Smart Lora parameters selection

Aghiles DJOUDI[12], Rafik ZITOUNI[2] and Laurent GEORGE[1]
[1]LIGM/ESIEE Paris, 5 boulevard Descartes, Cité Descartes, Champs-sur-Marne, France
[2]SIC/ECE Paris, 37 Quai de Grenelle, 75015 Paris, France
Email: aghiles.djoudi@esiee.fr, rafik.zitouni@ece.fr, laurent.george@esiee.fr

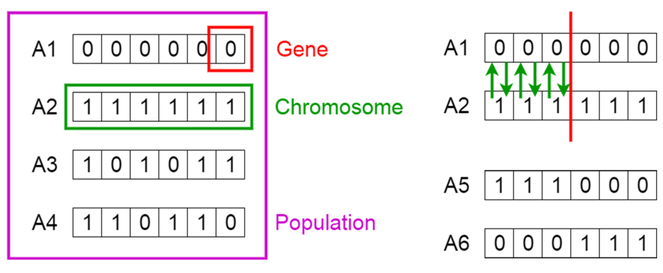
1. Introduction

The need of new kind of wireless communication that could send data far away with low power consumption emrged rencently to support IoT application like smart building smart enviroment monitoring. **LoraWan** is one of this emerging wireless communication [1], it allows sensors to reach the gatheway in a range of 5Km. Unlike other technologies Lorawan is the best versatile sollution to deploaye IoT apllication in both urban and rural area where there is no communication infrastructure.

2. Genetic Algorithm

A genetic algorithm is a search heuristic that is inspired by Charles Darwins theory of natural evolution [2]. This algorithm reflects the process of natural selection where the fittest configurations are selected for reproduction in order to produce offspring of the next generation.

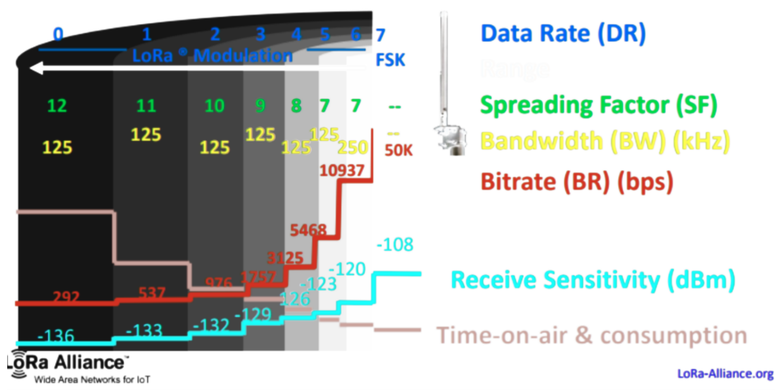
- **Gene:** QoS metric.
- **Chromosome:** QoS of one configuration.
- **Population:** QoS of all configuration.



3. Parameters selection

The physicla layer of Lora thecgnology (Semtech SX1276) hase 4 parameters which make 6720 possible settings [3]:

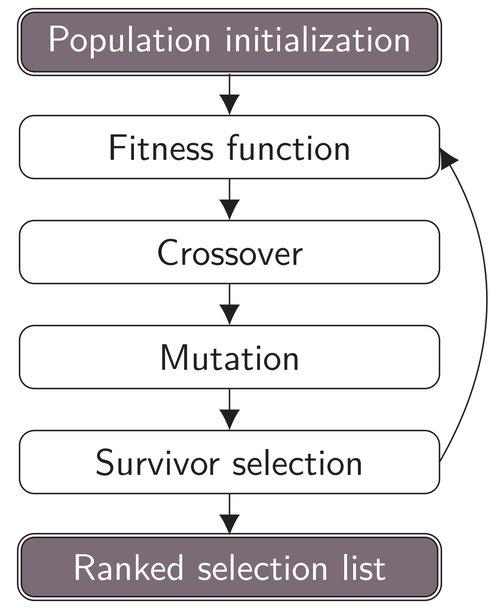
- **SF:** Spreading factor [SF7 - SF12]
- **CR:** Coding rate [4/5 - 4/8]
- **BW:** Bandwidth [7.8Khz - 500Khz]
- **Tx:** Transmition power [-4dBm +20dBm]



4. Experimentaion

In order to generate all the required metrics of each Lora configuration we use both simulation and real enviroment. We use ns3 simulator with 2 nodes and one gateway, the distance between each node and the gateway is set to 1km.

Define: stopping criteria, population size P, and mutation probability pm
Generate randomly an initial population of chromosomes
repeat:
. . . **for** each chromosome do
. . . . . . Train a model & compute chromosome's fitness
. . . **end**
. . . **for** each reproduction 1 ... P/2 do
. . . . . . **Select:** 2 chromosomes based on fitness
. . . . . . **Crossover:** Produce 2 child configuration
. . . . . . **Mutate:** child configurations with pm
. . . **end**
until stopping criterion are met



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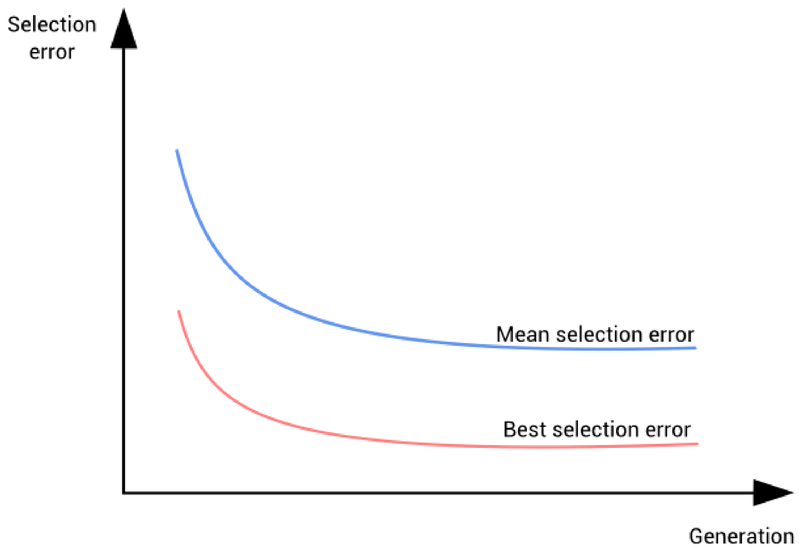
5. Results

Results show that genetic algorithm select the configuration that match beter the requiered QoS by the application. In fact, when we run an application that requires high quality of service, the algorithm select the configuration that gives large BW and hight data rate with minimum enrgy consumption. When we run an application that requiers less QoS, the algorithm rank configuration whith sufficient BW and DR.



Setup	Selection error	Rank	Fitness
1	0.9	1	1.5
2	0.5	3	4.5
3	0.7	2	3
n	0.5	4	6

6. Conclusions

As we have seen, feature selection is becoming very important in predictive analytics. Indeed, many data sets contain a large number of features, so we have to select the most useful ones. One of the most advanced methods to do that is the genetic algorithm.
Some advantages of genetic algorithms this method are the following:
They usually perform better than traditional feature selection techniques. Genetic algorithms can manage data sets with many features. They don't need specific knowledge about the problem under study. These algorithms can be easily parallelized in computer clusters.
And some disadvantages are:
Genetic Algorithms might be very expensive in computational terms, since evaluation of each configuration requires building a predictive model. These algorithms can take a long time to converge, since they have a stochastic nature.
In conclusion, genetic algorithms can select the best subset of variables for our predictive model, but they usually require a lot of computation. Neural Designer implements a more advanced genetic algorithm that the one described in this post. You can find it at the Inputs selection section in the Model selection pane.

7. References

[1] Wael Ayoub, Abed Ellatif Samhat, Fabienne Nouvel, Mohamad Mroue, and Jean-Christophe Prevotet. Internet of Mobile Things: Overview of LoRaWAN, DASH7, and NB-IoT in LPWANs Standards and Supported Mobility. 21(2):1561–1581. 00007.

[2] Eleni I. Vlahogianni, Matthew G. Karlaftis, and John C. Golias. Optimized and meta-optimized neural networks for short-term traffic flow prediction: A genetic approach. 13(3):211–234. 00506.

[3] Mahda Noura, Mohammed Atiquzzaman, and Martin Gaedke. Interoperability in Internet of Things: Taxonomies and Open Challenges. 00004.