Cover Sheet: Request 14449

AST 3XXX Advanced Computational Techniques in Physics and Astronomy

Info

Process	Course|New|Ugrad/Pro
Status	Pending at PV - University Curriculum Committee (UCC)
Submitter	Desika Narayanan desika.narayanan@ufl.edu
Created	11/13/2019 8:20:23 PM
Updated	10/13/2020 3:15:02 PM
Description of request	New course proposal for computational techniques in the natural sciences

Actions

Step	Status	Group	User	Comment	Updated
Department	Approved	CLAS - Astronomy 011629000	Elizabeth Lada		11/13/2019
No document changes					
College	Recycled	CLAS - College of Liberal Arts and Sciences	Joseph Spillane	The College Curriculum Committee recycles this request, with the following steps needed: 1) Please obtain a consult from the Mathematics Department, and from the Statistics Department regarding the possible fit with the new Data Science major; 2) the committee requests that you consider a narrower course title, feeling that "natural sciences" may be overbroad; 3) Please write the course title out fully on the form; 4) please improve the transcript title by capturing more of the course content; 5) please adjust weekly schedule to 15 weeks; 6) please add a Grading Scale.	1/24/2020
No document changes					
Department	Approved	CLAS - Astronomy 011629000	Elizabeth Lada		2/3/2020
No document changes					
College	Conditionally Approved	CLAS - College of Liberal Arts and Sciences	Joseph Spillane	The College Curriculum Committee conditionally approves this request, with the following update requested: please provide final consult from Math/Stats, in which they approve the revised proposal. NOTE: If this update is made this week, the proposal may be considered for the March UCC meeting.	2/17/2020
consultation.pdf					2/5/2020

Step	Status	Group	User	Comment	Updated
Department	Commented	CLAS - Astronomy 011629000	Desika Narayanan	Thanks Joe, UCC. I've uploaded the new consultations (consult_math.pdf and consult_stats.pdf). -desika	2/18/2020
consult_math.pdf consult_stats.pdf					2/18/2020 2/18/2020
Department	Approved	CLAS - Astronomy 011629000	Elizabeth Lada		7/23/2020
No document changes					
College	Approved	CLAS - College of Liberal Arts and Sciences	Joseph Spillane		9/18/2020
No document changes					
University Curriculum Committee	Commented	PV - University Curriculum Committee (UCC)	Casey Griffith	Course requesting title of "Advanced Computational Techniques in Physics and Astronomy", error in form preventing full title from being included. -C. Griffith	10/13/2020
No document changes					
University Curriculum Committee	Pending	PV - University Curriculum Committee (UCC)			10/13/2020
No document changes					
Statewide Course Numbering System					
No document changes					
Office of the Registrar					
No document changes					
Student Academic Support System					
No document changes					
Catalog					
No document changes					
College Notified					
No document changes					

Course|New for request 14449

Info

Request: AST 3XXX Advanced Computational Techniques in Physics and Astronomy
Description of request: New course proposal for computational techniques in the natural sciences

Submitter: Desika Narayanan desika.narayanan@ufl.edu
Created: 2/5/2020 2:55:42 PM
Form version: 4

Responses
Recommended Prefix AST
Course Level 3
Course Number XXX
Category of Instruction Intermediate
Lab Code None
Course Title Advanced Computational Techniq
Transcript Title Comp. Tech in Physics
Degree Type Baccalaureate

Delivery Method(s) On-Campus
Co-Listing No

Effective Term Earliest Available
Effective Year Earliest Available
Rotating Topic? No
Repeatable Credit? No

Amount of Credit 3

S/U Only? No
Contact Type Regularly Scheduled
Weekly Contact Hours 3
Course Description Advanced Computational Techniques in Astronomy and Physics

Advanced techniques in computational methods in the natural sciences and numerical analysis. Includes version controlling and programming in distributed environments; grid construction and convergence techniques; numerical differentiation; linear algebra; root finding; differential equations; Monte Carlo simulations; open source project development.
Prerequisites MAC2312 or equivalent

Co-requisites None
Rationale and Placement in Curriculum The modern natural sciences require a working knowledge and comfort with numerical analysis and computation. For example, upper-level classes within the Astronomy major (the host department), research projects performed in collaboration with faculty, and in jobs in the private sector require students to be able to address open-ended problems via computational techniques. For example, one can imagine asking a student: "how can we design a better traffic flow system?" (with the astrophysics analogy of simulating photon transport through stars), or "how should we best design congressional districts in an automated manner?" (with the astrophysics analogy of constructing grids in hydrodynamic simulations). And yet, we have no formal method for teaching students how to solve these sorts of problems. This course aims to do just this.

This course will be taught at the 3000 level, with the goal of preparing students for both careers in astrophysics, as well as broader STEM subjects. This course will build off of the course "Introduction to Simulations and Computational Techniques for Physical Sciences" (submitted course proposal by Prof. Paul Torrey; though it will not be necessary to have Prof Torrey's course as a pre-requisite) and teach a range of advanced techniques in numerical analysis. It will begin with an introduction to

standard numerical techniques (i.e. advanced methods to solve mathematical problems), and then leverage these techniques to work on larger-scale projects. The fundamental goal of this course is to empower students to approach problems in their classroom assignments, research projects, and career itself with the thought "I could solve this by writing a computer code."

This course will be 50-50 lecture and hands-on practical learning. Each subject will begin with a lecture with the professor at the board, followed by an in-class coding assignment/project, with the professor providing a guiding hand. The student will perform their programming on the University of Florida's HiPerGator2.0 supercomputing environment, which will expose the students to cutting-edge supercomputing facilities as a side-benefit.

This course is also being submitted as a possible course for the new data science major.
Course Objectives Students who successfully complete this course will be able to:

Demonstrate proficiency with version control and programming in a distributed environment
Demonstrate proficiency in the basic numerical techniques of calculus, differential equations, and linear algebra.
Demonstrate the ability to design a code base around an open-ended question in a manner that is modular and distributable.

Course Textbook(s) and/or Other Assigned Reading Computational Physics by Mark Newman, ISBN: 1480145513
Weekly Schedule of Topics Week 1: Linux/Git
Week 2: HiPerGator/Supercomputing Environments, Python
Week 3: Grids and Convergence
Week 4: Differentiation, Integration
Week 5: Continue Integration
Week 6: Linear Algebra
Week 7: Root Finding
Week 8: Ordinary Differential Equations
Week 9: Partial Differential Equations
Week 10: Monte Carlo Methods
Week 11: Fourier Transforms
Week 12: Smoothing/Signal Processing
Week 13: Coding in Distributed Environments
Week 14: Open ended project Design
Week 15: Group work and Presentations
Grading Scheme 75% (weekly) homeworks; 25% projects. The homeworks will be weekly, and there will be roughly 2 projects.

Unexcused late homework and projects will be accepted with 20% grade loss per day, for maximum of 5 days late. Exceptions include medical emergencies or other extenuating circumstances.

Code Rubric:

For homeworks, roughly 15 points will be available per homework. These will follow:
1. Does the program complete without crashing in a reasonable time frame? If yes, up to +3 points.
2. Does the program use the exact program files given (if given), and produce an answer in the specified format? If yes, +1 points
3. Does the code follow the problem specifications (i.e numerical method; output requested etc.) Up to +2 points
4. Is the answer correct? Up to +4 points
5. Is the code readable? Up to +2 points
5.1. Are variables named reasonably?
5.2. Are the user-functions and imports used?
5.3. Are units explained (if necessary)?
5.4. Are algorithms found on the internet/book/etc. properly attributed?
6. Is the code well documented? +3 points
6.1. Are the functions described and ambiguous variables defined?
6.2. Is the code functionality (i.e. can I run it easily enough?) documented?

A: 93-100
A-: 90-92
B+: 87-89
B: 83-86
B-: 80-82
C+: 77-79
C: 73-76
C-: 70-72
D+: 67-69
D: 63-66
D-: 60-62
E: 0-60
Instructor(s) Desika Narayanan
Attendance & Make-up Yes
Accomodations Yes
UF Grading Policies for assigning Grade Points Yes
Course Evaluation Policy Yes

RE: new computational course proposal

Knudson,Kevin P

Tue 2/18/2020 8:59 AM

To: Narayanan,Desika T <desika.narayanan@ufl.edu>; Daniels,Michael Joseph <daniels@ufl.edu>;

Cc: Lada,Elizabeth Anne <elada@astro.ufl.edu>;

Hi Desika.

The math department is fine with this course.

Best,
Kevin Knudson

Professor and Chair
UF Distinguished Teaching Scholar
Department of Mathematics
University of Florida
P.O. Box 118105
Gainesville, FL 32611-1805
ph: 352.294.2350
e: kknudson@ufl.edu
w: http://people.clas.ufl.edu/kknudson

From: Narayanan,Desika T <desika.narayanan@ufl.edu>
Sent: Tuesday, February 18, 2020 8:35 AM
To: Knudson,Kevin P <kknudson@ufl.edu>; Daniels,Michael Joseph <daniels@ufl.edu>
Cc: Lada,Elizabeth Anne <elada@astro.ufl.edu>
Subject: new computational course proposal

Hi Kevin and Mike,

Thanks again for your consult on our course proposal for computational astrophysics. The UCC is ready to approve but has asked that I get one more formal approval from you both on the most recent draft of the proposal. The major updates include:

[1] Revised prerequisites thanks to Kevin catching my misunderstanding of the Calculus sequence
[2] Narrower course title to reflect that the course will be mostly (astro)physics problems (this hopefully will also help distinguish it from MAD4401)
[3] Weekly schedule moved to 15 weeks
[4] Added grading scale

I've attached this revised course proposal here.

If you could please respond with some sort of affirmative statement to this email, then I can attach this email thread as our consultation (or, alternatively, if you suggest further updates please also let me know

of those).   They suggest if at all possible if I can send the consultation response from you both back by the end of this week, this could be approved during the March UCC meeting.

Thanks so much,
desika

Re: new computational course proposal

Daniels,Michael Joseph

Tue 2/18/2020 9:40 AM

To: Narayanan,Desika T <desika.narayanan@ufl.edu>;

Cc: Knudson,Kevin P <kknudson@ufl.edu>; Lada,Elizabeth Anne <elada@astro.ufl.edu>; Daniels,Michael Joseph <daniels@ufl.edu>;

Hi Desika,
The statistics department is supportive of this course.

Best regards,

Mike D

— — — — —
Mike Daniels
Professor and Chair
Andrew Banks Family Endowed Chair
Department of Statistics
University of Florida
Gainesville, FL 32611

On Feb 18, 2020, at 8:35 AM, Narayanan,Desika T <desika.narayanan@ufl.edu> wrote:

Hi Kevin and Mike,

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Thanks so much,
desika

<Form_14449.pdf>

Re: new course proposal

Narayanan,Desika T

Mon 2/3/2020 6:00 PM

To: Daniels,Michael Joseph <daniels@ufl.edu>;

Cc: Knudson,Kevin P <kknudson@ufl.edu>; Lada,Elizabeth Anne <elada@astro.ufl.edu>;

Thanks all!

It's a straight forward thing to do to swap out some of the more general problems I have for my assignments with (astro)physics homework sets and projects.   The advice is very much appreciated!

desika

From: Daniels,Michael Joseph
Sent: Monday, February 3, 2020 5:21 PM
To: Narayanan,Desika T
Cc: Knudson,Kevin P; Lada,Elizabeth Anne; Daniels,Michael Joseph
Subject: Re: new course proposal

Hi Desika,
 I agree with Kevin it is important to distinguish it from MAD 4401. Beefing up the (astro)physics problems would be a good way to do this. And once this is done, it would make a nice addition to the data science major electives.

 Best regards,

 Mike D

————
Mike Daniels
Professor and Chair
Andrew Banks Family Endowed Chair
Department of Statistics
University of Florida
Gainesville, FL 32611

On Feb 1, 2020, at 8:19 AM, Narayanan,Desika T <desika.narayanan@ufl.edu> wrote:

Hi Kevin,

Thank you so much for the detailed comments! I hadn't realized the course overlap with MAD 4401. As it currently is taught, our course has a number of (astro)physics example problems, though I can ensure that that gets beefed up even further to make it very distinguishable from 4401.

I'm sorry about the erroneous prereq ! Calc 2 for business majors was most certainly not my intention, and I think I grabbed the wrong course number. 2312 was my original intention (we do teach some baby linear algebra in the current version of the proposed course, though having taken numerical linear algebra is a bit overkill).

Thanks again,
desika

From: Knudson,Kevin P
Sent: Friday, January 31, 2020 11:00 PM
To: Narayanan,Desika T
Cc: Daniels,Michael Joseph; Lada,Elizabeth Anne
Subject: Re: new course proposal

Hi Desika.

There are two separate issues here. The first is that I think this course looks great as an elective for the data science major. So that's fine with me (Mike should weigh in on that, though, as Statistics will be running the major).

The other issue is the course content. There seems to be pretty serious overlap with MAD 4401, at least in principle. There is clearly a lot more going on in terms of programming in your proposed course, and, frankly, I wish our course were more like what you've proposed in some ways. This course won't interfere with ours, so I don't object, but I hope your course will have enough physics/astronomy examples to distinguish it from what we offer.

A note about prerequisites: MAC 2234 is the wrong thing. That's survey of calculus II, which is the second course in the sequence for business majors. Our numerical analysis course has a linear algebra course as a prereq (either MAS 3114 or MAS 4105), and in turn these have MAC 2312 (Calculus II) as a prereq (really it's more advanced than that for MAS 4105). The point being, MAC 2234 is not equivalent to MAC 2312, and your majors will have taken the latter. I don't know if your major requires a linear algebra course, so you may or may not want to have that as a prereq.

Best,
Kevin

Professor and Chair
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w: http://people.clas.ufl.edu/kknudson

On Jan 31, 2020, at 3:18 PM, Narayanan,Desika T <desika.narayanan@ufl.edu> wrote:

<Form_14449.pdf>