What is a calculator?

by Rata Ingram

Hello, I'm Rata, and my dream is to one day start a calculator museum. I collect all sorts of calculators, so if you happen to have one you no longer need, let me know. My talk is called…

What is a Calculator?

When you think of a calculator, what do you think of? Calculators aren't just your trusty Casio FX-82s and TI-84-plusses. That's just one kind of calculator.

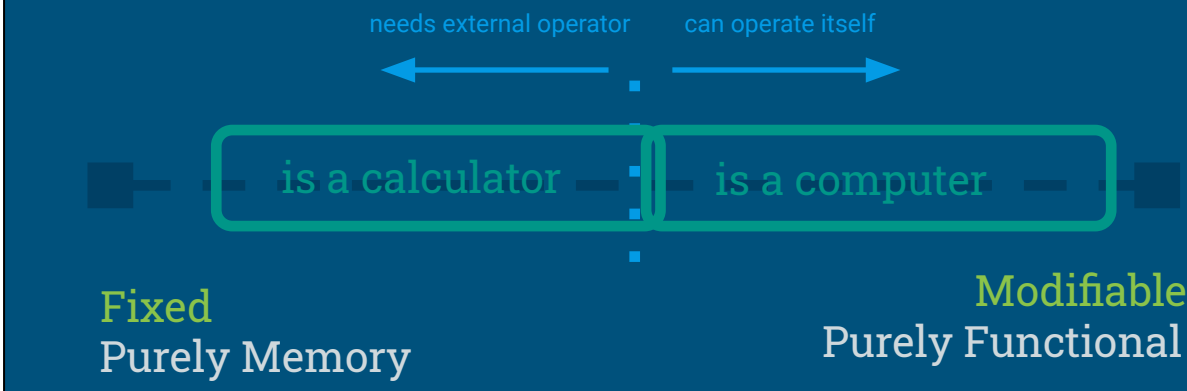
Five Types of Calculator

1. Placeholder / Accounting
2. Tabular
3. Mechanical
4. Electronic
5. Simulated

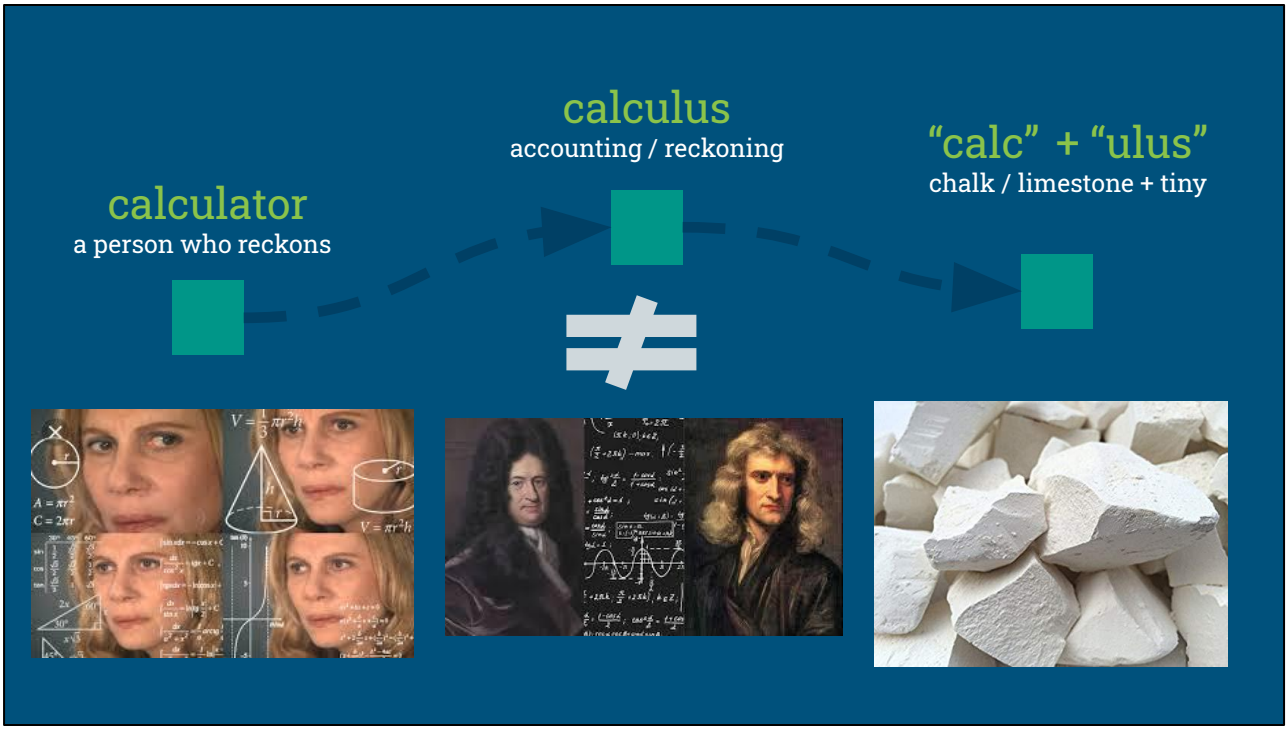
In the next five minutes I'm going to tell you about five distinct types of calculator: Placeholder calculators, tabular calculators, mechanical calculators, electronic calculators and simulated calculators.

What is a calculator?

An object you can use to perform a mathematical calculation.



So, what is a calculator? It's an object you can use to perform a mathematical calculation. But hold on, that includes things like "pencil" and "laptop," things you wouldn't usually refer to as calculators. So let's get more specific. If we had a gradient between purely information (fixed) and purely functional (modifiable), calculators sit about here. That also teaches us the difference between computers and calculators. Computers are more functional because they can be programmed to operate themselves, whereas calculators must be operated externally.

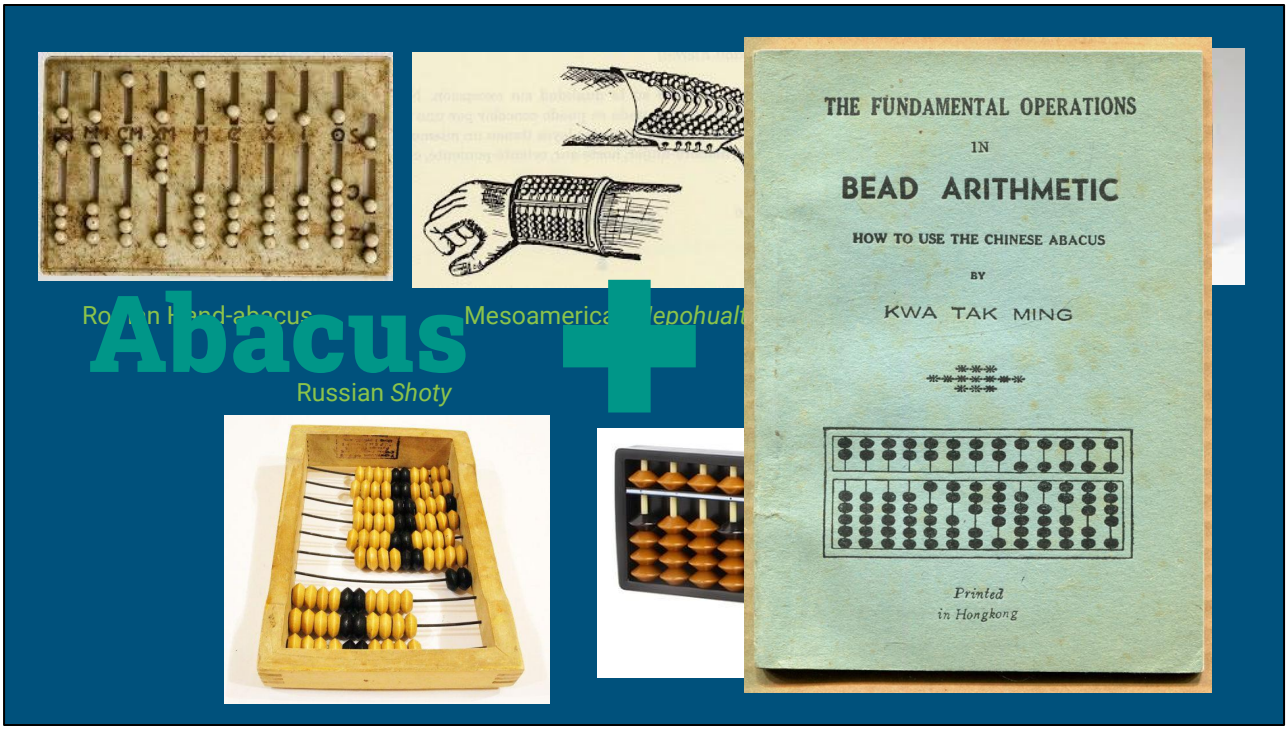


Let’s start at the beginning. Very much like the word “computer,” the word “calculator” used to refer not to a thing, but to a person: somebody doing “calculus”. We’re before Newton and Leibniz though – calculus meant “accounting or reckoning” and the word was *derived* from a diminutive form of the word for calc / limestone. Calculus literally meant “teensy chalk,” because pebbles of limestone were used as placeholders for accounting.

Placeholder / Accounting Calculators

Placeholder Calculators

So: calculators are teensy chalk users. We're back to one of the earliest forms of a calculator. Not the blackboard. The abacus. Its close cousin, pebbles on a line or counting board, dates from about 300BC or earlier. By the 16th century, all cultures around the world have developed many variations on the abacus,

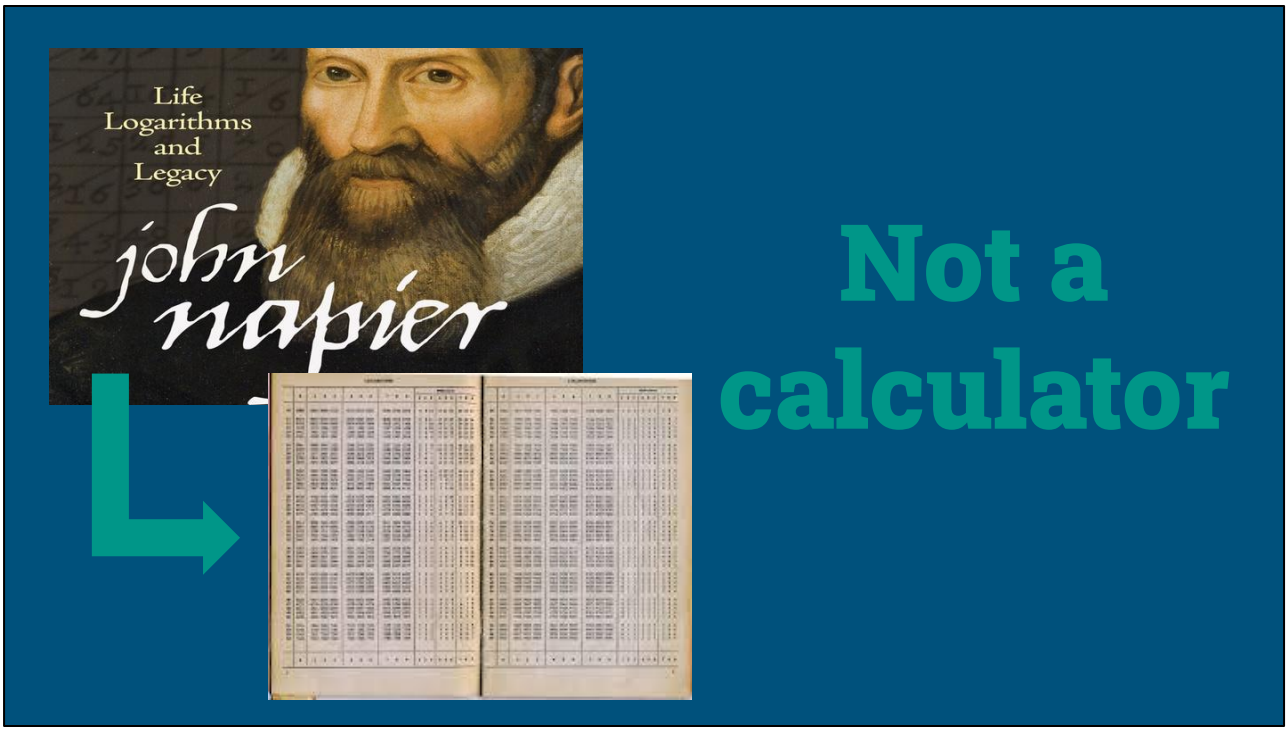


Here we have examples from the Roman Hand-abacus to the Mesoamerican *Nepohualtzintzin,* to the Chinese *Suan-pan*, the Russian *Shoty* and the Japanese *Soroban*. The soroban in particular are popular even today for speed calculating competitions. The abacus by itself is simply a memory device though, for a placeholder calculator to qualify as a calculator, we consider it as a package deal i.e. the abacus plus the associated algorithms performed on the beads = the calculator.

Tabular Calculators

Tabular Calculators

In the early 1600s we got a new way to use a thing to do calculations. Introducing: tabular calculators. These are objects that have (usually mathematical) relationships between numbers systematically laid out e.g. in tables or scales.



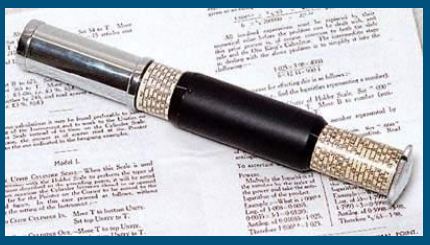
The invention of tabular calculators was inspired by John Napier's idea of logarithms, and log tables. So, are log tables calculators? I'd say no. Log tables are purely information. Everything in them has already been calculated, which wasn't the case with our placeholder calculators. In those, the relationship being explored wasn't physically manifest before the calculation was performed, but it is in a log table. They are "tabular calculateds." To qualify as a tabular calculator, we need some element of performing a function.

Faber-Castell 87/52

Concise Circular slide rule

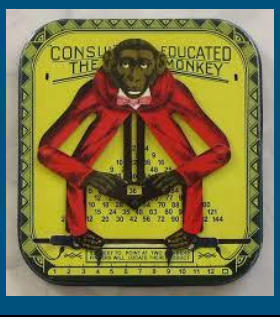
Dist-o-Map Mileage Calculator

Performing Monkey



Otis-King Calculator

IWA 11092 Flight Calculator



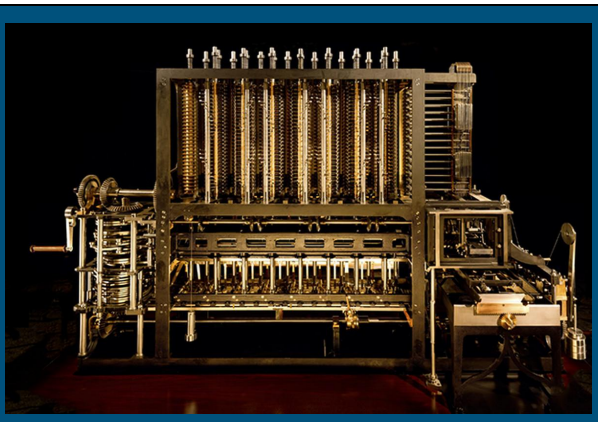
And that’s where we get slide rules: interactive log tables. We also get things like flight calculators, the performing monkey, and map-distance calculators, where “performing a function” is sliding the inputs into position.

Mechanical Calculators

Mechanical Calculators

Now skipping a couple of centuries, the first time the word “calculator” is used to refer to a thing instead of a person was in 1784. The mechanical calculator. These are typically constructed with moving levers and gearing that automate the process between input and output.

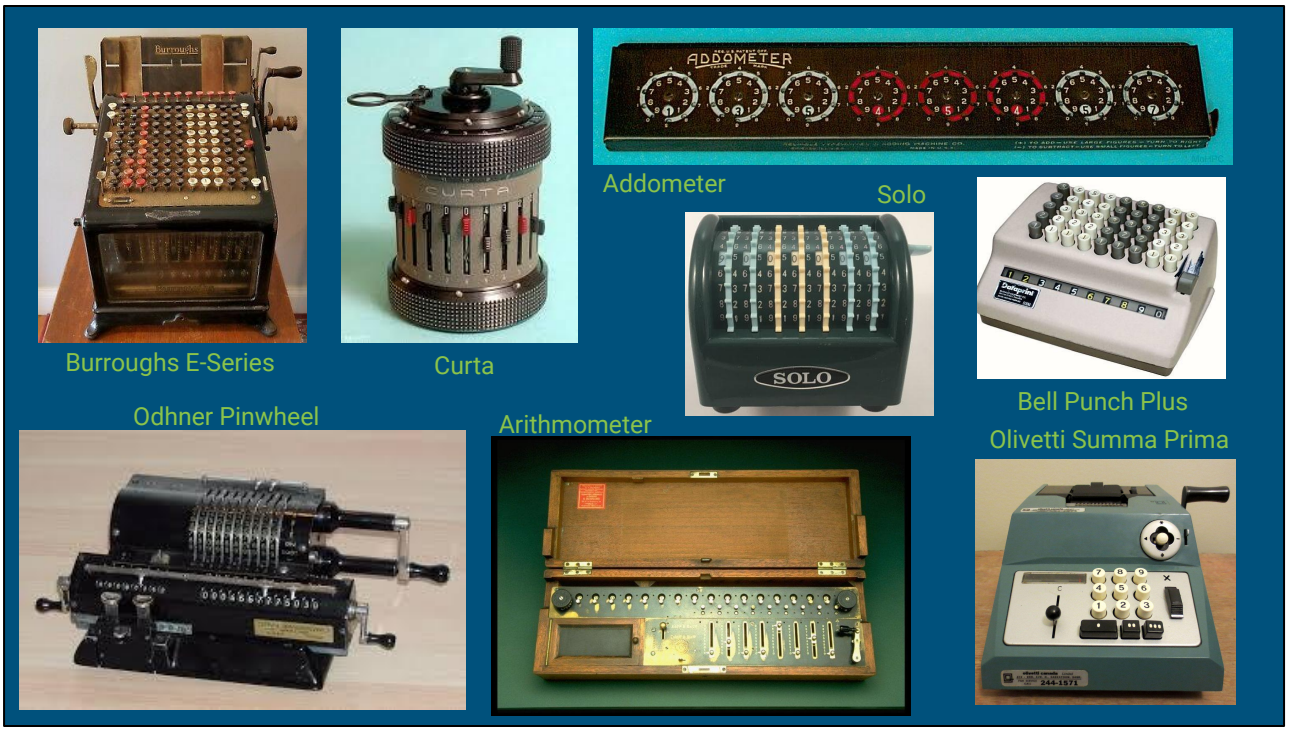
Pascaline



Difference Engine

Famous Early Mechanical Calculators

Famous early designs include Pascal's Calculator and Charles Babbage's Difference Engine, but mechanical calculators were common desk furnishings easily into the 1960s.

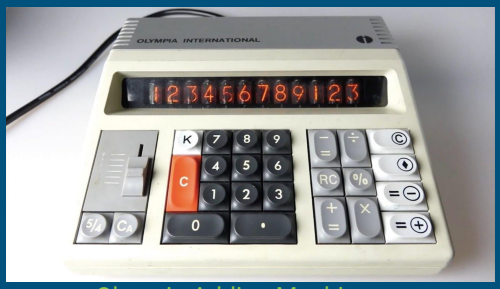


From Burroughs to Bell, Olivetti to Odhner, the Comptometer to the intricately crafted Curta, there are many fascinating incarnations of mechanical calculators

Electronic Calculators

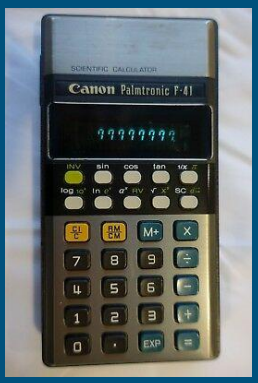
Electronic Calculators

In 1946, for the first time ever, “calculator” is used to refer to an electronic calculator. Thanks to the development of silicon microchips and transistors in the middle of the 20th century, the method of calculation shifts from mechanical to electronic, with calculations performed in binary via electric circuits.

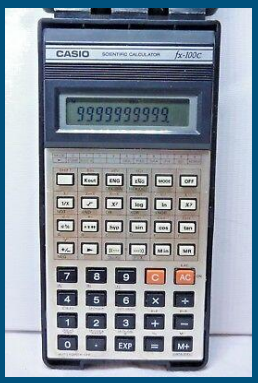


Olympia Adding Machine

Sharp Printing Calculator



Canon Palmtronic F-41



Casio fx-100C

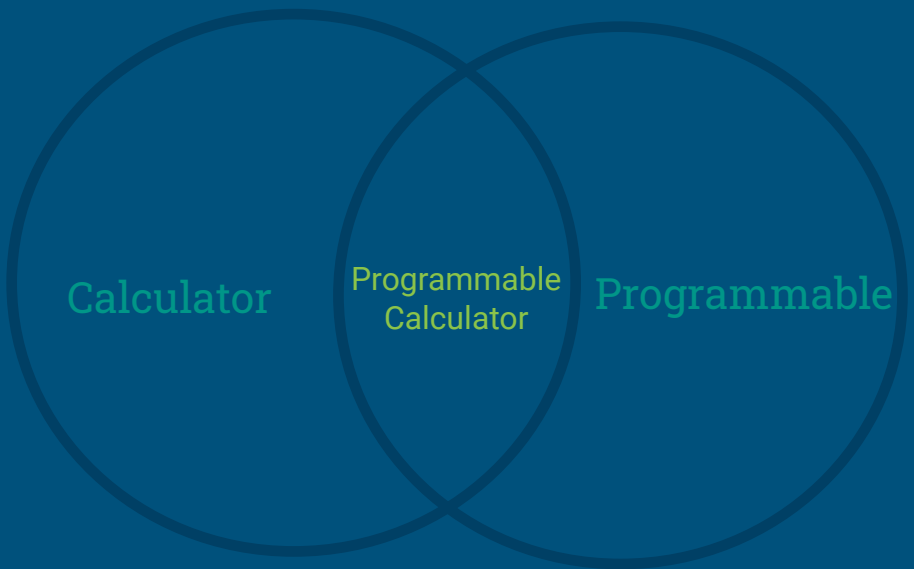
TI-Nspire

Seiko Calculator Watch

Hewlett-Packard 57C

Now we're in the era of Nixie tubes, 7-segments through LCD displays. Printing calculators, watches, scientific and graphing calculators. As technology progresses, we also get programmable calculators.

Are programmable calculators calculators?

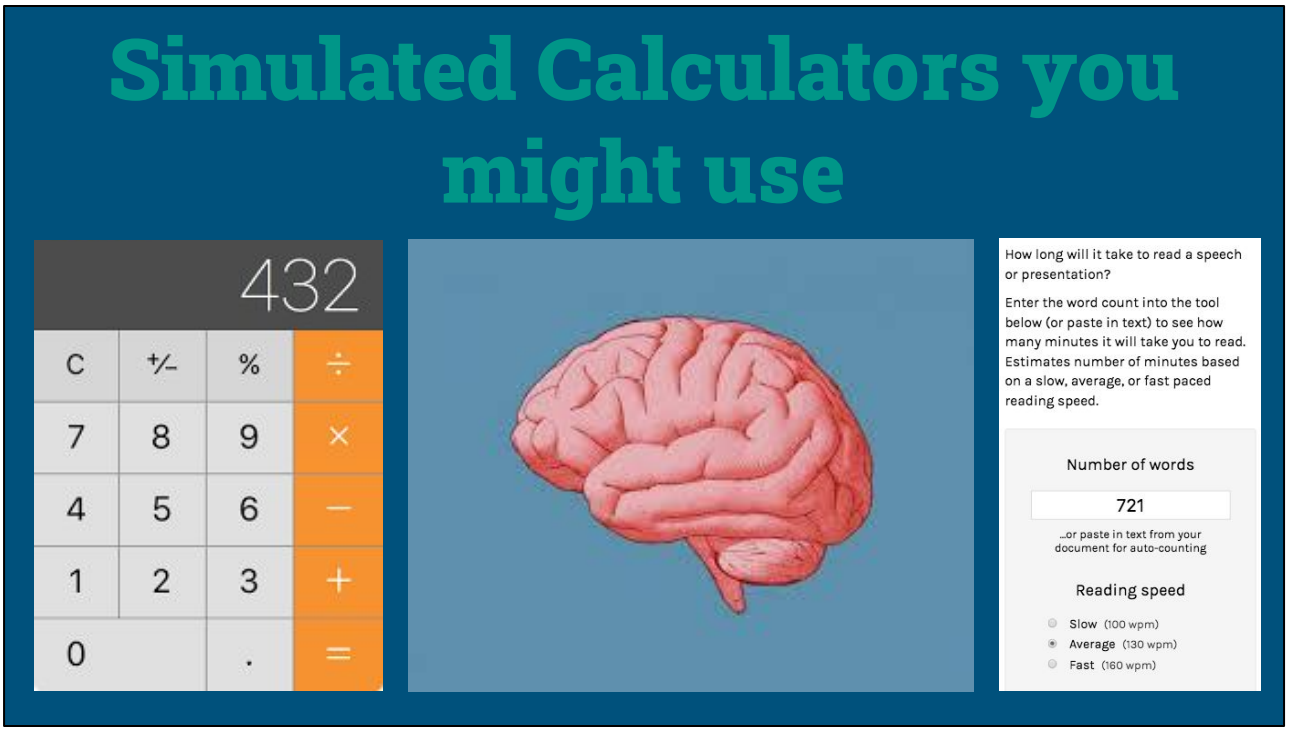


Are these calculators? After all, if they can be programmed, aren't they computers? I think they straddle the line as an edge case, because programmable calculators are very limited in comparison to what we would call a computer.

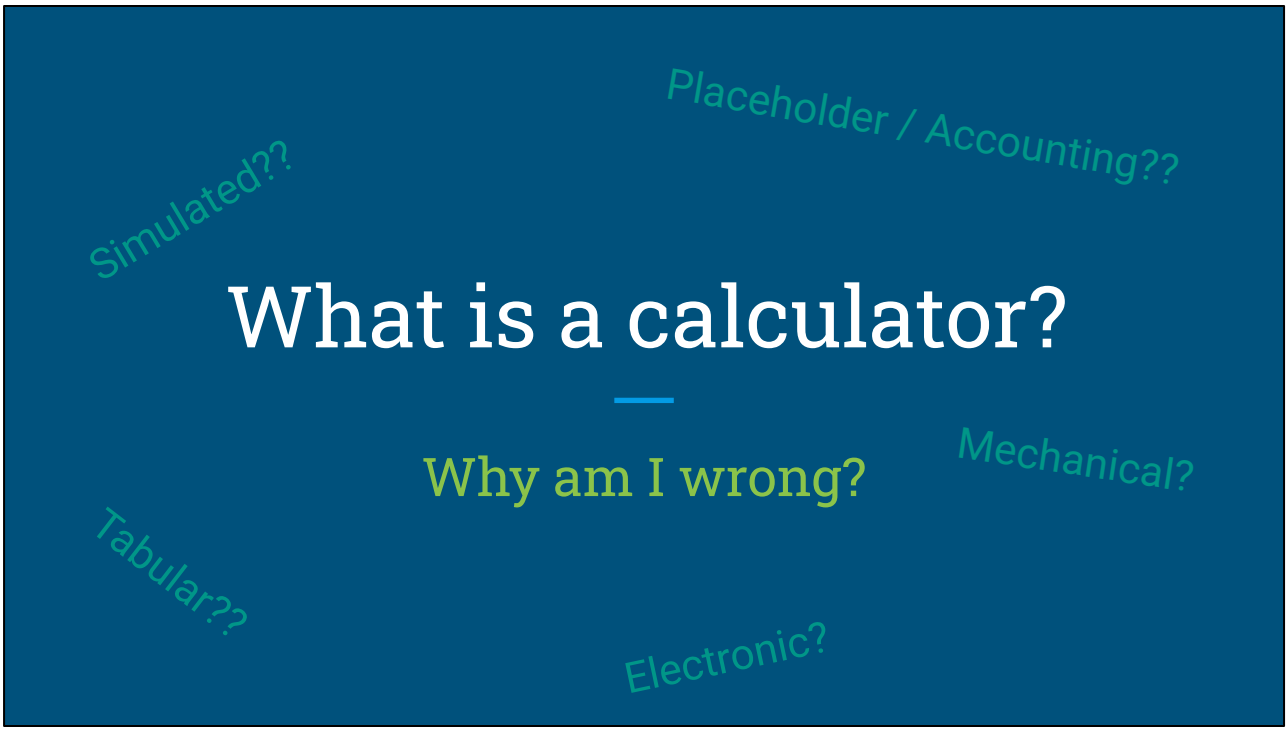
Simulated Calculators

Simulated Calculators

Finally, we get to simulated calculators. You might argue that these are the same as electronic calculators, but there's a difference: simulated calculators don't have dedicated hardware (and each kind of calculator I've discussed so far is mostly differentiated by its hardware!) In the simulated category, calculations aren't happening at the level of transistors: they're running as an abstraction.



If I do a mental calculation, such as 14*3, then I am running a simulated calculator in my brain. If I want to figure out how long it will take me to read this talk, I could access a simulated tabular calculator at www.wordstotime.com, which multiplies word-count by a constant to give me a time estimate. The calculator you probably use most often – on your phone – is also a simulated calculator.



The first two types of calculators I mentioned – placeholder calculators and tabular calculators – weren't actually referred to as calculators, but if you accept that simulated calculators are calculators, it's clear they belong in the same category.

Now, I've told you my definition of a calculator. I've showed you several. Your challenge is to tell me why I'm wrong. Maybe you'll have a *counter*-example? That's the ambition of my calculator museum. To explore what it means to be a calculator.