Teaching Statement

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My educational journey, profoundly shaped by the dedication and expertise of several remarkable teachers and mentors, have led me to a firm belief in the transformative power of good teaching on a student's life path. Over the years, I have contemplated and reflected on the quintessential pedagogy that balances the act of engaging, conveying, and inspiring. Specifically, in developing my course materials, I am guided by a series of introspective questions that aims at ensuring that the content not only is informative but also stimulates critical thinking.

I continually ask myself five key questions:

1. What insights will students gather while actively engaging with both my spoken words and the slide content?
2. What insights will students gather while independently examining the slide content at my lecture pace?
3. What are the takeaways for students when they revisit the slides on their own time?
4. How can I guarantee consistency in the key takeaways gathered across these varied learning contexts?
5. How do I structure the slide content to convey key messages to the students without them directly reading from it?

These practices have shaped my teaching philosophy, which emphasizes the effective use of visualization.

1 Teaching Philosophy

Visualization is central to my instructional approach, leveraging the human brain's rapid image processing ability, which reportedly surpasses text interpretation by 6x–600x[1] [1]. This capability enables students to extract information from visual aids alongside verbal explanations far more efficiently than text alone, allowing for profound engagement in class. In the realm of STEM education, where abstract theories and complex equations can be overwhelming, visualization serves as a vital bridge, translating intricate ideas into comprehensible and memorable images. It also elegantly addresses the pedagogical challenge of conveying essential concepts without resorting to simply reading from the slides—a practice that hinders critical thinking. Beyond the immediate classroom benefits, the ability to visualize data and concepts is an indispensable skill for students, one that is increasingly critical in both their academic pursuits and future research careers. Building on this philosophy, I address the challenge of ensuring consistent takeaways from the course materials in different learning contexts—whether inside or outside the classroom—by integrating concise bullet points alongside visuals, ensuring key messages being conveyed.

2 Pitfalls and Lessons Learned

Designing visuals that effectively encode information demands thoughtful consideration and attention to detail, ensuring accessibility for all learners. Informed by my personal experience with minor color vision deficiency, I am acutely aware of key pitfalls in visual information delivery, such as solely relying on color contrast to embed information. For instance, Fig. 1 demonstrates how using color as the sole differentiator between two spectra can make the data difficult to interpret for those with color vision impairments. The prevalence of color blindness, affecting approximately 8% of males and 0.5% of females [2], might surprise many. However, this statistic virtually guarantees that in any moderately sized classroom, at least one individual is likely to have a form of color vision deficiency. Acknowledging this, I am committed to employing multiple modes of differentiation in my teaching materials, such as patterns, textures, and annotations, to ensure that all students, regardless of visual ability, have equal access to the information presented.

3 Inclusive Teaching

My commitment to inclusivity extends beyond color vision awareness to embrace all facets of diversity and accessibility in education. I recognize that students come with a broad spectrum of cultural backgrounds, personal histories, and educational experiences, all of which influence their learning needs. In light of this, I will strive to create a classroom environment that is not only physically accessible but also cognitively and culturally welcoming. This entails the use of language that is inclusive and bias-free, as well as the incorporation of diverse examples in my teaching materials, practices that I will regularly reflect on to ensure adherence.

[1]Despite the discrepancy with the unfounded internet meme claiming 60,000x, as called out in *The 60,000 Fallacy* (https://policyviz.com/2015/09/17/the-60000-fallacy/), this is still substantial enough to warrant extra attention to the use of visualization in teaching.

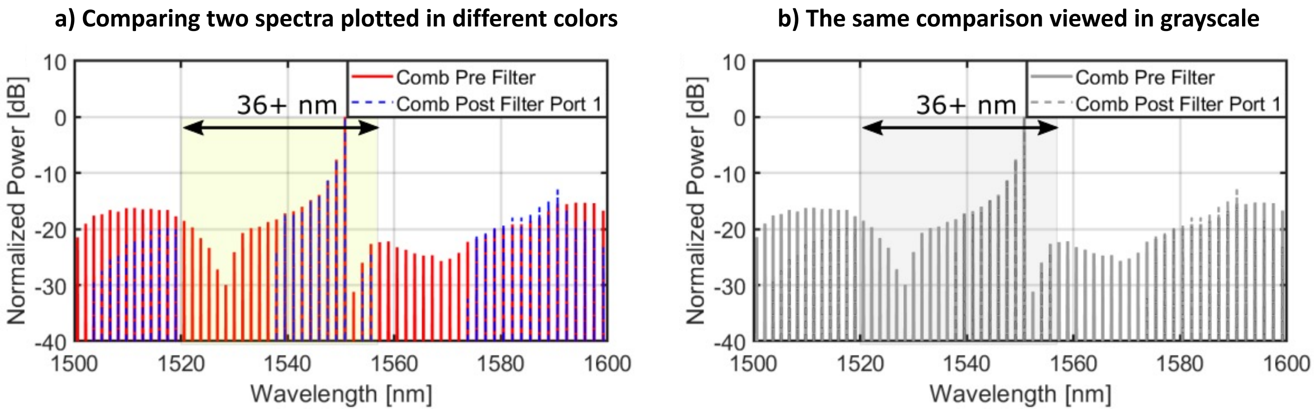

Figure 1: Example of non-robust information encoding solely with color contrast. **a)** Two spectra distinguishable by people with normal color vision. **b)** Illustrative rendering of the same two spectra possibly perceived by people with color vision deficiency.

4 Teaching Plans

In harmony with the esteemed curriculum of the School of Electrical and Computer Engineering at the Georgia Institute of Technology, I am eager to contribute by teaching a range of courses that intersect with my expertise, such as

- Fundamentals of Digital System Design (ECE2020),
- Optical Fiber Communications (ECE4502), and
- Optoelectronics: Devices, Integration, Packaging, Systems (ECE6542).

Believing that the preparation for teaching materials deepens my own understanding of the subject matter, I am also open to teaching courses beyond my immediate expertise, such as

- Advanced Computer Architecture (ECE4100), and
- Embedded Systems Design (ECE4180).

Moreover, I am enthusiastic about the prospect of designing new courses, currently not offered at the Georgia Institute of Technology, such as

- Electronic Photonic Design Automation, and
- Optical Interconnects for Digital Systems,

which could expand and enrich the department's already distinguished curriculum.

5 Mentoring

My mentoring philosophy extends beyond knowledge sharing and intellectual guidance. I am dedicated to providing holistic support for the academic and professional development of the students. I will strive to create a supportive and collaborative research environment, inspiring students to excel in their studies, uphold professionalism, and explore their own research interests until they emerge as independent researchers. My time as a postdoctoral researcher at the Columbia University allowed me to partially implement this philosophy, guiding several Ph.D. students to significant milestones, including publishing their first papers as lead authors at premier conferences like OFC and CLEO, and securing their initial industry positions. I eagerly anticipate the opportunity to extend and refine my mentorship practices at the Georgia Institute of Technology.

6 Post–COVID-19 Considerations

In the post–COVID-19 era, I have adapted to the emerging norms of hybrid teaching and research settings. I am prepared to further refine my teaching and mentoring approaches to accommodate these evolving challenges. For example, I plan to enhance my slides with additional annotations and essential animations to offset the lack of real-time interaction that a physical whiteboard provides. Additionally, I plan to introduce regular coffee hours and/or lunch meetings within the group to facilitate in-person discussion whenever feasible and in compliance with the university guidelines. Such adaptability is critical for navigating through the evolving educational landscape, and I am committed to the continuous innovation in my teaching and mentoring practices to provide all students with accessible and effective education.

References

[1] "Research: Is A Picture Worth 1,000 Words Or 60,000 Words in Marketing? | Emailaudience." [Online]. Available: https://www.emailaudience.com/research-picture-worth-1000-words-marketing/

[2] "Types of Colour Blindness." [Online]. Available: https://www.colourblindawareness.org/colour-blindness/types-of-colour-blindness/

Proposed Syllabus for *Electronic Photonic Design Automation*

Course Description:
This course delves into the increasing complexity of photonics integration and the urgent need for a comprehensive ecosystem of design tools and methodologies at the device, circuit, and system levels. As the photonics and traditional electronic design communities collaborate to develop various tools and methodologies, there remains a gap in fully addressing the needs of integrated photonics design. This course will provide an in-depth exploration of Electronic Photonic Design Automation (EPDA) tools, methodologies, and their applications in photonic device, circuit, and system design. Students will gain comprehensive knowledge and hands-on experience with integrated photonics design tools used in real-world design projects.

Textbooks and References:
The course does not rely on a single textbook. Reading material will be given, drawn from research articles and book chapters, in addition to the following reference books:

1. *Design Flow Automation for Silicon Photonics: Challenges, Collaboration, and Standardization – Chapter of Silicon Photonics III*
   Mitchell Heins, Chris Cone, John Ferguson, Ruping Cao, James Pond, Jackson Klein, Twan Korthorst, Arjen Bakker, Remco Stoffer, Martin Fiers, Amit Khanna, Wim Bogaerts, Pieter Dumon, and Kevin Nesmith
2. *Introduction to Layout Design and Automation of Photonic Integrated Circuits*
   Ahmadreza Farsaei
3. *Principles of Photonic Integrated Circuits*
   Richard Osgood jr. and Xiang Meng

Course Components:

1. Class participation (20%)
2. Literature review presentations (2x) (20% each)
3. Course project (40%)

Lecture Schedule:

1. Evolution of integrated photonics, overview of EDA, and the need for EPDA
2. Photonic device design foundations: tools and methodologies
3. Photonic device design optimization: techniques and challenges
4. Photonic circuit design: electronic-photonic co-simulation
5. Photonic circuit design: layout techniques and considerations
6. Schematic-driven layout and LVS: progress and challenges
7. Uncertainty quantification and variation-aware design
8. Integrated photonics systems: modeling and simulation
9. Integrated photonics systems: optimization and reconfiguration
10. Course project presentations

Lectures might be split across multiple weeks, and/or accompanied by guest lectures/seminars.

Proposed Syllabus for *Optical Interconnects for Digital Systems*

Course Description:
High-performance systems face challenges in scaling application performance due to increased communication demands and the energy costs and bandwidth limitations of existing interconnect technologies. Recent developments in silicon photonic technologies offer solutions with high-bandwidth, low-power optical connectivity. The course will explore advanced and emerging optical and electrical interconnection networks, covering current network models and providing essential tools for designing, understanding, and evaluating system networks and architectures. It will encompass various system aspects, from photonic devices to network routing algorithms and protocols, focusing on both physical-layer and system-level energy and performance metrics.

Textbooks and References:
The course does not rely on a single textbook. Reading material will be given, drawn from research articles and book chapters, in addition to the following reference books:

1. *Optical Interconnects for Future Data Center Networks*
   Christoforos Kachris, Keren Bergman, and Ioannis Tomkos (Eds.)
2. *Principles and Practices of Interconnection Networks*
   William James Dally and Brian Patrick Towles
3. *Principles of Photonic Integrated Circuits*
   Richard Osgood jr. and Xiang Meng
4. *Computer Architecture: A Quantitative Approach – Appendix F*
   John Hennessy and David Patterson (Rev. by Timothy M. Pinkston and José Duato)

Course Components:

1. Class participation (20%)
2. Literature review presentations (2x) (20% each)
3. Course project (40%)

Lecture Schedule:

1. Course introduction and supercomputer/datacenter overview
2. Overview of photonic interconnects
3. Interconnection network design considerations
4. Network basics and flow control
5. Network topologies, routing, arbitration, and switching – part 1
6. Network topologies, routing, arbitration, and switching – part 2
7. Physical layer design: optical link and components
8. Physical layer design: optical switches
9. Photonic interconnected systems
10. Course project presentations

Lectures might be split across multiple weeks, and/or accompanied by guest lectures/seminars.