The University of Georgia
Department of Computer Science

Course Information Sheet
CSCI 4530
Programming Languages

Brief Course Description
(50-words or less)

This is an introduction to robotics with a focus on autonomous mobile robots. The two major issues dealt with are: (1) cognitive behavior, and (2) motion. Cognitive behavior addresses problem solving using sensory inputs and desired goals. Motion deals with aspects of movement from simple robotic arm movement to autonomous rovers in unknown environments.
This course is cross-listed with ARTI 4530.

Extended Course Description / Comments

Use this section to put additional information that's relevant to whom this course is targeting

This course is part of the BS-CS Teamwork Requirement; students In CSCI 4530 are required to work in teams of size greater than 2.

Pre-Requisites and/or Co-Requisites

CSCI 2720
Data Structures

And permission of department

Approved Textbooks
(If more than one, course text used during a semester is at the discretion of the instructor)

1) *The Robotics Primer*, by Maja Mataric, MIT Press, 2007. 978-0-262-63354-3
2) *Introduction to Autonomous Mobile Robots*, by Siegwart & Nourbakhsh, MIT Press, 2nd Edition. 978-0-262-01535-6

Specific Learning Outcomes (Performance Indicators)

1-Outcome: Students are familiar with (know something about) constructing small autonomous mobile robots that achieve some goal.

1-Artifact: Team challenges, each team composed of three members.

1-Examples:

1) Using a LEGO Mindstorm Robotics kit, design and build a robot to travel in a square figure-eight pattern having 12-inch lengths, starting at the intersection and ending within one-half an inch of the start location.
2) Using a LEGO Mindstorm Robotics kit, design and build a robot to traverse a maze given specific start and end coordinates, while avoiding an en-route obstacle.
3) Building on the previous challenge (#2), enhance the robot to pick-up an object at the end location and deposit is at a drop-off coordinate.
4) Using an IntelliBrain Robotics kit, design and build a robot to search an open area for a specific object among several objects, pick up the object, take the object to the drop-off bin, and place the object inside the bin.
5) Using a robot kit of your choice or some combination, design and build a robot to achieve a challenge related to human recognition, or navigation and mapping.

2-Outcome: Students are familiar with (know something about) robot control architectures.

2-Artifact: Individual assignments.

2-Examples:

1) Define/describe the four common robot control architectures.
2) Design two robot challenges for the class of increasing difficulty with special emphasis on a particular robot control architecture.
3) Design and implement a component for handling uncertainty within a behavior based robot control architecture.

3-Outcome: Students are familiar with (know something about) the historical development of autonomous mobile robots.

3-Artifact: Team challenges, individual assignments.

3-Examples:

1) Identify and describe an historical robot most similar to one of your challenge robots.
2) Following the design philosophy inherent in the Shakey robot, describe its similarities and differences with your team maze navigation challenge robot.
3) Compare and contract Grey's tortoise with your square figure-eight challenge robot.

4-Outcome: Students are familiar with (know something about) the complexities of constructing autonomous mobile robots that achieve some specific goal.

4-Artifact: Individual assignments, team challenges, and exam questions.

4-Examples:

1) Explain to a layperson why robotics is hard, being sure to address issues of mechanical situatedness and computational reasoning ability.
2) Prepare detailed "lab" reports for each robotics challenge.
3) Prepare two class challenges of various difficulty, and explain the specific variations.

5-Outcome: Students are familiar with (know something about) the state-of-the-art of autonomous mobile robotics.

5-Artifact: Team challenges, individual assignments.

5-Examples:

1) Compare and contrast three current innovations in the field of robotics.

2) Scavenger hunt: locate current literature articles addressing three recent technological advances in robotics.

3) Visit the Uncanny Valley and report on your findings; include justification.

Relationship Between Student Outcomes and Learning Outcomes

		Student Outcomes										
		a	b	c	d	e	f	g	h	i	j	k
Learning Outcomes	1	•	•	•	•		•		•	•	•	•
	2	•	•	•	•		•		•	•	•	•
	3	•	•	•	•		•		•	•	•	•
	4	•	•	•	•		•		•	•	•	•
	5	•	•	•	•		•		•	•	•	•

Student Outcomes

a. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
b. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
c. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
d. An ability to function effectively on teams to accomplish a common goal.
e. An understanding of professional, ethical, legal, security and social issues and responsibilities.
f. An ability to communicate effectively with a range of audiences.
g. An ability to analyze the local and global impact of computing on individuals, organizations, and society.
h. Recognition of the need for and an ability to engage in continuing professional development.
i. An ability to use current techniques, skills, and tools necessary for computing practice.
j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
k. An ability to apply design and development principles in the construction of software systems of varying complexity.

Major Topics Covered
(Approximate Course Hours)

3 credit hours = 37.5 contact hours
4 credit hours = 50 contact hours

Note: Exams count as a major topic covered

Week1: Introduction and History of Robotics (7.0)
- Cybernetics
- Artificial Intelligence
- Robotics

Week 3: Robot Control Architectures (7.0)
- Reactive & Deliberative
- Subsumption
- Schema-Based
- The Feedback Control Loop

Week 5: What Can We Learn From Animal Behavior? (3.5)
- Insects
- Mammals

Week 6: What Are Robotic Behaviors? (7.0)
- Reaction
- Action
- Navigation
- Stimulus-Response

Week 8: Construction Architectures (14.0)
- Basic Electronics
- Motors and Gears
- Sensors
- Construction Rules and Techniques
- Mobile Architecture
- Reasoning Architecture

Week 12: Intelligent Behavior (14.0)
- Decision Making On The Move
- Self-Survival
- Achieving Goals
- Adaptation

Week 16: Robot Applications (3.5)
- Search and Rescue
- Surveillance
- Manufacturing
- Health Care
- Automotive

Week 17: Advanced Topics (3.5)
- Learning New Behaviors
- Cooperation
- Distributed Reasoning

Assessment Plan for this Course

Each time this course is offered, the class is initially informed of the Course Outcomes listed in this document, and they are included in the syllabus. At the end of the semester, an anonymous survey is administered to the class where each student is asked to rate how well the outcome was achieved. The choices provided use a 5-point Likert scale containing the following options: Strongly agree, Agree, Neither agree or disagree, disagree, and strongly disagree. The results of the

	anonymous survey are tabulated and results returned to the instructor of the course. The course instructor takes the results of the survey, combined with sample student responses to homework and final exam questions corresponding to course outcomes, and reports these results to the ABET committee. If necessary, the instructor also writes a recommendation to the ABET committee for better achieving the course outcomes the next time the course is offered.
How Data is Used to Assess Program Outcomes	Each course Learning Outcome, listed above, directly supports one or more of the student Outcomes, as is listed in "Relationships between Learning Outcomes and Student Outcomes". For ARTI/CSCI-4530, Student Outcomes (a)-(d), (f) and (h)-(k) are supported.
Course Master	Dr. Don Potter (updated 2/10/2012)
Course History	12-7-12: Course added to Teamwork Requirement block for BS-CS