Jupyter Notebooks and the UW-IT JupyterHub Pilot

INFORMATION TECHNOLOGY
UNIVERSITY of WASHINGTON

Jupyter Notebooks and JupyterHub

> Jupyter Notebooks and JupyterHub give users access to computational environments and resources without the hassle of installation and maintenance tasks.

> Jupyter Notebooks are web-based interactive computational environments that are pre-provisioned with course material.

> Students connect — each to their own copy of the environment — and develop content as directed, often writing short segments of code.

The UW-IT Service

- UW-IT sets up a Docker container for instructors to integrate alongside JupyterHub.

  (Alternatively, instructors can provide and configure their own Docker container.)

- Each student enrolled in a course receives access to a Jupyter notebook.

- UW-IT runs the infrastructure at no cost to instructors.

Jupyter Notebooks in the Classroom

- Strong potential as a teaching tool for both specific course content and programming languages
  - Flexibility for instructors and students
  - Accessible coding environment to learn and utilize Python

- Highly relevant for investigations in applied academic research

Pilot Study Goals

1. Determine support issues that would need to be addressed for a campus-wide rollout
2. Identify pedagogical challenges/opportunities related to integrating Jupyter notebooks in the classroom

Winter 2020	1 early adopter
Spring 2020	6 participants from 3 departments

Participants

Term	Name	Title	Department
Winter	David Shean	Assistant Professor	Civil and Environmental Engineering
Spring	Sarah Tuttle	Assistant Professor	Astronomy
	Mario Juric	Associate Professor	Astronomy
	Nicole Kelly	Lecturer	Astronomy
	Lutz Maibaum	Lecturer	Chemistry
	Alexandra Anderson-Frey	Assistant Professor	Atmospheric Sciences
	Chad Curtis	Lecturer	Chemical Engineering

Courses

Term	Course Number	Title
Winter	Civil and Environmental Engineering 498/599	Geospatial Data Analysis
Spring	Astronomy 480	Introduction to Astronomical Data Analysis
	Astronomy 324	Introduction to Astrostatistics and Machine Learning in Astronomy
	Astronomy 421	Stellar Observations and Theory
	Chemistry 553	Statistical Mechanics
	Atmospheric Sciences 493	Data Analysis for Atmospheric Sciences
	Chemical Engineering 599	Image Analysis for Scientists and Engineers

Assessment Methods

- Winter 2020
  - Pre- and post- interview with instructor
  - Class observation
  - Post-quarter student survey

- Spring 2020
  - Pre- and post- interviews with instructors

General Findings

> The service was well received by instructors and students; both noted ease of use and Jupyter notebooks' power as a learning tool.

> *Winter 2020*:
UW-IT successfully supported an edge case requiring complex setup and high level of resources.
  - Level of individual support required by UW-IT with such a case is not currently scalable to multiple instructors.

> *Spring 2020*:
Standard setup worked seamlessly for multiple instructors.

Findings: Engagement & Interaction

- Use of Jupyter notebooks and JupyterHub during class contributes to engaging and interactive learning spaces.
  - Students were able to follow instructor and test code in their own environment and at their own pace.
- Jupyter notebooks work well for remote learning.
  - Students worked together on coding problems in synchronous Zoom break-out rooms during class and asynchronously through other communication channels (e.g., Slack, email).
  - Some features in Zoom (e.g., remote control) may even offer pedagogical advantages over a computer lab for in-class learning.

Findings: Student Learning

- Students appreciated a greater focus on course content and programming skills, instead of focusing on technology setup.

- Students appreciated the opportunity to directly apply their course learning to real-world research questions and projects.
  - Jupyter notebooks are excellent supplements for portfolios since they include example code and highlight writing and communication skills.

Findings: Instruction

- Jupyter notebooks were easily adapted to a flipped classroom model.
  - Instructors pre-recorded lectures and used course time for peer collaboration and troubleshooting within notebooks.
- Common options allowed instructors to convert their notebooks to slide decks, streamlining lecture preparation.
- Instructors were able to write custom scripts to seamlessly integrate JupyterHub file directories with GitHub repositories.
  - Instructors can host data and code in GitHub and push updates to student directories.

Considerations

- Instructors may want to choose their feedback and grading tools based on individual course learning objectives.
  - Common Solutions: Canvas integration, GitHub, syncing student-instructor directories, nbgrader
- More advanced JupyterHub instructors with custom and/or complex needs may require admin privileges to add needed packages or manage resources.
- As with all remote learning, students' internet quality and stability is a potential issue when accessing cloud environments.

Interested?

- UW-IT is currently signing up faculty for Fall 2020
- Service is open to all UW instructors using Jupyter notebooks in a course
- Go to IT Connect to learn more: https://itconnect.uw.edu/learn/tools/research-tech/