



Sungkyunkwan University (SKKU) International Summer Semester (ISS) 2017  
"New Experience, New Engagement"

## How the Mind Works – a Big Data Approach

Prof. Prasenjit Mitra, The Pennsylvania State University

### SHORT COURSE DESCRIPTION

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Cognitive Science is the study of the mind; how we perceive the world, remember, reason, think, learn and communicate. To study the mind, cognitive psychologists use methods including laboratory experiments, computational models, brain imaging, statistical modeling of existing datasets, and studying the effects of brain damage. We will discuss all of these approaches during the course, learning about key theories and research findings that have emerged from the field of Cognitive Science. After successfully completing the course, you should be able to:

1. Relate key research findings to cognitive theories
2. Understand research methods in cognitive psychology, their strengths and weaknesses
3. Describe current issues in cognitive science research
4. Explain some of the broader implications of findings from cognitive science

More generally, I hope the course will help you develop an ability to understand and critique scientific ideas, and to apply these critical facilities to the ideas and information you encounter in your professional life.

### ABOUT YOUR INSTRUCTOR

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Prasenjit Mitra is a Professor & Chair, Faculty Council in the College of Information Sciences and Technology. His current research interests are in the areas of big data analytics, applied machine learning, and visual analytics. Mitra received his Ph.D. from Stanford University in 2004 where he investigated issues related to modeling data and the semantics of data in an information integration system. He was the principal investigator of the DOES project funded by the NSF CAREER Award.

Mitra has co-authored approximately 150 articles at top conferences and journals. His work along with his co-authors has resulted in a visual analytics system that was awarded the IEEE VAST '08 Grand Challenge award in the Data Integration area. He has served as the co-chair of the IEEE SOCIETY conference, and as an area chair, and a senior program committee member at top conferences such as CIKM, and IJCAI, respectively. Mitra has been a member of the Best Paper Award committee for CIKM'15 and the co-chair of four workshops including SNAKDD'09, WIDM'09, and WIDM'12. He has also served on the program committee of several top conferences including SIGMOD, VLDB, AAAI, IJCAI, WWW, CIKM, WSDM, KDD, and ICDM, and serves on the editorial board of the Journal of Data Mining and Digital Humanities. He has supervised over 15 Ph.D. students; and several M.S. students.

### READING MATERIALS

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The lectures provide the core content of the course, introducing key theories and research findings. The information is supplemented by readings from the textbook, and by other articles included in the homework assignments. Articles associated with the homework assignments will be available to download from the website. Not all material in the readings will be covered in the lecture, and vice versa, so it is important to keep up with both.

**Text book:** John R. Anderson: *Cognitive Psychology and its implications*. (To be read during class.)

### COURSE REQUIREMENTS AND GRADING

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After each class, you need to fill out a "log entry". This is your diary for this semester. You may reflect on what was discussed in the lecture, relate it to personal experience or research results you

are aware of, and you may provide feedback on what you liked or disliked in class. There will be a mid-term and a final exam, which will contain a mix of multiple-choice and essay questions. All answers must be given in English. The final grade is figured as 60% mini-exam results, 30% in-class presentation (if given), and 10% participation. This weighting is subject to adjustment. Grounds for failing the class include failure to reach at least 60% in grades; failure to show up for most classes, or for the exams, and academic dishonesty.

Please note that SKKU regulations require students to attend at least 80% of all classes.

## **COURSE SCHEDULE**

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### **– WEEK I (June 27<sup>th</sup> ~ June 30<sup>th</sup>) –**

Introduction: What is Cognitive Science?

#### **Module 1: Methods, Theories, and Perception**

Behavioral and Neurological Research Methods

Classic Theories, Levels of analysis - Modeling

Eye& Brain, Faces

Optical Illusions

Dorsal and Ventral pathways

Synesthesia/Review

### **– WEEK II (July 3<sup>rd</sup> ~ July 7<sup>th</sup>) –**

#### **Module 2: Attention**

Attention & Perception, Selective Attention

Early or Late Selection

Multi-Tasking

Proceduralization (and expertise-building)

Planning and Control

Problem-Solving and how experts do it

Inhibition

#### **Module 3: Memory**

Models of Memory / Working Memory

Capacity, Encoding, Amnesia

Explicit/Implicit Knowledge

Procedural Knowledge, Review

Rational Analysis and inference of memory properties from big data

### **– WEEK III & IV (July 10<sup>th</sup> ~ July 17<sup>th</sup>) –**

#### **Module 4: Language and Higher Cognition**

What is language? Words and Sentences

Language Acquisition

Language modeling using large text and speech corpora

Decision-Making, Experimental Game Theory

Cognitive Biases, Review