Lab Notes

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Rate of change in position over the rate of change in time is defined as velocity.

$$\frac{dx}{dt} = v$$

$$\frac{d^2x}{dt^2} = \frac{dv}{dt} = a$$

$$\frac{x_{n+1} - x_n}{\delta t} = v$$

$$x_{n+1} = v_0 \delta t + x_n$$

$$a = \frac{v_{n+1} - v_n}{\delta t}$$

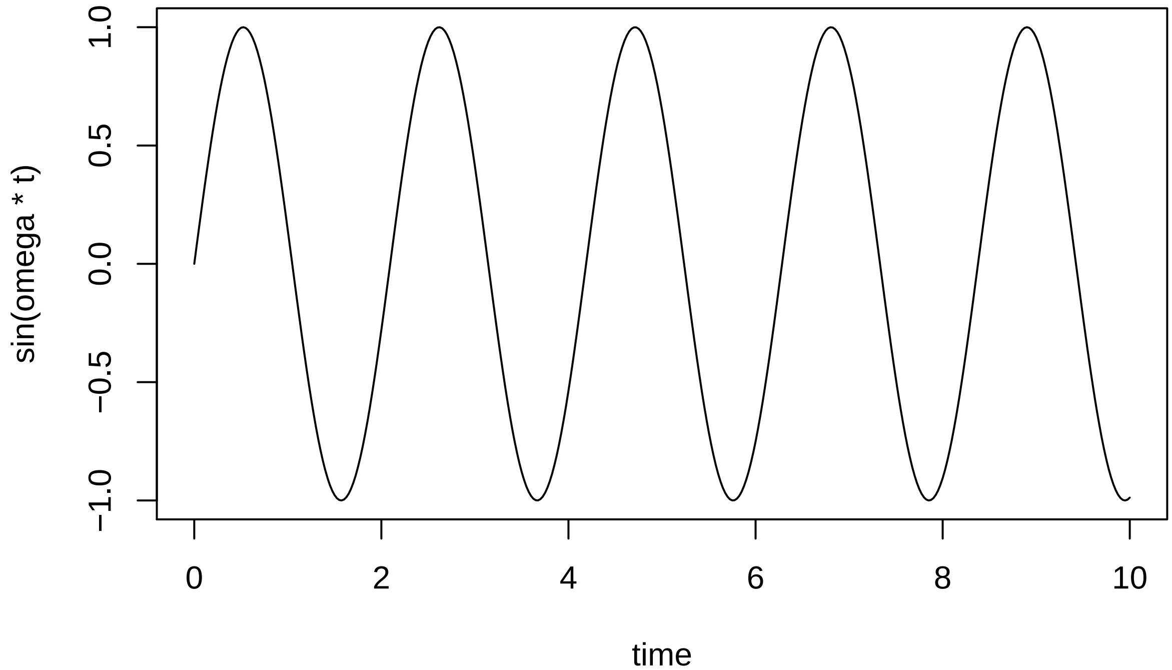
Euler's method. Verlay's method.

Which do you update first? Position or velocity?

Lab0

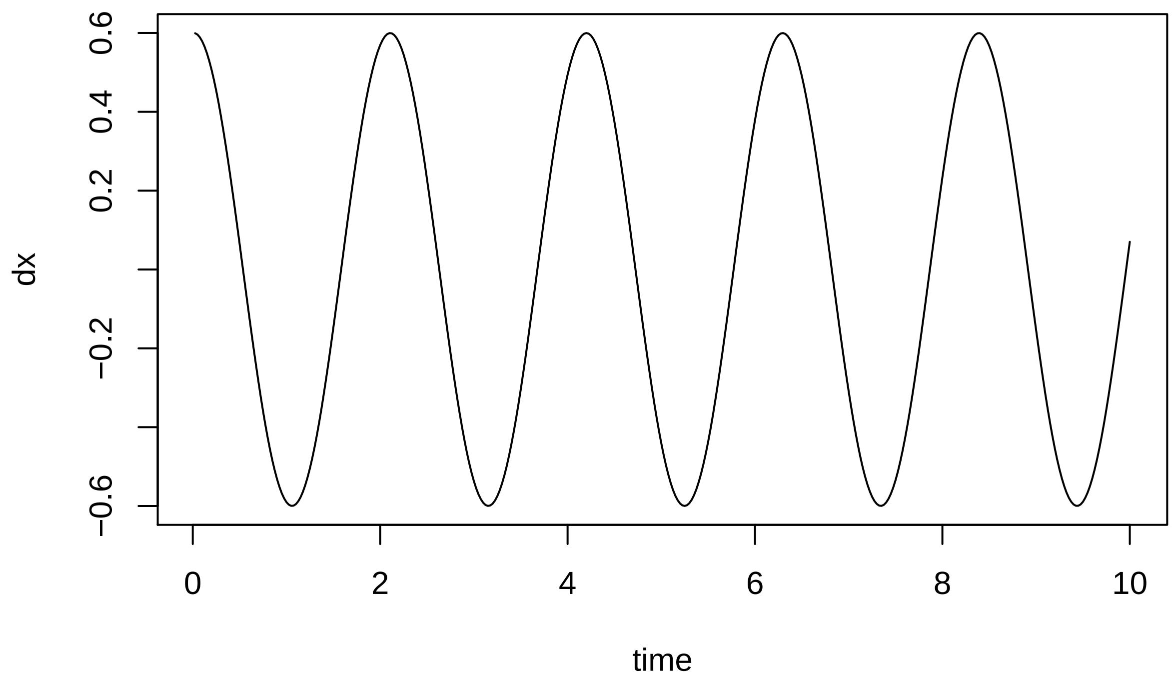
First, I'm going to reproduct the time and $sin(omegat)$ data and plot it.

```
omega <- 5
s <- 0.025
time <- seq(0, 10, s)
f <- function (t, omega = 3) {
  sin(omega * t)
}
plot(time, f(t = time), type = "l", ylab = "sin(omega * t)")
```

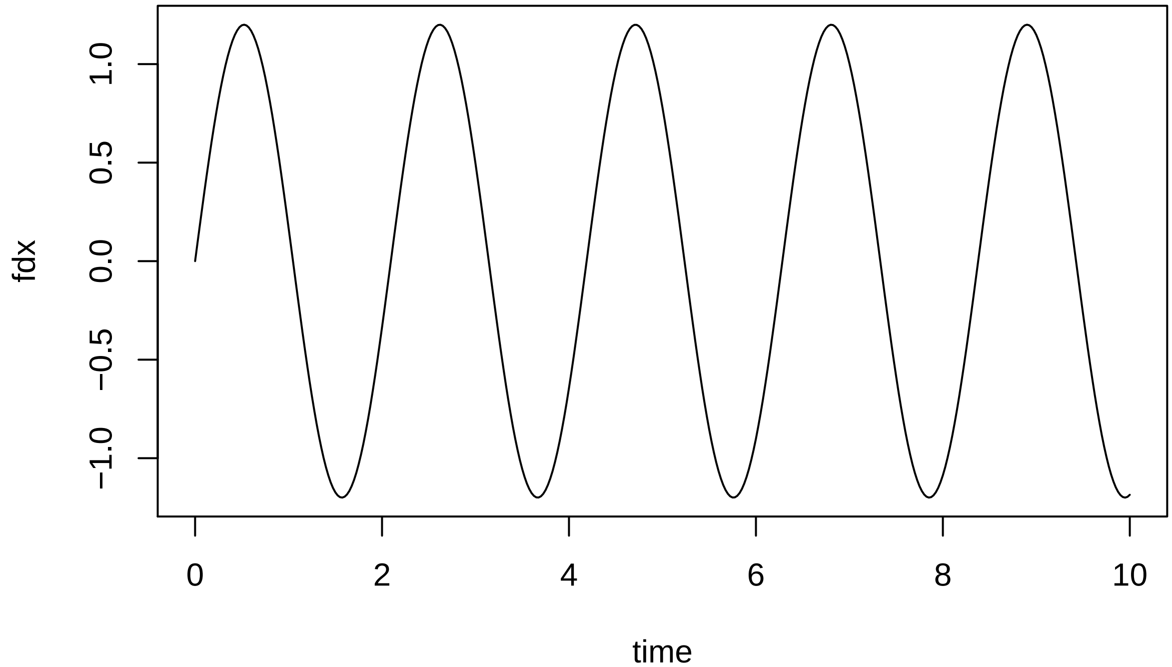


Now, we need to take the numerical derivative of $sin(omegat)$ with respect to time.

```
# in the lab we used excel and created a time diff by lag 2.
#dx <- numericDeriv(f(t = time), "time", dir = )
# the above code is wrong
dx <- diff(f(time)) / s / omega
fdx <- diffinv(dx) * s + c(0, f(time[-1]))
plot(time[-1], dx, type = "l", xlab = "time", ylab = ("dx"))
```



```r
plot(time, fdx, type = "l", xlab = "time", ylab = ("fdx"))
```



Using ggplot2 to put them on the same plot.

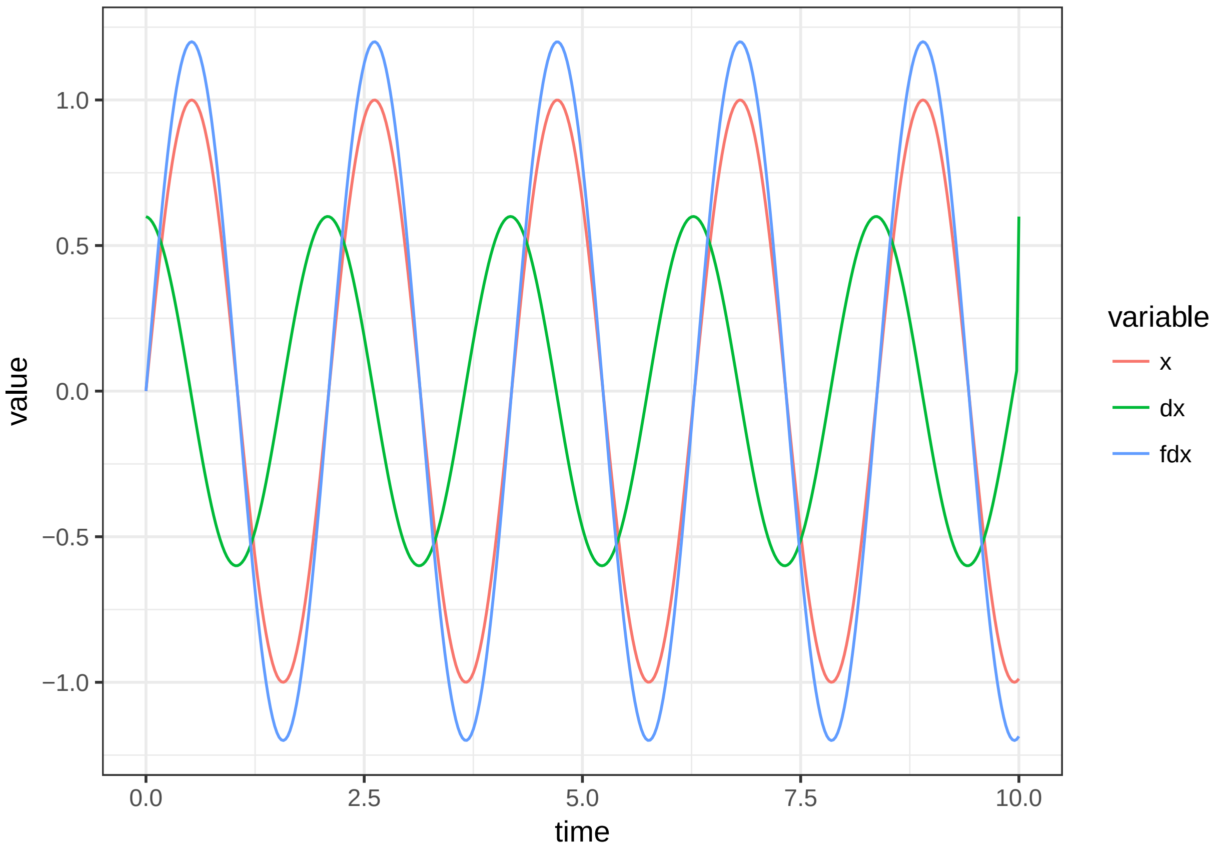
```r
# first take the integral of the derivative:
library(ggplot2)
df <- data.frame(cbind(time, f(time), dx, fdx))
```

```
## Warning in cbind(time, f(time), dx, fdx): number of rows of result is not a
## multiple of vector length (arg 3)
```

```r
names(df) <- c("time", "x", "dx", "fdx")
# xlab = expression(hat(mu)[0]), ylab = expression(alpha^beta),
#  main = expression(paste("Plot of ", alpha^beta, " versus ", hat(mu)[0])))
library(reshape2)
df_melt <- melt(df[-1])
```

```
## No id variables; using all as measure variables
```

```r
df_melt$time <- df$time
gg <- ggplot(df_melt, aes(x = time, y = value, color = variable))
gg + geom_line() + theme_bw()
```



8-31-17

Lecture is to derive kinematic equations for constant acceleration.

$$a = \frac{dv}{dt}$$

$$adt = dv$$

$$\int adt = \int v$$

$$at + v_0 = v$$

Moving onto the next one. We can rewrite v as the time integral of position.

$$at + v_0 = \frac{dx}{dt}$$

$$\frac{1}{2}at^2 + v_0 t + x_0 = x$$

The elastic force for a spring is $-k\Delta x$.

Sinusoidal position is $Asin(\omega t)$. $v = \omega Acos(\omega t)$ and $a = \omega^2 Asin(\omega t)$.

7-10 should be our spring constant if we do it right.

In excel, where A is time and B is pos make it

$$\frac{B_{n+2} - B_n}{A_{n+2} - A_n}$$