Open-Source Curriculum Development

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Challenge

Faculty spend an enormous amount of time duplicating curriculum development efforts already tackled by colleagues. Worse yet, curriculum is rarely, if ever, reviewed by, shared with, or extended upon by peers.

Teaching Like We Do Research

We do research by collaborating on open source research software with peers in our technical subfield at other campuses. **Could curriculum development for university courses operate as well as open-source software development does?**

Figure: Nuclear fuel cycle faculty at 6 universities participated. Prof. Neal Davis (Co-PI, CS) and Prof. Jenny Amos (SIIP Liason, BioEng) contributed guidance and perspective within this team.

May 2017	Project start:	GitHub/Video
Jun 2017	KickOff Workshop	Allerton
Interim	Remote Collaboration	GitHub/Video
Jun 2018	Retrospective Workshop	Illini Union

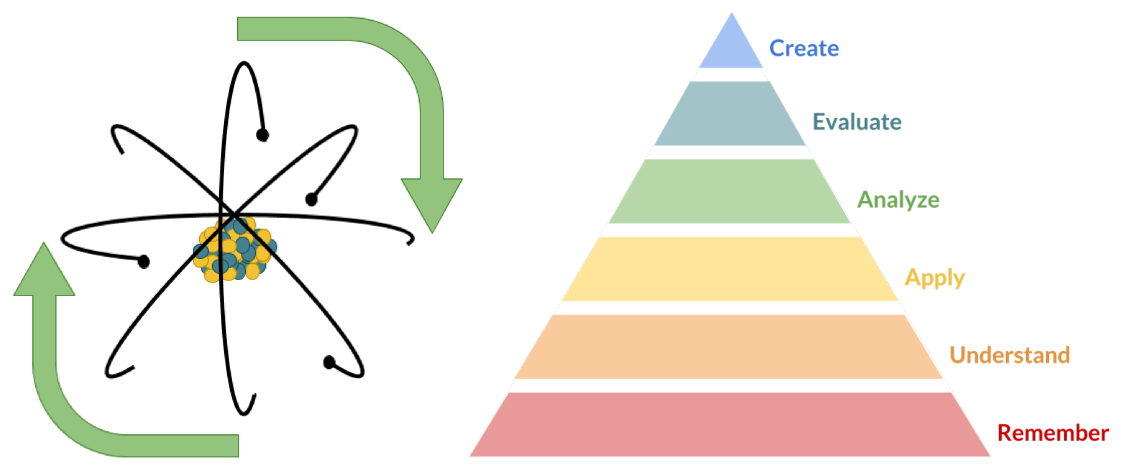
NECX

The Nuclear Engineering Curriculum eXchange (NECX) is an open repository for nuclear engineering curriculum materials intentionally prepared for **reuse, remixing and rejeuvination**. We targeted our approach to:

- improve the transfer of lessons learned
- connect instructors of the same course
- provide a template for future groups
- scale up for larger courses (e.g. CS101)

Nodes

We identified an **atomic unit of learning** as satisfying at least one learning objective.



Open-Source Software Development

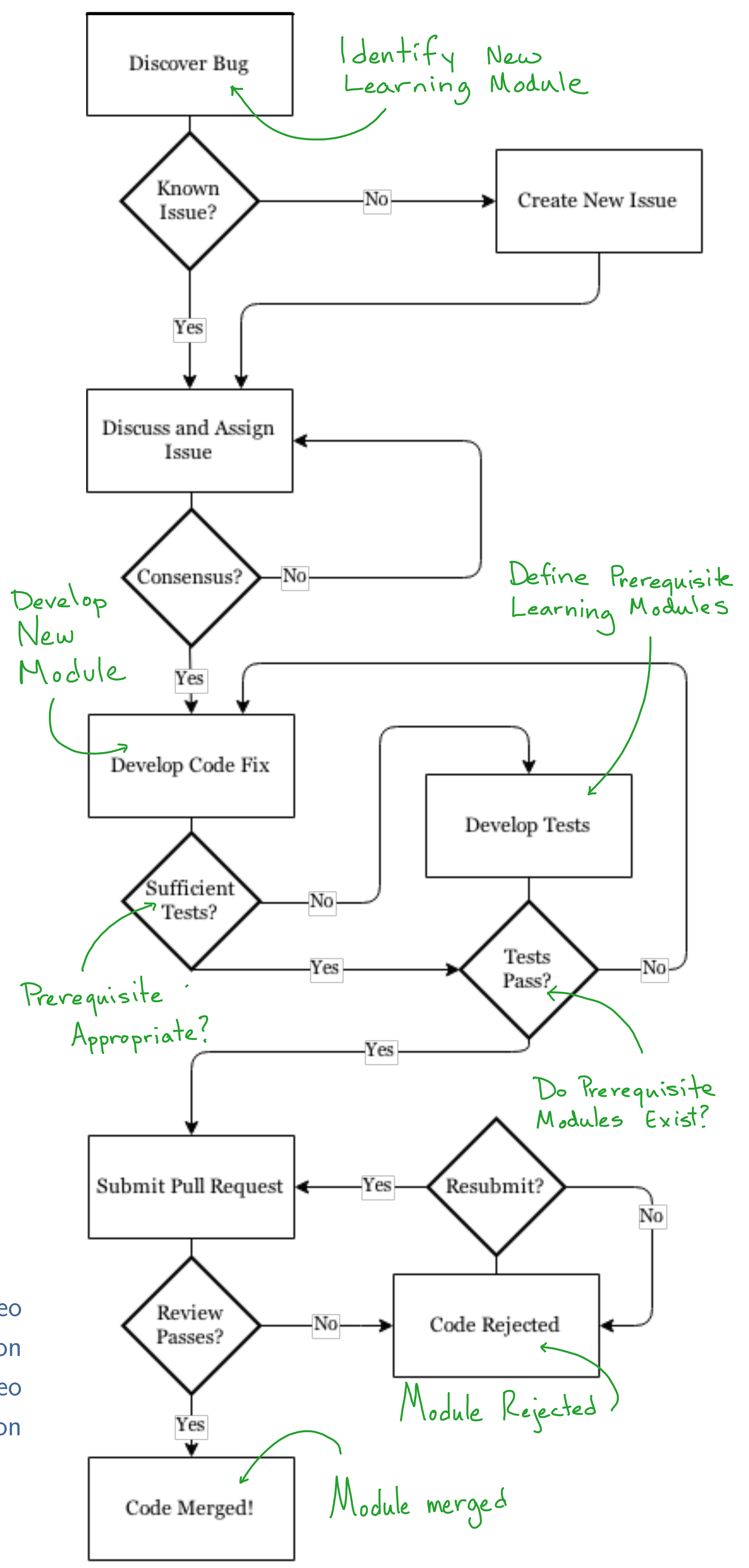


Figure: This figure captures the Git Flow process through which a new feature or bug fix enters a piece of open source software. We've adapted this model toward learning module development on GitHub.

Node Requirements

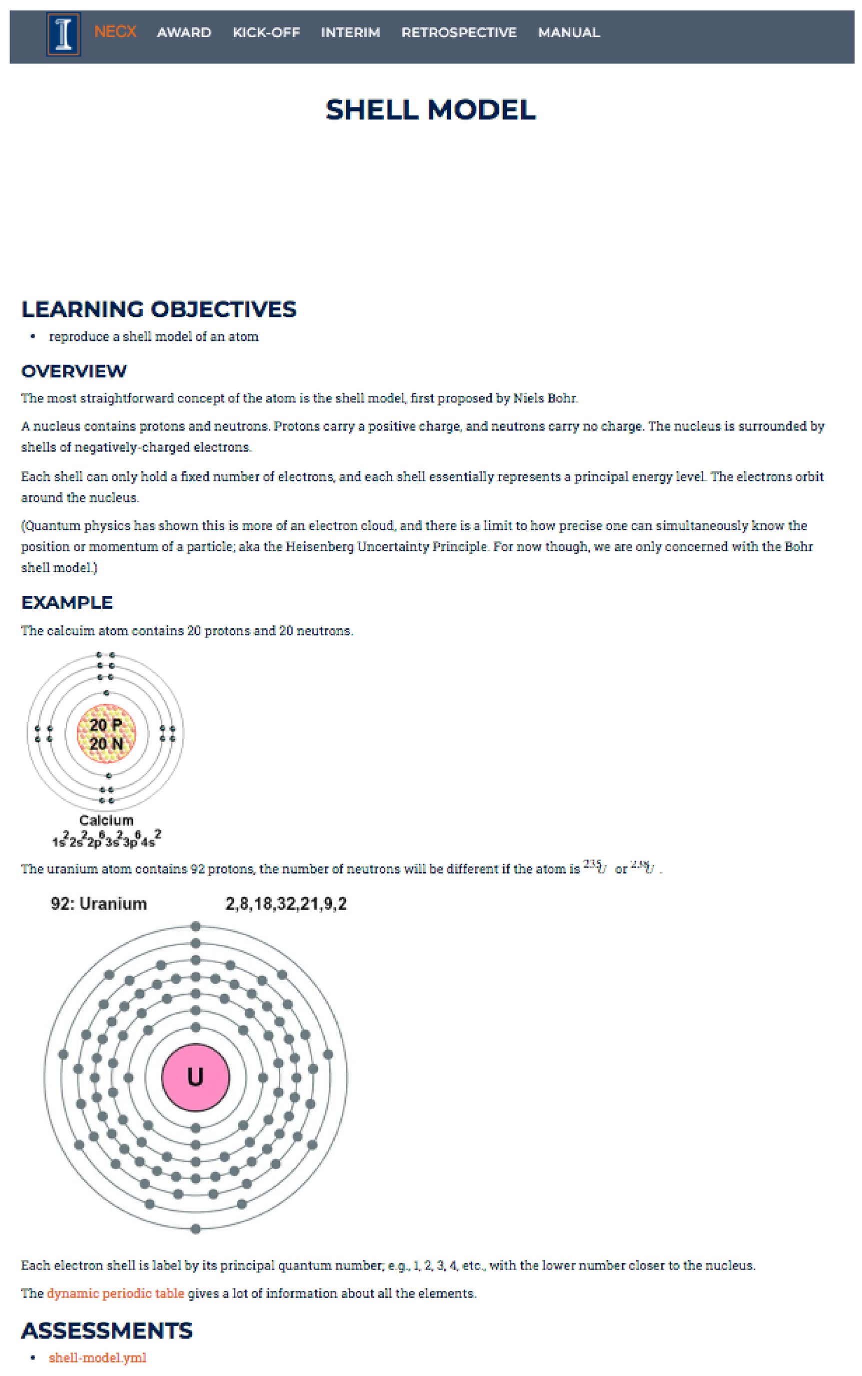
Required	Optional
• a title • a unique short identifying name (UID) • a list of prerequisites based on the UIDs of other nodes • learning objectives • a content summary • at least one assessment object	• course notes with equations • example source code • citations of other work • external readings • instructor guidance • graphics • videos • audio files • worked example problems • ABET Student Outcomes • active learning activities

Table: Minimum node requirements and suggested items.

Accomplishments

- Defined "Nodes"
- Established Contribution Workflow
- Created jekyll based website portal
- Began Node content creation

```
---
layout: node
title: Shell Model
uuid: shell-model
prerequisites:
  - periodic-table
learning_objectives:
  - reproduce a shell model of an atom
references:
  - None
abet_outcomes: None
assessments:
  - shell-model.yml
...

### Overview
The most straightforward concept of the atom is the shell model, first proposed
by Niels Bohr.

A nucleus contains protons and neutrons. Protons carry a positive charge, and
neutrons carry no charge. The nucleus is surrounded by shells of
negatively-charged electrons.

Each shell can only hold a fixed number of electrons, and each shell
essentially represents a principal energy level. The electrons orbit around the
nucleus.

(Quantum physics has shown this is more of an electron cloud, and there is a
limit to how precise one can simultaneously know the position or momentum of a
particle; aka the Heisenberg Uncertainty Principle. For now though, we are only
concerned with the Bohr shell model.)

### Example
The calcuim atom contains 20 protons and 20 neutrons.

![Ca shell atom](../img/calcium.gif)

The uranium atom contains 92 protons, the number of neutrons will be different
if the atom is $$^{235}U$$ or $$^{238}U$$.

![U shell atom](../img/uranium.jpg)

Each electron shell is label by its principal quantum number; e.g., 1, 2, 3, 4,
etc., with the lower number closer to the nucleus.

The [dynamic periodic table](https://ptable.com/) gives a lot of information
about all the elements.
```



Acknowledgements

This research was performed using funding received from the Academy for Excellence in Engineering Education Strategic Instructional Innovation Program (AE3-SIIP) at the University of Illinois. Travel funding was additionally supported by the home institutions of remote participants.

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