Freshman Seminar (FRSEMR 52E): Science and Technology Primer for Future Leaders

Instructor: Hongkun Park (Chemistry and Chemical Biology and Physics)

Time and Location: Mondays 3-5 pm @ Naito 030

Course Description: We live in a world that is shaped by science and technology. As modern citizens who will lead the U.S. and the world in the coming generation, we should be aware of the rapidly changing landscape of science and technology and be ready to participate in the decision-making processes for deploying these life-changing developments to the masses. In this Freshman Seminar, we will learn and debate contemporary topics we encounter every day and use them as motivating examples to explore the underlying science, math, and engineering principles. Some of the issues that we will discuss include, but are not limited to, the COVID-19 pandemic, the prosecutor's fallacy, climate change, information technology, quantum technology, artificial intelligence, genomics revolution, and brain-machine interfaces. These discussions will teach basic concepts in statistics, thermodynamics, quantum mechanics, information science, biomedical engineering, and nano-bio interfaces. In this Seminar course, the students will give presentations and participate in discussions and debates. The Seminar is intended for first-year students who plan to concentrate on humanities and social sciences.

Academic Integrity: For the group assignments/presentations, collaboration is encouraged. Still, the presented work should adhere to the scholarly and intellectual standards of accurate attribution of sources, appropriate collection and use of data, and transparent acknowledgment of the contribution of others to their ideas, discoveries, interpretations, and conclusions. **Using generative AI tools is permitted for investigative purposes, but the presentation should be entirely your own, not generated using AI**. Plagiarizing or misrepresenting the ideas or language of someone else as one's own, falsifying data, or any other instance of academic dishonesty violates the standards of our community and the standards of the wider world of learning and affairs.

Seminar Outline:

Unit 1: Statistical Reasoning

Week	Topic	Reading	Goal
1	Course introduction Covid-19 pandemic and vaccine	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1200696/pdf/bumc0018-0021.pdf https://www.youtube.com/watch?v=OvPg6PMI-q0 https://www.statnews.com/2020/11/10/the-story-of-mrna-how-a-once-dismissed-idea-became-a-leading-technology-in-the-covid-vaccine-race/	Introduction to the seminar Primers on virus, immunology, and vaccine
2	Why don't we adopt polygraph tests in the Honor Council?	https://www.nature.com/articles/454692a https://rss.onlinelibrary.wiley.com/doi/full/10.1111/j.1740-9713.2015.00839.x https://plus.maths.org/content/beyond-reasonable-doubt https://academic.oup.com/aje/article/179/9/1125/103523	Primers on probability/statistics
3	Statistical Inference	https://www.nytimes.com/2007/09/16/magazine/16epidemiology-t.html?_r=3&adxnnl=1&oref=slogin&ref=magazine&pagewanted=all&adxnnlx=1190214698-x6utHIGGAabp6Q2bZtiAjg&oref=slogin "Sex differences in immune responses" Science 371, 347 (2021) "Considering how biological sex impacts immune responses and COVID-19 outcomes" Nature Review Immunology 20, 442 (2020) "Bayesian clinical trials" Nature Reviews Drug Discovery 5, 27 (2006)	Central limit theorem Frequentist/Bayesian inference

Unit 2: Physical Science and Engineering

Week	Topic	Reading
4	Semiconductor/ information technology	Economist Technology Quarterly (Mar 2016): Double, double, toil, and trouble https://www.wsj.com/podcasts/wsj-the-future-of-everything/beyond-silicon-the-new-materials-charting-the-fu be53-4bff-bebb-54136cba4192
5	Quantum technology	Economist Technology Quarterly (Mar 2016): Quantum technology is beginning to come into its own https://iopscience.iop.org/article/10.1088/2058-9565/ab0441/pdf https://www.scientificamerican.com/article/will-quantum-computing-ever-live-up-to-its-hype/ https://www.scientificamerican.com/quantum-computing/
6	Artificial Intelligence	https://www.economist.com/technology-quarterly/2020-06-13 https://www.economist.com/leaders/2022/06/09/artificial-intelligences-new-frontier https://www.economist.com/interactive/briefing/2022/06/11/huge-foundation-models-are-turbo-charging-ai-p https://www.technologyreview.com/topic/artificial-intelligence/?gclid=CjwKCAiA3pugBhAwEiwAWFzwdf1LIzCuu8o45Pq9ld7yOe7qwE0FkbL4NdgFZJjbO8roU https://www.wsj.com/articles/google-ai-chatbot-bard-chatgpt-rival-bing-a4c2d2ad?mod=hp_lead_pos5
7	Artificial Intelligence continued	Artificial intelligence continued

Unit 3: Biomedicine

Week	Topic	Reading	Goal
8	Genomics revolution and personalized medicine	https://www.economist.com/technology-quarterly/2020-03-14 http://shaleklab.com/wp-content/uploads/2017/12/Shalek_Benson_STM_2017.pdf? https://www.nature.com/articles/nrg.2016.49.pdf	Genetics and genomics primer Pharmaceuticals primer
9	Genomic engineering: Improving our lives or playing God?	The Code Breaker by Walter Isaacson https://www.quantamagazine.org/doudnas-confidence-in-crisprs-research-potential-burns-bright-20190227/	Primers on genetic manipulation and CRISPR technology Synthetic biology
10	Brain-machine interface: blurring the boundaries	A Thousand Brains by Jeff Hawkins https://www.economist.com/technology-quarterly/2018/01/04/how-brains-and-machines-can-be-made-to-work-together	Primers on neuroscience and brain-machine interfaces

Putting it all together

Week	Topic	Reading	Goal
11	Putting it altogether (How will I change the world? Part 1)		
12	Putting it altogether (How will I change the world? Part 2)		