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> # Prof. Dr. Serkan Dağ
  # ME 310 Numerical Methods
  # File 13.2
  # Heun's Method
  # Solves the first-order ODE dy/dt = f(t,y)
  # Applicable for both linear and nonlinear ODE's
  # Interval of interest is [a,b]
  # n is the number of segments
  # y0 is the initial condition
> restart :
  Digits := 16 :
> # Open the output file
> out := fopen("E:\\Courses\\2019_Spring\\ME310\\Files\\resulth1.txt", 'WRITE', 'TEXT') :
> # Define the right-hand-side function
> f := g - (cp/m)·y^2;
```

$$f := g - \frac{cp\,y^2}{m} \tag{1}$$

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> m := 90 :
  cp := 0.225 :
  g := 9.81 :
> # Interval end points
> a := 0. :
  b := 5. :
> # Number of segments
> n := 16 :
> # Initial condition
> y0 := 0 :
> # Step size
> h := (b - a)/n;
```

$$h := 0.3125000000000000 \tag{2}$$

```
> # Initiate the integration
> t0 := a :
> for i from 1 by 1 to n
  while true do

  if i = 1 then
  printf("\n %5.1f %15.10f %8.4f", i - 1, y0, t0);
  fprintf(out, "\n %5.1f %15.10f %8.4f", i - 1, y0, t0) :
  end if:

  slope1 := subs({t = t0, y = y0}, f) :

  ypredict := y0 + slope1·h :

  tn := t0 + h :
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$slope2 := \frac{1}{2} \cdot (slope1 + subs(\{t = tn, y = ypredict\}, f)) :$

ycorrect $:= y0 + slope2 \cdot h$:

printf("\n %5.1f %15.10f %8.4f", i, ycorrect, *tn*);
fprintf(*out*, "\n %5.1f %15.10f %8.4f", *i*, *ycorrect*, *tn*) :

$t0 := tn$:
$y0 :=$ ycorrect :

end do:

```
 0.0    0.0000000000   0.0000
 1.0    3.0619538841   0.3125
 2.0    6.1092847148   0.6250
 3.0    9.1276565437   0.9375
 4.0   12.1032787450   1.2500
 5.0   15.0231513660   1.5625
 6.0   17.8752798751   1.8750
 7.0   20.6488523315   2.1875
 8.0   23.3343743436   2.5000
 9.0   25.9237596533   2.8125
10.0   28.4103765788   3.1250
11.0   30.7890526774   3.4375
12.0   33.0560417318   3.7500
13.0   35.2089584303   4.0625
14.0   37.2466868859   4.3750
15.0   39.1692694403   4.6875
16.0   40.9777820917   5.0000
```

> *fclose*(*out*) :

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