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} }, “cell\_type”: “markdown”, “metadata”: {}, “source”: [ “tensorflow1.JPG”, “”, “” ] }, { “cell\_type”: “markdown”, “metadata”: {}, “source”: [ “TensorFlow is an open source library developed at Google to support machine learning. Its focus is on deep neural networks. It was developed by Geoffrey Hinton, Jeff Dean (and many others!) starting in 2009 with an initial focus on speech recognition. It’s integrated with Kubernetes via the Kubeflow application. Version 2.0 was released in 2019, along with TensorFlow Graphics (deep learning in graphics). It’s main applications now are around image capturing.”, “”, “Google developed its ‘Tensor processing unit’ - a chip designed precisely for TensorFlow. These power Google Compute and when stacked into clusters of 64 TPUs can deliver 11.5 petaflops. They are now available to the world on the Google Cloud Platform.”, “”, “It’s got a Python API (3.7+). It also has bindings to C++, Go, Julia, and a host of others.”, “”, “It’s built on numpy and uses numpy.ndarray objects as base building blocks. It has a numpy-friendly API, so you can work with tensors pretty much the same way you’d work with numpy arrays. These links will get you started.”, “”, “To install: ”, “$ conda install -c anaconda tensorflow ”, “”, “https://www.tensorflow.org/guide/tf\_numpy”, “”, “https://www.tensorflow.org”, “”, “**Keras** is an API that allows easy creation of training tasks across multiple GPUs, TPUs, or machines. It handles a stack of single inputs and single outputs of tensors, sequentially processed. It can be used for feature extraction with complex models. It works well with Google Colab, a hosted Jupyter Notebook site.”, “”, “https://www.tensorflow.org/guide/keras/sequential\_model” ] }, { “attachments”: { “pytorch.JPG”: { “image/jpeg”: 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Torch is a scientific computing framework and machine learning library. Torch itself uses a Lua wrapper over a C implementation of tensor arrays. It has packages for loss functions (accuracy) and neural networks. PyTorch is a Facebook project that took over development of Torch in 2020.”, “”, “PyTorch supports automatic differentiation (calculation of high-dimension gradients) and a variety of optimization methods useful for building neural nets. It is built on top of numpy and the pytorch.Tensor object is fundamentally a numpy.ndarray. ”, “”, “PyTorch is CUDA-compatible (CUDA is an Nvidia platform/library for GPU-enabled parallel computing).”, “”, “Several other applications wrap and extend PyTorch including **Tesla Autopilot**, Uber’s **Pyro** application, and **PyTorch Lightning**.”, “”, “It’s supported on AWS, Google Cloud Platform, and Microsoft Azure.”, “”, “To install: ”, “$ conda install pytorch torchvision torchaudio cudatoolkit=10.2 -c pytorch ”, “”, “You can learn more here:”, “”, “https://pytorch.org/ ”, “”, “https://github.com/PyTorchLightning/pytorch-lightning”, “”, “https://developer.nvidia.com/about-cuda” ] }, { “attachments”: { “numba.JPG”: { “image/jpeg”: “” } }, “cell\_type”: “markdown”, “metadata”: {}, “source”: [ “numba.JPG” ] }, { “cell\_type”: “markdown”, “metadata”: {}, “source”: [ “Numba is a ‘just in time’ compiler that optimizes, compiles, and parallelizes arbitrary Python (3.6-3.9) functions - essentially turning your code into machine language using the LLVM compiler infrastructure. It’s CUDA-compatible, so can attain silicon-level optimization whether you’re using CPUs or GPUs. It’s built on numpy and mostly designed to optimize the performance of numpy.ndarray objects.”, “”, “It saves the step of converting Python into C/C++ code - this happens at execution time, making the performance enhancements completely portable. It’s implemented using simple decorator functions like.”, “”, “Here are some examples from the official docs:” ] }, { “cell\_type”: “code”, “execution\_count”: 1, “metadata”: { “ExecuteTime”: { “end\_time”: “2021-07-01T18:01:23.862721Z”, “start\_time”: “2021-07-01T18:01:23.200026Z” } }, “outputs”: [], “source”: [ “""" Parallelizes operations """”, “from numba import jit”, “@jit(nopython=True, parallel=True)”, “def simulator(out):”, " # iterate loop in parallel“,” for i in prange(out.shape[0]):“,” out[i] = run\_sim()" ] }, { “cell\_type”: “code”, “execution\_count”: 5, “metadata”: { “ExecuteTime”: { “end\_time”: “2021-07-01T18:14:23.076256Z”, “start\_time”: “2021-07-01T18:14:23.070756Z” } }, “outputs”: [], “source”: [ “""" Compile an arbitrary function """”, “from numba import jit”, “import random”, “”, “@jit(nopython=True)”, “def monte\_carlo\_pi(nsamples):”, " acc = 0“,” for i in range(nsamples):“,” x = random.random()“,” y = random.random()“,” if (x \*\* 2 + y \*\* 2) < 1.0:“,” acc 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AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAMjAyMTowNjozMCAxMTowODo0MgAyMDIxOjA2OjMwIDExOjA4OjQyAAAAcABhAHQAAAD/4QsWaHR0cDovL25zLmFkb2JlLmNvbS94YXAvMS4wLwA8P3hwYWNrZXQgYmVnaW49J++7vycgaWQ9J1c1TTBNcENlaGlIenJlU3pOVGN6a2M5ZCc/Pg0KPHg6eG1wbWV0YSB4bWxuczp4PSJhZG9iZTpuczptZXRhLyI+PHJkZjpSREYgeG1sbnM6cmRmPSJodHRwOi8vd3d3LnczLm9yZy8xOTk5LzAyLzIyLXJkZi1zeW50YXgtbnMjIj48cmRmOkRlc2NyaXB0aW9uIHJkZjphYm91dD0idXVpZDpmYWY1YmRkNS1iYTNkLTExZGEtYWQzMS1kMzNkNzUxODJmMWIiIHhtbG5zOmRjPSJodHRwOi8vcHVybC5vcmcvZGMvZWxlbWVudHMvMS4xLyIvPjxyZGY6RGVzY3JpcHRpb24gcmRmOmFib3V0PSJ1dWlkOmZhZjViZGQ1LWJhM2QtMTFkYS1hZDMxLWQzM2Q3NTE4MmYxYiIgeG1sbnM6eG1wPSJodHRwOi8vbnMuYWRvYmUuY29tL3hhcC8xLjAvIj48eG1wOkNyZWF0ZURhdGU+MjAyMS0wNi0zMFQxMTowODo0Mi42NDY8L3htcDpDcmVhdGVEYXRlPjwvcmRmOkRlc2NyaXB0aW9uPjxyZGY6RGVzY3JpcHRpb24gcmRmOmFib3V0PSJ1dWlkOmZhZjViZGQ1LWJhM2QtMTFkYS1hZDMxLWQzM2Q3NTE4MmYxYiIgeG1sbnM6ZGM9Imh0dHA6Ly9wdXJsLm9yZy9kYy9lbGVtZW50cy8xLjEvIj48ZGM6Y3JlYXRvcj48cmRmOlNlcSB4bWxuczpyZGY9Imh0dHA6Ly93d3cudzMub3JnLzE5OTkvMDIvMjItcmRmLXN5bnRheC1ucyMiPjxyZGY6bGk+cGF0PC9yZGY6bGk+PC9yZGY6U2VxPg0KCQkJPC9kYzpjcmVhdG9yPjwvcmRmOkRlc2NyaXB0aW9uPjwvcmRmOlJERj48L3g6eG1wbWV0YT4NCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgPD94cGFja2V0IGVuZD0ndyc/Pv/bAEMABwUFBgUEBwYFBggHBwgKEQsKCQkKFQ8QDBEYFRoZGBUYFxseJyEbHSUdFxgiLiIlKCkrLCsaIC8zLyoyJyorKv/bAEMBBwgICgkKFAsLFCocGBwqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKv/AABEIAHoBdQMBIgACEQEDEQH/xAAfAAABBQEBAQEBAQAAAAAAAAAAAQIDBAUGBwgJCgv/xAC1EAACAQMDAgQDBQUEBAAAAX0BAgMABBEFEiExQQYTUWEHInEUMoGRoQgjQrHBFVLR8CQzYnKCCQoWFxgZGiUmJygpKjQ1Njc4OTpDREVGR0hJSlNUVVZXWFlaY2RlZmdoaWpzdHV2d3h5eoOEhYaHiImKkpOUlZaXmJmaoqOkpaanqKmqsrO0tba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} }, “cell\_type”: “markdown”, “metadata”: {}, “source”: [ “pymc3.JPG” ] }, { “cell\_type”: “markdown”, “metadata”: {}, “source”: [ “PyMC3 is used for Bayesian linear regression (and Bayesian inference, generally). PyMC3 also contains a factor analysis module. It specializes in simulation-based optimization of complex, high-dimension data spaces and can even handle data spaces that are defined parametrically at run-time. PyMC3 also contains a factor analysis module”, “”, “With PyMC3, you can implement a Marcov chain Monte Carlo with sampling algorithms NUTS (No-U-Turn sampler) and HCM (Hamiltonian Monte Carlo) that’s self-tuning; that means you don’t need prior knowledge of the distribution.”, “”, “NUTS (No U-Turn Sampling) is a way to characterize an unknown distribution by drawing correlated samples that will converge in distribution to the unknown distribution. It’s written up by Matthew Hoffman (*J. Machine Learning Research, 2014*). It eliminates the need to do a random walk of the distribution by calculating gradients and using them for the next target region to explore.”, “”, “It’s a tweak to Hamiltonian Monte Carlo approach that replaces random walk with simulation of Hamiltonian dynamics. That’s the bit that requires calculation of the gradient. Gradient calculation requires that the user pick the step size ($\\epsilon$) and the number of steps (L) - and getting these right can be really tough. ”, “”, “Hamiltonian dynamics uses an auxialiary momentum variable for each model variable $\\theta\_d$. It’s based on partical dynamics where theta is a partical’s position in D-dimensional space. The momentum variable is the momentum in the dth dimension. It factors in the position-dependent negative potential energy and the kinetic energy of the particle.”, “”, “**Theano** is used under the hood for gradient calculation - it uses differentiation and can complile probabilistic problems to C on the fly. Theano allows expressions to be defined as tensors, which are tightly integrated with numpy.ndarray objects.”, “”, “To install:”, “”, “$ conda install -c conda-forge pymc3”, “”, “http://docs.pymc.io”, “”, “http://docs.pymc.io/pymc-examples/examples/pymc3\_howto/api\_quickstart.html”, “”, “Here is an example from the docs:” ] }, { “cell\_type”: “code”, “execution\_count”: null, “metadata”: {}, “outputs”: [], “source”: [ “import pymc3 as pm”, “”, “X, y = linear\_training\_data()”, “with pm.Model() as linear\_model:”, " weights = pm.Normal("weights", mu=0, sigma=1)“,” noise = pm.Gamma("noise", alpha=2, beta=1)“,” y\_observed = pm.Normal(“,” "y\_observed",“,” mu=X @ weights,“,” sigma=noise,“,” observed=y,“,” )“,”“,” prior = pm.sample\_prior\_predictive()“,” posterior = pm.sample()“,” posterior\_pred = pm.sample\_posterior\_predictive(posterior)" ] }, { “attachments”: { “bokeh.JPG”: { “image/jpeg”: 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AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAMjAyMTowNjozMCAxMjozODo1MAAyMDIxOjA2OjMwIDEyOjM4OjUwAAAAcABhAHQAAAD/4QsWaHR0cDovL25zLmFkb2JlLmNvbS94YXAvMS4wLwA8P3hwYWNrZXQgYmVnaW49J++7vycgaWQ9J1c1TTBNcENlaGlIenJlU3pOVGN6a2M5ZCc/Pg0KPHg6eG1wbWV0YSB4bWxuczp4PSJhZG9iZTpuczptZXRhLyI+PHJkZjpSREYgeG1sbnM6cmRmPSJodHRwOi8vd3d3LnczLm9yZy8xOTk5LzAyLzIyLXJkZi1zeW50YXgtbnMjIj48cmRmOkRlc2NyaXB0aW9uIHJkZjphYm91dD0idXVpZDpmYWY1YmRkNS1iYTNkLTExZGEtYWQzMS1kMzNkNzUxODJmMWIiIHhtbG5zOmRjPSJodHRwOi8vcHVybC5vcmcvZGMvZWxlbWVudHMvMS4xLyIvPjxyZGY6RGVzY3JpcHRpb24gcmRmOmFib3V0PSJ1dWlkOmZhZjViZGQ1LWJhM2QtMTFkYS1hZDMxLWQzM2Q3NTE4MmYxYiIgeG1sbnM6eG1wPSJodHRwOi8vbnMuYWRvYmUuY29tL3hhcC8xLjAvIj48eG1wOkNyZWF0ZURhdGU+MjAyMS0wNi0zMFQxMjozODo1MC4zMTk8L3htcDpDcmVhdGVEYXRlPjwvcmRmOkRlc2NyaXB0aW9uPjxyZGY6RGVzY3JpcHRpb24gcmRmOmFib3V0PSJ1dWlkOmZhZjViZGQ1LWJhM2QtMTFkYS1hZDMxLWQzM2Q3NTE4MmYxYiIgeG1sbnM6ZGM9Imh0dHA6Ly9wdXJsLm9yZy9kYy9lbGVtZW50cy8xLjEvIj48ZGM6Y3JlYXRvcj48cmRmOlNlcSB4bWxuczpyZGY9Imh0dHA6Ly93d3cudzMub3JnLzE5OTkvMDIvMjItcmRmLXN5bnRheC1ucyMiPjxyZGY6bGk+cGF0PC9yZGY6bGk+PC9yZGY6U2VxPg0KCQkJPC9kYzpjcmVhdG9yPjwvcmRmOkRlc2NyaXB0aW9uPjwvcmRmOlJERj48L3g6eG1wbWV0YT4NCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgPD94cGFja2V0IGVuZD0ndyc/Pv/bAEMABwUFBgUEBwYFBggHBwgKEQsKCQkKFQ8QDBEYFRoZGBUYFxseJyEbHSUdFxgiLiIlKCkrLCsaIC8zLyoyJyorKv/bAEMBBwgICgkKFAsLFCocGBwqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKv/AABEIAGQBfAMBIgACEQEDEQH/xAAfAAABBQEBAQEBAQAAAAAAAAAAAQIDBAUGBwgJCgv/xAC1EAACAQMDAgQDBQUEBAAAAX0BAgMABBEFEiExQQYTUWEHInEUMoGRoQgjQrHBFVLR8CQzYnKCCQoWFxgZGiUmJygpKjQ1Njc4OTpDREVGR0hJSlNUVVZXWFlaY2RlZmdoaWpzdHV2d3h5eoOEhYaHiImKkpOUlZaXmJmaoqOkpaanqKmqsrO0tba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} }, “cell\_type”: “markdown”, “metadata”: {}, “source”: [ “bokeh.JPG” ] }, { “cell\_type”: “markdown”, “metadata”: {}, “source”: [ “Bokeh is an all-purpose, interactive visualization library that wraps **matplotlib** and integrates tools like **Datashader** and **Holoviews**. It’s particularly useful for visual exploration of complex (or even streaming) data sets. It’s also useful for creating dashboards as "visual APIs" into your analytical work for presentation or collaboration purposes.”, “”, “To install:”, “”, “$ conda install -c anaconda bokeh ”, “”, “https://bokeh.org/”, “https://docs.bokeh.org/en/latest/docs/user\_guide.html”, “https://github.com/bokeh/bokeh”, “”, “Here’s an example from Bokeh’s on-line tutorial:” ] }, { “cell\_type”: “code”, “execution\_count”: 6, “metadata”: { “ExecuteTime”: { “end\_time”: “2021-07-01T18:15:25.107564Z”, “start\_time”: “2021-07-01T18:15:24.393272Z” } }, “outputs”: [ { “data”: { “text/html”: [ “”, "

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" ] }, “metadata”: {}, “output\_type”: “display\_data” }, { “data”: { “application/javascript”: [ “”, “(function(root) {”, " function now() {“,” return new Date();“,” }“,”“,” var force = true;“,”“,” if (typeof root.\_bokeh\_onload\_callbacks === "undefined" || force === true) {“,” root.\_bokeh\_onload\_callbacks = [];“,” root.\_bokeh\_is\_loading = undefined;“,” }“,”“,” var JS\_MIME\_TYPE = ‘application/javascript’;“,” var HTML\_MIME\_TYPE = ‘text/html’;“,” var EXEC\_MIME\_TYPE = ‘application/vnd.bokehjs\_exec.v0+json’;“,” var CLASS\_NAME = ‘output\_bokeh rendered\_html’;“,”“,” /\*\*“,” \* Render data to the DOM node“,” \*/“,” function render(props, node) {“,” var script = document.createElement("script");“,” node.appendChild(script);“,” }“,”“,” /\*\*“,” \* Handle when an output is cleared or removed“,” \*/“,” function handleClearOutput(event, handle) {“,” var cell = handle.cell;“,”“,” var id = cell.output\_area.\_bokeh\_element\_id;“,” var server\_id = cell.output\_area.\_bokeh\_server\_id;“,” // Clean up Bokeh references“,” if (id != null && id in Bokeh.index) {“,” Bokeh.index[id].model.document.clear();“,” delete Bokeh.index[id];“,” }“,”“,” if (server\_id !== undefined) {“,” // Clean up Bokeh references“,” var cmd = "from bokeh.io.state import curstate; print(curstate().uuid\_to\_server[‘" + server\_id + "’].get\_sessions()[0].document.roots[0].\_id)";“,” cell.notebook.kernel.execute(cmd, {“,” iopub: {“,” output: function(msg) {“,” var id = msg.content.text.trim();“,” if (id in Bokeh.index) {“,” Bokeh.index[id].model.document.clear();“,” delete Bokeh.index[id];“,” }“,” }“,” }“,” });“,” // Destroy server and session“,” var cmd = "import bokeh.io.notebook as ion; ion.destroy\_server(‘" + server\_id + "’)";“,” cell.notebook.kernel.execute(cmd);“,” }“,” }“,”“,” /\*\*“,” \* Handle when a new output is added“,” */“,” function handleAddOutput(event, handle) {“,” var output\_area = handle.output\_area;“,” var output = handle.output;“,”“,” // limit handleAddOutput to display\_data with EXEC\_MIME\_TYPE content only“,” if ((output.output\_type != "display\_data") || (!Object.prototype.hasOwnProperty.call(output.data, EXEC\_MIME\_TYPE))) {“,” return“,” }“,”“,” var toinsert = output\_area.element.find("." + CLASS\_NAME.split(’ ’)[0]);“,”“,” if (output.metadata[EXEC\_MIME\_TYPE]["id"] !== undefined) {“,” toinsert[toinsert.length - 1].firstChild.textContent = output.data[JS\_MIME\_TYPE];“,” // store reference to embed id on output\_area“,” output\_area.\_bokeh\_element\_id = output.metadata[EXEC\_MIME\_TYPE]["id"];“,” }“,” if (output.metadata[EXEC\_MIME\_TYPE]["server\_id"] !== undefined) {“,” var bk\_div = document.createElement("div");“,” bk\_div.innerHTML = output.data[HTML\_MIME\_TYPE];“,” var script\_attrs = bk\_div.children[0].attributes;“,” for (var i = 0; i < script\_attrs.length; i++) {“,” toinsert[toinsert.length - 1].firstChild.setAttribute(script\_attrs[i].name, script\_attrs[i].value);“,” toinsert[toinsert.length - 1].firstChild.textContent = bk\_div.children[0].textContent“,” }“,” // store reference to server id on output\_area“,” output\_area.\_bokeh\_server\_id = output.metadata[EXEC\_MIME\_TYPE]["server\_id"];“,” }“,” }“,”“,” function register\_renderer(events, OutputArea) {“,”“,” function append\_mime(data, metadata, element) {“,” // create a DOM node to render to“,” var toinsert = this.create\_output\_subarea(“,” metadata,“,” CLASS\_NAME,“,” EXEC\_MIME\_TYPE“,” );“,” this.keyboard\_manager.register\_events(toinsert);“,” // Render to node“,” var props = {data: data, metadata: metadata[EXEC\_MIME\_TYPE]};“,” render(props, toinsert[toinsert.length - 1]);“,” element.append(toinsert);“,” return toinsert“,” }“,”“,” /* Handle when an output is cleared or removed */“,” events.on(‘clear\_output.CodeCell’, handleClearOutput);“,” events.on(‘delete.Cell’, handleClearOutput);“,”“,” /* Handle when a new output is added \*/“,” events.on(‘output\_added.OutputArea’, handleAddOutput);“,”“,” /\*\*“,” \* Register the mime type and append\_mime function with output\_area“,” */“,” OutputArea.prototype.register\_mime\_type(EXEC\_MIME\_TYPE, append\_mime, {“,” /* Is output safe? */“,” safe: true,“,” /* Index of renderer in output\_area.display\_order \*/“,” index: 0“,” });“,” }“,”“,” // register the mime type if in Jupyter Notebook environment and previously unregistered“,” if (root.Jupyter !== undefined) {“,” var events = require(‘base/js/events’);“,” var OutputArea = require(‘notebook/js/outputarea’).OutputArea;“,”“,” if (OutputArea.prototype.mime\_types().indexOf(EXEC\_MIME\_TYPE) == -1) {“,” register\_renderer(events, OutputArea);“,” }“,” }“,”“,” “,” if (typeof (root.\_bokeh\_timeout) === "undefined" || force === true) {“,” root.\_bokeh\_timeout = Date.now() + 5000;“,” root.\_bokeh\_failed\_load = false;“,” }“,”“,” var NB\_LOAD\_WARNING = {‘data’: {‘text/html’:“,” "

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\n"+“,” "BokehJS does not appear to have successfully loaded. If loading BokehJS from CDN, this \n"+“,” "may be due to a slow or bad network connection. Possible fixes:\n"+“,” "

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re-rerun output\_notebook() to attempt to load from CDN again, or

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use INLINE resources instead, as so:

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\n"+“,” "\n"+“,” "from bokeh.resources import INLINE\n"+“,” "output\_notebook(resources=INLINE)\n"+“,” "\n"+“,” "

"}};“,”“,” function display\_loaded() {“,” var el = document.getElementById("1001");“,” if (el != null) {“,” el.textContent = "BokehJS is loading…";“,” }“,” if (root.Bokeh !== undefined) {“,” if (el != null) {“,” el.textContent = "BokehJS " + root.Bokeh.version + " successfully loaded.";“,” }“,” } else if (Date.now() < root.\_bokeh\_timeout) {“,” setTimeout(display\_loaded, 100)“,” }“,” }“,”“,”“,” function run\_callbacks() {“,” try {“,” root.\_bokeh\_onload\_callbacks.forEach(function(callback) {“,” if (callback != null)“,” callback();“,” });“,” } finally {“,” delete root.\_bokeh\_onload\_callbacks“,” }“,” console.debug("Bokeh: all callbacks have finished");“,” }“,”“,” function load\_libs(css\_urls, js\_urls, callback) {“,” if (css\_urls == null) css\_urls = [];“,” if (js\_urls == null) js\_urls = [];“,”“,” root.\_bokeh\_onload\_callbacks.push(callback);“,” if (root.\_bokeh\_is\_loading > 0) {“,” console.debug("Bokeh: BokehJS is being loaded, scheduling callback at", now());“,” return null;“,” }“,” if (js\_urls == null || js\_urls.length === 0) {“,” run\_callbacks();“,” return null;“,” }“,” console.debug("Bokeh: BokehJS not loaded, scheduling load and callback at", now());“,” root.\_bokeh\_is\_loading = css\_urls.length + js\_urls.length;“,”“,” function on\_load() {“,” root.\_bokeh\_is\_loading–;“,” if (root.\_bokeh\_is\_loading === 0) {“,” console.debug("Bokeh: all BokehJS libraries/stylesheets loaded");“,” run\_callbacks()“,” }“,” }“,”“,” function on\_error(url) {“,” console.error("failed to load " + url);“,” }“,”“,” for (let i = 0; i < css\_urls.length; i++) {“,” const url = css\_urls[i];“,” const element = document.createElement("link");“,” element.onload = on\_load;“,” element.onerror = on\_error.bind(null, url);“,” element.rel = "stylesheet";“,” element.type = "text/css";“,” element.href = url;“,” console.debug("Bokeh: injecting link tag for BokehJS stylesheet: ", url);“,” document.body.appendChild(element);“,” }“,”“,” const hashes = {"https://cdn.bokeh.org/bokeh/release/bokeh-2.3.2.min.js": "XypntL49z55iwGVUW4qsEu83zKL3XEcz0MjuGOQ9SlaaQ68X/g+k1FcioZi7oQAc", "https://cdn.bokeh.org/bokeh/release/bokeh-tables-2.3.2.min.js": "bEsM86IHGDTLCS0Zod8a8WM6Y4+lafAL/eSiyQcuPzinmWNgNO2/olUF0Z2Dkn5i", "https://cdn.bokeh.org/bokeh/release/bokeh-widgets-2.3.2.min.js": "TX0gSQTdXTTeScqxj6PVQxTiRW8DOoGVwinyi1D3kxv7wuxQ02XkOxv0xwiypcAH"};“,”“,” for (let i = 0; i < js\_urls.length; i++) {“,” const url = js\_urls[i];“,” const element = document.createElement(‘script’);“,” element.onload = on\_load;“,” element.onerror = on\_error.bind(null, url);“,” element.async = false;“,” element.src = url;“,” if (url in hashes) {“,” element.crossOrigin = "anonymous";“,” element.integrity = "sha384-" + hashes[url];“,” }“,” console.debug("Bokeh: injecting script tag for BokehJS library: ", url);“,” document.head.appendChild(element);“,” }“,” };“,”“,” function inject\_raw\_css(css) {“,” const element = document.createElement("style");“,” element.appendChild(document.createTextNode(css));“,” document.body.appendChild(element);“,” }“,”“,” “,” var js\_urls = ["https://cdn.bokeh.org/bokeh/release/bokeh-2.3.2.min.js", "https://cdn.bokeh.org/bokeh/release/bokeh-widgets-2.3.2.min.js", "https://cdn.bokeh.org/bokeh/release/bokeh-tables-2.3.2.min.js"];“,” var css\_urls = [];“,” “,”“,” var inline\_js = [“,” function(Bokeh) {“,” Bokeh.set\_log\_level("info");“,” },“,” function(Bokeh) {“,” “,” “,” }“,” ];“,”“,” function run\_inline\_js() {“,” “,” if (root.Bokeh !== undefined || force === true) {“,” “,” for (var i = 0; i < inline\_js.length; i++) {“,” inline\_js[i].call(root, root.Bokeh);“,” }“,” if (force === true) {“,” display\_loaded();“,” }} else if (Date.now() < root.\_bokeh\_timeout) {“,” setTimeout(run\_inline\_js, 100);“,” } else if (!root.\_bokeh\_failed\_load) {“,” console.log("Bokeh: BokehJS failed to load within specified timeout.");“,” root.\_bokeh\_failed\_load = true;“,” } else if (force !== true) {“,” var cell = $(document.getElementById("1001")).parents(‘.cell’).data().cell;“,” cell.output\_area.append\_execute\_result(NB\_LOAD\_WARNING)“,” }“,”“,” }“,”“,” if (root.\_bokeh\_is\_loading === 0) {“,” console.debug("Bokeh: BokehJS loaded, going straight to plotting");“,” run\_inline\_js();“,” } else {“,” load\_libs(css\_urls, js\_urls, function() {“,” console.debug("Bokeh: BokehJS plotting callback run at", now());“,” run\_inline\_js();“,” });“,” }“,”}(window));" ], “application/vnd.bokehjs\_load.v0+json”: "(function(root) {function now() {return new Date();}var force = true;if (typeof root.\_bokeh\_onload\_callbacks === "undefined" || force === true) {root.\_bokeh\_onload\_callbacks = [];root.\_bokeh\_is\_loading = undefined;}if (typeof (root.\_bokeh\_timeout) === "undefined" || force === true) {root.\_bokeh\_timeout = Date.now() + 5000;root.\_bokeh\_failed\_load = false;}var NB\_LOAD\_WARNING = {‘data’: {‘text/html’:"

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\n"+"BokehJS does not appear to have successfully loaded. If loading BokehJS from CDN, this \n"+"may be due to a slow or bad network connection. Possible fixes:\n"+"

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re-rerun output\_notebook() to attempt to load from CDN again, or

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use INLINE resources instead, as so:

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\n"+"\n"+"from bokeh.resources import INLINE\n"+"output\_notebook(resources=INLINE)\n"+"\n"+"

"}};function display\_loaded() {var el = document.getElementById("1001");if (el != null) {el.textContent = "BokehJS is loading…";}if (root.Bokeh !== undefined) {if (el != null) {el.textContent = "BokehJS " + root.Bokeh.version + " successfully loaded.";}} else if (Date.now() < root.\_bokeh\_timeout) {setTimeout(display\_loaded, 100)}}function run\_callbacks() {try {root.\_bokeh\_onload\_callbacks.forEach(function(callback) {if (callback != null)callback();});} finally {delete root.\_bokeh\_onload\_callbacks}console.debug("Bokeh: all callbacks have finished");}function load\_libs(css\_urls, js\_urls, callback) {if (css\_urls == null) css\_urls = [];if (js\_urls == null) js\_urls = [];root.\_bokeh\_onload\_callbacks.push(callback);if (root.\_bokeh\_is\_loading > 0) {console.debug("Bokeh: BokehJS is being loaded, scheduling callback at", now());return null;}if (js\_urls == null || js\_urls.length === 0) {run\_callbacks();return null;}console.debug("Bokeh: BokehJS not loaded, scheduling load and callback at", now());root.\_bokeh\_is\_loading = css\_urls.length + js\_urls.length;function on\_load() {root.\_bokeh\_is\_loading–;if (root.\_bokeh\_is\_loading === 0) {console.debug("Bokeh: all BokehJS libraries/stylesheets loaded");run\_callbacks()}}function on\_error(url) {console.error("failed to load " + url);}for (let i = 0; i < css\_urls.length; i++) {const url = css\_urls[i];const element = document.createElement("link");element.onload = on\_load;element.onerror = on\_error.bind(null, url);element.rel = "stylesheet";element.type = "text/css";element.href = url;console.debug("Bokeh: injecting link tag for BokehJS stylesheet: ", url);document.body.appendChild(element);}const hashes = {"https://cdn.bokeh.org/bokeh/release/bokeh-2.3.2.min.js": "XypntL49z55iwGVUW4qsEu83zKL3XEcz0MjuGOQ9SlaaQ68X/g+k1FcioZi7oQAc", "https://cdn.bokeh.org/bokeh/release/bokeh-tables-2.3.2.min.js": "bEsM86IHGDTLCS0Zod8a8WM6Y4+lafAL/eSiyQcuPzinmWNgNO2/olUF0Z2Dkn5i", "https://cdn.bokeh.org/bokeh/release/bokeh-widgets-2.3.2.min.js": "TX0gSQTdXTTeScqxj6PVQxTiRW8DOoGVwinyi1D3kxv7wuxQ02XkOxv0xwiypcAH"};for (let i = 0; i < js\_urls.length; i++) {const url = js\_urls[i];const element = document.createElement(‘script’);element.onload = on\_load;element.onerror = on\_error.bind(null, url);element.async = false;element.src = url;if (url in hashes) {element.crossOrigin = "anonymous";element.integrity = "sha384-" + hashes[url];}console.debug("Bokeh: injecting script tag for BokehJS library: ", url);document.head.appendChild(element);}};function inject\_raw\_css(css) {const element = document.createElement("style");element.appendChild(document.createTextNode(css));document.body.appendChild(element);}var js\_urls = ["https://cdn.bokeh.org/bokeh/release/bokeh-2.3.2.min.js", "https://cdn.bokeh.org/bokeh/release/bokeh-widgets-2.3.2.min.js", "https://cdn.bokeh.org/bokeh/release/bokeh-tables-2.3.2.min.js"];var css\_urls = [];var inline\_js = [function(Bokeh) {Bokeh.set\_log\_level("info");},function(Bokeh) {}];function run\_inline\_js() {if (root.Bokeh !== undefined || force === true) {for (var i = 0; i < inline\_js.length; i++) {inline\_js[i].call(root, root.Bokeh);}if (force === true) {display\_loaded();}} else if (Date.now() < root.\_bokeh\_timeout) {setTimeout(run\_inline\_js, 100);} else if (!root.\_bokeh\_failed\_load) {console.log("Bokeh: BokehJS failed to load within specified timeout.");root.\_bokeh\_failed\_load = true;} else if (force !== true) {var cell = $(document.getElementById(\"1001\")).parents('.cell').data().cell;\n cell.output\_area.append\_execute\_result(NB\_LOAD\_WARNING)\n }\n\n }\n\n if (root.\_bokeh\_is\_loading === 0) {\n console.debug(\"Bokeh: BokehJS loaded, going straight to plotting\");\n run\_inline\_js();\n } else {\n load\_libs(css\_urls, js\_urls, function() {\n console.debug(\"Bokeh: BokehJS plotting callback run at\", now());\n run\_inline\_js();\n });\n }\n}(window));" }, "metadata": {}, 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hover\_fill\_color=index\_cmap)\n", "\n", "p.add\_tools(HoverTool(tooltips=[(\"MPG\", \"@mpg\_mean\"), (\"Cyl, Mfr\", \"@cyl\_mfr\")]))\n", "\n", "show(p)" ] }, { "cell\_type": "code", "execution\_count": 8, "metadata": { "ExecuteTime": { "end\_time": "2021-07-01T18:15:41.771314Z", "start\_time": "2021-07-01T18:15:41.353754Z" } }, "outputs": [ { "data": { "text/plain": [ "'C:\\\\Users\\\\pat\\\\Documents\\\\patfiles\\\\python\_related\\\\learninglab\\\\data\_sci\_tech\\\\custom\_filename.html'" ] }, "execution\_count": 8, "metadata": {}, "output\_type": "execute\_result" } ], "source": [ "%matplotlib inline\n", "from bokeh.plotting import figure, output\_file, save, show\n", "\n", "# prepare some data\n", "x = [1, 2, 3, 4, 5]\n", "y = [4, 5, 5, 7, 2]\n", "\n", "# set output to static HTML file\n", "output\_file(filename=\"custom\_filename.html\", title=\"Static HTML file\")\n", "\n", "# create a new plot with a specific size\n", "p = figure(sizing\_mode=\"stretch\_width\", max\_width=500, plot\_height=250)\n", "\n", "# add a circle renderer\n", "circle = p.circle(x, y, fill\_color=\"red\", size=15)\n", "\n", "# save the results to a file\n", "save(p)\n" ] }, { "cell\_type": "code", "execution\_count": 9, "metadata": { "ExecuteTime": { "end\_time": "2021-07-01T18:15:43.506947Z", "start\_time": "2021-07-01T18:15:43.485863Z" } }, "outputs": [ { "data": { "text/html": [ "\n", " <iframe\n", " width=\"900\"\n", " height=\"500\"\n", " src=\"https://demo.bokeh.org/sliders\"\n", " frameborder=\"0\"\n", " allowfullscreen\n", " ></iframe>\n", " " ], "text/plain": [ "<IPython.lib.display.IFrame at 0x2644ca7e250>" ] }, "execution\_count": 9, "metadata": {}, "output\_type": "execute\_result" } ], "source": [ "# Create and deploy interactive data applications\n", "\n", "from IPython.display import IFrame\n", "IFrame('https://demo.bokeh.org/sliders', width=900, height=500)" ] }, { "cell\_type": "code", "execution\_count": null, "metadata": {}, "outputs": [], "source": [ "# If you need to reset the plotting object\n", "from bokeh.plotting import reset\_output, output\_notebook\n", "try:\n", " reset\_output()\n", " output\_notebook()\n", " show(p)\n", "except:\n", " output\_notebook()\n", " show(p)" ] }, { "cell\_type": "markdown", "metadata": {}, "source": [ "import numpy as np, datashader as ds, pandas as pd\n", "import datashader.utils as du, datashader.transfer\_functions as tf\n", "from scipy.spatial import Delaunay\n", "import dask.dataframe as dd\n", "\n", "n = 10\n", "np.random.seed(2)\n", "\n", "x = np.random.uniform(size=n)\n", "y = np.random.uniform(size=n)\n", "z = np.random.uniform(0,1.0,x.shape)\n", "\n", "pts = np.stack((x,y,z)).T\n", "verts = pd.DataFrame(np.stack((x,y,z)).T, columns=['x', 'y' , 'z'])" ] }, { "attachments": { "datashader.JPG": { "image/jpeg": 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AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAMjAyMTowNjozMCAxNjozNjo1MwAyMDIxOjA2OjMwIDE2OjM2OjUzAAAAcABhAHQAAAD/4QsWaHR0cDovL25zLmFkb2JlLmNvbS94YXAvMS4wLwA8P3hwYWNrZXQgYmVnaW49J++7vycgaWQ9J1c1TTBNcENlaGlIenJlU3pOVGN6a2M5ZCc/Pg0KPHg6eG1wbWV0YSB4bWxuczp4PSJhZG9iZTpuczptZXRhLyI+PHJkZjpSREYgeG1sbnM6cmRmPSJodHRwOi8vd3d3LnczLm9yZy8xOTk5LzAyLzIyLXJkZi1zeW50YXgtbnMjIj48cmRmOkRlc2NyaXB0aW9uIHJkZjphYm91dD0idXVpZDpmYWY1YmRkNS1iYTNkLTExZGEtYWQzMS1kMzNkNzUxODJmMWIiIHhtbG5zOmRjPSJodHRwOi8vcHVybC5vcmcvZGMvZWxlbWVudHMvMS4xLyIvPjxyZGY6RGVzY3JpcHRpb24gcmRmOmFib3V0PSJ1dWlkOmZhZjViZGQ1LWJhM2QtMTFkYS1hZDMxLWQzM2Q3NTE4MmYxYiIgeG1sbnM6eG1wPSJodHRwOi8vbnMuYWRvYmUuY29tL3hhcC8xLjAvIj48eG1wOkNyZWF0ZURhdGU+MjAyMS0wNi0zMFQxNjozNjo1My4wNTU8L3htcDpDcmVhdGVEYXRlPjwvcmRmOkRlc2NyaXB0aW9uPjxyZGY6RGVzY3JpcHRpb24gcmRmOmFib3V0PSJ1dWlkOmZhZjViZGQ1LWJhM2QtMTFkYS1hZDMxLWQzM2Q3NTE4MmYxYiIgeG1sbnM6ZGM9Imh0dHA6Ly9wdXJsLm9yZy9kYy9lbGVtZW50cy8xLjEvIj48ZGM6Y3JlYXRvcj48cmRmOlNlcSB4bWxuczpyZGY9Imh0dHA6Ly93d3cudzMub3JnLzE5OTkvMDIvMjItcmRmLXN5bnRheC1ucyMiPjxyZGY6bGk+cGF0PC9yZGY6bGk+PC9yZGY6U2VxPg0KCQkJPC9kYzpjcmVhdG9yPjwvcmRmOkRlc2NyaXB0aW9uPjwvcmRmOlJERj48L3g6eG1wbWV0YT4NCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgPD94cGFja2V0IGVuZD0ndyc/Pv/bAEMABwUFBgUEBwYFBggHBwgKEQsKCQkKFQ8QDBEYFRoZGBUYFxseJyEbHSUdFxgiLiIlKCkrLCsaIC8zLyoyJyorKv/bAEMBBwgICgkKFAsLFCocGBwqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKv/AABEIAFMBwwMBIgACEQEDEQH/xAAfAAABBQEBAQEBAQAAAAAAAAAAAQIDBAUGBwgJCgv/xAC1EAACAQMDAgQDBQUEBAAAAX0BAgMABBEFEiExQQYTUWEHInEUMoGRoQgjQrHBFVLR8CQzYnKCCQoWFxgZGiUmJygpKjQ1Njc4OTpDREVGR0hJSlNUVVZXWFlaY2RlZmdoaWpzdHV2d3h5eoOEhYaHiImKkpOUlZaXmJmaoqOkpaanqKmqsrO0tba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It has built-in, automatic processes to ingest data streams, complile rendering code using \*\*Numba\*\*, distribute processing load to available CPUs (with \*\*Dask\*\*) or GPUs (with \*\*CUDA\*\*).\n", "\n", "To install:\n", "\n", "$ conda install -c anaconda datashader“,”“,”Documents and tutorials can be found here. The downloadable notebooks are excellent.“,”“,”https://datashader.org/“,”“,”https://datashader.org/user\_guide/Trimesh.html“,”“,”Here’s a small example from the many provided in the official tutorial:" ] }, { “cell\_type”: “code”, “execution\_count”: 10, “metadata”: { “ExecuteTime”: { “end\_time”: “2021-07-01T18:16:06.464687Z”, “start\_time”: “2021-07-01T18:16:04.198154Z” } }, “outputs”: [ { “data”: { “image/png”: “”, “text/html”: [ “<img style="margin: auto; border:1px solid" src=‘data:image/png;base64,’/>” ], “text/plain”: [ “<xarray.Image ‘Raster’ (dim\_0: 400, dim\_1: 400)>”, “array([[0, 0, 0, …, 0, 0, 0],", " [0, 0, 0, …, 0, 0, 0],", " [0, 0, 0, …, 0, 0, 0],", " …,", " [0, 0, 0, …, 0, 0, 0],", " [0, 0, 0, …, 0, 0, 0],", " [0, 0, 0, …, 0, 0, 0]], dtype=uint32)”, “Dimensions without coordinates: dim\_0, dim\_1” ] }, “execution\_count”: 10, “metadata”: {}, “output\_type”: “execute\_result” } ], “source”: [ “import numpy as np”, “import pandas as pd”, “import datashader as ds”, “”, 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} }, “cell\_type”: “markdown”, “metadata”: {}, “source”: [ “It’s a bit beyond the scope of this class, but it’s also possible to generate layered GIS maps based on shapes, shading, and a wireframe all suppoorted by the Datashader support offered within **Holoviews**. ”, “”, “Here’s an example of an interactive rendering of Chesepeke and Deleware Bays. By ‘interactive’ I mean you can zoom in and out to see individual pixels represent individual data points. Each data point is available for viewing, even if there are millions of them.”, “”, “You can download the project here and run it in a local notebook:”, “”, “https://examples.pyviz.org/bay\_trimesh/bay\_trimesh.html”, “”, “chessie\_bay.JPG” ] }, { “cell\_type”: “code”, “execution\_count”: null, “metadata”: {}, “outputs”: [], “source”: [] } ], “metadata”: { “kernelspec”: { “display\_name”: “py39”, “language”: “python”, “name”: “py39” }, “language\_info”: { “codemirror\_mode”: { “name”: “ipython”, “version”: 3 }, “file\_extension”: “.py”, “mimetype”: “text/x-python”, “name”: “python”, “nbconvert\_exporter”: “python”, “pygments\_lexer”: “ipython3”, “version”: “3.9.0” } }, “nbformat”: 4, “nbformat\_minor”: 2 }