Student Learning Assessment Report, Academic

Report Year

2022-2023

Program

Computational Physics Major

Department Head

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Submitted By

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Previously Submitted Reports

2021-2022 Computational Physics Major

Mission

The Computational Physics program at Siena College (major and minor) aims to give Siena students fundamental and technical computer skills, so that they can use computational physics skills to address physics problems. This program emphasizes the fact that in the current Information Age computational physics has become a third way of doing physics and complements traditional modes of theoretical and experimental physics. Moreover, this program contributes to the goals of a liberal arts curriculum in a substantial and unique way since computational physics is itself interdisciplinary, integrating knowledge and techniques from mathematics, computer science, and physics. This program emphasizes that science itself is comprehensive, and that theory, modeling, mathematical algorithms, and empirical data have a role in building scientific knowledge.

Assessment

1. Major/Program Student Learning Outcomes

Student will be able to...

Process Data to demonstrate Technical Computing Skills (skills that must be developed in order to engage productively in the production and dissemination of physics knowledge by using computers)
Example: Use least-squares fitting of data to a functional form, and plot the data with uncertainties together with the fit function, e.g., fitting a set of points in two dimensions.
Example: Compute the average of several data sets to reduce the effects of run-to-run variations and compare to theoretical models.
It is worth noting that processing data can be done without a specific model in mind; and so this technical skill is distinguished
from the computational physics skill of extracting physical insight.

2. Phase

Check all that apply

- [x] **Planning/ determining procedure**
- [ ] **Planning/ Redesigning based on past assessment**
- [ ] **Collecting/ analyzing assessment data**
- [ ] **Discussing/ using result**
- [ ] **Determining if Changes had an Impact on Student Learning**
- [ ] **Objective not assessed this year**

3. Assessment Procedures (Planning/ determining)

Method: (ex. tests, presentations, research paper, describe the assessment course and student sample when it is applicable, etc.)

Written final exams or final projects (from CSIS 210 and CSIS 310).
I contacted the instructor of CSIS210, and we realized that learning outcome LO1 nicely aligns with the learning goal of CSIS210 to have students able to pick the best fit data structure and an efficient algorithm to solve a given problem. The instructor of CSIS210 shared a set of problems that can be used for the assesment procedure. Therefore, a reasonable assessment procedure could be: 75% of students should meet or exceed grade of C (70%) in a selected set of problems.

It was not possible to contact any instructor for CSIS310 because the course was not offered in 2022-2023. I addressed this issue in my 2022-2023 5-year program review, where I propose significant changes to the program. These changes could potentially impact the assessment methods for measuring LO1 in the future.

While CSIS210 was offered in both the Fall of 2022 and the Spring of 2023, there were no students enrolled from the Computational Physics program. Consequently, there is no available sample to use for the assessment.
Please find in attachment the Curriculum Map relative to this Student Learning Assesment Report.

When does assessment occur?

End of Spring Semester.

How often does assessment occur?

Once a year.

Criteria (How do you know students are achieving learning outcome?)

75% of students should meet or exceed grade of C (70%).

Assessment

1. Major/Program Student Learning Outcomes

Student will be able to...

Represent Data Visually to demonstrate Technical Computing Skills.

Students should be able to produce static visualizations (i.e., plots) of data because plots are fundamental to facilitating analysis and communication of data. Additionally, because different types of plots are appropriate for different data sets and analyses, students should be able to generate several types of plots. It is critically important for students to be able to graphically represent uncertainties on the data because the physical insights that can be extracted from data are constrained by uncertainty.

Example: Produce two-dimensional plots of one or more sets of data with error bars in both dimensions.
Example: Produce a contour plot of the period of a physical pendulum as a function of its center of mass position and the characteristic size of the pendulum.

2. Phase

Check all that apply

- [x] **Planning/ determining procedure**
- [ ] **Planning/ Redesigning based on past assessment**
- [ ] **Collecting/ analyzing assessment data**
- [ ] **Discussing/ using result**
- [ ] **Determining if Changes had an Impact on Student Learning**
- [ ] **Objective not assessed this year**

3. Assessment Procedures (Planning/ determining)

Method: (ex. tests, presentations, research paper, describe the assessment course and student sample when it is applicable, etc.)

Written final exams or final projects (from CSIS380 and PHYS250). CSIS380 was not offered in 2022-2023 , so I plan to reach out to the instructor next year. On the other hand, PHYS250 was offered in Spring 2023 and consistently emphasizes numerical computations and their visualization. Using the final exam grade is an appropriate method for assessing LO2.

Once again, due to the absence of Computational Physics students, there is no available sample to utilize for the assessment.

When does assessment occur?

End of Spring Semester.

How often does assessment occur?

Once a year.

Criteria (How do you know students are achieving learning outcome?)

75% of students should meet or exceed grade of C (70%).

Assessment

1. Major/Program Student Learning Outcomes

Student will be able to...

2. Phase

Check all that apply

Prepare documents for presentations to demonstrate Technical Computing Skills.

Students should be able to prepare documents and presentations. This skill is required to communicate results and is necessary in any professional field.

Example: Write a technical memo that incorporates the graphical representation of data.
Example: Prepare an oral or poster presentation that satisfies the guidelines of a professional organization)

- [x] **Planning/ determining procedure**
- [ ] **Planning/ Redesigning based on past assessment**
- [ ] **Collecting/ analyzing assessment data**
- [ ] **Discussing/ using result**
- [ ] **Determining if Changes had an Impact on Student Learning**
- [ ] **Objective not assessed this year**

3. Assessment Procedures (Planning/ determining)

Method: (ex. tests, presentations, research paper, describe the assessment course and student sample when it is applicable, etc.)

Final presentation grade (from CSIS499 or MATH499 or PHYS470 or SCDV480). All CSIS499-MATH499-PHYS470-SCDV480 courses that were offerred in 2022-2023 were not relevant for the Computational Physics major (i.e. independent studies were offered on completely different topics). Planning to contact instructors of CSIS499/MATH499/PHYS470/SCDV480 to identify specific methods that are appropriate for assessing LO3.

When does assessment occur?

End of Spring Semester.

How often does assessment occur?

Once a year.

Criteria (How do you know students are achieving learning outcome?)

75% of students should meet or exceed grade of C (70%).

Assessment

1. Major/Program Student Learning Outcomes

Student will be able to...

Translate a model into algorithms and code to demonstrate Computational Physics Skills.

Students should be able to translate a theoretical or algorithmic model into code that enables computation. This is a multifaceted skill, which includes the abilities to: use a computational tool to write readable, documented code with correct syntax. In particular, apply physics knowledge of the given system to make discretization choices and monitor numerical errors, convergence, etc.

Example: Write code to set up arrays of values, perform calculations in a sequence and/or under specified conditions, and generate numerical or graphical output. Consider trade-offs between complexity and execution speed when choosing an algorithm.
Example: Use reference materials to adapt code examples to perform a particular task, such as calculating the sum of values in a particular array (e.g., summing forces exerted by an array of charged particles.

2. Phase

Check all that apply

- [x] **Planning/ determining procedure**
- [ ] **Planning/ Redesigning based on past assessment**
- [ ] **Collecting/ analyzing assessment data**
- [ ] **Discussing/ using result**
- [ ] **Determining if Changes had an Impact on Student Learning**
- [ ] **Objective not assessed this year**

3. Assessment Procedures (Planning/ determining)

Method: (ex. tests, presentations, research paper, describe the assessment course and student sample when it is applicable, etc.)

Written exams and lab practicums (programming) (from CSIS385 and PHYS350).

Although PHYS350 was not offered in 2022-2023 academic year, CSIS385 was offered in the Spring of 2023.
In CSIS385, the assignments, labs, and exams revolve around translating algorithms into code, analyzing algorithmic complexity, comparing different algorithms, and evaluating execution speeds. The homework and labs frequently involve designing and implementing algorithmic solutions. However, the course does not address numerical issues. On the other hand, PHYS350 primarily focuses on numerical aspects, making it a complementary course to CSIS385 .

Considering the above, the Final Exam grades have been determined as the most appropriate for assessing LO4.
However, due to the absence of Computational Physics students, there is no available sample to utilize for the assessment.

When does assessment occur?

End of Spring Semester.

How often does assessment occur?

Once a year.

Criteria (How do you know students are achieving learning outcome?)

75% of students should meet or exceed grade of C (70%).

Assessment

1. Major/Program Student Learning Outcomes

Student will be able to...

Extract physical insight from computational models, to demonstrate Computational Physics Skills.

Students should be able to extract physical insight from a computation by converting the raw output of a computation into a useful form, asking nteresting questions, and using the computation to answer these questions. Often this process involves repeating a computation many times using different sets of parameter values of particular interest, and communicating results effectively to others in forms authentic to the discipline. Students should use their results to determine the effectiveness and/or limitations of a
model and further refine the model (e.g., by adding missing phenomena) based on a comparison to experimental or theoretical results or other validated models.. Students should navigate the cycle from model to implementation to results to concepts to revised model, in order to experience the iterative nature of constructing physics knowledge.

Example: being able to establish a connection between the real physical quantities and the actual results of the computations. For instance, if modeling the motion of an object falling through air, realize that different models for air drag produce different trajectories, corresponding to different physical realizations.

2. Phase

Check all that apply

- [x] **Planning/ determining procedure**
- [ ] **Planning/ Redesigning based on past assessment**
- [ ] **Collecting/ analyzing assessment data**
- [ ] **Discussing/ using result**
- [ ] **Determining if Changes had an Impact on Student Learning**
- [ ] **Objective not assessed this year**

3. Assessment Procedures (Planning/ determining)

Method: (ex. tests, presentations, research paper, describe the assessment course and student sample when it is applicable, etc.)

Written final exams from PHYS250 and PHYS350.

Although PHYS350 was not offered in 2022-2023 academic year, PHYS250 was offered in the Spring of 2023. The instructors of PHYS250 and PHYS350 concur that those courses teach students how to extract physical insight from computational models and develop computational physics skills. In particular, PHYS250 focuses specifically on computational methods for physics applications, while PHYS350 provides a broader perspective on modeling and simulation techniques applicable to various scientific domains, including physics.

In conclusion, the instructors of PHYS250 identified the Final Exam grades as most appropriate for assessing LO5.
However, due to the absence of Computational Physics students, there is no available sample to utilize for the assessment.

When does assessment occur?

End of Spring Semester.

How often does assessment occur?

Once a year.

Criteria (How do you know students are achieving learning outcome?)

75% of students should meet or exceed grade of C (70%).

Package History

Date	User	Action	
7/2/2023 9:28:09 AM	Graziano Vernizzi		Submitted 'Student Learning Assessment Report'
7/2/2023 9:29:04 AM	Michele McColgan		Received
7/2/2023 9:29:04 AM	School of Science - Asst. Dean		Received
7/2/2023 9:29:04 AM	Institutional Effectiveness		Received
7/2/2023 9:29:04 AM	Thomas Giarla		Received
7/2/2023 9:29:04 AM	Provost and Senior Vice President		Received
7/2/2023 9:29:04 AM	School of Science - Dean		Received
7/2/2023 10:21:12 AM	Margaret Madden		Decision Approved
7/5/2023 6:29:15 PM	Michele McColgan		Decision Approved