Taming I/O in Intermittent Computing (Work in progress)

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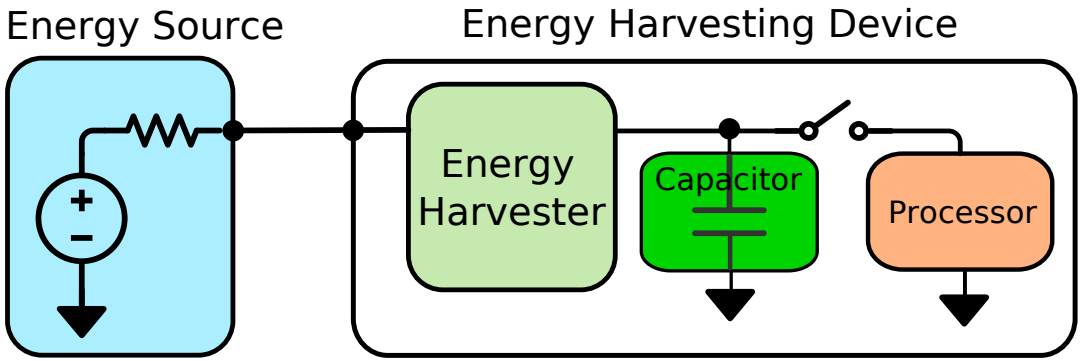
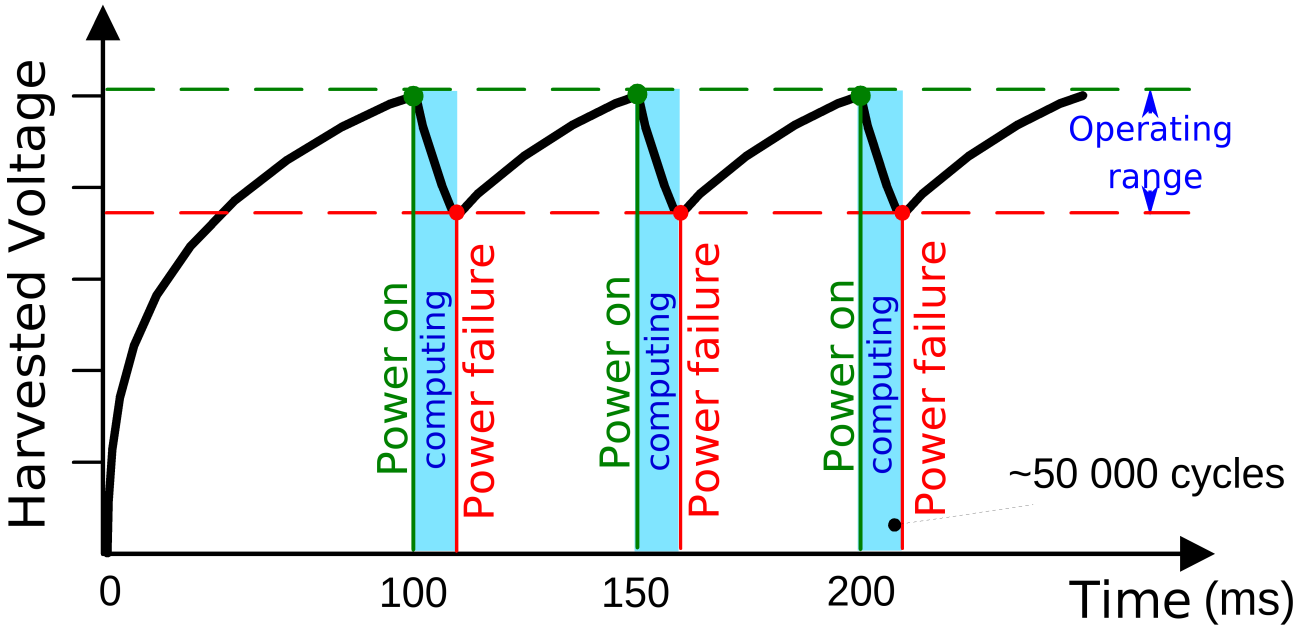
Energy harvesting applications

- **Devices powered with energy from the environment (e.g., solar)**
- **Devices of tiny form factory that do not have batteries and wires**
  - RFID for inventory tracking
- **Devices in space, things, bodies**
  - In-body sensors



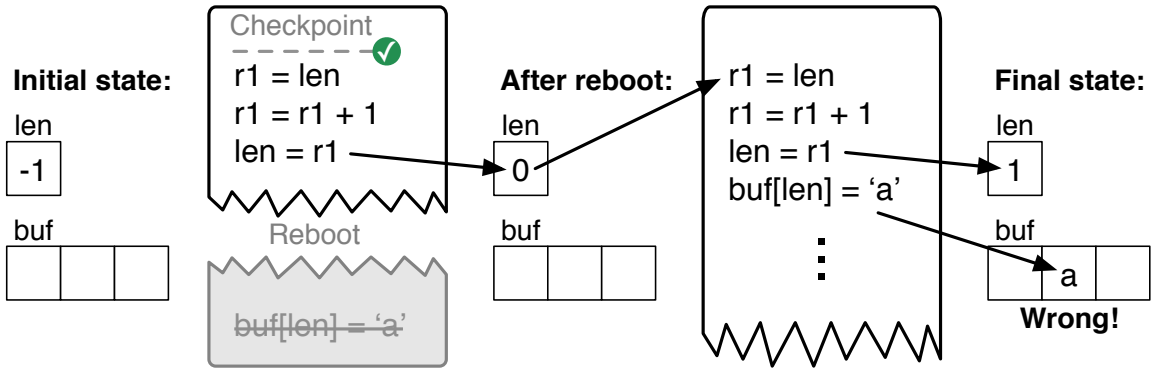
Intermittent computation

- Energy is available intermittently → programs run intermittently



Checkpoints

- The only way to make progress in intermittent computing
- Cannot be done at arbitrary places
- Proposed fixes: explicit task boundaries, runtime inserts check pointing/restore consistent memory: Dino [PLDI'15], Ratchet [OSDI'16], Alpaca [OOPSLA'17]



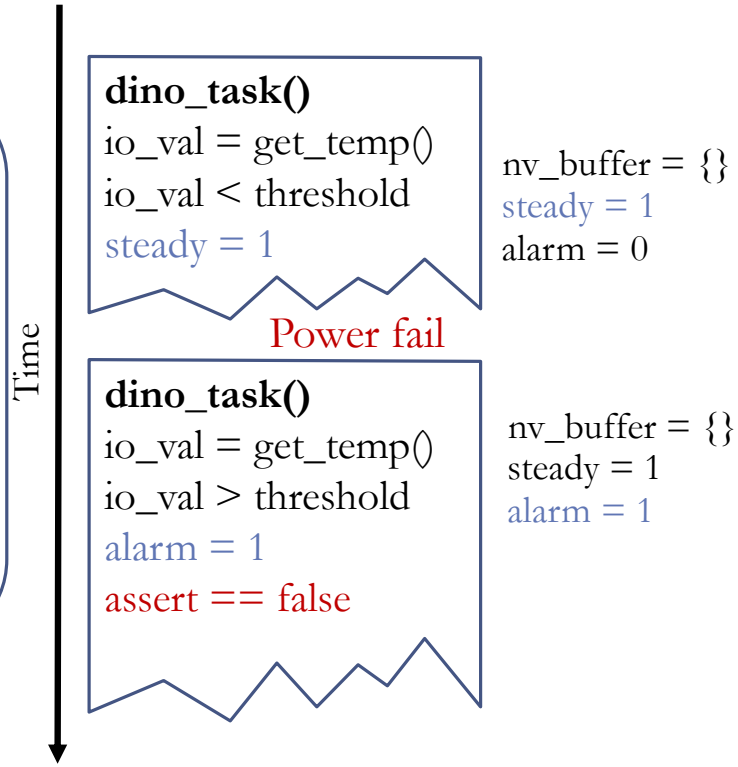
I/O

- **I/O operations are not idempotent:**
  - Different sensor reading after reboot

I/O

- **I/O operations are not idempotent:**
  - Different sensor reading after reboot
- **Consequences**
  - state machine mess up
  - corrupted data

```
dino_task()
io_val = get_temp()
if (io_val < threshold):
  steady = 1
else:
  alarm = 1
assert(!(alarm & steady))
dino_task()
```



A tool for bug finding and fixing

- **Bug finding:**
  - Taint analysis: **source:** I/O inputs, **sink:** writes in branches on I/O dependent data
  - Found many bugs in embedded device drivers
- **Bug fixing:**
  - Source-to-source rewriting to allow existing tools to understand I/O

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- **Bug finding:**
  - Taint analysis: **source:** I/O inputs, **sink:** writes in branches on I/O dependent data
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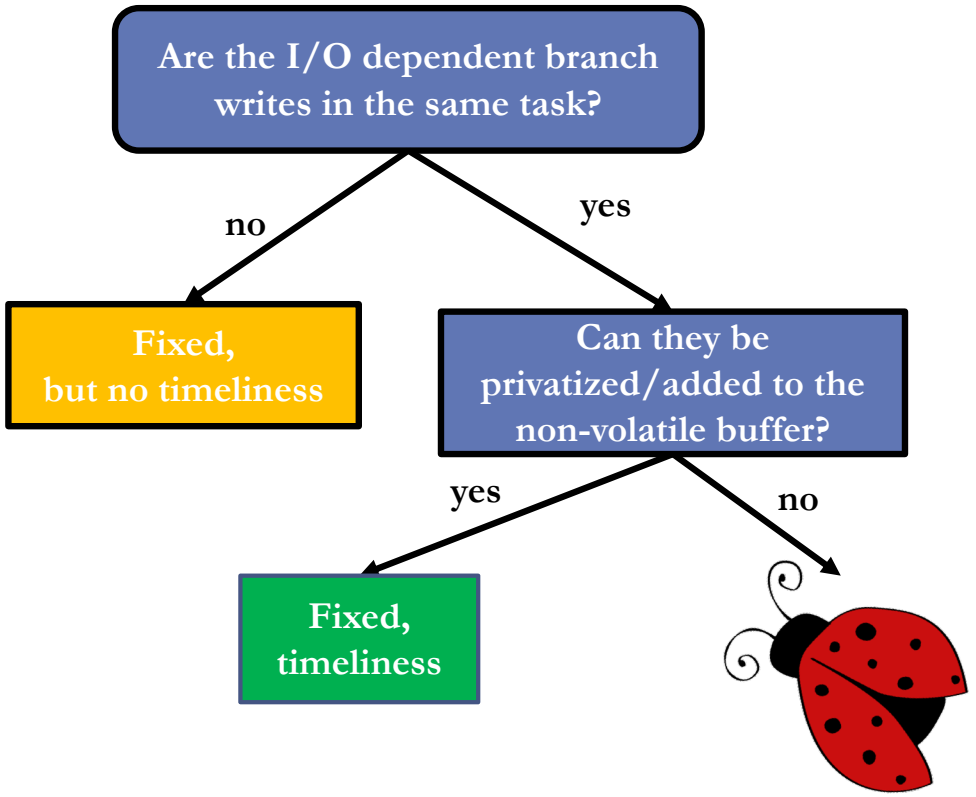
- **Bug fixing (on going):**
  - Source-to-source rewriting to allow existing tools to understand I/O



Formal modeling (future work)

- How do we know our fixes are correct?
- Model intermittent computing
- Define correctness and other properties
- Compare different approaches