

## Rug-cutting robots

Performing arts, computer science students team up to teach robots to dance



The Dancing Robots class is aptly named because students work at programming robots such as the one above, to dance. Photo by Tim Schoon.

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You’ve probably seen people dancing “the robot,” all stiff limbs and sudden stops—but how about robots dancing like people?

Meet Amanda. She’s a two-foot-tall humanoid robot with flexible shoulder, neck, hip, knee, and ankle joints that allow her to approximate human movements. She’s one of four interactive robots University of Iowa students are teaching to dance in a new course offered through the Departments of **Computer Science** and **Dance** in the **College of Liberal Arts and Sciences**.

The class, aptly titled “Dancing Robots,” charges its eight students—seven undergraduate dance, computer science, and electrical engineering majors, and one performing arts graduate student—with choreographing a dance for the robots, then programming them to perform it.

### From pliés to Python

The NAO H25 robots—Amanda, Christopher, Denise, and Alberto—were developed by Aldebaran Robotics for use in research and STEM (science, technology, engineering, and math) education. ("NAO" is the company's futuristic spelling of "now," and H25 refers to the humanoid robots having 25 degrees of freedom.) Their behavior can be controlled by computer, via the programming languages Python, C++, and Java, or via the graphical programming tool Choregraphe, whose user-friendly interface facilitates the process for those with little programming experience.

Still, it's not easy to tell a robot what to do. "Since the robots are relatively recent models," says Sean Laughead, a senior dance major from West Des Moines, "there isn't much technical support online, and we're really having to pioneer different strategies to articulate movement. Whenever we achieve one of our goals, it's really exciting—even if that goal is just to have the robot wave its hand."

### **Watch the robots wave, fist-pump, and practice ballet positions.**

During a typical class period, the students work in small, mixed-major groups to design and present simple sequences of robotic actions in response to a piece of music or a verbal cue. Each group, supplied with a laptop and a robot, brainstorm possible motions while deliberating the robots' physical limitations. How high can a robot raise its arms? Can it balance on one leg? Do the splits?

It's not unusual for the dancers in the groups to jump to their feet and demonstrate these movements while their classmates take notes and video. They then reconvene around the laptop to translate the desired movements into instructions the robots can understand.

## **A classroom for the 21st century**

"The students are collaborating really well," says Denise Szecsei, the course's primary instructor and a lecturer in computer science. "The dance students are stepping up to explain the vision of a dance, and the computer science students are contributing their knowledge of how to control the robots. They're explaining terminology to each other and exchanging ideas. It's an ideal environment—it's what I live to teach."

Szecsei has a point. The course is almost a paradigm for the modern liberal arts and sciences classroom, with culturally, socially, and academically diverse students respectfully working together, using communication and critical-thinking skills to solve complex problems and create art.

"It's probably the only class of its kind anywhere," notes co-instructor and associate professor

of dance Charlotte Adams, who coaches the students in the elements of choreography. “Collaboration is an especially vital skill. The world needs creative thinkers and scientific thinkers working together and learning together,” she says.

## **Communication, critical thinking, and creativity**

The course is the outcome of a 2014 Innovations in Technology Award received by Alberto Segre, professor of computer science, and George De La Pena, associate professor of dance, whose proposal, “Making Algorithmic Thinking Concrete via Collaboration with the Performing Arts,” stood out to the selection committee as a model of cross-discipline, collaborative teaching. The award allowed Segre and De La Pena to purchase five of the robots and the Choregraphe software.

Writes Maggie Jesse, chair of the Academic Technologies Advisory Committee, “Bringing students together from such different areas provides them with a new experience that will benefit them throughout their lives. Performing arts students learn about computation, computer science, and informatics students learn about creative work, and both sides gain a new appreciation for the other discipline. That’s really powerful.”

And Szecsei notes that it’s good real-world practice for both groups. “All computer science students should learn about other disciplines that use their tools so they can understand what users need. They should also practice communicating with nontechnical people and people who have different skill sets.”

Alic Szecsei, a computer science major in the class, is grateful for the opportunity to collaborate with dancers. “They’ve given me a lot of perspective on how we move. Usually when you’re walking or gesturing, you don’t think about the specifics of how you’re moving—but the dancers are intensely focused on those specifics,” he says.

For their part, the performing arts students benefit from thinking about their craft in a new way. “They’re used to working with human bodies that have certain motions,” says Denise Szecsei, “but now they have to think about how motion is conveyed and performed with a different ‘species.’ They’re learning to think algorithmically, breaking the motions down into components.”

## **Robots on parade**

As a STEM initiative with a performing arts twist, the three-semester-hour course is a ready-made outreach tool. Szecsei plans to visit area schools with the dancing robots and even

teach a week-long K–12 robot camp. “I can’t wait to tell the kids, ‘Look what technology can do! Even if you’re interested in dance, it doesn’t mean you can’t do technology and computer science, too.’”

In May, the UI class will invite the public to a concert in which the robots, programmed with the students’ choreography, will perform alongside the student dancers. Equipped with cameras for “eyes,” microphones for “ears,” and speakers for “mouths,” the robots will also emcee the production, cracking jokes and introducing performers using their text-to-speech function. For a preview, check out the robots’ brief debut performance at this year’s **University of Iowa Computing Conference** at 4 p.m. on Saturday, March 1, in the Andersen Galleria, W101 Pappajohn Business Building.

If you plan to go, plan to be surprised. Not only are the robots cuter than you’d expect a computer to be, but, as Laughead notes, “They’re easy to personify, and you begin to feel bad for them when they fall over.” (When they fall over, they say “ouch.”)

Individuals with disabilities are encouraged to attend all UI-sponsored events. If you are a person with a disability who requires a reasonable accommodation in order to attend the event, contact the Department of Computer Science in advance at 319-335-0713.

## Media Advisory

Members of the media are invited to visit the class Tuesday, Feb. 25, from 10 a.m. to 12:30 p.m. in B13 MacLean Hall.

Instructor Denise Szecsei (SAY-chay) will be available to speak with media throughout the class period. Charlotte Adams will be available from 10 to 11:15 a.m. If you plan to attend, please contact Amy Mattson in advance at 319-384-0070 or at [amy-mattson@uiowa.edu](mailto:amy-mattson@uiowa.edu).

Media are also welcome to view the robots’ brief debut performance at this year’s **University of Iowa Computing Conference** to take place at 4 p.m. p.m. Saturday, March 1, in the Andersen Galleria of the Pappajohn Business Building.

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