College Curriculum Proposal Approval and Routing Form

TITLE OF PROPOSAL: New Course – Artificial Intelligence: Neural Networks and Reinforcement Learning

Originating Faculty: Valery Rousseau

Department/College: Physics/College of Arts and Sciences Chairperson: Armin Kargol

Contact Phone/Email: X3066/vroussea@loyno.edu

Type of Proposal (Check all that apply):

New Major[1]_____ New Minor___ New Concentration _____ Revise Existing Program_____

New Course___X___ Change to Existing Course _____ Discontinue Program _

Undergraduate _X_ Graduate ___ Online ___ Professional & Cont. Studies ___ Other _____

1. **Resources and Fees:**
   If this is a proposed revision, are there existing fees? N/A No_____ Yes_____ $_____
   Will course or program fees be required for this course/program? No___X__ Yes_____ $_____
   Are new resources needed for implementing this proposal? No___X___ Yes_____
   If yes, include complete description and dollar amount in proposal.

2. **College Review and Approvals:**

   a. Department/School_____ (Chair) Date: _____
      Approved _____ Not Approved _____

   b. College Curriculum Committee_____(Chair) Date: _____
      Approved _____ Not Approved _____

   c. College Dean _____Date: _____
      Supported _____ Not Supported _____

3. **Intercollegiate Review and Recommendations Required as applicable to proposal:**

   a. Online Education Committee_____(Chair) Date:_____

      Recommended _____ Not Recommended _____

   b. Professional and Continuing Studies Committee_____ (Chair) Date:_____
      Recommended _____ Not Recommended _____

   c. Graduate Council _____(Chair) Date: _____
      Recommended _____ Not Recommended _____

4. **University[2] Recommendations Required as applicable to proposal:**

   a. University Courses & Curriculum Committee_____(Chair) Date: _____
      Recommended _____ Not Recommended _____

   b. Standing Council for Academic Planning _____(Chair) Date: _____
      Recommended _____ Not Recommended _____

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1 New Degree to be Offered---**Requires SACS Notification 6 Months Prior to Start**

2 Approval by the Strategic Planning Team, University Budget Committee, and/or Board of Trustees may be required for proposals that have significant impact on resources or mission. Proposals to establish or discontinue degree programs require approval by Board of Trustees and SACS.

COLLEGE COURSE PROPOSAL FORM

Instructions: Use this form for new college course proposals and substantial course revisions.

Department/College: Physics/CAS

Chairperson: Armin Kargol

Course Title: Artificial Intelligence
Course Number: P H Y S - A 437

Term: x Fall x Spring ___ Summer Credit Hours: 3 Major ___ Required x Elective

Effective Term S'17 Course I.D. (SUBJ-LEVL) PHYS A437 Contact Hours 3

Grade Type (Normal or Pass/Fail) Maximum Capacity 30

Activity Type (LEC, STU, LAB, LLB...)

Inter-disciplinary Classification (s) _____

Common Curriculum Classification (s) _____

Pre-requisites/Registration Controls:

PHYSA102, MATHA258

New Resources and Fees

a. If this is a revised course, was there a course fee? Yes_____ $_____

   No___x___

b. Will a course fee be required for this course? Yes_____ $_____

   No___x___

c. Are new resources needed for implementing this course? Yes_____ No_____
   If yes, provide descriptions and dollar amounts in Section V.

Course Description: (maximum 350 spaces)

The course provides an introduction to the field of artificial intelligence, and focuses on neural networks and reinforcement learning. No particular background is required, as the course is self-contained and the needed mathematical tools will be developed in class.

Complete the following sections:

I. Justification for the course: provide a clear and compelling rationale for any proposed curriculum modification, including additions and deletions to the course inventory, changes in

degree/program requirement, new degree programs, and other major curriculum revisions. The justification should state explicitly and clearly how the changes relate to the college and department plans.

Physics program offers five different tracks requiring a number (1-3) of Advanced Physics Elective (APE) courses. These are courses that introduce students to more advanced topics in specific areas of physics and complement the more foundational required courses in the physics curriculum. In the Department we have developed a number of APE courses which are currently offered one a semester on a rotating basis in 2-3 year cycle. The proposed course will add a new choice to our selection of Advanced Electives. It will give students an in-depth introduction to artificial intelligence. The synergy between human behavior and the structure of the human brain, and the development of intelligent machines will be emphasized. This course will offer the students preparation for entry into the field of robotics, biomedical engineering etc. and will expand their post-graduation career options. This course is also a part of the proposed program change converting the existing Pre-Health Physics (PHYP) major into a Biophysics/Pre-Health major. For Biophysics/Pre-Health students the course will be one of the required advanced biophysics courses. According to the program proposal the students will be required to take at least two out of three advanced biophysics courses: Cellular Biophysics (PHYS A436 – existing), Biomechanics and Neural Control (proposed), and Artificial Intelligence (proposed). These three courses will have an interesting synergy exposing students to physical basis of biological control systems at different levels, from molecular level through complex systems. The courses are also closely related to the research programs of our faculty members (Dr. Kargol in Cell Biophysics, Dr. Biswas in Biomechanics, and Dr. Rousseau in Robotics and Artificial Intelligence) and will prepare students for collaborative research which is one of the cornerstones of Loyola's QEP.

II. Impact on the Curriculum:

A. Review your current course offerings and requirements in light of the proposed change. How will the proposed change or changes improve your program and enhance the educational outcomes you seek to accomplish?

This course impacts our curriculum in two areas. For students in existing PHYS or PHYL tracks it will add to the inventory of Advanced Physics Elective courses and improve the choice of courses offered to our students. It will expose the students to a new, rapidly developing field in physics and biomedical engineering.

This course is also important to the proposed programmatic change. For the students in the proposed Biophysics/Pre-Health track (which will replace the existing PHYP track) it will be part of the selection of advanced biophysics courses. Student will elect two out of three courses, as explained in sec. I

B. How will proposed change impact the major/adjunct/elective hour distribution requirement for the major or program?

The course will not change any requirements for the existing PHYS, PHYL, PHYE or PHYT tracks. It will add to our inventory of advanced electives offered to students one a semester on a rotating basis. This course is a part of the proposed conversion of the PHYP track into Biophysics/Pre-Health and the hour distribution for the new major is described in the Program Proposal.

III. Impact of a new course on frequency of course offerings:

A. Specify whether or not the offering of the new course will increase the number of courses or sections offered by the department during the semester in which this course is offered or during the following year;

The advanced physics elective courses are taught on a rotating basis. The frequency that they are offered depends on the demand and interest of the students and the availability and interest of the faculty. The addition of this course will have no impact on the frequency of offerings of required major courses, adjunct courses or common curriculum courses in the physics department. This course will not increase the number of courses or sections offered by the department during any given semester.

B. Specify, if there is no increase in the number of courses offered, which course(s) or section(s) will be dropped in a given semester to accommodate the frequency with which this course will be offered;

This elective course will be offered on a rotating basis with other elective courses in the department, typically in a 3-year cycle.

C. Specify what effect the new course will have on enrollments in other courses or sections within the department and whether or not offering this course will prevent an important or required course from being offered in a given semester.

This course will have no effect on enrollments in other courses or sections within the department and will not prevent any important or required course from being offered in a given semester.

D. Is there a service learning component? If yes, please attach a memo from the director of service learning describing this component.

There is no service learning component to this course.

E. Explain how this proposal does or does not impact other departments, especially those serviced by your department or program and those that provide adjunct service to your department or program.

Students in other science majors who are completing a minor in physics will be able to take this course to fulfill their physics elective requirement. This course may be especially attractive to biology students.

F. Attach a complete functional syllabus for the course as outlined in the Syllabus Template & Policy Undergraduate and Non-Law Graduate Courses

Syllabus is attached at the end of this document

IV. **Attach a detailed plan for assessment of the proposed course that includes the following elements:**

A. Student learning outcomes for this course that are tied to course content and assignments. Key Question: What do you want student to know or be able to do at the end of this course?

- **Students will have a basic understanding of how intelligent machines are built from successful attempts to imitate humans.**
- **Students will have a basic understanding of how a machine can make an intelligent decision.**
- **Students will understand how a machine can program itself in order to make its own decision.**
- **Students will understand how a machine can learn from its own experience and mistakes, and improve its future actions.**

B. Methods, tools, instruments that will be employed to measure success. Describe methods for measuring inputs and outputs. Key Question: What the indicators of learning and course effectiveness?

Assessment will be based on

- **problem-solving homework assignments – these are directly connected to the learning outcomes listed in Sec IV A**
- **written exams**
- **a research project on a topic chosen jointly between the student and instructor resulting in the building of a Lego Mindstorm robot capable of achieving a given task.**

C. Criteria that will be used to measure accomplishments or outcomes. Key Question: How will we know that we are having a positive impact on our students' learning?

Evaluation of all the assessment results will tell us whether or not the students have achieved the learning outcomes for IV A. Individual assessments will be directly linked to those outcomes.

D. Frequency and schedule of assessment of student learning in this course.

There will be weekly homework assignments, two tests during the semester and a final exam. There will be one project with a demonstration during the semester

E. Describe mechanisms that will be in place to ensure continuous improvement of course.

The assessment results feed back to changes in elements of the course – reinforcing those that work and changing/eliminating those that don't.

F. Structure and process for administrative and academic oversight of course.

Course instructor is responsible for the structure and content of the course, and reports to the Department Chair

G. Impact of course on accreditation or certification.

N/A

V. Impact on the budget:

A. Staffing. Is current staffing sufficient or will new faculty be needed (whether full-time or part-time)?

No additional staffing is required for this course

B. Library Support. Describe how library support will be affected by this proposal. Include name of library liaison and date this proposal was discussed with liaison.

No additional library support is needed.

C. Support services. Will the proposed change require additional support services (Media Services audio/visual: typing/secretarial, computer services, computer time)?

No additional support services are needed.

D. New equipment. Does the proposed change presuppose the purchase of new equipment or software, whether for support or instruction?

A number of sets of Lego Mindstorm robots will be purchased from tech fees to allow the students to work on a research project in which they would have to build a robot capable of achieving a given task, putting in practice the theory learned during the course. The estimated cost is $3,000.

E. Is a student fee requested? If yes, provide justification and basis for amount.

No student fee is requested

F. Additional physical space. Does the proposed change require additional physical space (for classes or labs) or modifications of existing physical plant space?

No additional physics space is needed

G. Impact on other departments. How will the proposed change impact the staffing, equipment, and service budgets of other departments?

There is no impact on other departments.

Artificial Intelligience: Neural Networks and Reinforcement Learning
PHYS XXXX-XXX, Fall 2017

Time and Place:	XXXXXXX, Monroe Hall
Instructor:	Dr. Valery Rousseau
Contact:	vroussea@loyno.edu, (504) 865-3066
Office hours:	MO 259, Wednesday 12:00-1:00 pm or by appointment
Textbook:	None

COURSE INFORMATION AND POLICIES

Course Scope: This course is one of the three advanced biophysics courses offered two students in the Biophysics/Pre-Health track, two of which they must select. It is also available to all other physics majors and minors as an Advanced Physics Elective, as required by their respective tracks.

Course Objective: This course is designed to provide an introduction to artificial neural networks and reinforcement learning techniques for students in their early years of undergraduate study. The first main part of the course will illustrate how a crude imitation of the basic structure of a human brain allows computers and robots not only to learn from examples, but also to generalize these examples and make guesses. The second main part of the course will illustrate how a simple implementation of human feelings such as "pain" and "happiness" allows computers and robots to develop their own strategy in order to reach their assigned goal. The overall objective of the course is to make a connection between the structure of the human brain, human psychology, and the development of intelligent machines. Through this course, students should develop many competencies, among which:

- Understanding the scientific method.
- Developing their understanding of the synergy between math and our everyday life.
- Using typical software used in sciences and engineering (Word, PowerPoint, Excel, Matlab, LabView, ...).
- Working in a team in order to achieve a goal.

Course Outline (subject to change):

- Course introduction
- History of artificial intelligence
- The human brain
    A. Basic structure
    B. Neurons, action potentials
    C. How neurons communicate with each other
- Artificial neurons
    A. Mathematical model: The perceptron
    B. How a perceptron makes a decision
    C. How to train a perceptron to make the right decision

1. Supervised learning
2. The gradient descent

D. Capabilities and limitations of a perceptron
E. Examples of applications

- Neural networks
  - F. Monolayer neural networks
  - G. Multilayer feedforward neural networks
    1. Training: Backpropagation of the gradient
    2. Examples of applications
  - H. Multilayer recurrent neural networks
    1. Training: Error minimization
    2. Examples of applications
- Human psychology and artificial intelligence
  - I. How to correct a human's behavior: The feelings of pain and happiness
  - J. How to induce pain and happiness to a computer
  - K. Reinforcement learning
  - L. Examples of applications
- Team project: Design your own crawling robot
  - M. Proposition and selections of projects
  - N. Build your robot
  - O. Let your robot learn itself how to crawl.
  - P. Robot show day

Grading: Your final grade will be determined by the following scale:

Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	F
From %	92	90	87	83	80	77	73	70	65	60	0
To %	100	92	90	87	83	80	77	73	70	65	60

You will earn points from a team project (30 pts), final exam (50 pts), a number of homework assignments throughout the semester (10 pts), and attendance (10 pts) for a total of 100 pts max for the entire course. Each student must have a Blackboard account to access various assignments. The final exam is as scheduled in the university calendar. The deadlines for the homework will be announced for each assignment.

Homework and quizzes: You will be given homework sets throughout the semester. You will have one week to complete and submit the homework via Blackboard. Homeworks must be submitted before the beginning of the lecture at the due date. The goal of the homework is for you to practice. In some ways, physics is like a sport or like playing a musical instrument. It is not enough to know intellectually how to hit a baseball with a bat, or how to play arpeggios on the piano. To actually make a home run, or make it to Carnegie Hall, you have to practice. For physics, that practice is homework. Like sports or music, it is more important to try than to worry about getting it right the first time. To encourage you to work on the challenging homework problems, they are graded partially on effort. The important part of your homework is how you solve the problem, not the number that you get as a result. Consultation and collaboration with your fellow students is recommended, but the homework solutions you hand in must be your own work.

Blackboard: There is a website for this course that can be accessed through https://loyno.blackboard.com/. I will post course materials and announcements on Blackboard, so please visit it regularly.

Attendance Policy: The attendance will be checked every class. Every student is entitled to one unexcused absence with no penalty. At the beginning of the semester each students has a 10 pts attendance grade. For the second and third unexcused absence each there will be a 5 pts deduction from this grade. A student with three or more unexcused absences will receive no points for attendance. Only absences for important reasons, such us documented illness, family issues, or official university business, will be excused. You may be asked to provide explanation and evidence for your absence.

Punctuality: Coming on time to class is important! A latecomer will miss important points and disturb the others. If you anticipate being late for lab for some important reason, please inform the instructor at least two days in advance.

Other remarks:

5. Please turn off your cell phones while you are in the class.
6. Any other electronic devices (laptops, tablets) may be used only with an explicit permission from the instructor and you will be required to submit your electronic notes at the end of every class by e-mail. Your failure to do so will result in the permission to use the device being revoked.

Disability services and accommodations: If you have a disability and wish to receive accommodations, please contact the University's Disability Services. If you are eligible to receive test accommodations (e.g. extended test time) through the Academic Resource Center, you will need to give the course instructor an official Accommodation Form from Disability Services. For more information regarding disability services, please see http://www.loyno.edu/arc/disability-services

Statement on Academic Integrity: The Academic Honor Code of Loyola University New Orleans represents the University community's commitment to the highest intellectual and ethical standards of honesty, integrity, fairness and justice. Violations of the Academic Honor Code include but are not limited to cheating, plagiarism, false citations, falsified data, falsification of academic records, unauthorized collaboration, misuse of electronic material, and violation of academic property laws. A student in doubt about whether a particular course of conduct might violate the University's Academic Honor Code should talk with the course instructor before engaging in that conduct. For more information please read the University policies and procedures http://2013bulletin.loyno.edu/academic-honor-code.

Emergency Operations: At times, ordinary university operations are interrupted as a result of tropical storms, hurricanes, or other emergencies that require evacuation or suspension of on-campus activities. To prepare for such emergencies, please familiarize yourself with the University's emergency policies available on the Academic Affairs web site: http://academicaffairs.loyno.edu/students-emergency-responsibilities.