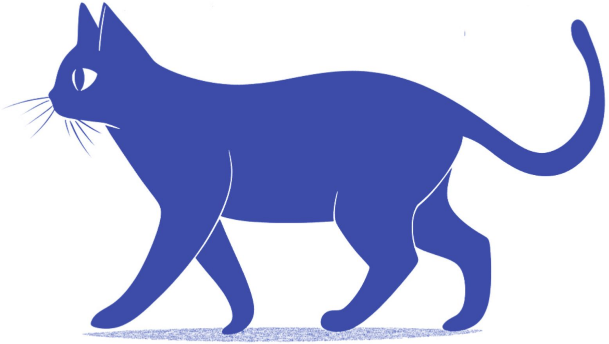
Adaptively Generating Heterogeneous Execution Strategies using the VOILA Framework

Tim Gubner



Problem: We want specific optimal Instances

Example: Book cover

- Some French word:	*VOILA / voilá*
- Sword from some British story:	*Excalibur*
- Some cat:	*Foppie*

⇨ many possible covers

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- Some French word: *VOILA / voilá*
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Often, we want the “best” instance

⇨ “best” often depends

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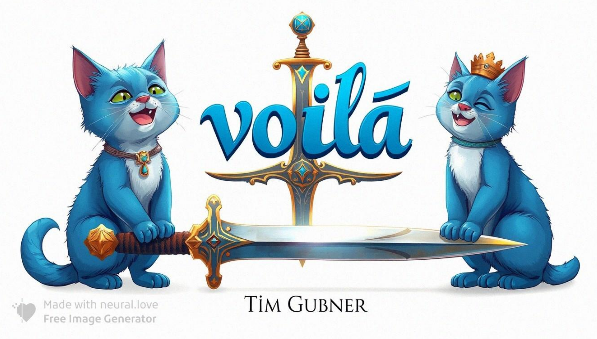
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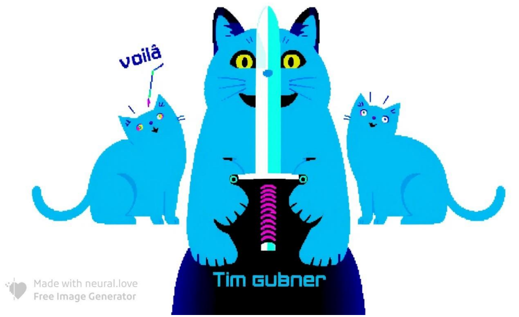
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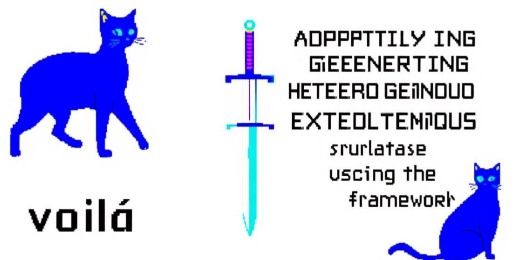
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Application to Database Management Systems

1. User issues a query

What's the sum of the stored integers?

2. System computes result

110

Computing the Sum

Stored := 1, 1, 2, 2, 3, 3 … 10, 10 (first 10 natural integers, each twice)

“Naively” add each integer:
(1+1+2+2+3+3+4+4+5+5+6
+6+7+7+8+8+9+9+10+10) =
110

19 additions

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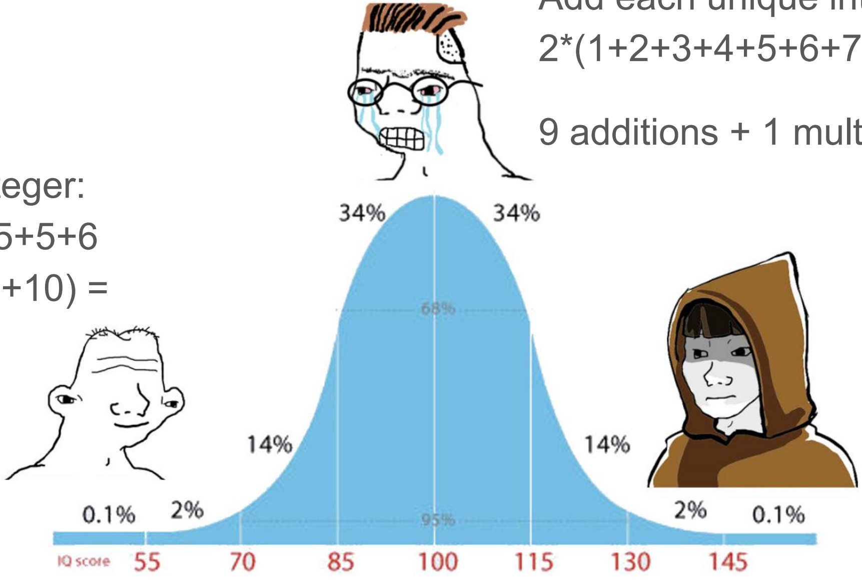
Add each unique integer once, multiply by 2:
2*(1+2+3+4+5+6+7+8+9+10) = 2 * 55 = 110

9 additions + 1 multiplication



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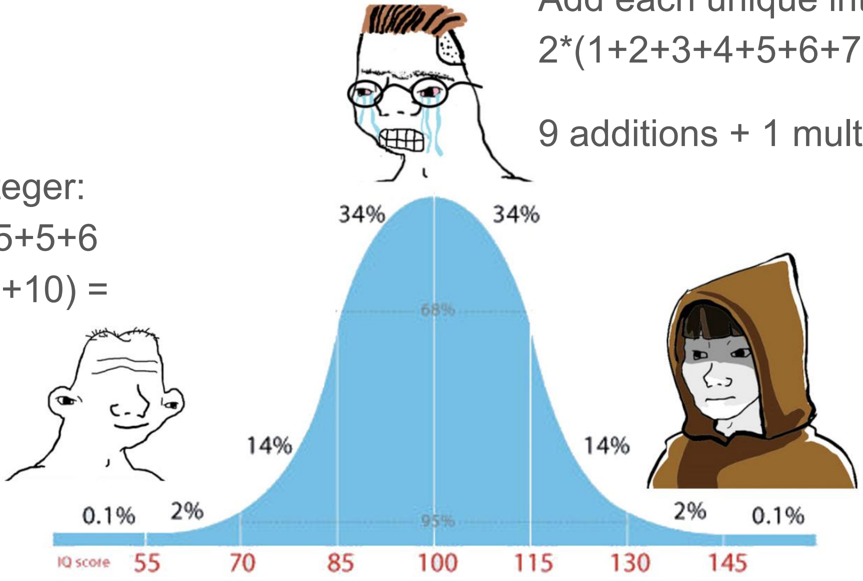

2 * Gauß formula: 2* (N^2 + N)/2 = N^2+N = 10 * 10 + 10 = 110

1 addition + 1 multiplication

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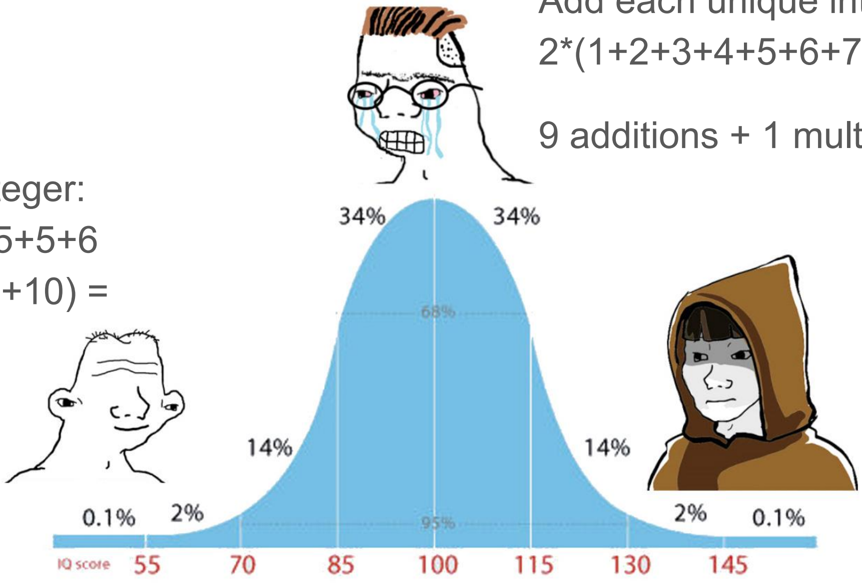

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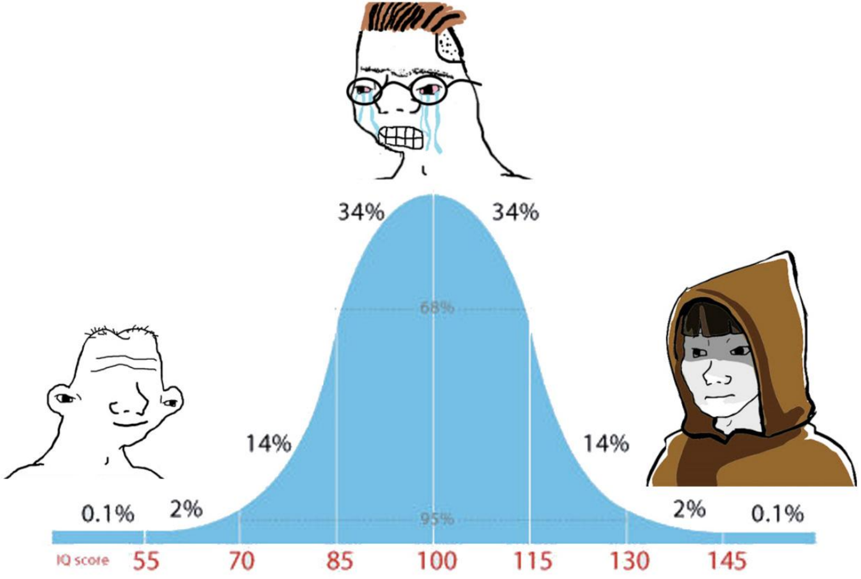
More instance-specific

Instance-Specific Optimizations



“Holy Grail”

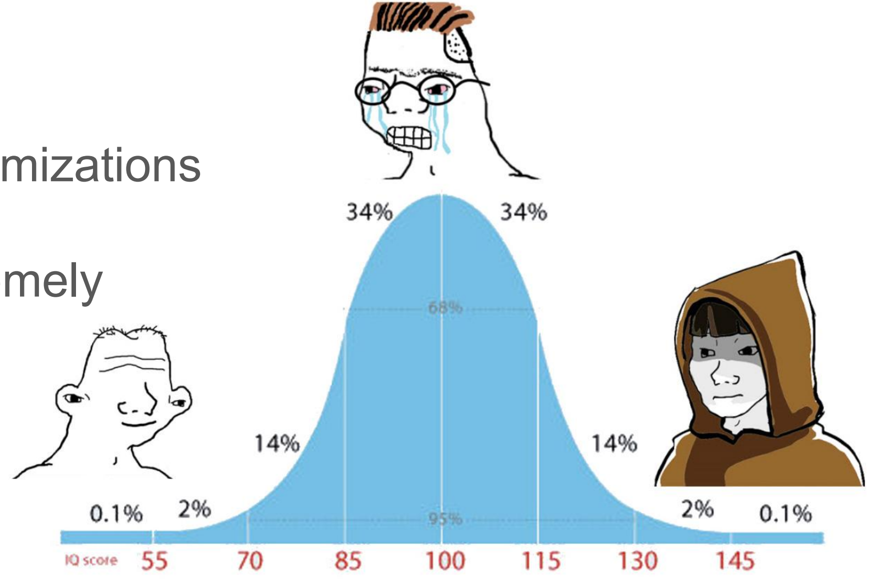
- Too specific to be practical?
- Needs to be generated by computer

More instance-specific

Instance-Specific Optimizations

“Normal” Optimizations

- Not extremely specific
- Possibly do-able



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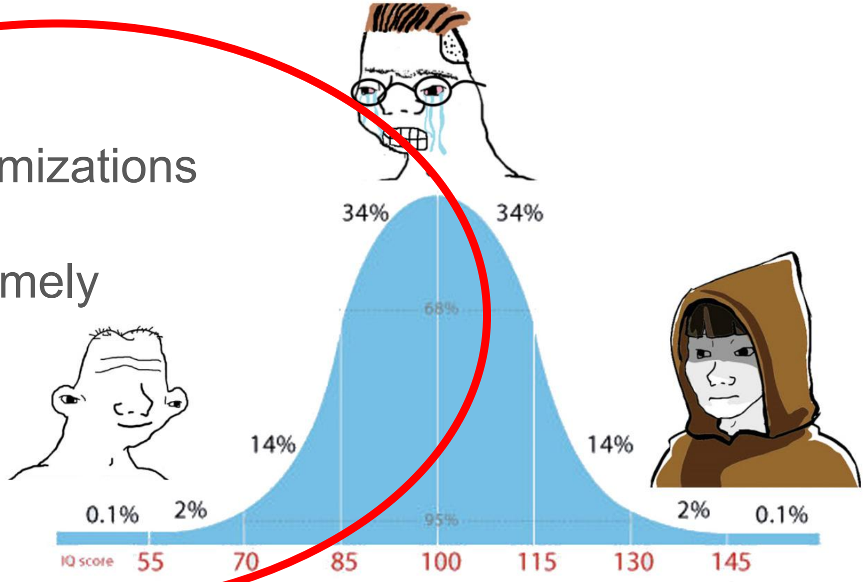

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More instance-specific

Smarter = Better?

#Integers	*Naive*	*“Medium Smart”*	*“Super Smart”*
200	199 additions	99 additions, 1 multiplication	1 addition, 1 multiplication
20 (example)	19 additions	9 additions, 1 multiplication	1 addition, 1 multiplication
2	1 addition	1 multiplication	1 addition, 1 multiplication

Smarter = Better?

Assume: an addition costs 1 and multiplication 10

Costs:

#Integers	*Naive*	*“Medium Smart”*	*“Super Smart”*
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- **“Smarter” not always better**
- **Runtime depends on many factors (static & dynamic)**
- **A system would need to make a choice**

This Thesis

Manual exploration:

- Data representations (e.g. number repeats)
- Algorithms optimized for specific cases
- Different implementation styles (“book cover layouts”)

VOILA: Framework to generate specific implementation styles

Excalibur: Automated exploration & adoption of better implementations, *while query is running*

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