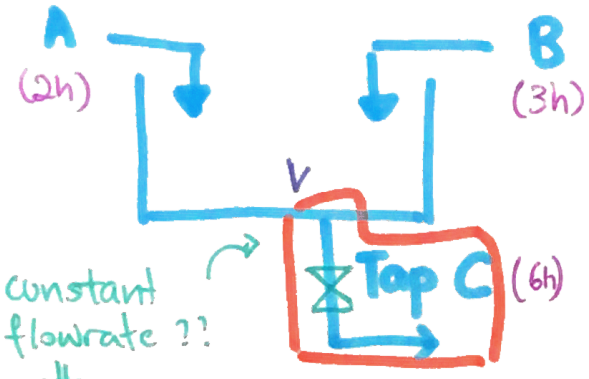
Introduction to Dynamic Models

Dynamic systems : → Non-steady state.
Described using differential Equations.

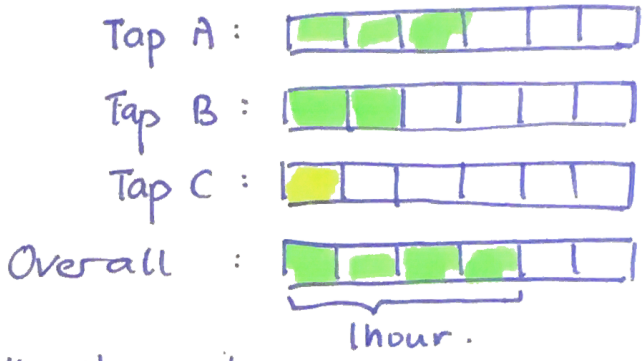
Mechanistic Modeling → Material
→ Energy
→ Momentum
} Dynamic Model

Fish Tank Problem.



Process Control Problem.

Basis of 1hour.



4units : 1hour
6units : 6/4 × 1 = 1.5 hours

Dynamic Modeling.

Let tank volume = V_0

Tap A ⇒ $\frac{dV_A}{dt} = \frac{V_0}{2}$: $\frac{dV_B}{dt} = \frac{V_0}{3}$: $\frac{dV_C}{dt} = \frac{V_0}{6}$

$$\boxed{\frac{dV}{dt}} = \boxed{\frac{dV_A}{dt}} + \boxed{\frac{dV_B}{dt}} - \boxed{\frac{dV_C}{dt}} = \frac{2}{3}V_0$$

Acc = In − Out

$t=0,\ V=0$

$t=t,\ V=V_0$

$$\int_0^{V_0} dV = \int_0^t \frac{2}{3}V_0\, dt$$

$$\Rightarrow V_0 = \frac{2}{3}V_0 t$$

$$\Rightarrow t = \frac{3}{2}\text{ hours} = 1.5\text{ hour}$$

Tap C is not constant flowrate

$$\frac{dV_C}{dt} = f(h)$$

$$\frac{dV}{dt} = A\frac{dh}{dt}$$