



# Evolutionary algorithms

Practical assignment:

The low-autocorrelation problem



# Rules of engagement

- Design and implement an evolutionary algorithm for solving the **low-autocorrelation** problem
- Write a report (conference format) about your findings and hand in your report together with the code
- You can work in groups of two
- Best paper award: 50 Euros and potentially a submission to a conference
- Deadline: **December 7<sup>th</sup>, 2007**



# Rules of engagement - Code

- Implement your algorithm in MATLAB.
- Your MATLAB implementation should work
- Make sure that the implementation is easy to run (if necessary, add a README file with instructions)
- We provide you with an implementation of the objective function at:

<http://www.liacs.nl/baeck/EA/pa/merit.m>



# Rules of engagement - Report

- Report about your implementation, design choices, results, etc.
- Follow the ACM SIG Proceedings Template
- The ACM SIG Proceedings Template can be found at:

<http://www.acm.org/sigs/publications/proceedings-templates>



# Autocorrelation

From wiki:

- Autocorrelation is a mathematical tool used frequently in signal processing for analyzing functions or series of values, such as time domain signals.
- Informally, it is a measure of how well a signal matches a time-shifted version of itself, as a function of the amount of time shift.
- More precisely, it is the cross-correlation of a signal with itself.



# The low-autocorrelation problem

- Find a binary string of dimension  $n$ :

$$\vec{y} \in \{-1, +1\}^n$$

- For an optimal string for:

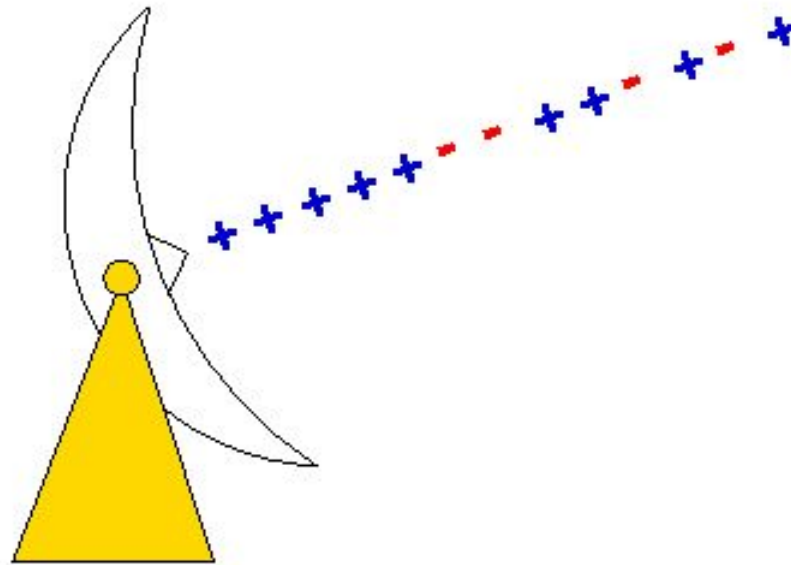
$$f(\vec{y}) = \frac{n^2}{2 \cdot E(\vec{y})} \rightarrow \text{maximization}$$

- With:

$$E(\vec{y}) = \sum_{k=1}^{n-1} \left( \sum_{i=1}^{n-k} y_i \cdot y_{i+k} \right)^2$$

# Application in radar measurements

- Low autocorrelation binary sequences are used in high precision radar measurements.





# MATLAB - a hint to get you going...

Create a random vector of length '10' containing only the values -1 and 1 with:

```
>> x = randsample([-1,1],10,true,[0.5, 0.5])
```