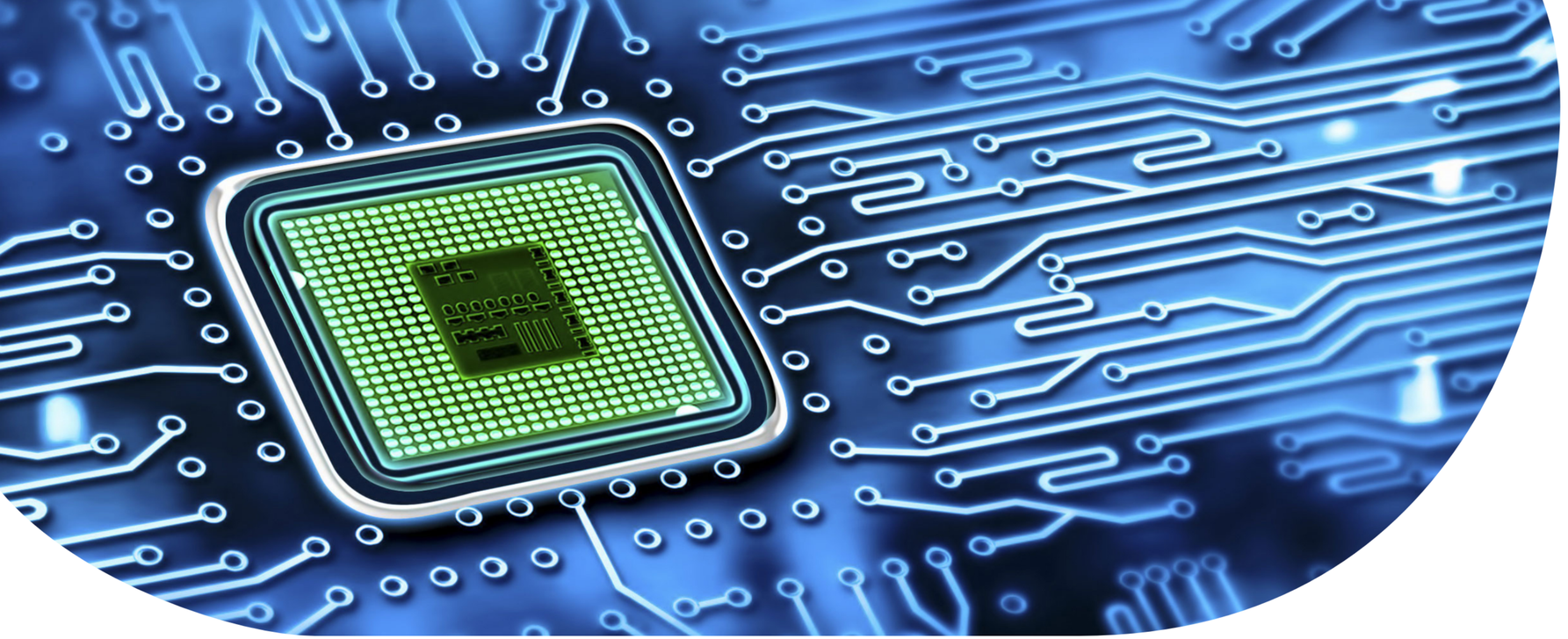

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CS356 Hardware Accelerator Architectures

Clear and Creative Thinking

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Slides based on “Clear and Creative Thinking” by Nick Feamster and Alex Gray

Modify your thinking algorithms

- Clear thinking: avoiding conceptual blocks
  - Perceptual blocks
  - Emotional blocks
  - Cultural and environmental blocks
  - Intellectual and expressive blocks
- Creative/expansive thinking
  - General techniques
  - Techniques for groups

Conceptual blocks

Perceptual blocks

- Problem: Seeing what you expect to see, based on stereotypes (overly simple models)
  - Let's you complete incomplete data; experience creates templates
  - But leads to inaccurate conclusions
  - You tend to reinforce what is already in your brain; may devalue info that doesn't 'fit'
- Solution: Be aware of stereotypes, go deeper

Perceptual blocks

- Problem: Seeing things the way someone already framed it
  - e.g. architect asked to put in a better latch for a door between two rooms
- Solution: Be the problem stater; be childlike and ask the most basic questions

Perceptual blocks

- Problem: Solving it the way people have been solving it
  - e.g. “we need a better graph-cut algorithm”
- Solution: Think about it yourself first, without reading any of the literature – come with a clean mind

Perceptual blocks

- Problem: Delimiting the problem too closely
  - e.g. nine dot puzzle – consider folding, making spiral, cutting, problem on sphere, crumple and stab, use a fat line…
- Solution: Cheat! Negotiate!

Perceptual blocks

- Problem: Not defining the problem well enough
  - Too fuzzy to make progress
  - Framing the problem at different scales of specificity leads to different solutions
- Solution: Solve a very constrained version, then reconsider the general problem

Perceptual blocks

- Problem: Seeing the problem from one limited viewpoint
  - e.g. in a personal dispute, see from both sides
- Solution: Look at the problem from the standpoint of different theories, or wearing different hats

Perceptual blocks

- Problem: Seeing the problem from one limited viewpoint
  - e.g. in a personal dispute, see from both sides
  - e.g. artists looking upside-down, or looking away from a nice sunset
- Solution: Look at the problem from the standpoint of different theories, or wearing different hats; look at the parts normally ignored

Perceptual blocks

- Problem: Ignoring some valuable inputs
  - Often in the form of people
- Solution: Be open-minded: keep door open; eat at other lunch tables

Emotional blocks

- Problem: Fear of making a mistake, failing, taking a risk
  - We're taught to live safely; punished for mistakes; "bird in the hand"
  - But need to go toward the mysterious, the unknown, the puzzling, the difficult
- Solution: Realize that others are also ignorant, self-conscious, afraid; think out the worst case – it's not as bad as you think

Emotional blocks

- Problem: Inability to tolerate ambiguity, chaos
  - Control over your environment can give efficiency, aesthetic satisfaction, security
  - Solution of a complex problem is a messy process
  - Must usually wallow in misleading and ill-fitting data, hazy and difficult-to-test concepts, opinions, etc.
  - Problem-solving is bringing order to chaos; the ability to tolerate chaos is a must
- Solution: Let loose!

Emotional blocks

- Problem: Preference for judging ideas, rather than generating ideas
  - Freud: Ideas come from unconscious mind, ego/superego filter them
  - Criticism, tough-mindedness, and practicality are essential – but not too early
  - Newly formed ideas are fragile and imperfect; need time to acquire the detail needed to make them believable
  - …

Emotional blocks

- Ideas often lead to other ideas; brainstorming depends on maintaining way-out ideas long enough to let them mature and spawn more realistic ideas
- But judgement is easier, makes you look smarter, and is thus rewarded in society

- Solution: Withhold dismissal; encourage crazy ideas; work for your own satisfaction instead of external motivations

Emotional blocks

- Problem: Lack of challenge, or excessive zeal
  - Can’t do your best unless sufficiently motivated
  - But excessive motivation to succeed, especially quickly, can lead to poor solutions; tortoise vs. hare
- Solution: Get excited, but pace yourself

Emotional blocks

- Problem: Your ego doesn't like the real solution
  - e.g. competitors' solutions are better
- Solution: Always approach people as if they probably have something to teach you; don't take criticism badly

Cultural blocks

- Problem: Cultural taboos and traditions
  - e.g. defying authority
- Problem: Cultural roles
  - e.g. reason vs. intuition, left-handed vs. right-handed thinking, science vs. humanities, single-answer vs. multi-answer

Environmental blocks

- Problem: Interruptions and distractions
  - Can take 15 minutes to get into a task, and sometimes several hours to enter “creative flow” state
  - Solution: Protected times of day, isolated work environment
- Problem: Environment not supportive or comfortable
  - Solution: Spend time making it nice, just how you like it

Environmental blocks

- Problem: Advisor too autocratic, judgmental, unsupportive, etc.
- Solution: Make sure advisor/boss matches in terms of:
  - Goals/interests
  - Feedback style
  - Amount of direction
  - Personality, humor, life perspective
- If not, negotiate with him/her; failing that, switch

Environmental blocks

- Problem: lack of access to areas of imagination
  - Solution: daydream; read science fiction; stretch reality; use humor
- Problem: lack of control over your imagination
  - Solution: use others as filter

Things you can do

Achieve Basic Competency

- If you are constantly working on just “getting by”, your mind won’t find the spare cycles to be creative
- Put in the time to master the mechanics
  - Math skills
  - Programming skills
  - Human-centered skills

Build intuition

- This comes from experience
- Creativity requires the manipulation and recombination of experience

Let it incubate (“sleep on it”)

- Often: you work for weeks on something, complete a solution for a deadline, then at a random time later, get a better idea
- Often: you get the right idea right before the deadline
- This was incubated in the unconscious mind
- Technique: Immerse yourself for enough time for incubation; forget about something for a while then return

Use multiple modes

- Visual: big sheet of paper
- Verbal: dialogue, negotiation
- Other senses help to imagine something

Morphological analysis

- List the attributes of the situation
- Below each, list many alternatives
- Look at different combinations
- e.g. improve a pen:
  - Attributes: cylindrical, plastic, separate cap
  - Alternative 1: faceted, metal, attached cap
  - Alternative 2: beaded, wood, no cap
  - Etc.

Questions list

- Put to other uses?
- What's similar?
- Modify?
- Magnify? Minify?
- Substitute?
- Rearrange/transpose?
- Reverse/negate?
- Combine?
- Etc.

Go wild

- Force yourself to connect two random things somehow
- In your wildest dream, what does the solution look like?

Analogies

- Establish an abstract sense in which your problem/situation is “like” some other one
- Then list the attributes of the metaphorical version, and make correspondences
- Create the three-of-four parts of an analogy with something

Escape

- Take a break from the problem
- Hike
- Take a trip
- Get out of a whole area

Take notes

- Don’t forget old trains of thought
- You may return to them now able to fill in some missing pieces

Keep going with innovations

- Don’t stop at first ‘good’ idea
- Multiple (connected) elements of innovation simultaneously – what makes great papers

Creativity in groups

- Difficulties: group-think, lowest-common-denominator, committees
  - Everyone needs to be happy; consensus is the goal, not optimality
- Affiliation needs vs. ego needs – some want to dominate
- Brainstorming in groups:
  - Lack of judgment is key
  - Go for quantity
  - Recorder
  - Keep going after lull

Being “In the Zone”

- Creativity often comes in spurts
  - For a long time, nothing
  - In one week, you may come up with a flood of ideas. Important to have writing devices around when this happens
- Big question: Is this a fluke?
  - How to actually create this state of mind?

Purpose

- Vague intentions and goals will make it tough for you to focus
- Be very specific about what you want to “create”
  - What specific research problem would you like to come up with a solution to?
  - Write it down if need be

Find the motive

- Doing what you want to do vs. what you have to do will make a big difference
- Often, it helps to pick a project that will both help you and other people