(Introducing changes in red)

CUSP-GX-5005&5006:
Urban Science Intensive I-II
(Spring & Summer 2020)
Capstone Project Syllabus

All activites will be online for the rest of the Fall and Spring semester

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Projects Sponsor and Faculty Mentor:

This information will be confirmed on February 17, together with the final capstone' teams.

1. Course Objectives

The Urban Science Intensive (USI I and II) is a two-semester capstone sequence being a key experiential learning component of the program. USI I,II facilitate the first and second half of capstone program and provide useful resources to help students start and succeed with their capstone projects.

The expectation is that during USI I, the students will be assigned to the capstone teams and will conclude preliminary phases of the capstone work, including planning and scoping the project, literature review, selection of the research methodology as well as data acquisition, cleaning, pre-processing. The USI II will focus on finalizing project analytics and drafting final deliverables.

The learning objectives include:

- Apply data science tools to address a specific urban domain problem.
- Work effectively and cooperatively in teams comprised of students with different discipline specializations and academic backgrounds.

- Engage effectively with industry and agency partners to evaluate needs, decision-making metrics, and opportunities for new data sources.
- Improve written and oral presentation skills, and learn how to effectively communicate technical and scientific language to a broad audience of stakeholders.
- Build analytical problem-solving capacity.

2. Capstone Project Description

Student teams engage in real-world applied data projects through problem definition; collection, integration, and analysis of data; definition and testing of possible solutions; identification of implementation strategies and constraints; and communication and interpretation of results. Student teams are challenged to utilize urban informatics within the real-world constraints of city operations and development, while cognizant of political, policy, and financial considerations and issues of data privacy, validity, and transparency. In so doing, student teams will be tasked with creating innovative and replicable solutions to pressing urban problems. The end product of the Intensive sequence is intended to be the result of the integration of multiple skill sets from each student's domain and discipline specialization and core courses.

The capstone is advised by CUSP faculty mentor together with additional support from project leads of the Industry and Agency Partners, as appropriate. The course culminates with deliverables in the form of models, visualizations, a written report, and oral presentations to relevant stakeholders. Here you can find a few examples from previous years: https://cusp.nyu.edu/previous-capstone-projects. Students are provided with hands-on experience in communicating their technical output to a non-technical audience, in such a way that bridges theoretical and practical foundations.

3. Program logistics

- Weekly or biweekly online team meetings with the assigned faculty mentor, specific times TBD with each faculty mentor.
- Additional online meetings with faculty mentors, as needed. Also TBD with each faculty mentor.
- Additional online consultations with course instructors and course assistants in the following schedules – upon previous request by email:
    - Stanislav Sobolevsky - Wednesdays, 4:00-6:30pm. Possible topics to discuss: data acquisition, data curation, data analytics, machine learning methods, report writing.
    - Victoria Alsina - Wednesdays, 6:00-8:30pm. Possible topics to discuss: Project management issues, relationships with industry and agency partner, other stakeholder interactions, report writing.
    - Soniya Chawla – Tuesdays, 2:00-4:00pm. Doubts about the project development and evaluation.
    - Tirupal Rao Ravilla – Tuesdays, 4:00-6:00pm. Doubts about the project development and evaluation.

- Two face to face introductory classes (January 29 and February 12) -all group together face to face-.

- Three progress reports and two presentations -all group together online- will be required during the spring and summer, plus the submission of the final project deliverables and final capstone presentation at the end -all group together online-. More details in the next sections.

Important note: The consultations with course instructors will provide additional support (complementary to the one provided by the capstone faculty mentor) discussing challenges in planning and managing the projects, processing and analyzing the data, and writing the reports. In addition, the course assistant will be available for appointments on data curation challenges the teams might be facing.

4. Calendar and deliverable deadlines:

Spring semester:

- Before the first class: A final version of the capstone catalogue will be distributed
- January 29 (class time): Class introductory meeting I (all group together face to face)
- February 5, 6-8pm: Meet & greet event with project sponsors, mentors, and students (all together face to face)
- February 7: Open project application form for students
- February 10: Deadline for students to submit their project preferences
- February 12 (class time): Class introductory meeting II (all group together face to face)
- February 19: Announcement of project assignments to students. Start of the capstone work by groups
- April 1 (noon): First progress report due, submission using the course page
- April 1 (class time): First progress report presentation – Part I (all group together online)
    - Groups presenting (in this order, 15 minutes each, including Q&A):
        - Documenting the Economic Impacts of New York City's Investment in Water Supply: A Data Visualization Foundation for Economic Analysis
        - Smart Monitor for Accelerating Regional Transformation (SMART)
        - Assessing the Circular Economy Opportunity in NYC
        - Pathways to Legal Occupancy: Preserving Nightlife Cultural Spaces
        - Crowdsourced Security Cameras Enabling a Real-time Scaled Response to Crime
        - Mapping Economic Change in Telecom Industry
- April 8, (class time): First progress report presentation – Part II (all group together online)
    - Groups presenting (in this order, 15 minutes each, including Q&A):
        - Security Analysis of Trajectory Data
        - Applying Multi-Agent RL to SLAM with Graph Pose for Sampled-Data MPC and CPN of Autonomous Drone Swarms
        - Urban Dynamics of Bird Migration
        - Digital CEQR 2.0: Real-Time Prediction of City Planning Proposals' Environmental Impact
        - The Bronx Work Zone Interagency Traffic Data, Modeling, and Analysis
        - Mapping Sustainable Mobility in NYC Nightlife Culture
- April, 29 (noon): Second progress report due, submission using the course page

- April 29 (class time): Second progress report presentation – Part I (all group together online)
    - Groups presenting (in this order, 15 minutes each, including Q&A):
        - Security Analysis of Trajectory Data
        - Applying Multi-Agent RL to SLAM with Graph Pose for Sampled-Data MPC and CPN of Autonomous Drone Swarms
        - Urban Dynamics of Bird Migration
        - Digital CEQR 2.0: Real-Time Prediction of City Planning Proposals' Environmental Impact
        - The Bronx Work Zone Interagency Traffic Data, Modeling, and Analysis
        - Mapping Sustainable Mobility in NYC Nightlife Culture
- May, 6 (class time): Second progress report presentation - Part II (all group together online)
    - Groups presenting (in this order, 15 minutes each, including Q&A):
        - Documenting the Economic Impacts of New York City's Investment in Water Supply: A Data Visualization Foundation for Economic Analysis
        - Smart Monitor for Accelerating Regional Transformation (SMART)
        - Assessing the Circular Economy Opportunity in NYC
        - Pathways to Legal Occupancy: Preserving Nightlife Cultural Spaces
        - Crowdsourced Security Cameras Enabling a Real-time Scaled Response to Crime
        - Mapping Economic Change in Telecom Industry

Summer:

- June, 22 (noon): Third progress report due
- July, 20 (noon): Final project report, code repository, webpage due
- July 23 (schedule TBC): Capstone final presentation day (all group together online)

* Calendar for students doing the Milano's Project may change. Please confirm final dates with instructors.

5. Course Requirements

In addition to weekly/bi-weekly meetings with faculty mentors, the course requirements include:

- First progress report (capstone problem statement and research plan)
- Presentation of the first progress report
- Second progress report (abstract/executive summary, introduction, literature review, data and methods sections expected to be finalized, any draft results wellcome)
- Presentation of the second progress report
- Third progress report (further elaboration on results, last checkpoint and feedback before final deliverables, no presentations)
- Final report, code repository, and webpage
- Final presentation

Please plan your time appropriately to meet all requirements. Teamwork and student engagement are key parts of the course, and students should be prepared to work together. Students are expected to attend all team meetings and participate fully in all team project work. Although emphasis and specific components will vary depending on the project assigned, the critical elements of the applied project include:

- Problem definition
- Data collection, curation, integration
- Literature review
- Problem assessment, methodology definition
- Data analysis and interpretation
- Identification of policy implications
- Information visualization and communication
- Risk mitigation and alternative approach selection and implementation
- Feedback, benchmarking, and evaluation

6. Grading

All requirements must be completed by the specified day and time included in this syllabus and using the class site (http://classes.nyu.edu) or they may not be counted toward the final grade. Late submissions of the progress report will be penalized by 5-50% depending on the severity of delay. No late submissions of the final deliverables will be accepted.

Grading scheme for USI I:

- First progress report – 30%
- First progress report presentation - 10%
- Second progress report – 45%
- Second progress report presentation – 15%

Grading scheme for USI II:

- Third Progress Report – 15%
- Final Project Report – 40%
- Final Presentation – 20%
- Project website – 5%
- Documented code in the form of GitHub repository – 5%
- Individual engagement and participation – 15%

Individual engagement and participation is graded as per the project faculty mentor's feedback. Final Presentation is graded by external judges. Other deliverables to be graded by course instructors and assistants taking into account faculty mentor's feedback.

a) Progress Reports Requirements

The goal of the progress reports is to provide milestones for faculty and students to evaluate progress and set and re-consider goals for the remainder of the semester. They should serve as a basis for the final technical report and give opportunity to get feedback from the sponsor on project progress. The sequence of progress reports will build upon each other and will be leading towards final report.

The first progress report needs to contain problem statement and research plan. The proposed structure: Title, Abstract, Introduction (motivation for the study, some of the most relevant prior literature references are welcome), Problem statement (specific formulation of the research question and expected outcomes), Data and methods (any first rough sketch to give a general idea is fine at this point), Research plan (Gantt chart reflecting important steps, milestones and the timeline as well as discussion of project risks and mitigation strategies, Team roles (please specify which team members are expected to take the lead on various aspects of your work). No specified page limits, but you can imagine something between 3-7 pages adequately addressing the points above. The team will be then expected to present the problem statement and the research plan during one of the scheduled presentation session. Each team will have 10 minutes for this presentation, including Q&A.

The second progress report provides further iteration on the problem statement and research plan, concludes data acquisition and preliminary data analysis, delivering an elaborate write-up on data and methods. Any preliminary analytic results are welcome but does not have to be conclusive. The following structure is proposed:

- Title
- Abstract (must briefly introduce project motivation, research question/problem statement, approach, expected results and their implications; keep those parts concise, ideally one sentence for each)
- Introduction (motivation for the study) and a comprehensive literature review (separate section or within an introduction; at this point should be a comprehensive narrative, outlining the bibliographic/policy context of the problem, and/or relevant prior achievements and approaches in the field). Should be accompanied by appropriate references and a bibliography - choose a citation style and be consistent in how you use it
- Problem statement (a specific formulation of the research question and expected outcomes, such as in the form of a hypothesis statement)
- Data (detailed description of the datasets used -more extensive details can go to appendix-, their structure, main characteristics and limitations) and Methods (approaches to be taken; relevance and adequacy of the proposed methodology as well as the feasibility of the study should be considered). Be specific in your methods and models, avoid generic language such as ‘a model has been developed'
- Results (any initial results of the study; do not have to be conclusive)
- Updated Research Plan (requiring Gantt chart reflecting important steps, milestones and the timeline as well as discussion of the encountered/remaining project risks and mitigation strategies)
- Team collaboration statement (please specify which team members are expected to take the lead on various aspects of your work, and do not hesitate to reach out if you are experiencing challenges related to team contribution).

Formatting is important at this point - check the consistency of your font sizes, colors, alignments, spelling, grammar and referencing (list of bibliographic references, consistently formatted, all figures and tables need to be labeled, have captions and referenced appropriately). Same holds for the third progress and the final report. The report should be approximately 5-7 pages long (up to 1500-2000(max) words in double spacing). Otherwise, the

formatting requirements are the same as stated for the final report below. The team will be then expected to present the problem statement and the plan during one of the scheduled presentation session. Each team will have 10 minutes for this presentation, including Q&A.

The third progress report should focus on progress and results to date, identify challenges, point out changes in scope and/or in methodology, explaining the decisions taken and iterate on the final expectations. An important part is the work-plan for the rest of the project indicating next steps with defined deadlines, what else is expected to be achieved, what other approaches will be considered and tested, etc. The report should be up to 8-10 pages long (up to 2000-2500(max) words in double spacing). The formatting requirements are the same as stated for the final report below.

b) Final Technical Report Requirements

Building off of the USI I Capstone Preliminary Paper and the Third Progress Report, your Final Technical Report should be final and publication-ready technical paper that presents your analysis, results, implications, potential impact, as well as recommendations for further research. It should contain the following documents:

- **Abstract** - up to 150-200 words synopsis of the project. Motivation, problem statement, approach (including novelty if any), expected results, broader implications should be briefly introduced
- **Main Body** - up to 2500 words (not including references, captions, and tables and any appendices or supplementary material) and structured exactly with the following sections (feel free to use any subsections if necessary):
    - **Introduction** (problem definition, literature review (reports and publications helping to scope the project, related previous achievements, works introducing relevant methodology unless cited within the methodology section)
    - **Data** (data sources, rationale for their selection, data curation, data limitation and exploratory data analysis if relevant, description of final dataset)
    - **Methodology** (discussion of models and analytic approaches of the project, rationale for their selection, limitations)
    - **Results** (findings of the project and their interpretation; policy implications if relevant)
    - **Conclusions** (conclusive summary reiterating on the most significant findings, novelty statements, implications of results and the project, and future work if relevant)
    - **References** (consistently use one of the common formatting styles, like Harvard, APA, MLA)
    - The main body can include up to 10 figures or tables; captions are required for each figure or table and must not exceed 75 words per caption.
- **Supplementary materials** – text of any size and any number of figures/tables (with captions required) for example technical description of data cleaning and handling, data format, implementation of methodology, some quantitative details of the approaches, modelling, and computational details that are essential to the conclusions in the main body, but are too technical to be of broad interest. This document should contain sufficient detail to allow the reader to reproduce the Results section in the Main Body. All parts of the supplementary materials should be referenced from the main text. All figures, tables or formulas from the supplementary materials should be introduced and referenced within them but not necessary from the main text. While supplementary materials can serve a useful extension of your report for an interested reader without affecting the word limit, ***it should be possible to evaluate the report without reviewing appendice***s and please be aware that the graders won't be required to evaluate the appendices unless they find it relevant.

The report abstracts as well as the full reports may be publicly hosted (unless restricted by the project sponsor) on CUSP Capstone repository.

c) Final Presentations Requirements

Each team will develop a 15-minute final presentation during the Capstone Final Event. In addition, they may be asked to do an additional presentation to project sponsors, as appropriate.

d) Project website

Each Capstone Team is required to submit a webpage summarizing the project. Even though the style, format and detailed content of each individual website is contingent on project specification, they all should contain the following elements:

- problem statement and scope
- visualization of main results with proper explanation
- links to additional resources (Final Technical Report, previous work or related projects, data if openly available etc.)
- Information about the team and the partner sponsor

Minimal required content functionality could be provided by a Github-generated webpage for example, although teams are encouraged to consider any other technical tools as appropriate given the content they wish to share. The website will be publicly available during and after the final capstone presentations and serve as a capstone project showcase.

e) Documented code collected in a GitHub repository

In order to ensure project reproducibility and showcase students' technical and coding skills, each project team is required to provide and maintain GitHub repository with properly documented and commented code according to the established standards (eg. PEP8 for Python). The repository needs to contain a descriptive README file that documents the scope of the project and describes how to run the code in the repository. The repository should collect the code only, without committing any inputs or outputs. All of the repositories will be hosted under official CUSP Capstone GitHub organization.

f) Individual engagement and participation

Each team member should equally contribute to the project advancement. To facilitate it and allow tracking work progress, the teams may choose to fill out weekly working log describing individuals tasks and work done. The format of individual progress reporting is specified by the mentor. The mentors will provide the individual participation component of the project grade based on each student's individual engagement, professionalism and work ethic.

A Note on Written Submission and Presentation Requirements: All written work must be submitted on-time. All charts, graphs, and tables should be included in the paper. Pages and figures should be numbered and labeled appropriately. All sources used should be appropriately cited in the text and included in a list of references at the

end of the Main Body of the paper. Spelling, grammar, format, and style of the written work will all factor into the grade, so please be sure to leave sufficient time to proof-read and edit your work.

NYUClasses

You must have access to the class Blackboard site (http://classes.nyu.edu/). All announcements and class-related documents (supplemental and suggested readings, discussion questions, etc.) will be posted there.

Statement of Academic Integrity

NYU-CUSP values both open inquiry and academic integrity. Full and Part-Time graduate students and advanced certificate students are expected to follow standards of excellence set forth by New York University. Such standards include but are not limited to: respect, honesty and responsibility. The program has zero-tolerance for violations of academic integrity. Such violations are deemed unacceptable at NYU and CUSP. Instances of academic misconduct include but are not limited to:

- Plagiarism
- Cheating
- Submitting your own work toward requirements in more than one course without (1) prior documented approval from instructor and (2) proper citation
- Forgery of academic documents with the intent to defraud
- Deliberate destruction, theft, or unauthorized use of laboratory data, research materials, computer resources, or University property
- Disruption of an academic event (lecture, laboratory, seminar, session) and interference with access to classroom, laboratories, or academic offices or programs

Students are expected to familiarize themselves with the University's policy on academic integrity and CUSP's policies on plagiarism as they will be expected to adhere to such policies. Please be aware that some or all assignments in this course may be checked for plagiarism using TurnItIn via NYUClasses.

7. Suggested Readings

General

Booth, Wayne C., Gregory G. Colomb, and Joseph M. Williams. *The craft of research*. University of Chicago press, 2003.

Scientific writing

Glasman, Hilary. *Science research writing for non-native speakers of English*. Imperial College Press, London, 2010.
J. Gibaldi and W. S. Achert: The MLA Handbook for Writers of Research Papers, 2003.
Hale, Constance. *Sin and syntax: How to craft wicked good prose*. Three Rivers Press, 2013.
Hancock, Elise. *Ideas into words: Mastering the craft of science writing*. JHU Press, 2003.
Hult A. and Huckin T. N.: The New Century Handbook, 2nd edition. 2003
Gastel, Barbara, and Robert A. Day. How to write and publish a scientific paper. ABC-CLIO, 2016.
Perkel, Jeffrey M. "Scientific writing: the online cooperative: collaborative browser-based tools aim to change the way researchers write and publish their papers." Nature 514.7520 (2014): 127-129.
Schimel, Joshua. *Writing science: how to write papers that get cited and proposals that get funded*. OUP USA, 2012.

Schuster, Ethel, Haim Levkowitz, and Osvaldo N. Oliveira, eds. *Writing scientific papers in English successfully: your complete roadmap*. 2014.
Strunk, William. *The elements of style*. Penguin, 2007.
Turabian, Kate L. *A manual for writers of research papers, theses, and dissertations: Chicago style for students and researchers*. University of Chicago Press, 2013.
Zinsser, William. "On writing well: The classic guide to writing nonfiction." 2006.

Presentation skills

Reynolds, Garr. *Presentation Zen: Simple ideas on presentation design and delivery. New Riders, 2011.*
Gallo, Carmine. *Talk Like TED. The 9 Public Speaking Secrets of the World's Top Minds*. Macmillan,2015
Alley, Michael*. The craft of scientific presentations. New York (NY): Springer, 1996.*
Coughter, Peter. The Art of the Pitch:Persuasion and presentation skills that win business. Springer,2016.
Weissman, Jerry. Presenting to win: the art of telling your story. FT Press, 2008.
https://www.elsevier.com/connect/how-to-give-a-dynamic-scientific-presentation

Latex

Oetiker, Tobias, et al. "The not so short introduction to LATEX 2ε." (2001). https://tobi.oetiker.ch/lshort/lshort.pdf
Latex WikiBook https://en.wikibooks.org/wiki/LaTeX

Authorea

https://www.authorea.com/users/8850/articles/213710-getting-started-with-authorea