



EECE5155: Wireless Sensor Networks and the Internet of Things

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Research Project Instructions

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Steps in the Research Project

- **First step:** teaming and topic selection (due on October 4)
- **Second step:** abstract and first list of references (due on October 18)
- **Third step:** the paper (due on November 20)
- **Fourth step:** the video presentation (due on December 6)

First Step: Teaming

- The research project will be done in teams of 4 students
 - If you already have a team, go ahead and self-enroll in Canvas:
 - Navigate to the course, select People on the left-hand column, look at the Groups tab, select an “empty team” and ensure that you and your teammates select the same

The screenshot shows the 'Groups' tab selected in the Canvas navigation bar. On the left, a sidebar lists course navigation links: Home, Announcements, Syllabus, Modules, Discussions, Quizzes, People (which is currently selected), Grades, Panopto Video, and Zoom Meetings. The main content area displays three groups under the heading 'Research Project Teams': 'Research Project Team 1 Research Project Teams' (0 students), 'Research Project Team 2 Research Project Teams' (0 students), and 'Research Project Team 3 Research Project Teams' (0 students). A search bar labeled 'Search Groups or People' is also visible.

EECE5155.18875.202110 > People > Groups

202110_2 Fall 2020 Semest...

Home Announcements Syllabus Modules Discussions Quizzes People Grades Panopto Video Zoom Meetings

Everyone Groups

Search Groups or People

Research Project Team 1 Research Project Teams 0 students

Research Project Team 2 Research Project Teams 0 students

Research Project Team 3 Research Project Teams 0 students

First Step: Teaming

- If you do not have a team, you are strongly encouraged to utilize the Discussion thread titled, “Team Formation” to find teammates.
 - If you already know the IoT topics that interest you, you could list those out and look for classmates with similar interests.

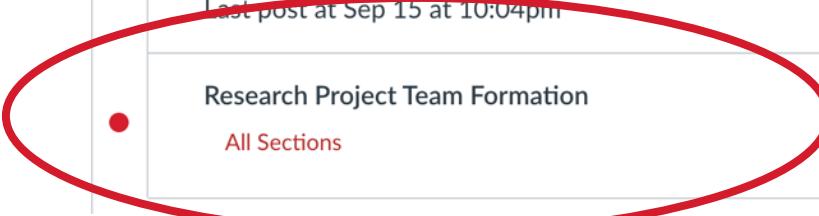
≡ EECE5155.18875.202110 > Discussions

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▼ Pinned Discussions

Introduce Yourself	All Sections
Last post at Sep 17 at 11:43am	
General Course Q&A	All Sections
Last post at Sep 15 at 10:04pm	
Research Project Team Formation	All Sections



The screenshot shows a course navigation menu on the left with 'Discussions' selected. The main area displays 'Pinned Discussions' with three entries: 'Introduce Yourself', 'General Course Q&A', and 'Research Project Team Formation'. A red oval highlights the 'Research Project Team Formation' entry.

First Step: Teaming

- If you cannot find a team, you will be randomly assigned to a team with less than 4 members

As everything at Northeastern: think of this as a learning experience. For example, do you think you will get to pick your teammates when you join a research lab or your next job?

First Step: Topic Selection

- A list of IoT-related research topics will be provided by the weekend:
 - Each team should provide their top 4 preferences
 - Or suggest a new topic, relevant to the Internet of Things
 - I will try to accommodate all the requests, but it might always be possible
 - **Good news:** there are no bad topics!

First Step: Topic Selection

- Some examples:
 1. The Internet of Things in 2030: What is expected 10 years from now?
 2. The role of Artificial Intelligence in the Internet of Things
 3. Security and Data Privacy in the Internet of Things
 4. Powering the IoT (from batteries to energy harvesting)
 5. The Internet of Underground Things
 6. The Internet of Underwater Things
 7. The Internet of Space Things
 8. The Internet of Nano-Things
 9. The Industrial IoT: Future Manufacturing Environments
 10. IoT and Vehicular Networks
 11. The role of IoT in Smart Health
 12. The role of IoT in Smart Cities
 13. Democratizing the IoT: Facilitating the access to IoT technologies and applications
 14. ...

First Step: Due Date

- The teams and they preferred topics should be finalized by **October 4, 2020**.
 - Your team should have all its members
 - As a team, you will complete the topic selection assignment in Canvas:
 - Only one student per team needs to complete the assignment

The screenshot shows a list of course sections in a navigation menu:

- Research Project
- Overview
- Instructions and Materials
- Assignments
- Team Selection
Oct 4 | 0 pts

A red oval highlights the "Assignments" section, and a red square highlights the "+" icon next to the "Research Project" section header.

Second Step: The Abstract & References

- Teams are expected to conduct an independent survey on the state of the art for the topic that they have been finally assigned based on their preferences
- To start with, each team will have to submit:
 - A **brief abstract** (less than 200 words)
 - A **preliminary list of references**

This will be used to make sure that the team is working in the right direction and correct it if necessary

More in a few slides!

- The submission will be completed on Canvas, only one team member needs to submit it:
 - **Due date:** October 16, 2020

Third Step: The Paper

- After the abstract, all teams will receive feedback from the instructor and continue working on the preparation of the final paper
- Papers should:
 - Be at least 6 pages long, two-column format, 10-point font size
 - Contain at least 15 references
 - Follow the IEEE template

http://www.ieee.org/publications_standards/publications/authors/author_templates.html

More in a few slides!

- The submission will be completed on Canvas, only one team member needs to submit it:
 - **Due date:** November 20, 2020

Fourth Step: The videopresentation

- Teams will prepare and record a presentation of their paper, to be shared and evaluated with the class:
 - Presentations should be 15 minutes long
 - A slide template will be provided
- The submission will be completed on Canvas, only one team member needs to submit it:
 - **Due date:** the video should be uploaded in Canvas by December 6, 2020.

Project Grade Distribution

- The total project is worth 25% of your final grade, out of which:
 - 20% corresponds to the abstract and references
 - 40% corresponds to the paper
 - 40% corresponds to the presentation

What is Research?

What is Research?

Research

- **Definition:** The systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions
- **Origin:** from Old French
 - **Re:** expresses intensive force
 - **Cerchier:** to search

Search Engines

- There are many search engines for scientific papers:

- **IEEE Xplore:**

<http://ieeexplore.ieee.org/Xplore/home.jsp>

- **Science Direct:**

<http://www.sciencedirect.com>

- **Google Scholar:**

<http://scholar.google.com>

The “Search” Process

- It is easy to look for papers:
 - **Keyword search**
 - **Author search**
- But how to find good quality papers?
 - In the majority of the cases, good papers are published in top journals:
 - IEEE Transactions on:
 - Communications, Wireless Communications, Networking, Nanotechnology, Solid State Devices, Terahertz Science and Technology, Circuits and Systems, etc.
 - IEEE JSAC, Proceedings of the IEEE
 - Nature, Science, Nature Electronics, Nature Nanotechnology, Applied Physics Letters

The “Search” Process

- A good starting point:
 - **Survey and roadmap papers:**
 - Provide an “overview” of the problem to study and an updated discussion on the state of the art on the topic
 - Contain many references and pointers to the top groups in the field: the next step for you to search!

The “Search” Process

- Rarely, you will find “useful” **books** on an open research topic:
 - Usually they are just collections of papers related to the topic, but not a real “text book” with a well-defined and consistent flow...

Research Project

- What should each team do next:
 - To conduct a **literature search**:
 - Look for papers related to your topic
 - If possible, try to find survey/roadmap papers, which can help you understand the “big picture”
 - Keep an eye on the authors of the papers:
 - Where are they? Are they still working on the topic?
 - Are they consistently publishing good papers?

Research Project

- First, each team member should conduct the literature search **independently!**
- Second, the team members should **go through the references together**
 - Hopefully many will be the same!
- Third, identify the main sub-topics in the field, divide the load, and continue with the literature search

The Abstract

The Abstract

Abstract

- **Definition:** A complete but concise description of the contents in the paper
- **Parts of an Abstract:** Depend on the type of paper we are writing:
 - **Standard Research Paper:**
 - **Motivation:** Which is the topic and why is it important?
 - **Problem:** Which is the problem you are solving?
 - **Approach:** How do you solve the problem?
 - **Results:** Which are the outcome of your approach?
 - **Conclusions:** What did we learn? Future steps?

Abstract

- **Survey Paper:**
 - **The field:** Which is the topic and why is it important?
 - **State of the Art:** What are the latest advancements in the field?
 - **Open Challenges:** Which problems still need to be solved?

Example

- **Title:** The Internet of Nano-Things
- **Abstract:**
 - Nanotechnology promises new solutions for many applications in the biomedical, industrial and military fields as well as in consumer and industrial goods.
 - The interconnection of nanoscale devices with existing communication networks and ultimately the Internet defines a new networking paradigm that is further referred to as the Internet of Nano-Things.
 - Within this context, this paper discusses the state of the art in electromagnetic communication among nanoscale devices.
 - An in-depth view is provided from the communication and information theoretic perspective, by highlighting the major research challenges in terms of channel modeling, information encoding and protocols for nanonetworks and the Internet of Nano-Things.

100 words!

How to Cite Papers?

- Journal papers:
 - S. Khan, J. Chan and H. Simpson, “An Example Manuscript with the IEEE LaTeX Template,” IEEE Transactions on Random Contents, vol. I, no. 3, pp. 584-585, March 2015.
- Conference:
 - S. Khan, J. Chan and H. Simpson, “An Example Manuscript with the IEEE LaTeX Template,” in Proc. of First International Conference on Random Contents, Buffalo, NY, March 2015, pp. I-2.
- Many other formats! (technical reports, books, patents,...):

<https://ieeearchauthorcenter.ieee.org/wp-content/uploads/IEEE-Reference-Guide.pdf>

The Paper

The Paper

Structure of the Paper

- There is no general structure for the paper, it really depends on the topic!
- A generic survey paper would look like:
 - Abstract
 - Introduction:
 - What is the topic? Which are its applications?
 - Why is this topic important now? What has changed?
 - Contributions of the paper (e.g., Review of state of the art, list new challenges, propose new solutions)
 - Structure of the rest of the paper
 - (Applications)
 - (Basic concepts)
 - State-of-the art
 - You can have this divided into multiple sections...
 - Next Steps/Roadmap
 - You can have this divided into multiple sections...
 - Conclusions

Submission Guidelines

- Papers should:
 - Follow the IEEE template:
 - http://www.ieee.org/conferences_events/conferences/publishing/templates.html
 - Be at least 6 pages long (2 columns format)
- Contain at least 15 references:
 - Please be careful with the formatting!
 - <https://ieeearchercenter.ieee.org/wp-content/uploads/IEEE-Reference-Guide.pdf>

- The preparation of the paper might be a good excuse for you to add a new skill to your toolbox, i.e., LaTeX:
 - A document preparation system for high-quality typesetting:
 - Widely used for medium-to-large technical or scientific documents
 - Simplifies the process of:
 - Incorporating equations
 - Handling references (BibTeX)
 - In the past, getting LaTeX to run required installing many tools, now it can be done directly online with a free account on Overleaf (and you can all work simultaneously on it!)
 - www.overleaf.com
- For more information and details,
 - <http://latex-project.org/intro.html>