ALS 5932
ROOT: ARCHITECTURE 2 FUNCTION
2 CREDITS

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Webpage: https://ufl.instructure.com/courses/385139

Contact Information:

- Email: use the Canvas e-mail (the most efficient)
- Phone: 772-577-7341.
- Office hours: online conferencing via Canvas/Zoom (by request)

Lectures: In person short summer course.

Pre-requisite: Participants must have knowledge in botany and plant physiology and some knowledge in soil chemistry. **Attendance to the "Linking Root Architecture to Function: Theory, Methods and Technology" short summer course (Aug. 11th-16th, 2019) is mandatory in order to get credits**.

Background & Rationale

Agricultural production systems are confronted with an array of challenges that limit resource availability needed for plant productivity:

- Climate change is affecting average temperature and rainfall (amount and distribution)
- Soil degradation and limits to inputs are reducing nutrient availability
- Abiotic and biotic stresses alone and in combination are increasing – emphasis must be on maintaining productivity efficiency as opposed to simply survival under stress conditions

In addition to these challenges, the rising world population is increasing its demand for quantity and quality of plant-based products.

Significant research has been done on plant responses to changes in the environment, in which an important role for roots has been recognized. However, given the complexity of belowground dynamics and the logistical difficulties in adequately measuring the root system, many breakthroughs in the quantification of root systems and their functions have happened relatively recently and are ongoing using cutting edge techniques.

One element of roots that has received increasing attention in recent years is the root system architecture. Various imaging and sampling techniques have been developed, but now the emphasis appears to be the ability to link

architectural information with function – from many different scales including whole system to cellular. Effectively coupling studies of root architecture would give the most promising impact towards addressing the true role of roots in mitigating the challenges in stress and environmental perturbation.

Scope:

The central focus of this course will include an exploration of new techniques that couple studies of root system architecture and function, hands-on experience with some of these techniques, and the new approaches to delve deeper into the analysis of the resulting data, from modeling to machine learning techniques. Specific topics will include:

- **Defining root structure (cellular, organ), architecture, and function** – Arriving at a common set of definitions used throughout the course
- **Methods Overview** – imaging, sensing
  - What are the limitations of each approach – practical vs. theoretical? Controlled conditions vs. field
  - What are the scales at which methods are appropriate? Whole plant to cellular, molecular
  - What questions are addressed most appropriately in each approach?
  - What are the approaches that can most effectively integrate across structure, architecture, and function to arrive at mechanistic understanding of process?
- **Resulting Data**
  - What sorts of data are produced in a given approach?
  - What are the techniques (current and in development) available for analyzing this data?
  - Benefits and pitfalls of modelling – when does it hold up and when does it fail?
  - Note: we will have a hands-on data set to illustrate the application of modelling vs. machine learning approaches.
- **The next step** – identifying adapted phenotypes

Course format

The course is composed of a series of lectures, discussions sessions, working group activities, hands-on data analyses, excursions to a root research sites, and a final course debate of a case study. The course will be 5.5 days.

- **Key-note / Introduction Lecture**

  The course starts off (Sunday afternoon after dinner) with an introduction lecture by an invited speaker to give an overview of the current state of knowledge on root biology and the challenges and opportunities that are present.

- **Lectures and Discussion**

  Following each lecture (30-45 minutes), a 30-45 minutes discussion will be held.

- **Hands-on tours and data analysis**

  Afternoons will include tours of ongoing root research projects at various locations and analysis of actual data sets from the projects. For data analysis, various approaches will be compared for their effectiveness

in addressing specific questions focused on for the project where the data originated. Students will work in groups of 3-4 and will report their findings and critique of the methods for analysis that were utilized. What questions were answered, what were the limitations to the approach?

- **Evening paper discussions**

  Current literature will be discussed each evening after dinner. Student groups (2-3 students each) will be responsible for presenting the paper for a given evening and leading a discussion about the topic.

- **Final class debate**

  On the final day of the course, student groups will be presented with case studies aimed at examining root architecture and function at different scales. Two groups will be paired to address one case study. The two groups will debate the issues presented in class – feasibility of the method, appropriate scale for the questions asked, data analysis approaches, and the synthesis and impact of information gained.

EVALUATION OF LEARNING

Students whose have attended the "Linking Root Architecture to Function: Theory, Methods and Technology" short summer course (Aug. 11th-16th, 2019) will receive an A mark.

COURSE POLICIES

<u>Attendance and Make-up Policy</u>

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at:

- *UF Attendance policy*, https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

<u>Academic Honesty</u>

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity." You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action.

- For more information regarding the Student Honor Code, please see:
  http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code

Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken when appropriate.

Services for Students with Disabilities

Students with disabilities requesting accommodations should first register with the Disability Resource Center by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

- *Disability Resource Center*, 0001 Reid Hall, (352) 392-8565, www.dso.ufl.edu/drc/

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *Counseling and Wellness Center*, 3190 Radio Road, 392-1575**,** www.counseling.ufl.edu

    Counseling Services

    Groups and Workshops

    Outreach and Consultation

    Self-Help Library

    Wellness Coaching

- *U Matter We Care*, www.umatter.ufl.edu
- *Sexual Assault Recovery Services (SARS),* Student Health Care Center, 392-1161.
- *University Police Department*, 392-1111 (or 9-1-1 for emergencies), www.police.ufl.edu

Additionally, if you would like orientation on choosing a major, finding an internship, or planning your career, I encourage you to use the university's on-campus resources.

- *Career Connections Center,* CR-100 Reitz Union, 392-1601, https://career.ufl.edu/

Course Evaluation Process

Student assessment of instruction is an important part of the effort to improve teaching and learning. At the end of the semester, you are expected to provide feedback on the quality of instruction in this course using a standard set

of university and college criteria. Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Evaluations are typically open during the last two or three weeks of the semester. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/.

Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/

Student Complaints
You can file and resolve any complaints about your experience in this course in the following site:
- *Student complaints in residential courses*, https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/
- *Student complaints in online courses,* http://distance.ufl.edu/student-complaint-process/