



# Computer Science (CSCI) 698 Practicum in Teaching Computer Science

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# How the brain learns

- Why study how the brain learns?
  - What is teaching?



# Hebbian theory

- [https://en.wikipedia.org/wiki/Hebbian\\_theory](https://en.wikipedia.org/wiki/Hebbian_theory)
- "Cells that fire together, wire together"
- Attempts to explain "associative learning"
- Cells that are active at the same time grow stronger connections
- Repetition is key...
- But of course learning is much more complicated



# Closer look at Hebbian

- <https://neurosciencenews.com/wire-fire-neurons-19835/>
- Simulating simple Hebbian networks causes activity amplifications and instabilities not seen in real animals
- Studied as a computational neuroscience problem
- Hebbian activity must have some time dependent damping to keep activity stable
- Is that the whole picture...



# Structural changes/white matter

- <https://www.scientificamerican.com/article/the-brain-learns-in-unexpected-ways/>
- Some great quotes
  - What we retain depends on our emotional response to an experience, how novel it is, where and when the event occurred and our level of attention and motivation during the event,
  - Because learning encompasses so many elements of our experiences, it must incorporate different cellular mechanisms beyond the changes that occur in synapses. (synapses = local, learning is global)
  - But subsequent research found that learning changes the structure of the brain.
  - showed that 16 laps around a race track in a computerized video game were enough to cause changes in new players' hippocampal brain region.
- Some structural changes driven by myelin, once thought to be simply “insulation” for our axons
- Adjust timing of neural signals to synchronize brain waves



# Upgrade Your Teaching

- Synapses, white matter very low level
  - But inform how teaching/learning work
- Dopamine is key
  - To further optimize students' success in school, you can engage the dopamine-reward response to motivate the brain to put forth the mental effort needed for new learning.
  - What about dopamine disorders?
- Video Game Model:
  - (1) establishing a desirable goal
  - (2) offering an achievable challenge
  - (3) providing constant assessment with specific feedback
  - (4) acknowledging progress and achievement enroute to a final goal.



# Understanding the brain...

- After two decades of pioneering work in brain research, the education community has started to realize that “understanding the brain” can help to open new pathways to improve educational research, policies and practice.



# Teaching philosophies

- If teaching is the act of getting students to engage their brains with new material so their brain learns
- Then teaching philosophies are the “how” of how to get them to engage





# 12 Common teaching philosophies

- <https://www.indeed.com/career-advice/career-development/teaching-philosophies>
- Some comments...
  - Behaviorism, Conservatism
  - Constructivism
  - Positivism, Pragmatism, Progressivism
- Do *\*you\** have a teaching philosophy?



# Teaching Philosophy/Statement

- Who/when will care about your teaching?
  - Students (now)
  - Students (future)
  - Other faculty (future)
- Teaching statement is for faculty evaluating you as an applicant
  - And later for tenure/promotions



# The Teaching Statement

- Required as part of the application for a faculty position
- Must be written out explicitly and separately
- Typically written as an essay



# Essential Elements

- An essay about one's teaching beliefs and practices
- Both reflective and forward looking
- Includes concrete examples from prior classroom or other experiences
- What could possibly go wrong?



# Your statement is

- **Too long**
- In CS anything more than 3 pages is too long
- This is a guideline, not a hard threshold



# Your statement lacks

- **Evidence**
- Do not tell or narrate
- Instead, show or prove
- The idea is to be explain the principles that guide your teaching



# Your statement is

- **Obvious**
- If your statement repeats generic truisms that will appear on many other statements, it's no good



# You statement makes you appear

- **Excessively humble or emotional**
- Leave out (for the most part) your emotions (e.g., how delighted you were when you did something, how excited you were to have done something etc.)





# Your statement is isolated from

- **Your research**
- At any good university, there is an expectation that your research will inform your teaching. Divesting the two is poor form.



# Your statement is

- **Unstructured**
- Like any good essay, your statement must have a beginning, a middle and an end. The end must wrap up and conclude with a firm takeaway message.

# Understand what your target department needs



- **E.g., at USC CS:**
- Undergrad teaching (need more T/T faculty willing to do it ...)
- Master's teaching (need to teach large service classes)
- Bleeding edge PhD teaching (need to keep top PhD students at the forefront of research)

# Example statements



Fredo Durand – now professor at MIT –

<https://people.csail.mit.edu/fredo/DurandTeaching.pdf>

Praveen Paruchuri – now associate prof IIIT Hyderabad –

<http://www.cs.cmu.edu/afs/cs/user/paruchur/www/docs/teaching.pdf>

Brigitte Pientka – now associate prof at McGill –

<https://www.cs.mcgill.ca/~bpientka/papers/teaching-bp.pdf>

Manish Jain – now CEO of his own startup –

[http://teamcore.usc.edu/manish/files/teaching\\_statement.pdf](http://teamcore.usc.edu/manish/files/teaching_statement.pdf)

many more are available on the web!

	Appropriate Length	Evidence based	Obvious and generic	Excessively humble or emotional	Tied to research	Structured	Relevant to dept needs
Durand							
Paruchuri							
Pientka							
Jain							