# LOESS

## 1 Method definition

Loess (or Lowess for LOcally WEighted Scatterplot Smoothing) estimates the recombination rates by locally adjusting a polynomial curve. The size of the local window is defined as a percentage of the total number of markers and therefore can adapt to the variation of the density of markers across the map. Inside of a given window, each marker is attributed a weight depending on how far they are from the center of the window. The parameters $\beta$ of the curves are those that minimize the mean squared deviation between the data and the curve:

$$Q = \sum_{i=1}^{n} \omega_i [y_i - f(x_i, \hat{\beta})]^2$$

where ($x_i$ , $y_i$) are the observed data and $\omega_i$ is the weight of each marker calculated by:

$$\omega(u) = (1 - u^3)^3$$

with:

$$u = \frac{|x_0 - x_i|}{max_N(x_0)|x_0 - x_i|}$$

For this method, you can select the degree of the fitted curve (in `MareyMapOnline`, it is fixed at 2) and the size of the window (`Span` parameter). The span parameter is the percentage of the total number of points to take into account for computing the local polynomial at the vicinity of a marker. Span controls the degree of smoothing.

## 2 R code

The `calcRecomRates_loess` (see below) allows to build the loess model from the physical (`physcoord`) and genetical (`gencoord`) coordinates and to calculate recombination rates at some physical positions (`physpos`).

This function is based on the `R loess` function.
In the `loess` function, the `span` parameter is defined by users in the application and the `degree` parameter (the polynomial degree) is fixed to 2.
For more information about this method, write `?loess` in a `R` console.

```
calcRecomRates_loess <- function(physpos, physcoord, gencoord) {
  modelLoess <- loess(gencoord ~ physcoord, span = input$Span, degree = 2,
    na.action = na.exclude)
  pp1 <- physpos + 1
  pm1 <- physpos - 1
  gp1 <- predict(modelLoess, newdata = pp1)
  gm1 <- predict(modelLoess, newdata = pm1)
  out <- mapply(function(xa, xb, ya, yb)
    {round((yb - ya) / ((xb - xa) / 1000000), 2)}, pm1, pp1, gm1, gp1)
  return(out)
}
```

# 3 Bibliography

*Robust Locally Weighted Regression and Smoothing Scatterplots.* W.S. Cleveland. Journal of the American Statistical Association (1979). Vol. 74, No. 368, pp. 829-836.

*Consistent Nonparametric Regression.* C.J. Stone. The Annals of Statistics (1977). Vol. 5, No. 4, pp. 595-620.

*Non-Parametric Estimation of a Smooth Regression Function.* R. M. Clark. Journal of the Royal Statistical Society, Series B (Methodological) (1977). Vol. 39, No. 1, pp. 107-113.