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> # Prof. Dr. Serkan Dağ
  # ME 310 Numerical Methods
  # File 13.4
  # Euler's Method
  # Solves the system of ODEs dy1/dt=f1, dy2/dt=f2,..., dyn/dt=fn
  # Applicable for both linear and nonlinear ODE's
  # Interval of interest is [a,b]
  # n is the number of segments
> restart :
  Digits := 16 :
> # Open the output file
> out := fopen("E:\\Courses\\2019_Spring\\ME310\\Files\\result.txt", 'WRITE', 'TEXT') :
> # Define the right-hand-side functions
> f1 := v;
  f2 := -(c/m)·v − (k/m)·x;
```

$$f1 := v$$

$$f2 := -\frac{c\,v}{m} - \frac{k\,x}{m} \quad \textbf{(1)}$$

```
> # Define the parameters
> m := 20 :
  c := 5 :
  k := 20 :
> # Interval end points
> a := 0. :
  b := 15. :
> # Number of segments
> n := 64 :
> # Initial conditions
> x0 := 1 :
  v0 := 0 :
> # Step size
> h := (b − a)/n;
```

$$h := 0.2343750000000000 \quad \textbf{(2)}$$

```
> # Analytical solution
> omega := 3·sqrt(7)/8 :
  A := 1 :
  B := 0.125/omega :
  xtrue := exp(−t/8)·(A·cos(omega·t) + B·sin(omega·t)) :
  vtrue := diff(xtrue, t) :
> # Initiate the integration
> t0 := a :
> for i from 1 by 1 to n
  while true do
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if i = 1 then

#printf("\n %5.1f %10.5f %15.8f %15.8f %15.8f %15.8f", i − 1, t0, x0, v0, x0, v0) :
fprintf(out, "\n %5.1f %10.5f %15.8f %15.8f %15.8f %15.8f", i − 1, t0, x0, v0, x0, v0) :

end if:

x := x0 + subs({v = v0}, f1) · h :

v := v0 + subs({v = v0, x = x0}, f2) · h :

tn := t0 + h :

xtruen := subs(t = tn, xtrue) :
vtruen := subs(t = tn, vtrue) :



#printf("\n %5.1f %10.5f %15.8f %15.8f %15.8f %15.8f", i, tn, xtruen, vtruen, x, v) :
fprintf(out, "\n %5.1f %10.5f %15.8f %15.8f %15.8f %15.8f", i, tn, xtruen, vtruen, x, v) :


t0 := tn :
x0 := x :
v0 := v :

end do:

> fclose(out) :
>
```