). Also in this case we suggests to create this `data.frame` before to perfomed an entire analysis of *SVM2CRM*.

```
> setwd(system.file("data", package="SVM2CRMdata"))
> load("train_positive.rda")
> load("train_negative.rda")
```

## 4 External data

In *SVM2CRMdata* we provided ChIP-seq data from H2AK5ac, H2K23ac, H2AK9ac, H3K27ac, H3K4me1, H3K4me2, H3K4me3. This data contains the signals of the histone modification normalized using the procedure described in ([2]). The user can use these data to create the object described in the first section of this vignette. This object is one of the most important input required to perfomed the prediction of analysis with *SVM2CRM*. As described previously this object contains the genome wide signals of the histone modifications provided by the user. The user can create this input simple using `cisREfindbed` function from *SVM2CRM*. The parameters required are `bin.size` used to binnarized the signal of the histone modification (in this case 100bp), the size of the windows to consider the signals of the histone marks (each 1000 bp), and the function that the user want use to model the signals of the histone marks inside the windows (optional). The object that is generate using `cisREfindbed` several columns. A column with the chromosome, the start and end of the genomic windows, the signals of the histone marks inside the windows. The number of columns that contains the signals of the histone marks dependes on the window size. For details see section "Introduction" in the vignette of *SVM2CRM*

## 5 References

### References

- [1] Rosenfeld JA Wang Z, Zang C, Schones DE, Cuddapah S Barski A, Roh TY Cui K, Zhang MQ Peng W, and Zhao K. Combinatorial patterns of histone acetylations and methylations in the human genome. *Nature Genetics*, 7(40):897–903, 2008.
- [2] Hiram A Firpi, Duygu Ucar, and Kai Tan. Discover regulatory dna elements using chromatin signatures and artificial neural network. *Bioinformatics*, 26(13):1579–86, 2010.

## 6 Session information

The output in this vignette was produced under the following conditions:

```
> sessionInfo()

R version 4.3.0 RC (2023-04-18 r84287)
Platform: x86_64-pc-linux-gnu (64-bit)
Running under: Ubuntu 22.04.2 LTS

Matrix products: default
BLAS:      /home/biocbuild/bbs-3.18-bioc/R/lib/libRblas.so
LAPACK:   /usr/lib/x86_64-linux-gnu/lapack/liblapack.so.3.10.0

locale:
[1] LC_CTYPE=en_US.UTF-8        LC_NUMERIC=C
[3] LC_TIME=en_GB              LC_COLLATE=C
[5] LC_MONETARY=en_US.UTF-8    LC_MESSAGES=en_US.UTF-8
[7] LC_PAPER=en_US.UTF-8       LC_NAME=C
[9] LC_ADDRESS=C                LC_TELEPHONE=C
[11] LC_MEASUREMENT=en_US.UTF-8 LC_IDENTIFICATION=C

time zone: America/New_York
tzcode source: system (glibc)

attached base packages:
[1] stats      graphics   grDevices  utils      datasets  methods   base

other attached packages:
[1] SVM2CRMdata_1.33.0

loaded via a namespace (and not attached):
[1] compiler_4.3.0 tools_4.3.0
```