URBAN COMPUTING

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AI6128 Urban Computing

Course Logistics

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Contents

- Couse Logistics
  - Instructors
  - Lectures
  - Quizzes
  - Literature review assignment
  - Course projects
  - Timeline

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Instructors

- Part 1
  - Dr. TAN Rui
    tanrui@ntu.edu.sg
    N4-02C-85

- Part 2
  - Dr. LONG Cheng
    c.long@ntu.edu.sg
    N4-02C-117a

  - Dr. CONG Gao
    guest lecturer (2 lectures)

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Lecture-based Learning

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Lectures

- Time/Location
  - Saturday, 2.30pm-5.30pm, live online at Zoom
  - 3 hours per week
    - 2.5 hours lecture, 0.5 hour consultation/discussion

- Two parts
  - Part 1 (Urban IoT): Week 1-6
  - E-learning (Advanced topics): Week 7
  - Part 2 (Urban data analytics): Week 8-13

- Course materials (enough for completing this course)
  - Lecture notes
  - Pre-selected research papers for literature review assignment
  - Course project manual

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References

- For extended knowledge and scope
  - Wireless Sensor Networks: An Information Processing Approach, by Feng Zhao and Leonidas J. Guibas, Morgan Kaufmann Press Online e-book (NTU login required): https://www.sciencedirect.com.remotexs.ntu.edu.sg/book/9781558609143/wireless-sensor-networks
  - Urban Computing, by Yu Zheng, MIT Press (available at NTU library)

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Part 1: Urban IoT

- **Introduction to urban IoT**
  - What is urban computing?
  - IoT applications
  - IoT architecture

- **Urban sensing**
  - Sensor and facility deployment
  - Data acquisition
  - Communication infrastructures

- **Localization and time acquisition**
  - GPS
  - Indoor localization
  - Indoor time acquisition

- **Cloud computing support**
  - Concepts, mechanisms, architecture
  - Virtualization, SaaS, PaaS, IaaS
  - Prevalent clouds

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Part 2: Urban Data Analytics

- **Urban data management**
  - Spatial data indexing and querying
  - Spatio-temporal data indexing and querying

- **Urban data analytics**
  - Spatial data mining
  - Spatio-temporal data mining
  - Deep learning on spatial and spatio-temporal data

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Overall Assessment

- Weightage
  - Two course projects: 50% (25% each)
  - Two quizzes: 20% (10% each)
  - Literature review: 30%
  - No final exam

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Quizzes

- Quiz 1
  - Open book
  - Any 20 minutes during Week 5 lecture
  - Coverage: Contents in Week 1, 2, 3, 4
  - Make-up: Any 20 minutes during Week 6 lecture

- Quiz 2
  - Closed book
  - Any 20 minutes during Week 12 lecture
  - Coverage: Contents in Week 8, 9, 10, 11
  - Make-up: Exam Week 1

- Policy on make-up quizzes
  - For students who miss the quiz without a valid excuse, a penalty of 20% reduction will be applied to the make-up quiz score

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E-Learning: Advanced Topics

- Edge computing
- Urban computing in industry

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Group-based Self-learning and Hands-on Activities

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Student Groups

- For both <u>literature review assignment</u> and <u>course projects</u>

- Group assignment will be generated on August 20th (i.e., after course add/drop period)
    – Based on index number in NTULearn
    – 2~4 students each group
    – Check your group assignment in NTULearn in Week 3
    – Liaise with your group mates in Week 3
    – Change of group assignment is not advisable, unless there are special reasons

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Literature Review Assignment

- 18 topics
    – Each group will select a topic exclusively
    – Each topic has 4 pre-selected papers

- Use a Google Form to select your group's topic after knowing your group in Week 3
    – Each group designates one member to use the form to submit selection
    – Each group can only submit once!
    – Topics that have been selected by other groups are not shown on the form
    – Although selections are exclusive, no need to hurry because we have abundant topics
    – Google Form address announced in Week 3, submit the selection by end of **Week 4**

- Minimum reading requirement
    – Each student in a group should read **at least 2 papers** related to the selected topic, with at least 1 paper from the pre-selected papers
    – Students in a group should read different sets of papers
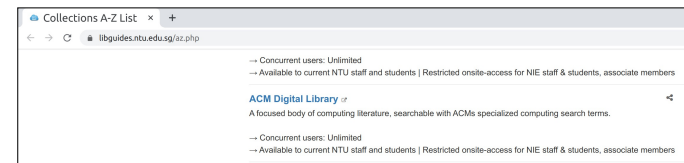
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How to Access a Research Paper?

- Most computer science/engineering papers can be found from three databases
    – ACM Digital Library, IEEE Xplore, ScienceDirect

Step 1: Visit https://libguides.ntu.edu.sg/az.php and find the database

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How to Access a Research Paper? (cont'd)

Step 2: Login using your NTU account and agree the terms of use.

Step 3: Use the database's search function to look for the paper. You can enter the title of the paper to do the search.

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Group-based Presentation

- Week 13
  - Presentation time will be allocated proportional to group size

- Suggested format
  - Introduction by a lead presenter
    - Background of the topic
    - What the topic is about?
    - Significance (why it is important?)
  - Presentation of each reviewed paper
    - What problem addressed
    - Why the problem addressed is important
    - How the problem is addressed
    - How the experiments are conducted
    - What results are obtained
    - What limitations the paper has
    - How to address these limitations if you will do further research

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Literature Review Assessment

- Purely based on the presentation

- Assessment criteria
  - Introduction (group's common score)
  - Each paper review (individual's score)
  - Extra paper review (individual's variable bonus)

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Course Projects

- Two course projects
- A report is required for each project
  - Two reports to be submitted

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Course Project 1

- Topic
  - Use a publicly available dataset to study indoor localization for smartphone
- Objective
  - Reinforce understanding on various sensors
  - Get familiar with spatio-temporal data
  - Able to pre-process and visualize spatio-temporal data
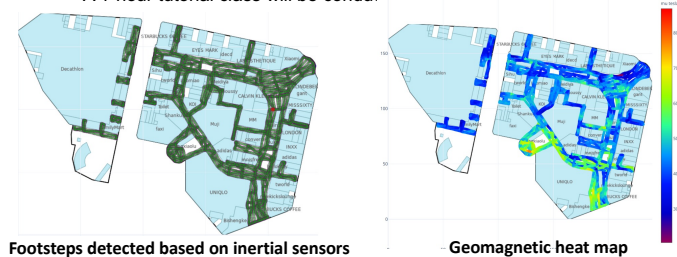 - Understand challenges of indoor localization

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Course Project 1 (cont'd)

- Dataset
  - Sample data of Microsoft Indoor Location Competition 2.0 (https://github.com/location-competition/indoor-location-competition-20)
  - Data collected by a smartphone in two multistorey commercial buildings
  - A 1-hour tutorial class will be conducted in Week 5

Footsteps detected based on inertial sensors   **Geomagnetic heat map**

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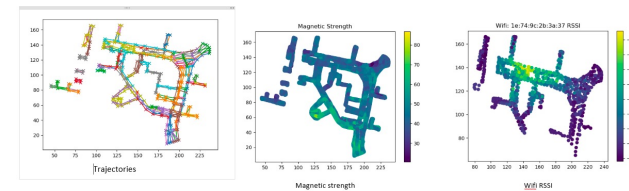## Course Project 1 (cont'd)

- Essential tasks (100%)
  - Visualize way points (ground-truth locations)
  - Visualize geomagmetic heat map
  - Visualize RSS heat maps of 3 Wi-Fi APs
  - Requirements
    - You can choose any programming language
    - While you can refer to the sample code in Python, write your own code to pre-process the data and use a basic plotting tool (e.g., matplotlib) to visualize data
    - No need to superimpose your visualization onto map
    - 2-person group to cover 2 essential tasks
    - 3-person group to cover 3 essential tasks

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Sample Completion

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Course Project 1 (cont'd)

- Bonus tasks
  - Build a deep learning-based location fingerprint model
  - Study the performance improvement brought by multi-modal machine learning
  - Study the performance improvement brought by integrating temporal relationship via SLAM
  - Any other you can claim

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Project 1 Report

- Format
  - Use IEEE A4-size two-column conference templates https://www.ieee.org/conferences/publishing/templates.html
  - Don't change page margins and font sizes
- Submit the writeup in PDF format
  - To tanrui@ntu.edu.sg by the end of **Week 9 (Oct 17th)**
  - If no acknowledgement is received within 3 days, resend and contact Dr. Rui Tan via Microsoft Teams
- One-week grace period for late submissions
  - No penalty if a valid excuse provided; otherwise, a penalty of 20% reduction will be applied to the mark of the late submission
  - Zero mark for submissions after the grace period
- Policy on plagiarism
  - Write by yourselves based on your own understanding
  - We will use a tool to check submissions against databases
  - Obvious plagiarism cases will have zero scores

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Suggested Project 1 Report Content

- Section 1: Introduction (0.5 page)
- Section 2: Dataset (0.5 page)
- Section 3: Essential tasks (1 page each)
  - Subsection 3.1: Visualization of waypoints
  - …
- Section 4 (optional): Bonus tasks (1 page each)
- Section 5: Group member contributions (within 1 page)
- Appendix: source code

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Project 1 Assessment

- Purely based on report
- Overall achievement and quality (70%)
  - Coverage of essential tasks
  - Pre-processing result quality
  - Depth of discussion on the results (e.g., what challenges experienced, how they are addressed or why they cannot be addressed, etc)
- Individual contribution (30%)

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Extracurricular Activity

- Very successful groups may consider to participate in Microsoft's Indoor Location Competition 2.0 on Kaggle https://www.kaggle.com/c/xyz10test/overview

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Course Project 2

- To be announced by Part 2 instructor shortly

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Timeline

Week	Lecture Progress		Assessment and related activities
Week 1		Introduction	
Week 2		Introduction, sensing	
Week 3		Sensing	Check group assignment, liaise with group mates
Week 4	Part 1: Urban IoT	Localization	Literature review topic selection due
Week 5		Localization + tutorial	**Quiz 1 (10%)**
Week 6		Cloud computing	Quiz 1 make-up
Week 7 (E-learning)	Offline: Advanced topics		
Recess week	No lecture		
Week 8	Part 2: Urban data analytics		
Week 9			**Submission of Project 1 report (25%)**
Week 10			
Week 11			
Week 12			**Quiz 2 (10%)**
Week 13	**Literature review presentation (30%)**		
Exam Week 1	No lecture		**Submission of Project 2 report (25%)**; Quiz 2 make-up;

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Clicker

- A few questions at the end of each week
- Questions are not scored
- They are used for you (and me also) to check your level of understanding
- Wooclap: Web-based response system
  - Scan a QR code to participate
  - No authentication

wooclap

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