Artificial General Intelligence Course

Review:

The course presents a large set of ideas in the field of artificial general intelligence. It combines ideas from many scientific fields, such as neuroscience, computer science, psychology, and more. The course is not technical/practical, yet occasionally presents the mathematics behind different methods. The course has a vision of how AGI should be approached, researched and learned. See here about the importance of having a vision.

Takeaways:

1) The student will be able to expand his/her horizons in a new, exciting, and uncharted field of AGI.
2) The real purpose is to provide the students many different AI tools to perform their own research, in AI or AGI fields.
3) This knowledge might be relevant in research labs around the world e.g. AI Initiative at KAUST, CSAIL (MIT AI Lab) and more. Also, in different companies around the world that do R&D in this topic: Meta AI (Yann LeCun) or FAIR (Facebook AI research), Google AI, DeepMind, Open AI, Decodea, AI21 Labs (Amnon Shashua), Numenta (Jeff Hawkins), SingularityNET (Ben Goertzel), ABRAINA, Keen Technologies (John Carmack), VERSES AI and more.

Teaching:

In academics:

Via regular presentations or via "flipped classroom":

1) Watch lecture video for that week.
   Suggestion: if you come up with misunderstandings during the playback, please replay and watch it more than once.
2) Feedback: fill up form of review, ideas, suggestions, etc.
3) At class: discussion (recap, then Q&A, additional information about the subject, and then dive deeper to the/more ideas/techniques).

In high-school:

The purpose is to train the young students to prepare for a higher-education form of learning. Hence, the learning outcome is innovative for them in these aspects:

1) Being able to perform theoretical and abstract type of learning (besides their usual practical form).
2) Being able to watch individually lectures, in English, and comprehend them appropriately.
3) Final project's aim is to handle academic literature. Read one or several papers. Then, being able to review, analyze, comparison among papers, and perform other operations on them.

Subsequently, the learning is also (as in academics above) via regular presentations or via "flipped classroom".

Grade:

- 10%: attendance.
- 30%: feedback after home-watching lectures.
- 60%: final summary paper/presentation about some subject in more depth, e.g., some Cognitive Architecture.
  A list of papers will be supplied to choose from, or there will be an option for the student to find other AGI-related papers in the literature.
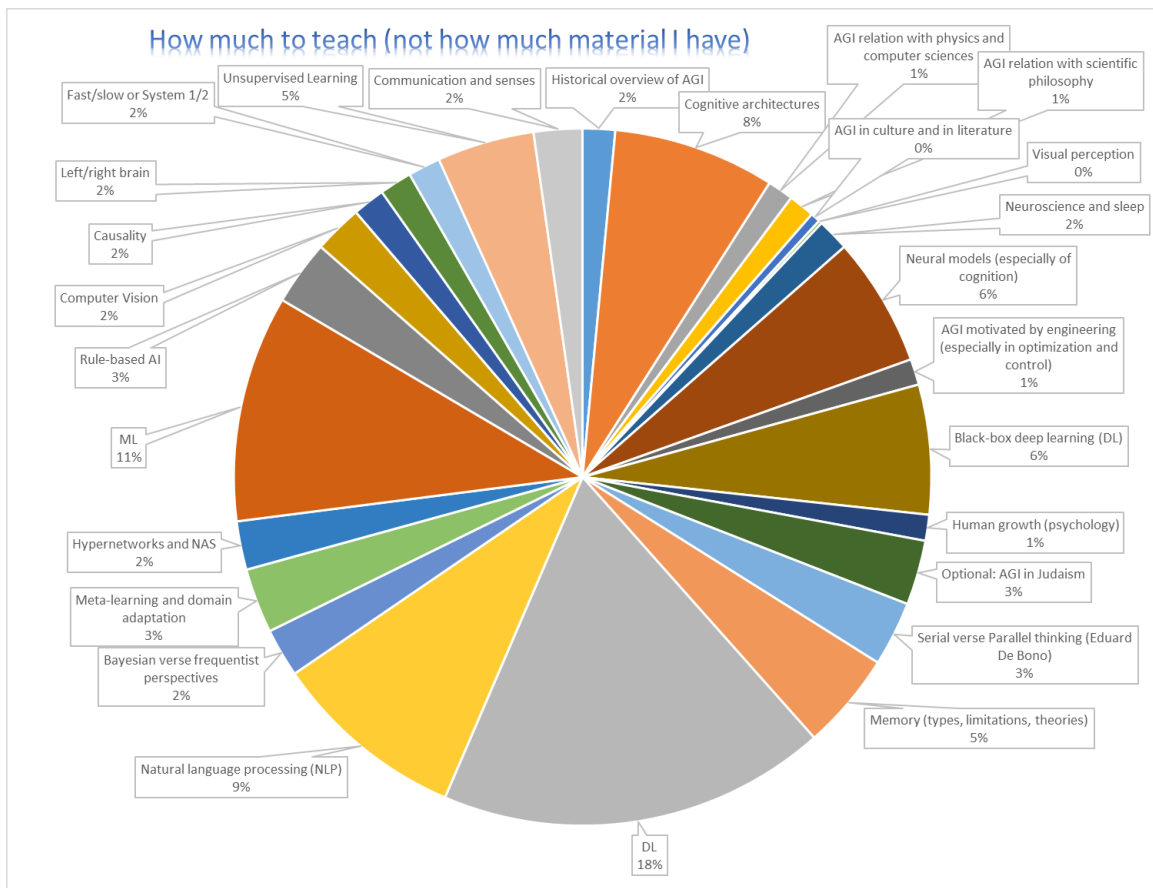
Syllabus:

1. Historical overview of AGI
   - AGI relation with physics and computer sciences
   - AGI relation with scientific philosophy
   - AGI in culture and in popular literature
   - Optional: AGI in Judaism
2. Neuro-science
   - Pathom Brain theory
   - Other Brain theories
   - System 1 & 2
   - Jeff Hawkins' Neocortex models
   - Selected studies
3. Deep Learning (DL)
   - Hierarchical classification
   - Generative models
   - Other Neural Network types
   - Network Architecture Search
4. Unsupervised Learning
5. Other Learning approaches and types
6. Natural language processing (NLP)
   - Embeddings
   - Model of computation (Chomsky Hierarchy)
   - Syntax and Semantics
   - John Ball's NLU
7. Understanding DL (Black-box issue)
8. Bayesian theory (Brain Hypothesis, optimization, BNN, GP, PML)
9. Classical AI
   - Knowledge Representations
   - Logic
   - Programming Paradigms
10. Cognitive Architectures
11. State space (RL, control theory, Markov)
12. Neuro-Symbolic AI
13. Other topics:

- Visual perception
- AGI motivated by engineering (as in optimization and control)
- Human growth (psychology)
- Serial verse Parallel thinking (Eduard De Bono)
- Memory (types, limitations, theories)
- Consciousness
- Time series
- Cognitive Bias

Sources:

	Text	Presentation
Historical overview of AGI		AI_presentation12.pptx
Cognitive architectures	Ben Goertzel in AIsummary16.docx, Ricardo R. Gudwin in AIpapers15.docx	AI_presentation12.pptx
AGI relation with physics and computer sciences		AI_presentation12.pptx
AGI relation with scientific philosophy		AI_presentation12.pptx
AGI in culture and in literature		AI_presentation12.pptx
Visual perception	Visual perception in AIsummary16.docx	AI_presentation12.pptx
Neuroscience and sleep	Neuroscience in AIsummary16.docx	AI_presentation12.pptx
Neural models (especially of cognition)	Jeff Hawkins in AIsummary16.docx, After "skymind articles" in AIpapers15.docx	AI_presentation12.pptx
AGI motivated by engineering (especially in optimization and control)		AI_presentation12.pptx
Black-box deep learning (DL)	Information theory in AIpapers15.docx	AI_presentation12.pptx
Human growth (psychology)	Psychology in AIsummary16.docx	AI_presentation12.pptx
Optional: AGI in Judaism	AIsummary16.docx	AI_presentation12.pptx
Serial verse Parallel thinking (Eduard De Bono)	Eduard De Bono in AIsummary16.docx	AI_presentation12.pptx
Memory (types, limitations, theories)	"Course 8" and "DL for sequential pattern.." in AICourses01.docx, "ANNs finally yield.." in AIsummary16.docx	AI_presentation12.pptx, NLP+DL.pptx, Framework AI 05.pptx
DL	RL, GNN, scene graphs in AIpapers15.docx, DL.docx, Intro to NLP.docx	NLP+DL.pptx, AI_presentation12.pptx, Graph NNs.pptx
Natural language processing (NLP)	Intro to NLP.docx	NLP+DL.pptx, Framework AI 05.pptx
Bayesian verse frequentist perspectives	Bayesian Brain Hypothesis in AIsummary16.docx	
Meta-learning and domain adaptation	"Course 13, 14" in AICourse01.docx	NLP+DL.pptx
Hypernetworks and NAS	"Structural priors.." , "Hypernetworks.." in AICourse01.docx	MyDNN.pptx, NLP+DL.pptx
ML	Courses in AICourse01.docx	AI_presentation12.pptx
Rule-based AI	"Course 10" in AICourse01.docx, "Course of AI" in AIsummary16.doc	"From course of AI" Transportation AGI 05.pptx

Computer Vision	"Course 12" in AICourse01.docx, More stuff in DL.docx, CNN_images.docx	Transportation AGI 05.pptx
Causality	"Course 15", "Towards cau.." in AICourse01.docx	
Left/right brain	Psychology in AIsummary16.docx	
Fast/slow or System 1/2	"Towards caus.." in AICourse01.docx, Ben Goertzel in AIsummary16.docx	AI_presentation12.pptx
Unsupervised Learning	"Deep clustering" in AICourse01.docx	Unsupervised Learners.pptx
Communication and senses		AI_presentation12.pptx, Framework AI 05.pptx

How much to teach (not how much material I have)

Leading Names in AI

Joshua Tenenbaum
MIT Computer Science & Artificial
Intelligence Lab

Yann LeCun
VP and Chief AI Scientist, Facebook
New York University.

Geoffrey E. Hinton
Department of Computer Science
University of Toronto

Andrew Yan-Tak Ng
Computer Science Department
Stanford University

Lex Fridman
AI researcher working on
autonomous vehicles, human-robot
interaction, and machine learning
MIT and Tesla

Yoshua Bengio
Department of CS and Operations
Research at the Université de
Montréal

… and many others

taken from [here](#)…

Ian Goodfellow

<u>AGI</u>:

Ben Goertzel

Sam Adams

John Carmack

Psychology:

Jean Piaget

Edward de Bono

Daniel Kahneman

Lev Vygotsky

Gary Marcus

Judea Pearl

My favorite:

John S. Ball

Cognitive Language scientist

Jeff Hawkins

Neuro-scientist