Intro to Model Learning

General representation of a dynamical system.

$$\dot{x} = f(x, u)$$

x state vector

for a second order mechanical system the state might be the configuration and its derivative

e.g $x = [q \; \dot{q}]$

u input vector

e.g motor torque

Forward model learning means finding what f is. That is given the current state and input, how will the state change?

Inverse model learning

$$u = g(x, \dot{x})$$

Find g or, given the current state and desired change in state, what input is required to achieve the desired change?

Discrete time

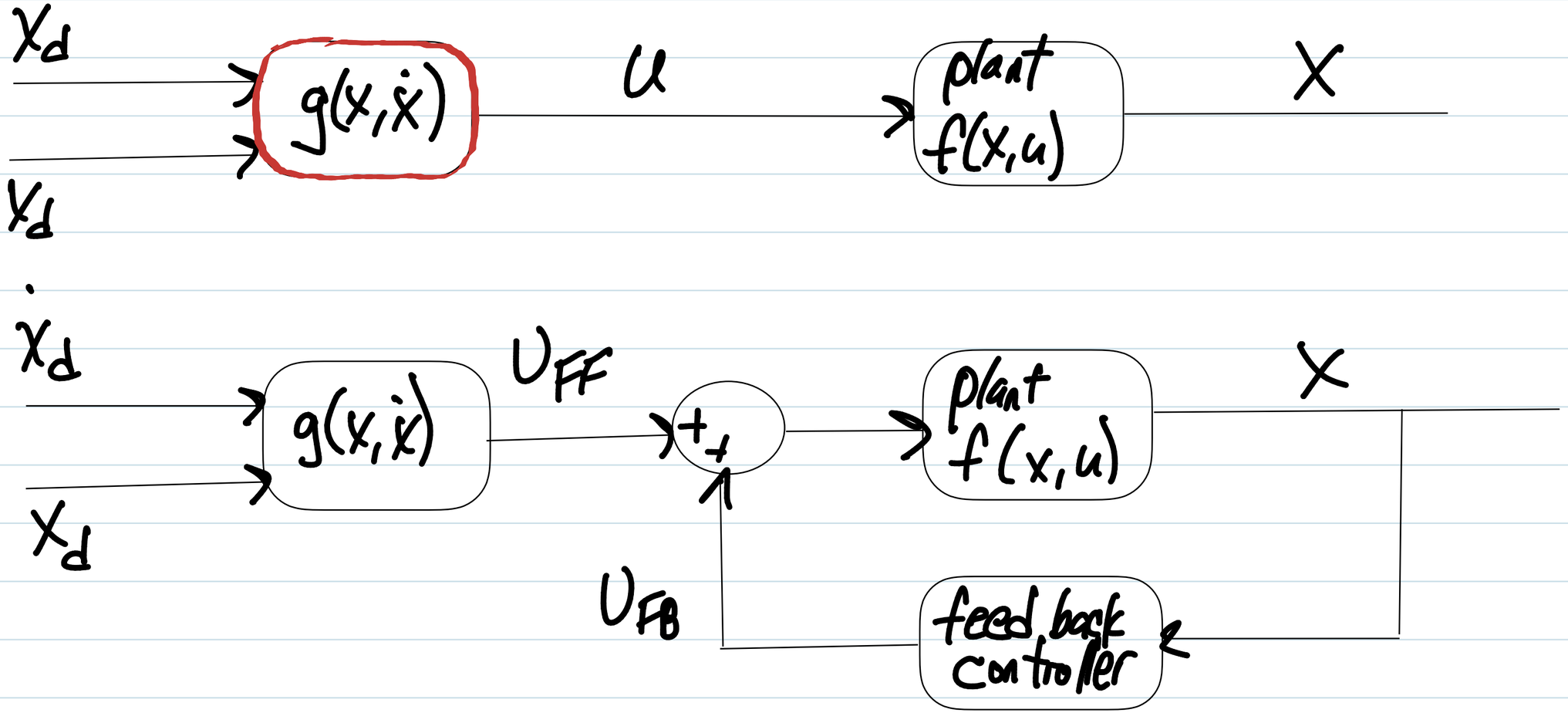
forward $x_{i+1} = f(x_i, u_i)$

given current state and input, what will the next state be?

inverse model $u_i = g(x_i, x_{i+1})$

Given the current state and desired next state,
what control input should I apply?

Inverse models are great for control.



Forward models are required for planning and for optimal control.

Goal of model learning is to learn how systems work by collecting data.

1) Parameterize model based on physics

e.g. $F = m\vec{a}$ or Kirchoff's voltage law

model learning means finding the model's parameters

eg the mass

2) Black box function approximators

- polynomial regression
- Gaussian Mixture Models
- radial basis functions
- locally weighted regression

- artificial neural networks
- Gaussian process regression