Animals do not act to maximize abstract rewards; they act to keep their bodies alive. Hunger, fatigue, and temperature continuously reshape what an animal does next, and this pressure of staying alive leaves its fingerprints on the circuits of the brain. Today's AI agents, in contrast, chase hand-designed reward functions and are famously brittle once the world changes. This project sits exactly at that intersection.

We build artificial agents that have a body and a physiology: they must find food, avoid toxins, and manage their energy in a simulated world, and they learn by keeping their internal state within viable bounds rather than by collecting points. We have shown that such agents spontaneously develop animal-like behavior, including hunger-dependent foraging, torpor-like energy saving, and toxin avoidance, together with modular circuit motifs whose causal role can be dissected by ablation, which is something we can rarely do in a real brain.

As an intern, you will build on this work to ask how internal needs give rise to naturalistic behavior and embodied intelligence. Possible directions, to be chosen with your interests in mind:

- agents with multiple competing drives (e.g., hunger vs. safety) and how the network arbitrates between them
- richer physics-based bodies, to see how morphology shapes control
- comparing the agents' artificial circuits with neural recordings from homeostatic brain circuits
- testing whether need-driven agents are more robust and adaptive than reward-maximizing ones

Why this project may appeal to you: if you come from biology or neuroscience, it offers a fully observable model organism, where every neuron, every bodily variable, and the full behavioral repertoire are visible at once, for asking how brain, body, and needs interact. If you come from AI or machine learning, it offers a biologically grounded alternative to hand-designed reward functions, and a concrete testbed for robustness and generalization. You will gain hands-on experience in deep reinforcement learning, embodied simulation, and the analysis of neural population activity.

The project is part of a broader effort in our group to understand adaptive decision-making, the capacity that lies at the core of behavioral flexibility across species, and to uncover its computational, biological, and ecological principles.