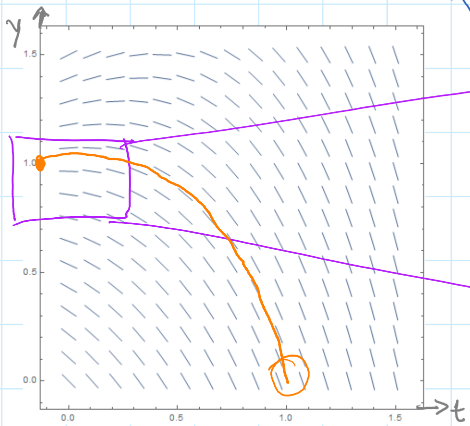
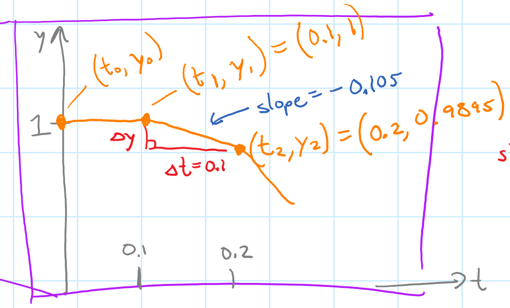
PROBLEM: $\frac{dy}{dt} = \underbrace{y - e^t}_{f(t,y)}$, $y(0) = 1$. What is $y(1)$?

(approximation is ok)





At $(0,1)$, $\frac{dy}{dt} = 1 - e^0 = 0$ slope = 0

At $(0.1, 1)$ $\frac{dy}{dt} = 1 - e^{0.1} = -0.105$

slope $= -0.105 = \frac{\Delta y}{0.1}$

$(0.1)(-0.105) = \Delta y$

$-0.0105 = \Delta y$

$y_2 = y_1 + \Delta t(-0.105)$

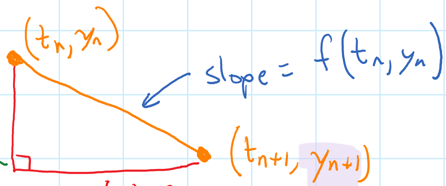
$y_2 = 1 - 0.0105$

$= 0.9895$

KEY IDEA:

$\Delta y = \cancel{y_n - y_{n+1}}$

$\Delta y = y_{n+1} - y_n$



$\Delta t = t_{n+1} - t_n$

slope $= f(t_n, y_n) = \frac{\Delta y}{\Delta t}$

$f(t_n, y_n) = \frac{y_{n+1} - y_n}{\Delta t}$

$\Delta t \cdot f(t_n, y_n) = y_{n+1} - y_n$

$$\boxed{f(t_n, y_n) \cdot \Delta t + y_n = y_{n+1}}$$

MATHEMATICA:

- **Do loop:** Do[expr, {var, min, max}]

  e.g. Do[Print[i^2], {i, 0, 9}]

- **Euler's method with a Do loop:**

```
Clear[y]
f[t_,y_] := y - E^t
y[0] = 1
Δt = 0.01
Do[y[n+1] = f[Δt*n, y[n]]*Δt + y[n], {n, 0, 99}]
eulerTable = Table[{Δt*n, y[n]}, {n, 0, 99}]
Grid[%]
```

After running this line, y[100] contains our approx. of y(1)

$y(1) \approx 0.020$