

A close-up photograph of a hand holding a clear measuring cup. The cup is filled with a vibrant red liquid, and the liquid level is marked at approximately 150 on the side scale. The background is a soft-focus blue and white. The word 'Experimenteren' is written in a large, white, sans-serif font across the middle of the image.

Experimenteren

Wouter Vrielink

Topics

Vergelijken

- Time complexity
- Space complexity
- Emperisch
 - Iteraties
 - Evaluaties
 - Tijd
 - Geheugen

Algoritmische Analyse

- Sensitivity analysis (OFAT/grid/sampling)
- Meta heuristics/algorithms

Dos and Don'ts

Radio Russia Voorbeelden

Wanneer is een algoritme
beter dan een ander
algoritme?

Emperisch vergelijken

Waarop vergelijk ik?

- Iteraties
- Evaluaties
- Tijd
- Geheugen

Eerlijkheid

Constructief vs iteratief

Aanpak

Emperisch vergelijken

Iteraties

- Eerlijk?
- Constructief?

Evaluaties

- Eerlijk?
- Constructief?

Tijd

- Eerlijk?
- Aanpak?

Geheugen

- Eerlijk?
- Aanpak?

Sensitivity analysis

One Factor At the Time (OFAT)

- Simpel
- Snel
- Geen relaties

Grid

- Tijdsintensief
- Grofmazig
- Wel relaties
- Biased?

lets er tussenin:

Sampling -> Monte Carlo?

Sensitivity analysis

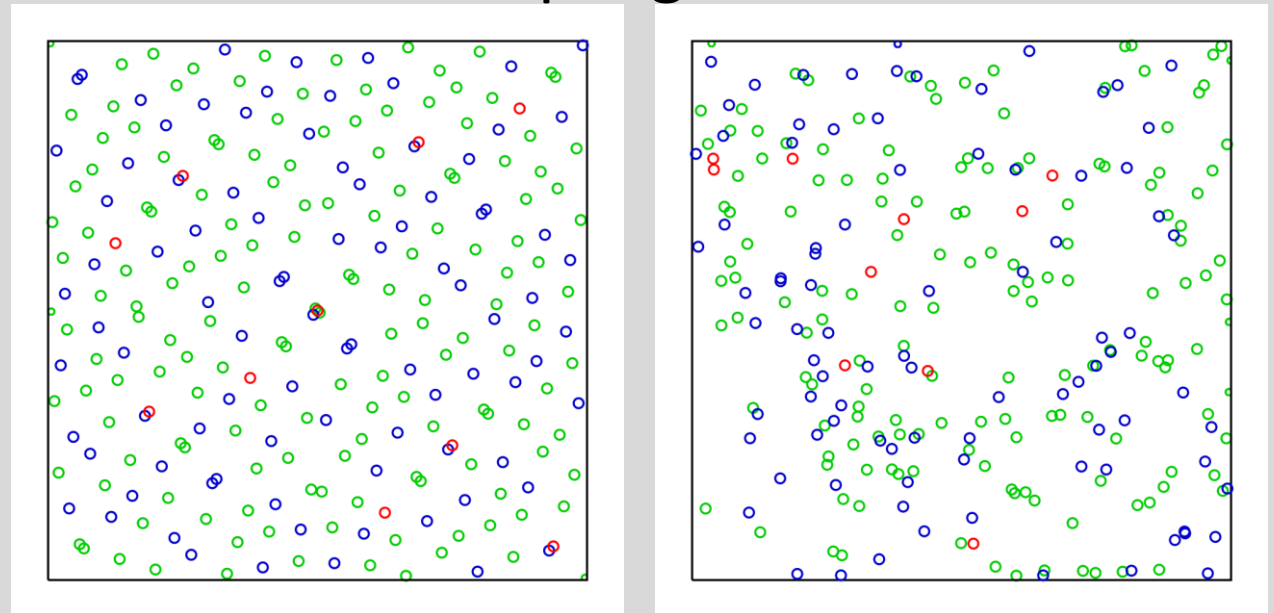
One Factor At the Time (OFAT)

- Simpel
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Grid

- Tijdsintensief
- Grofmazig
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- Biased?

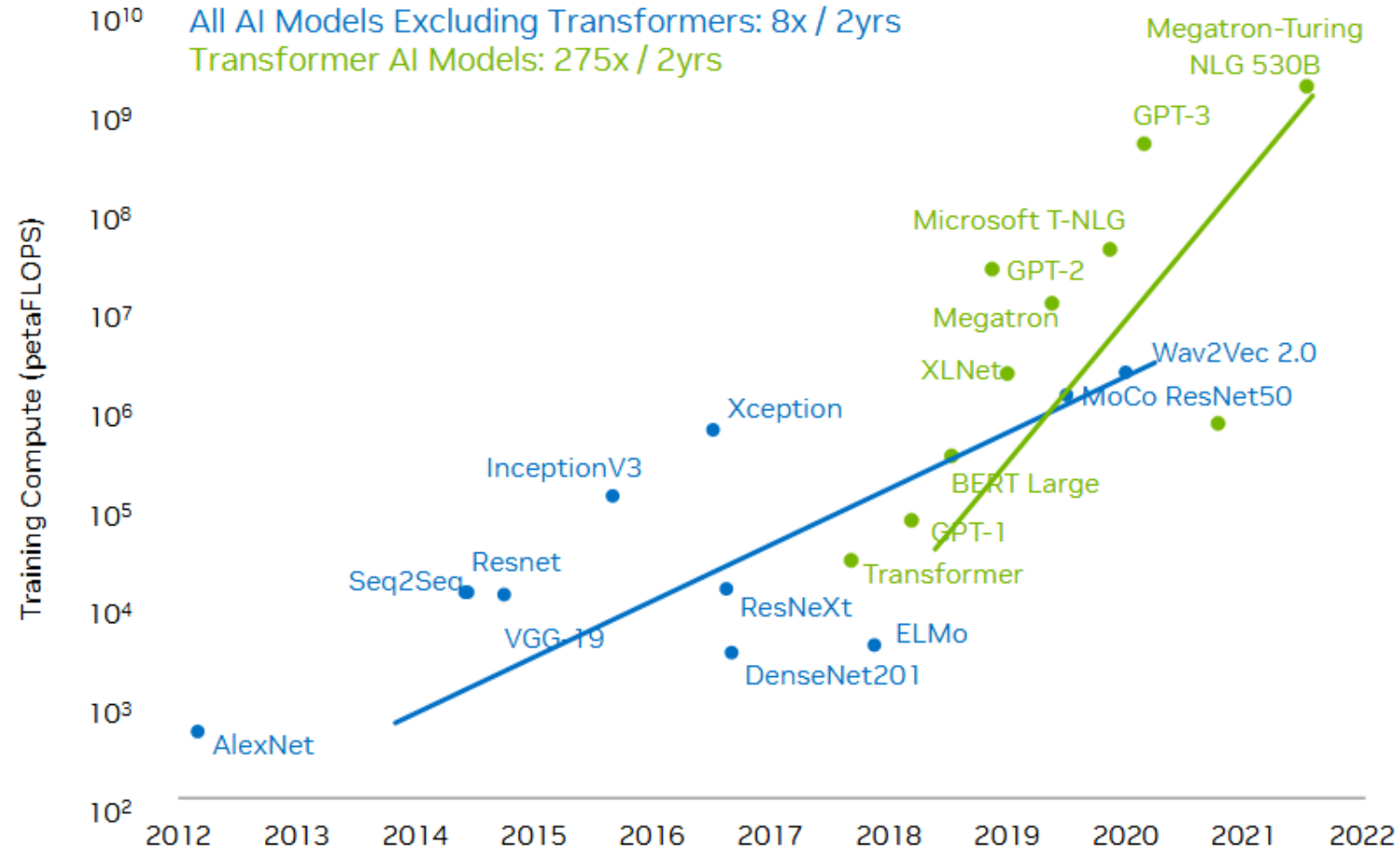
Sobol sampling vs random



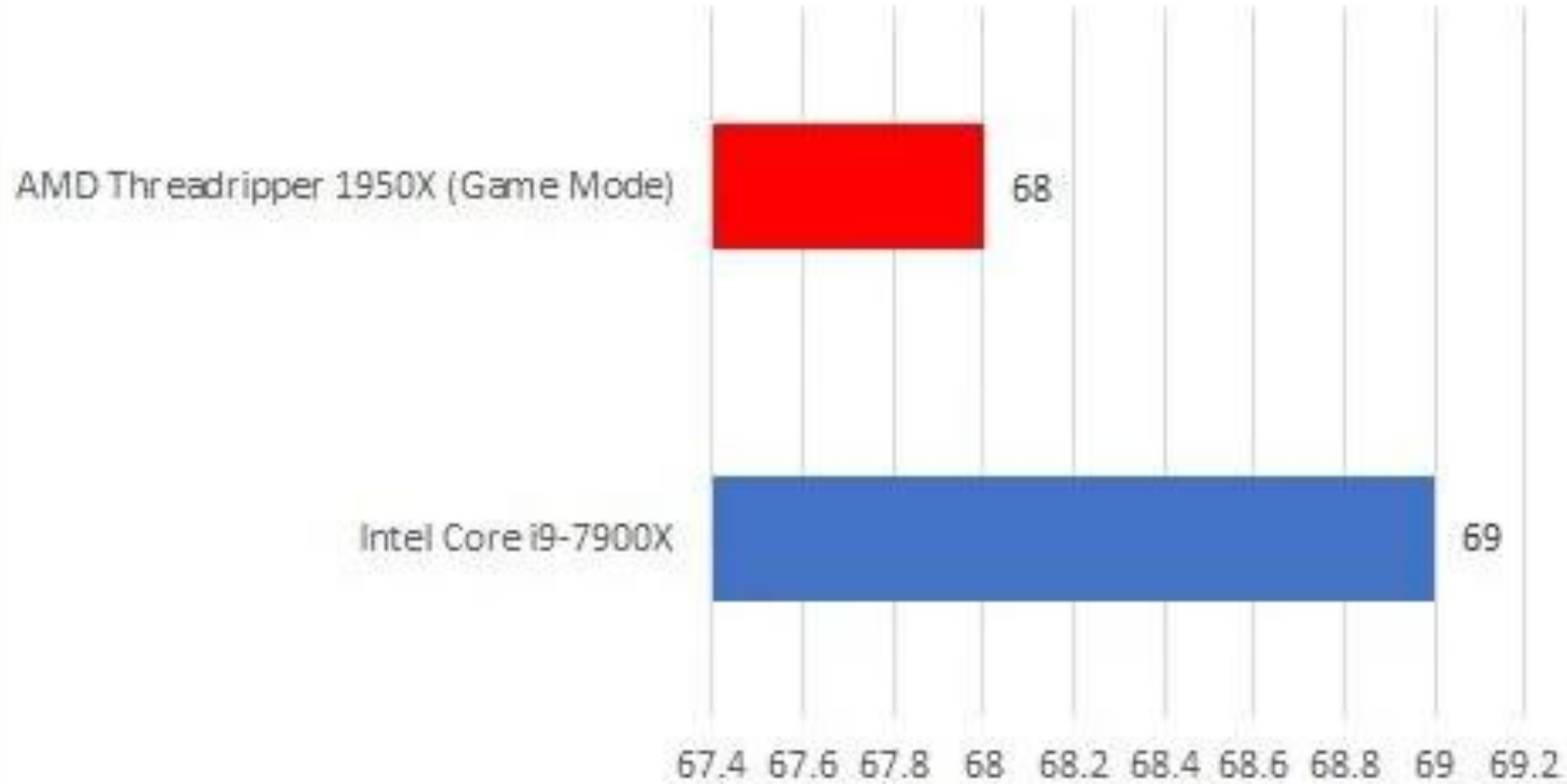


DON'Ts

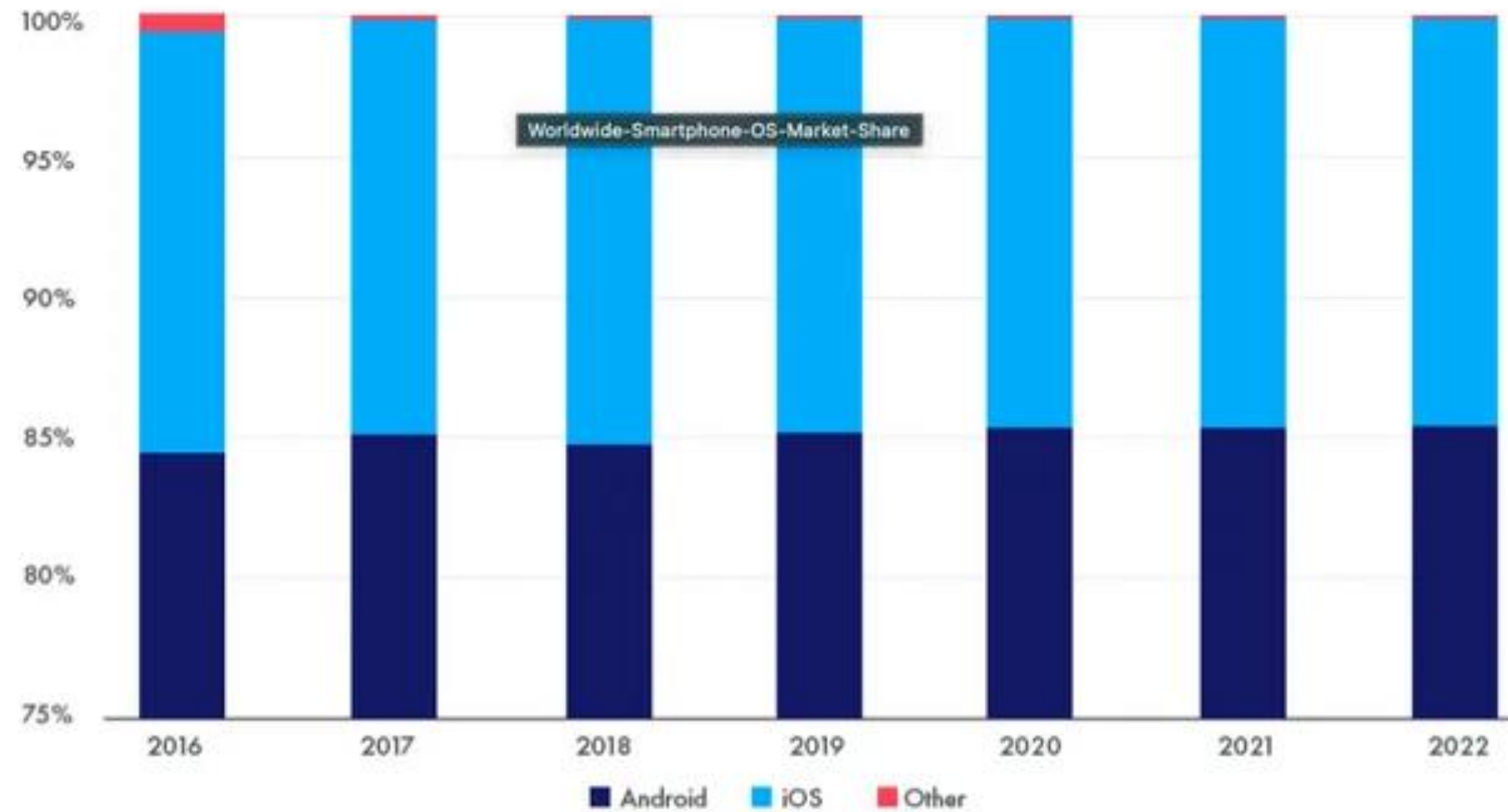
AI Training Computational Requirements

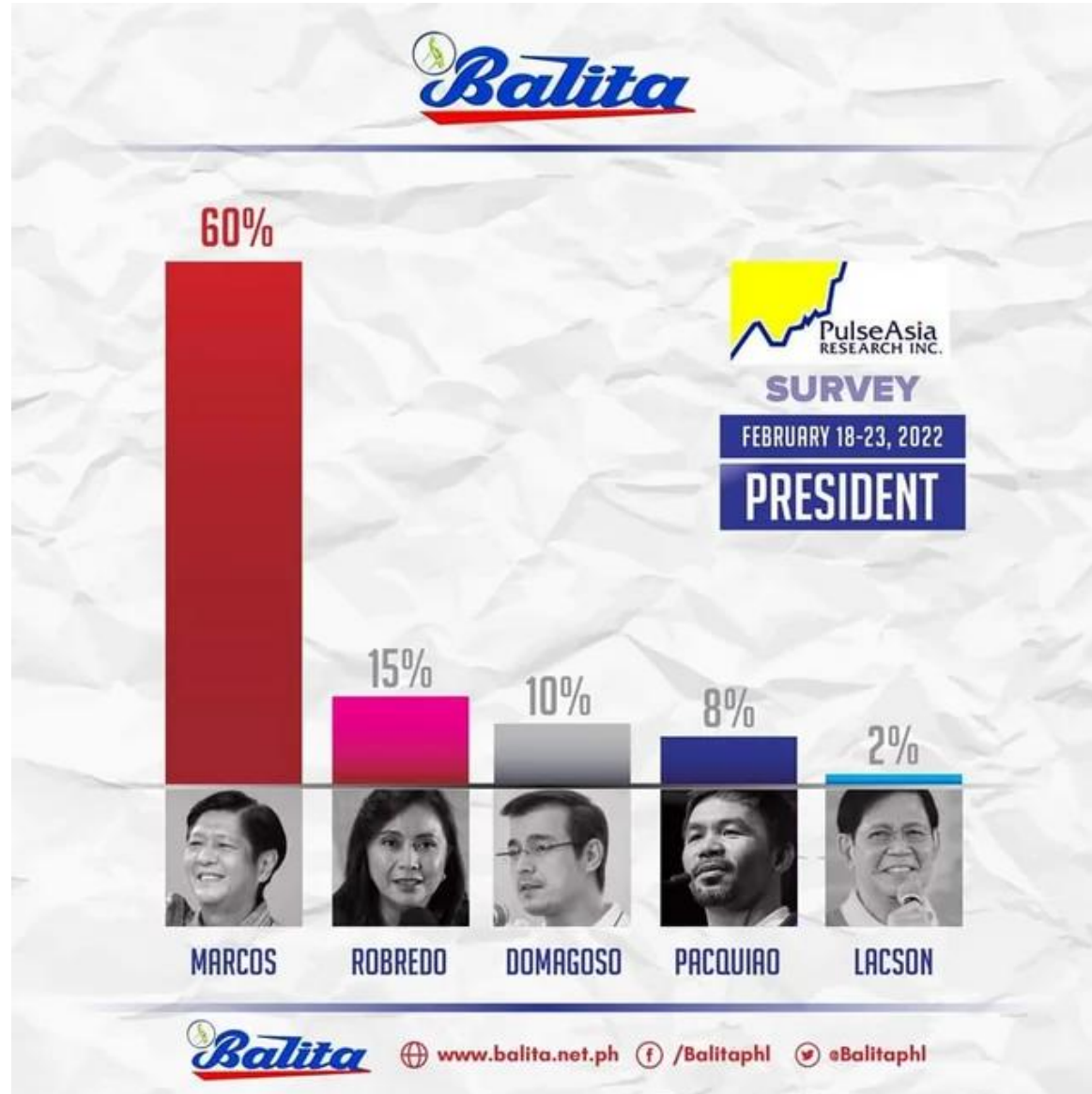


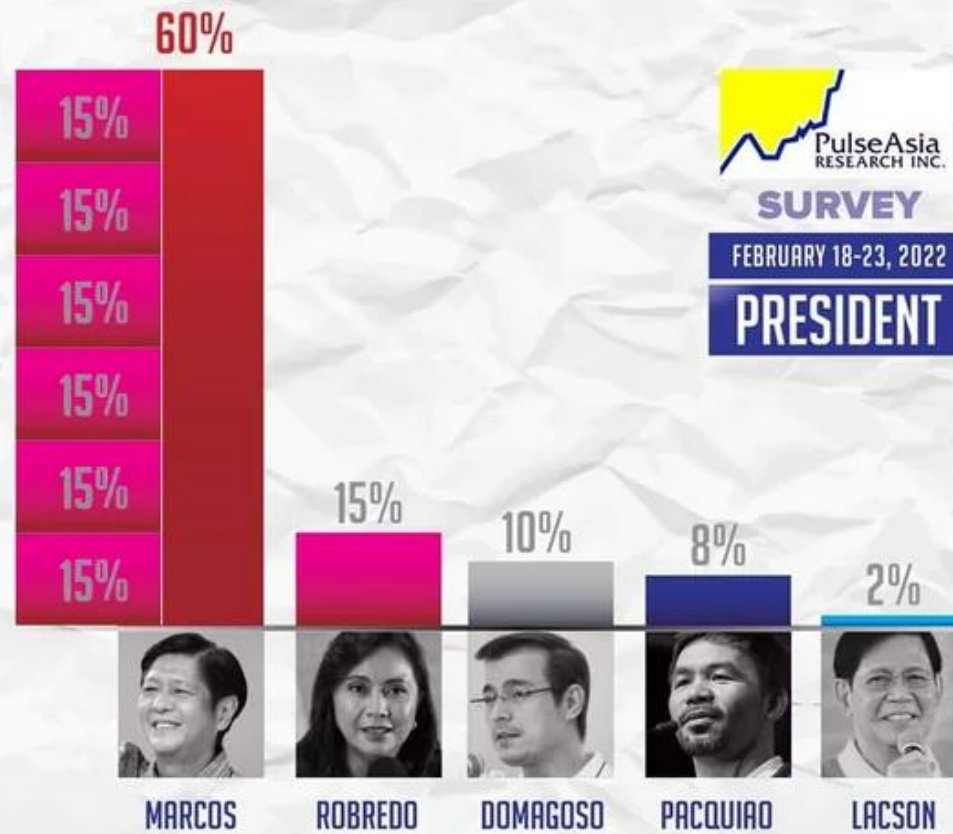
Total War: Warhammer @ 2160p (fps)



Worldwide Smartphone OS Market Share







www.balita.net.ph [/Balitaphl](#) [@Balitaphl](#)

REPUBLICANS & TRUMP



RUN FOR PRESIDENT

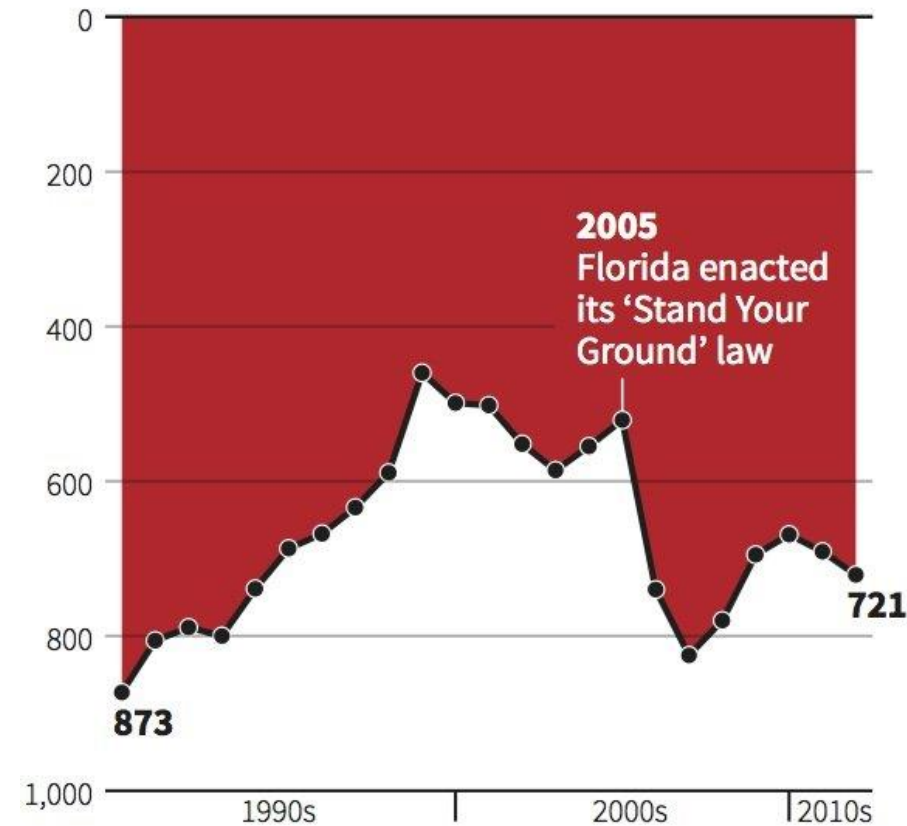
SOURCE: PEW RESEARCH CENTER

POLL: 44% OF REPUBLICANS WANT TRUMP TO RUN AGAIN

SUNDAY TODAY
with Willie Geist

Gun deaths in Florida

Number of murders committed using firearms



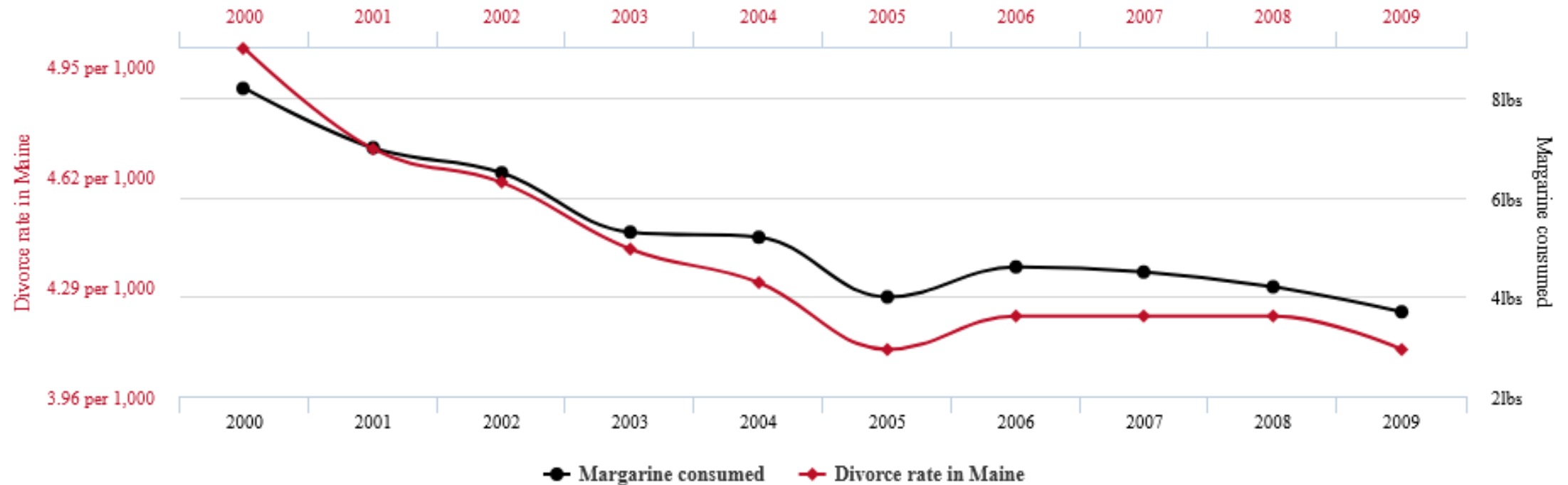
Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

REUTERS

Divorce rate in Maine correlates with Per capita consumption of margarine

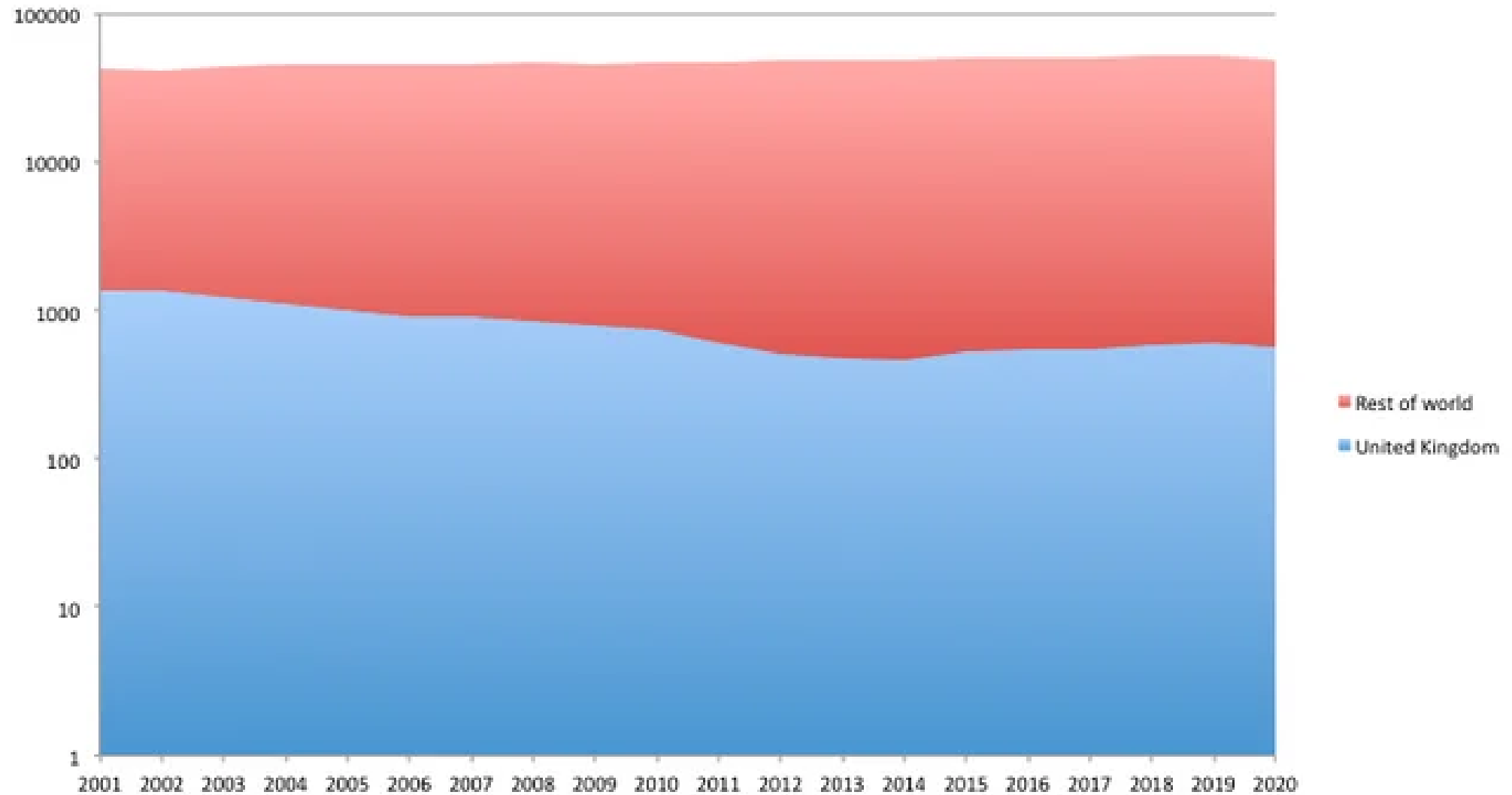
Correlation: 99.26% (r=0.992558)



Data sources: National Vital Statistics Reports and U.S. Department of Agriculture

tylervigen.com

World oil production (Twh/year)



Jamaal Williams Rushing Touchdowns

Length of each individual rushing touchdown by yards run.

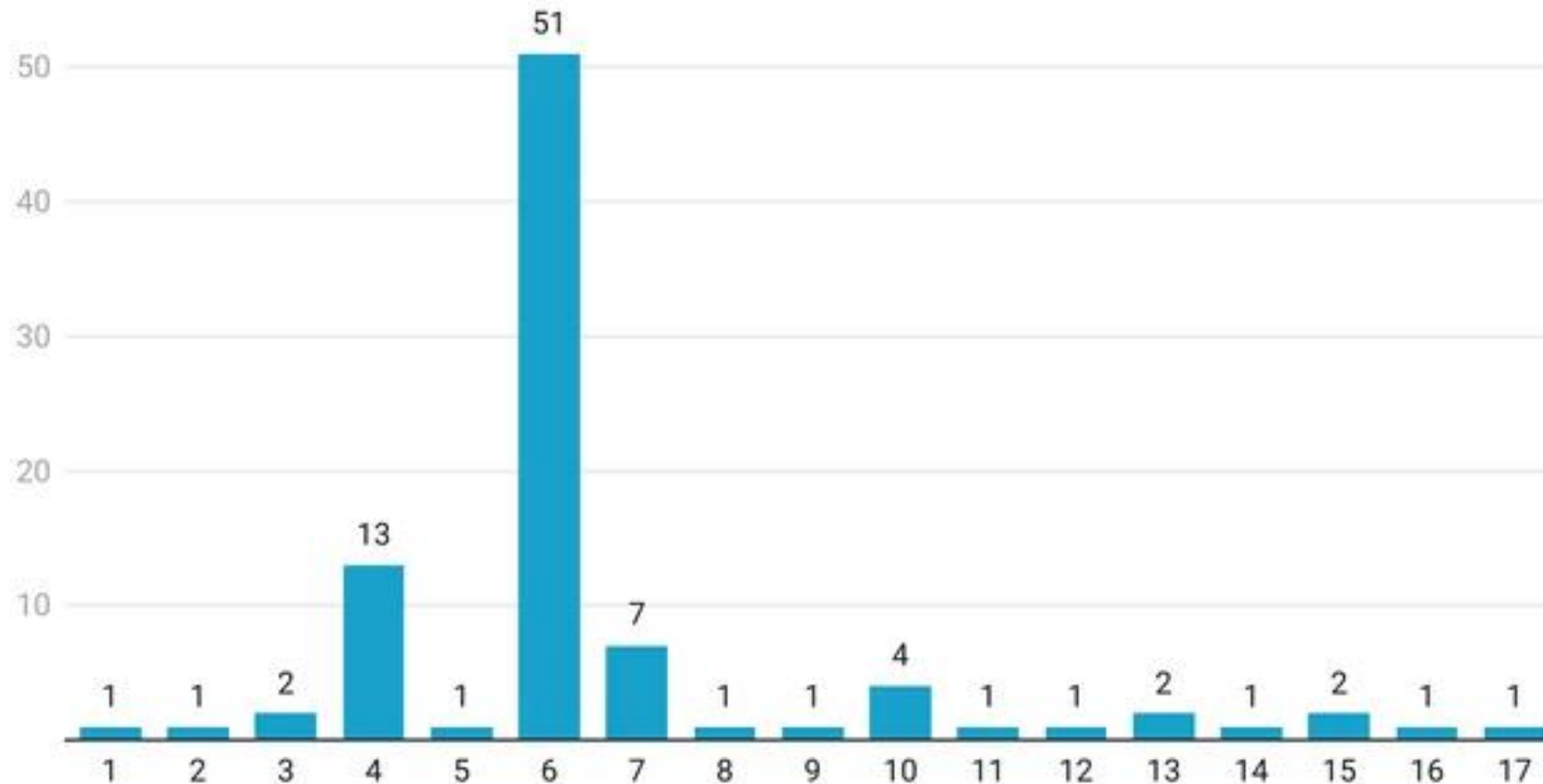
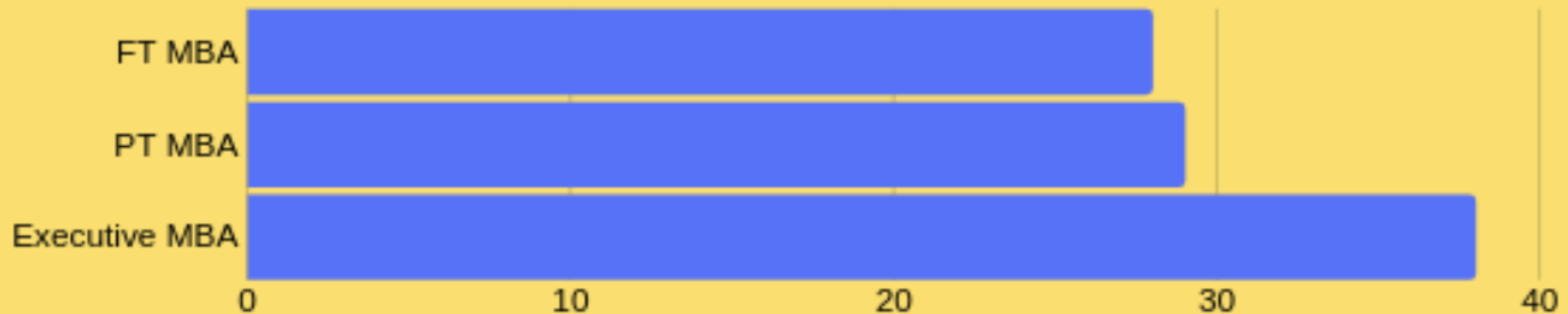


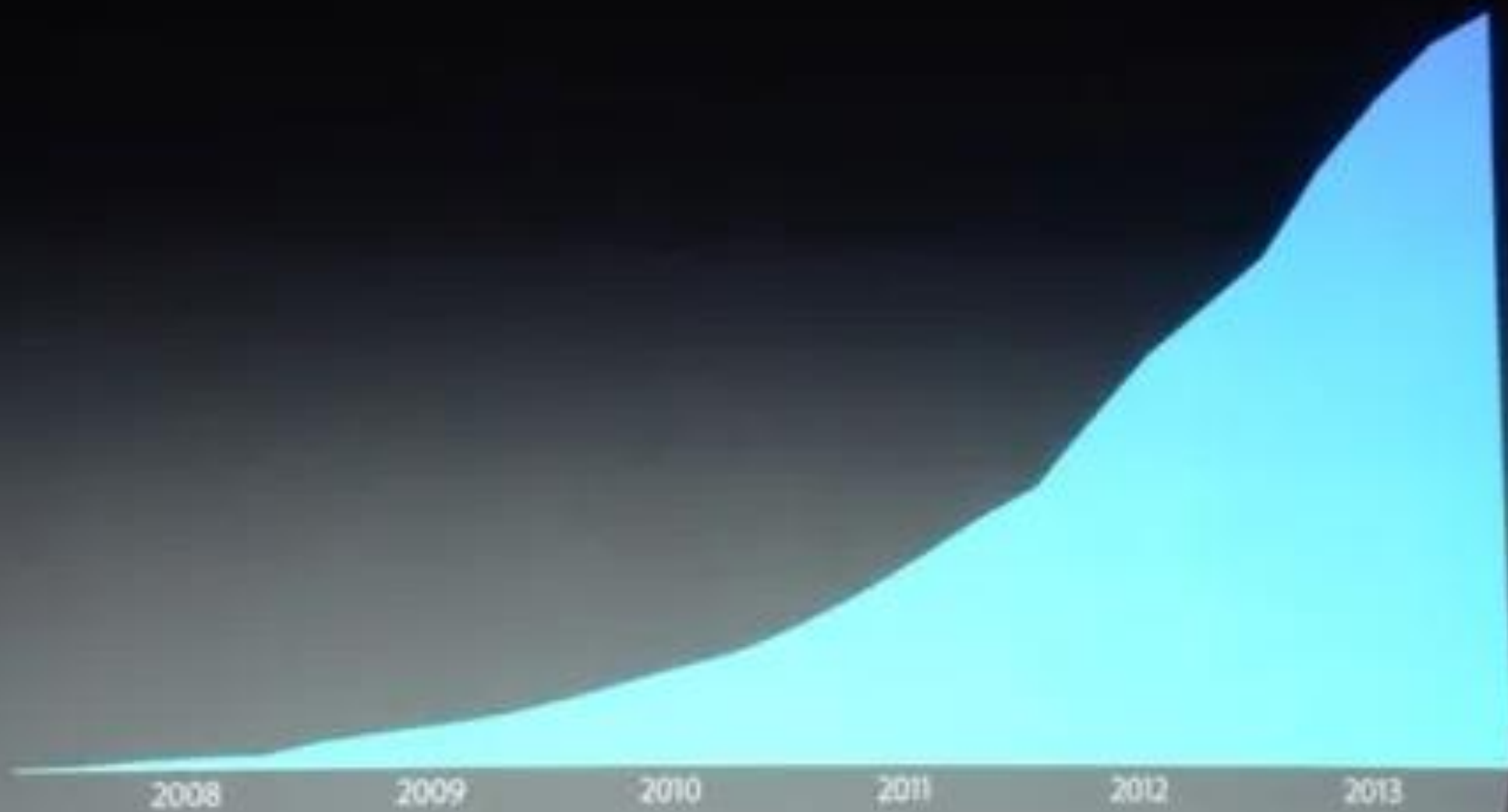
Chart: u/SL4MUEL • Source: Pro-Football-Reference.com • Created with Datawrapper

Average Age of USC Marshall School of Business Students Class of 2018

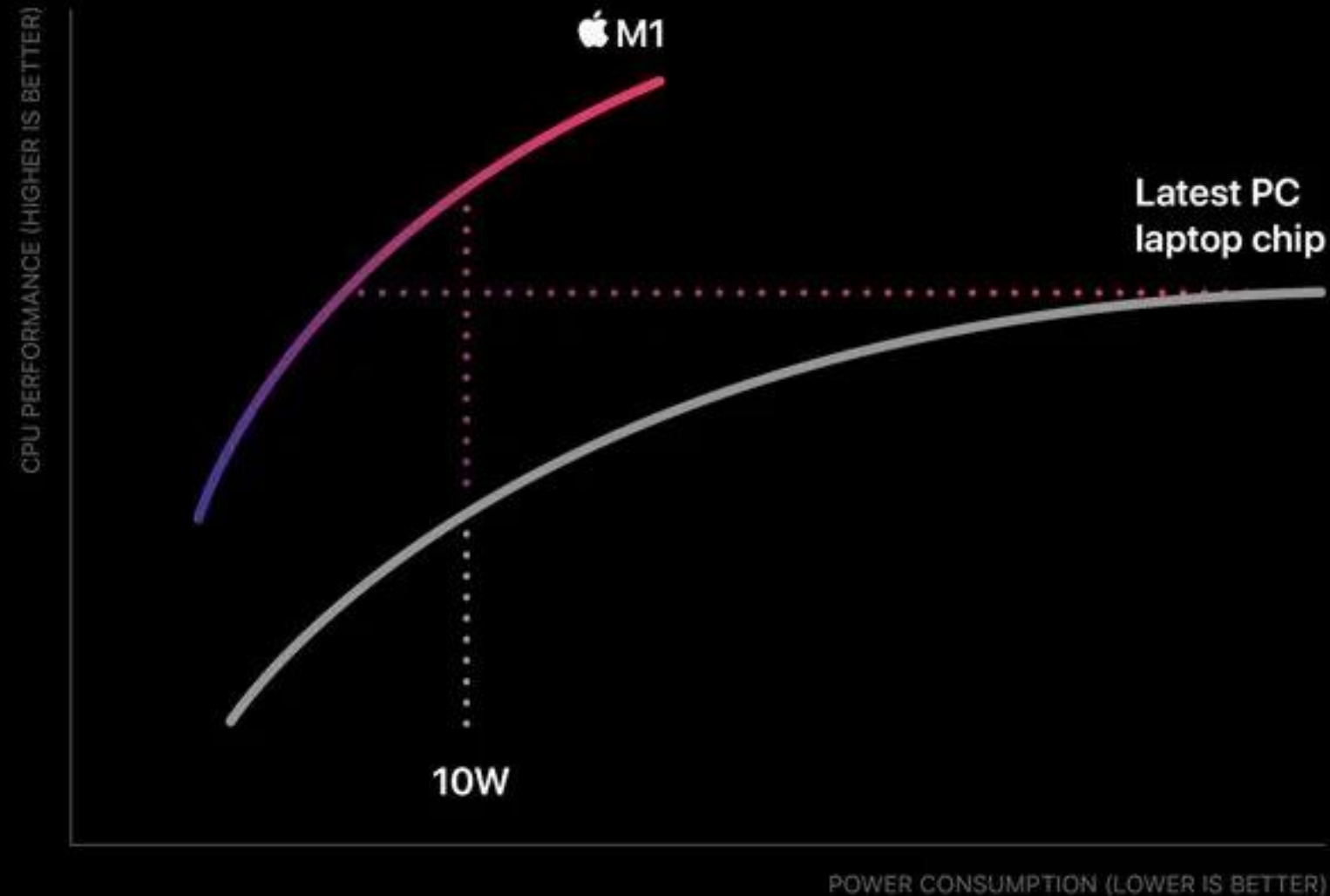


Data compiled from <https://www.marshall.usc.edu/programs/mba-programs>

Cumulative iPhone sales

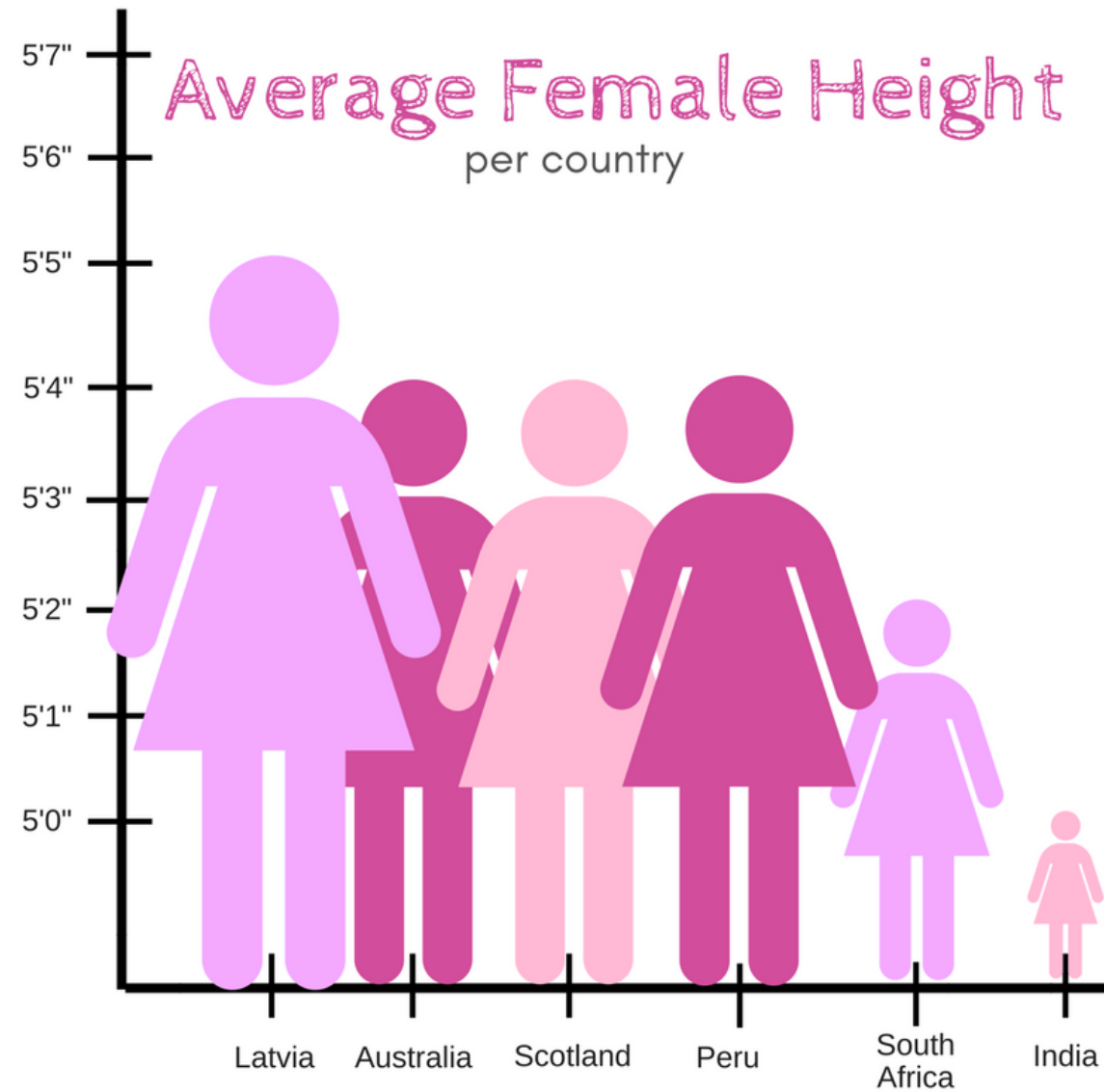


CPU performance vs. power






















Up to
2x
faster CPU
performance[†]

Matches peak PC
performance using
25%
of the power[†]



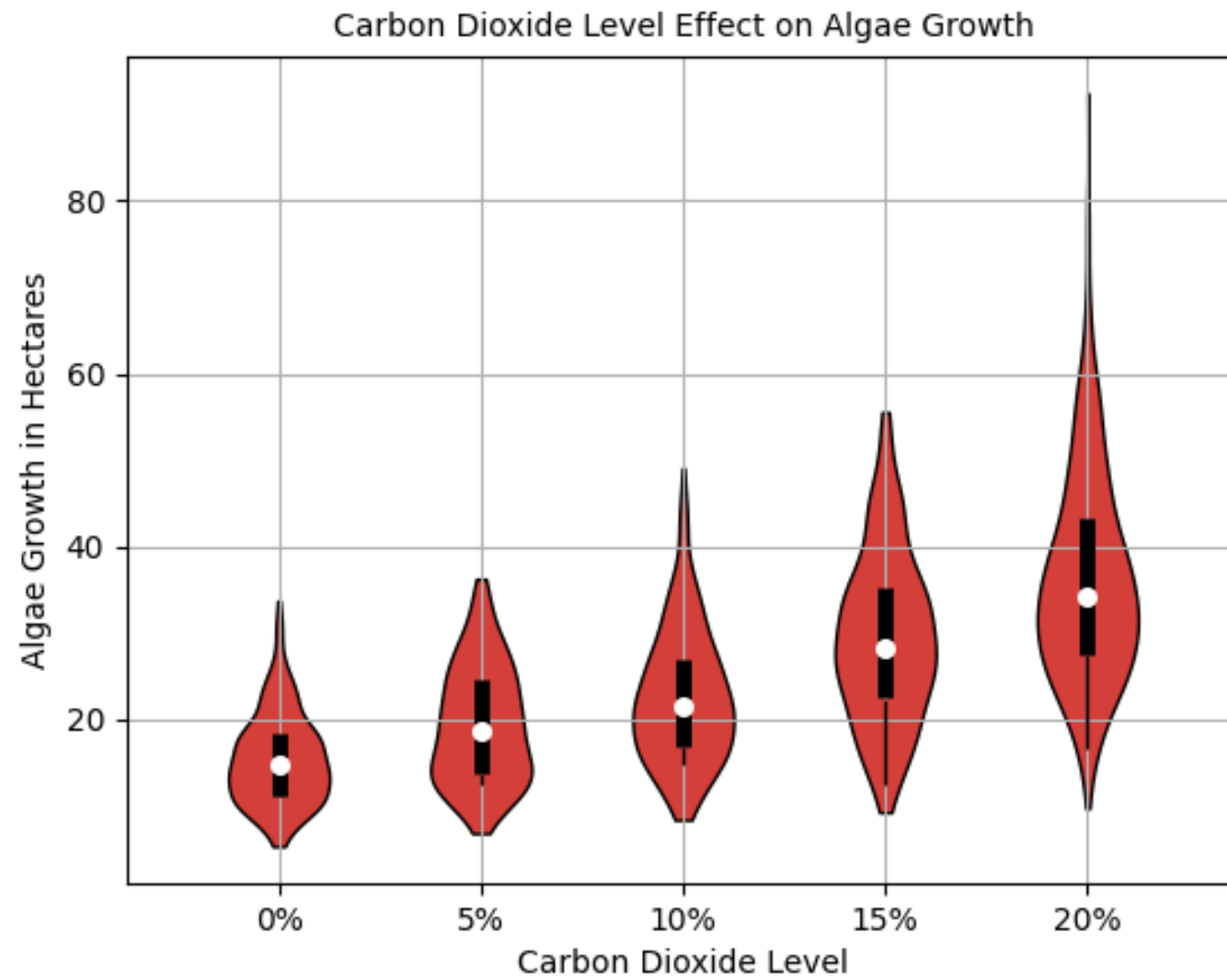
Top Goal Scorers of FIFA World Cup History

	Goals scored	Matches played	Tournaments
 Miroslav Klose  Germany	16	24	4
 Ronaldo  Brazil	15	19	3
 Gerd Müller  Germany	14	13	2
 Just Fontaine  France	13	1	
 Pelé  Brazil	12	4	
 Sándor Kocsis  Hungary	11	1	
 Jürgen Klinsmann  Germany	11	17	3
 Helmut Rahn  Germany	10	2	
 Gary Lineker  England	10	12	2
 Gabriel Batistuta  Argentina	10	12	3

German striker Miroslav Klose holds the record for most FIFA World Cup goals in history, having scored 16 times in 24 appearances across four editions (2002, 2006, 2010 and 2014). He won the tournament in 2014.

FIFA match reports do not include exact information about players' appearances before 1970

Source : FIFA



Veel gemaakte fouten

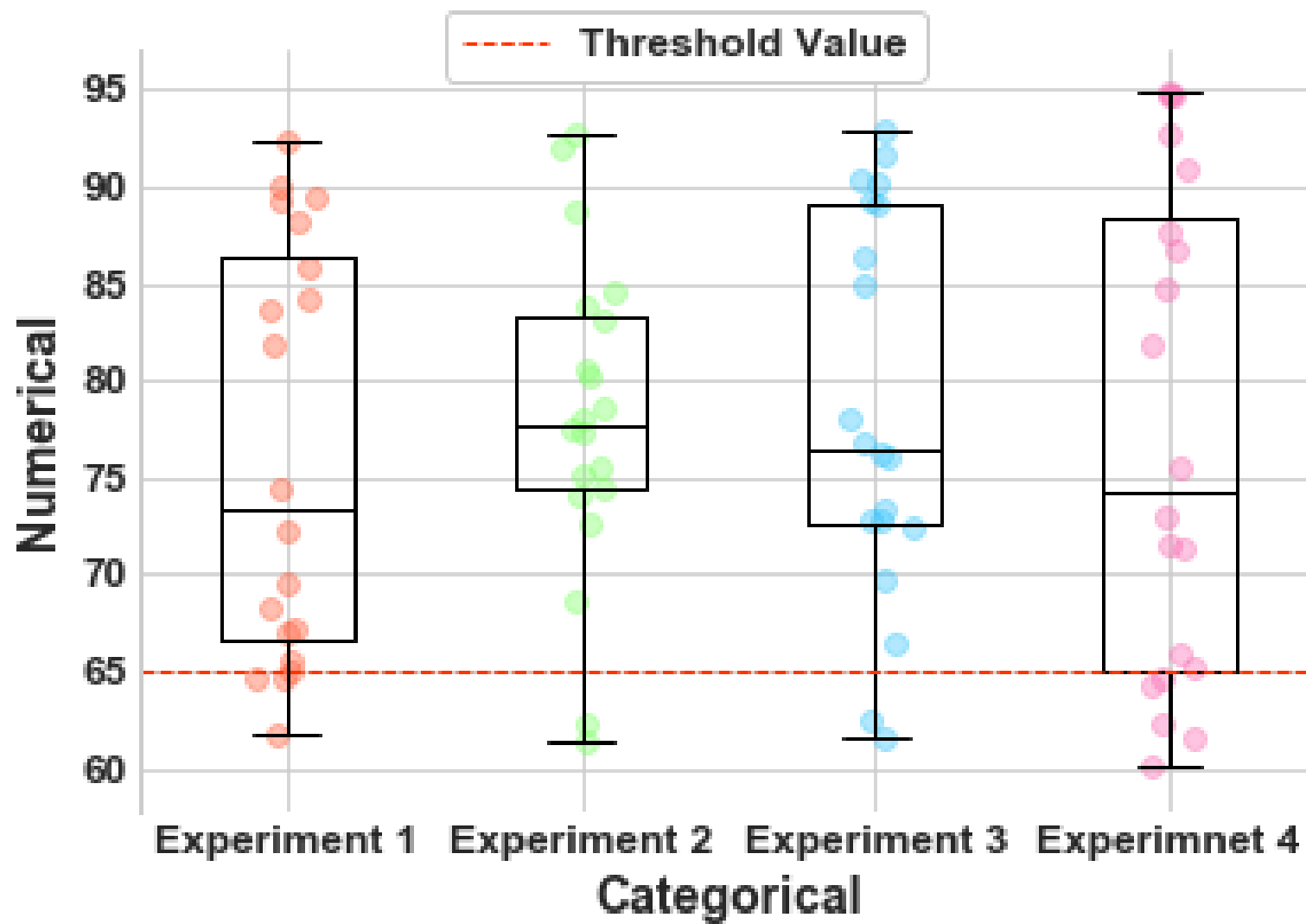
- As beginnen op een andere waarde dan 0
- As groter of kleiner schalen
- Cherry picking
- Verkeerde soort grafiek
- Tegen conventies in gaan
- Overprikkelen/te veel informatie
- Verkeerde data/schaal
- Te complex



DOs

Gebruik

- Legendas
- Duidelijke kleuren
- (as-)Titels
- Niet te veel verschillende data
- De correcte soort grafiek!
- Highlights
- Formules



Exponential multiplicative cooling proposed by [Kirkpatrick et al. \(1983\)](#) decreases the temperature by multiplying the initial temperature by a factor.

$$T_k = T_0 \alpha^k \quad (2)$$

Logarithmic multiplicative cooling proposed by [Korst and Aarts \(1989\)](#) decreases the temperature by multiplying the initial temperature by a factor that decreases in inverse proportion to the natural logarithm of the temperature cycle.

$$T_k = \frac{T_0}{1 + \frac{1}{\alpha} \log(1 + k)} \quad (3)$$

Linear multiplicative cooling decreases the temperature by multiplying the initial temperature by a factor that decreases in inverse proportion to the temperature cycle.

$$T_k = \frac{T_0}{\alpha k} \quad (4)$$

Quadratic multiplicative cooling decreases the temperature by multiplying the initial temperature by a factor that decreases in inverse proportion to square of the temperature cycle.

$$T_k = \frac{T_0}{\alpha k^2} \quad (5)$$

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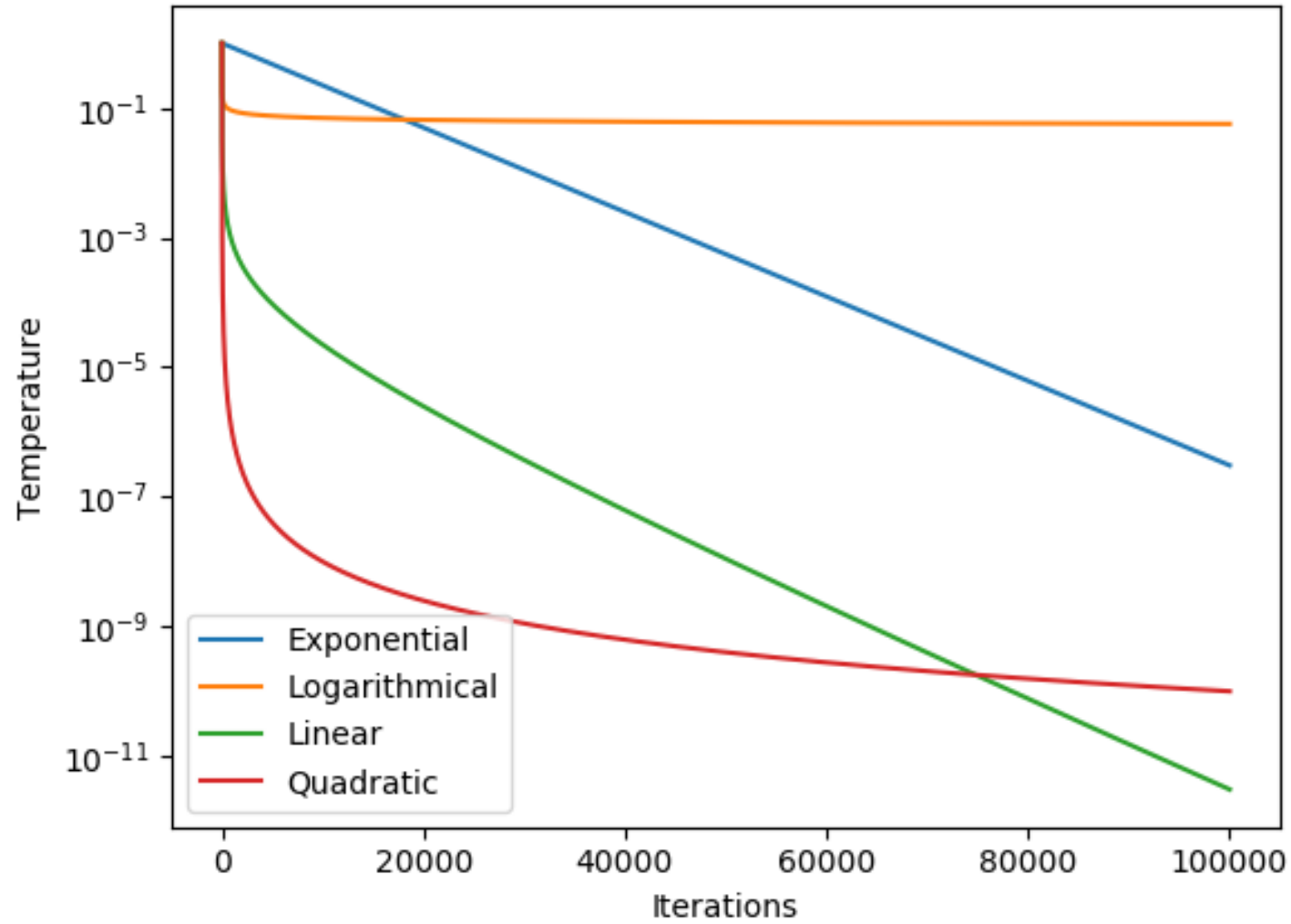
k = iteratie

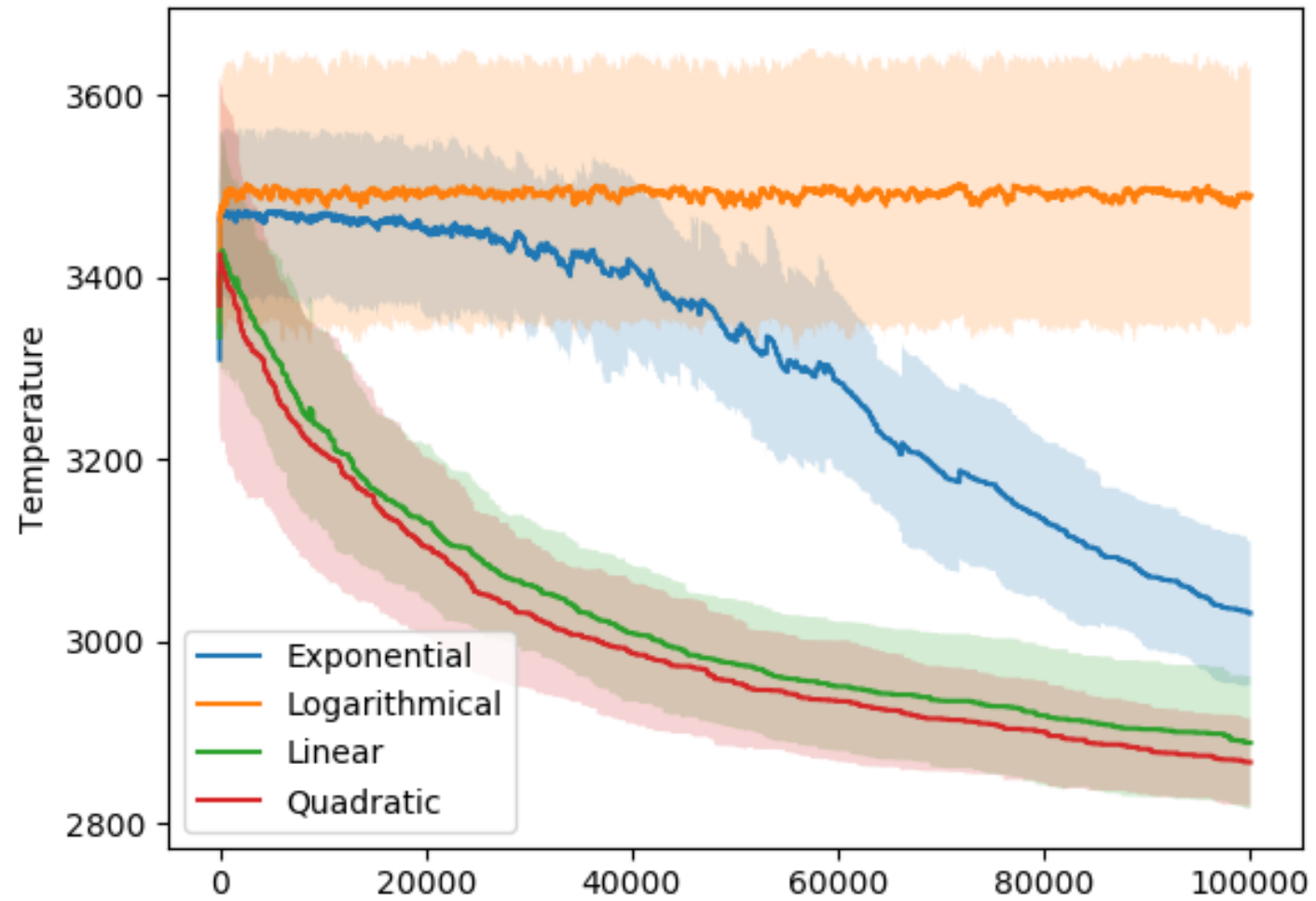
α = factor

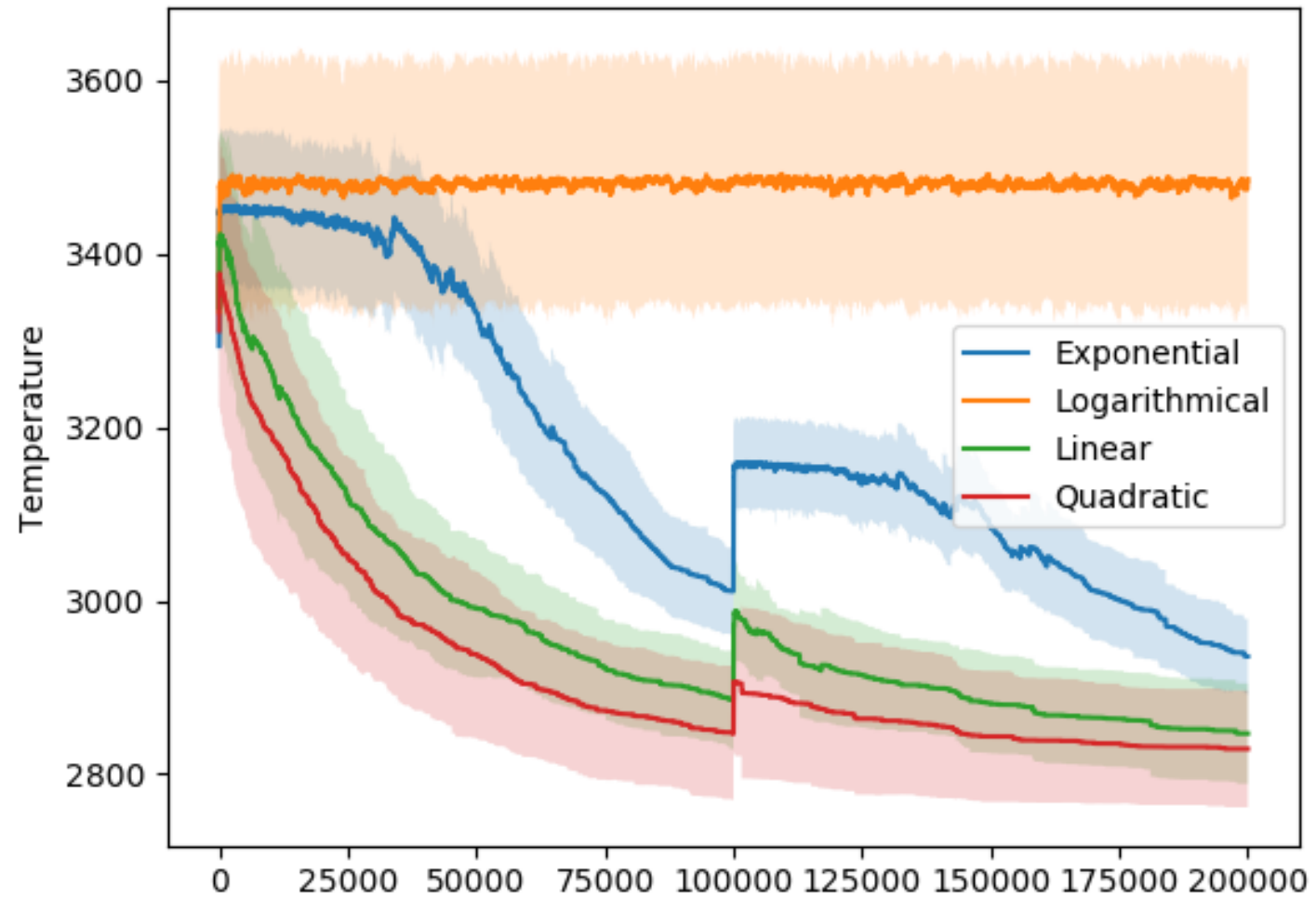
T_0 = starttemperatuur

T_k = temperatuur op iteratie

α is set to $1 - 15 * (1.0/100000)$







Problem	Algorithm	Time Complexity	Space Complexity	Best Case	Worst Case	Advantages/Disadvantages
Sorting	QuickSort	$O(n \log n)$	$O(\log n)$	$O(n \log n)$	$O(n^2)$	QuickSort is efficient in practice and has good average case performance. It's also an in-place sorting algorithm.
	MergeSort	$O(n \log n)$	$O(n)$	$O(n \log n)$	$O(n \log n)$	MergeSort is a stable and efficient sorting algorithm. It's not an in-place sorting algorithm.
	BubbleSort	$O(n^2)$	$O(1)$	$O(n)$	$O(n^2)$	BubbleSort is easy to understand and implement, but it's not efficient for large datasets.
Searching	Binary Search	$O(\log n)$	$O(1)$	$O(1)$	$O(\log n)$	Binary search is efficient and has a good average case performance. It requires that the data is sorted.
	Linear Search	$O(n)$	$O(1)$	$O(1)$	$O(n)$	Linear search is simple and easy to understand but not efficient for large datasets.
	Ternary Search	$O(\log n)$	$O(1)$	$O(1)$	$O(\log n)$	Ternary search is similar to binary search but with a slightly worse average case performance. It also requires that the data is sorted.

Problem	Algorithm 1	Algorithm 2	Algorithm 3
Sorting	QuickSort	MergeSort	BubbleSort
Searching	Binary Search	Linear Search	Ternary Search
Graph traversal	DFS	BFS	Dijkstra's
String matching	KMP	Boyer Moore	Rabin-Karp
Shortest Path	Bellman Ford	Dijkstra's	A*

Algorithm	Sphere	Rastrigin	Rosenbrock	Ackley
PPA	0.03	0.08	0.1	0.14
FWA	0.02	0.07	0.12	0.16
DE	0.01	0.06	0.11	0.15
GA	0.04	0.05	0.09	0.13
PSO	0.05	0.09	0.08	0.12

Benchmark Function	PPA	FWA	DE	GA	PSO
Sphere	0.03	0.02	0.01	0.04	0.05
Rastrigin	0.08	0.07	0.06	0.05	0.09
Rosenbrock	0.1	0.12	0.11	0.09	0.08
Ackley	0.14	0.16	0.15	0.13	0.12

Benchmark Function	PPA	FWA	DE	GA	PSO
Sphere	0.03	0.02	0.01	0.04	0.05
Rastrigin	0.08	0.07	0.06	0.05	0.09
Rosenbrock	0.1	0.12	0.11	0.09	0.08
Ackley	0.14	0.16	0.15	0.13	0.12
Total	0.35	0.37	0.33	0.31	0.34 38

Writing files to csv/json

Demo

Case study; Radio Russia

Radio Russia - Algoritmes

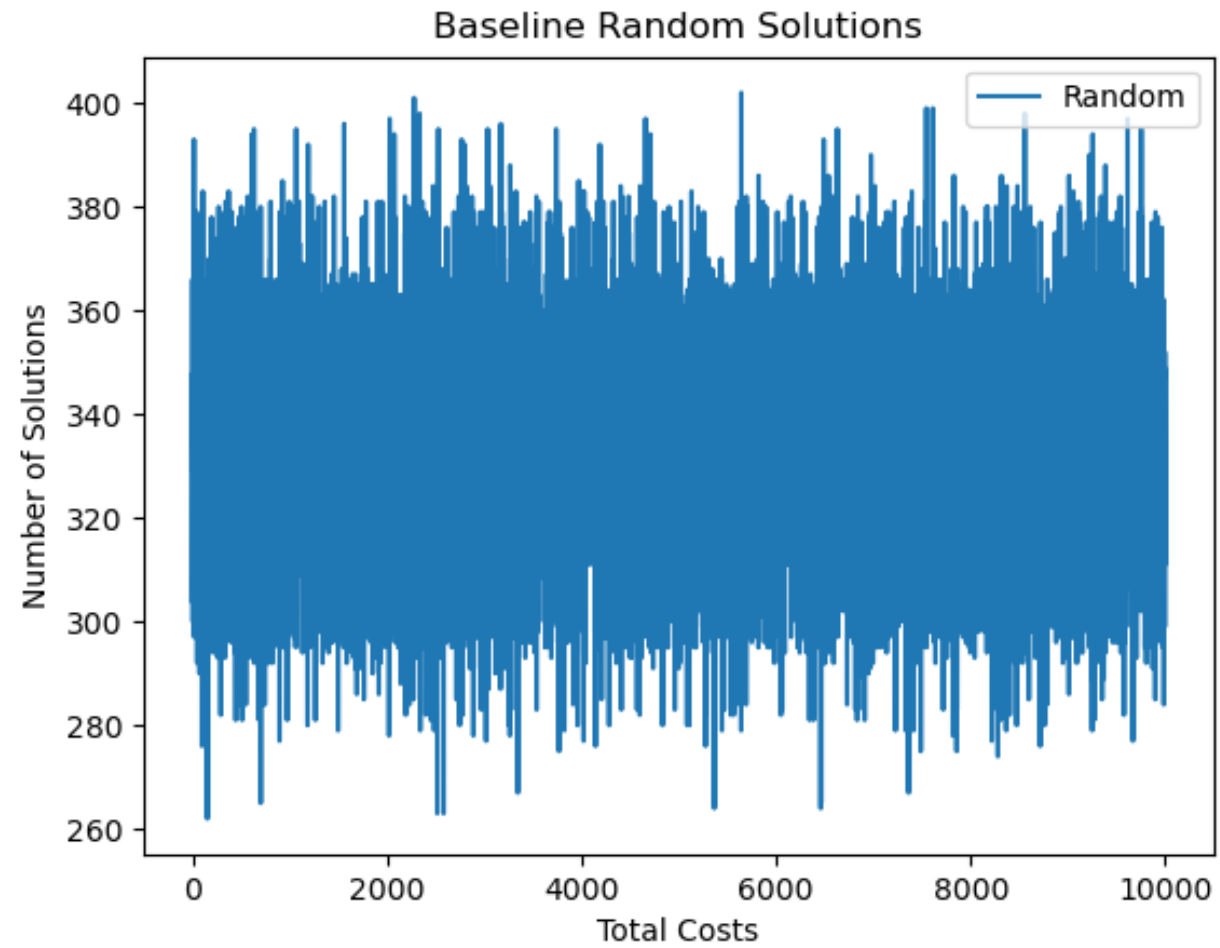
Constructief

- Random
- Greedy
- Breadth first + Best first
- Depth first

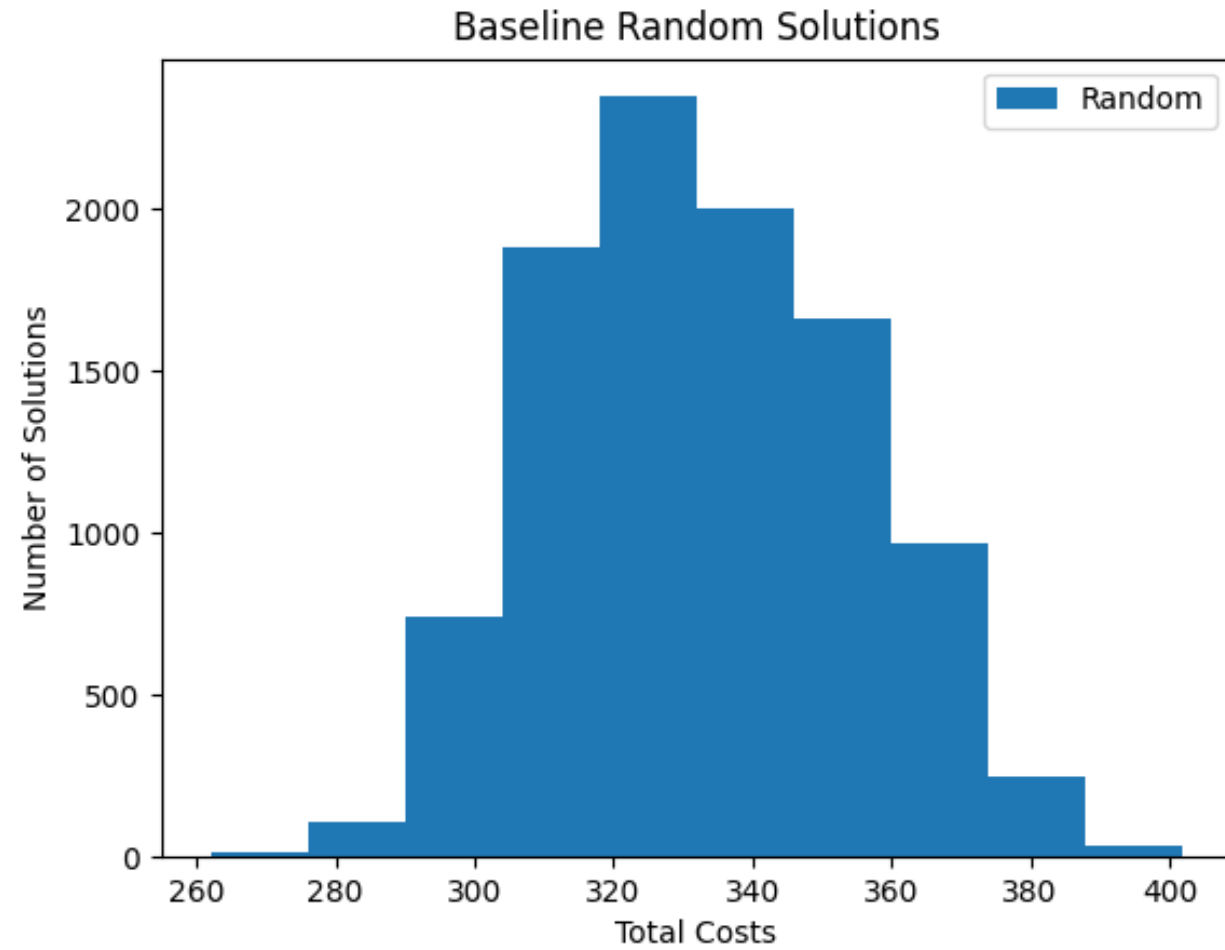
Iteratief

- Hillclimber
- Simulated Annealing

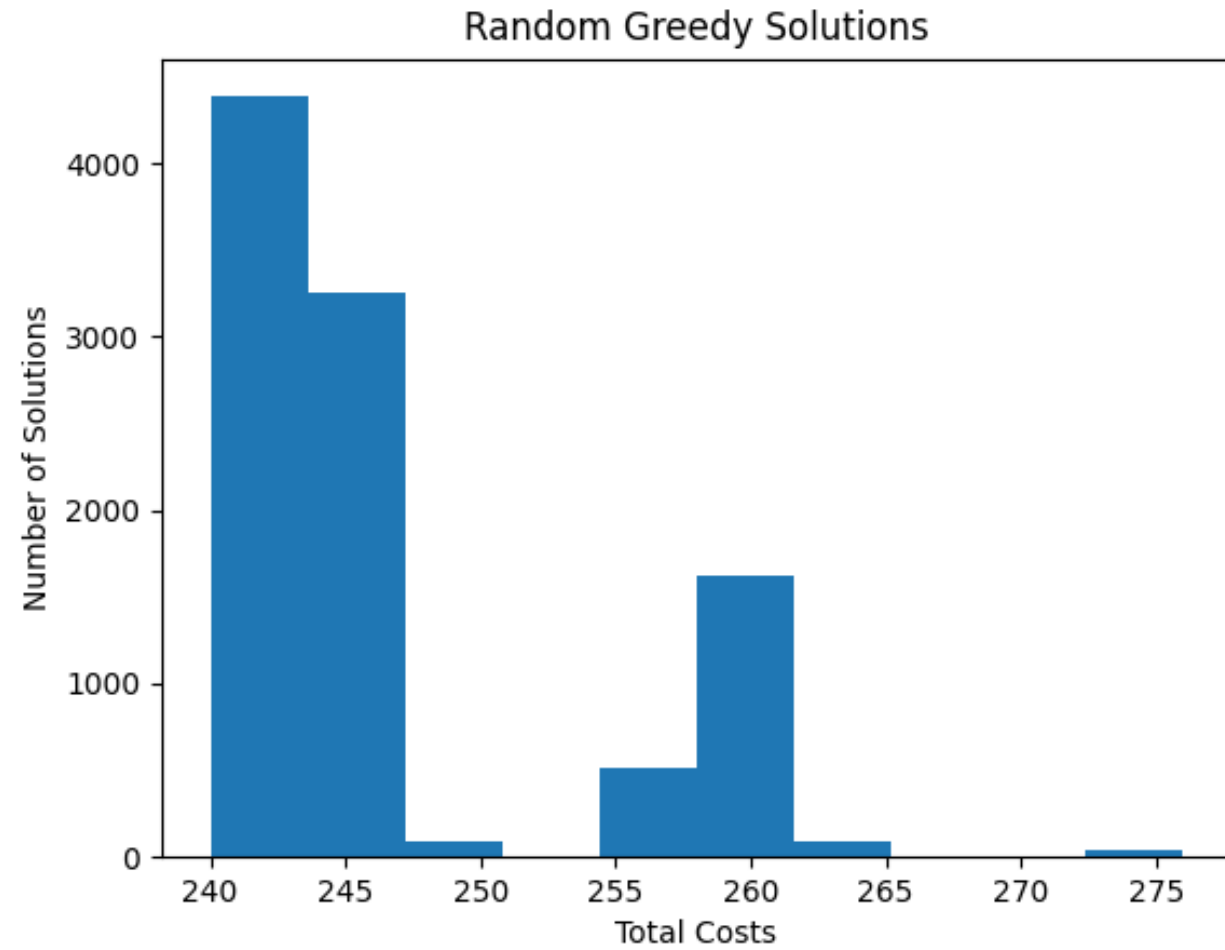
Constructieve
Algoritmes
-
Random



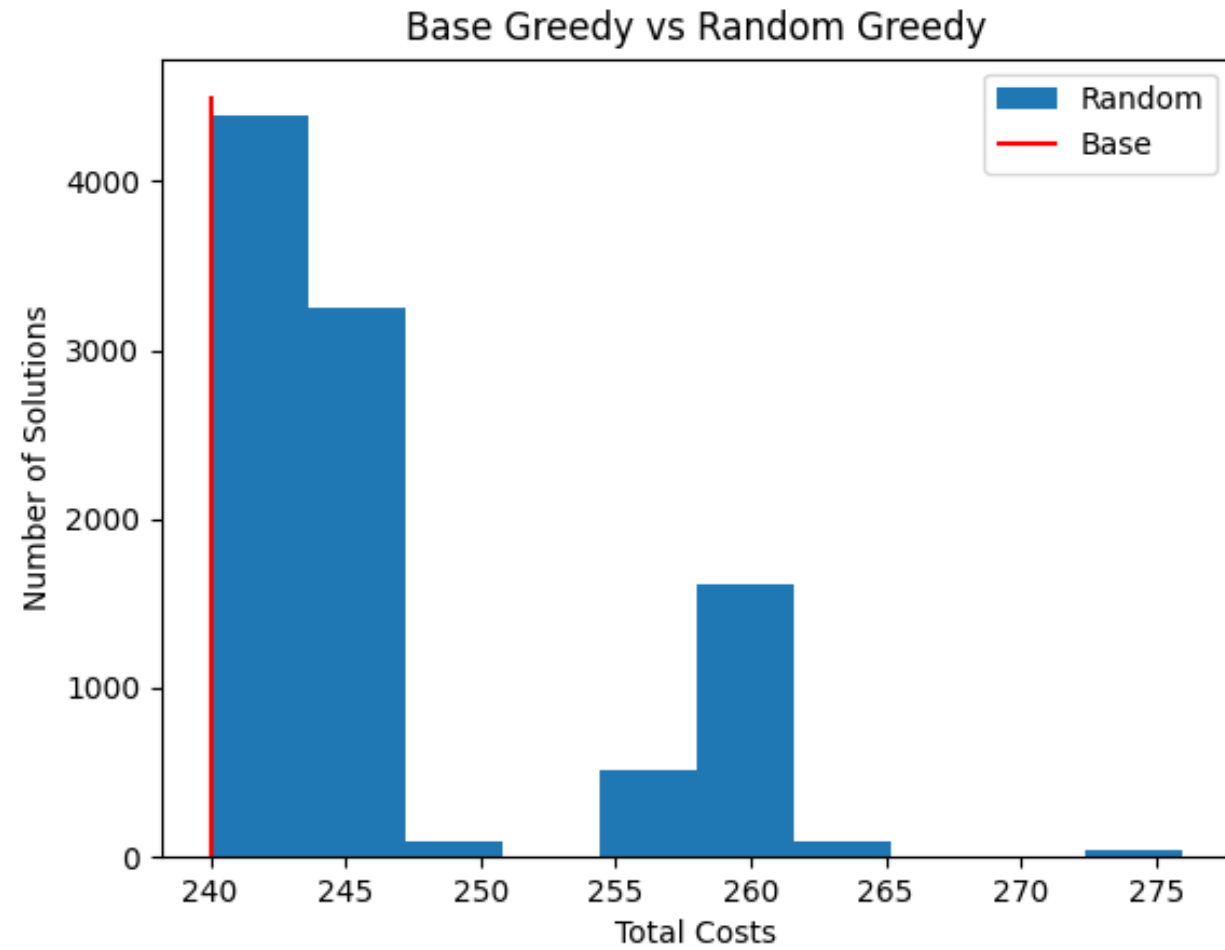
Constructieve
Algoritmes
-
Random



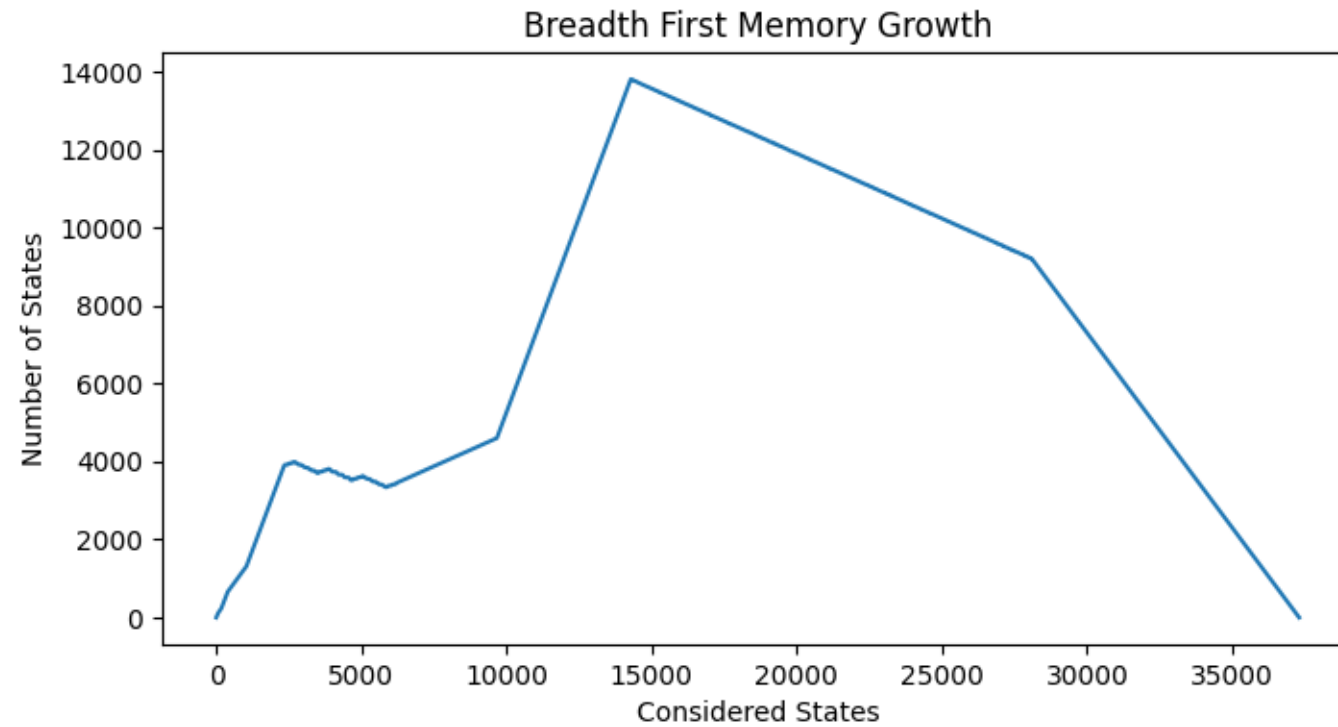
Constructieve
Algoritmes
—
Greedy



Constructieve Algoritmes — Greedy

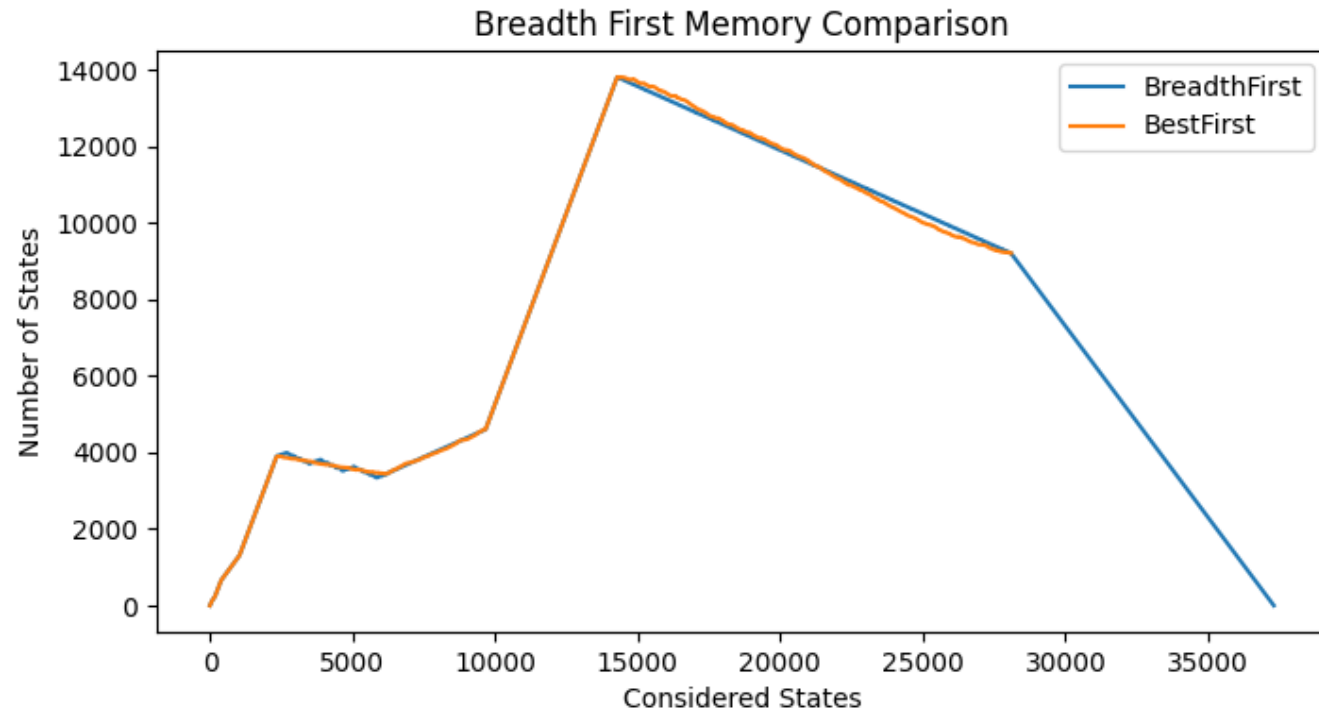


Constructieve Algoritmes — Breadth First

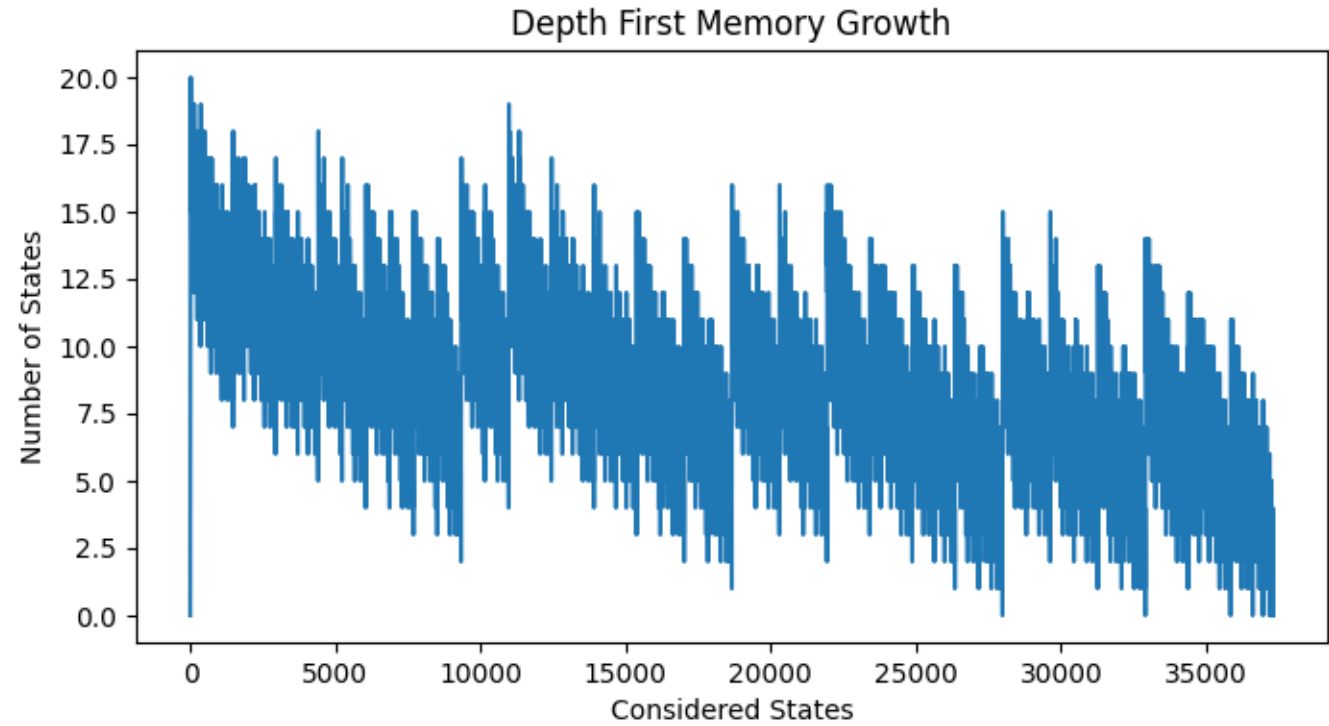


	Visited State Count	Max States Size	Solution Count	Objective Value
DepthFirst	37317	13824	9216	240

Constructive Algorithms — Best First

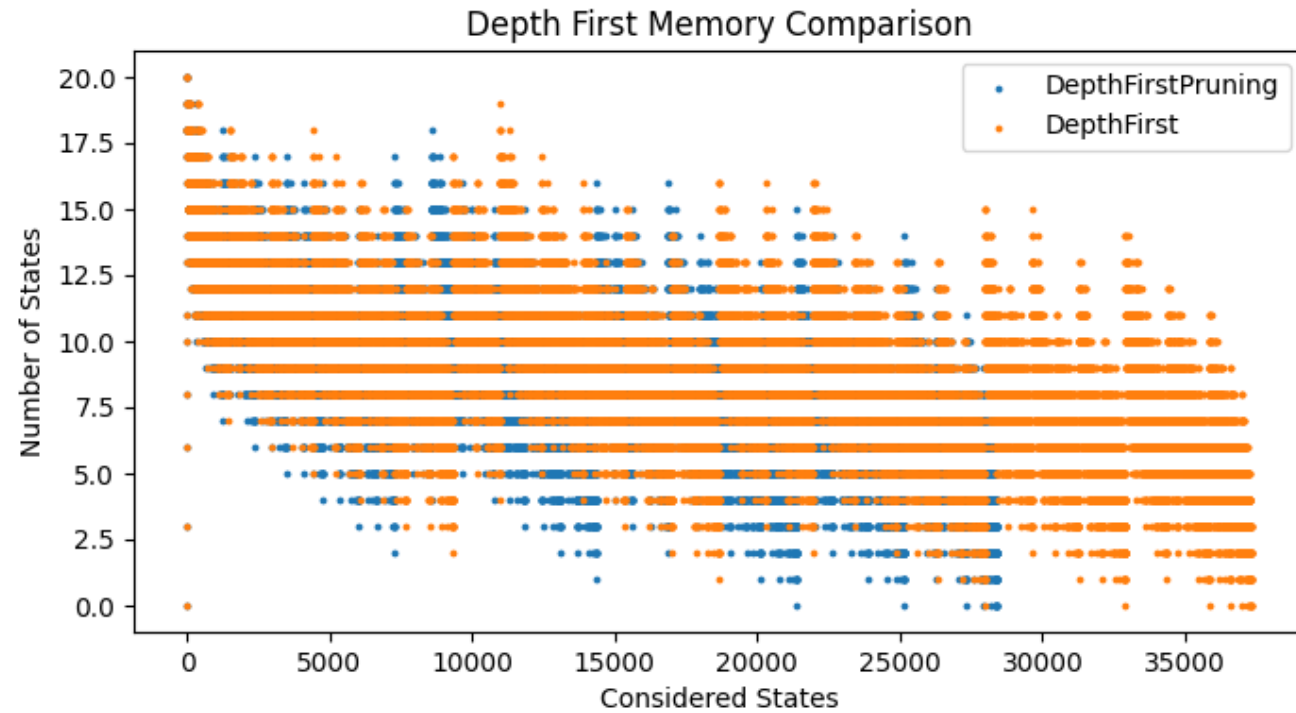


Constructive Algorithms – Depth First

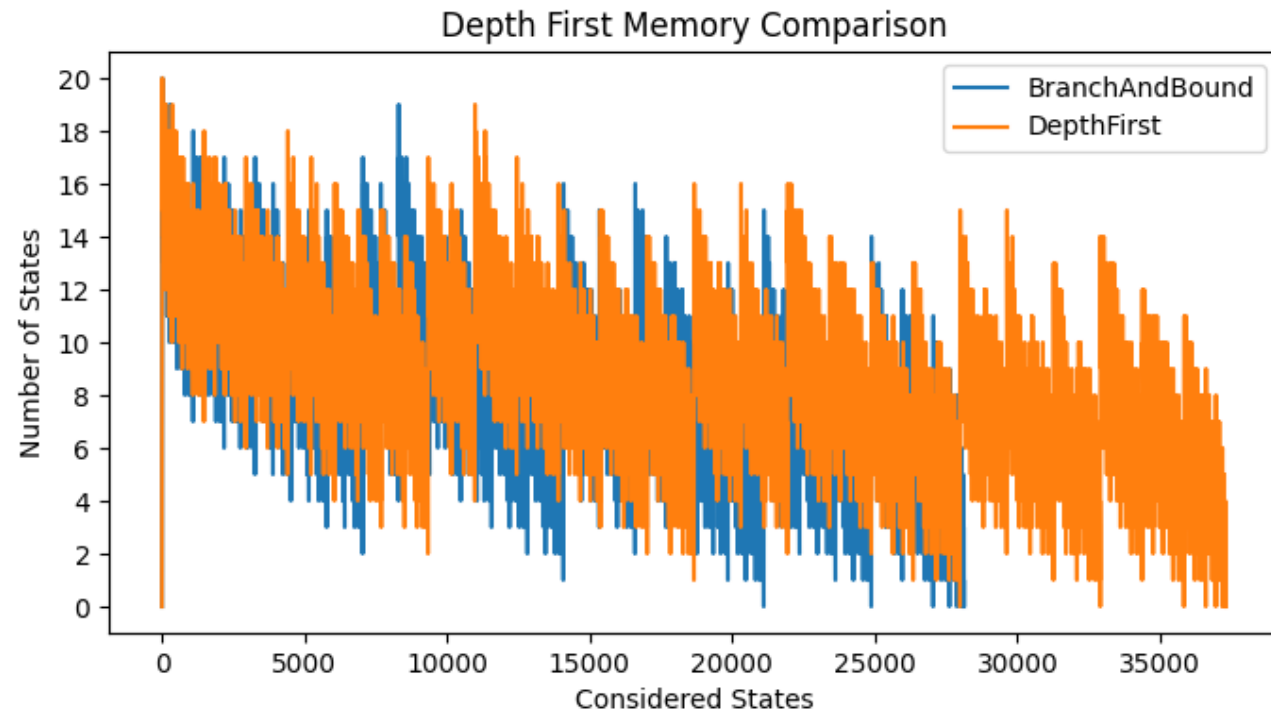


	Visited State Count	Max States Size	Solution Count	Objective Value
DepthFirst	37317	20	9216	240

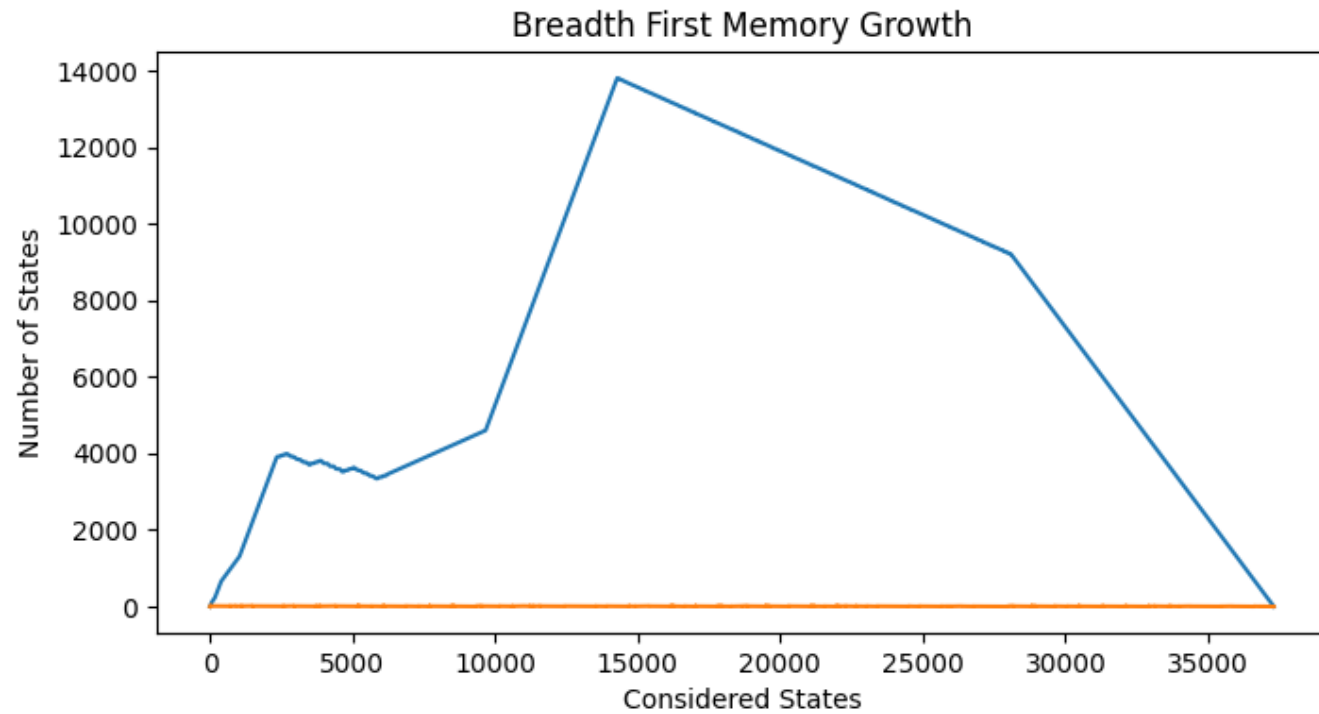
Constructive Algorithms – Depth First



Constructieve Algoritmes – Depth First



Constructieve Algoritmes – BFS vs DFS

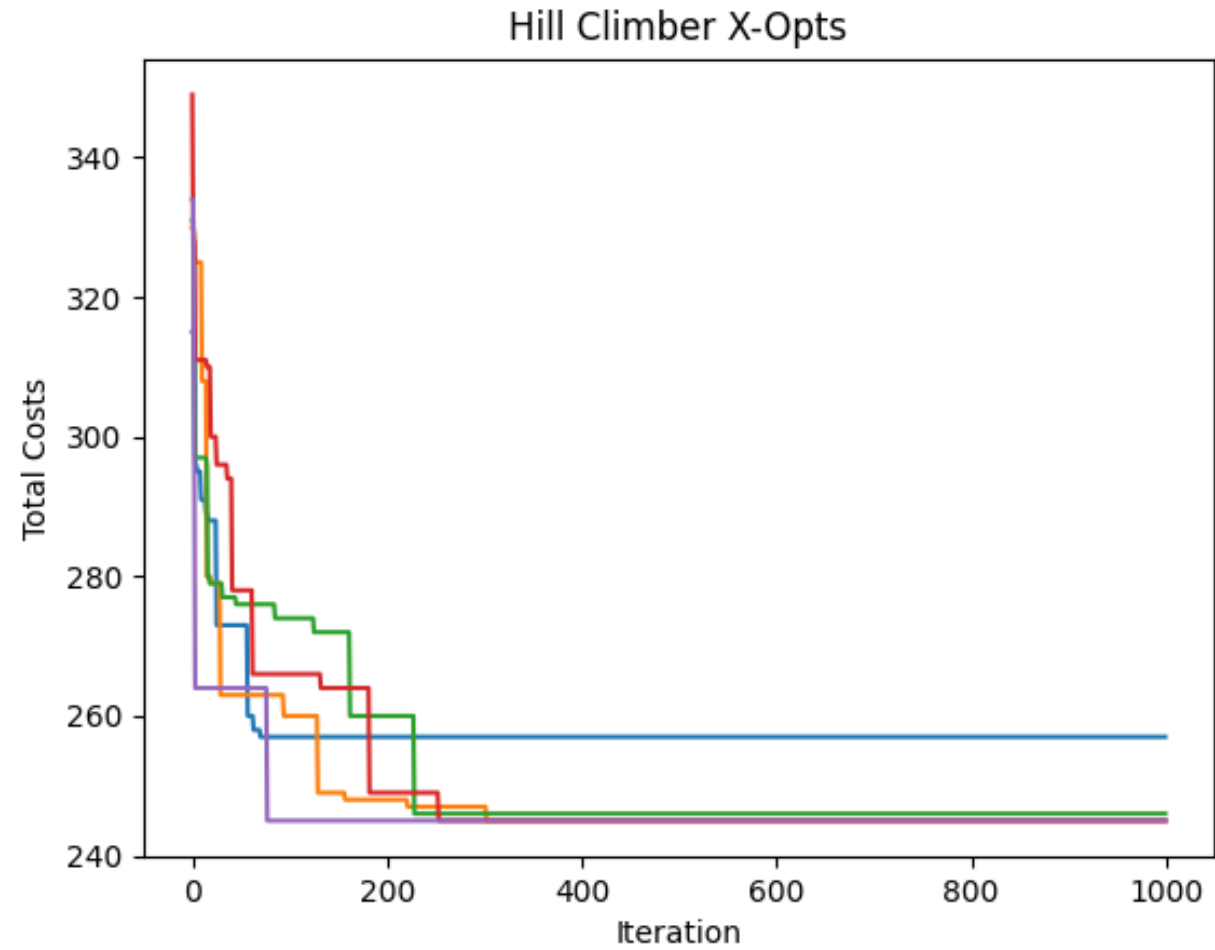


Constructieve Algoritmes – Overview

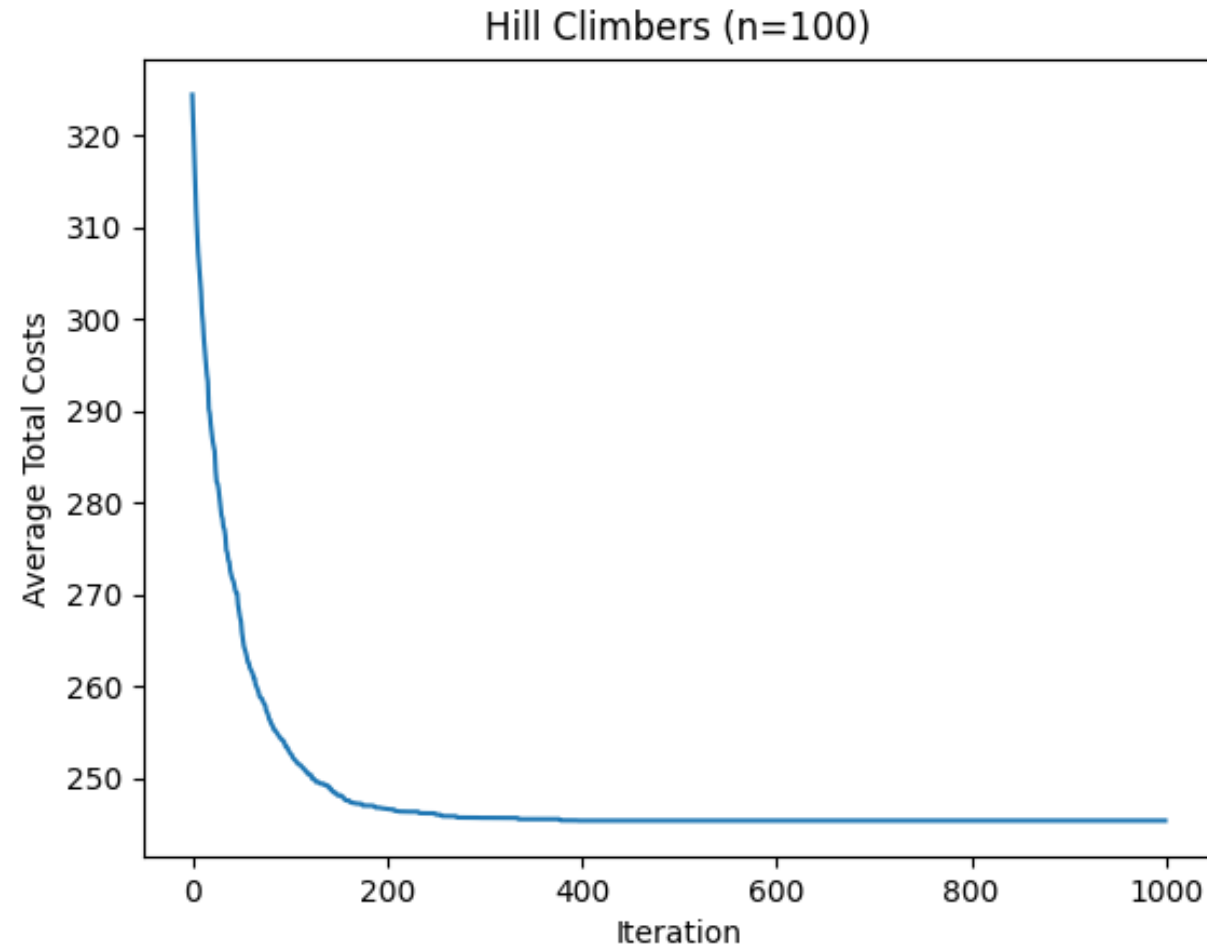
Constructive Overview

	Visited State Count	Max States Size	Solution Count	Objective Value
DepthFirst	37317	20	9216	240
BranchAndBound	28133	20	32	240
BreadthFirst	37317	13824	9216	240
BestFirst	28102	13825	1	240

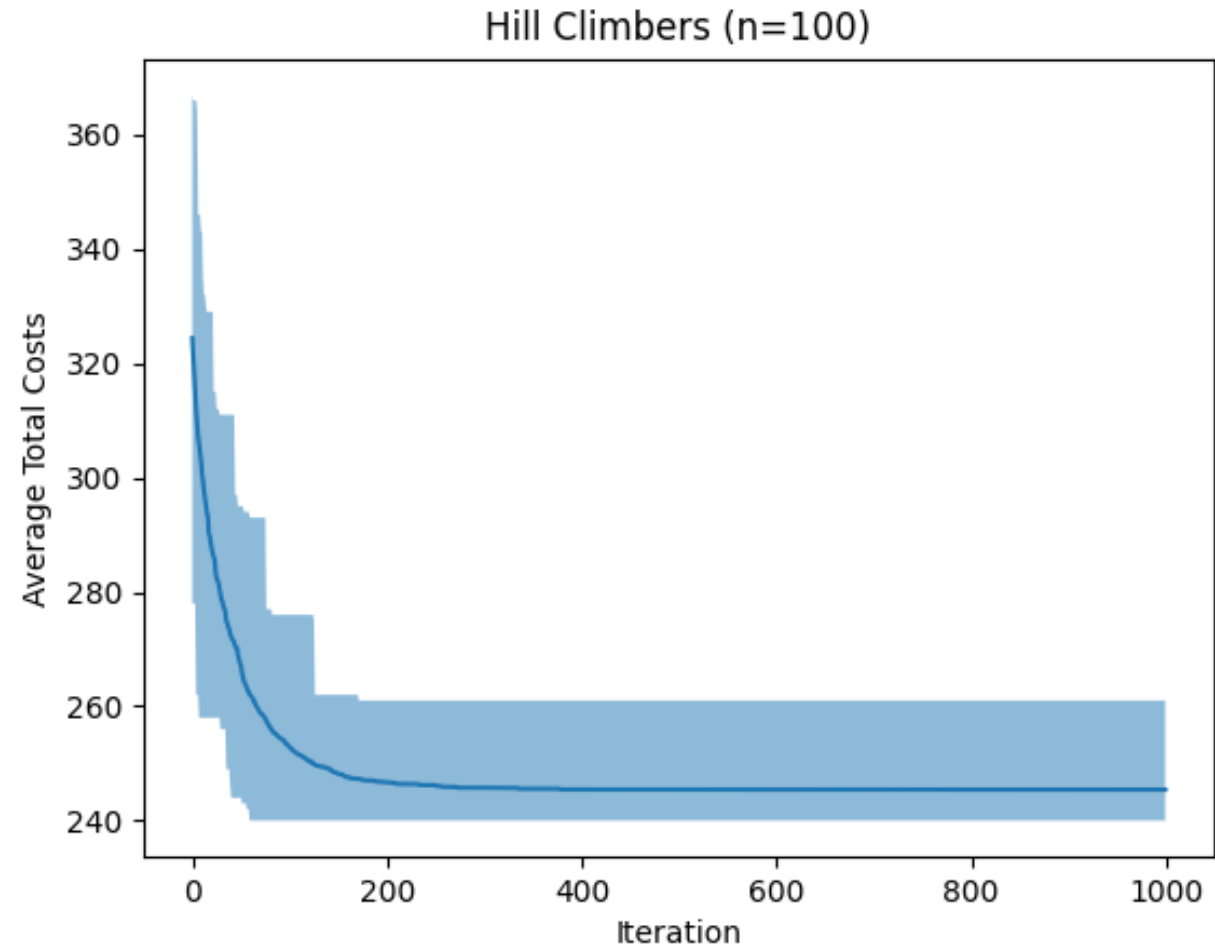
Iteratieve Algoritmes – Hillclimber



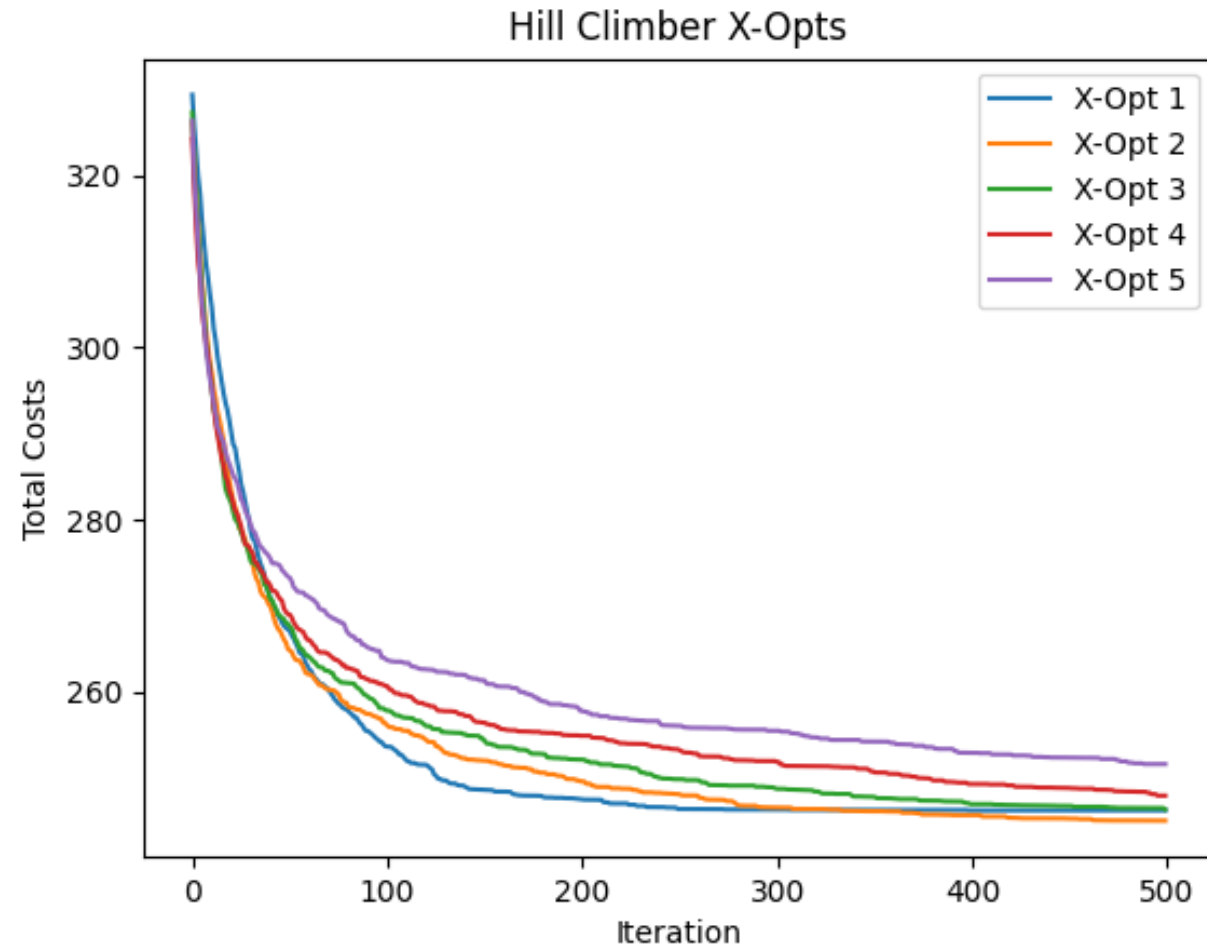
Iteratieve Algoritmes – Hillclimber



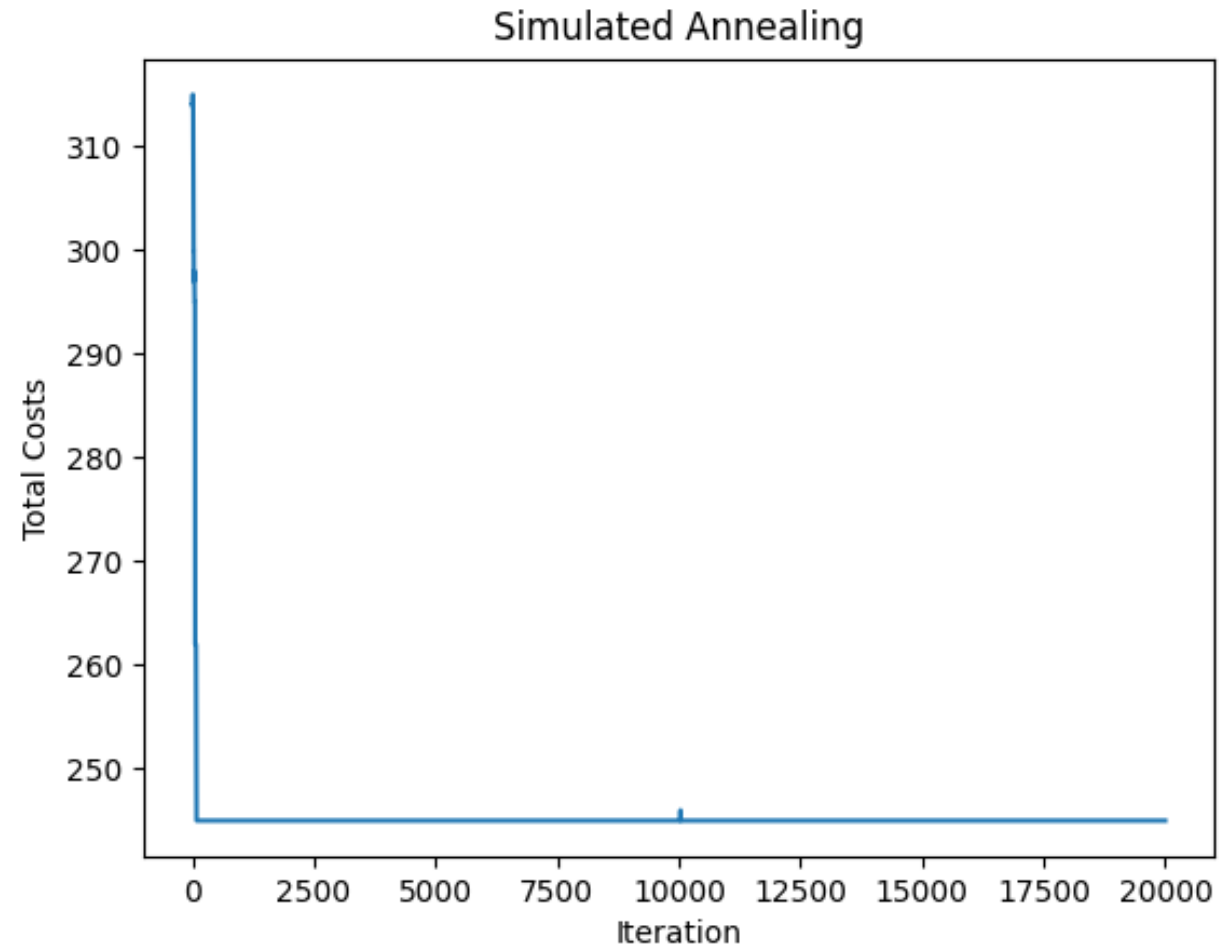
Iteratieve Algoritmes – Hillclimber



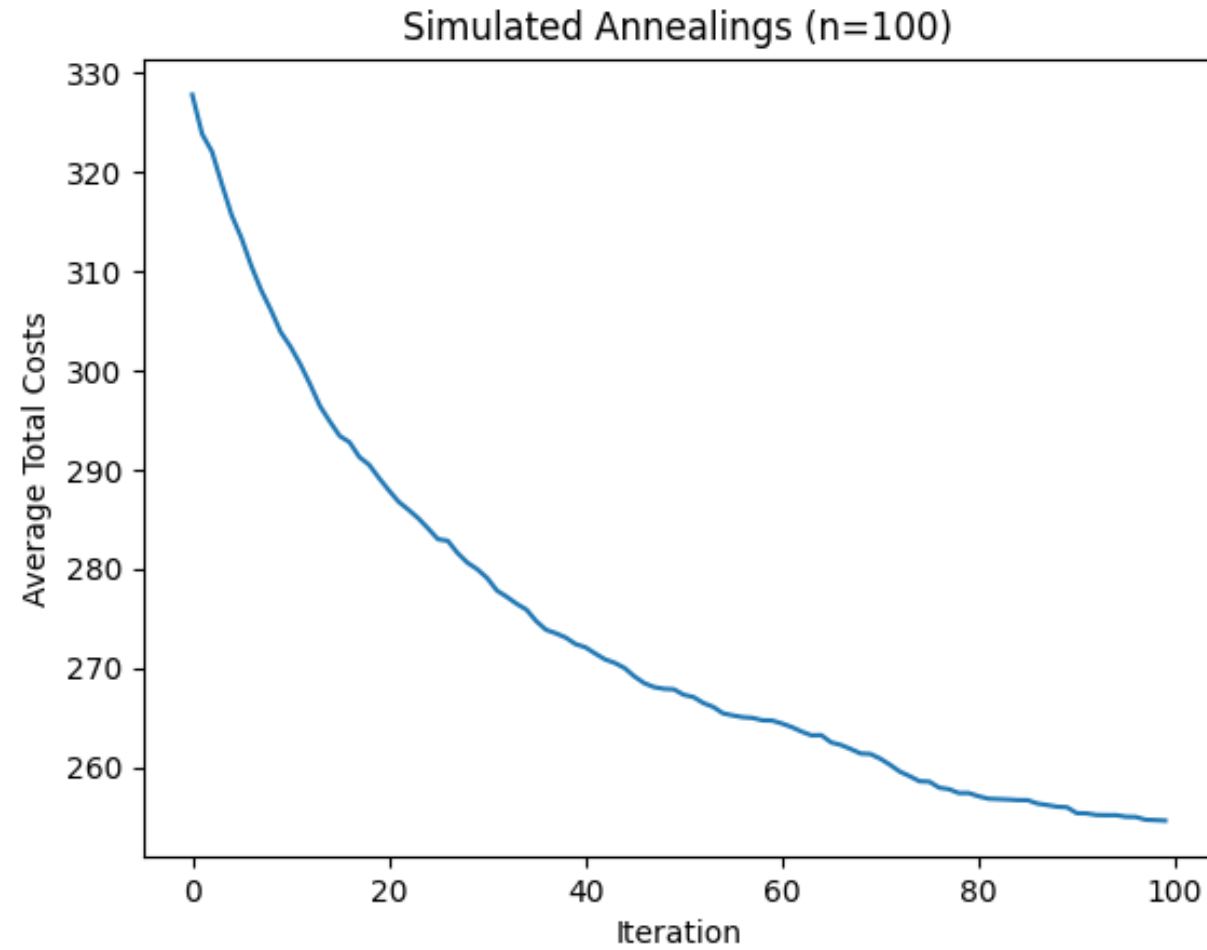
Iteratieve Algoritmes – Hillclimber



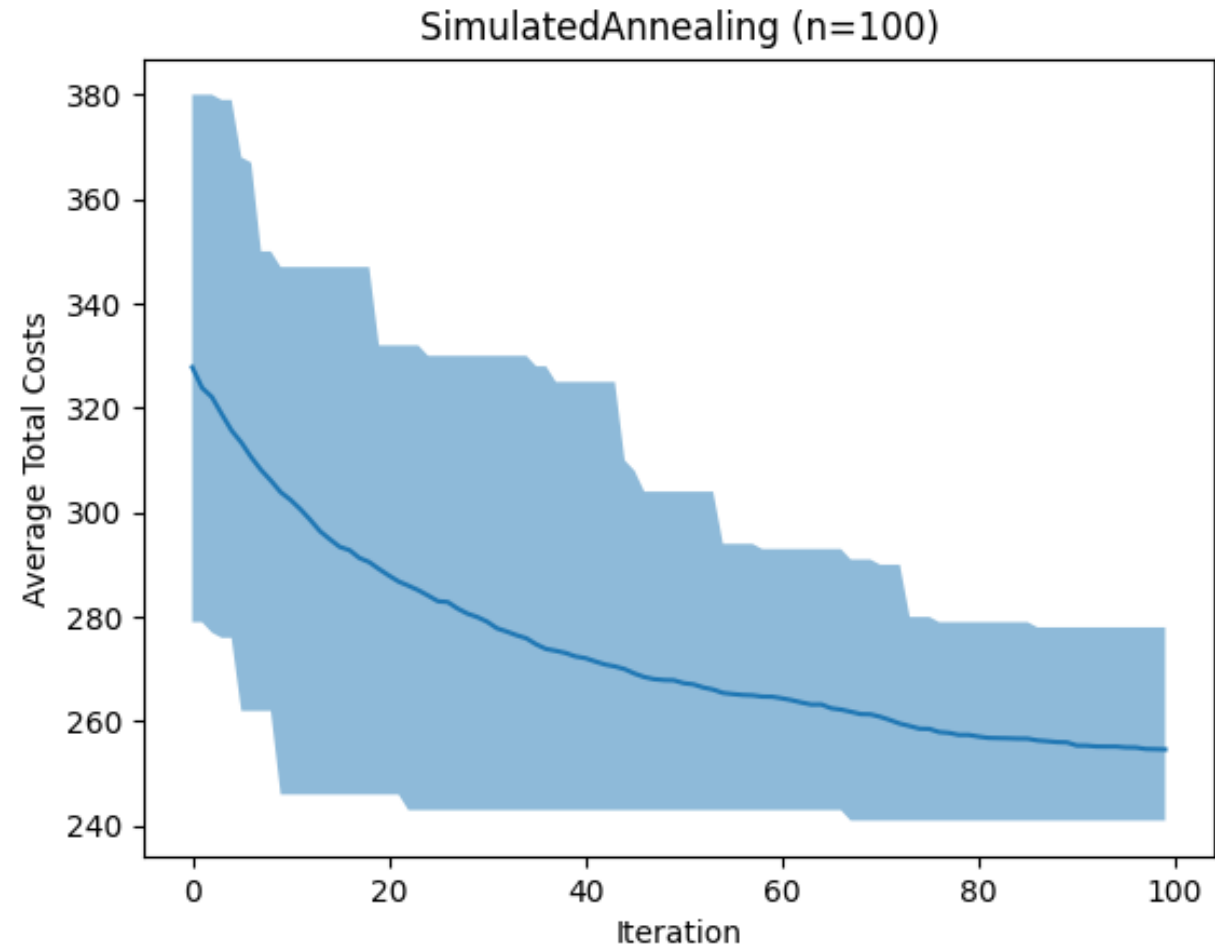
Iterative Algorithms – Simulated Annealing



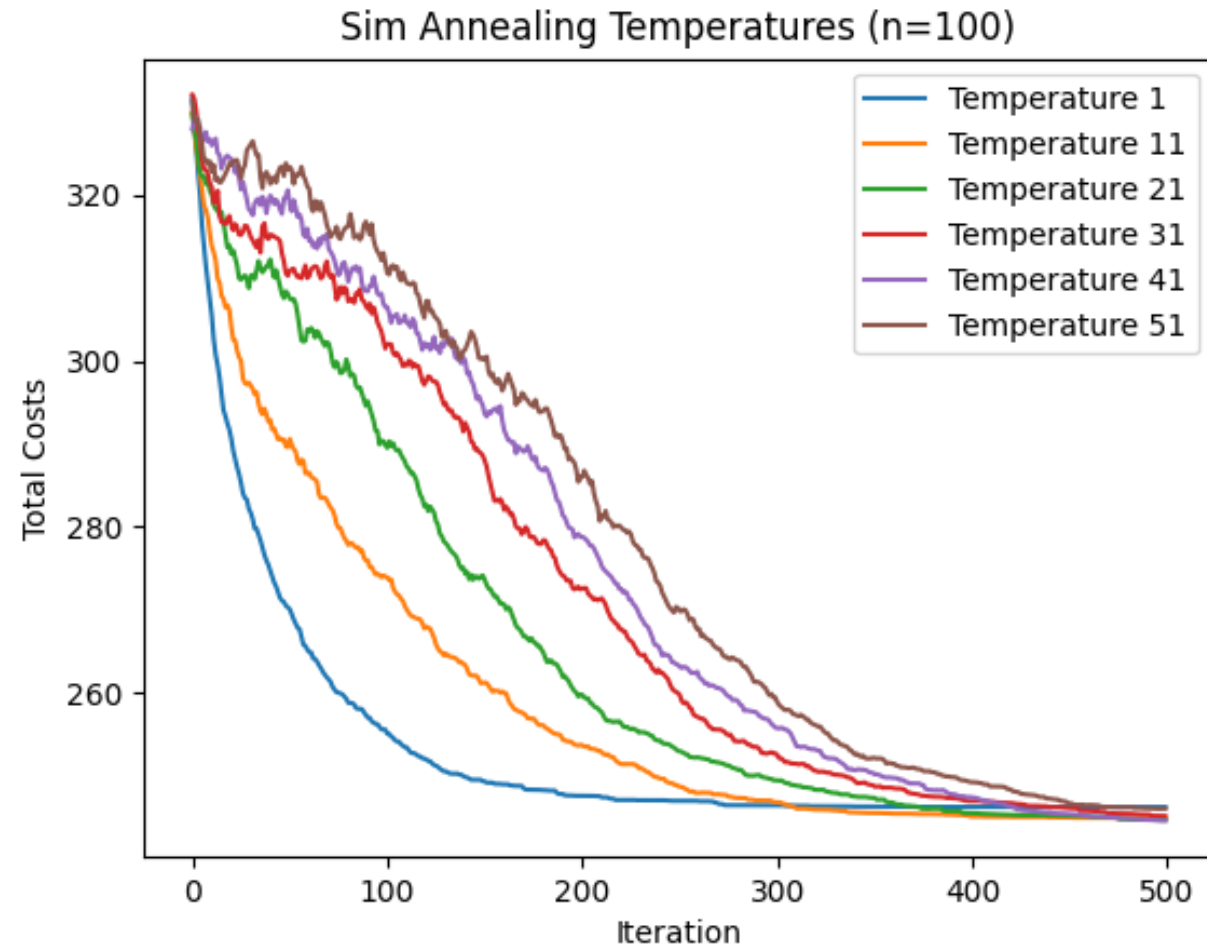
Iterative Algorithms – Simulated Annealing

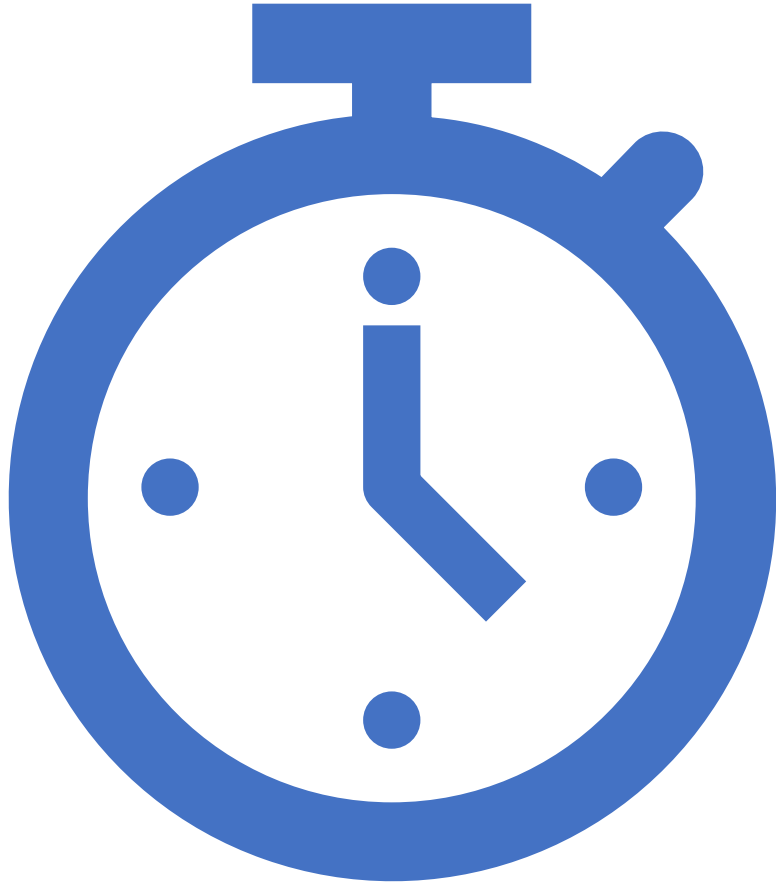


Iterative Algorithms – Simulated Annealing



Iterative Algorithms – Simulated Annealing





Presentaties

10 minuten!

- Uitleggen case (<2 min)
- Statespace (1 min)
- Algoritmes (2-3 min)
- Resultaten (3 min)
- Conclusie (1-2 min)

Uitleggen case + statespace

- Probleem uitleggen
- Interpretatie van de case
- Terminologie
- Wat is een oplossing en hoe beoordelen we die?

Methode + resultaten

- Algoritmes in grote lijnen
- Details in hoe deze toegepast worden op de case
- Sequentieel

- Grafieken tabellen
- Vergelijk!

Probeer een verhaal te vertellen

Conclusie + future work

- Wat werkt waarop het best?
 - Kunnen we zeggen waarom?
 - Welke onderdelen waren moeilijk op te lossen, welke makkelijk
 - Andere vermoedens
-
- Future work alleen wanneer nuttig

Algemene tips

- Geen code, UMLs, of live demo's
- Goede afbeeldingen en visualisaties
- Extra slides voor vragen
- Slidenummers
- Oefenen