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**Dan Lenski**, Semiconductor engineer with a physics PhD

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You can't, due to the enormous and ever-growing capital costs and complexity of manufacturing semiconductors ([Rock's law](#) , seen as a corollary to [Moore's law](#)).

Making a microprocessor (an [integrated circuit](#)) requires a [semiconductor fabrication plant](#) , which would likely cost $\$10^8$ (for a very rudimentary facility) to $\$10^{10}$ (for the latest state-of-the-art industrial fab).

You *could* build a very simple *non-integrated* CPU circuit to learn more about digital logic design, using discrete integrated circuits. Here are a couple nice examples: [Home-Built TTL CPU](#) , [4-Bit TTL Scratchbuilt Computer](#) .

This project would probably take many hours and $\sim \$10^2$ to buy the components, and would result in a CPU that is physically much larger, but comparable to the capabilities of the [Intel 4004](#) which was introduced in 1971, and somewhat less powerful than an ordinary \$2 pocket calculator.

Written May 5, 2015 • View Upvotes • Answer requested by Time Chijo

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1.3k Views

Creating a simple microprocessor from scratch is your standard introduction to computer organization final project these days. To make a microprocessor you have to learn a hardware descriptor language such as Verilog and have a firm understanding of the design of a microprocessor. With that knowledge you can start building modules such as Register Files, ALUs, control logic, and the like. From there you just have to wire it up and synthesize it for your favorite FPGA toolchain.

If you're asking about creating an actual microprocessor IC, then you're dealing with a whole nother problem.

Written May 5, 2015 • View Upvotes

**Anonymous**

1.5k Views

Depends on what you mean by *from scratch*.
Let's take a very quick trip down the rabbit hole.

If by, *from scratch*, you simply mean the logical design, then the easiest approach would be to design the your processor using a hardware descriptive language (HDL) such as Verilog or VHDL, and implement it by programming it onto a field programmable gate array (FPGA) using the tool chain of your choice. Even this has vary levels of how 'from

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scratch' you want to get, depending on what level of abstraction you want to get down to, at the highest level you can simply connect pre-built logical elements like ALUs (Arithmetic Logic Units) and register files with some control circuitry and glue logic, all the way down all of these functional elements 'from scratch' out of individual logic gates (note that there are multiple layers of abstraction between a logic gate and a fully functional ALU. Or if you prefer, instead of using an HDL you could enter the design using a schematic layout package.

If you want to create a custom integrated circuit (IC) you could do that as well. For a relatively modest fee (i.e. several thousand dollars) you could have a chip foundry implement the design for you.

If you want to go deeper still, you could build your own foundry*, but this is likely a very sizable investment, since a modern foundry can cost tens of billions, sure you could probably get by with a more rudimentary set up, but it's still going to be costly.

What about the silicon wafers, are you going to buy those pre-made, or will you have to make those too? Will you buy the raw materials (e.g. silicon) or are you going to have to refine them yourself?

The above gives a a very high level description of the various stages of IC production with an obscene amount of hand waving. For example, it says nothing about where the tools come from, both hardware and software, you could also build those *from scratch*; you could, for example, created the language *from scratch* as well. Ultimately, how you define *'from scratch'* must be arbitrary because you will very quickly lose tractability before you reach some fundamental, base level *'scratch.'*

If your processor doesn't need to be integrated, and you mean this only as an academic exercise, you may consider building the processor out of discrete components. Again it's your choice how deep you want to go, i.e. there are ready made ALU's on an IC, or you could limit your self to gates, or even individual transistors. I suppose you could create your own transistors, but at that point you're back to needing a foundry.

*a [Semiconductor fabrication plant](#) aka chip fab or, simply, fab.

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All the Children of Ilúvatar, Elves and Men, have two parts: the *fëa*, spirit or soul; and the *hröa*, the body. Elvish bodies are somewhat like human bodies, but they are far stronger, do not age or get diseases, and

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