Welcome to CS 225

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  *(Include [CS225] in the subject – no spaces)*  
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› **Course Website**: [https://www.cs.ucr.edu/~amr/#teaching](https://www.cs.ucr.edu/~amr/#teaching)
Course Content

- Introduction to Spatial Computing
- Spatial Relationships and Data Models
- Spatial Data Storage and Indexing
- Spatial Query Processing
- Spatial Networks
- Geo-visualization
- Spatial Data Mining
- Trends and Innovations in Spatial Applications
Course Content

Course Research Elements:

- "Introduction to Research" lecture
- Surveying the literature methodology
- Paper reviews practice
- Presenting research papers
- Writing technical papers (survey and/or final report)
- Project stages (identifying idea, literature survey, tackling the problem, and documenting the results)
- Lecture contents on new trends on spatial-related research
Grading and Policies

 › Course work
   › Project (65%)
   › Hands-on on spatial technologies (7.5%)
   › Class participation (Evaluating others) (5%)
   › Paper reviews (7.5%)
   › Mini-topics Presentations (10%)
   › Final exam (5%)

 › Delivery policies:
   › Groups of 3-4 students required for the project.
   › Delivery instructions and policies announced per assignment.

 › Cheating is not allowed and will be reported
   › If you are using any external source, you must cite it and clarify what exactly got out of it.
   › You are expected to understand any source you use.
Project: Grade Breakdown

- Idea Proposal (with potential revision cycles) (5%)
  - extra credit up to 10% for exceptional ideas and above-average quality ideas
- Outline of project deliverables
- Literature survey (10%)
- Project deliverables (35%)
- Final report, presentation, and discussion (15%)
Project: Categories

- **Novel Research**
  - Preliminary investigation for a novel research idea

- **Literature Survey Paper**
  - Surveying the literature of a certain spatial topic

- **Literature Experimental Evaluation**
  - Experimentally compare major techniques of a certain spatial topic

- **Vision Analysis**
  - Track the advances in topics of a vision report (e.g., CCC Spatial Computing 2020 Workshop)

- **Interdisciplinary project**
  - Apply spatial computing technologies to a non-CS field

- **Spatial Application**
  - Apply spatial technologies to a real use case.
Project: Deliverables and Assessment

› Novel Research
  › Clearly identifying and presenting the research elements
  › Preliminary solution idea
  › Preliminary evaluation results

› Literature Survey Paper
  › Comprehensive list of papers
  › Literature classification/taxonomy
  › Manuscript quality (writing, figures, organization,…etc)

› Literature Experimental Evaluation
  › Long and short lists of papers
  › Evaluation outline and corresponding implementations from the short list (or a subset)
  › Evaluation results
Project: Deliverables and Assessment

- **Vision Analysis**
  - Itemized analysis of the vision report
  - Quality of surveying work on each topic

- **Interdisciplinary Project**
  - Clear problem definition and importance
  - Survey of related work
  - Quality of the main deliverable, e.g., script, program, etc

- **Spatial application**
  - Quality of the delivered software modules
Paper Reviews and Presentations

- **Two review assignment (7.5%)**
  - Summarization of paper research elements
  - Paper critique

- **Mini-topics presentations (10%)**
  - Group-based topic preparations (titles and tentative outlines provided).
  - Each group member must present.
  - Involve presenting research papers as well as relevant articles.
  - Open for new title suggestions.
Hands-on on Spatial Technologies

Any spatial technology is fine, check instructor approval
Any reasonable-sized hands-on is fine as well
Candidate technologies

- Spatial Databases
  - PostGIS, Oracle Spatial, SpatiaLite, MonetDB/GIS, etc
- GIS Software
  - ArcGIS, QGIS, etc
- Maps
  - Google Maps, Bing Maps, ESRI Maps, etc
- ESRI Story Maps
- Big Spatial Data Systems
  - Simba, SpatialHadoop, GeoSpark, SpatialSpark, etc
- GeoSpatial Analysis Tools
  - PySAL, GeoPandas, Fiona, Shapely, GeoDa, SSN & STARS, SP and SF R packages, OGR GDAL
Final Exam

- Lectures content
Sample Survey Papers


Suggested Projects

Literature Surveys

1. Scalable Techniques for *Kriging Spatial Interpolation*
2. Spatial operations using *doubly connected edge lists* (DCELs).
3. Spatial Applications on *Multi-scale Geographically Weighted Regression* (MGWR)
Suggested Projects

Spatial Applications (Real use cases in UCR)

Irrigation status app

Purpose: Display status of irrigation blocks, record duration of irrigation events and technicians responsible.

Core functionality

App will display on web map:

- Irrigation blocks currently being irrigated.
- Date/time of next scheduled irrigation by block of blocks not being irrigated.
- Irrigation technician responsible for Irrigation.
- Record date and time of irrigation started and ended by block; calculate duration.
Suggested Projects

Spatial Applications (Real use cases in UCR)

- Pesticide application app

  Purpose: Display where pesticides have been and will be applied and records pesticide applications.

  Core functionality

  - App will display on web map:
    - Locations that have been treated with a pesticide, include name if selected.
    - Locations currently under REI,
    - Locations scheduled for pesticide application, include name if selected.
    - Tentative date/time of scheduled applications.
    - Record pesticide applications by treatment block, include pesticide name and treatment end date/time.
Suggested Projects

- ESRI GeoAI tools
  - ArcGIS and Microsoft AI: Scalable GeoAI in the Cloud
    - https://www.youtube.com/watch?v=m7GqaC5_fFU
  - Geo Artificial Intelligence
    - GeoAI medium blogs
    - GeoAI Demonstration Gallery

- Geospatial Data Science
  - Spatial Analysis and Data Science
  - R-ArcGIS Bridge
  - Bridging Into New Realms: R-ArcGIS Bridge and Microsoft R
  - R Notebooks in ArcGIS Pro for Spatial Data Science
  - ArcGIS API for Python – A powerful python library for spatial analysis, mapping and GIS
Suggested Projects

- ESRI GeoAI tools
  - Online Lessons:
    - Use Deep Learning to Assess Palm Tree Health
    - Extracting Information using Image classification
    - Downscale Climate Data with Machine Learning
    - Predict Seagrass Habitats with Machine Learning
    - Identify and Ecological Niche for African Buffalo (with R-ArcGIS Bridge)
    - Analyze Crime using Statistics and R-ArcGIS Bridge
    - Analyzing violet crime using hot spot analysis and space time cube
Credits

› Prof. Shashi Shekhar course
  › http://www.spatial.cs.umn.edu/Courses/Spring18/8715/index.php