

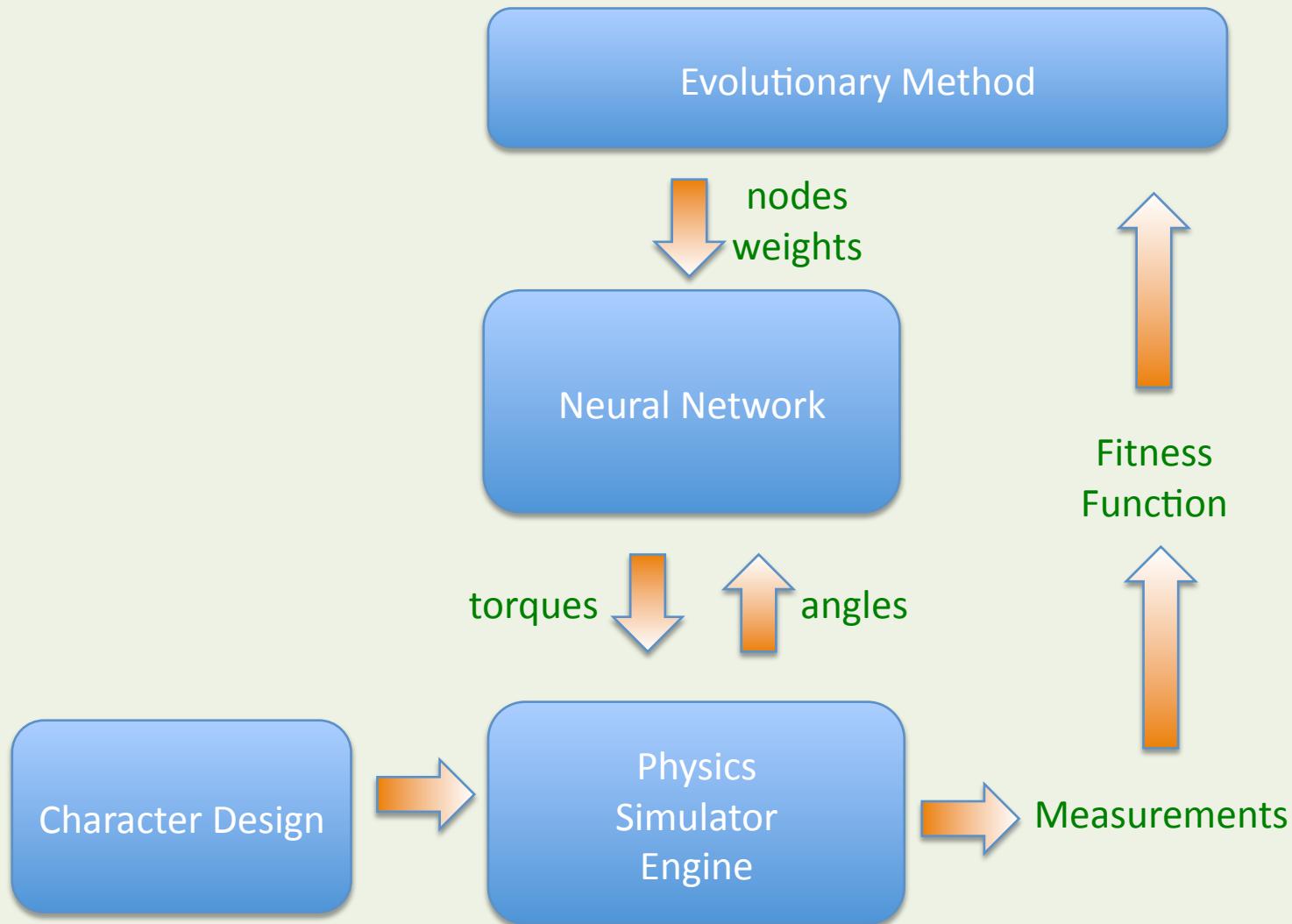
Learning Humanoid Jumping using Neural Evolution

Toni Ivanov

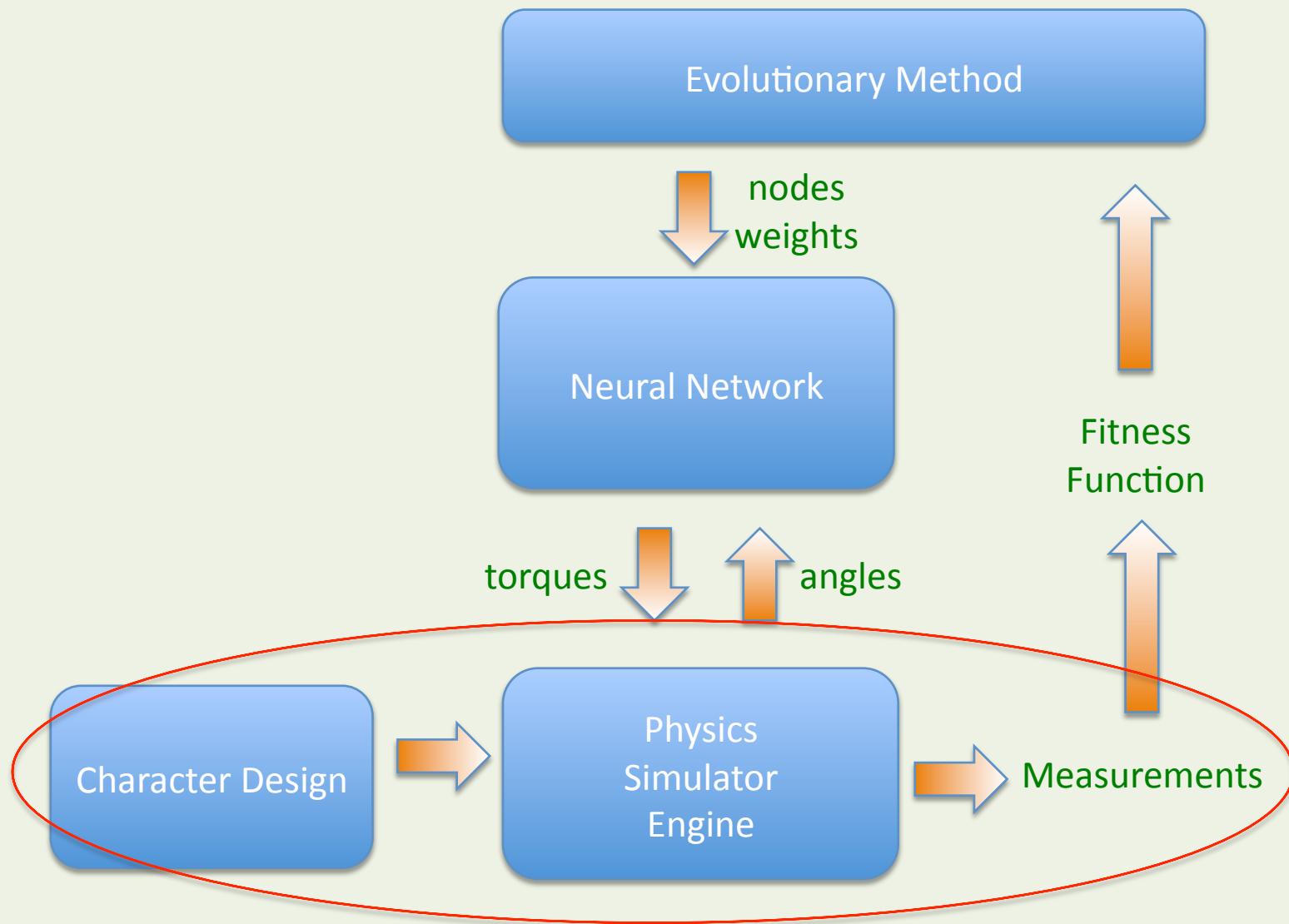
Kevin Lu

Yichen “Peter” Chen

System Diagram



Character Design

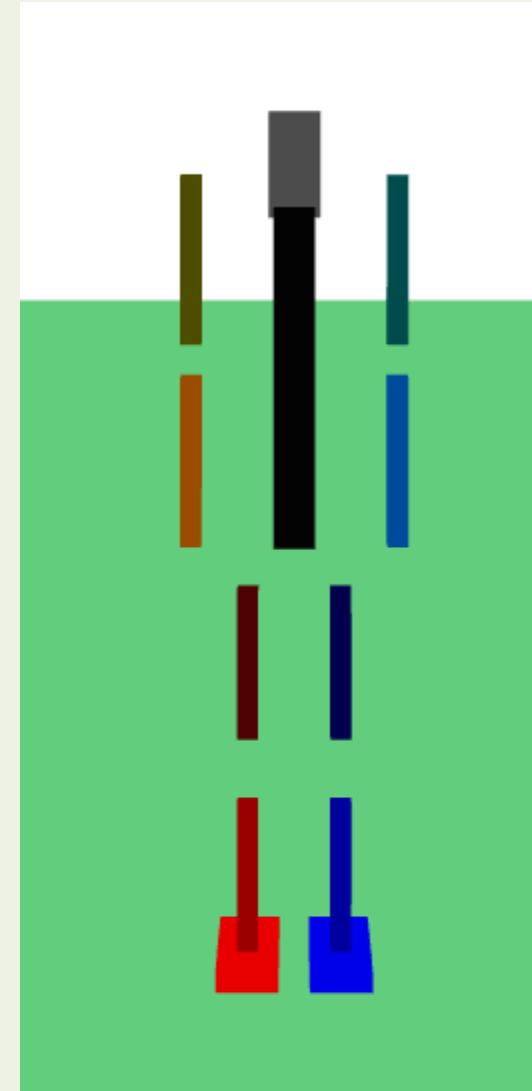


Character Design

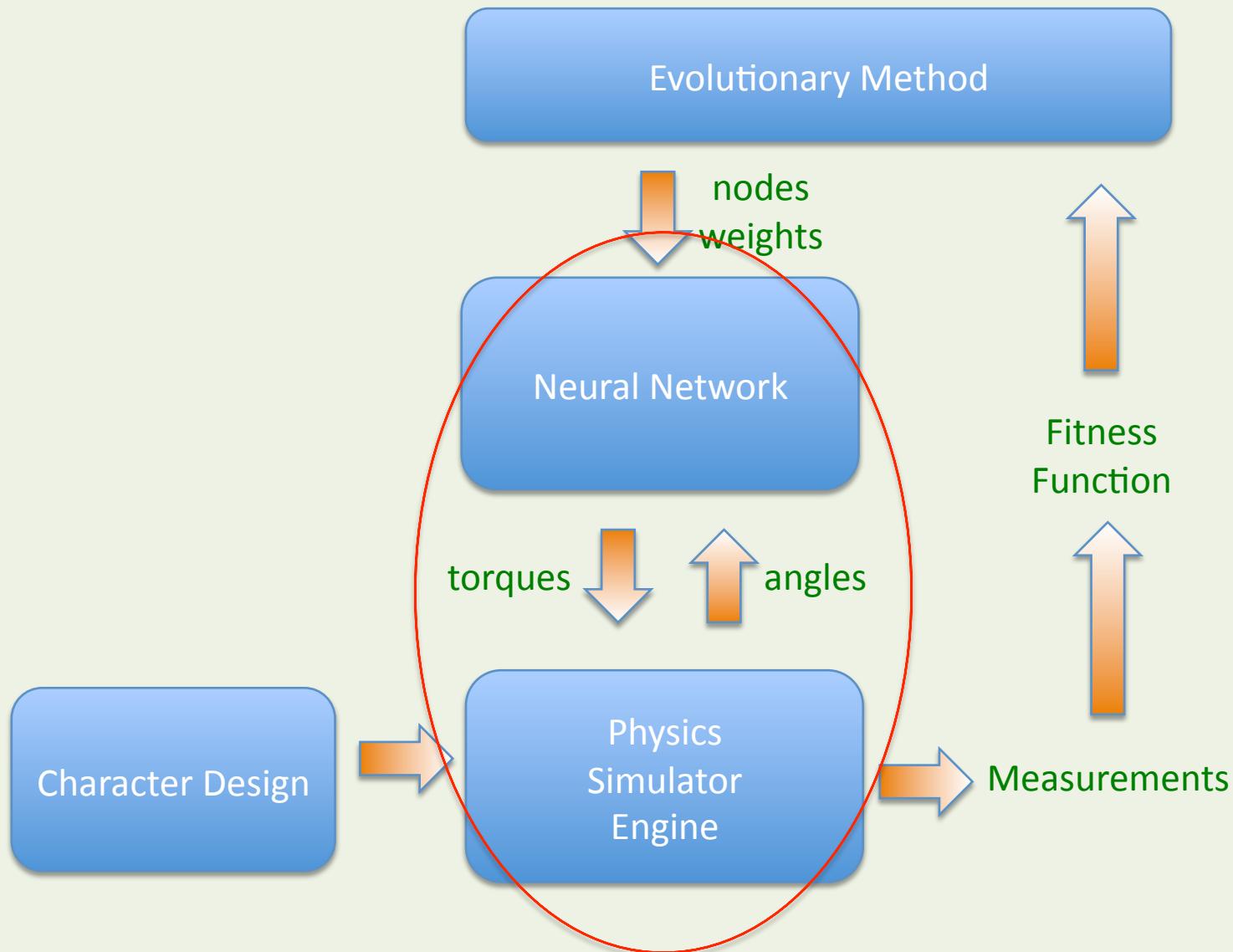
Set up

Anthropometric design based on human body measurements
Joint types – hinge
ODE open-source physics engine

Measurement:
Joint angles
Joint velocity
Center of mass
Balance detection
Feet contact detection

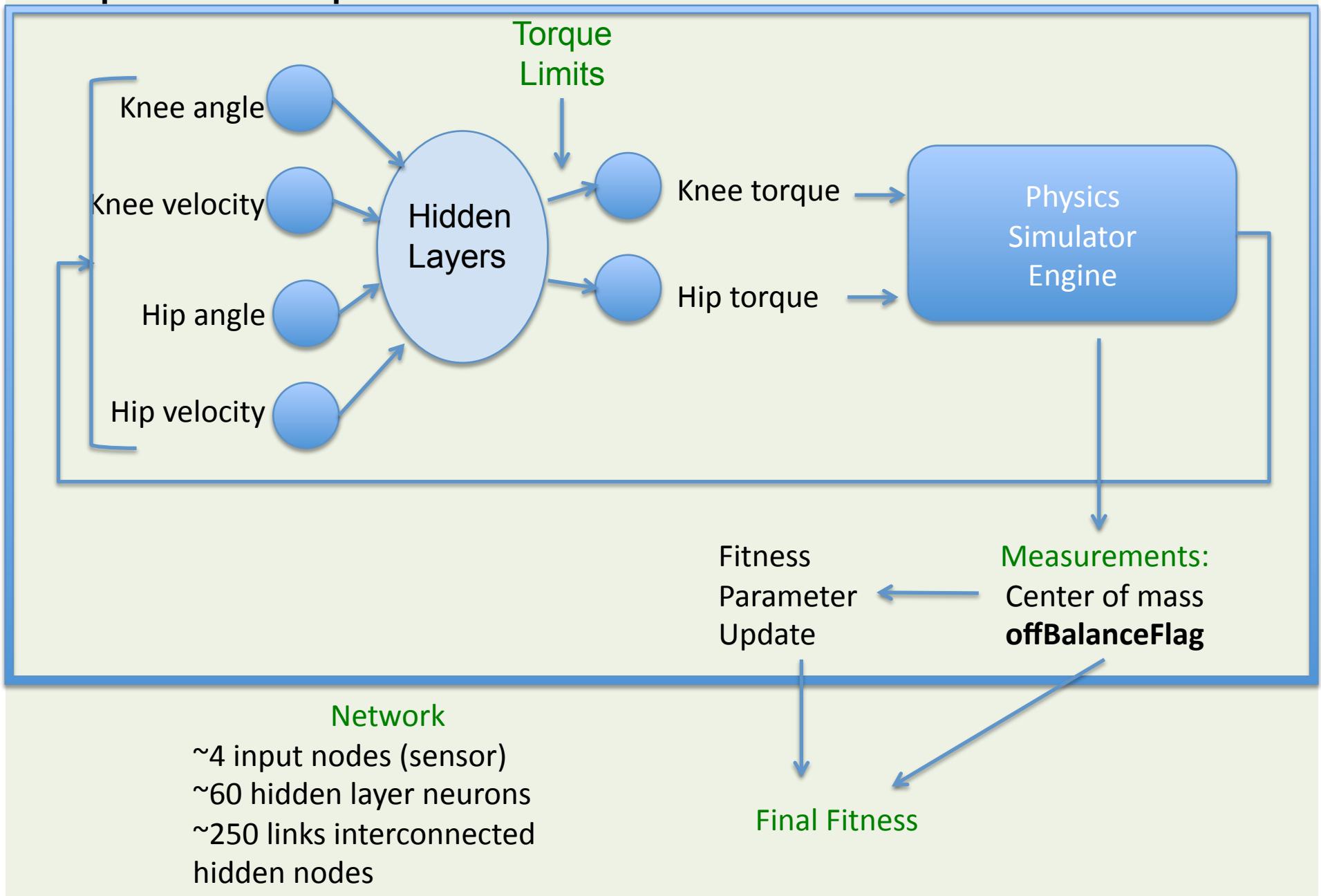


Simulation

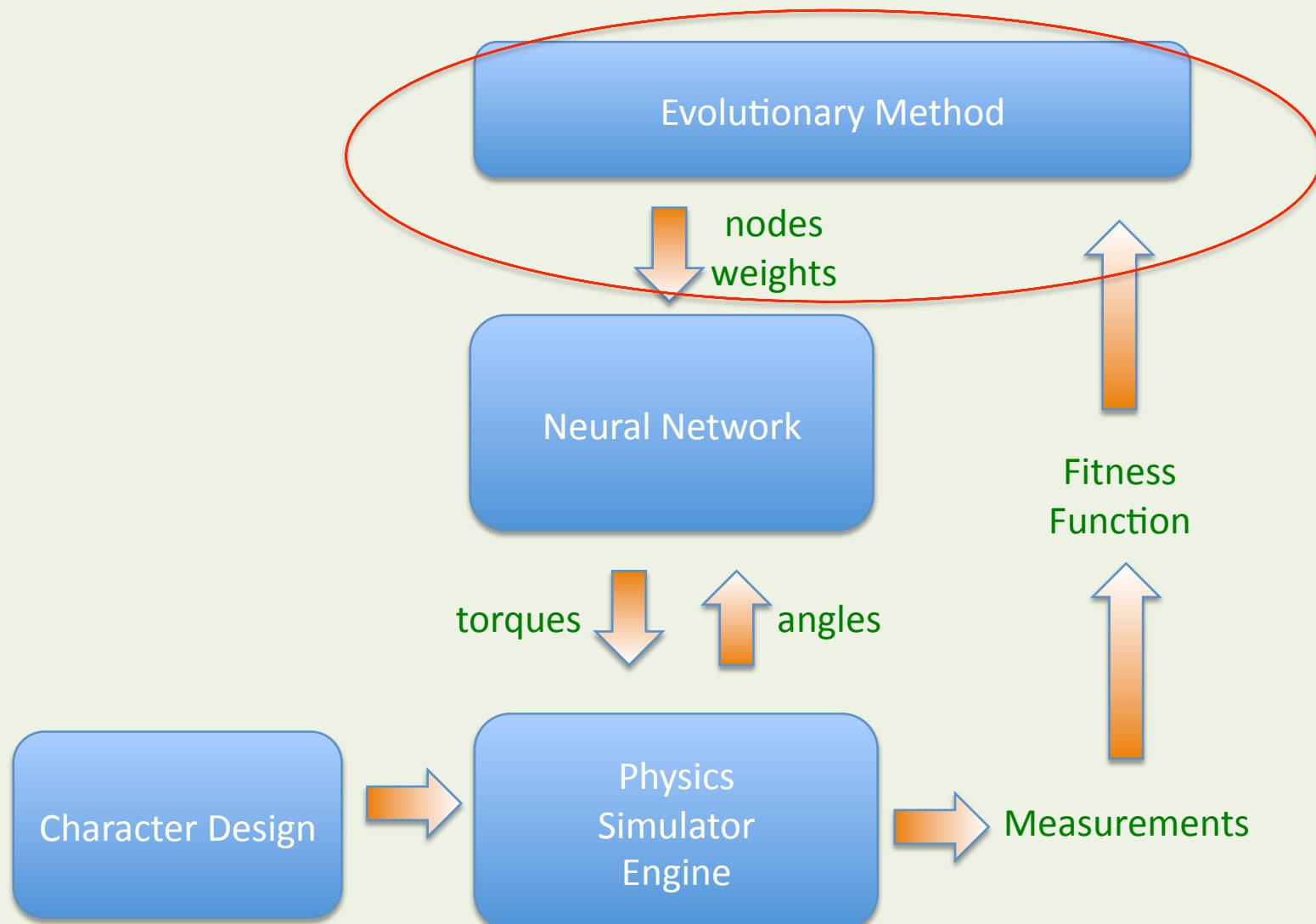


Loop over time steps

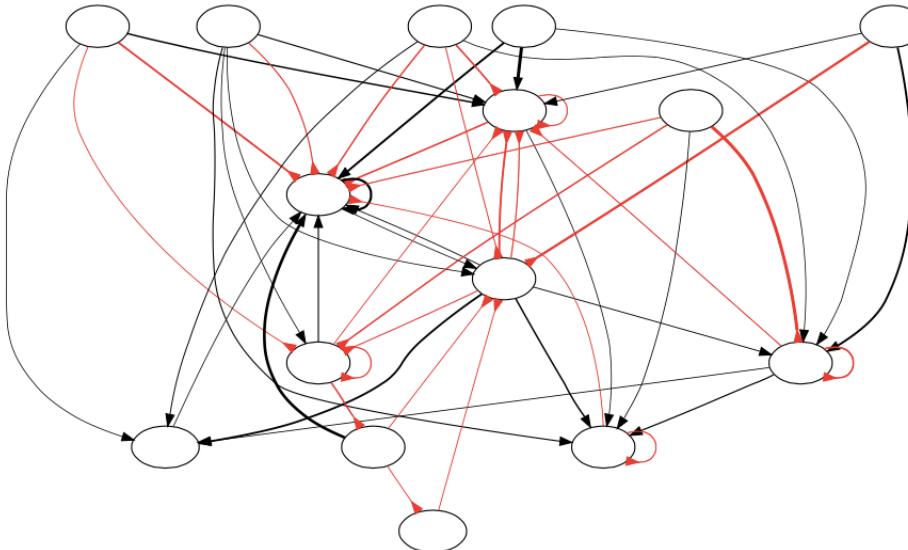
Simulation



Evolution



Evolution of Neural Network



NEAT (NeuroEvolution of Augmenting Topology)

Features: historical markings and speciation

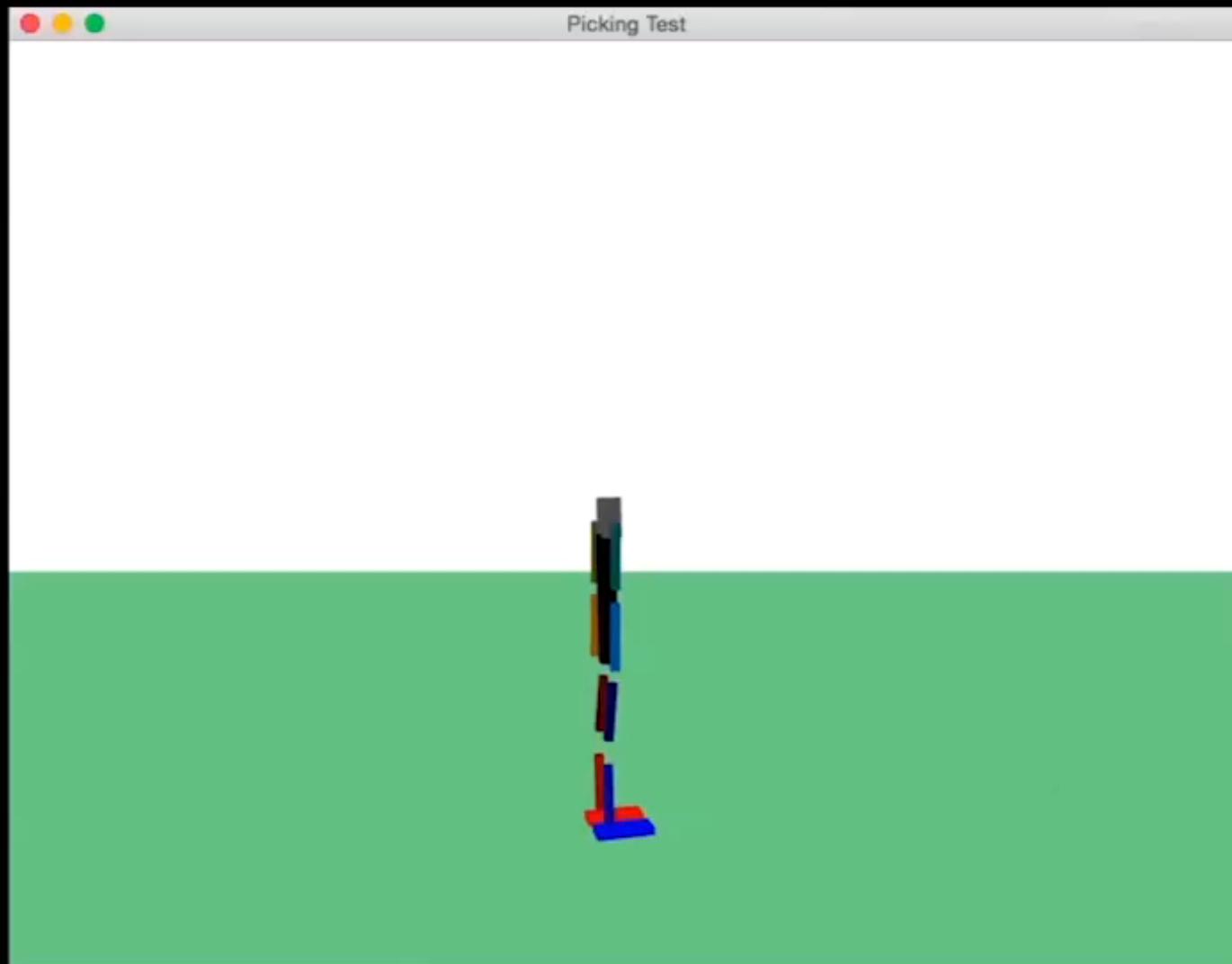
Components:

Organisms (networks)

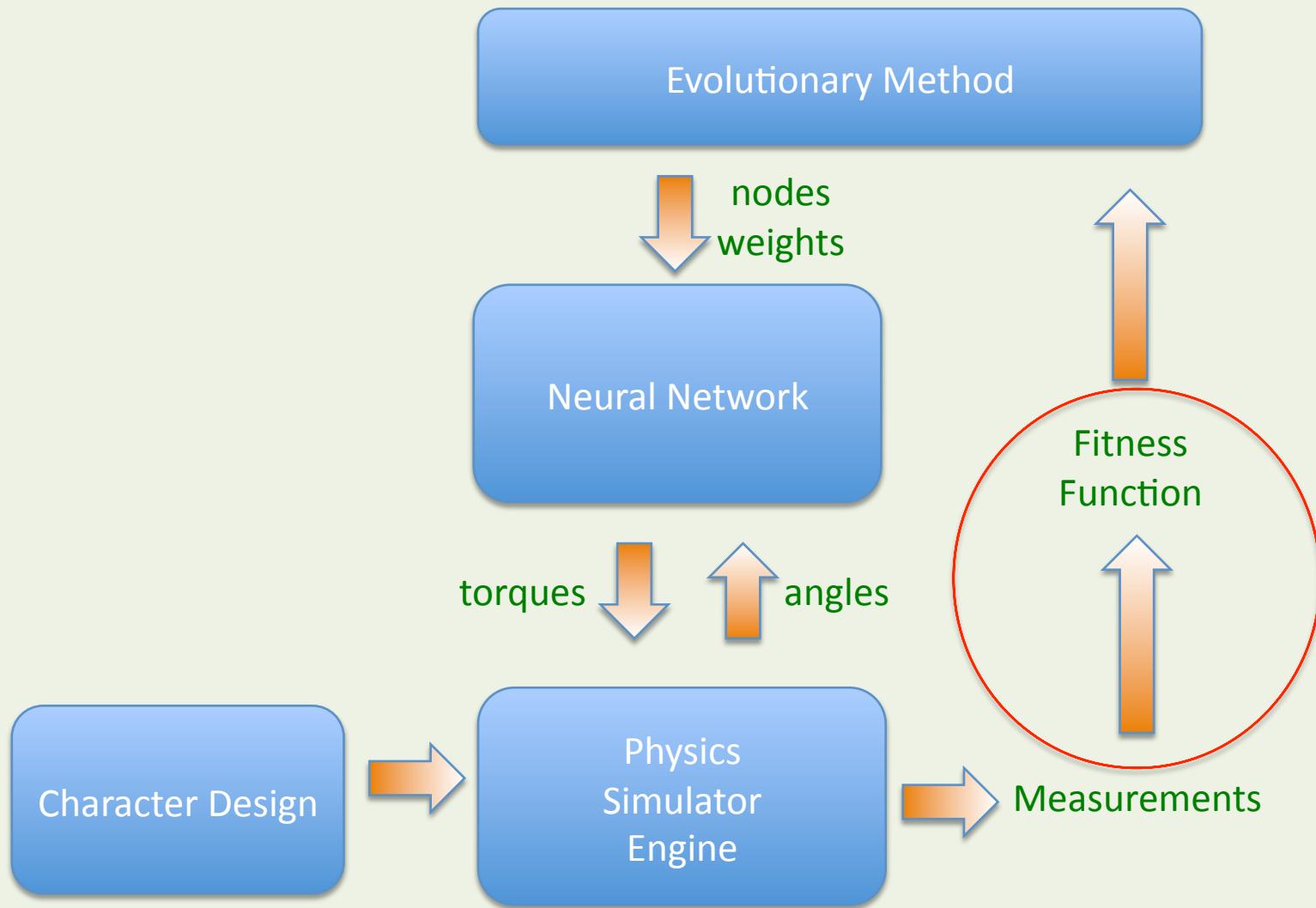
Nodes -- Genes (network parameters)

Network topology evolution:

- add/remove neurons
- add/remove links
- change weights

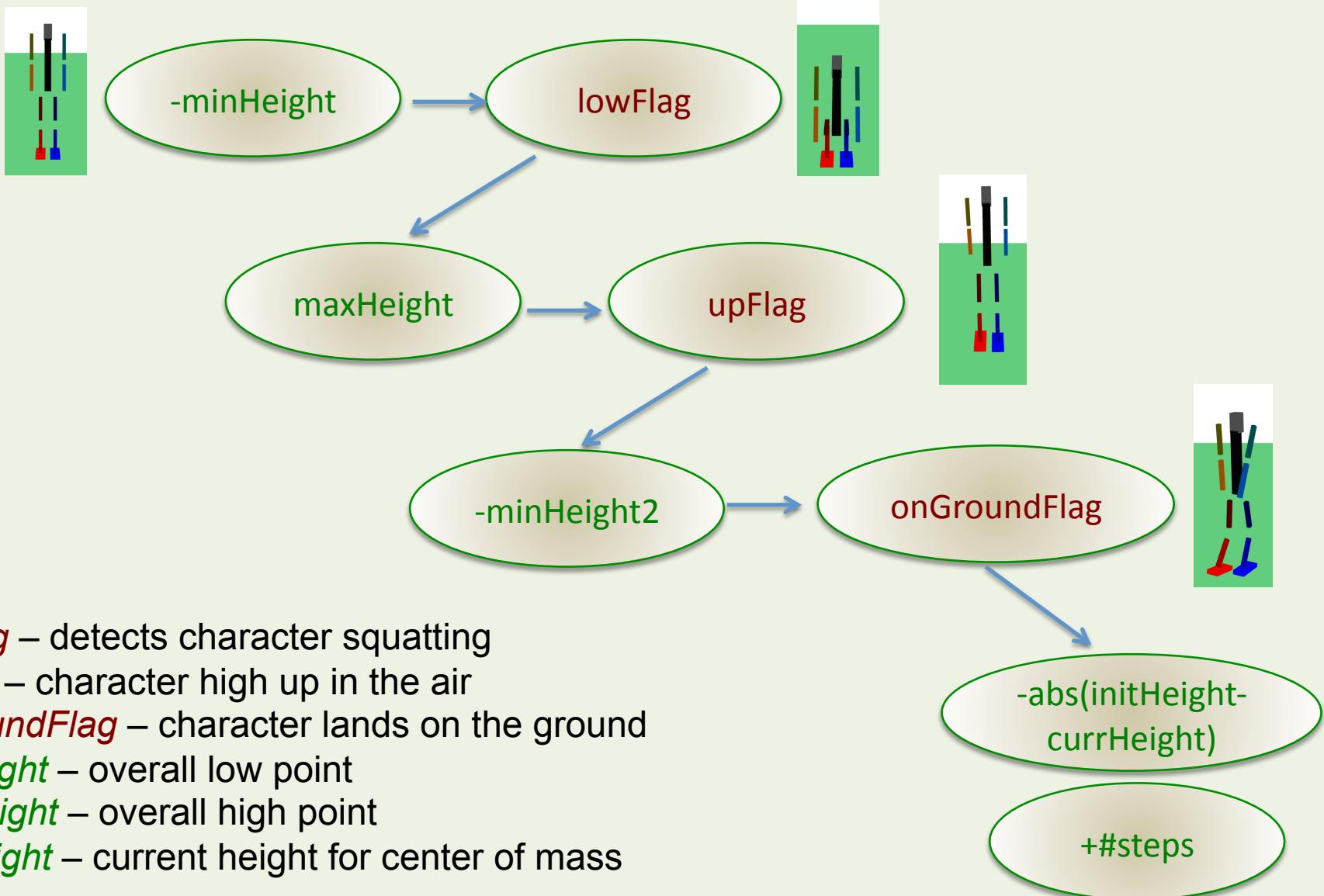


Fitness



Fitness

$(1-lowFlag)*(10-minHeight)+lowFlag*(10+(1-upFlag)*maxHeight+upFlag*(10+(10-minHeight2)+standUpFlag*(10-abs(4.785339-currHeight)+steps)));$



Future Work

Fitness function:

- Stochastic optimization of fitness parameters
- Novelty search to achieve alternative jumping styles

Physical model:

- Controlling arm swing to aid in jumping

Advanced scenarios:

- Jumping on top of objects
- Jumping from running
- Single foot jumping