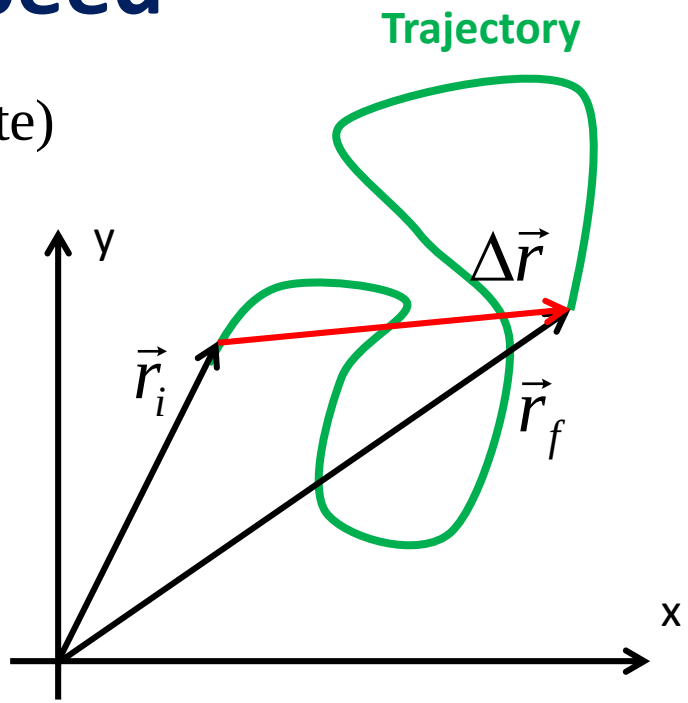
Velocity and Speed

$\vec{r}_i, \vec{r}_f$ - position vectors (initial and finite)

displacement : $\Delta\vec{r} = \vec{r}_f - \vec{r}_i$

travel time : $\Delta t = t_f - t_i$



Average ***velocity:***

$$\vec{v} = \frac{\Delta\vec{r}}{\Delta t}$$

d – distance travelled (length of the trajectory)

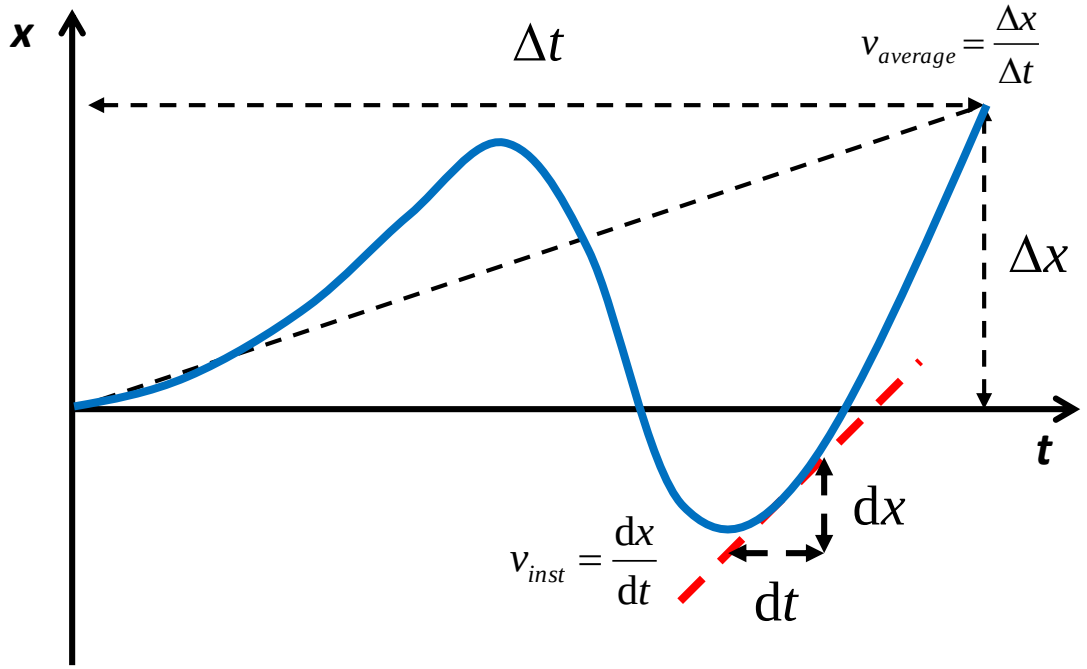
Average ***speed:***

$$v = \frac{d}{\Delta t}$$

NB: **Distance** *and* **Speed** *are* *scalars*
Displacement *and* **Velocity** *are* *vectors*

Instantaneous Velocity

Consider 1D motion: only one coordinate ***x*** changes as a function of time ***t***:



Instantaneous Velocity is the same as average, but Δt is really small:

$$v_{inst} \underset{\Delta t \to 0}{=} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

$\frac{dx}{dt}$ is the local slope of the plot "x vs. t". It is called "time *derivative* of function x(t)".

"d" stands for "really small Δ".

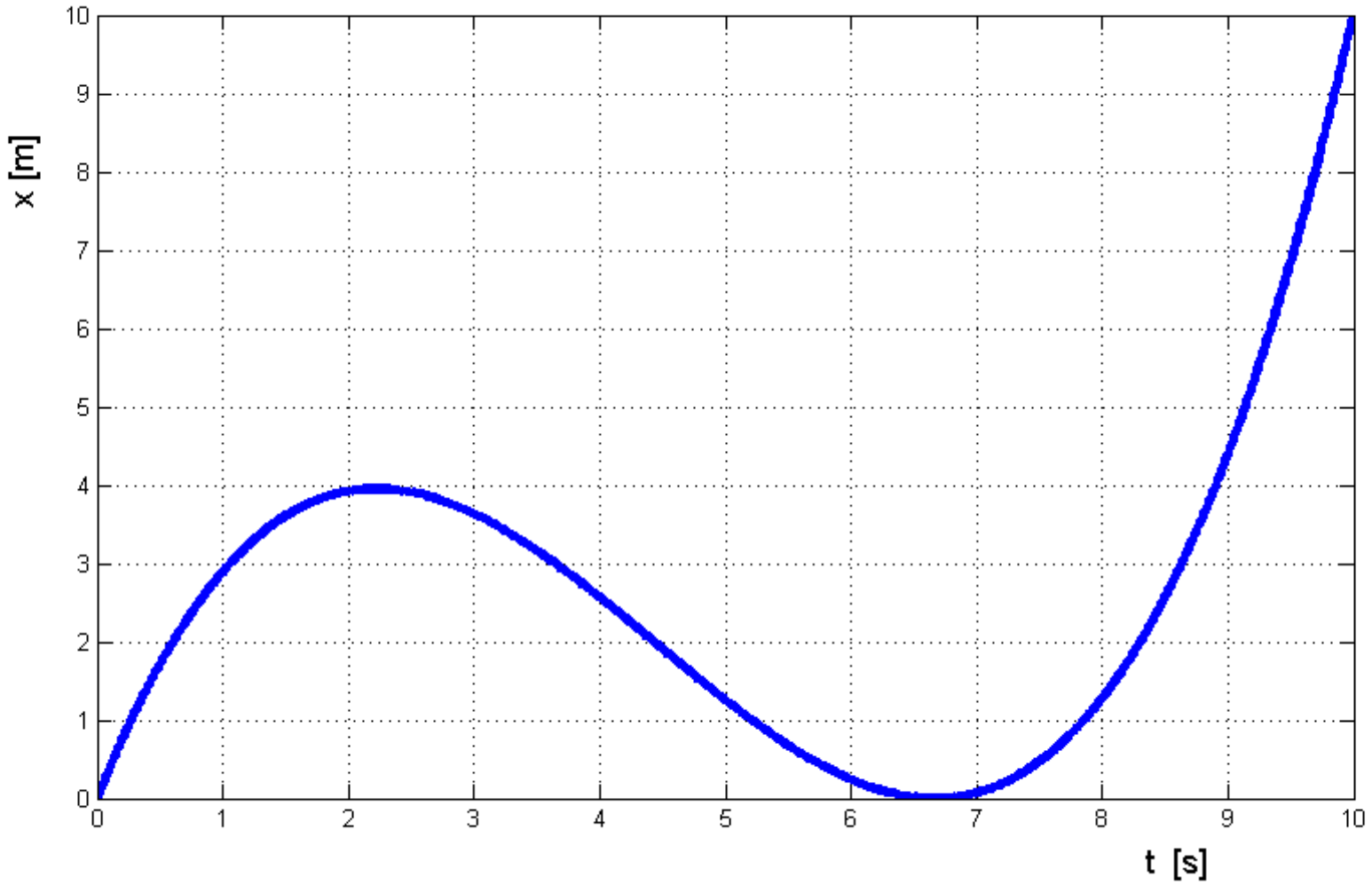
Homework 2

Problem 1.

A student travels from school to home by foot, with average speed v. There, he picks up a bike and rides it back three times as fast, along the same route. Calculate the average speed and average velocity of his whole trip from school to home and back.

Hint: Assume the distance between the home and the school to be D. To find the average speed, you need to find the total distance travelled and the total time.

Problem 2 This plot shows position of a certain object moving in 1D, as a function of time:



From the plot, determine the following:

a) Average velocity and average speed for the whole time range shown;

b) Instantaneous velocity at time t= 1s;

c) Maximum and minimum values of instantaneous velocity.