Adenosine triphosphate (ATP) is a molecule which stores energy at the cellular level, and is seen by biologists as the “energy currency of life”- necessary for basic activities like plant growth, or the inner workings of a politician's mind. ATP is quite capable of powering more than just life though: scientists have created a biological supercomputer (let's just call it BioS, for short) which runs on ATP-powered protein strings.
Compared to a synthetic supercomputer, the BioS is smaller, uses less energy, and does not overheat. Imagine supercomputers that fill whole rooms being replaced with an instrument the size of a book. Impossible? Heck, it's been done before.

The international team of researchers led by Prof. Nicolau, the Chair of the Department of Bioengineering at McGill University, have published their findings in the Proceedings of the National Academy of Sciences (PNAS).

“We've managed to create a very complex network in a very small area,” says Dan Nicolau, Sr. who started the project with his son, Dan Jr. a decade ago. “This started as a back of an envelope idea, after too much rum I think, with drawings of what looked like small worms exploring mazes.”

Indeed, the final product isn't quite so different; seen from above, a “chip” in the BioS resembles a 1.5cm square that has tiny grooves engraved into it; your maze. The little strings of protein powered by ATP navigate the maze in what passes for little packages of data moving from place to place; your worms.

“In simple terms, it involves the building of a labyrinth of nano-based channels that have specific traffic regulations for protein filaments. The solution in the labyrinth corresponds to the answer of a mathematical question, and many molecules can find their way through the labyrinth at the same time,” director of nanoscience at Lund University in Sweden, Heiner Linke said in a statement. “The fact that molecules are very cheap and that we have now shown the biocomputer’s calculations work leads me to believe that biocomputers have the prerequisites for practical use within ten years.”
“Certainly, quantum computers can be more powerful in the long term, but there are considerable practical problems involved in getting them to work,” said Heiner Linke. While the BioS is able to solve complicated mathematical problems using the same kind of parallel computing deployed by its synthetic counterparts, it isn’t quite ready to replace supercomputers. It seems, there are limitations to a purely biological agent.

“This would not have been possible without the enthusiasm and hard work of Prof. Linke, who is also co-corresponding author, and his group, Prof. Månsson and his group – both from Sweden, Prof. Diez and his group from Germany, and Dr. Van Delft from Philips, The Netherlands. Now that this model exists as a way of successfully dealing with a single problem, there are going to be many others who will follow up and try to push it further, using different biological agents, for example,” says Nicolau.

The solution then is to combine the strengths of a “living” computer with those of a dead one, and create an Frankenstein abominia – err, a hybrid “android” (nothing to do with your phone) device.

“It’s hard to say how soon it will be before we see a full scale bio super-computer. One option for dealing with larger and more complex problems may be to combine our device with a conventional computer to form a hybrid device. Right now we’re working on a variety of ways to push the research further.”