REPS and Third Wave AI: General Learning, Reasoning and Problem Solving

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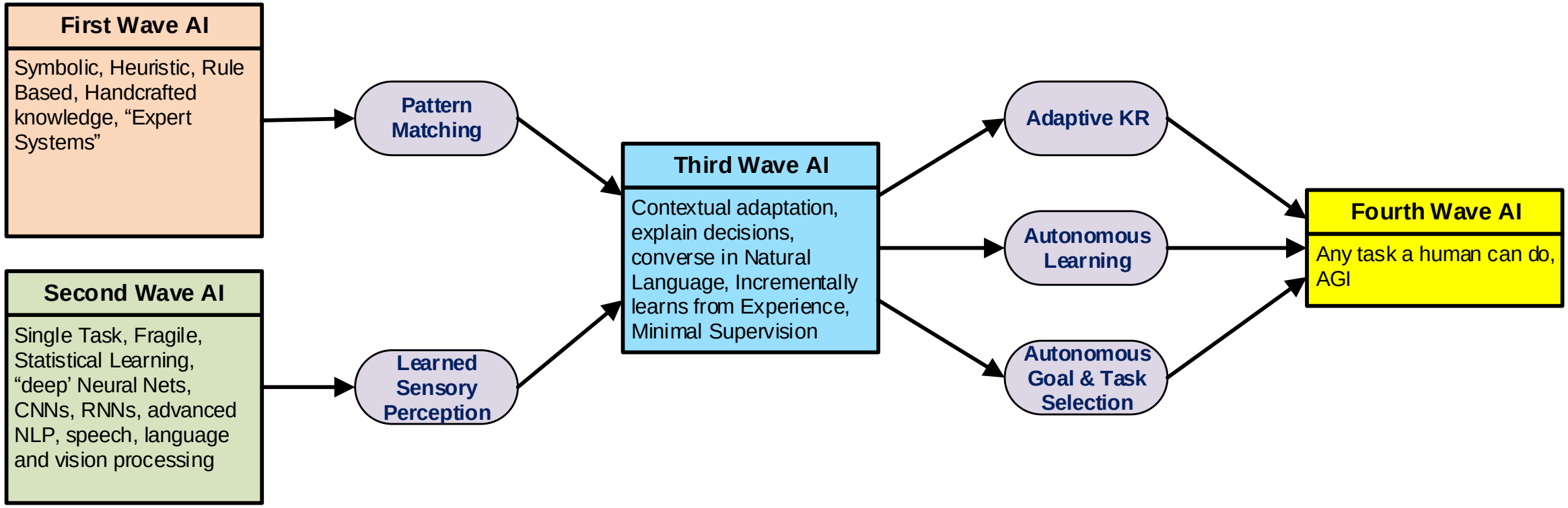
Topics Discussed

- AI Landscape
- Starting from First Principles
  - What is intelligence?
  - Consciousness and Time
  - Change, perception and memory
- General Learning, Reasoning and Problem Solving
  - Prediction: What can happen next?
  - Prescription: Choosing the best course;
    - What to do
    - How to do it
- Explainable AI

Contributions of each Wave of AI



What is intelligence?

There are many POV on this. So (for discussion sake) let's choose…

"Human intelligence is the intellectual capacity of humans, which is characterized by perception, consciousness, self-awareness, and volition.

Intelligence enables humans to remember descriptions of things and use those descriptions in future behaviors. It is a cognitive process.

It gives humans the cognitive abilities to learn, form concepts, understand, and reason, including the capacities to recognize patterns, comprehend ideas, plan, problem solve, and use language to communicate.

Intelligence enables humans to experience and think."

https://en.wikipedia.org/wiki/Intelligence

Breaking that definition down we have:

- **Perception**
  - Reading natural language text (this may be interactively) and then usefully retain what was read, and be able to “read between the lines”.
- **Consciousness**
  - awareness of itself and the world. Ability to experience one’s self
- **self-awareness**
  - the capacity for introspection and the ability to recognize oneself as an individual separate from the environment and other individuals.
- **Volition**
  - the act of willing, choosing, or resolving
- **remember descriptions of things**
  - Reference-able memory
- **use those descriptions in future behaviors**
  - Learn from experience
- **cognitive abilities to learn**
  - acquiring knowledge and understanding through thought, experience, and the senses.
- **Ability to form concepts**
  - Create distinctions by observation
- **Understand**
  - Map experience (e.g. language) to a cognitive model (i.e., world view)
- **Reason**
  - apply a set of reasoning methods to your understanding to create new understanding
- **recognize patterns**
  - Patterns in memory, patterns as experience
- **Plan**
  - Identify goals and determine a sequence of actions to achieve the goals
- **problem solve**
  - Recognize an unknown and apply different techniques to derive a solution
- **use language to communicate**
  - Not only read but write natural language

Consciousness and Time

- We experience consciousness through the passage of time.
- We experience time by noticing change.
- We experience change in two ways; (1) by noticing a change in the observer (ourselves) and (2) by noticing a change in the objects being observed.
- Either can change; and either can be noticed. But, at least one needs to happen for us to experience time.
- As far as consciousness is concerned, a change happens only when noticed. <I know, this sounds like “Schrödinger’s cat”.>
- Each change is a unit of consciousness; an event.

Change, perception and memory

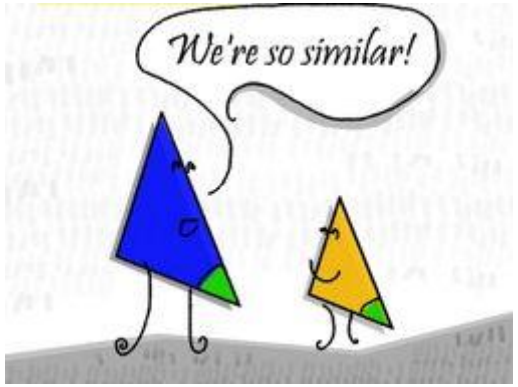
- We perceive and record the passage of time as a sequence of discrete events.
- These discrete events may appear “continuous” whenever we are unable to isolate each event individually.
- Each event has a preceding state and a succeeding state.
- We identify and classify events based on the relative similarity of preceding states and succeeding states.
- Whatever is required for an event to occur must be present in the preceding state.

General Learning, Reasoning and Problem Solving

A real-world situation has many influencing parts and real-world predictions have many resulting parts. REPS considers many influencing parts to produce many resulting parts.

Prediction: Learning from Experience

- A given state may be similar (to varying degrees) with one or more preceding states of previous events.
- A given state may be similar (to varying degrees) with one or more succeeding states of previous events.
- When we recognize the similarity of a given state to previously experienced preceding states, we are reminded of previous similar events. We start to expect an event or combination of events, or maybe a new event, similar (but not exactly the same) to one or more previous events.
- Our ability to identify and resolve the similarity of preceding and succeeding states is key to our ability to anticipate and navigate a [consistent and yet] dynamically changing world.
- This insight is a key to the Third Wave AI.



Prediction : What will happen Next?

- After identifying previous similar situations, we tend to expect similar outcomes from similar events.
- Similar outcomes may have both aspects in common and aspects that differ.
- The most common aspects are more likely to occur again.
- Across all similar situations the common aspects can be arranged in sets of common variations.
- These sets can be arranged in order based on descending commonality.
- What is left is to choose which outcome sets to consider for your purposes.

Prescription: Choosing the best course

- This comes down to two very related questions:
  1. What should be done?
  2. How to do it?
- By first determining what to change (change sets) to get the desired outcome, each associated set of actions for a change set can be evaluated for feasibility.
- This yields an ordered set of outcome-action-feasibilities.
- The most feasible set of actions that give the most desired outcome can be chosen. However some may be so similar as to be virtually equivalent.
- Event after taking into account the relative reliability of the situation data, you may need to simply choose a course based on non-situational preference.

Explainable AI

- Prediction Explanation
  - Explanation by Precedence
    - Each prediction is based on similarities to past events. An ordered list of the most closely matching previous experiences showing where they are similar and where they are different is provided.
  - Explanation by Possible Cause
    - Co-occurring patterns of facts that tend to lead to each prediction are identified. Based on the trained experiences, each combination of facts in this explanation represents predictors of part or all of the facts in the given Prediction.
- Prescription Explanation
  - For each prescription, the explanation identifies the previous experiences that contributed to identifying the recommended changes, as well as, the relative contribution of each Desirability Statement to the ordering of the Prescriptions.