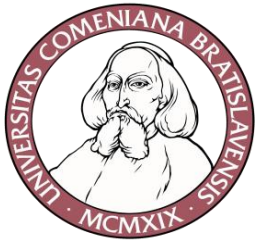

Introduction to cognitive science

Session 2: Philosophy

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The Philosophy Perspective

- Philosophy is the search for knowledge.
- The branch of *metaphysics* examines the nature of reality.
- The branch of *epistemology* is the study of knowledge.

Philosophy in cognitive science

- Theoretical / methodological questions
  - What is mind?
  - How can we study it?
    - First person perpective vs. third person perspective
  - How can we know anything in principle?
    - Philosophy of science

Cognitive science

- Cognitive science is an **interdisciplinary** study of **mind** using the **scientific method** (Friedenberg & Silverman, 2012)

Scientific method

- Empirical method of acquiring knowledge
- Observation
- Scepticism
- Formulating hypotheses via **induction**
- Experimental testing of **deductions** (consequences) from hypotheses

Induction

- Swan A is white
- Swan B is white
- Swan C is white
- $\Rightarrow$ **All swans are white**

Deduction

- Modus ponens:
  - if P then Q
  - P
  - $\Rightarrow$ **Q**
- Example:
  - All humans are mortal (If X is human, X is mortal)
  - Socrates is human
  - $\Rightarrow$ **Socrates is mortal**

Prediction

- Swan D is … ?
- $\Rightarrow$ **white!**

Hypothesis testing

- Verification vs Falsification
- Modus tollens:
  - Hypothesis H: if P then Q
  - P
  - Not Q
  - $\Rightarrow$ refute H
- Example:
  - All swans are white (If X is swan, X is white)
  - X is swan
  - X is black
  - $\Rightarrow$ **Not** "All swans are white"

Theory

- Hypothesis - falsifiability
- Experiments – replication, observer independence
- Peer review
- A well established hypothesis becomes a **theory**
- **Principle of parsimony – Occam's razor**

William of Ockham, 1287 – 1347

Theory vs Hypothesis

- A *theory* is a general understanding of the world that organizes a set of facts and aids us in understanding how the world works.
- A *hypothesis* is a more specific statement about the world that is frequently derived from a hypothesis and can be tested.

Experiments

- Scientists use experiments to test hypotheses.
- An experiment must have at least two variables.
- The *independent variable* is manipulated by the researcher.
- The *dependent variable* is measured by the researcher.

Experiments

- An experiment must also have at least two conditions or groups.
- The *experimental group* receives the independent variable.
- The *control group* does not.

Experiments – An Example

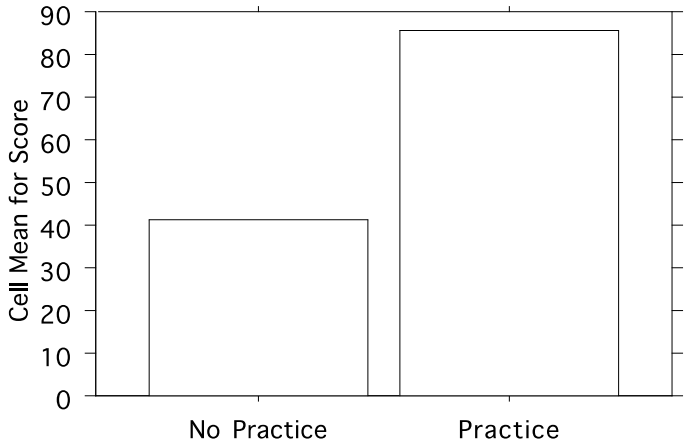
- Theory: Practice facilitates problem solving.
- Hypothesis: Doing logic problems before being tested will increase scores on a subsequent logic test.

Experiments – An Example

- **Experimental group:**
  - 20 participants.
  - Allowed to practice solving problems for 10 minutes.
  - Then given a test problem.
  - Independent variable is practice.
- **Control group:**
  - 20 participants.
  - Not allowed to practice.
  - Given the same test problem.
  - Dependent variable is scores on the test.

Experiments – An Example

- Scores on the dependent variable for the two groups are compared.
- If test scores in the experimental group are significantly higher, then the hypothesis is supported.



Theories are temporary

- No number of experiments can ever prove a theory
- A single reproducible and sound experiment or observation can refute it.
- **If data contradict our theory, we should dismiss the theory, not the data!**

Paradigm

- **Scientific paradigm -** A set of concepts and practices that define a scientific discipline at any particular period of time (Thomas Kuhn - *The Structure of Scientific Revolutions*, 1962)
- Set of assumptions, theories, research methods and established standards for what constitutes a valid research.

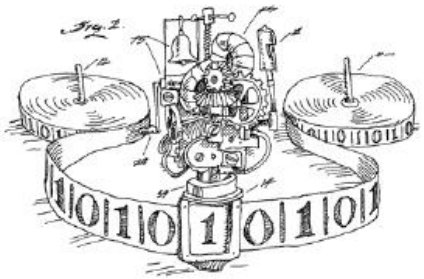
Paradigm - Examples

- Aristotelian dynamics
- Newtonean dynamics
- Relativistic dynamics (Einstein)

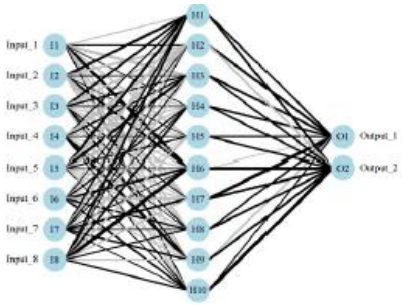
- Light:
  - Particles (Newton – 18th century)
  - Waves (Young, Fresnel – 19th century)
  - Photons – quantum-mechanical entities with properties of particles and waves (Planck, Einstein - 20th century)

Paradigms in cognitive science

Cognitivism



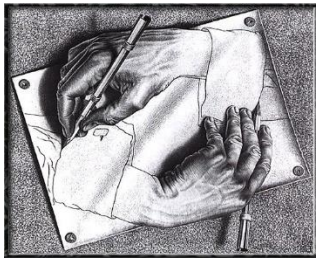
Connectionism



Embodiment

Dynamical systems

Enactivism



Back to philosophy

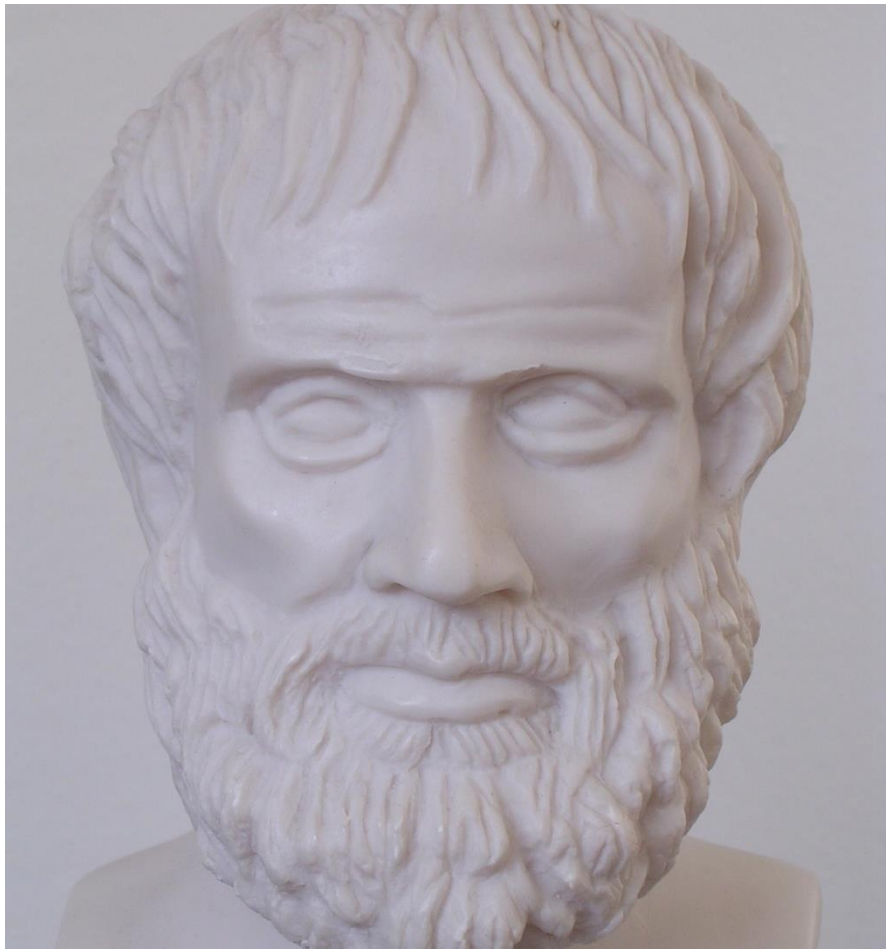
- What is mind?
  - Mind-body problem
- What is consciousness?

The Mind-Body problem

- Describes the seeming incompatibility between the physical properties of the brain and the mental qualities of the mind.
- The brain is material and physical and can be studied objectively.
- The mind consists of subjective phenomena such as thoughts, feelings, and beliefs.
- Is the mind physical?

Monism

- According to *monism*, the mind and the body are both made up of the same substance, either mental or physical.
- Aristotle (384—322 B.C.) advocated a physical form of monism. He believed the mind and body were both physical.
- He stated that aspects of mind correspond to the different physical states the brain assumes.



Dualism

- Plato (427—347 B.C.) was a dualist.
- *Dualism* argues that mind and body are of two different natures; the brain is a physical substance and the mind is a mental substance.
- Plato thought the body resided in a world that is material, extended, and perishable.
- The mind, he believed, resided in an ideal world of forms that was immaterial, non-extended, and eternal.

More on Monism

- According to monism the world is either mental or physical.
- If entirely mental, then we have *idealism*. The universe as God's mind.
- Not scientifically testable but cannot be falsified.
- If entirely physical then we have *physicalism*. The universe as material.

Mental Terminology

- *Identity theory* – the mind is the brain.
- Specifically, mental states are physical brain states.
- Should we get rid of mental language?
- *Eliminativism* says yes, let's use only physical objective scientific terms like "neuron".
- *Folk psychology* uses familiar subjective terms like "tired".

Evaluating Monism

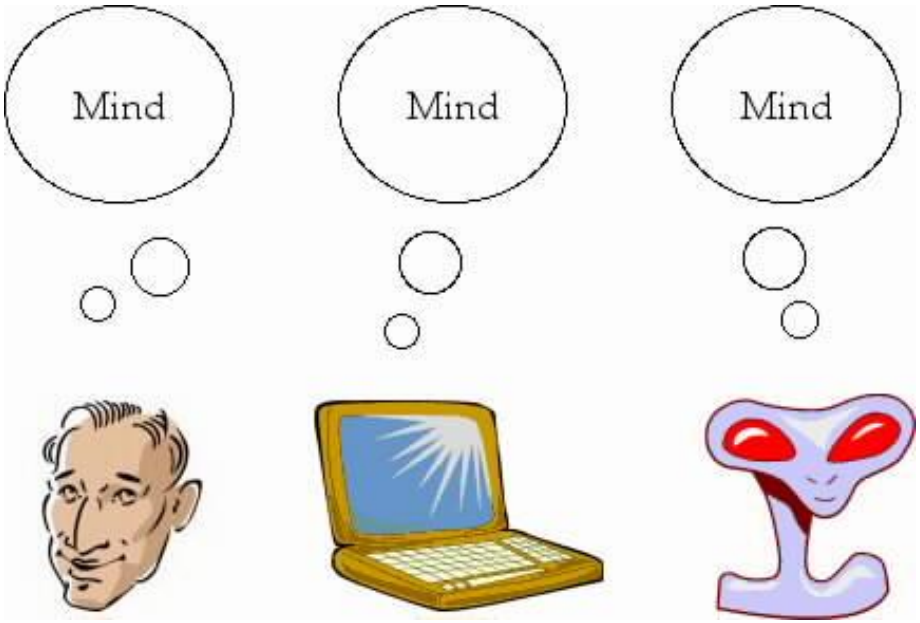
- Monism is simpler, there is only one set of terms. Occam's razor.
- It is the scientific view.
- Lot's of evidence to support the brain's role as the mind.
- However, pain may be different in different people, animals, etc.
- This is the notion of *multiple realization*.

More on Dualism

- *Classical dualism* started with Descartes (1596-1650).
- He thought the mind controlled the brain and body through the pineal gland.
- *Substance dualism* holds that mind and body are composed of different substances.
- The body is made up of atoms.
- What is the mind made up of?

Functionalism

- A mind is the result of the execution of certain processes or functions. These functions can give rise to mind no matter what the physical substrate in which they are embedded.



Functionalism

- Is not a paradigm, but a philosophical stance that gave rise to cognitivism, but can be related to / applied across several cognitive science paradigms.
- Based on a basic claim that **cognitive phenomena are best defined/constituted by their function or functional organization**.

What is functionalism

- Doctrine that what makes something a mental state of a particular type (pain, thought, etc.) **does not depend on its internal constitution, but rather on the way it functions**, or the role it plays, in the cognitive system of which it is a part.
- E.g. *pain* is a state that tends to be caused by bodily injury, to produce the belief that something is wrong with the body, and the desire to be out of that state, to produce anxiety, etc.
- Only creatures with internal states that meet these conditions are capable of being in pain

Putnam's functional definition

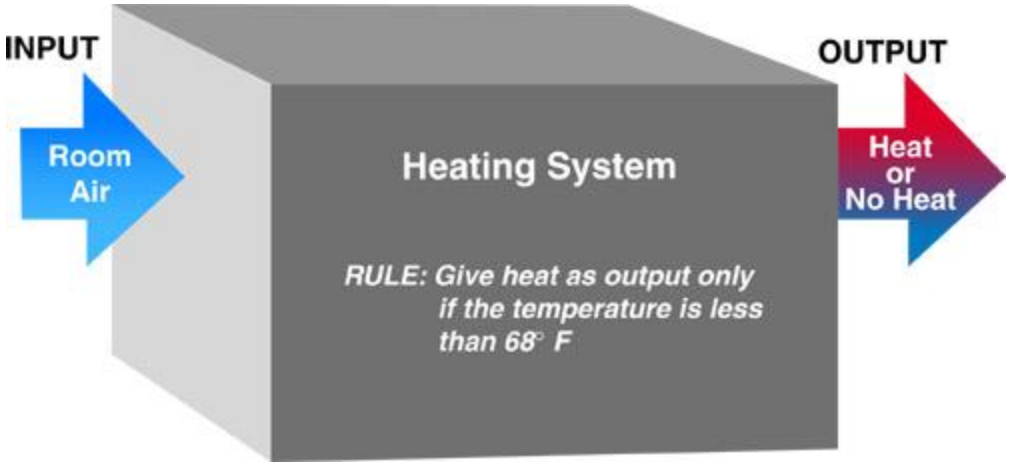
- *Pain* is a functional state of a whole organism, such that:
  - there is an input detected by sensory organs whose function is to detect damage to the body, or dangerous extremes of temperature, pressure, etc.,
  - this input represents a condition that the organism assigns a high disvalue.
    - This does not mean that the organism will always avoid this condition; depending on its Total State and whether it is necessary for attaining some higher-valued goal.

What is being in pain?

- Suppose that in humans there is some distinctive kind of neural activity that meets Putnam's conditions (like C-fiber stimulation) =>
- Humans are in pain when C-fibers stimulated (actually not necessarily)
- However, the theory says, that if some silicon-based Martians could meet these conditions, they too **would be in pain.**
- Pain can be *realized* by different types of physical states in different kinds of creatures.
  - **Multiple realizability**

Functional system as a black box

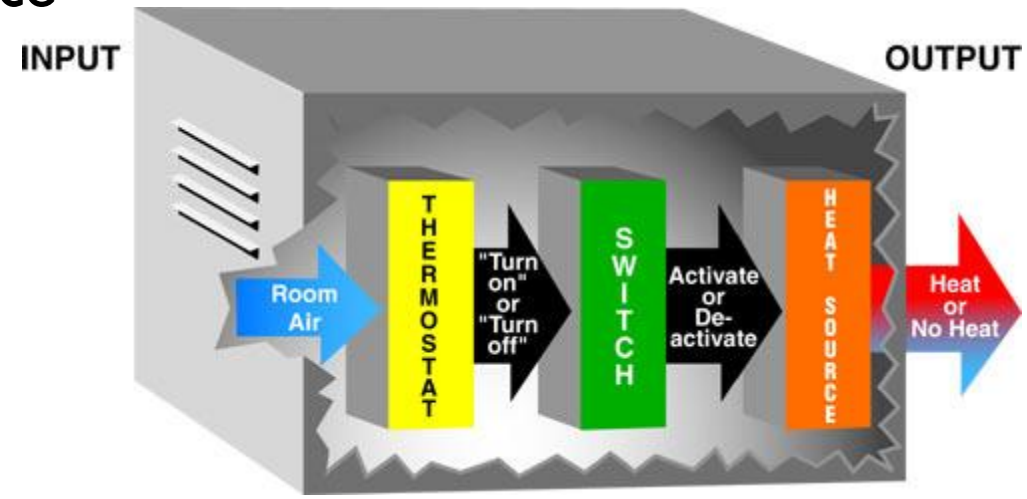
- Function of an automated heating system – to produce heat if air temperature drops below certain level
- Input – air
- Output - heat



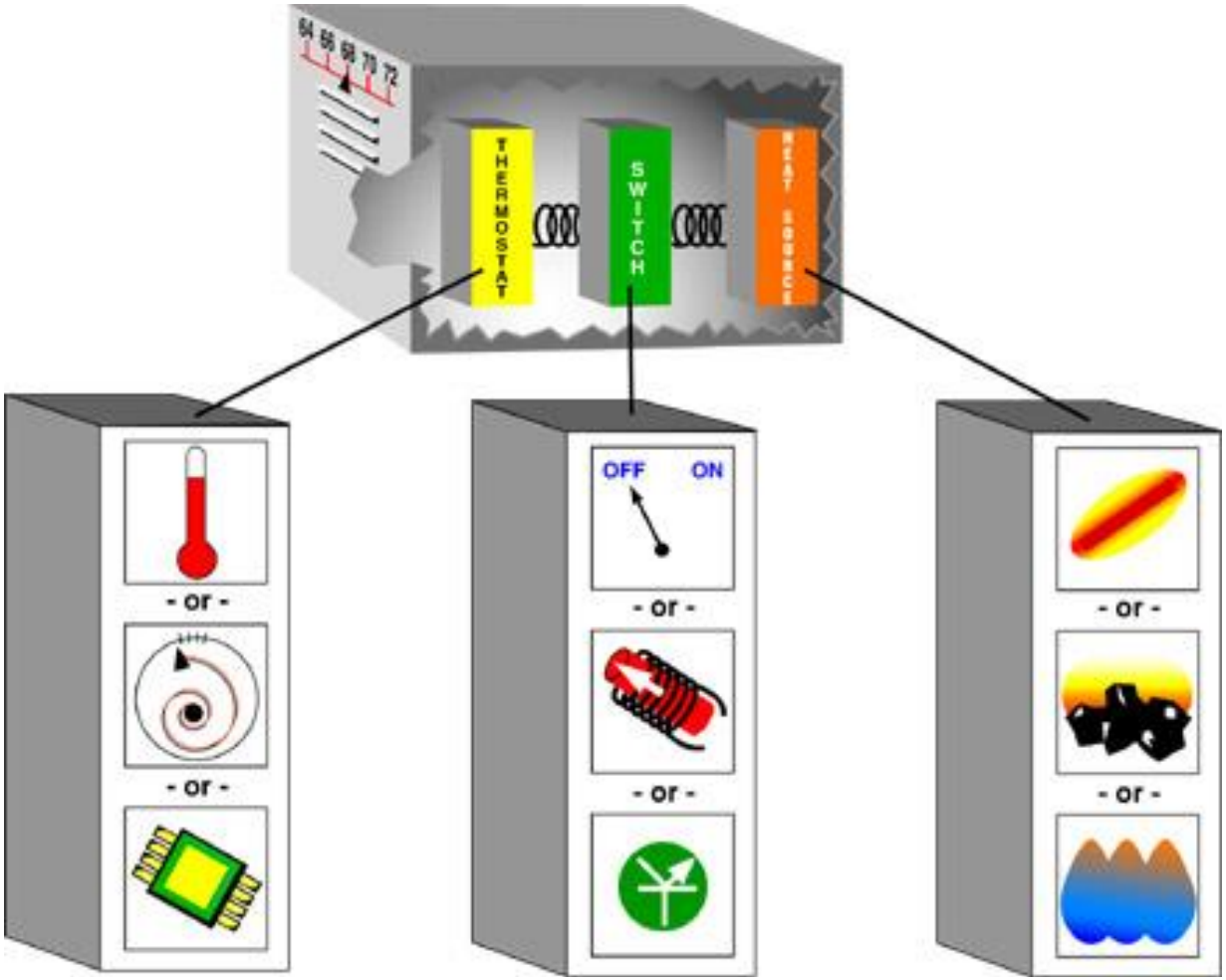
In Anderson, D.L: http://www.mind.ilstu.edu/curriculum/functionalism_intro/functionalism_intro.php

What is in the black box?

- 3 functional components:
  - A thermostat
  - A switch
  - A heating source



Multiple realizability



Alternative thesis 1

- What Putnam calls "**brain state theory**"
  - Each type of mental state is identical with a particular type of *neural* state.
  - Identity theory: the mind *is* brain. Mental states are brain states (i.e. states of "hardware". Functionalists conceive them as states of "software".)
- $\Rightarrow$ No creature with brains unlike ours can share our sensations, beliefs, and desires, no matter how similar its behavior or internal organization is to ours.

Alternative thesis 2

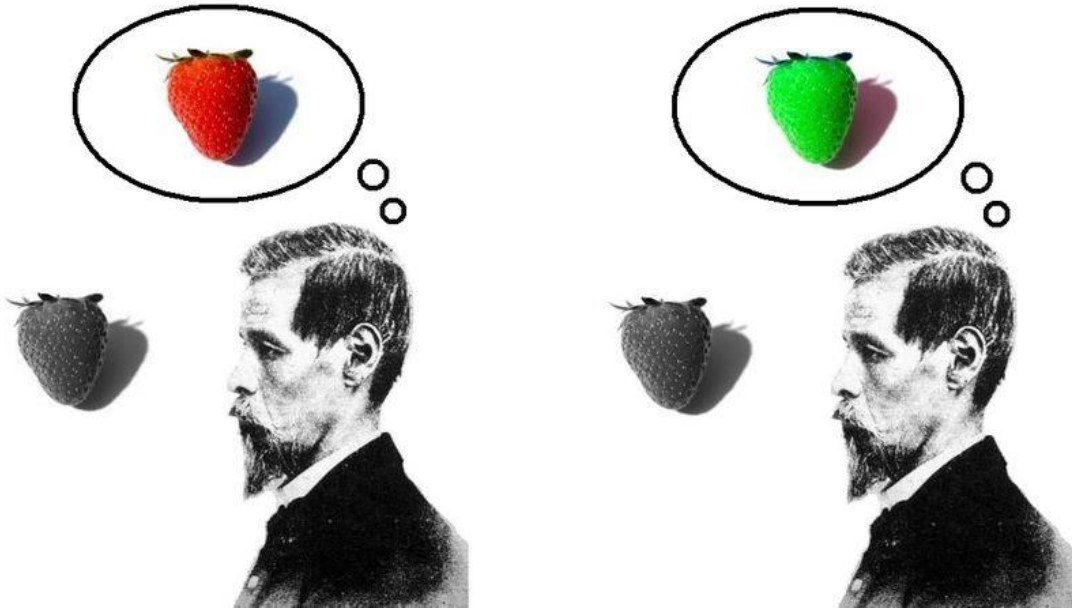
- What Putnam calls "**behavioral disposition**".
  - We know little about brains and functional organization of animals. We tell whether they feel pain by observing their behavior.
  - "The animal behaves *as if* in pain".
- Criticism
  - 2 animals with motor nerves cut, one of them with pain sensory nerves cut
  - 2 persons, one with pain sensory nerves cut, the other a "hero" suppressing pain.

Evaluating Functionalism

- It cannot account for the subjective quality of mental states.
- Specific states like seeing red are *qualia*.
- We can program a computer to see red but does it experience qualia?
- The fact that qualia may be different in different people or machines only complicates the matter.

Qualia

- Thought experiments
  - Inverted spectrum (Block, Fodor, 1972)
  - Zombies (Chalmers, 1996)
  - Chinese nation (Block, 1980)



Next week

- Turing test
- Chinese room argument
- Physical symbol system hypothesis
- Turing machine
- Symbolic paradigm

Questions?