Recap!

Ch. 4: Solution Methods based on Scaling Concepts

- Similarity Method
  Convert PDE to ODE
- Perturbation Analysis
  Solve ODE that contains small/large dimensionless parameter

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Similarity Method

With the similarity method we combine two original, independent variables into one composite variable to reduce a PDE into a ODE

Ex: $\frac{\partial \Theta}{\partial t} = D\frac{\partial^2 \Theta}{\partial x^2}$; $\Theta(x,t)$ (transient gov. eq.)

membrane problem 3.5-1 during start-up

$$\Rightarrow \frac{d^2\Theta}{d\eta^2} + \frac{gg'}{D}\eta\frac{d\Theta}{d\eta} = 0 \; ; \; \Theta(\eta)$$

$\eta(x,t)$ ... composite variable

$g(t)$ ... scaling factor (rate factor)

$g' \equiv \frac{dg}{dt}$

One specific application of the similarity method are similarity problems for which the dependent variable

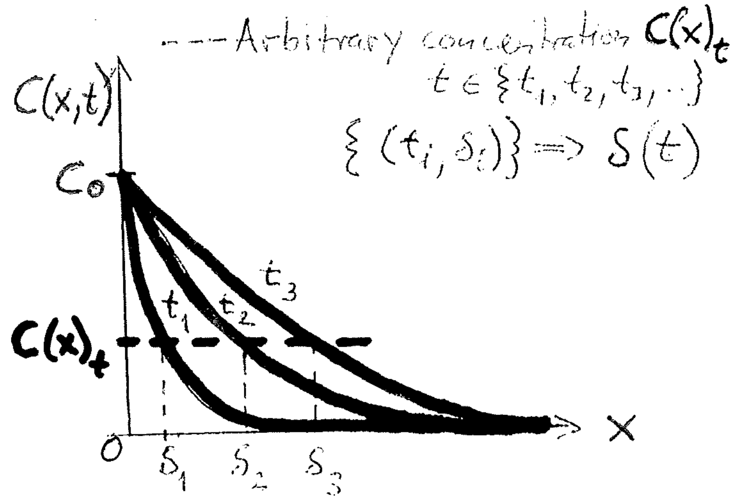
$C(x,t)$ in mass transfer

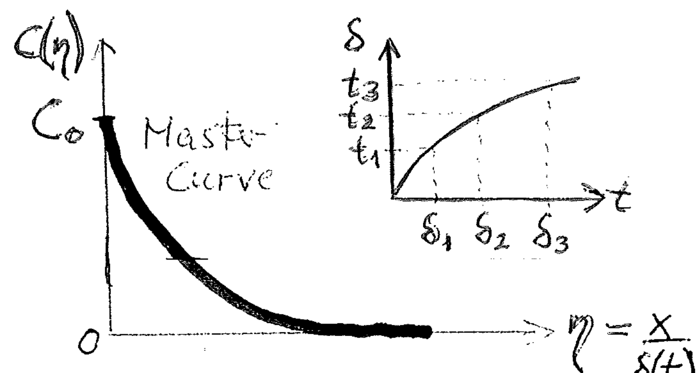
$T(x,t)$ in heat transfer

$v(x,t)$ in momentum transfer

is self-similar in time or position.

	Ex	General
scaling factor:	$\delta(t)$	$g(t)$
composite variable:	$\eta = \frac{x}{\delta(t)}$	$\eta = \eta(x,t)$





based on location-time invariance