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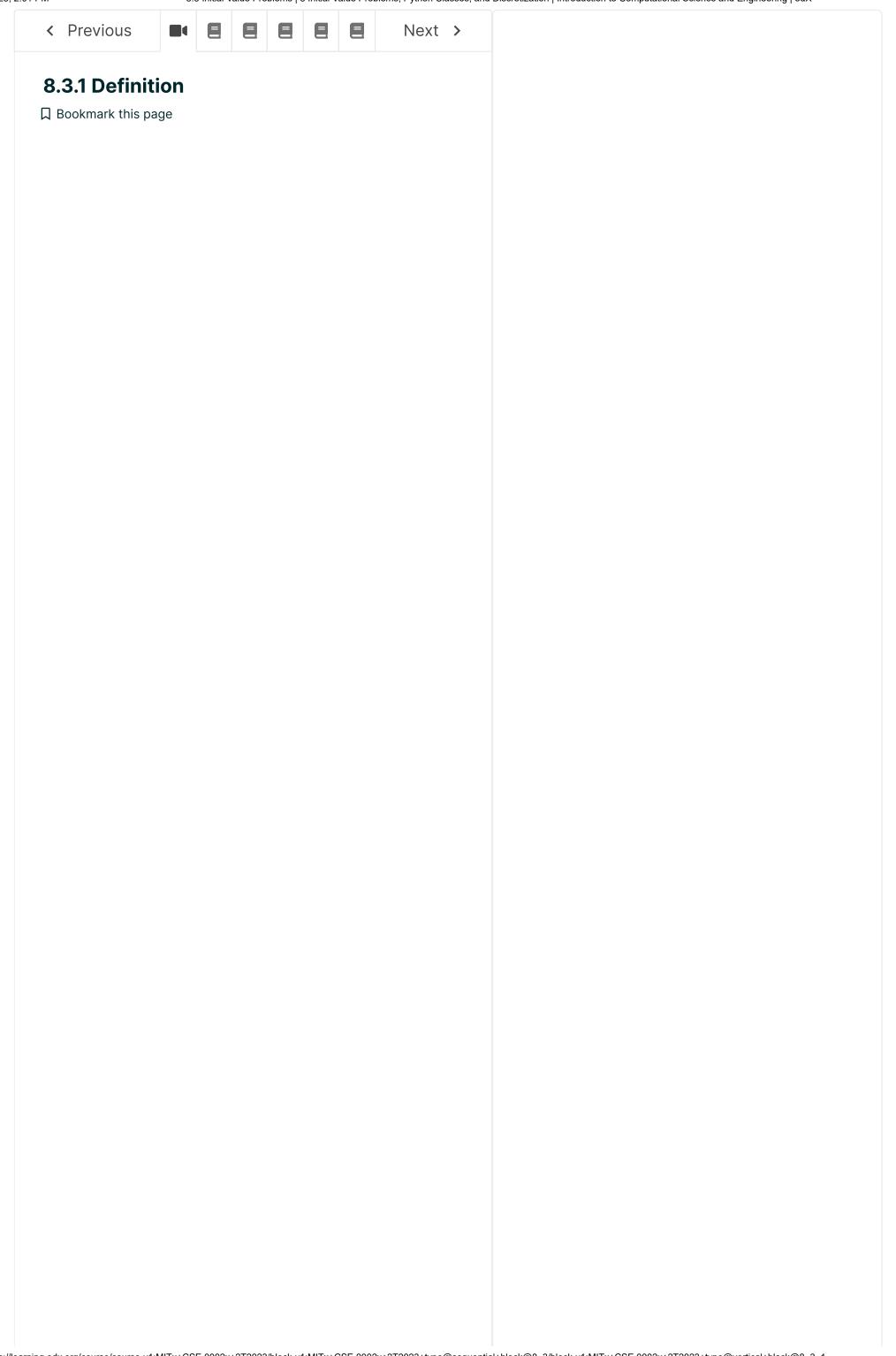
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MO2.4

In the previous section, you've seen several examples of time-dependent phenomena and their model equations. Next, we will introduce the idea of an Initial Value Problem (IVP), which is the general mathematical form of these types of phenomenon and model equations.

Definition 1 (Initial Value Problem (IVP)).

Let $\underline{u}\left(t\right)$ be a time-dependent vector of M states,

$$\underline{u}\left(t
ight) = egin{bmatrix} u_{0}\left(t
ight) \ u_{1}\left(t
ight) \ dots \ u_{M-2}\left(t
ight) \ u_{M-1}\left(t
ight) \end{bmatrix}$$

with an initial condition, $\underline{u}(t_I) = \underline{u}_I$. The evolution of the state from the initial condition at $t = t_I$ until the final time $t = t_F$ is governed by the system of differential equations,

$$\frac{\mathrm{d}\underline{u}}{\mathrm{d}t} = \underline{f}(\underline{u}, t) \quad \text{for} \quad t_I < t < t_F$$
(8.36)

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Pemark 10.

When $M=\mathbf{1}$, we refer to the problem as a scalar

ed For convenience and clarity, we drop the underline notation and write the scalar IVP as,

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(8.37)

(8.35)

edX for Business(u,t) for $t_I < t < t_F$

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Newith $u\left(t_{I}
ight)=u_{I}$.

Legal 11.

Tewhile the IVE cless dription above is for a range of time Privacy Poticify, often we may not know a precise final Acomesidative of the varieties of the problem Tradition when some event occurs. For example, Sitemas coffee cooling, perhaps we want to know how Cookie we have until the temperature drops to Your Privacy Choir for the water tank problem, we may want to run the simulation until the tank is completely

emptv. In either case. we will not know ahead of time

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