SmartHelio
THE DOCTORS OF SOLAR PLANTS

A Big Data Clean Energy Intelligence Company

Genetic Algorithms for PV Power Simulation and Digital Twinning

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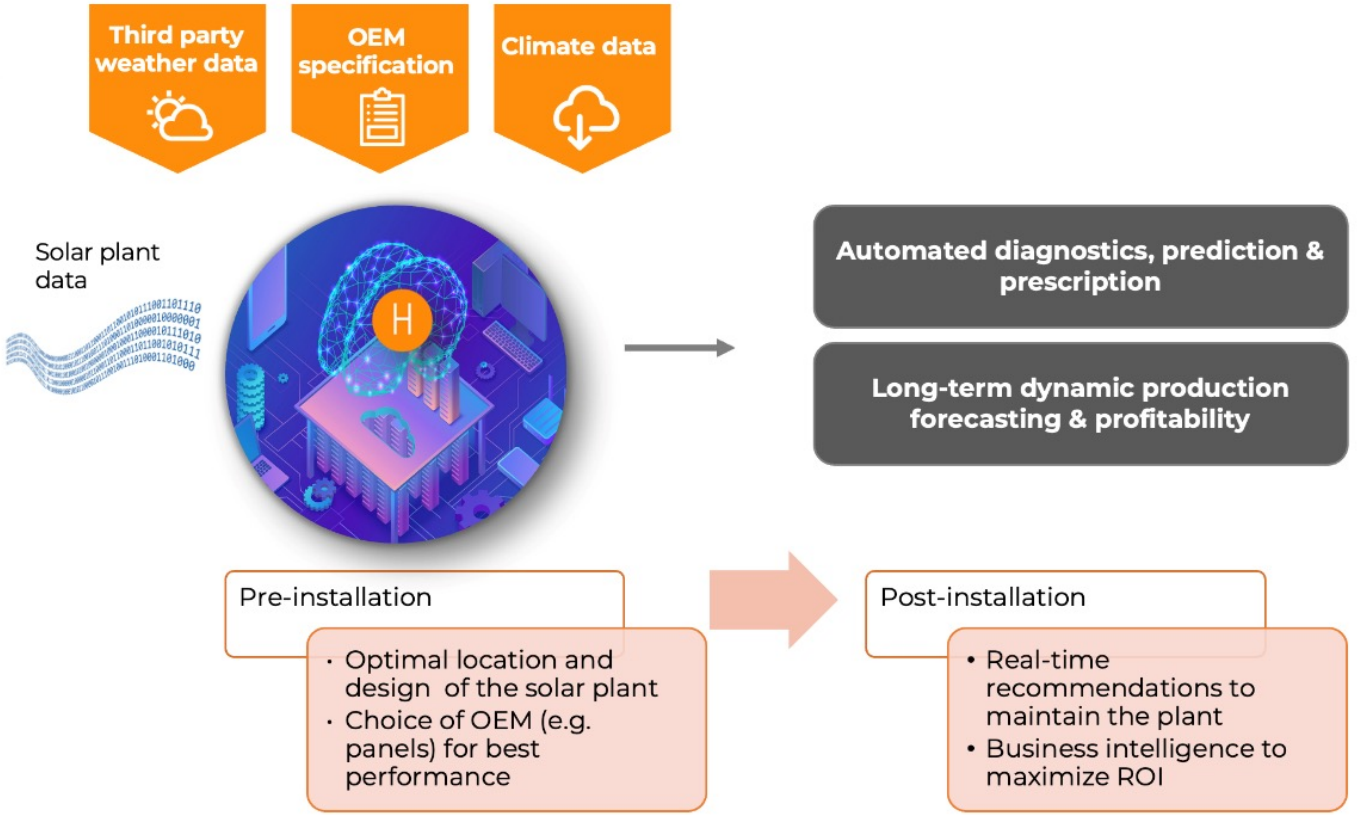
*About **SmartHelio***

*SmartHelio (Certified B Corporation) is a **Big Data Clean Energy Intelligence company** based out of Switzerland. **SmartHelio is the doctor for solar plants**: we remotely diagnose existing problems, predict faults and prescribe solutions in real time.*



How do we help you?

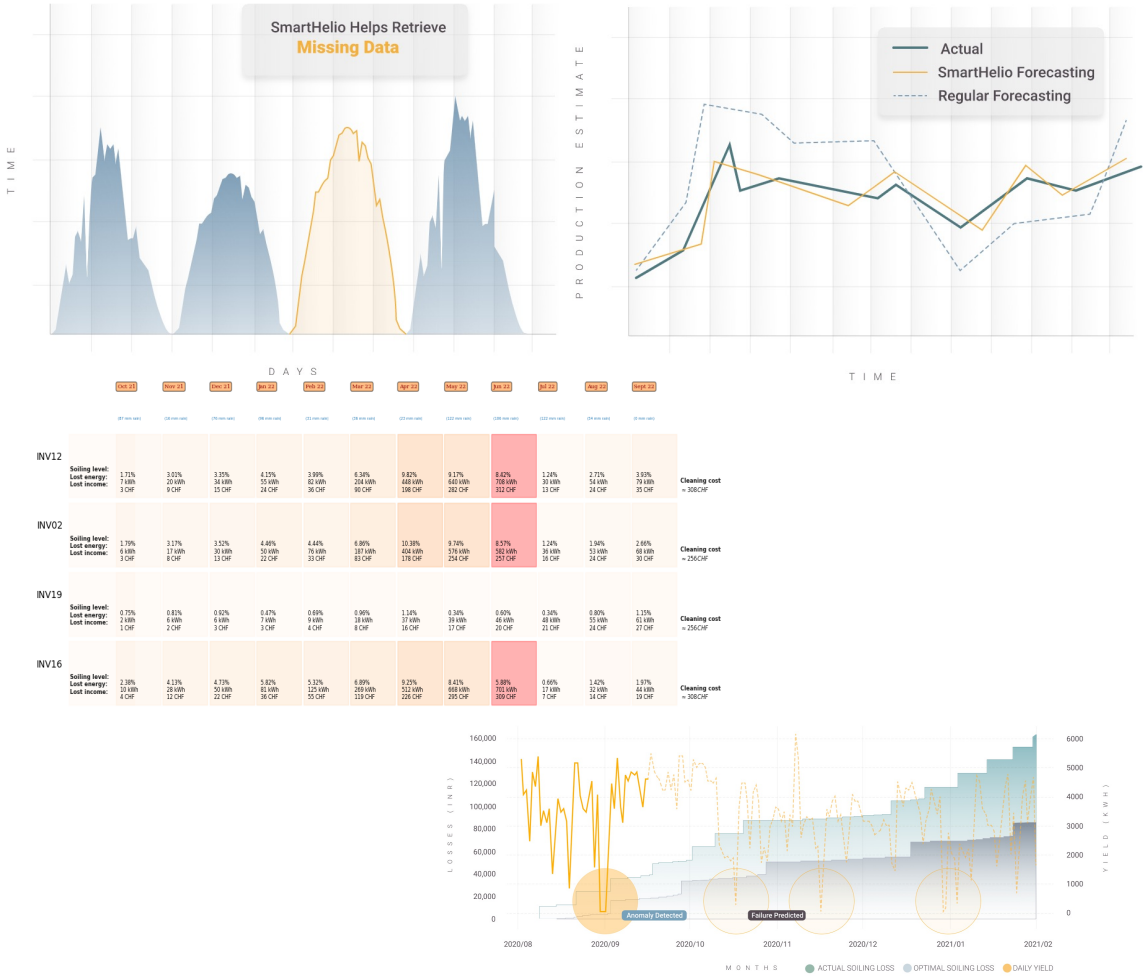
FORECASTING & ASSET DUE DILIGENCE
Get a realistic future assessment of your asset's performance.

PREDICTIVE ANALYTICS
Using our physics-based pattern recognition technology, we predict faults and help avoiding system failures.

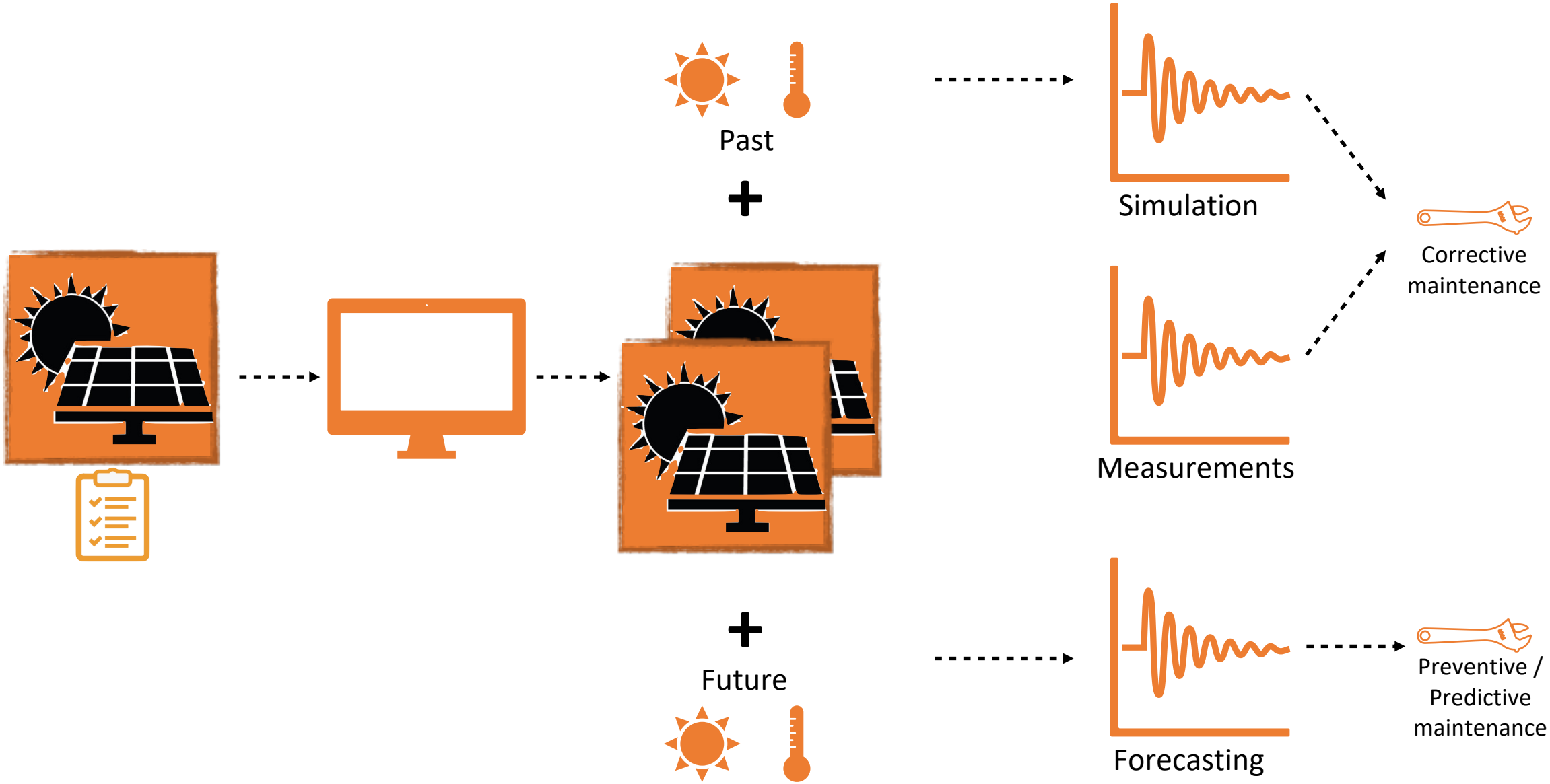
UNKNOWN REASONS FOR UNDERPERFORMANCE
We detect, categorize and quantify losses of your system that you might not even be aware of.

RECOVER MISSING DATA
With over 98% accuracy using our Machine/Deep Learning models.

PANEL-LEVEL ANALYTICS
Track the performance of your plant at the panel-level, know precisely your modules' health status and increase their life expectancy by 1.5 times.

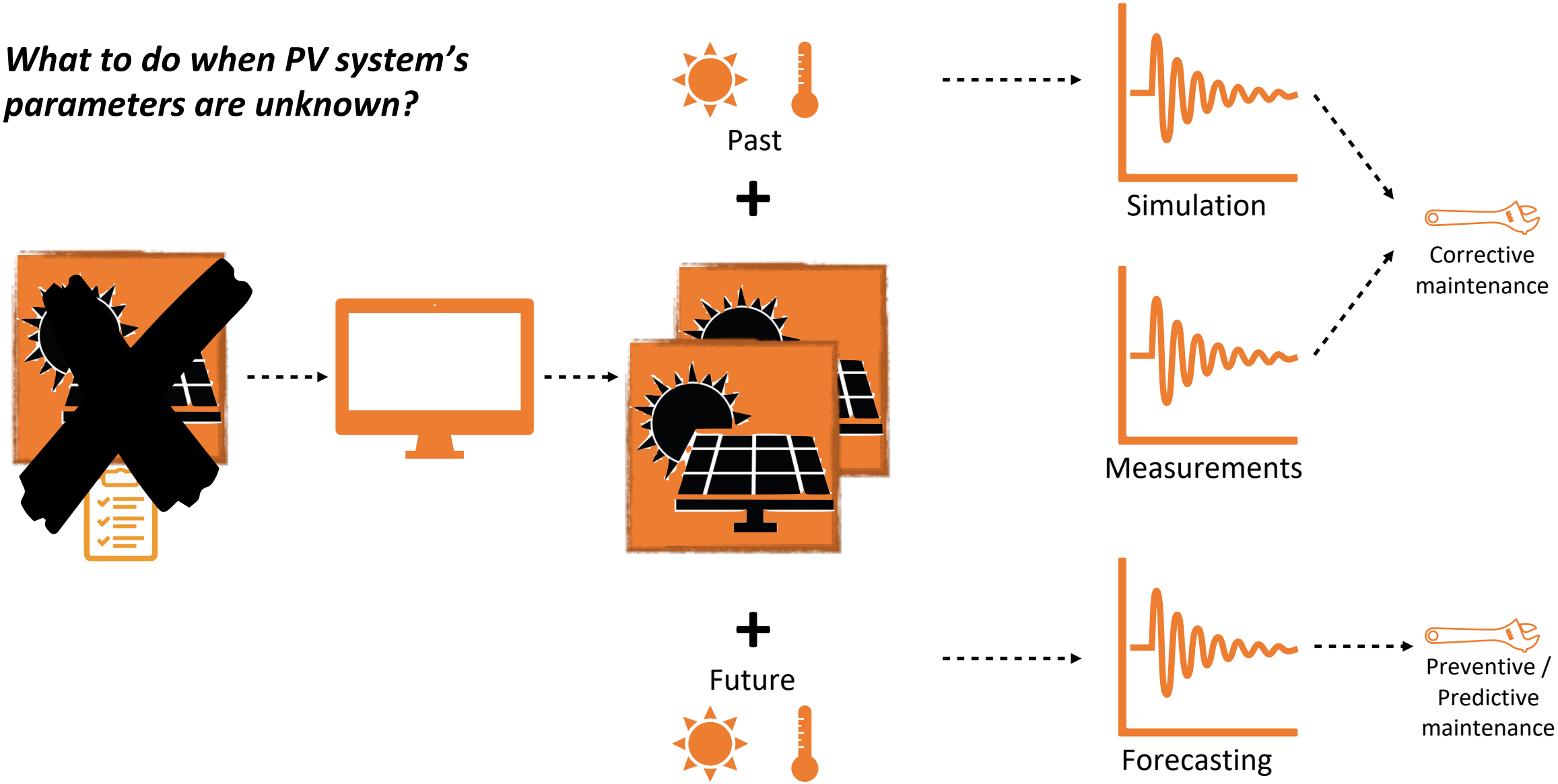


Case Study


Past
+
Simulation
Corrective maintenance
Measurements
+
Future
Forecasting
Preventive / Predictive maintenance

Case Study

What to do when PV system's parameters are unknown?



Case Study

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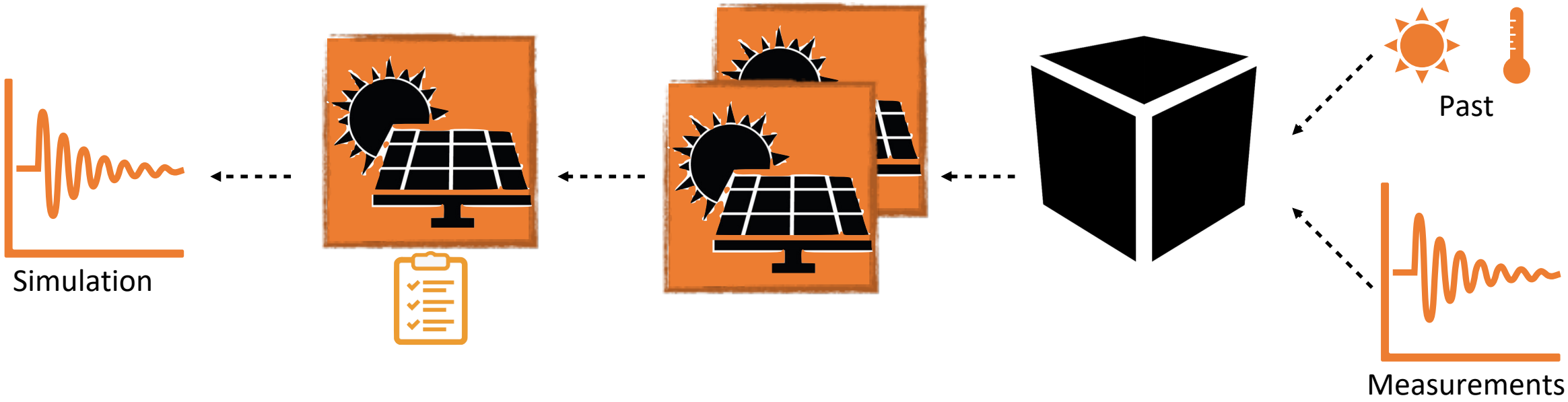
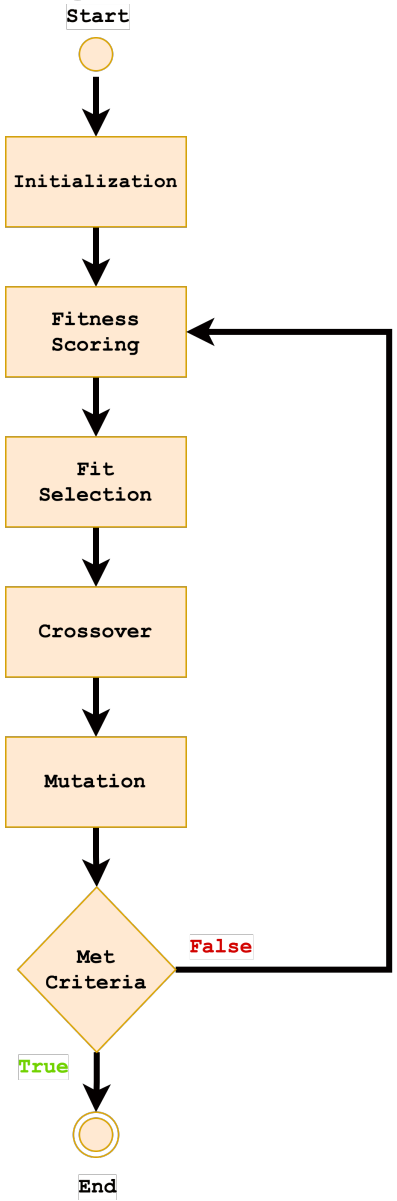


Genetic Algorithm Optimization



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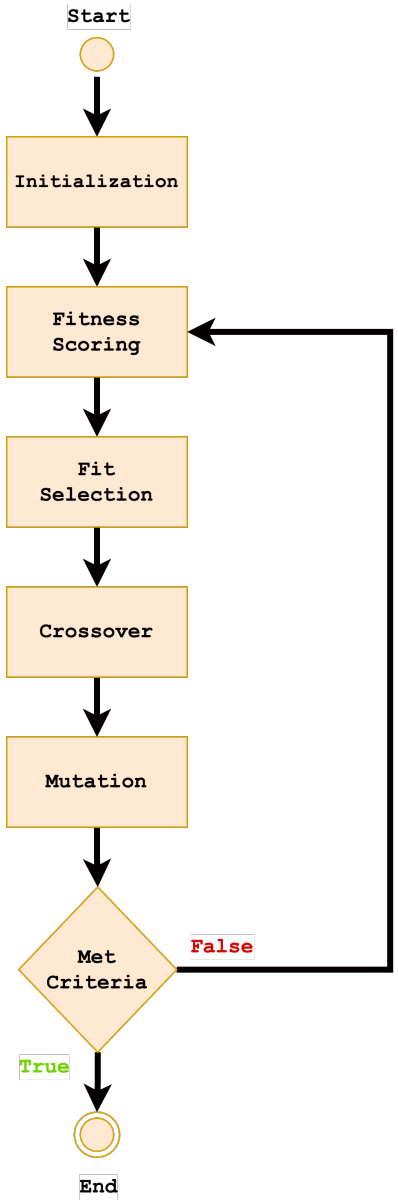
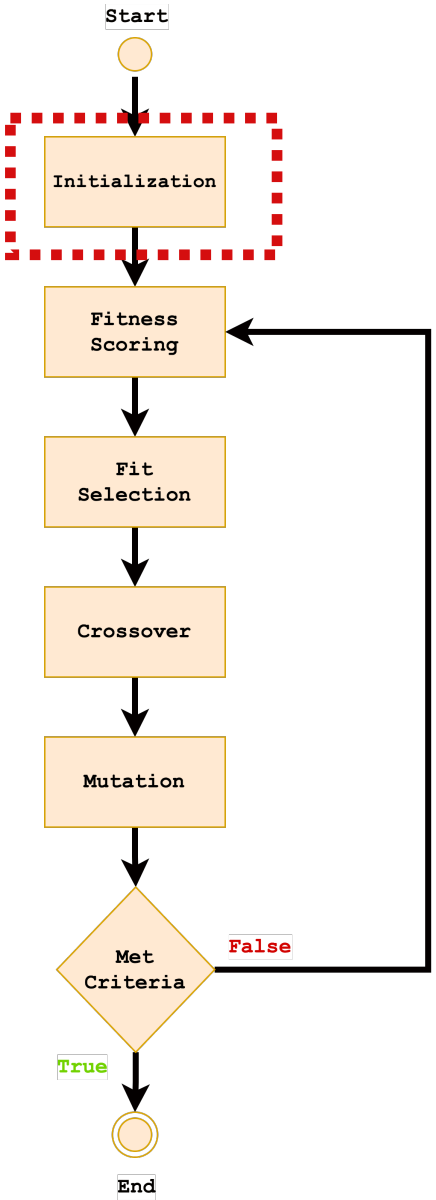


6 PV system parameters:

- ***Nominal power***
- ***Tilt angle***
- ***Azimuth angle***
- ***Albedo effect on irradiance***
- ***Power temperature coefficient***
- ***DC/AC ratio***

Genetic Algorithm Optimization



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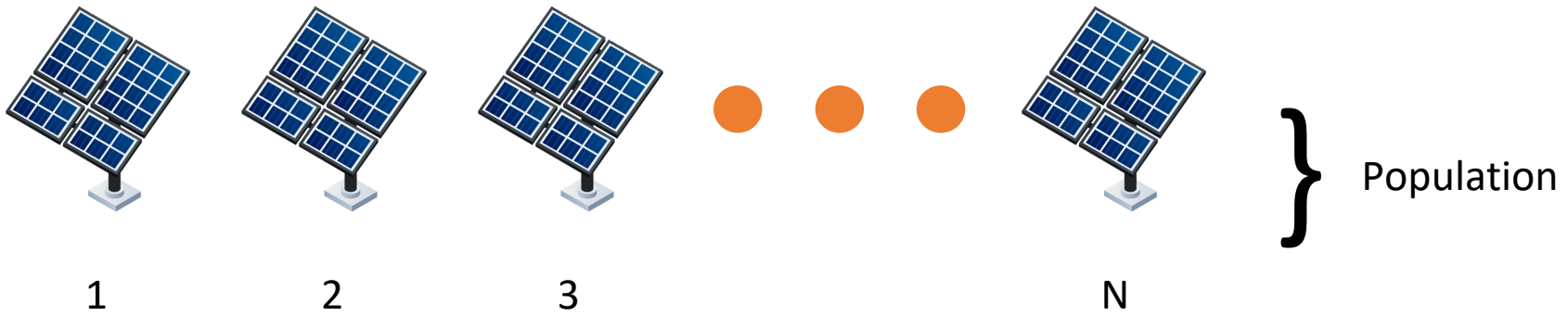
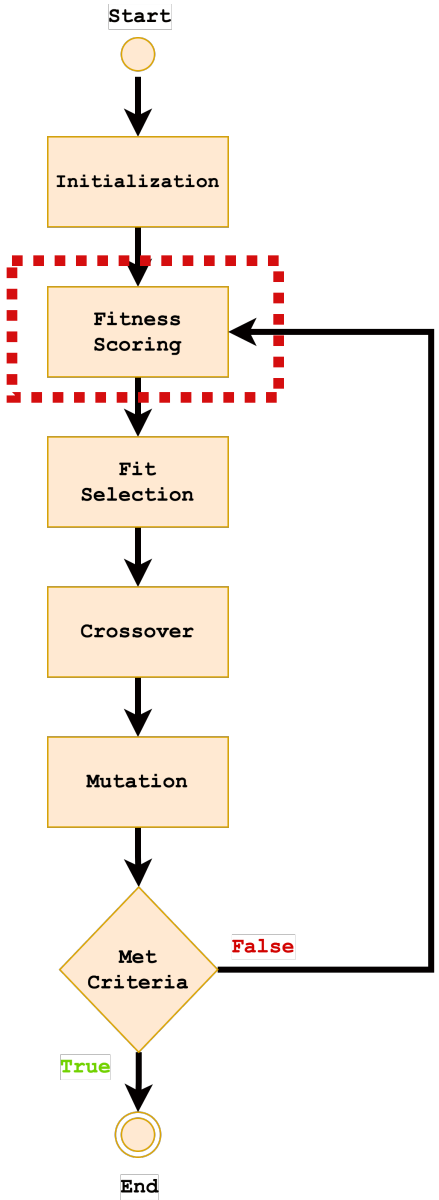
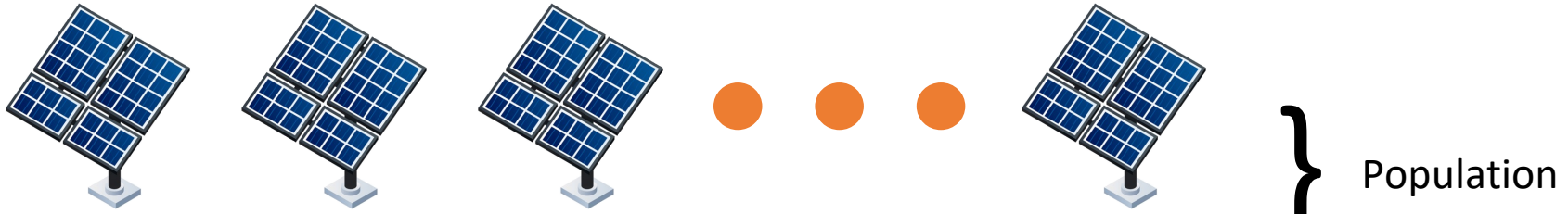


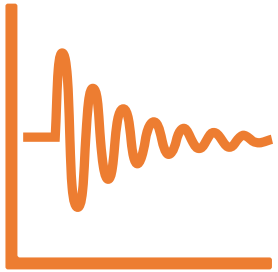
Genetic Algorithm Optimization



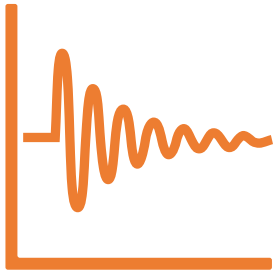


1 2 3 N

Population



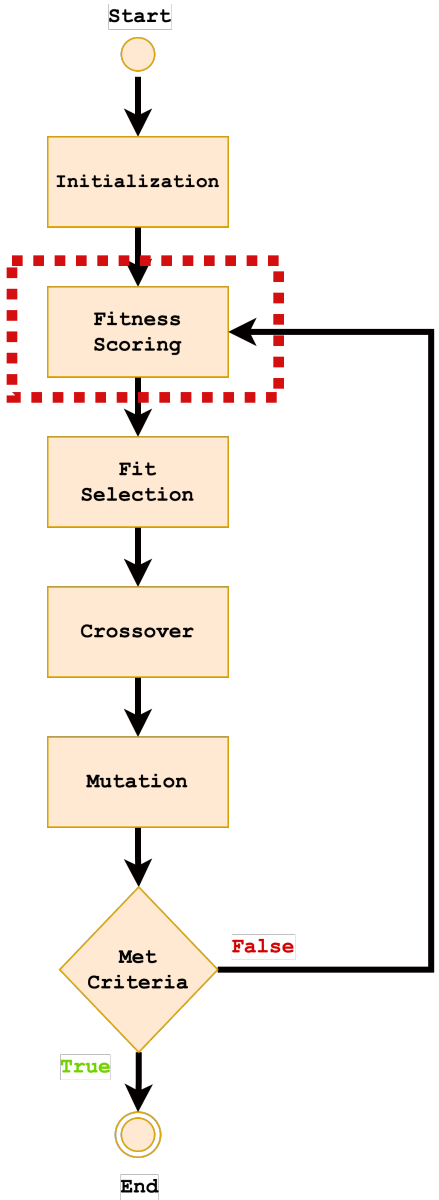
Simulation

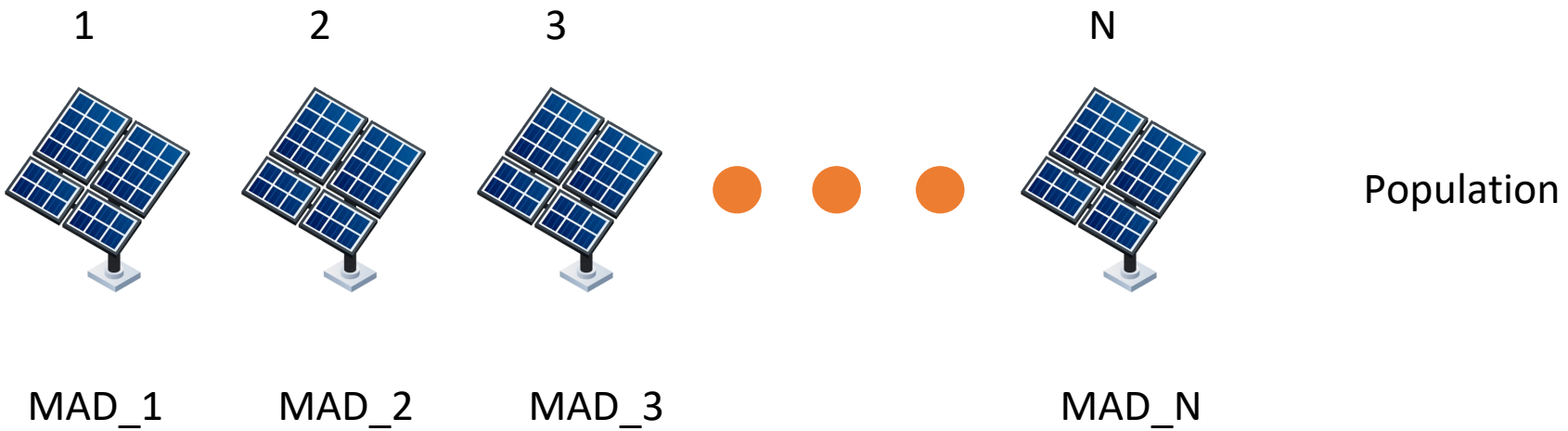


Measurements

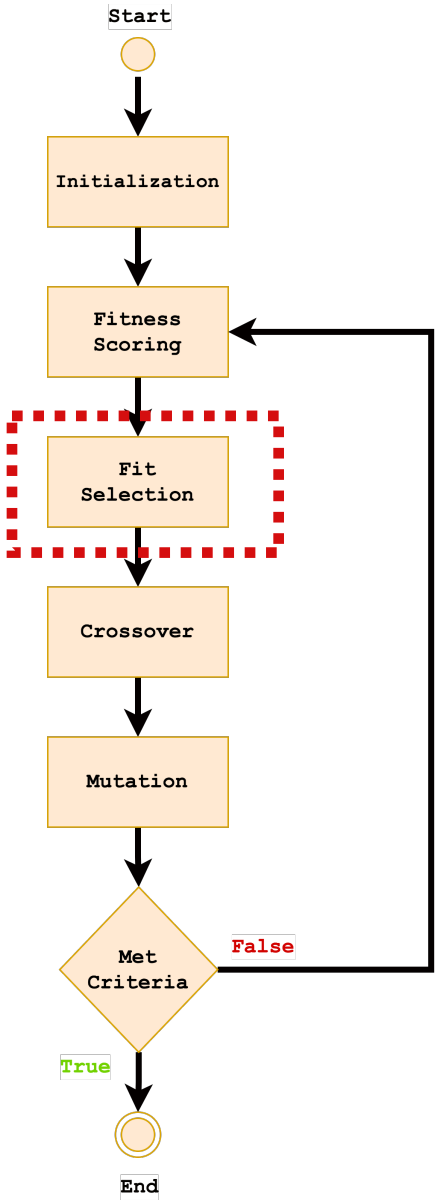
Mean Absolute Deviation (MAD)

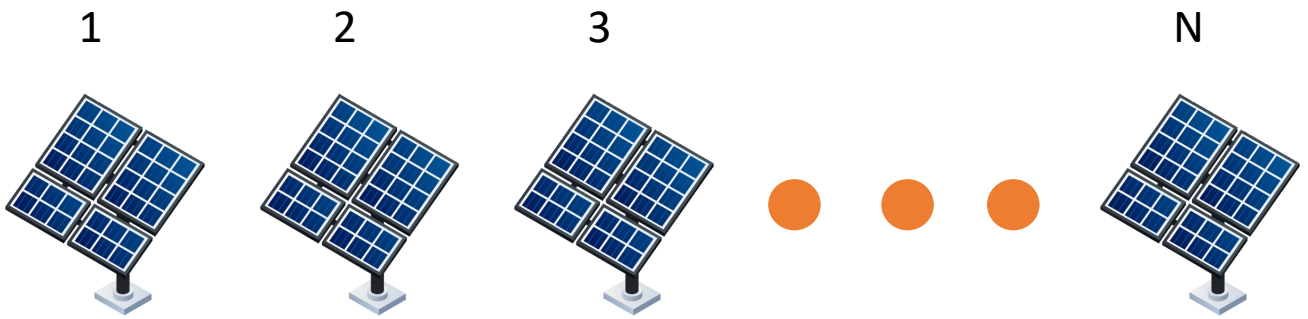
Genetic Algorithm Optimization





Genetic Algorithm Optimization

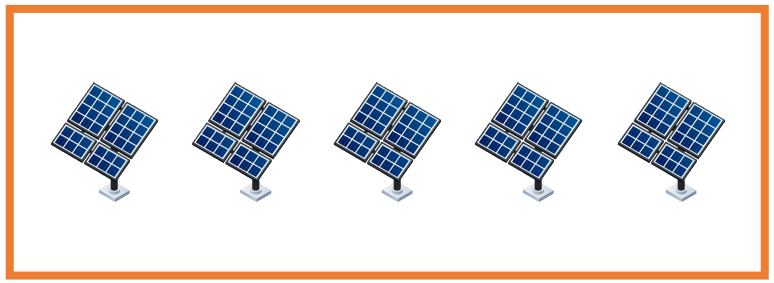




Population_1

MAD_1 MAD_2 MAD_3 MAD_N

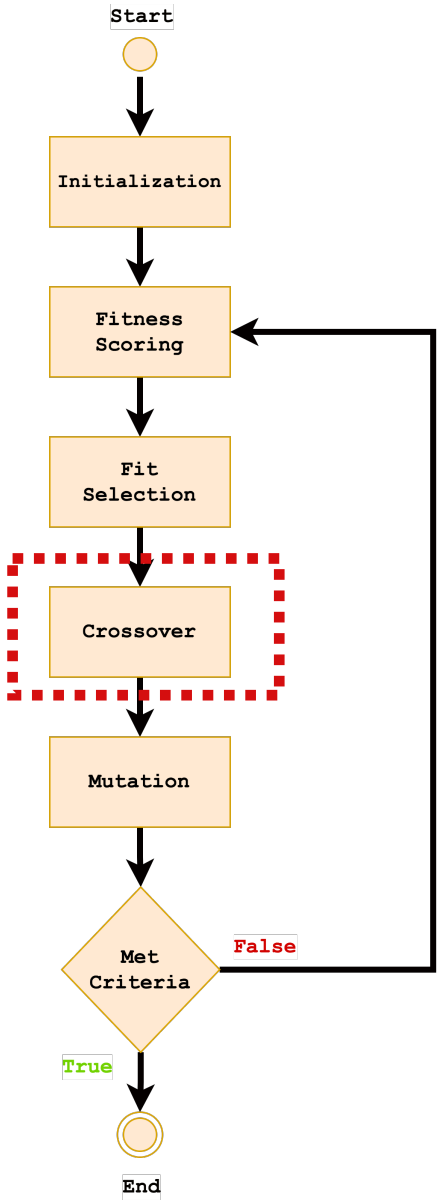
High score = High probability

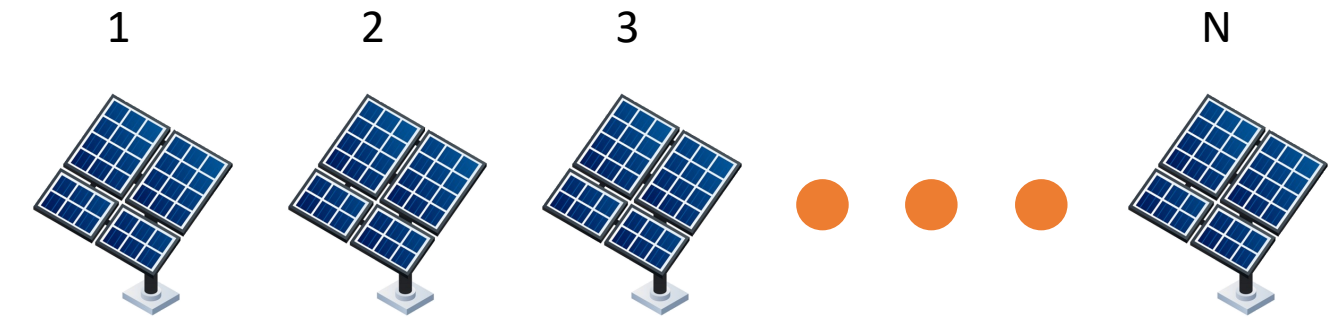


Population_2

Best of previous population
(85 %)

Genetic Algorithm Optimization

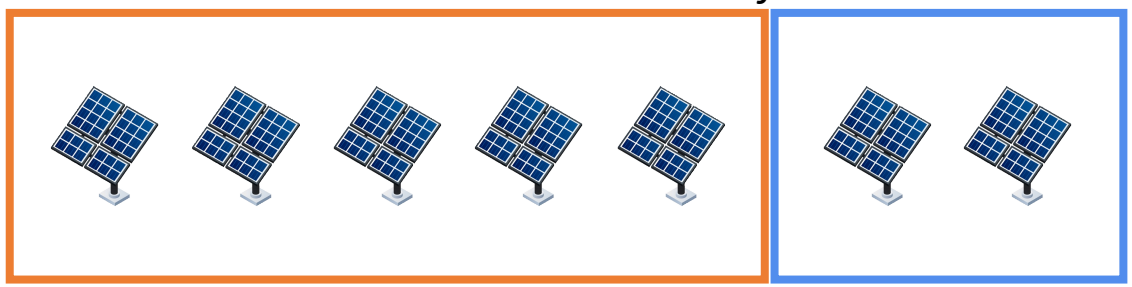




Population_1

MAD_1 MAD_2 MAD_3 MAD_N

Mix of parameters from best scored

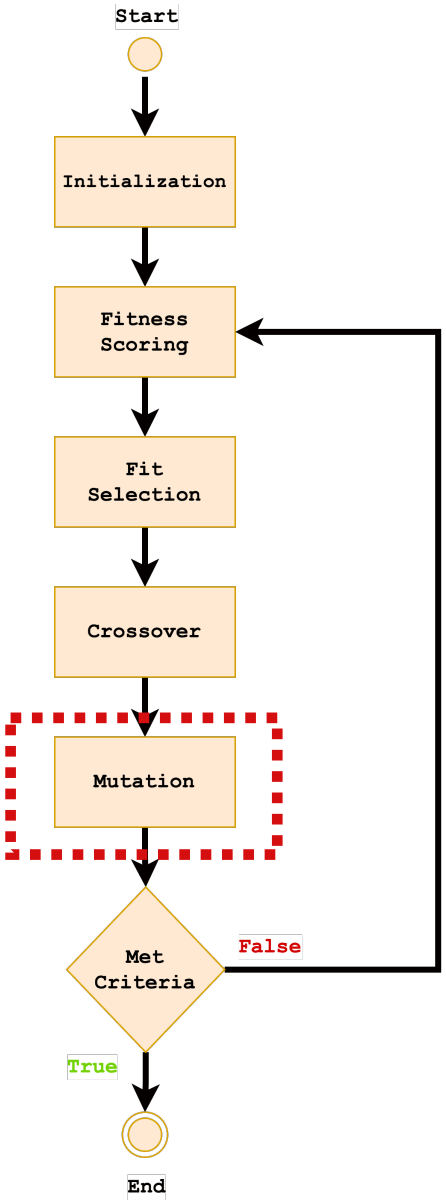


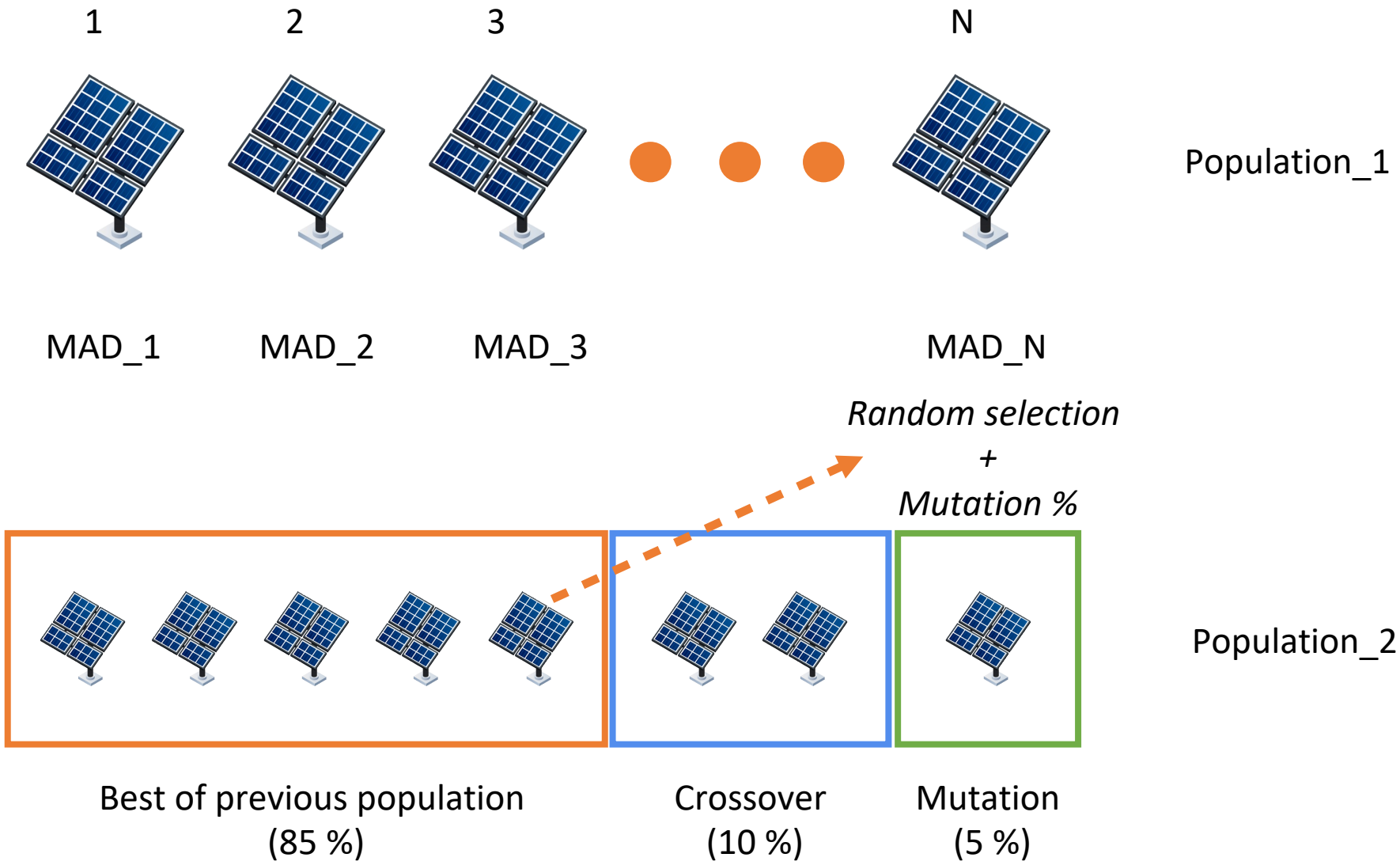
Population_2

Best of previous population (85 %)

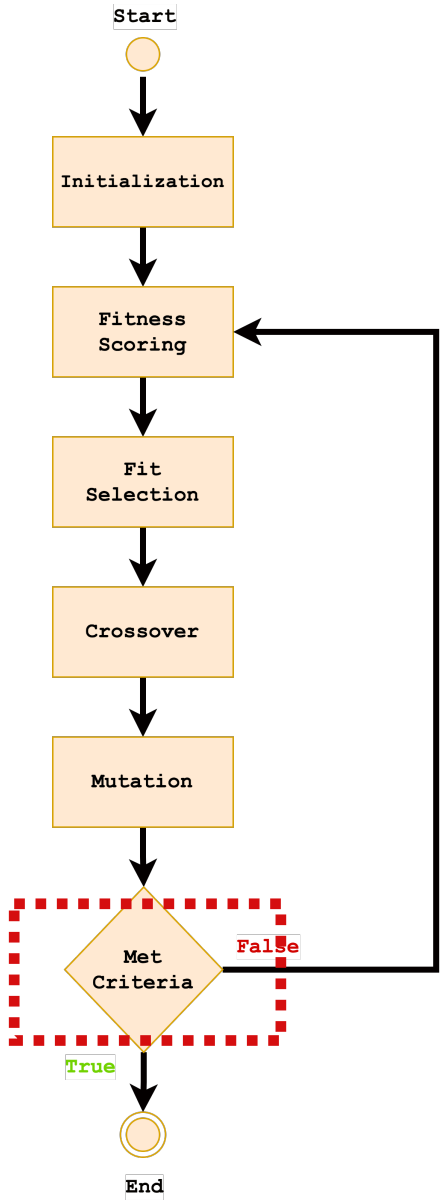
Crossover (10 %)

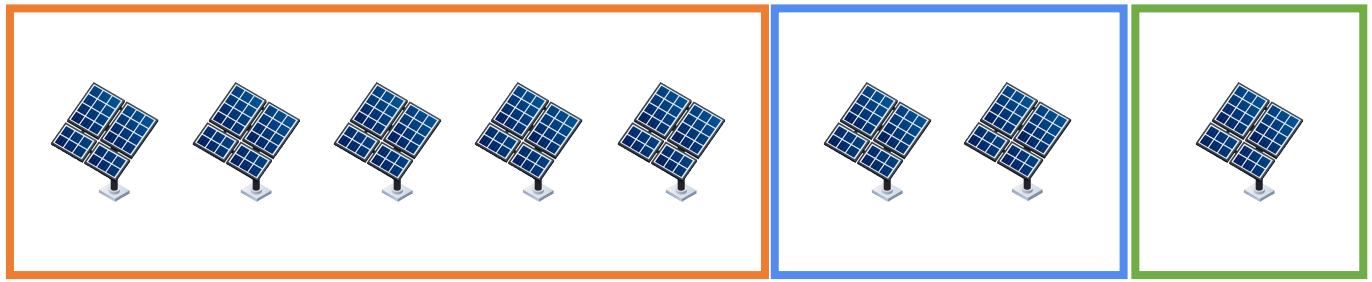
Genetic Algorithm Optimization





Genetic Algorithm Optimization



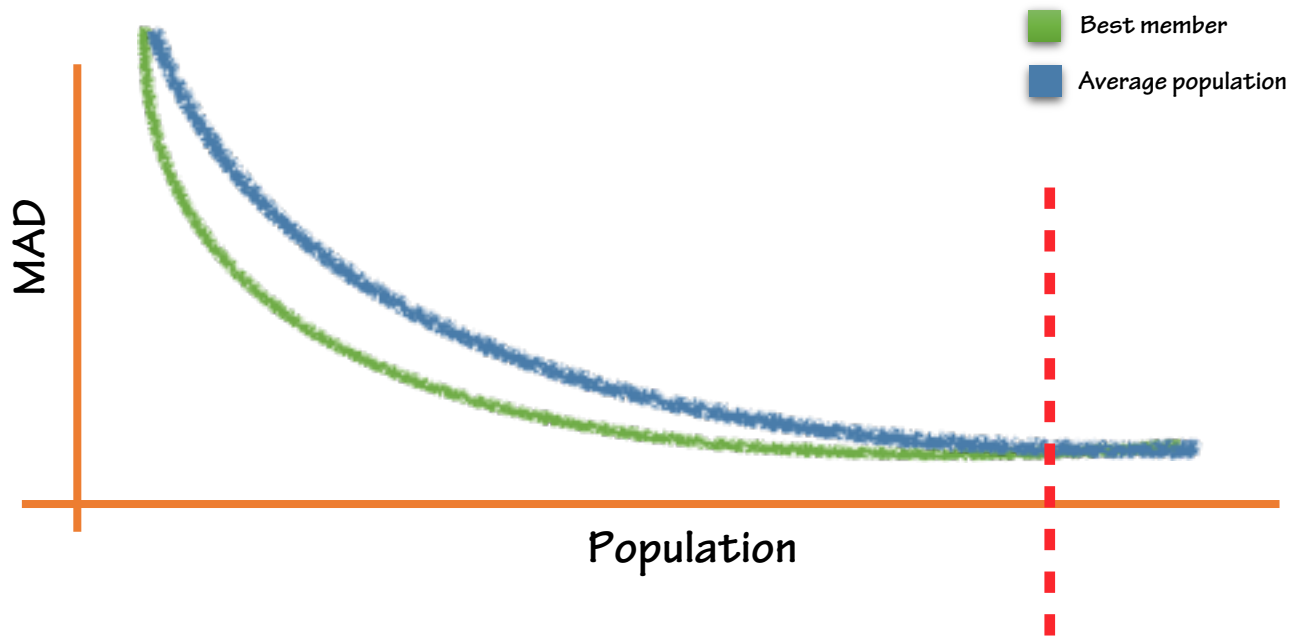


Population_N

Best of previous population (85 %)

Crossover (10 %)

Mutation (5 %)



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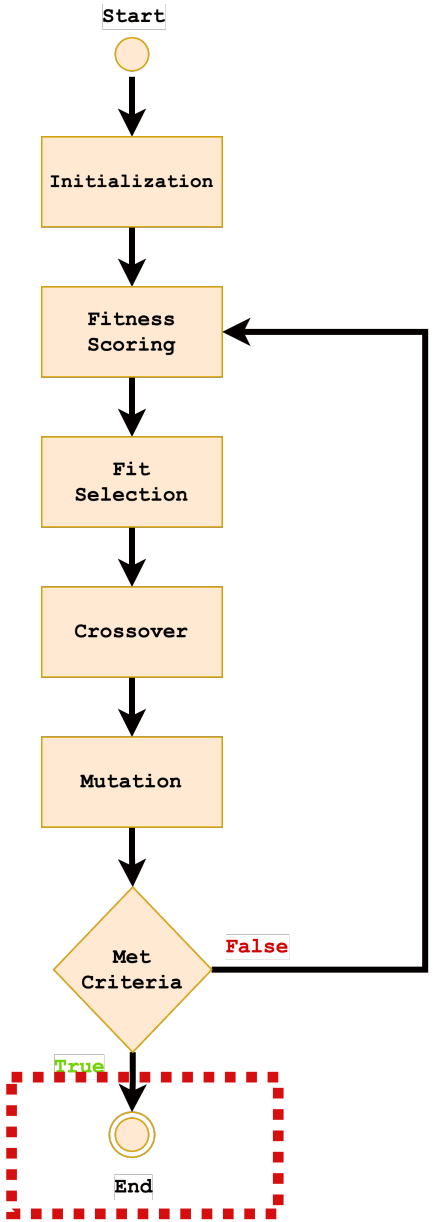
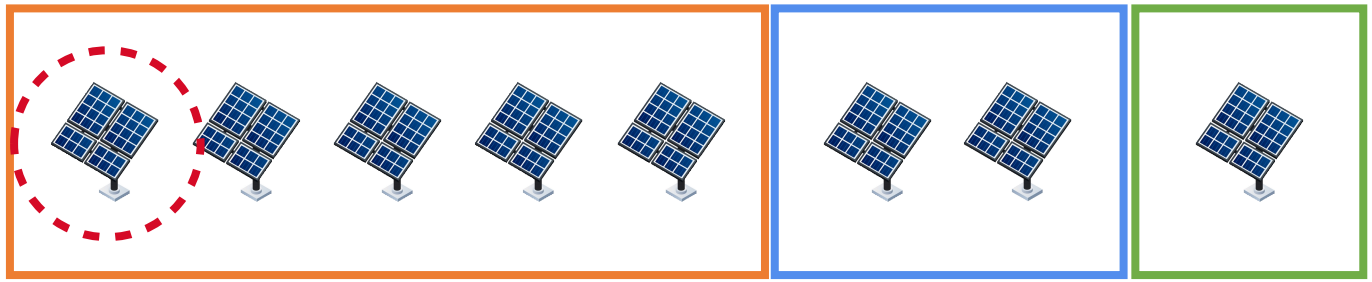




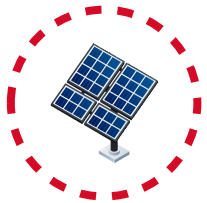
Population_N

Best of previous population (85 %)

Crossover (10 %)

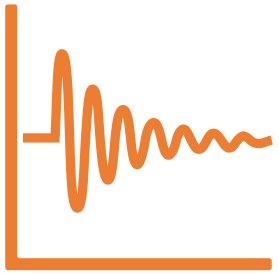
Mutation (5 %)

Best member

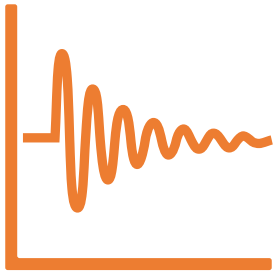


Digital twin:

- ***Nominal power***
- ***Tilt angle***
- ***Azimuth angle***
- ***Albedo effect on irradiance***
- ***Power temperature coefficient***
- ***DC/AC ratio***



Simulation



Forecasting

Additional information

Guzman Razo, D.E.; Müller, B.; Madsen, H.; Wittwer, C. A Genetic Algorithm Approach as a Self-Learning and Optimization Tool for PV Power Simulation and Digital Twinning. Energies 2020, 13, 6712, doi:10.3390/en13246712.

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THANK YOU

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