Programming Language, Type System, and Compiler Design for Cyber-physical Digital Microfluidic Biochips: Automating Programmable Biochemistry at the Microfluidic Scale

Challenge:

- Programmability of microfluidic devices is arcane; need for high level languages and compiler support for modern devices.

manifest A

manifest B

instructions:

mixture = mix 1 unit of A with 1 unit of B for 13s
heat mixture at 50c for 10s

dispose mixture

Solution:

- Programming language
  – custom DMFB compiler
  – real-time timing constraints
- Chemical-safe type system
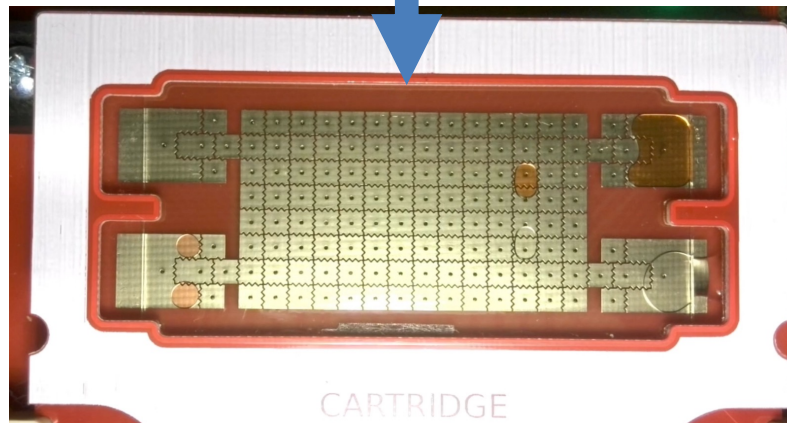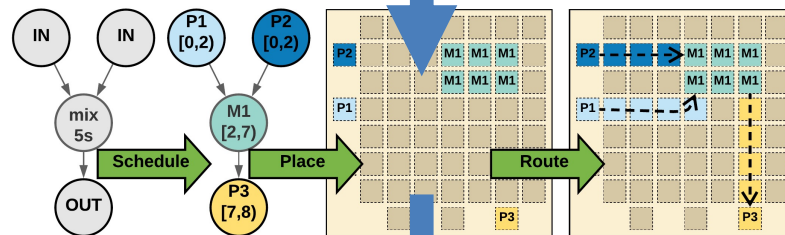
Scientific Impact:

- DNA sequencing
- Point-of-care diagnostics
- Prenatal screening

Broader Impact:

- Lower barrier to entry into microfluidics
- Increased productivity for biosciences researches
- *Hundreds* of hours saved for even basic protocols