A FORMAL TECHNICAL TEXT

Transistors are seldom used in isolation and are more commonly packaged into larger components before use in larger digital circuits: these components form what are often called logic styles. The most frequently used style, and one of the reasons behind the popularity of MOSFET type transistors, is called Complementary Metal-Oxide Semiconductor (CMOS); it was invented in 1963 by Frank Wanlass at Fairchild Semiconductor. The idea of CMOS is to pair each N-MOSFET transistor with a P-MOSFET partner into a component sometimes termed a cell. Figure 2.2 details a CMOS cell; the two transistors are arranged in a complementary manner such that whenever one is conducting, the other is not. This arrangements allows one to form circuits which have two key features: a pull up network of P-MOSFET transistors which sit between the positive power rail (that supplies the Vdd voltage level) and the output, and a pull down network of N-MOSFET transistors which sit between the negative power rail (which supplies the GND voltage level) and the output. Only one of the networks will be active at once, so aside from leakage a CMOS cell only consumes power when the inputs are toggled or switched. Since we commonly aim to build circuits with many very small transistors in close proximity to each other, this feature provides some significant advantages. In particular, it means that the use of CMOS reduces power consumption and heat dissipation which in turn aids reliability and enables size reduction. Thus, CMOS can be characterised as a low-power alternative to competitors such as Transistor-Transistor Logic (TTL) which is usually built from Bipolar Junction Transistors (BJT) and is operationally faster. It can be common to mix the characteristics of CMOS and TTL in one circuit, a technology termed bipolar-CMOS (BiCMOS).hen constructing higher-level components that utilise these behaviours, we use the symbols detailed in Figure 2.3 to represent different transistor types. We term the higher-level components we are aiming for logic gates, the idea being that they implement some function related to those we saw at the end of Chapter 1 and whose behaviour is described by Table 2.1. For example, consider building a component which inverts the input; we call this a NOT gate. That is, when the input x is Vdd the component outputs GND and vice versa. We can achieve this using the arrangement of transistors in Figure 2.4a. To see that this works as required, consider the different states the input can be in and the properties of N-MOSFET and P-MOSFET transistors. When the input x is connected to GND the bottom transistor will be closed while the top one will be open: the output r will be connected to Vdd. When input x is connected to Vdd the bottom transistor will be open while the top one will be closed: the output will be connected to GND. We can build two further components in a similar way; these are the NAND (or NOT AND) and NOR (or NOT OR) gates in Figure 2.4b-c. We can reason about their behaviour in a similar way as above. For example, consider the NAND gate.

(an excerpt from Daniel Page's book A practical introduction into Computer architecture).

LITERARY-TECHNICAL TEXT

Look, it can exist in the Autoverse" ... the obvious response to that will be: "Yes, it can exist—if you put it there by hand—but that doesn't mean it's ever likely to have formed." If we can demonstrate a range of starting conditions that lead to planetary systems with suitable worlds, that will be one less element of uncertainty to be used against us."

Durham had eventually agreed, so she'd taken an off-the-shelf planetary-system modeling program—irreverently titled The Laplacian Casino—and adapted it to Autoverse chemistry and physics; not the deep physics of the Autoverse cellular automaton, but the macroscopic consequences of those rules. Mostly, that came down to specifying the properties of various Autoverse molecules: bond energies, melting and boiling points versus pressure, and so on. Aqua was not just water by another name, yellow atoms were not identical to nitrogen—and although some chemical reactions could be translated as if there was a one-to-one correspondence, in the giant fractionating still of a protostellar nebula subtle differences in relative densities and volatilities could have profound effects on the final composition of each of the planets. There were also some fundamental differences. Since the Autoverse had no nuclear forces, the sun would be heated solely by gravitational energy—the velocity its molecules acquired as the diffuse primordial gas cloud fell in on itself. In the real universe, stars unable to ignite fusion reactions ended up as cold, short-lived brown dwarfs—but under Autoverse physics, gravitational heating could power a large enough star for billions of years. (Units of space and time were not strictly translatable—but everybody but the purists did it. If a red atom's width was taken to be that of hydrogen, and one grid-spacing per clock-tick was taken as the speed of light, a more or less sensible correspondence emerged.) Similarly, although Planet Lambert would lack internal heating from radioisotope decay, its own gravitational heat of formation would be great enough to drive tectonic activity for almost as long as the sun shone.

Without nuclear fusion to synthesize the elements, their origin remained a mystery, and a convenient gas cloud with traces of all thirty-two—and the right mass and rotational velocity—had to be taken for granted. Maria would have liked to have explored the cloud's possible origins, but she knew the project would never be finished if she kept lobbying Durham to expand the terms of reference. The point was to explore the potential diversity of Autoverse life, not to invent an entire cosmology.

Gravity in the Autoverse came as close as real-world gravity to the classical, Newtonian inverse-square law for the range of conditions that mattered, so all the usual real-world orbital dynamics applied. At extreme densities, the cellular automaton's discrete nature would cause it to deviate wildly from Newton—and Einstein, and Chu—but Maria had no intention of peppering her universe with black holes, or other exotica. (an excerpt from Greg Egan’s book *Permutation City*)