Eight Consciousness of Buddhism and Cognitive Science

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Human Intelligence: P (erception), T (hinking), A (ction) \sim O (bservation), D (ecision), A (ction).

Machine Intelligence (Humanlike Intelligence): Computing Intelligence+Storage+ Disciplines by Human

Philosophy studies Human intelligence in West, Buddhism researches human mind in East.
Advances in AI

- Moves: Imitation Game, Ex Machina, Her
- Auto Pilots for Autos
- IBM’s DeepBlue beats World Chess Champion Kasparoff
- Google’s DeepMind’s α-GO beats World GO Champion Li, Shiduo
- VC investment to AI explosively increased since 2012 in USA, Japan and Taiwan
- Hot spots include Deep Learning, Topological Data Analysis, Cognitive Science, Quantum Consciousness, Applications of higher math languages- category theory, topos, algebraic topology etc.
Eight Consciousness of Buddhism (ECB)

- The Five sense consciousnesses = Five Perceptrons
  - Eye (Sight)
  - Ear (Sound)
  - Nose (Smell)
  - Tongue (Taste)
  - Body (Feel)
- Mental Consciousness = Synthesizer of the previous 5 senses = Perception
- Manas = Deluded awareness = I = Self consciousness = Self-grasping, Disturbing emotion or attitude
- Alayas = Archetypes database of universe, category of categories = storage of seeds = All-encompassing foundation consciousness = Reflexive awareness = Holograph?
- Buddha wants to destroy Manas = “I”, Renaissance liberated “I”.
- iPhone, iRobot
The Diagram of ECB

Alayas → Manas → Mental → Nose → Tongue → Eye

Eye → Ear → Mental → Nose → Tongue → Body

众生八识之间的关系

向外看

眼识（缘色境）
耳识（缘声境）
鼻识（缘香境）
舌识（缘味境）
身识（缘触境）

向内看

缘带质境

身识（缘触境）

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A+I or A-I?

- The opposite of above processes is also right (Buddhism, Tao, Philosophy)
- AI without sensation, feeling, emotion, consciousness, moral will not be intelligent
- AI with sensation, feeling, emotion, consciousness may not be controllable.

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Eight Consciousness of Buddhism and Cognitive Science
Giulio Tononi’s IIT (Integrated Information Theory) in Wisconsin-Madison is trying to formalize/symbolize human consciousness.

2014 MIT’s Max Tegmark published a paper on arxiv saying he generalized the IIT idea through quantum mechanic and he claims that the consciousness is a state of quantum matter.
Quantum Behavior

- Uncertainty Principle \((x, p), (t, E), (f, \sim f)\)
- Quantum Entanglement, non-locality
- Existence relying on measurements (Shrodinger’s Cat)
- Wave-particle duality
- Human psychology and behavior is very similar to quantum
A kind of math language $\mathcal{C} = \{\text{obj}(\mathcal{C}),\text{Hom}\}$

Elements in collection $\text{Hom}(A, B)$ are called arrows, morphisms etc, and denoted by $f : A \rightarrow B$

If $g \circ f$ makes sense, it is an associative op. $1_A : A \rightarrow A$ is the do-nothing arrow.

The map between two categories are called functor, Functors will keep some homomorphism rule, satisfactory rule etc.

Category theory is becoming the basis for theoretical computer science and AI.
In a category $\mathcal{C}$, Arrows can be viewed as the relation of keep structures/states, but also can be viewed as generalized “belonging relations”

$$A, B \in \text{obj}(\mathcal{C}), \ x : B \rightarrow A \Leftrightarrow x \in \text{hom}(B, A)$$

We also use notation $x \in_B A$, and call $x$ a generalized element of $A$, $B$ is called the definition stage of element $x$, or the variable domain. $x \in_B A$ is also read as “at $B$-stage, $x$ is in $A$”.

If there is another $y : C \rightarrow B$, then $x \circ y : C \rightarrow A$, $x \circ y \in_C A$. Discovered an arrow between two objects, is in some sense to find “a classification”, “a similarity”, “a cognition”, Or in the Buddhism word, “a LiaoBie = an identifying”.

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Classical Pattern Recognition in Category Language

- \( \alpha : X \rightarrow Y, \quad X \cong Y \) or not

\[ \begin{array}{c}
\mathcal{A} \quad \text{category of recognition} \\
\downarrow \\
\mathcal{B} \\
\mathcal{F} \quad \text{sensor functor}
\end{array} \]

- Example: \( \text{hom}(x, y) = \{id\} \) if \( x = y \)

\[ \mathcal{B} = \mathbb{R}^n, \]

\[ \quad \text{or} \quad \mathbb{R}^D = \{f : D \rightarrow \mathbb{R} \text{ functions}\} \]

\[ \quad \text{or} \quad K_1 \times K_2 \times \cdots \times K_m \text{ etc} \]

- This classical \( \mathcal{B} \xrightarrow{\text{feature functor}} \mathcal{C} \) comparing with the seeds
Examples

\[ \mathcal{A} \xrightarrow{F} \mathbb{R}^n \]

\( E \) needs to be learned, \( E \) could be determined by \( I \) (Monas) and Seeds or Archetypes from Alayas.

- \( F(a) = \text{image} = \text{a vector of millions-dimension} \)
- \( F(b) = (\text{Body temperature, blood oxygen, cholesterol,} \ldots) \), \( \text{a vector of measurements of “properties/attributes”} \)
- \( I \) (including Experience, Theories etc) \( \Rightarrow \) an equivalent relation \( E \) in \( \mathbb{R}^n \)
- \( \mathbb{R}^n/E \xrightarrow{\text{Classifier}} \xrightarrow{\text{Qualitative Mapping}} \text{a logic domain} \)

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Ontology

- From Aristotle, trying to build ontology (concepts, attributes, relations, logic models etc) for every context world or universe.
- The goal is to make knowledge accumulation and reuse possible.
- Category theory may become the best formal language for Ontology.
- This is also related to build the seamless relationship between Human and Machine.
- Related to combining complex of AI, AI Society, HI-AI society harmoniously.
In the frame of ontology, we can rebuild Epistemology, including
- ANN (Artificial Neural Networks)
- CNN (Convolution NN), BNN (Bayes NN) and Deep Learning
- General Pattern Recognition based on Category Theory

An observable universe (Some existence in space-time) $U$

A group of functors from $U$ to Image Space $I$ (Model Theory in category theory syntax)

Assume $I$ is based on model $M$, and when $M=$ (the real numbers, boolean logic), they are classical PR or Prof Wang/Prof Feng’s Factor-Space theory/property mapping theory: $p : U \rightarrow R(M, n)$, $x; p$ is the property mapping. If in $R(M, n)$ we introduce some threshold neighborhood concept, one can do very complicated first order logic calculus by language $L$ in $M$ to accomplish very complex cognition tasks.
Knowledge Representation in Category

- Healy converted ANN to category theory which makes the concept-subconcept convenient. [H]
- Goguen reformulated concepts, the fusion of concepts etc in category, and proposed a new concept Institution for the frame of KR and modeless logics. [G]
- Gonczarowski-Lehman proposed a category model to describe Robot perception. [GL]
- Ehresmann-Vanbremeersch go further to propose a mathematical model of consciousness: Memory Evolutive Model. [EV]
(E, I, p) is called a perception model means E is the external world, I is the internal world (Manas?), p(E, I) has values T, F, U. T=TRUE, F=FALSE, U=Uncertain, Not Interested in, or Not Related etc.

For a fixed E, I and p can vary, we can define the arrow \( f: (I_1, p_1) \rightarrow (I_2, p_2) \), by requiring \( f \) does not blur TRUE/FALSE.

Therefore we have a category for a fixed E call it the Perception Cat.

Coproducts, products, pull back, push forward represent maximum trust, minimum trust, common sense, cooperation etc.
Imaginary Thinking

- Topos=Logic with Geometric Flavors
- Shape Theory based on Category Theory
- Abstract Pattern Recognition

![Diagram](attachment:image.png)
## HI vs. AI-AutoPilot

<table>
<thead>
<tr>
<th>Human</th>
<th>Human-Like</th>
</tr>
</thead>
<tbody>
<tr>
<td>● 8 consciousnesses</td>
<td>● $N$ consciousnesses</td>
</tr>
<tr>
<td>● Based on regulations, moral, knowledge, judgement</td>
<td>● based on computing</td>
</tr>
<tr>
<td>● Muscle memory-Intuition</td>
<td>● Digitized knowledge: Storing, extracting, processing, learning</td>
</tr>
<tr>
<td>● Judgement on capabilities</td>
<td>● Physical restrictions</td>
</tr>
<tr>
<td>● Fuzzy information Processing, Satisfactory Principle</td>
<td>● Perception, Sense, Feeling (Not yet?)</td>
</tr>
<tr>
<td>● Habit, Race, Society</td>
<td>● No such a thing</td>
</tr>
<tr>
<td>● Lost attention/focus</td>
<td>● Never</td>
</tr>
</tbody>
</table>

*AI Drive = emulation trained learning machine with sophisticated knowledge base and perception agencies*
Thank You
佛学八识与认知科学-中文版

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2016年9月29日
人类智能：P (erception), T (hinking), A (ction) ～ O (bservation), D (ecision), A (ction). 观，思，行。

机器智能（类人智能）：类人机器 + 计算 + 存储 + 遵守机器道德准则

哲学研究人类智能
人工智能的进展

- 模仿游戏，机器姬，她
- 自动驾驶
- IBM 的 DeepBlue 击败世界象棋冠军
- DeepMind 的 α-GO 击败围棋世界冠军
- 2012 年起人工智能投资在美国激增
- 深度学习，拓扑数据分析，认知科学，量子意识，范畴论，拓扑斯，直觉主义逻辑，认识与脑科学的形式化
佛学八识

- 八识：眼、耳、鼻、舌、触、意、末那、阿赖耶
- 前五 = Perceptrons
- 意 = 综合器
- 末那 = I, 我, the Gate
- 阿赖耶 = 藏识, archetypes database of universe, category of categories
- 佛学灭我，文艺复兴兴我
- iPhone, iRobot
认知科学

- Damásio: Descartes’ Error 笛卡尔的错误–环境-身体-情绪-思维 (认知，推理，判断，理论，想象，艺术，行动)
- 上述过程反过来也对 (佛学，道学，皇帝内经)
- 没有感觉-意识的 AI 不聪明
- 具有感觉-意识的 AI 不可控
Wisconsin-Madison 的 Giulio Tononi 的 IIT (Integrated Information Theory) 试图形式化人类意识

2014 MIT 的 Max Tegmark 依据量子力学推广了上述理论，称意识是一种遵循量子力学的物质态
量子行为

- 不确定性原理 \(((x, p), (t, E), (f, \sim f))\)
- 量子纠缠
- 存在取决于观测（薛定谔的猫）
- 波粒二象性
- 人类心理与决策行为
范畴论

- 一种数学结构 \( \mathcal{C} = \{ \text{obj}(\mathcal{C}), \text{Hom} \} \)
- 集合 \( \text{Hom}(A, B) \) 里的元素称为箭头、映射、态射，记为 \( f: A \to B \)
- \( g \circ f \) 有意义，满足结合率。\( 1_A: A \to A \) 是到自身的 “无为” 箭头
- 范畴之间的映射称为函子，函子要保持 “满意原则”，“同态”，交换率，因果率等
- 范畴论已经成为理论计算机科学，未来的人工智能的基础
在一个范畴 $\mathcal{C}$ 里，箭头可以看作 “保持状态” 的关系，也可以看作广义的 “隶属” 关系

$$A, B \in \text{obj}(\mathcal{C}), x: B \to A \iff x \in \text{hom}(B, A)$$

我们也用记号 $x \in_B A$，并且称 $x$ 为 $A$ 的一个 “广义” 的元素，$B$ 被称为这个元素的定义阶段 (stage)，或者变化域。$x \in_B A$ 也被读成 “在 $B$-阶段，$x$ 在 $A$ 中”。

如果还有一个 $y: C \to B$，则 $x \circ y: C \to A, x \circ y \in_C A$。发现一个箭头，等于广义地发现了一个 “分类”，一个 “相似”，一个 “识别”，用佛学的术语说，一 “了别”。
经典模式识别的范畴论

- $\alpha : X \to Y$, $X \cong Y$ or not

\[ A \quad \text{category of recognition} \]

\[ F \quad \text{sensor functor} \]

\[ B \]

- Example: $\text{hom}(x, y) = \{id\}$ if $x = y$

\[ B = \mathbb{R}^n, \]

\[ \text{or } \mathbb{R}^D = \{f : D \to \mathbb{R} \text{ functions}\} \]

\[ \text{or } K_1 \times K_2 \times \cdots \times K_m \text{ etc} \]

- This classical $B \xrightarrow{\text{feature functor}} C$ comparing with the seeds
例子

\[
\mathcal{A} \xrightarrow{F} \mathbb{R}^n \quad E \text{是需要学习的，} \quad E \text{由} \ I \text{ (monas) 以及阿赖耶识中的种子决定}
\]

- \[F(a) = \text{image} = \text{千万维矢量}\]
- \[F(b) = (\text{体温，血氧，胆固醇，⋯}) \text{，a vector of measurements of “properties”}\]
- \[I (\text{包括经验，理论等}) \rightarrow \mathbb{R}^n \text{上的等价关系} \ E\]
- \[\mathbb{R}^n/E \xrightarrow{\text{classifier}} \text{a logic domain}\]
模仿哲学，对每种领域建立最基本的本体论（概念化，属性，关系，模型论）
让知识可以积累和复用
范畴论将成为本体论的最佳形式语言
人机无缝
组合复杂 AI，AI 社会，人类 AI 社会
计算机体系结构的本体论？
在 Ontology 的框架下建立的 Epsitomology，包括了
- ANN (人工神经网络)
- 卷积神经网络，贝叶斯神经网络，深度学习
- 模式识别一般理论 (范畴型论，范畴神经网络)

一个被观察的宇宙 (在时空中存在的存在物) \( U \)

一组映射到某个模型 (Model Theory in category theory syntax) 的函子，此目标模型范畴被称为印象空间 \( I \)

假设 \( I \) 是基于模型 \( M \)，当 \( M = ( \text{实数体系} \), boole 逻辑), 它就是汪-冯的属性论：
\[
p : U \rightarrow R(M, n), x; p \text{ 就是定性映射。如果在 } R(M, n) \text{ 引入阈值领域，人们就在 } M \text{ 的语言 } L \text{ 进行复杂的一阶逻辑谓词演算来完成复杂的认知判断}
\]
认知的范畴表述

- Healy 把 ANN 的概念形成都范畴化了. [H]
- Goguen 在范畴语言下考察了概念，概念的融合等等，并且提出一种更加一般的知识描述框架 institution. [G]
- Gonczarowski-Lehman 提出了一种描述 Robot 感知 (perception) 的范畴模型. [GL]
- Ehresmann-Vanbremeersch 更进一步提出了意识 (consciousness) 的数学模型，称为记忆演化模型 (Memory Evolutive Model). [EV]
- Gomez-Sanz 的综述和书
(\(E, I, p\)) 称为一个感知模型，是指 \(E\) 是外部世界，\(I\) 是内部世界 (内心世界)，\(p(E, I)\) 取值 \(T, F, U\)。 \(T =\) 真，\(F =\) 假，\(U =\) 不定，不感兴趣，无关等等

固定一个 \(E, I\) 和 \(p\) 可以变化，则可以定义 \((I_1, p_1)\) 到 \((I_2, p_2)\) 的态射 \(f\)，要求 \(f\) 不要 blur 真假

这样对一个固定的外部世界，所有感知模型构成一个范畴

Coproducts, products, pull back, push forward 反映了极大信任，极小信任，常识，合作等等
形象思维

- Topos=Logic with Geometric Flavors
- 基于范畴论的型论
- 抽象模式识别

![Diagram](image.png)
<table>
<thead>
<tr>
<th>人类</th>
<th>类人</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 识</td>
<td>N 识</td>
</tr>
<tr>
<td>基于法规-道德-知识的判断</td>
<td>基于逻辑和数字运算</td>
</tr>
<tr>
<td>肌肉记忆-直觉</td>
<td>数字化知识存储/提取/处理/学习</td>
</tr>
<tr>
<td>对自己能力判断</td>
<td>物理限制</td>
</tr>
<tr>
<td>不精确信息处理，满意原则</td>
<td>感知、知觉、感性 (没有建立?)</td>
</tr>
<tr>
<td>习惯，种类，社会</td>
<td>不明确不受限的</td>
</tr>
<tr>
<td>失去注意力</td>
<td>一般不会</td>
</tr>
</tbody>
</table>

AI Drive = emulation trained learning machine with sophisticated knowledge base and perception agencies
谢谢