Cog Sci Final Google Doc

**Innateness**

Rationalist vs. empiricist

* + innate knowledge vs. experience

Plato vs. Aristotle

* + Plato: rationalist, innate knowledge
		- poverty of stimulus
		- Plato’s problem: we know things we could not have learned, soul must have understood them for all time
		- humans have limited contact with the world, yet we know so much
		- Plato’s meno: learning is remembering
	+ Aristotle (blank slate): empiricist
	+ Plato was the teacher of Aristotle

Leibniz(veins in da marble) vs. Locke (white paper).

* + locke: 2 sorts of experience, sensation and reflection
	+ complex ideas are formed from simple ideas
	+ Leibniz: experience is necessary but not sufficient to account for our knowledge

Blank slate; innate knowledge

Plato’s problem - humans have limited contact with the world, yet we know so much

* + - argument from poverty of stimulus

Induction vs. deduction.

* + Induction: acquiring knowledge from instances, generalizes beyond the data given, guided by biases, can be wrong!
	+ Deduction: derives new truths from know truths, conclusions are absolutely certain

**Alphabet of human thought:** theory of thought should predict and expain the thoughts people have

Aristotle, syllogisms

* + certain things having been supposed, deriving a conclusion different from those supposed results

**Leibniz’**s dream or “wonderful idea”.

* + vision was to create a universal characteristic
	+ ideal language that perfectly represents the relationships between thoughts

**Boole:** propositional logic

* + xx=x
	+ x(1-x) = 0 the set of one thing and the set of everything that’s not that thing is going to be nothing

**Logic**

**Frege:**

* + *Begriffsschrift*: creates formal language that captures the relationships of thought
		- Remember, Bertrand’s devastating letter to Frege; sets in sets
	+ propositional vs. predicate logic; quantification. Truth tables. Frege did not provide a procedure that will tell you whether conclusion C follows from premises P.

**Infinity**

Infinity: a rationalist challenge to empiricism, going beyond (necessarily finite) experience.

Countably vs. uncountably infinite

* + countably: natural numbers, odd and even numbers
	+ there’s 2 sizes of infinity

Cantor, diagonal method

* + there’s always a halting set that hasn’t been used yet
	+ always one step ahead
	+ uncountable infinity
	+ Turing used to diagonal method to prove that the decision problem is impossible
		- there are claims that can’t be decided computationally
		- more halting sets than Turing machines
		- same thing as more conclusions that premises

**Thought as computation**

**Hilbert**: decision problem (Entscheidungsproblem).

* + Wants to know if you can get a procedure for determining if a conclusion followed a premise. IMPOSSIBLE, why? Turing: diagonal method...more conclusions that premises.

**Turing**: Turing machine (a machine for a specific purpose). Universal Turing machines as general-purpose computers, distinction between program and data. The mind and the

computer: different hardware, same software.

Thought, computation, and the world

Thinking as computation.

Symbol grounding problem.

**Descartes**: what can we know with certainty? Evil genius, deceives me by changing the

information I receive through my senses.

* + “I think therefore I am.”
	+ Doubted existence for the body, and doesn’t trust his senses.
	+ mind and matter can’t be reduced to one another, no explanation of the mind in physical terms
	+ Mind & body problem: how do they communicating

Dualism vs. materialism

* + dualism: if you think that physical sciences can’t be explain operation of the mind
		- mental states can’t be reduced to neural states
	+ materialism: belief that mind can’t be reduced to matter
		- mind can be thought of in physical terms

**Behavior and the mind**

**Wundt:** introspection, reaction times, apperception. Subjective element in introspection.

* + Brass instrument psychology
	+ Making the study of the mind a science
	+ Studying reaction times

**Ebbinghaus**: not introspection, measured memory retention

* + Not everyone used introspection
	+ Found a sort of curve in which people forget things
		- Exponential forgetting curve, spacing effect

**Behaviorism**: John Watson, analysis of behavior, not mind. Deliberate rejection of introspection.

* + Purely objective kind of approach
	+ opened door to theories developed with animals

Classical conditioning vs. operant conditioning.

* + classical conditioning: learning one cu is associated with another that naturally elicits a reaction
	+ operant conditioning: learing that performing an action results in a reward/punishment

**Skinner:** radical behaviorist, sought to dispense with talk of mental states entirely.

* + Asked by Whitehead in the dinner convo, why are there no black scorpions falling on the table?!

**The cognitive revolution**

Tolman, latent learning, cognitive maps

* + cognitive maps - mental representations
	+ latent learning: rats can still learn without a reward

Mental representations as key defining feature of cognitive science

* + argument against behaviorism

Newell and Simon

* + Logic theorist
	+ first AI program
	+ found proof of mathematical facts
	+ used heuristics - working backwards for extremely large search space

Miller

* + magic number 7 plus or minus 2
	+ chunking
	+ constraint on human mental representation

Lashley

* + hierarchy of planning

Chomsky

* + structural language
	+ that it’s hierarchically structured

**Language**

Language as: hierarchically structured – not just a string of words; uniquely human; rule-driven:

infinite generative capacity from finite means.

Skinner vs. Whitehead

* + Whitehead’s challenge to skinner: there’s a black scorpion on this table
	+ how is that behaviorally driven? No stimulus that prompts you to say something like that

Chomsky vs. Skinner

* + Skinner’s book verbal behavior was negatively reviews by Chomsky
	+ skinner: classic empiricist, chomsky: classic rationalist
	+ language reflects knowledge and can’t be accounted for without reference to mental representation
	+ some of this knowledge is innate - related to Leibniz’s veins in the marble

The logical problem of language acquisition.

* + similar to poverty of stimulus
	+ don’t correct the kid enough, not enough negative information for the kid to learn all the rules of language by themselves

Universal grammar - answers these 3 questions

* + plato’s problem
	+ why is language uniquely human - because it’s learnable
	+ why are there language universals, patterns found in all and unrelated languages

**The discipline matures**

Symbolic vs. imagistic (or more generally experiential) representations

* + symbolic: rules, thinking in language
	+ imagistic: one particular image, Shephard & Metzler’s mental rotation
	+ Kossyln’s mental scanning: mental representation, scanning a mental image
	+ evidence for each

Marr’s 3-level framework

* + computation
		- what is the goal that is established
	+ representational (algorithm)
		- level where the design or “how” we can reach the goal is established
	+ hardware implementation
		- the actual physical implementation of a goal

Marr’s model of vision

* + create an image via the laws of optics, how neurons fire
	+ going from imagistic -> symbolic
	+ explains how we process and understand things

**The Turing test and its critics**

Theories of the mind often driven by current technology

The physical symbol system hypothesis

* + Newell and Simon: takes symbols and you can manipulate them to create new expressions
	+ A physical symbol system has the [necessary and sufficient means](http://en.wikipedia.org/wiki/Sufficient) for general intelligent action.

The Turing test

* + The testing if you’re human game

The Chinese room argument

* + Argument about computers, do they really understand?
	+ If you put the Chinese room inside the person, does it make them understand?

**The turn to the brain**

Brain organization: lobes, hemispheres, etc.

Two cortical visual systems: what vs. where pathways

* + Dorsal stream: “how” or where, goes up, parietal
	+ Ventral stream: “what”, goes down, temporal

Words in the brain: serial vs. parallel models

Accidents, surgery, imaging as sources of knowledge

**Neural networks and connectionism**

Neural computation, connectionism, as alternate view of computation in cognition

Localist vs. distributed representations, soft constraints

McCulloch-Pitts model; linear separation; perceptrons vs. multi-layer networks; learning rules

Supervised vs. unsupervised learning

Cognition as satisfaction of soft constraints

**Neural representation**

Single cell recording, dye, lesioning, brain damage, direct cortical stimulation, imaging.

Structures and processes probed through these techniques.

Both localist and distributed representations. Population code.

**Culture, language, and thought**

Sapir-Whorf hypothesis. Evidence for and against from: sense of self, conceptual networks, space,

color naming and perception.

**Symbols and social cognition**

Language as uniquely human: bee waggle dance, vervet calls, Alex, Kanzi.

Universal grammar as explanation for: 1. language universals, 2. language learnability, 3. human

uniqueness of language. Alternative explanations.

Language as part of uniquely human capacity or motivation for social coordination, sharing

Plus major highlight points, not details, from the guest lectures by:

1. John Campbell (philosophy)

* John Searle’s Chinese Room
	+ Doesn’t really understand it
* Symbol Grounding Problem

2. George Lakoff (cognitive linguistics)

3. Clayton Critcher (decision making)

4. Dan Klein (artificial intelligence)

5. Alison Gopnik (developmental psychology)

6. Rich Ivry (the brain and motor control)

7. Bob Knight (cognitive neuroscience)

8. Keith Johnson (language and society)