

A photograph of a person standing on a rocky mountain peak at night. The sky is filled with stars and bright green streaks of the Aurora Borealis. The person is silhouetted against the light from the aurora.

# Python DeCal

## Week 9

# Announcements

- Project Proposal Just Due lololol
- Final Projects
  - Keep working on it - don't stop lol
  - Keep coming to OHs
  - Deliverable due 2nd December
  - Presentations on 2/12 and 4/12 (last two lectures)
- Attendance: <https://tinyurl.com/too-busy-no-sleep>

# Recap and Discussion

- What are some of the challenges that you have had when writing your project proposal?
  - LaTeX? Etc.
- Are you planning to use **class** in your final project?

# SHOW-AND-TELL

# Differential equations (DiffEQs)...

- They govern the world...
- You have already seen some and you will see more in the future

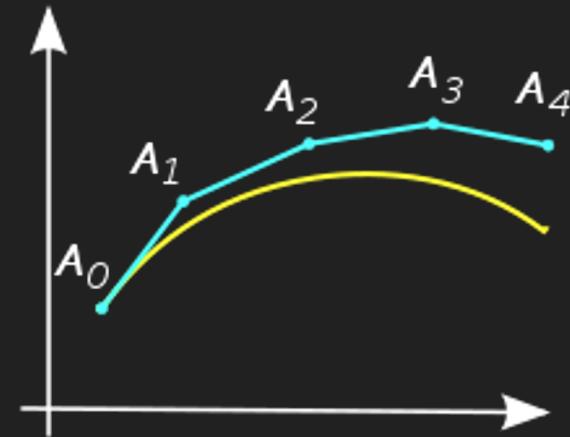
$$\frac{dx}{dt} = v(t)$$

$$\frac{d^2 \mathbf{r}}{dt^2} = \frac{\mathbf{F}(\mathbf{r})}{m}$$

$$\frac{\partial^2 f(x, t)}{\partial t^2} = c^2 \frac{\partial^2 f(x, t)}{\partial x^2}$$

# Solving ordinary differential equations (ODEs)...

- Euler's method (very similar to numerical integration)
  - Break down to segments
  - Specifying initial condition
    - You need to start from somewhere
    - Order of diff eq. = # of initial conditions
  - Need to specify your step size
- Assign! Not Append!



# Solving ordinary differential equations (ODEs)...

$$\frac{dy}{dx} = xy \quad (x_0, y_0) = (2, 3)$$

```
dx = 0.01
x0, y0 = 2, 3
def derivative(y,x):
    return x*y
x_arr = np.linspace(x0,5,301)
y_arr = np.zeros(301)

y_arr[0] = y0
for i in range(1, 301):
    dy = derivative(y_arr[i-1], x_arr[i-1]) * dx
    y = y_arr[i-1]+dy
    y_arr[i] = y
```

# Scipy function as well...

<https://docs.scipy.org/doc/scipy/reference/generated/scipy.integrate.odeint.html>

```
from scipy.integrate import odeint
```

**odeint(func, y0, t)**

```
def deriv(y,t):  
    return ...
```

Your function, make sure  
y is the first variable



Initial condition on y

Time point at which you  
would like to evaluate  
the function for

Equivalent to `x_arr`