Machine Learning: Libraries: Matplotlib

CPSC 501: Advanced Programming Techniques
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Jonathan Hudson, Ph.D
Assistant Professor (Teaching)
Department of Computer Science
University of Calgary

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matplotlib

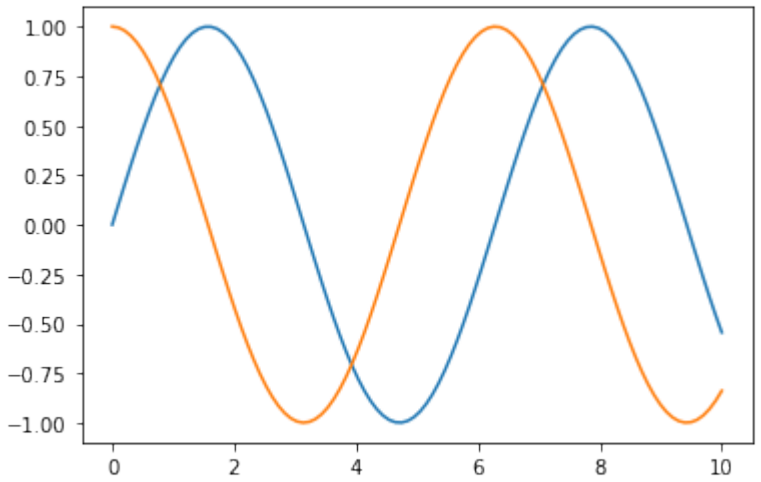
- **matplotlib** (2003) OG chart making inspired by MATLAB
- It received an early boost when it was adopted as the plotting package of choice of the Space Telescope Science Institute (the folks behind the Hubble Telescope), which financially supported Matplotlib's development and greatly expanded its capabilities.
- Big benefit (script chart making)
- Larger base has used it
- Style and usage is dated (one big reason why R and ggplot is popular) is that they are simpler (especially for non-programmers)
- Seaborn often used to look better, but others like ggpy, Holoviews, Altair exist

seaborn

- seaborn improvement on top of matplotlib
- Hides a lot of boilerplate
- Uses panadas dataframes which came post matplotlib
- Good defaults and bunch of presets (like ggplot in R)
- 2.0 matplotlib is response to try and integrate seaborn ideas

Quick matplotlib

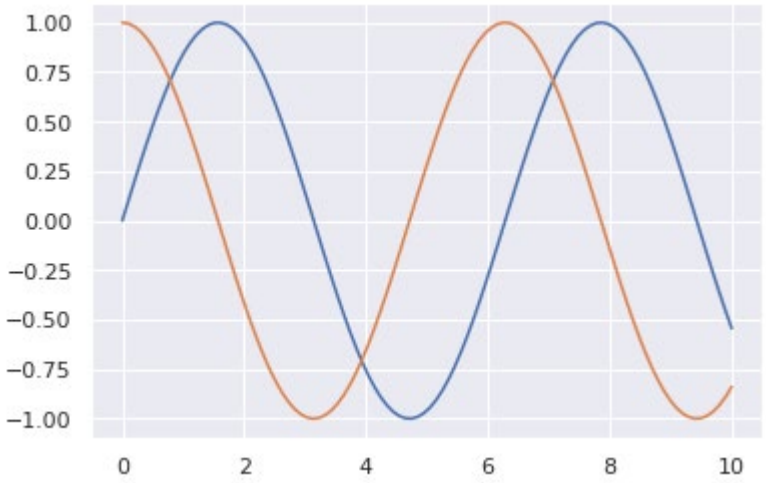
```
import matplotlib.pyplot as plt
import numpy as np

x = np.linspace(0, 10, 100)

plt.plot(x, np.sin(x))
plt.plot(x, np.cos(x))

plt.show()
```



The plt.show() command does a lot under the hood, as it must interact with your system's interactive graphical backend.

Quick seaboarn

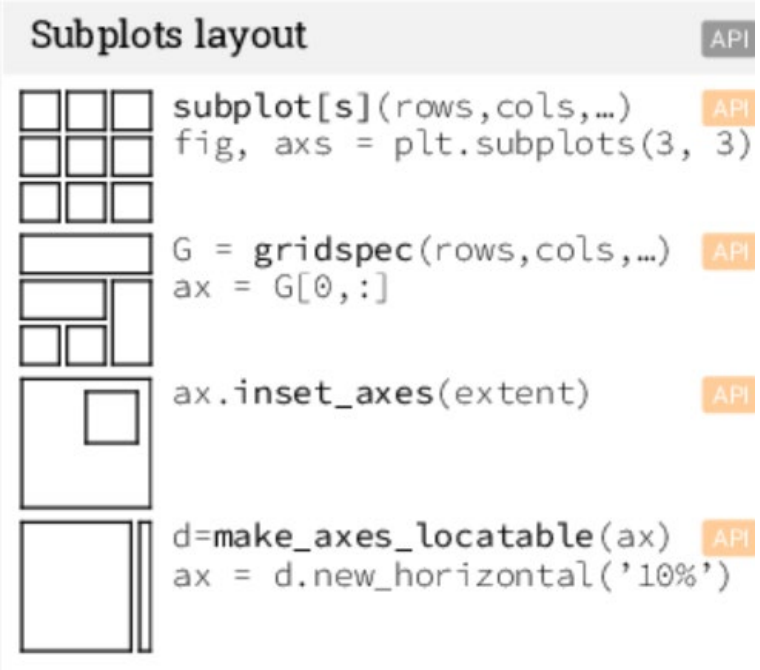
```
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
sns.set()
x = np.linspace(0, 10, 100)

plt.plot(x, np.sin(x))
plt.plot(x, np.cos(x))

plt.show()
```

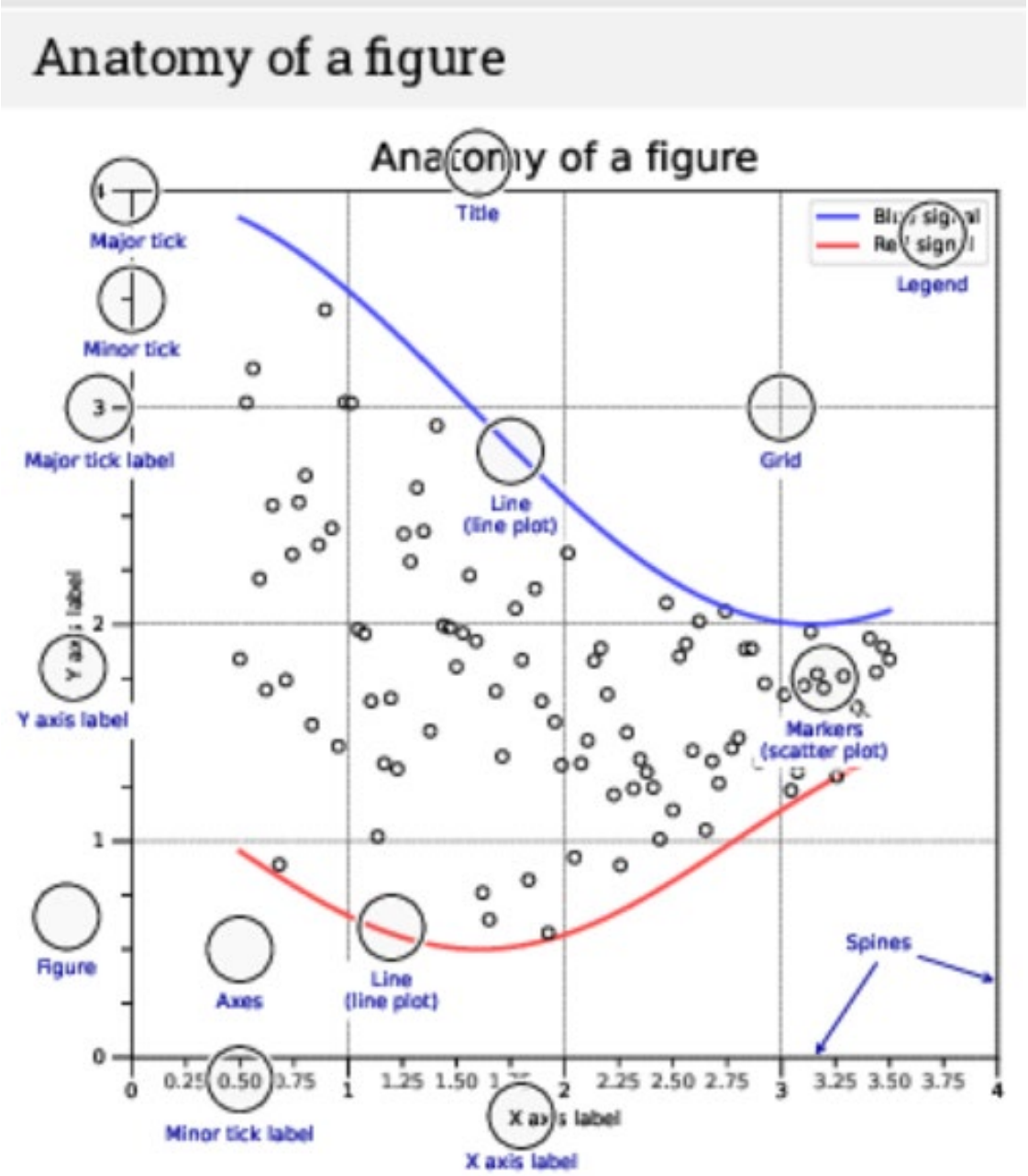


The plt.show() command does a lot under the hood, as it must interact with your system's interactive graphical backend.

Matplotlib parts

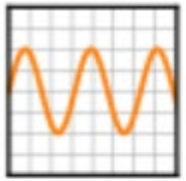
- Matplotlib parts are sensibly named
- Is support for layouts but not near as natural as R





Matplotlib plot types

Basic plots



`plot([X],Y,[fmt],…)` API
X, **Y**, fmt, color, marker, linestyle

`scatter(X,Y,…)` API
X, **Y**, [s]izes, [c]olors, marker, cmap

`bar[h](x,height,…)` API
x, **height**, width, bottom, align, color

`imshow(Z,…)` API
Z, cmap, interpolation, extent, origin

`contour[f]([X],[Y],Z,…)` API
X, Y, **Z**, levels, colors, extent, origin

`pcolormesh([X],[Y],Z,…)` API
X, Y, **Z**, vmin, vmax, cmap

`quiver([X],[Y],U,V,…)` API
X, Y, **U**, **V**, C, units, angles

`pie(X,…)` API
Z, explode, labels, colors, radius

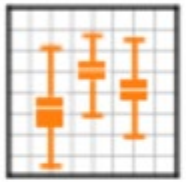
`text(x,y,text,…)` API
x, **y**, **text**, va, ha, size, weight, transform

`fill[_between][x](…)` API
X, Y1, Y2, color, where

Matplotlib plot types

Advanced plots

`step(X,Y,[fmt],…)` API
X, **Y**, fmt, color, marker, where

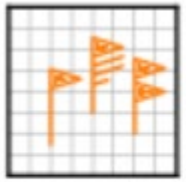


`boxplot(X,…)` API
X, notch, sym, bootstrap, widths

`errorbar(X,Y,xerr,yerr,…)` API
X, **Y**, xerr, yerr, fmt

`hist(X, bins, …)` API
X, bins, range, density, weights

`violinplot(D,…)` API
D, positions, widths, vert



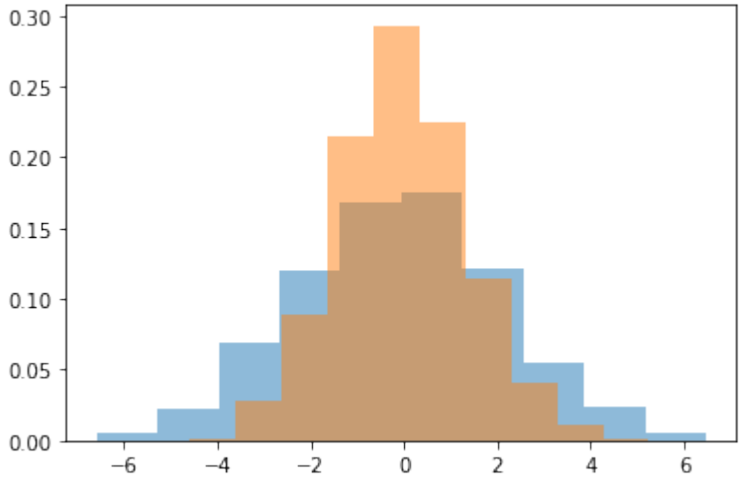
`barbs([X],[Y], U, V, …)` API
X, Y, **U**, **V**, C, length, pivot, sizes

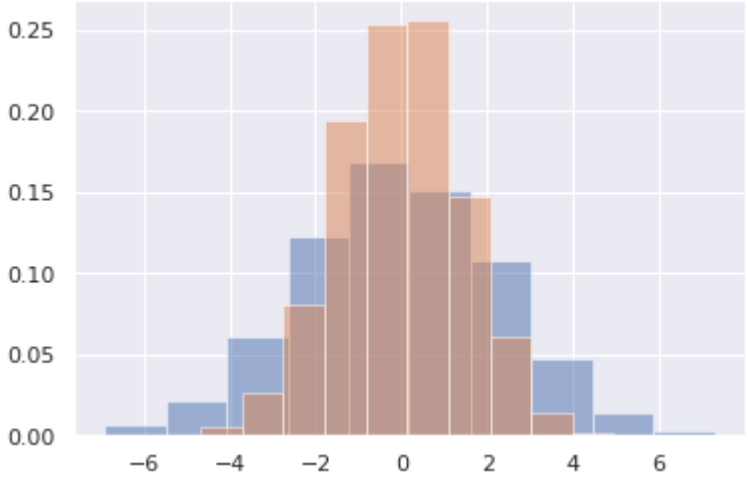
`eventplot(positions,…)` API
positions, orientation, lineoffsets

`hexbin(X,Y,C,…)` API
X, **Y**, C, gridsize, bins

Matplotlib other

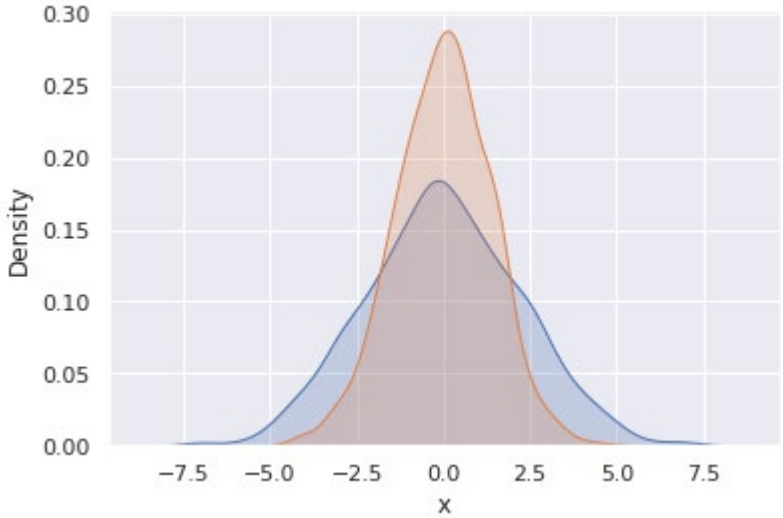
```
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
import pandas as pd
data = np.random.multivariate_normal([0, 0], [[5, 2], [2, 2]], size=2000)
data = pd.DataFrame(data, columns=['x', 'y'])

for col in 'xy':
    plt.hist(data[col], density=True, alpha=0.5)
```



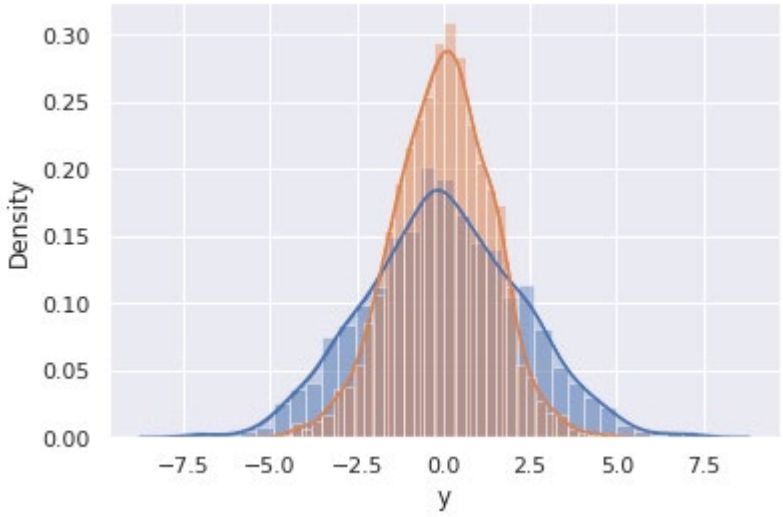


Seaborn

```
for col in 'xy':
    sns.kdeplot(data[col], shade=True)
```

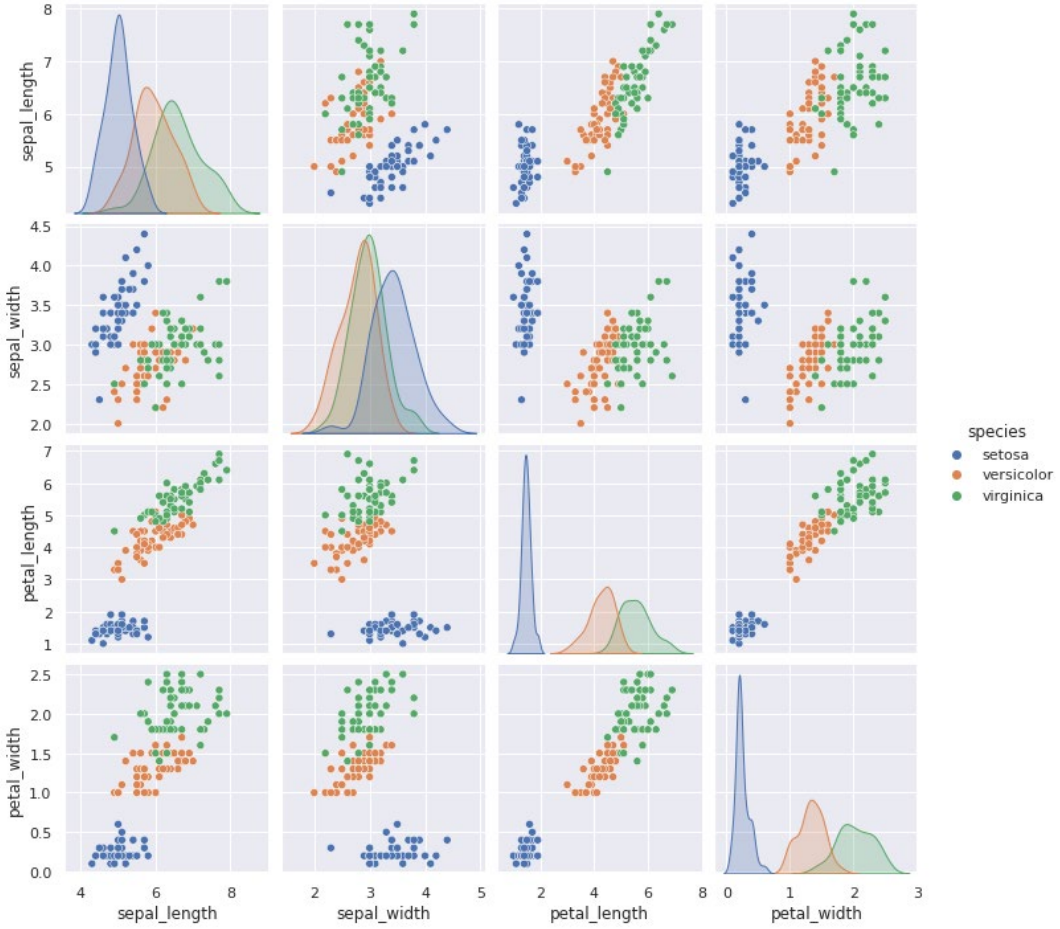



```
#Add in
sns.distplot(data['x'])
sns.distplot(data['y']);
```



Seaborn pair plots

```
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import seaborn as sns

iris = sns.load_dataset("iris")
sns.pairplot(iris, hue='species', height=2.5);
```



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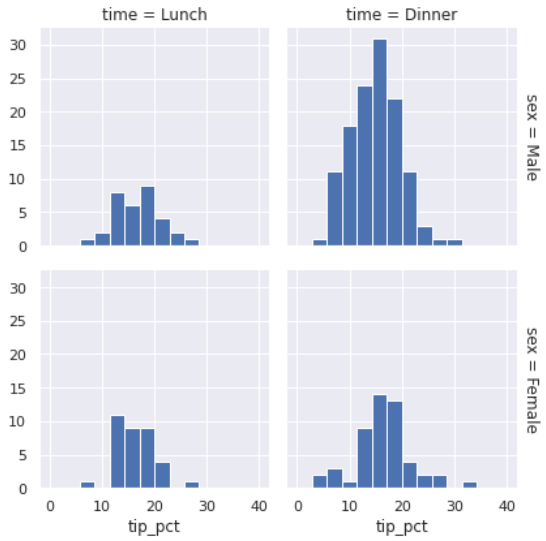
Seaborn others

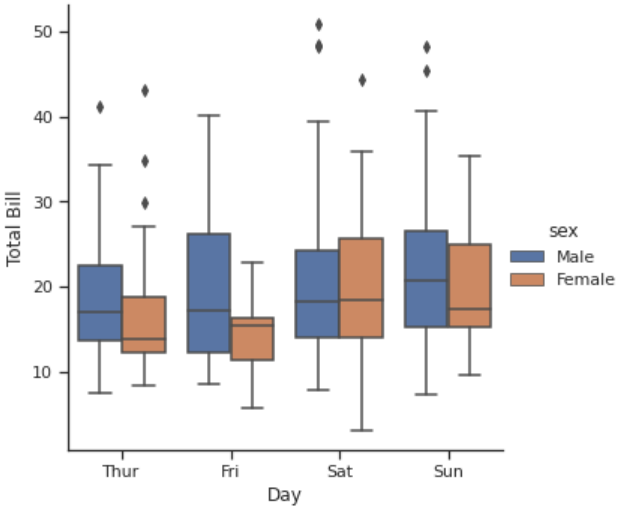
Faceted histograms, sns.FacetGrid

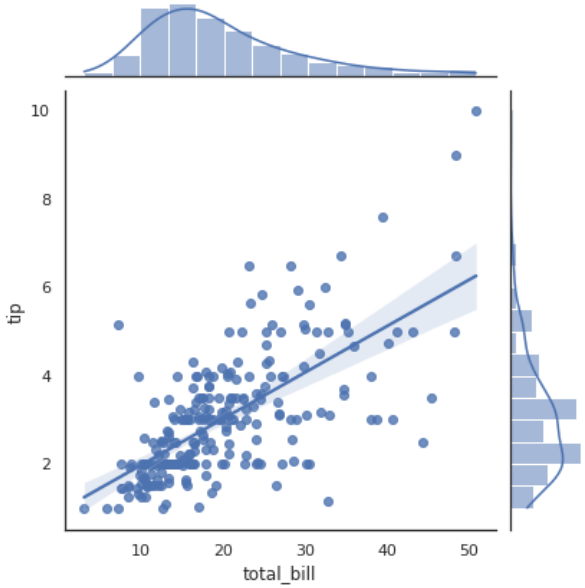
Factor (Category plots) sns.catplot

Joint Distributions sns.jointplot

So much easier (like in R)







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Onward to … Artificial Intelligence

Jonathan Hudson
jwhudson@ucalgary.ca
https://pages.cpsc.ucalgary.ca/~jwhudson/

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