Lecture 9:
Human Cognition (contd.)

Logistics

- Homework due on Sunday
- Next quiz on Friday the 14th Feb (covering basics of humans).

Recap

- Attention
  - Mechanism to process some stimulus and ignore others
  - Could be endogenous / exogenous
  - Distractions are costly

- Memory
  - Perceptual memory (act as sensory buffers)
  - Short-term / working memory (5-9 chunks, short lived)
  - Long-term memory: lifetime, remembered by rehearsals
    - Procedural memory, Episodic memory, Semantic memory

- Today → Thinking, Decision Making, Learning

Thinking: reasoning & problem solving

- Now that stuff is in memory, can be used to “think”
  - Two kinds: reasoning, problem solving
- Reasoning → derive new “insights” from prior knowledge
- Deductive reasoning (deduce from facts)
  - If Tuesday, then class. Today is Tuesday. There is class.
  - If Tuesday, then class. Tomorrow is Wednesday. Is there class tomorrow?
- Inductive reasoning
  - Create a general rule to guess unseen instances based on seen instances
  - Useful: Helps fill gaps, guess what to expect, etc.
- Abductive reasoning
  - Special type of inductive reasoning (used to generalize based on observations)
  - Goes beyond just patterns to assign causes for why something happens
  - We are horrible at this (so, don’t leave gulf of evaluation!)

What this means for HCI?

- Reasoning is information heavy
- Prone to confusion and fallacies
- Computers are very good at this stuff
  - There's a lot of scope for computers to support humans on this
  - Information heavy, computers can also help there
  - Think of a time when this is useful?
- When people don't know an interface:
  - They try to "reason" their way out, "guess" (make inferences), etc.
  - Do not allow for that – humans are horrible at it!!!

Problem solving

- Finding solution to an unfamiliar problem / task
  - E.g., Math problems
- How do we do this: reproduce + productive restructuring
- How else: path finding from start to goal state, one step at a time.
  - Search through possible states in between using heuristics
- Use of analogy
- Pick up skills, over time, most things become familiar problems
  - Different strategies to break up problems, deeper knowledge structures
- Involves meta-cognition
  - Thinking about how you are thinking, what is working or not, “what am I doing”, etc.

What this means for HCI?

- Problem solving tools are common!
- A lot of user interaction is a problem solving exercise.
  - How to use an appliance, program, solve a puzzle, use complex software
  - Can we make paths clear from current to goal state?
  - Offer feedback along the way?
  - Help people remember what they have done, so they can backtrack?
  - Information-intensive; people seek help and so needs to be easy.

Decision making

- Given choices, what to pick.
- Suppose you must decide whether to take or drop CS798H
  - Choices are Continue taking, drop, defer to later (no decision).
- How do you decide?
  - Cost-value optimizations; pick one that offers most value/cost.
- Often, under uncertainty
  - We also add risks → some weighing factor for costs and values.

For HCI…

- Decision making is challenging
- Information intensive, imperfect under uncertainty
- Crippling (decision fatigue, paradox of choice)

- Decision support systems
  - Suggestions, data to support, estimates of uncertainty/risk, comparisons, what-if.
  - More on this, when we talk Human-AI interaction.

Learning

- Process of gaining knowledge and skills
  - What's the difference?
- How do we learn?
  - Commit stuff to LTM or memorize
  - Form mental models of how things work
  - Form structures in mind (relating to prior knowledge)
- Meta-cognition
  - Notice how we learn, what is missing in knowledge, relations, etc.
  - Hard for novices, so we provide aids (maps, charts, etc.)

What does it mean for HCI?

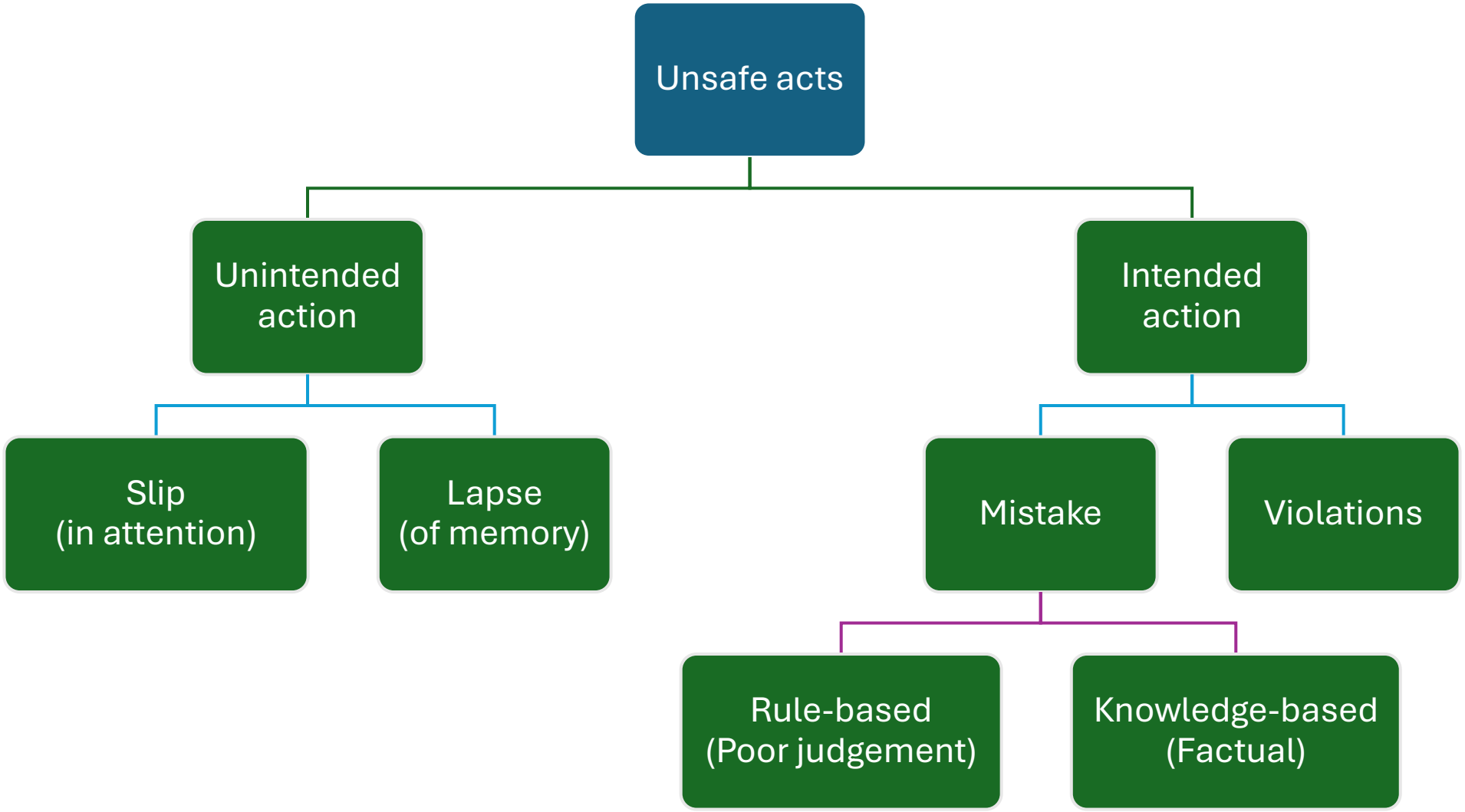
- All things EdTech use these ideas
- Instructional design
  - We use them in classrooms
- Acquiring knowledge, building skills and developing abilities
  - Each needs its own approach to teaching
  - Can you guess what we do in this course?

A note on metacognition

- It is a mark of adults/experts
- Hard to pick, but can be cultivated by deliberate and slow practice
- Fails under rush, needs time to think and then think about thinking (or think /learn about learning)
- Over time, this builds to knowledge and might not be needed.

Human Error

- Error is when someone does something they did not intend to
  - Actions resulting in unintended consequences


Unsafe acts
Unintended action
Intended action
Slip (in attention)
Lapse (of memory)
Mistake
Violations
Rule-based (Poor judgement)
Knowledge-based (Factual)

What it means?

- People make slips
  - Help catch them (easy to also catch)
- People make memory lapses
  - Send reminders, verify, put in poka-yoke
- People get facts wrong
  - Don’t make them remember!
- People are poor at higher-order thinking (decisions, inference)
  - Don’t make them do it!
  - Keep interfaces simple and stupid
  - For all else, build new tools!

Summary

- Today…
  - Human thinking: Reasoning, Problem solving
  - Learning
  - Decision making
  - Meta cognition
  - Human error
- Emotions
  - Won’t do in class, read up on your own!

Readings:

- “Attention and its implication for HCI”, Claudia Roda
- Finish Dix, Chapter on “Humans”