10. Diagnosing convergence

At the end of the rainbow is a pot of gold.

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When will we get there?

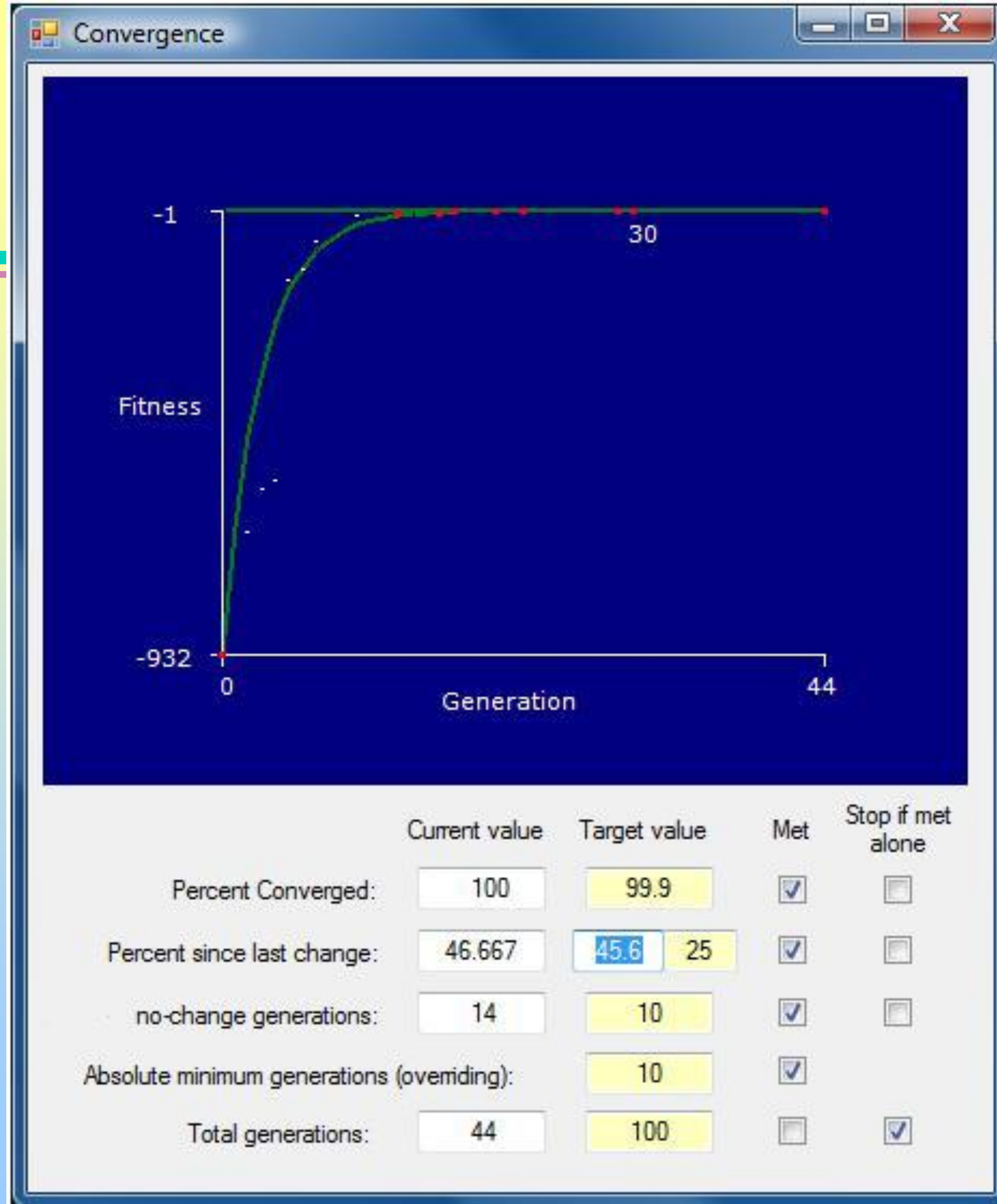
- Like the kid in the back seat, on the way to the beach. Never sure when the journey will be over (or at least within a short walk to the waves).
- Up front, Dad will tell you lies, just to keep you quiet. Maybe you will jump out at the next set of traffic lights.
- When the car finally stops you are at the waves. Or as close as makes little difference.

When will we get there?

- For most practical problems, we never ***know*** that we have arrived.
- It could be a local optimum (a river with some sand, perhaps). But surfing around the solution space can help detect that situation (ever tried surfing at the river?)
- Find a ***satisficing*** solution

Criteria for stopping

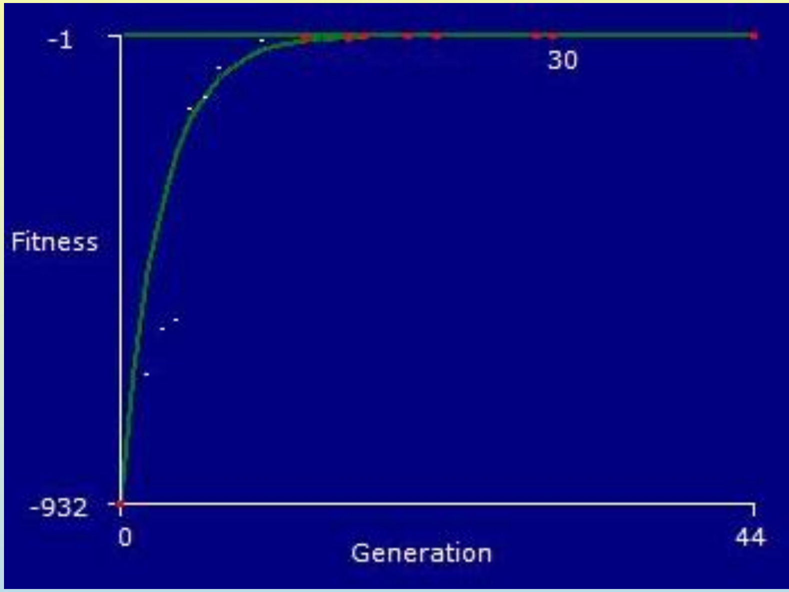
- Many possible criteria
- Stop when an appropriate mix of criteria have been met (see last 2 columns of checkboxes …)
- Do not take this as the only strategy available!



Criteria for stopping

1. Predicted percent converged

- Fit a non linear function
- One point for each jump in fitness + plus last generation.
- I use the red dots: 1 + 8.



$$S_g = S_{max} * \left(1 - e^{-k.g^b}\right) + \text{error}$$

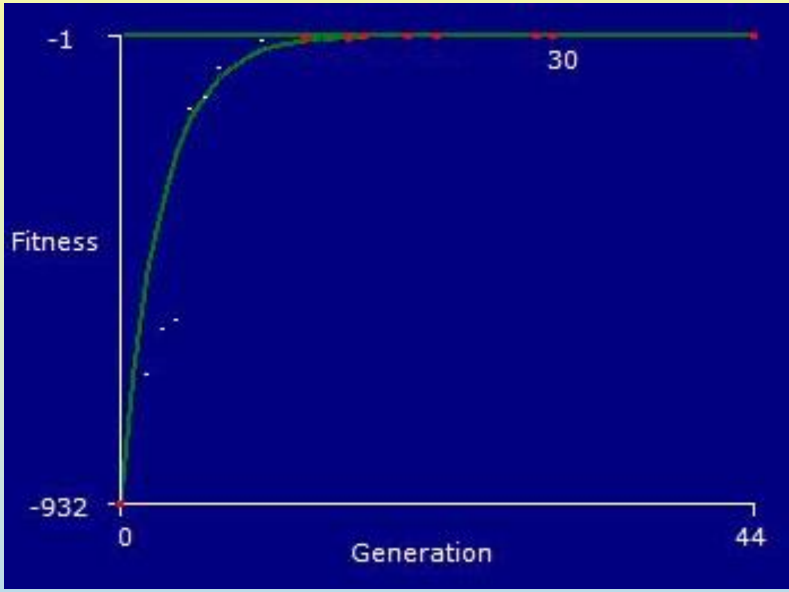
[S_g is the best fitness solution at generation g]

Criteria for stopping
1. Predicted percent converged

$$S_g = S_{max} * \left(1 - \mathrm{e}^{-k.g^b}\right) + \text{error}$$

- Find S_{max} and k that minimise:

$$\sum \left(S_g - \hat{S}_g\right)^2$$



- Could use an EA! But there is an easier way.

Criteria for stopping
1. Predicted percent converged

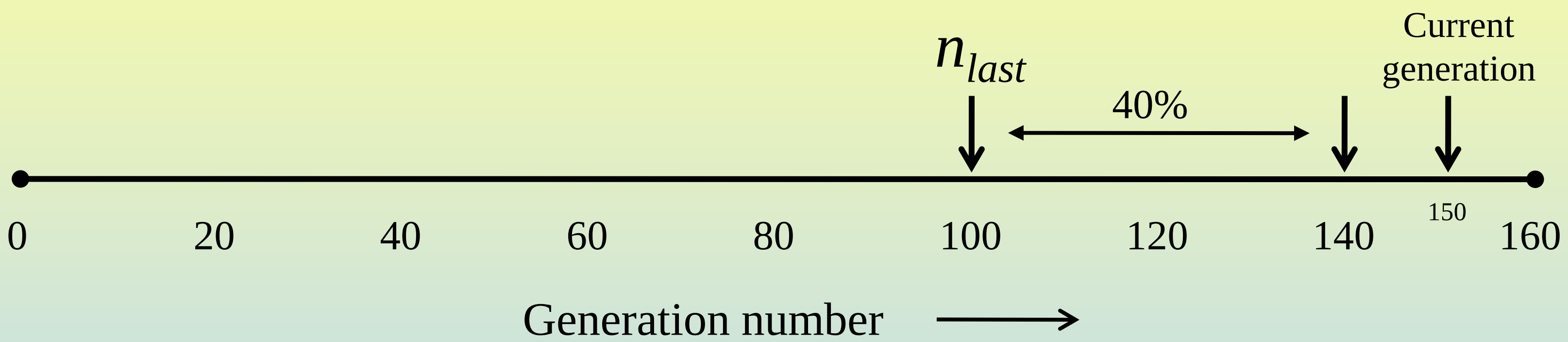
$$S_g = S_{max} * \left(1 - \mathrm{e}^{-k.g^b}\right) + \mathrm{error}$$

$$\hat{S}_{max} = \frac{S_g}{\left(1 - \mathrm{e}^{-k.g^b}\right)}$$

- Given k and b, we have $\hat{S}_{max}$
- So, only need to optimise *k* (if b is constant)
- “Exocet”

Criteria for stopping

2. No improvement over the last p_{nc} percent of n_{last} generations



- $150 > 1.40 \times 100$, so ...
- Current generation passes this test

Criteria for stopping

2. No improvement over the last p_{nc} percent of n_{last} generations

$$p_{nc}(\text{corrected}) = p_{nc} * \text{sqrt}\left(\frac{MaxGens}{n_{last}}\right)$$

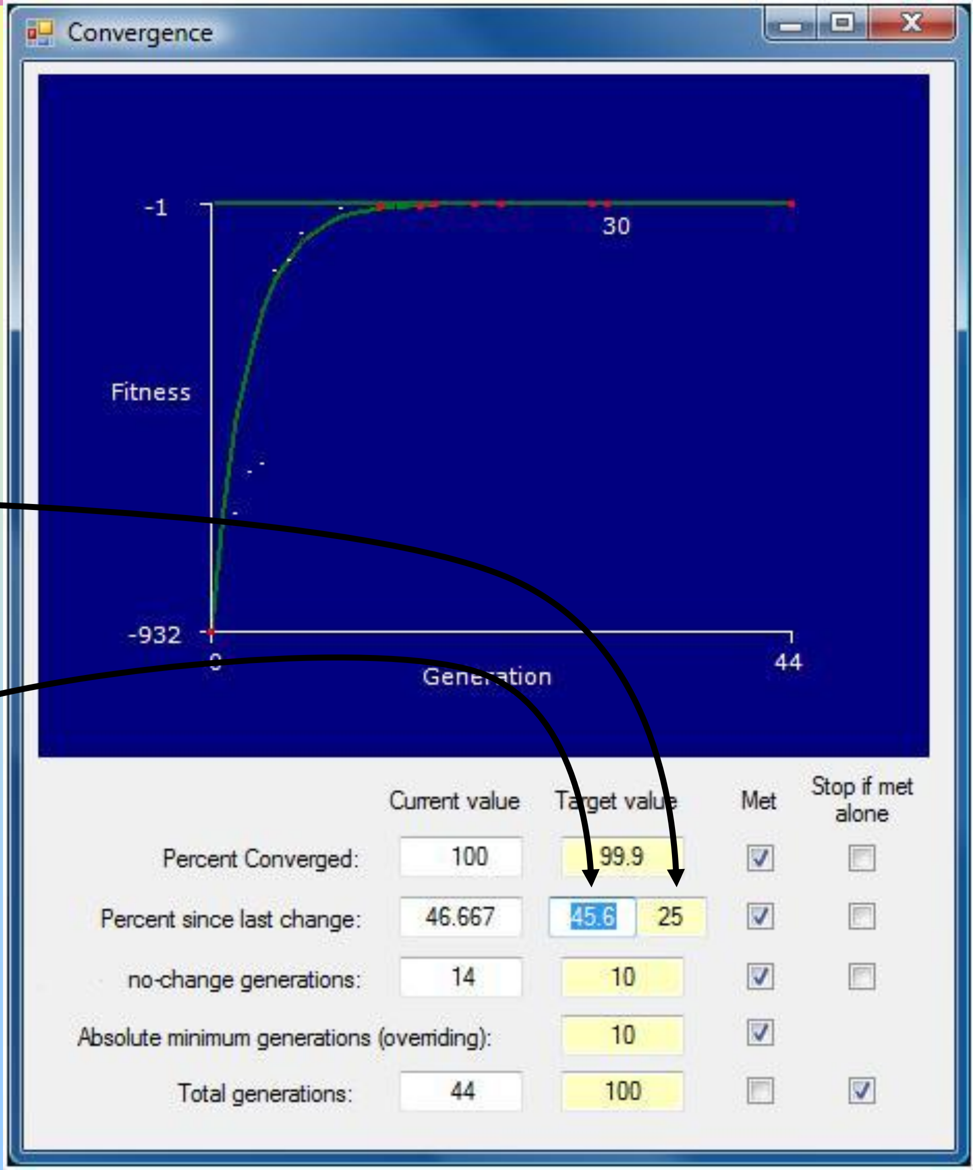
- Eg. *MaxGens* = 20,000 ...

p_{nc} (%)	*MaxGens*	n_{last}	p_{nc} (Corrected)	Stop at generation
20	20,000	10	894	99.4
20	20,000	20,000	20	24,000
20	20,000	100,000	8.9	108,944

Criteria for stopping

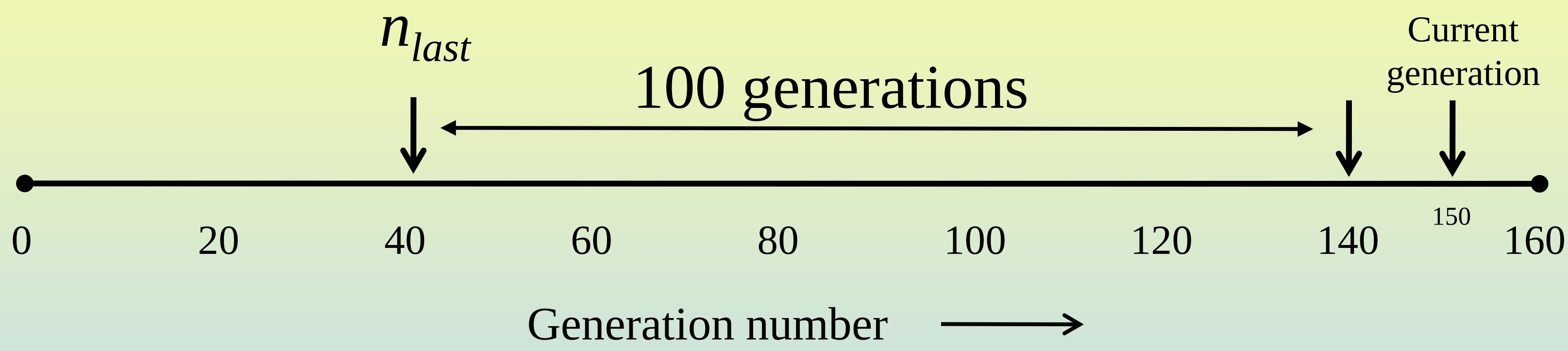
2. No improvement over the last p_{nc} percent of n_{last} generations

- p_{nc}
- p_{nc} (Corrected)



Criteria for stopping

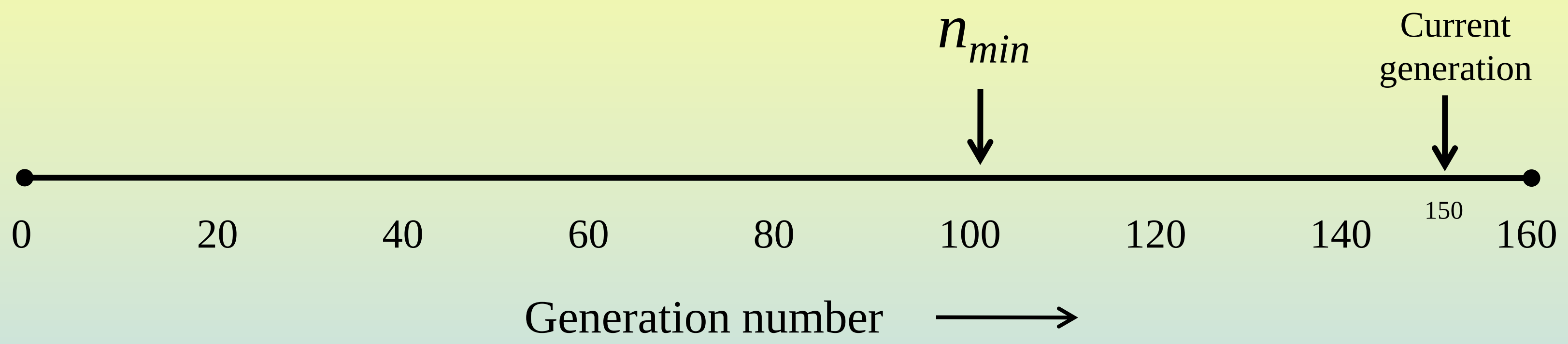
3. No improvement for a specified fixed number of generations.



- $150 > 40 + 100$, so ...
- Current generation passes this test

Criteria for stopping

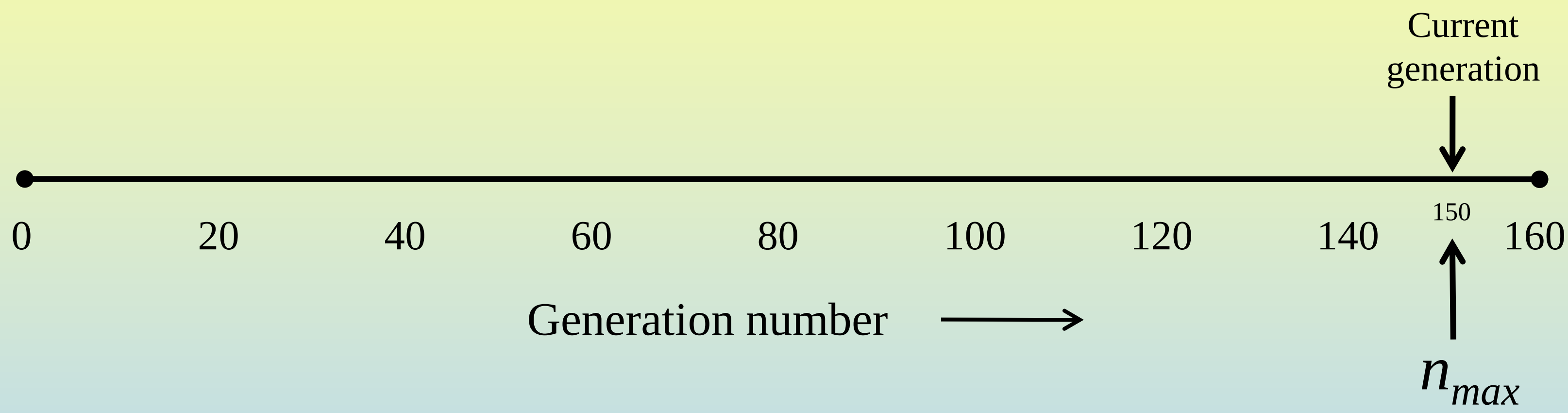
4. No fewer than n_{min} generations in total.



- 150 > 100, so ...
- Current generation passes this test

Criteria for stopping

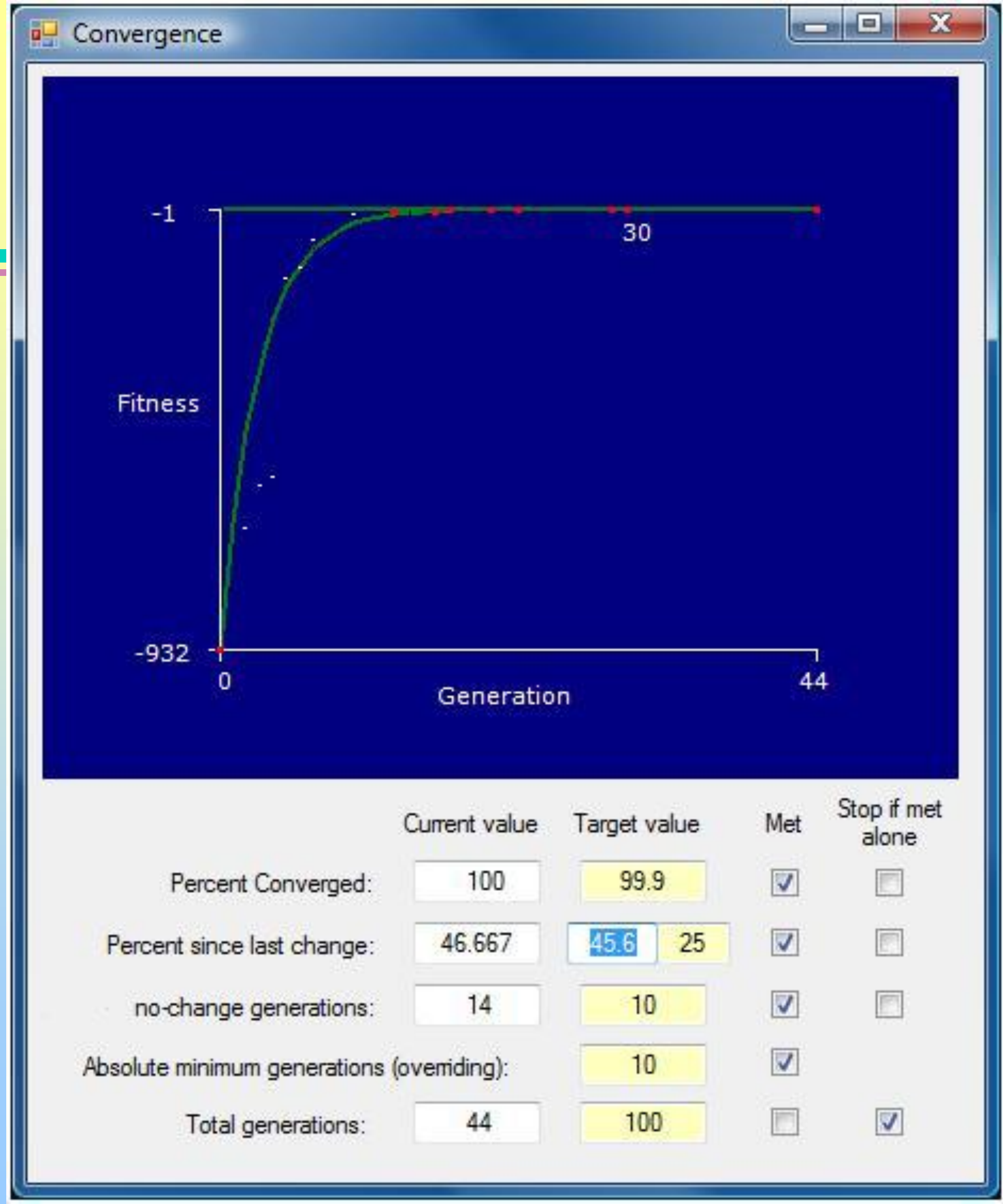
5. No more than n_{max} generations in total.



- $150 = 150$, so ...
- Current generation passes this test

Criteria for stopping

- Many possible criteria
- Stop when an appropriate mix of criteria have been met (see last 2 columns of checkboxes …)
- Do not take this as the only strategy available!



No Guarantee !

- There is no guarantee that convergence has been truly met …
  - … unless you already ***know*** the true maximum
- Observe the best solution achieved, and realize (if true) that it has all the properties that you think it should have ...
  - That it is a "***Satisficing Solution***".


The End