Puddle is a programming system for microfluidic automation. Using techniques from systems and programming languages, we aim to make wet-lab automation easier, more reliable, and more accessible.

**High-Level Interface**

```python
def thermocycle(droplet, temps_and_times):
    for temp, time in temps_and_times:
        heat(droplet, temp, time)
        if droplet.volume < MIN_VOLUME:
            droplet += input("water", min_volume)

def pcr(droplet, n_iter):
    thermocycle(droplet, n_iter * [
        (95, 3 * minutes),
        (62, 30 * seconds),
        (72, 20 * seconds),
    ])```

- High-level API conveys semantics
- Users mix computation and fluidics
- Laziness gives the runtime extra flexibility
- Hardware independent, no low-level details
- Puddle performs automatic error correction

**Future Work**

- We can safely execute high-level programs
- What static guarantees can we provide?
- Safe (polymorphic) volume management
- How to incorporate domain knowledge?
- Fluidic and chemical co-simulation

**PurpleDrop Hardware**

- Order of magnitude cheaper than other devices
- PCB (a) holds a modular microfluidic surface (b)
- Includes heaters (c) and a pump (d,e)
- Controlled by a Raspberry Pi (f)
- Camera (g) provides sensing and error detection

- Cheapest, most flexible microfluidic technology
- Move droplets on grid to mix and split them
- Can occur anywhere (and in parallel)
- Other operations: heaters, input/output, etc.
- Fixed to specific locations