EXAMPLE

- $S = \{ i \mid i \in \mathbb{N} \text{ and } 0 \leq i \leq 15 \}$
- $\forall i \in S$, $f(i)$ = NUMBER OF 1s IN THE BINARY REPR. i
- MAXIMIZATION

NEIGHBORHOOD:

$\forall i, j \in S$, $j \in N(i) \iff |i - j| = 1$

ASSUME :

$i = 5$ (RANDOM EVENT)

$bin(5) = 101$

$f(i) = 2$

$N(i) = \{4, 6\}$

$bin(4) = 100$

$bin(6) = 110$ } $j = 6$

$f(j) = 2$

$i := j$

$i = 6$

$N(i) = \{5, 7\}$

$bin(5) = 101$, $f(5) = 2$

$bin(7) = 111$, $f(7) = 3$ } $j = 7$

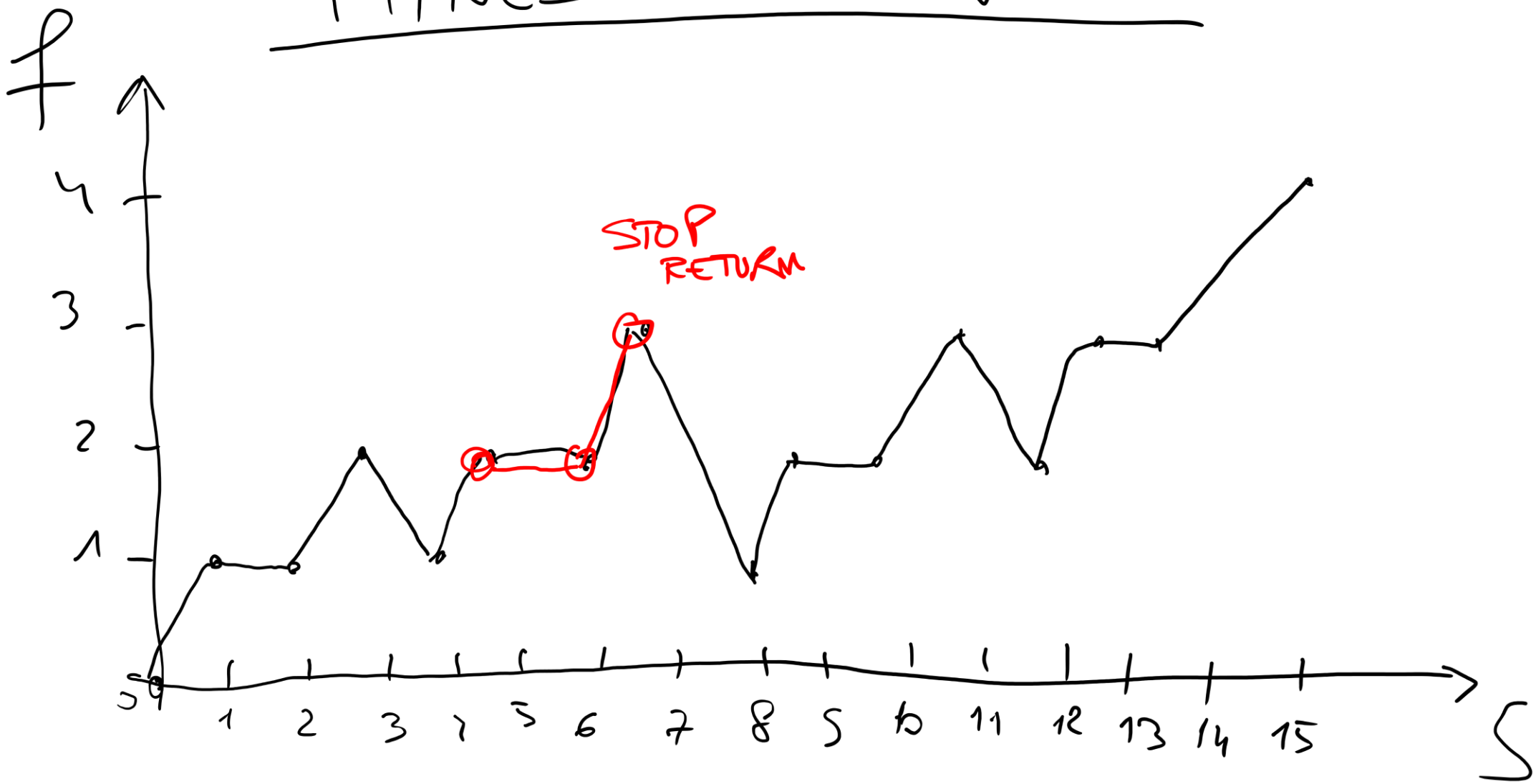
$i := j$

$i = 7$ $N(i) = \{6, 8\}$

$f(6) = 2$

$bin(8) = 1000$, $f(8) = 1$ } $j = 6$

FITNESS LANDSCAPE



FITNESS LANDSCAPES (F.L.)

GIVE A VISUAL RENDERING OF THE HARDNESS OF A PROBLEM.

- "SMOOTH" LANDSCAPE WITH ONLY ONE HILL (EASY PROBLEM)

- "RUGGED" LANDSCAPE (HARD PROBLEM)

F.L. IN GENERAL CANNOT BE DRAWN, BECAUSE

- S IS HUGE
- N IS MULTI-DIMENSIONAL

EXAMPLE

$S = \{ i \mid i \in \mathbb{N} \text{ and } 0 \leq i \leq 15 \}$

$\forall i$, $f(i)$ = NUMB. OF 1s OF THE BINARY CODE OF i

MAXIMIZATION

NEIGHBORHOOD:

$\forall i, j \in S \quad j \in N(i) \iff$ THE BINARY CODES OF i and j DIFFER BY ONLY 1 BIT

0100
0101
} Neighbors

0100
0111
} NOT Neighbors

F.L. UNIMODAL

EVERY
SOLUTION THAT IS NOT A GLOBAL OPTIMUM
HAS AT LEAST ONE 0 IN ITS BINARY CODE

IF WE CHANGE THAT 0 INTO A 1, WE OBTAIN A SOLUTION
THAT IS:

- A NEIGHBOR OF THE PREVIOUS ONE
- BETTER THAN THE PREVIOUS ONE

→ ~~FOR~~ EVERY SOLUTION DIFFERENT FROM GLOB. OPT.
↳ HAS AT LEAST ONE BETTER NEIGHBOR

EXAMPLE

$S = \{ i \mid i \in \mathbb{N} \text{ and } 0 \leq i \leq 15 \}$

$\forall i \in S \;,\; f(i) = i^2$

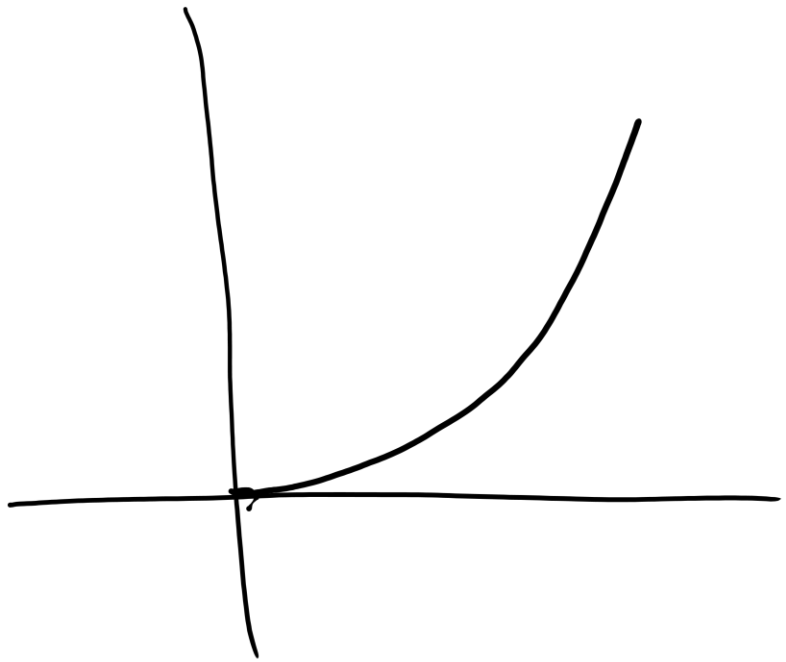
MAXIMIZ.

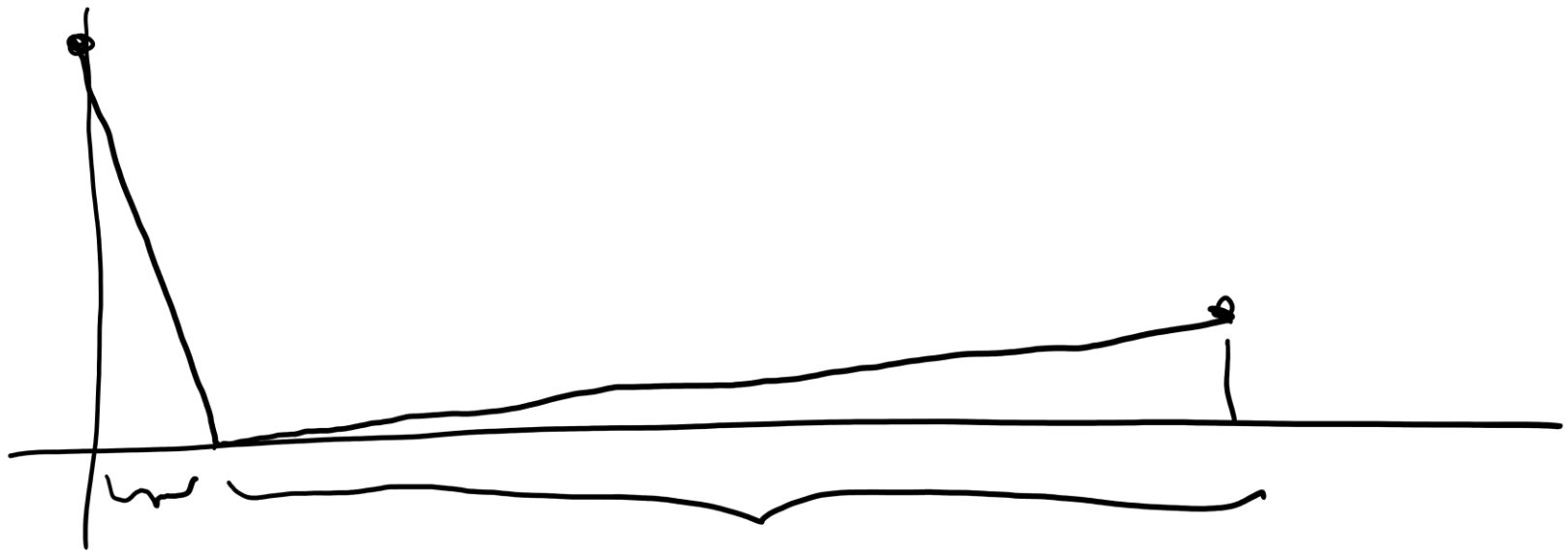
NEIGHBORHOOD:

$\forall i, j \in S \;,\; j \in N(i) \iff |i - j| = 1$

F.L.

UNIMODAL !





MAXIMIZATION

DECEPTIVE PROBLEMS

RANDOM SEARCH IS THE BEST OPTION !

PROS AND CONS OF H.C.

PROS

- EASY TO IMPLEMENT, ..
- FAST
- FLEXIBLE

CON

- IT ALWAYS STOPS ON LOCAL OPTIMA

HOW TO IMPROVE H.C. ?

- ITERATED H.C. ↓
- BETTER / LARGER NEIGHBORHOOD ↓
- MEMORY (TABU SEARCH)

SIMULATED ANNEALING

EXTENDS H.C. WITH THE POSSIBILITY OF WORSENING THE FITNESS OF THE CURRENT SOLUTION ("GO DOWNHILL")

INSPIRED BY ANNEALING
IS A CHEMISTRY EXPERIMENT
AIMED AT FINDING THE STATE OF
A MATERIAL THAT IS SOLID
WITH THE MIN. LEVEL OF ENERGY