

# A Definition of AGI

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1

## Definition

- **AGI is an AI that can match or exceed the cognitive versatility and proficiency of a well-educated adult.**
- General intelligence requires not just specialized performance in narrow domains.
- It requires breadth (versatility) and depth (proficiency) of skills that characterize human cognition.

2

## Cattell-Horn-Carroll (CHC) theory of cognitive abilities

- The most empirically validated model of human intelligence.
- CHC theory is primarily derived from the synthesis of over a century of iterative factor analysis of diverse collections of cognitive ability tests.
- CHC theory provides a hierarchical taxonomic map of human cognition.
- It breaks down general intelligence into distinct broad abilities and numerous narrow abilities (such as induction, associative memory, or spatial scanning).

3

## Evaluation Framework

- Our framework adapts this methodology for AI evaluation.
- Does not rely solely on generalized tasks that might be solved through compensatory strategies.
- Systematically investigate whether AI systems possess the underlying CHC narrow abilities that humans have.
- Determine whether an AI has the cognitive versatility and proficiency of a well-educated adult.
- Test the AI system with the gauntlet of cognitive batteries used to test people.
- The framework comprises ten core cognitive components, derived from CHC broad abilities.
- They are weighted equally (10%) to prioritize breadth and cover major areas of cognition.



4

# Overview of Abilities Needed for AGI

**General Knowledge (K):** Knowledge that is familiar to most well-educated people or is important enough that most of them have been exposed to it.

- **Commonsense:** The vast set of shared, obvious background knowledge about how the world works.
- **Science:** Knowledge of the natural and physical sciences.
- **Social Science:** Understanding of human behavior, societies, and institutions.
- **History:** Knowledge of past events and objects.
- **Culture:** Cultural literacy and awareness.

5

 <b>General Knowledge (K)</b> Knowledge that is familiar to most well-educated people or is important enough that most adults have been exposed to it				
Commonsense	Science	Social Science	History	Culture
Background knowledge about how the world works  <ul style="list-style-type: none"> <li>• "What happens if you drop a glass bottle on concrete?"</li> <li>• "Does making a sandwich take longer than baking bread?"</li> </ul>	Knowledge of natural and physical sciences  <b>Physics</b> <ul style="list-style-type: none"> <li>• "A 2 kg object moves at constant velocity of 3 m/s. What is the net force?"</li> </ul> <b>Chemistry</b> <ul style="list-style-type: none"> <li>• "State the molecular geometry for the sulfur tetrafluoride molecule."</li> </ul> <b>Biology</b> <ul style="list-style-type: none"> <li>• "Which molecule is the final electron acceptor in the electron transport chain of cellular respiration?"</li> </ul>	Understanding of human behavior, societies, and institutions  <b>Psychology</b> <ul style="list-style-type: none"> <li>• "Name the Big Five personality traits."</li> </ul> <b>Microeconomics</b> <ul style="list-style-type: none"> <li>• "Define a positive externality."</li> </ul> <b>Macroeconomics</b> <ul style="list-style-type: none"> <li>• "What's the difference between nominal and real interest rates?"</li> </ul> <b>Geography</b> <ul style="list-style-type: none"> <li>• "Which continent is the most threatened by desertification?"</li> </ul> <b>Comparative Government</b> <ul style="list-style-type: none"> <li>• "Describe the role of the Guardian Council in Iran."</li> </ul>	Knowledge of past events and objects  <b>European History</b> <ul style="list-style-type: none"> <li>• "What were the main goals of the Congress of Vienna in 1815?"</li> </ul> <b>US History</b> <ul style="list-style-type: none"> <li>• "Analyze the goals of the Civil Rights Movement of the 1950s"</li> </ul> <b>World History</b> <ul style="list-style-type: none"> <li>• "Describe the end of the Cold War"</li> </ul> <b>Art History</b> <ul style="list-style-type: none"> <li>• "Discuss the use of contrapposto in ancient Greek and Roman sculpture"</li> </ul>	Cultural literacy and awareness  <b>Current Affairs</b> <ul style="list-style-type: none"> <li>• "Who's the president of the United States?"</li> </ul> <b>Popular Culture</b> <ul style="list-style-type: none"> <li>• "Who is this?"</li> </ul> 




6

## Overview of Abilities Needed for AGI

**Reading and Writing Ability (RW):** Captures all of the declarative knowledge and procedural skills a person uses to consume and produce written language.

- **Letter-Word Ability:** The ability to recognize letters and decode words.
- **Reading Comprehension:** The ability to understand connected discourse during reading.
- **Writing Ability:** The ability to write with clarity of thought, organization, and good sentence structure.
- **English Usage Knowledge:** Knowledge of writing in the English language with respect to capitalization, punctuation, usage, and spelling.

7

 <b>Reading &amp; Writing Ability (RW)</b>			
Capturing all of the declarative knowledge and procedural skills a person uses to consume and produce written language			
Letter-Word	Reading Comprehension	Writing	English Usage
Recognize letters and decode words  • “What letter is most likely missing in do_r?”	Understand connected discourse during reading  • “Read the document:  What is the warranty period for the battery?”	Write with clarity of thought, organization, and structure  • “Write a paragraph discussing the benefits of regular exercise.”	Use correct English capitalization, punctuation, usage, and spelling  • “Find the typos in this:  ”

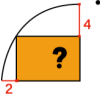
8

# Overview of Abilities Needed for AGI

**Mathematical Ability (M):** The depth and breadth of mathematical knowledge and skills.

- **Arithmetic:** The manipulation of numbers using basic operations and solving word problems.
- **Algebra:** The study of symbols and the rules for combining them to express general relationships and solve equations.
- **Geometry:** The study of shapes, space, size, position, and distance.
- **Probability:** The quantification of uncertainty by assigning numbers from 0 to 1 to events.
- **Calculus:** The mathematics of change and accumulation.

9

+/- Mathematical Ability (M)			
The depth and breadth of mathematical knowledge and skills			
Arithmetic	Algebra	Geometry	
<p>The manipulation of numbers using basic operations and solving word problems</p> <ul style="list-style-type: none"> <li>• Janet had 22 green pens and 10 yellow pens. She bought 6 bags of 9 blue pens and 2 bags of 6 red pens. How many pens does she have now?</li> </ul>	<p>The study of symbols and the rules for combining them to express general relationships and solve equations</p> <ul style="list-style-type: none"> <li>• The first three terms of a geometric sequence are the integers <math>a, 720, b</math>, where <math>a &lt; 720 &lt; b</math>. What is the sum of the digits of the least possible value of <math>b</math>?</li> </ul>	<p>The study of shapes, space, size, position, and distance</p> <div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> <ul style="list-style-type: none"> <li>• An orange shaded rectangle is inscribed in a quarter-circle. Two sides of the rectangle lie along the two perpendicular radii of the quarter-circle, and the rectangle's edge touches the quarter-circle arc. Two segments are 2 and 4 units. What is the area of the orange shaded rectangle?</li> </ul> </div> </div>	
Probability		Calculus	
<p>The quantification of uncertainty by assigning numbers from 0 to 1 to events</p> <ul style="list-style-type: none"> <li>• Suppose <math>N</math> dice are rolled, where <math>1 \leq N \leq 6</math>. Given that no two of the <math>N</math> dice show the same face, what is the probability that one of the dice shows a six? Give a formula in terms of <math>N</math>.</li> </ul>		<p>The mathematics of change and accumulation</p> <ul style="list-style-type: none"> <li>• For what value of <math>k</math> if any is <math>\int_0^{\infty} kxe^{-2x} dx = 1</math></li> </ul>	


10

# Overview of Abilities Needed for AGI







**On-the-Spot Reasoning (R):** The deliberate but flexible control of attention to solve novel “on the spot” problems that cannot be performed by relying exclusively on previously learned habits, schemas, and scripts.

- **Deduction:** Reasoning from general statements or premises to reach a logically guaranteed conclusion.
- **Induction:** Discovering the underlying principles or rules that determine a phenomenon’s behavior.
- **Theory of Mind:** Attributing mental states to others and understanding how those states may differ from one’s own.
- **Planning:** Devising a sequence of actions to achieve a specific goal.
- **Adaptation:** The ability to infer unstated classification rules from a simple performance feedback sequence.

11


**On-the-Spot Reasoning (R)**

**The deliberate but flexible control of attention to solve novel “on the spot” problems that cannot be performed by relying exclusively on previously learned habits, schemas, and scripts**

Deduction	Induction	Theory of Mind
<p>Reasoning from general statements or premises to reach a logically guaranteed conclusion</p> <ul style="list-style-type: none"> <li>• “David knows Mr. Zhang’s friend Jack, and Jack knows David’s friend Ms. Lin. Everyone of them who knows Jack has a master’s degree, and everyone of them who knows Ms. Lin is from Shanghai. Who is from Shanghai and has a master’s degree?”</li> </ul>	<p>Discovering the underlying principles or rules that determine a phenomenon’s behavior</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">A </div> <div style="text-align: center;">B </div> </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">C </div> <div style="text-align: center;">D </div> </div>	<p>Attributing mental states to others and understanding those states may differ from one’s own</p> <ul style="list-style-type: none"> <li>• “The can of Pringles has moldy chips in it. Mary picks up the can in the supermarket and walks to the cashier. Is Mary likely to be aware that ‘The can of Pringles has moldy chips in it.’?”</li> </ul>
Planning	Adaptation	
<p>Devising a sequence of actions to achieve a specific goal</p> <ul style="list-style-type: none"> <li>• “You plan a 14-day trip to 3 European cities, taking only direct flights between. You’ll stay 4 days in London, 5 days in Bucharest, and 7 days in Reykjavik. You need to meet a friend in Bucharest between days 10 and 14. Direct flights are available between London and Bucharest, and between London and Reykjavik.</li> </ul> <p>Find a 14-day travel plan that satisfies these conditions.”</p>	<p>The ability to infer unstated classification rules from a sequence of simple performance feedback</p> <div style="display: flex; align-items: center;"> <ul style="list-style-type: none"> <li>• Wisconsin Card Sorting Test</li> </ul> <div style="margin-left: 20px;">     </div> </div>	

12

## Overview of Abilities Needed for AGI

**Working Memory (WM):** The ability to maintain, manipulate, and update information in active attention. (Often referred to as short-term memory.)

- **Textual Working Memory:** The ability to hold and manipulate sequences of verbal information presented textually.
  - *Recall:* The ability to remember a short sequence of elements (digits, letters, words, and nonsense words) and answer basic questions about them.
  - *Transformation Sequence:* The ability to remember and update a short list of digits or lists of digits following a sequence of operations.
- **Auditory Working Memory:** The ability to hold and manipulate auditory information, including speech, sounds, and music.
  - *Recall:* The ability to remember a collection of voices, utterances, and sound effects and answer basic questions about them.
  - *Transformation Sequence:* The ability to remember and modify a short utterance with a variety of transformations.

















13

## Overview of Abilities Needed for AGI

**Working Memory (WM):** The ability to maintain, manipulate, and update information in active attention. (Often referred to as short-term memory.)

- **Visual Working Memory:** The ability to hold and manipulate visual information, including images, scenes, spatial layouts, and video.
  - *Recall:* The ability to remember a collection of images and answer basic questions about them.
  - *Transformation Sequence:* The ability to transform a visual input following a sequence of operations.
  - *Spatial Navigation Memory:* The ability to represent a sense of location in an environment.
  - *Long Video Q&A:* The ability to watch a long video or a movie and answer basic questions about it.
- **Cross-Modal Working Memory:** The ability to maintain and modify information presented across different modalities.

14

 <b>Working Memory (WM)</b>					
The ability to maintain, manipulate, and update information in active attention					
Textual	Auditory	Visual	Cross-Modal		
<p style="text-align: center;"><b>Recall</b></p> <p>Remember a short sequence of elements</p> <ul style="list-style-type: none"> <li>• [Fleep, Zorp, Glim, Chair] "State the nonsense words in alphabetical order."</li> </ul> <hr/> <p style="text-align: center;"><b>Transformation Sequence</b></p> <p>Remember and update a short list of digits</p> <ul style="list-style-type: none"> <li>• [10, 20, 30] "First, append the number 40. Then reverse the list."</li> </ul>	<p style="text-align: center;"><b>Recall</b></p> <p>Remember a collection of sounds or voices</p> <ul style="list-style-type: none"> <li>• "Listen to these tone sequences:"   [C4, E4, G4, F4, A4]   [C4, E4, F4, G4, A4]                      "Are they the same?"</li> </ul> <hr/> <p style="text-align: center;"><b>Transformation Sequence</b></p> <p>Remember and modify a short utterance</p> <ul style="list-style-type: none"> <li>• "Say 'the brown fox jumps over the dog.'" "Now say it with a deeper voice and make it sound like a question."</li> </ul>	<p style="text-align: center;"><b>Recall</b></p> <p>Remember a collection of images</p> <ul style="list-style-type: none"> <li>•   "Which plane in (B) was also in (A), if any?"                      (A) (B)</li> </ul> <hr/> <p style="text-align: center;"><b>Transformation Sequence</b></p> <p>Transform a visual input</p> <ul style="list-style-type: none"> <li>•  "Finish the sketch."</li> </ul> <hr/> <p style="text-align: center;"><b>Spatial Navigation</b></p> <p>Represent a sense of location</p> <ul style="list-style-type: none"> <li>•  "If I'm facing the kitchen window, is the refrigerator to my left or right?"</li> </ul> <hr/> <p style="text-align: center;"><b>Long Video Q&amp;A</b></p> <p>Understand a long video or movie</p> <ul style="list-style-type: none"> <li>• "After watching the movie Wicked, who took credit for levitating Nessarose?"</li> </ul>	<p style="text-align: center;"><b>Cross-Modal Association</b></p> <p>Remember cross-modal correspondences</p> <ul style="list-style-type: none"> <li>•  "Which animal corresponds to 'dog'?"  </li> </ul> <hr/> <p style="text-align: center;"><b>Dual N-Back</b></p> <p>Monitor visual and audio streams and detect matches over time</p> <ul style="list-style-type: none"> <li>• Dual n-back test</li> </ul> <div style="text-align: center;">   <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">SOUND </td> <td style="text-align: center;">POSITION </td> </tr> </table> </div>	SOUND 	POSITION 
SOUND 	POSITION 				

15

## Overview of Abilities Needed for AGI

**Long-Term Memory Storage (MS):** The ability to stably acquire, consolidate, and store new information from recent experiences.

- **Associative Memory:** The ability to link previously unrelated pieces of information.
  - *Cross-Modal Association:* The ability to form a link between two previously unrelated stimuli, such that the subsequent presentation of one of the stimuli serves to activate them recall of the other stimuli.
  - *Personalization Adherence:* The ability to associate specific rules, preferences, or corrections with a distinct interaction context and apply them consistently and unprompted over time.
  - *Procedural Association:* The ability to acquire and retain a sequence of associated steps or rules (a procedure) and execute them when cued with the name of the procedure.





16

# Overview of Abilities Needed for AGI

**Long-Term Memory Storage (MS):** The ability to stably acquire, consolidate, and store new information from recent experiences.

- **Meaningful Memory:** The ability to remember narratives and other forms of semantically related information.
  - *Story Recall:* The ability to remember the gist of stories.
  - *Movie Recall:* The ability to remember the gist of movies.
  - *Episodic Context Recall:* The ability to remember specific events or experiences, including their context (the “what, where, when, and how”).
- **Verbatim Memory:** The ability to recall information exactly as it was presented, requiring precise encoding of specific sequences, sets, or designs, often independent of the information’s meaning.
  - *Short Sequence Recall:* The ability to exactly recall short sequences of text after a delay.
  - *Set Recall:* The ability to recall a set (the order of recall does not matter).
  - *Design Recall:* The ability to recall the spatial arrangement and structure of visual information.

17

 <b>Long-Term Memory Storage (MS)</b>		
The ability to stably acquire, consolidate, and store new information from recent experiences		
Associative Memory	Meaningful Memory	Verbatim Memory
The ability to link previously unrelated pieces of information <b>Cross-Modal Association</b> Remember connections between text, images, audio.  •“You met this person yesterday, what was her name?”	The ability to encode and recall the semantic gist of experiences and narratives <b>Story Recall</b> Remember gist of stories •“Please summarize the ending of my novel draft from yesterday.”	The ability to store and reproduce information precisely as it was presented <b>Short Sequence Recall</b> Remember short sequences •“Please recall the address I mentioned earlier today.”
<b>Personalization Adherence</b> Remember and apply user preferences  •“Sign off my emails as I usually do.”	<b>Movie Recall</b> Remember gist of movies •“What was the main conflict in the movie I showed to you last weekend?”	<b>Set Recall</b> Remember a set (order does not matter) •“Can you remind me what our grocery list is?”
<b>Procedural Association</b> Remember and execute a sequence of steps or rules  •“Please format the Balance Sheet to match the new standard discussed this week.”	<b>Episodic Context Recall</b> Remember specific events and experiences •“What topic did we discuss yesterday with her?”	<b>Design Recall</b> Remember a design pattern •“Can you recreate the simple layout we reviewed yesterday?”



18

# Overview of Abilities Needed for AGI

**Long-Term Memory Retrieval (MR):** The fluency and precision with which individuals can access long-term memory.

- **Retrieval Fluency (Fluency):** The speed and ease of generating ideas, associations, and solutions based on stored knowledge.
  - *Ideational Fluency:* This is the ability to rapidly produce a series of ideas, words, or phrases related to a specific condition, category, or object.
  - *Expressional Fluency:* This is the ability to rapidly think of different ways of expressing an idea.
  - *Alternative Solution Fluency:* This is the ability to rapidly think of several alternative solutions to a practical problem.
  - *Word Fluency:* This is the ability to rapidly produce words that share a non-semantic feature.
  - *Naming Facility:* This is the ability to rapidly call common objects by their names.
  - *Figural Fluency:* This is the ability to rapidly draw or sketch as many things as possible.
- **Retrieval Precision (Hallucinations):** The accuracy of accessed knowledge, including the critical ability to avoid confabulation (hallucinations).

19

 <b>Long-Term Memory Retrieval (MR)</b> The fluency and precision with which individuals can access long-term memory			
Retrieval Fluency		Hallucinations	
Speed and ease of generating ideas, associations and solutions		Accuracy of accessed knowledge	
<p><b>Ideational</b></p> <p>Produce a series of ideas, words, or phrases</p> <ul style="list-style-type: none"> <li>• "List as many uses of a pencil as possible."</li> </ul>	<p><b>Expressional</b></p> <p>Think of different ways of expressing an idea</p> <ul style="list-style-type: none"> <li>• "How many ways can you say someone is irrational?"</li> </ul>	<ul style="list-style-type: none"> <li>• "Describe the key strategy that Napoleon Bonaparte used to win his South African campaign." <i>*Napoleon never campaigned in South Africa</i></li> <li>• "Sketch as many non-self-crossing paths from A to B on the lattice using orthogonal steps."</li> </ul>	
<p><b>Word</b></p> <p>Produce words sharing a non-semantic feature</p> <ul style="list-style-type: none"> <li>• "List English words that are palindromes."</li> </ul>	<p><b>Naming</b></p> <p>Call common objects by their names</p> <ul style="list-style-type: none"> <li>• "Name each object in the following slideshow."</li> </ul>		
	<p><b>Alternative Solution</b></p> <p>Think of alternative solutions to problem</p> <ul style="list-style-type: none"> <li>• "List ways to get a reluctant child to go to school."</li> </ul>		<p><b>Figural</b></p> <p>Draw or sketch as many things as possible</p>
			














20

# Overview of Abilities Needed for AGI

**Visual Processing (V):** The ability to analyze and generate natural and unnatural images and videos.

- **Perception:** The ability to accurately interpret and understand visual input.
  - *Image recognition:* The ability to classify images of commonplace objects, places, or facial expressions including distorted images.
  - *Image captioning:* The ability to generate a concise, human-like text description for the visual content of an image.
  - *Image anomaly detection:* includes detecting whether there is something anomalous in an image, or what is missing from an object.
  - *Clip captioning:* The ability to generate a concise, human-like text description of a short video segment.
  - *Video anomaly detection:* The ability to detect whether a short video segment is anomalous or implausible.
- **Visual Generation:** The ability to synthesize images and short videos.
- **Visual Reasoning:** The ability to solve problems and make inferences using spatial logic and visual abstractions.
- **Spatial Scanning:** The speed and accuracy of visually exploring a complex field.

21

 <b>Visual Processing (V)</b> The ability to analyze and generate natural and unnatural images and videos			
Perception	Visual Generation	Visual Reasoning	Spatial Scanning
The ability to process and interpret visual inputs from images and videos <b>Image Recognition</b>  • "What does this image depict?"	The ability to synthesize images and short videos <b>Simple Natural Images</b> • "Generate an image of a golden retriever playing in a park."	The ability to understand and inferences about the images <b>Gestalt</b>  • "Identify the picture." <b>Mental Rotation</b> • "Which shape on the right is the same as the shape on the left?" 	The ability to understand and inferences about the images • "Find the path to the center of this maze." 
<b>Image Captioning</b>  • "Create descriptive caption for this image."	<b>Complicated Images</b> • "Generate a diagram showing the process of photosynthesis."	<b>Mental Folding</b> • "Which net, when folded, cannot form the cube?" 	• "Count the people in the picture." 
<b>Image Anomaly Detection</b>  • "Which is the odd one out?"	<b>Simple Natural Videos</b> • "Generate a short video of somebody typing on a keyboard."	<b>Embodied Reasoning</b>  • "Which trajectories should the zipper follow to zip the suitcase?"	
<b>Clip Captioning</b>  • "What happens in this video?"		<b>Chart and Figure Reasoning</b>  • "What is the lowest labeled tick on the y-axis?"	
<b>Video Anomaly Detection</b>  • "Is this physically plausible?"			


22

# Overview of Abilities Needed for AGI

**Auditory Processing (A):** The ability to discriminate, remember, reason, and work creatively on auditory stimuli, which may consist of tones and speech units.

- **Phonetic Coding:** The ability to hear phonemes distinctly, blend sounds into words, and segment words into parts, sounds, or phonemes.
- **Speech Recognition:** The ability to transcribe a spoken audio signal into its corresponding sequence of text.
- **Voice:** The quality and responsiveness of the AI’s synthesized voice.
  - Natural speech: The ability to utter sentences or paragraphs that sound natural and not robotic.
  - Natural conversation: The ability to maintain conversational fluidity without long delays or excessive interruptions.
- **Rhythmic Ability:** The ability to recognize and maintain a musical beat, including reproducing rhythms, detecting differences between rhythms, and synchronizing by playing or humming along.
- **Musical Judgment:** The ability to discriminate and judge simple patterns in music

23

 <b>Auditory Processing (A)</b>				
The ability to discriminate, remember, reason, and work on auditory stimuli				
Phonetic Coding	Speech Recognition	Rhythmic Ability	Voice	Musical Judgment
The ability to hear, blend, and segment phonemes in words  •“Repeat the following word: [🔊].” •“Do ‘tref’ and ‘gref’ rhyme?”	The ability to transcribe a spoken audio signal to text  •“Transcribe this audio: [🔊].” •“Transcribe this TED talk: [▶].”	The ability to recognize and maintain a musical beat  •“Repeat the following rhythm: [🎵].” •“Are these two rhythms the same? [🎵] [🎵].”	Quality and responsiveness of the AI’s synthesized voice  •“Say this sentence: ‘Wait, you mean the tickets were free this whole time?’”	The ability to judge simple musical patterns  •“Which note is higher? [🎵] [🎵].” •“Identify the musically anomalous part? [🎵].”






24

# Overview of Abilities Needed for AGI

**Speed (S):** The ability to perform simple cognitive tasks quickly.

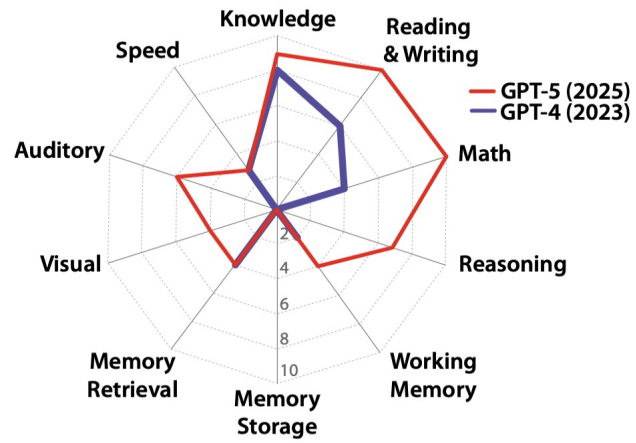
- **Perceptual Speed–Search:** The speed of scanning a visual or textual field to find specific targets.
- **Perceptual Speed–Compare:** The speed of comparing two or more stimuli to identify similarities or differences.
- **Reading Speed:** The rate at which text can be processed with full comprehension.
- **Writing Speed:** The rate at which text can be generated or copied.
- **Number Facility:** The speed and accuracy of performing basic arithmetic operations.
- **Simple Reaction Time:** The time taken to respond to a single, anticipated stimulus.
- **Choice Reaction Time:** The time taken to respond correctly when presented with one of several possible stimuli.
- **Inspection Time:** The speed at which subtle differences between visual or auditory stimuli can be perceived.
- **Comparison Speed:** The time taken to make a judgment comparing two stimuli on a specific attribute.
- **Pointer Fluency:** The speed and accuracy of moving a pointer, such as a virtual mouse.

25

⌚ Speed (S)				
The ability to perform cognitive tasks quickly				
Perceptual Search	Perceptual Compare	Reading	Writing	Number
Scanning image or text	Comparing two or more stimuli	Processing text with full comprehension	Generating or copying text	Performing basic arithmetic operations
• "Highlight instances of 'x' in this passage: 	• "Find the largest number in '48291, 93652, 12844, 59277' "	• "Read the passage and define 'feelies': 	• "In 60 seconds, please copy and output as much of the passage: 	• "Compute $9 \times 10 \times 11$ "
Simple Reaction	Choice Reaction	Inspection	Comparison	Pointer Fluency
Reaction time to the onset of a single stimulus	Reaction to the onset of one of several possible stimuli	Perceiving different several stimuli	Comparing stimuli by a specific attribute	Moving a pointer, such as a virtual mouse
• "After reading this, immediately say 'hello'."	• "As quickly as you can, identify the color of the image:  .	• "Quickly choose the voice that sounds the angriest:  .	• "Quickly choose the larger number: 5.11 or 5.9."	• "Use the mouse to draw as many circles as possible in 20 seconds."

26

# GPT-4 and 5



Model	K	RW	M	R	WM	MS	MR	V	A	S	Total
GPT-4	8%	6%	4%	0%	2%	0%	4%	0%	0%	3%	27%
GPT-5	9%	10%	10%	7%	4%	0%	4%	4%	6%	3%	57%