

Details of the default long finger prints

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This document describes the long finger prints. The finger prints are based on the recognition of some interactions. Each atom bears a certain number of flags describing which kind of potential interactions it can be involved in. An interaction is detected if two atoms bear compatible flags and have a compatible geometry. This section describes how each flag is assigned and what are the geometry expected.

1 Flag and geometric descriptor assignement

The table 1 describes the different flags that can be assigned:

Note that the definition of an hydrogen bond and a weak hydrogen bond is not very well established. We have kept our definition as simple as possible for hydrogen bonds. This is why there is no hybridization considerations. In the same idea, if sulfur hydrogen bond strength is not sufficient for binding it is relevant for specificity and binding mode recognition. For weak hydrogen bonds we refer only to hydrogen bonds involving carbons.

2 Geometry

Between a couple of atoms, an interaction is detected if the corresponding flag are compatible and if some geometric criteria (table 2) is respected between their geometric descriptors.

For example, a pi-cation is detected if:

- one atom has the flag “cation” and the other is “aromatic”
- the center of the aromatic ring, the “aromatic” atom belongs to, and the cation are closer than 4 Å

Flag	SMARTS
Donor	H-[O,N,S]
Acceptor	[[O,N,S,Cl,F]&[!+*]]
Cation	[+*]
Anion	[-*]
Aromatic	[a&R]
Hydrophobe	[I,Br,C,[H-C]]
Weak Acceptor	[c,Cx3,Cx2]
Donneur Faible	H-[c,Cx3,Cx2]
Metal	[Mg,Ca,Mn,Fe,Co,Ni,Cu,Zn,Cd]

Tab. 1: For each flag defined in the long finger print the rule for assignment is given using Daylight SMARTS.

Interaction	Rule 1	Rule 2
Hydrogen bond	$ \overrightarrow{HA} \leq 3.5\text{\AA}$	$\widehat{\overrightarrow{DH}, \overrightarrow{HA}} \in [-\frac{\pi}{4}, +\frac{\pi}{4}]$
Weak Hydrogen bond	$ \overrightarrow{HA} \leq 2.8\text{\AA}$	$\widehat{\overrightarrow{DH}, \overrightarrow{HA}} \in [-\frac{\pi}{6}, +\frac{\pi}{6}]$
Ionic	$ \overrightarrow{+-} \leq 4.0\text{\AA}$	
Hydrophobe	$ \overrightarrow{Y_1Y_2} \leq 3.0\text{\AA}$	
Metal	$ \overrightarrow{M_1M_2} \leq 2.8\text{\AA}$	
Face to Face	$ \overrightarrow{ac_1ac_2} \leq 4.0\text{\AA}$	$\widehat{\overrightarrow{n_1}, \overrightarrow{n_2}} \in [-\frac{\pi}{6}, \frac{\pi}{6}]$
Edge to Face	$ \overrightarrow{ac_1ac_2} \leq 4.0\text{\AA}$	$\widehat{\overrightarrow{n_1}, \overrightarrow{n_2}} \in [\frac{\pi}{6}, \frac{5\pi}{6}]$
Pi Cation	$ \overrightarrow{ac+} \leq 4.0\text{\AA}$	$\widehat{\overrightarrow{n}, \overrightarrow{ac+}} \in [-\frac{\pi}{6}, \frac{\pi}{6}]$

Tab. 2: Geometric conditions for an interaction to be detected. *H* stands for hydrogen, *A*, for acceptor, *D* for donor, *+* for cation, *−* for anion, *Y* for hydrophobe, *M* for a metal, *ac* for geometric center of an aromatic ring, *n* for the normal to the aromatic ring.

Position in the bit vector	Cavity atom Flag	Ligand atom flag	Interaction
1	Hydrophobe	Hydrophobe	Hydrophobe
2	Aromatic	Aromatic	Face to face
3	Aromatic	Aromatic	Edge to face
4	Donor	Acceptor	Hydrogen bond
5	Acceptor	Donor	Hydrogen bond
6	Cation	Anion	Ionic
7	Anion	Cation	Ionic
8	Weak donor	Weak acceptor	Weak hydrogen bond
8	Weak donor	acceptor	Weak hydrogen bond
9	Weak acceptor	Weak donor	Weak hydrogen bond
9	acceptor	Weak donor	Weak hydrogen bond
10	Aromatic	Cation	cation
10	Cation	Aromatic	cation
11	Metal	Metal	Metal

Tab. 3: Bit significance by residue

- the normal to the aromatic plane makes an angle no wider than $\frac{\pi}{6}$ with the direction defined by the aromatic ring center and the cation position

3 Finger Print structure

The finger print is composed of 7 or 11 bits long blocks, one per residue in the cavity. The structure of each of those blocks is described in the table 3.