

Assignment Project Exam Help

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Wrap-Up

Lesson Preview

- Major topics revisited
- Principles of KBAI revisited
- Modern KBAI research
- Final thoughts

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Cognitive System

Metacognition

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Reasoning

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Learning

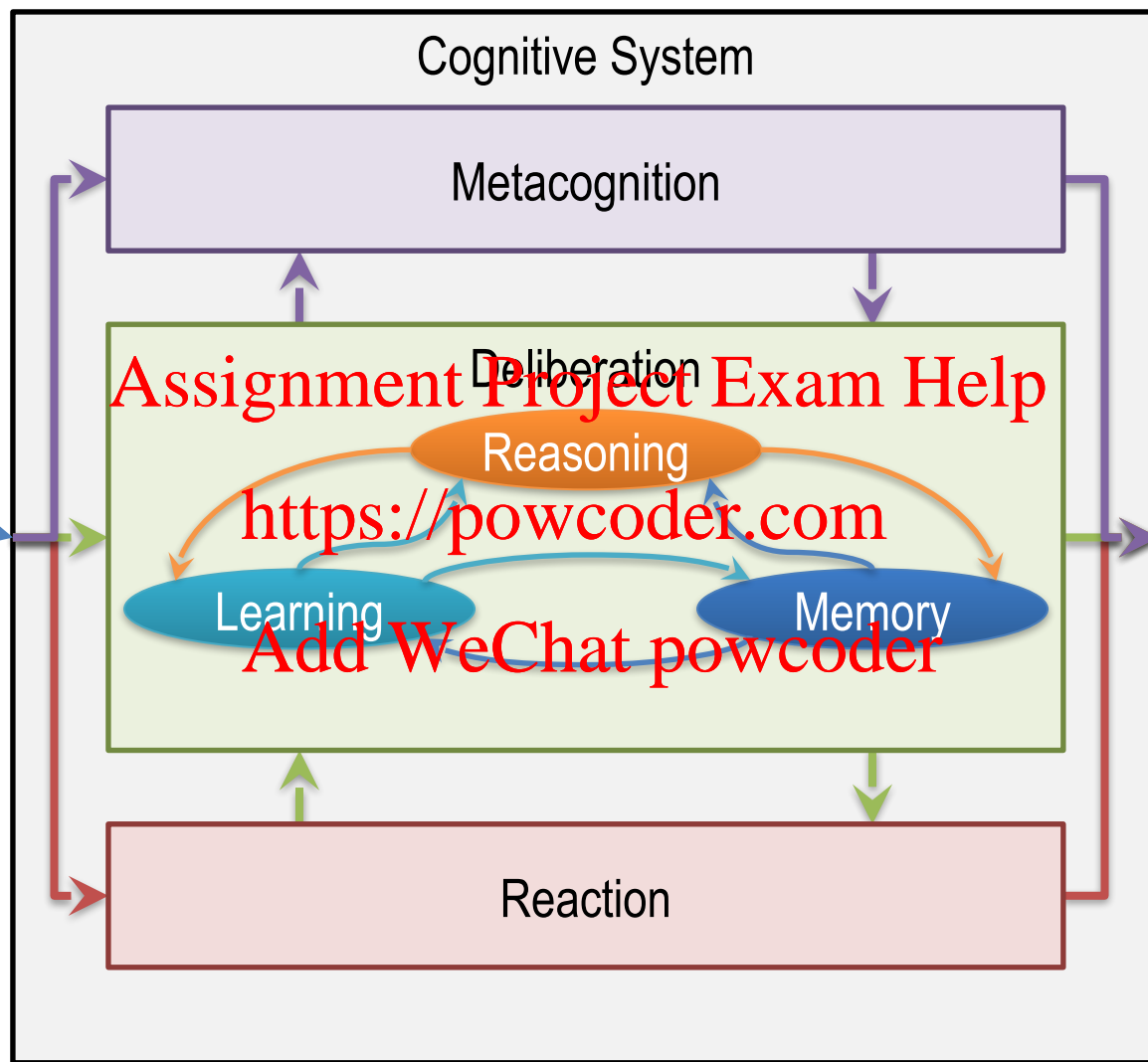
Memory

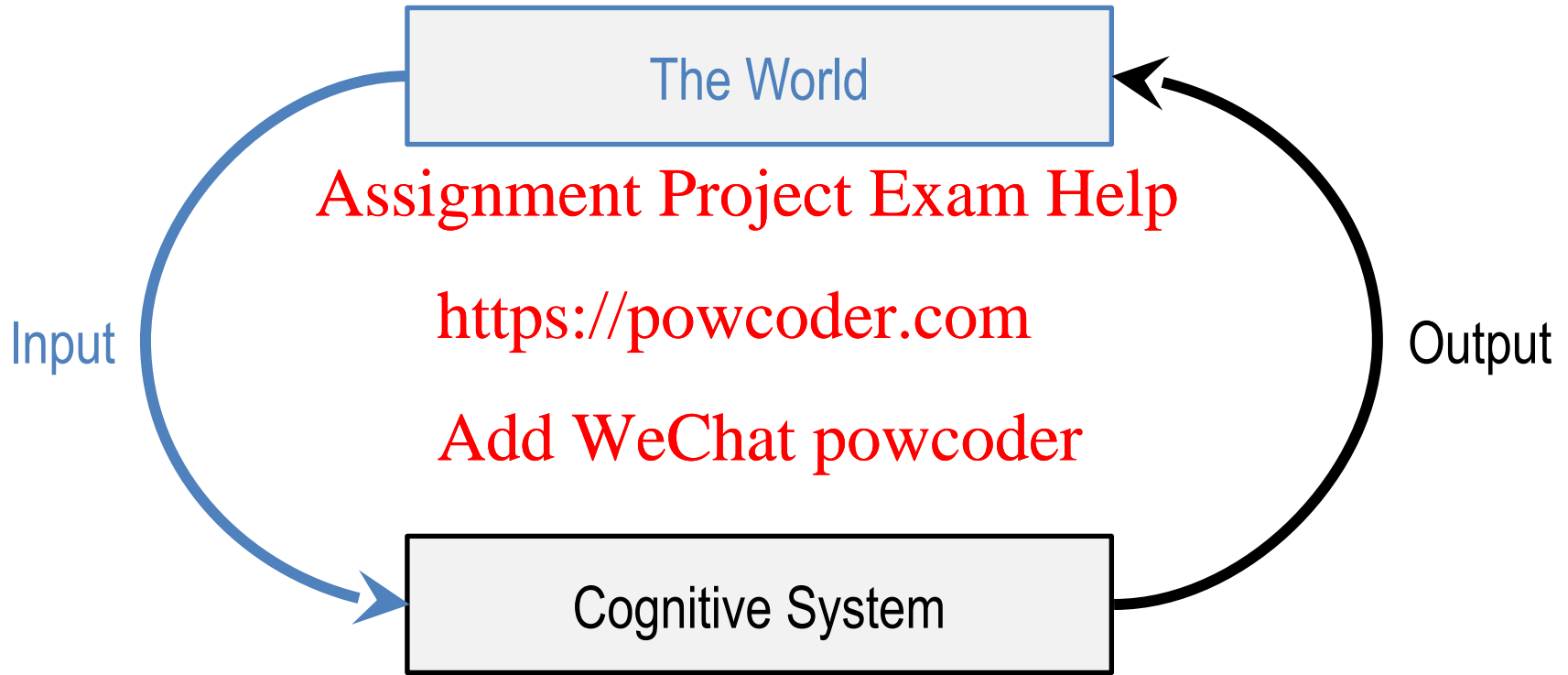
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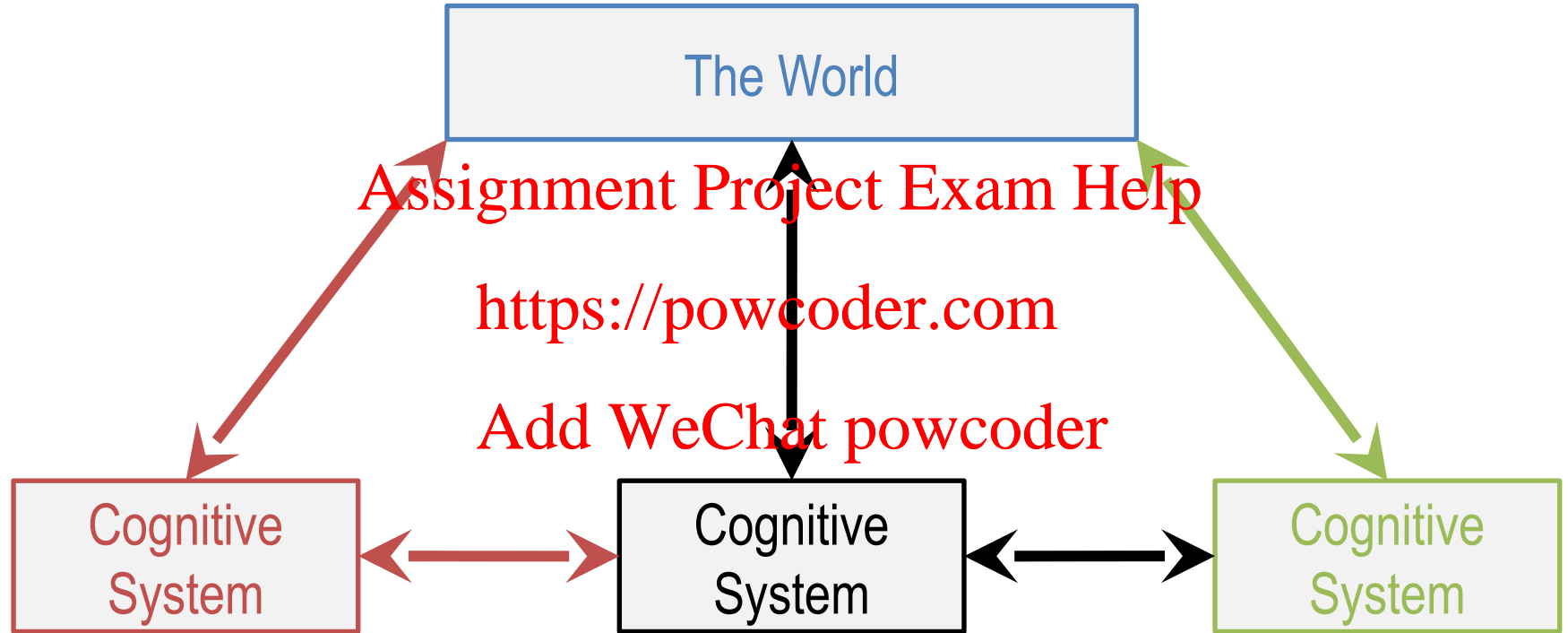
Reaction

Input

Output

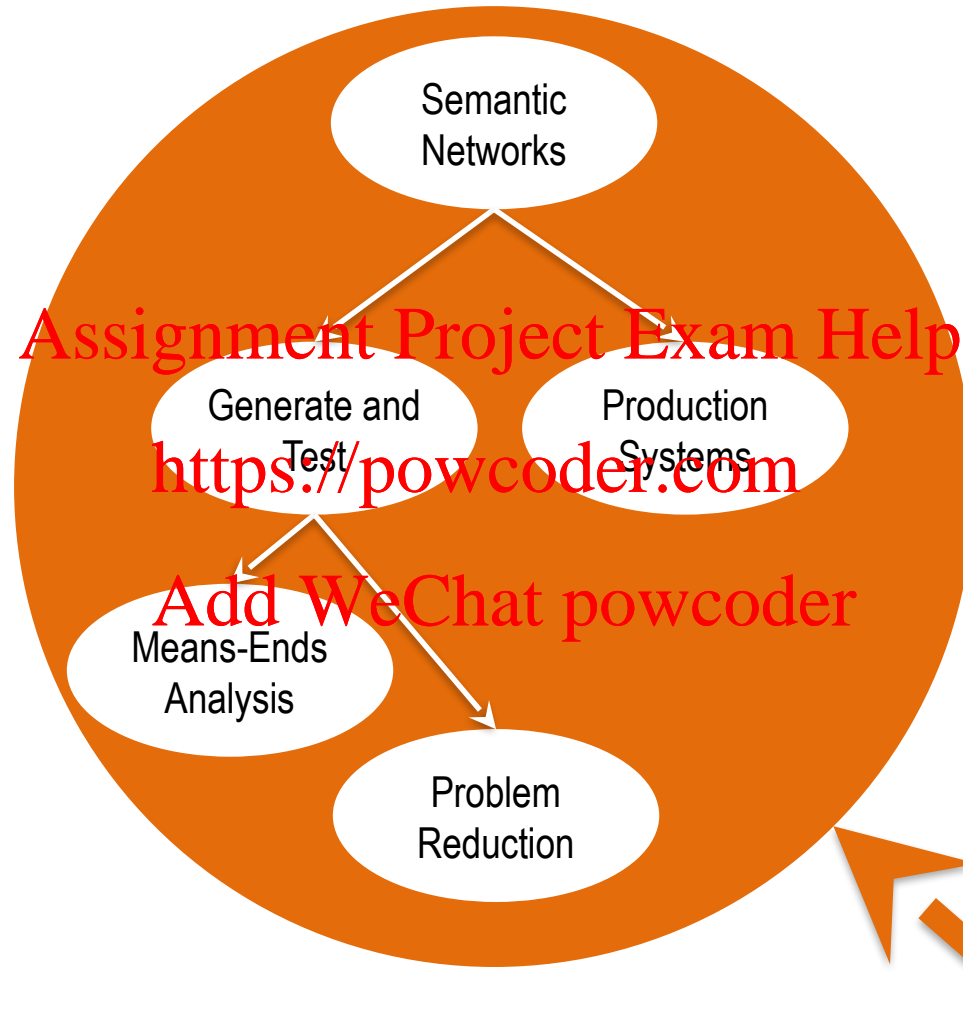








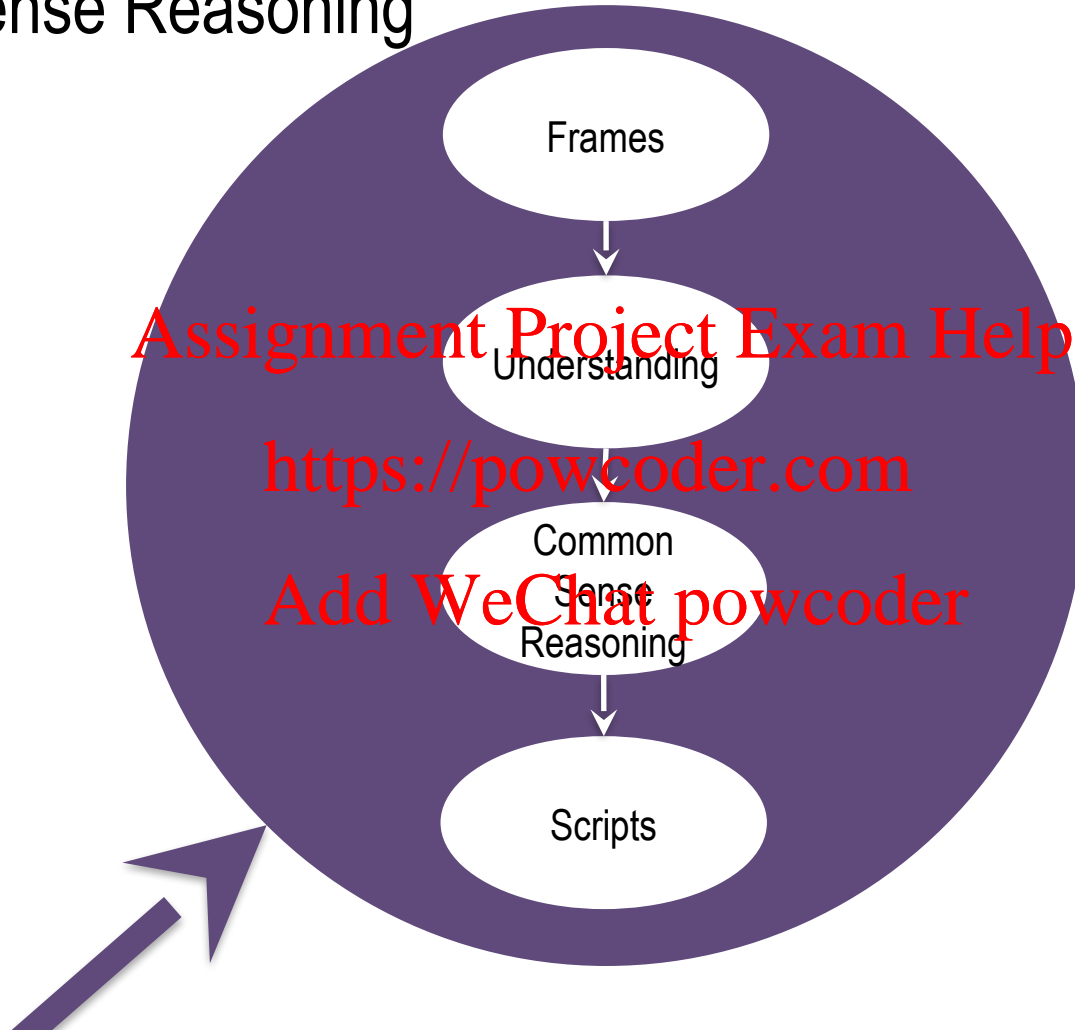
Fundamentals



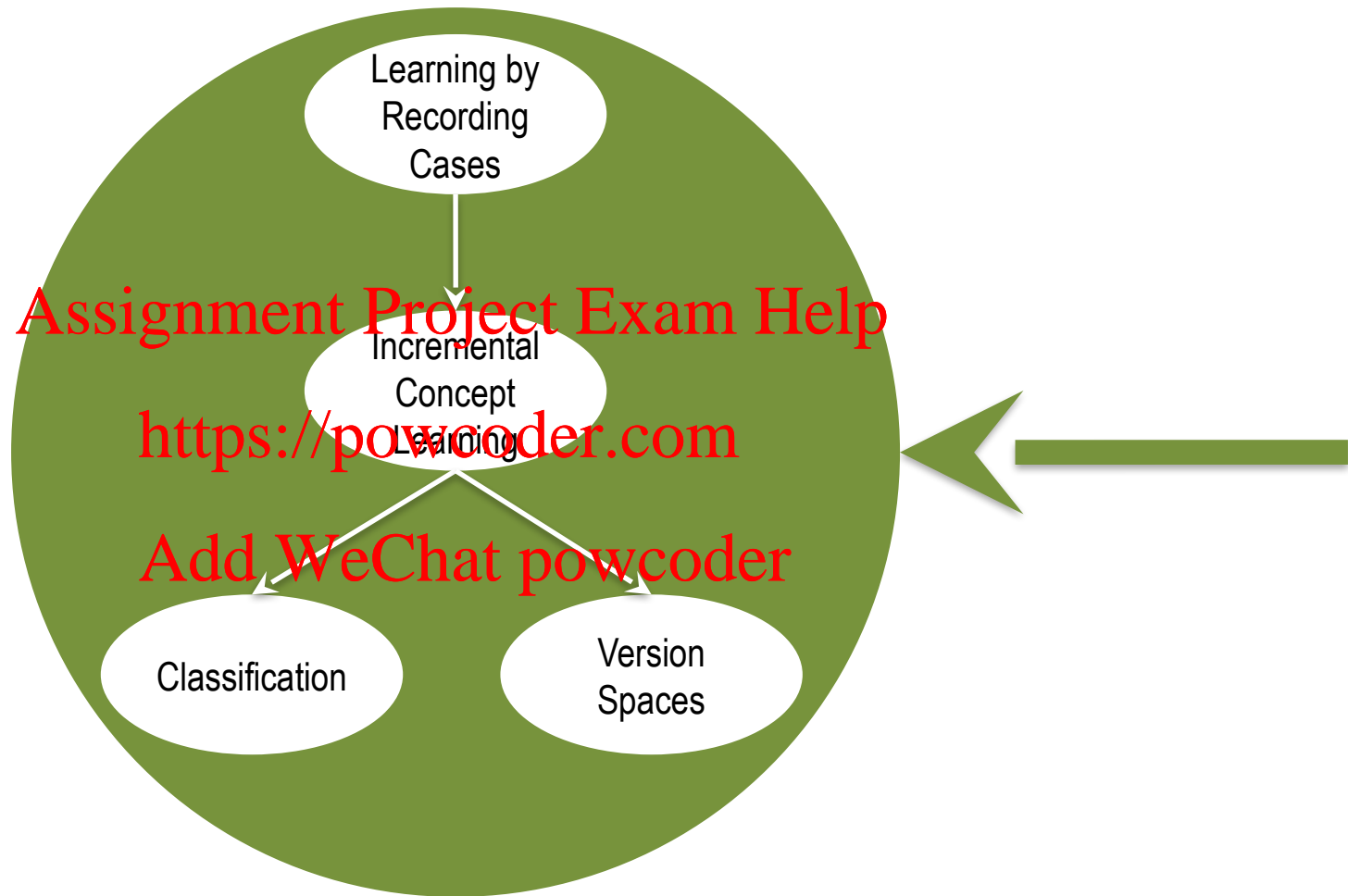
Planning



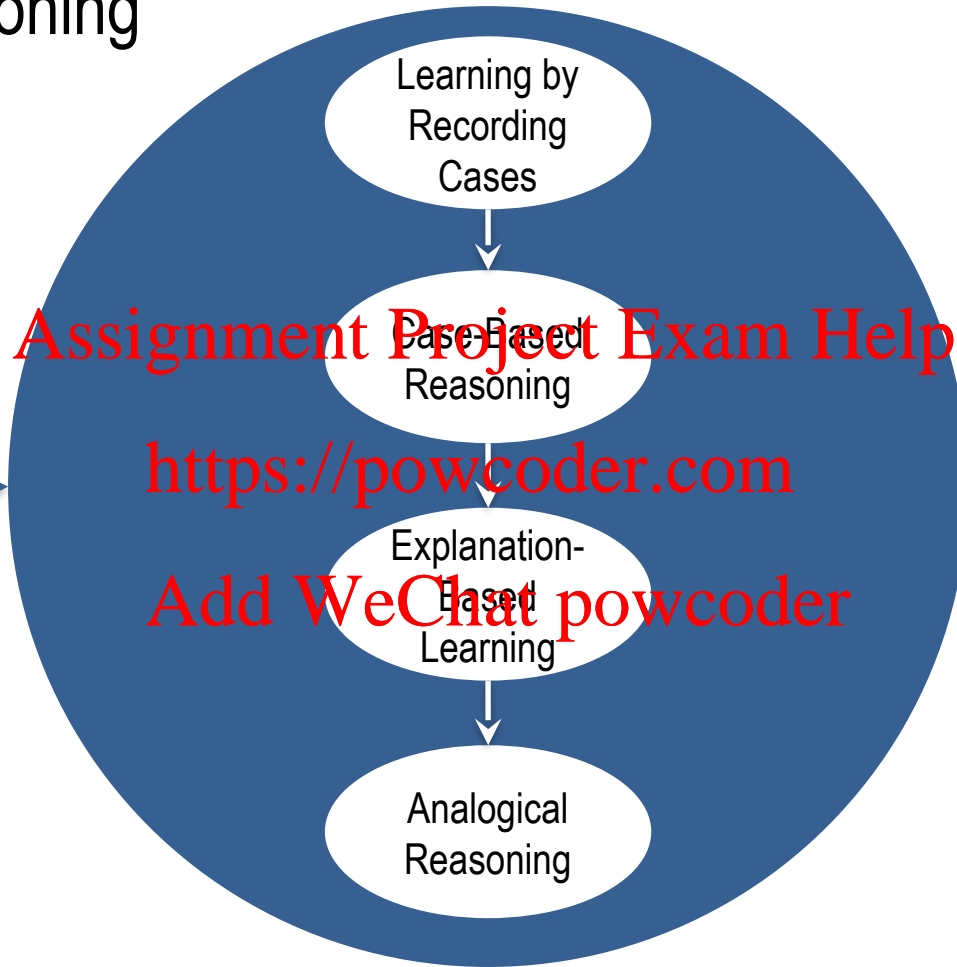
Common Sense Reasoning



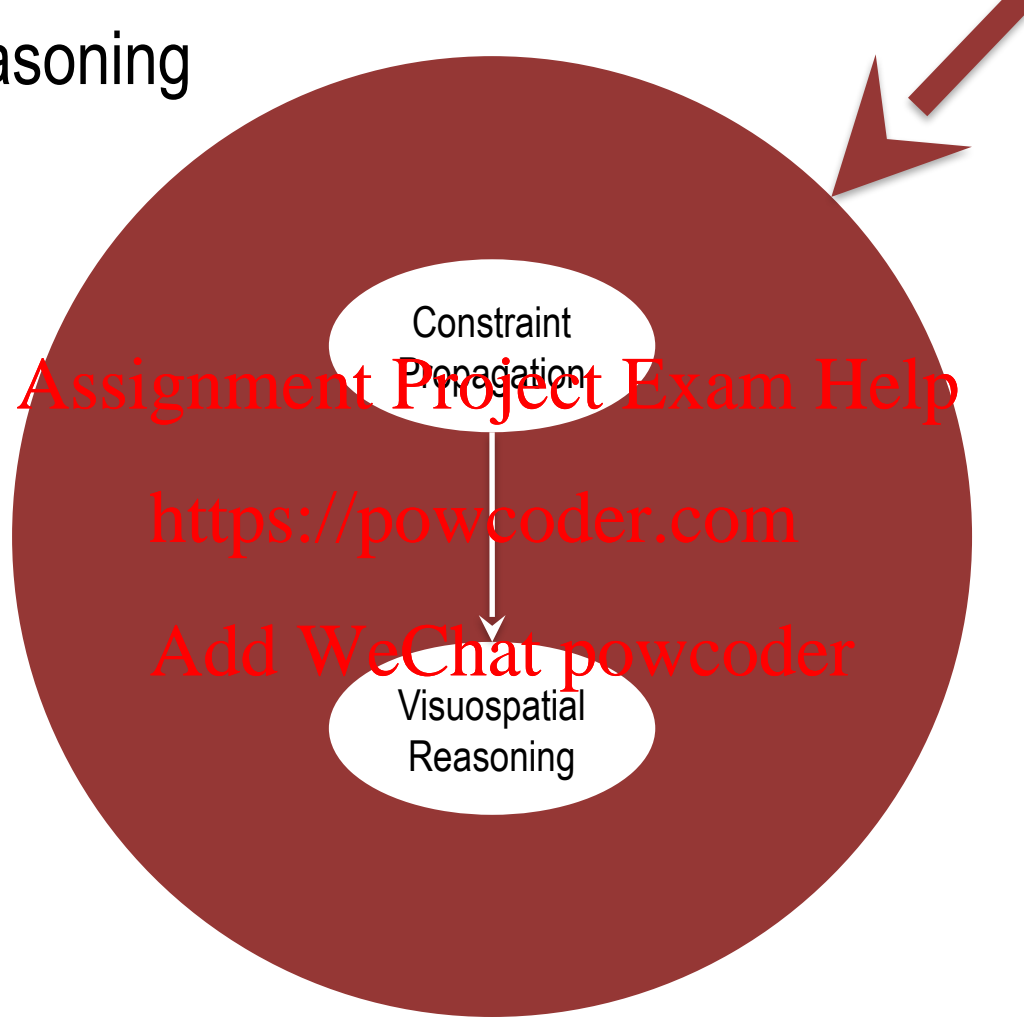
Learning



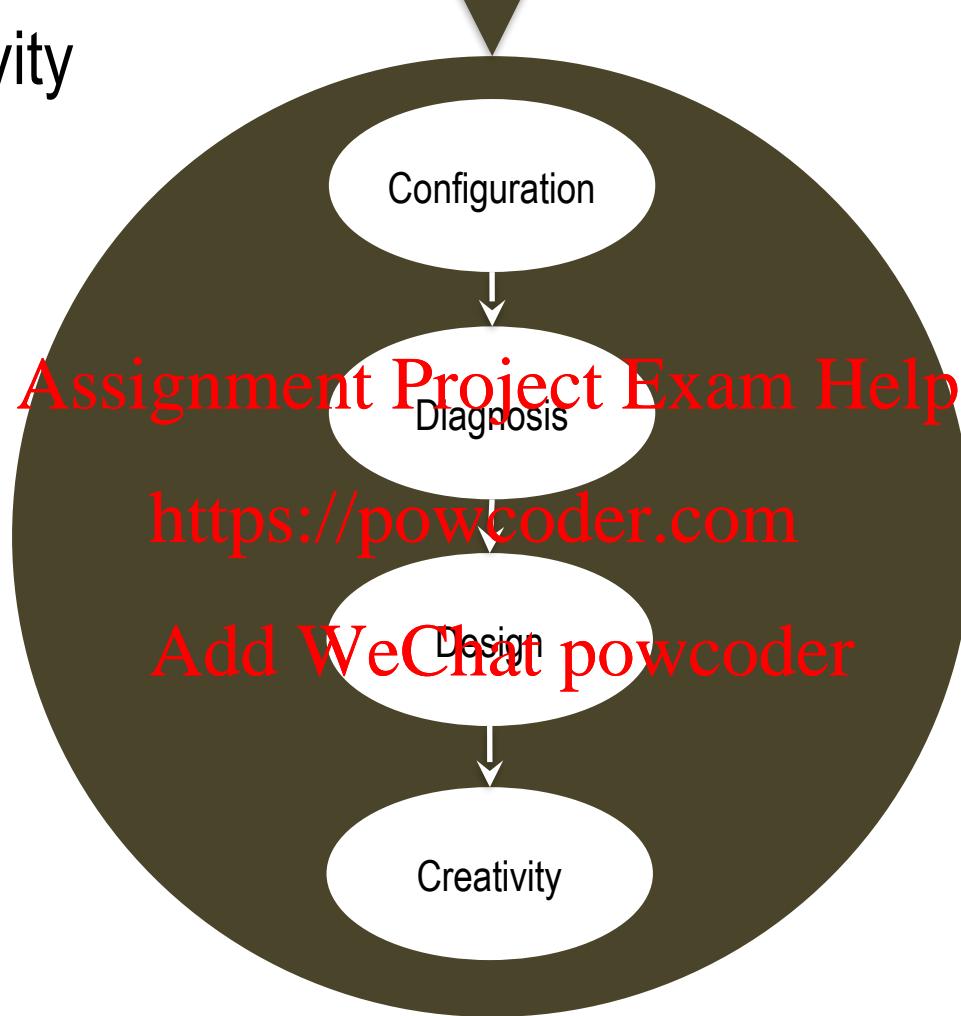
Analogical Reasoning



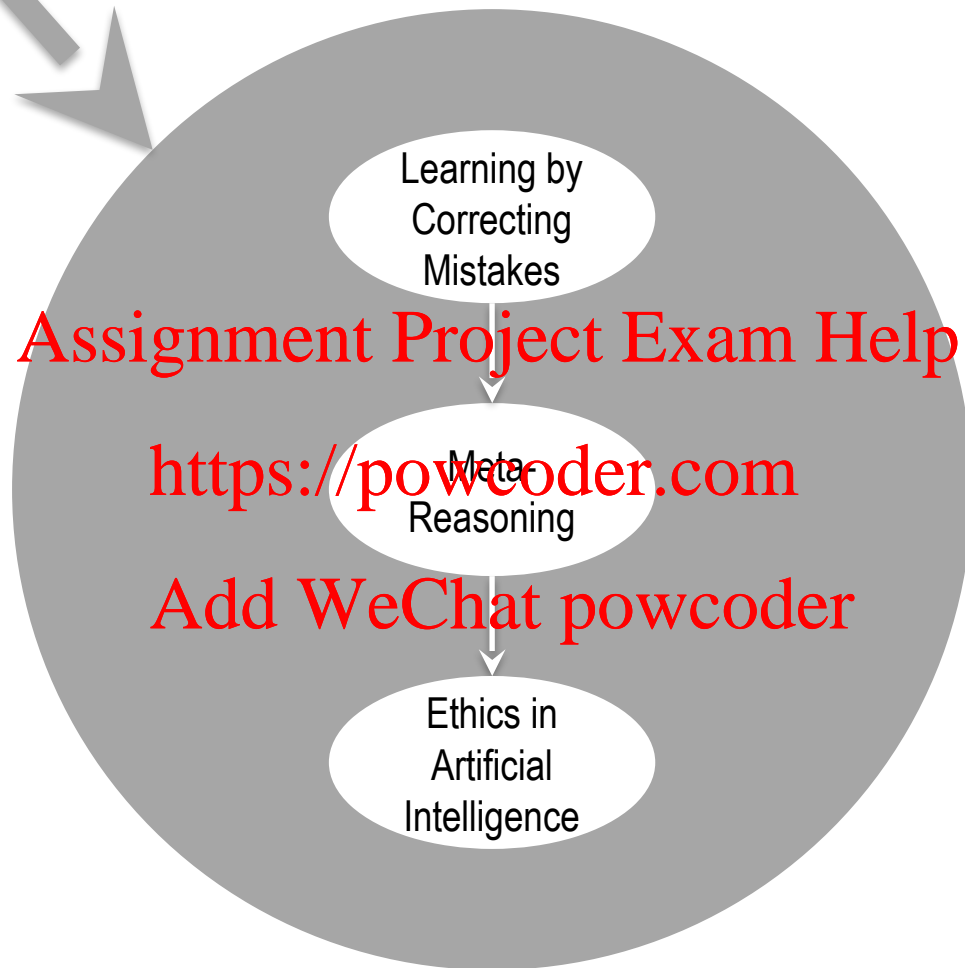
Visuospatial Reasoning



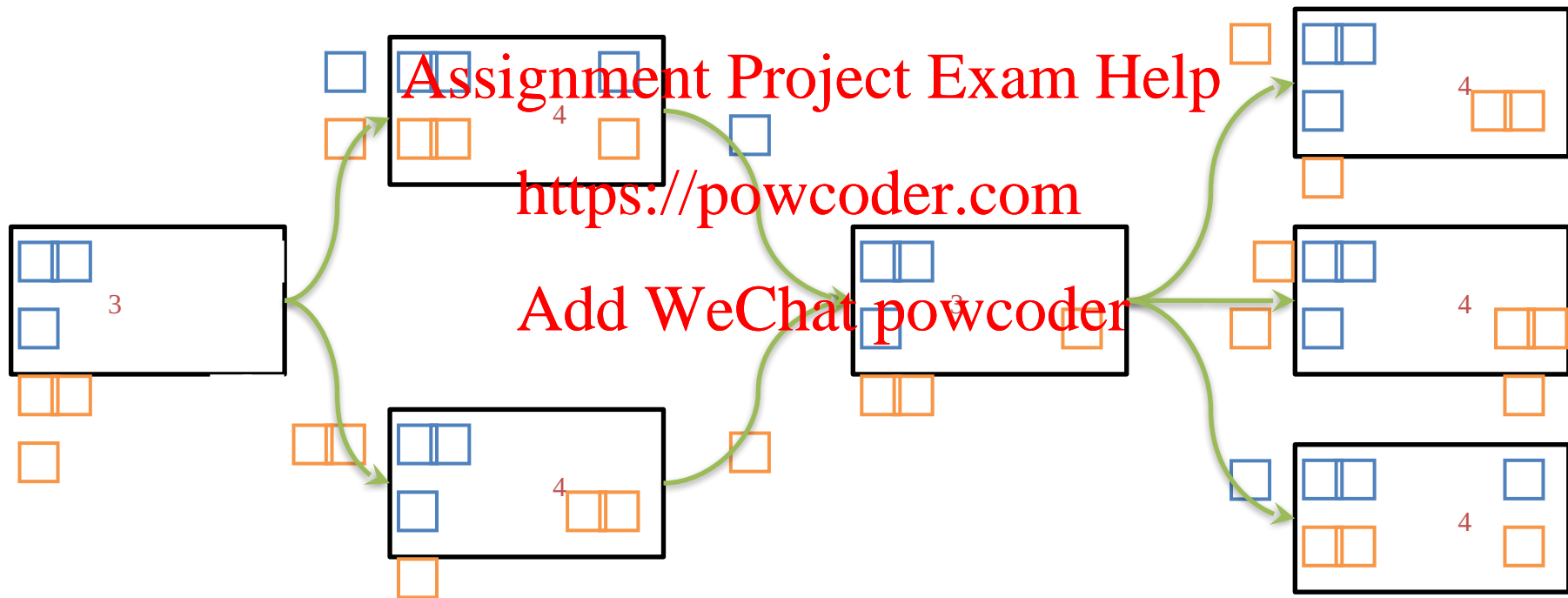
Design & Creativity



Metacognition



Principle #1: KBAI agents represent and organize knowledge into knowledge structures to guide and support reasoning.



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Sentence 1: A serious earthquake killed 25 people in Lower Slabovia.

Sentence 2: The President of Lower Slabovia killed 25 proposals for earthquake prediction.

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kill. *verb.* /kil/

- to cause the death of
- to put an end to



```
kill11
agent :
victim :
```



```
kill12
agent :
object :
```


Principle #1: KBAI agents represent and organize knowledge into knowledge structures to guide and support reasoning.

S = Ashok; P = Olive Garden; W = Andrew

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Action Frame

prim. : move-body-part
agent : Ashok
part : body
destination : sitting

Action Frame

prim. : move-object
agent : Andrew
object : Andrew
destination : Ashok

Action Frame

prim. : see
agent : Andrew
object : Ashok

Action Frame

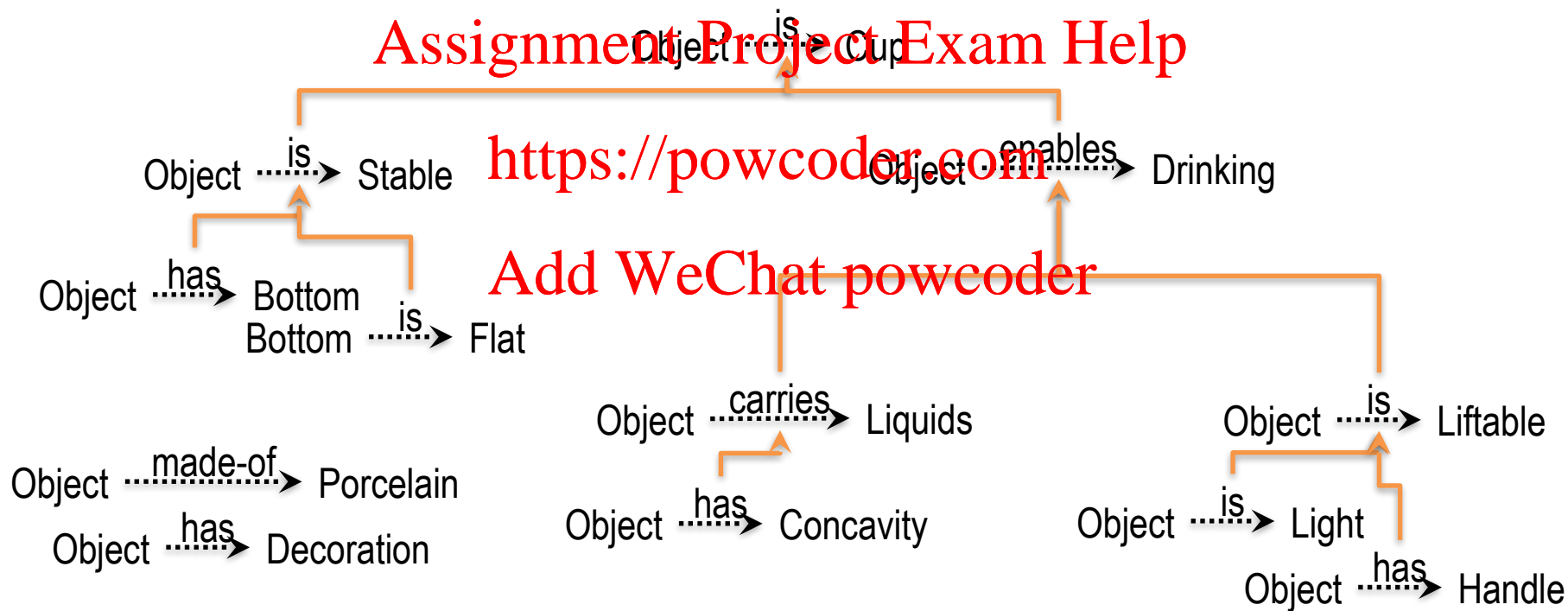
prim. : move-object
agent : Andrew
object : menu
destination : Ashok

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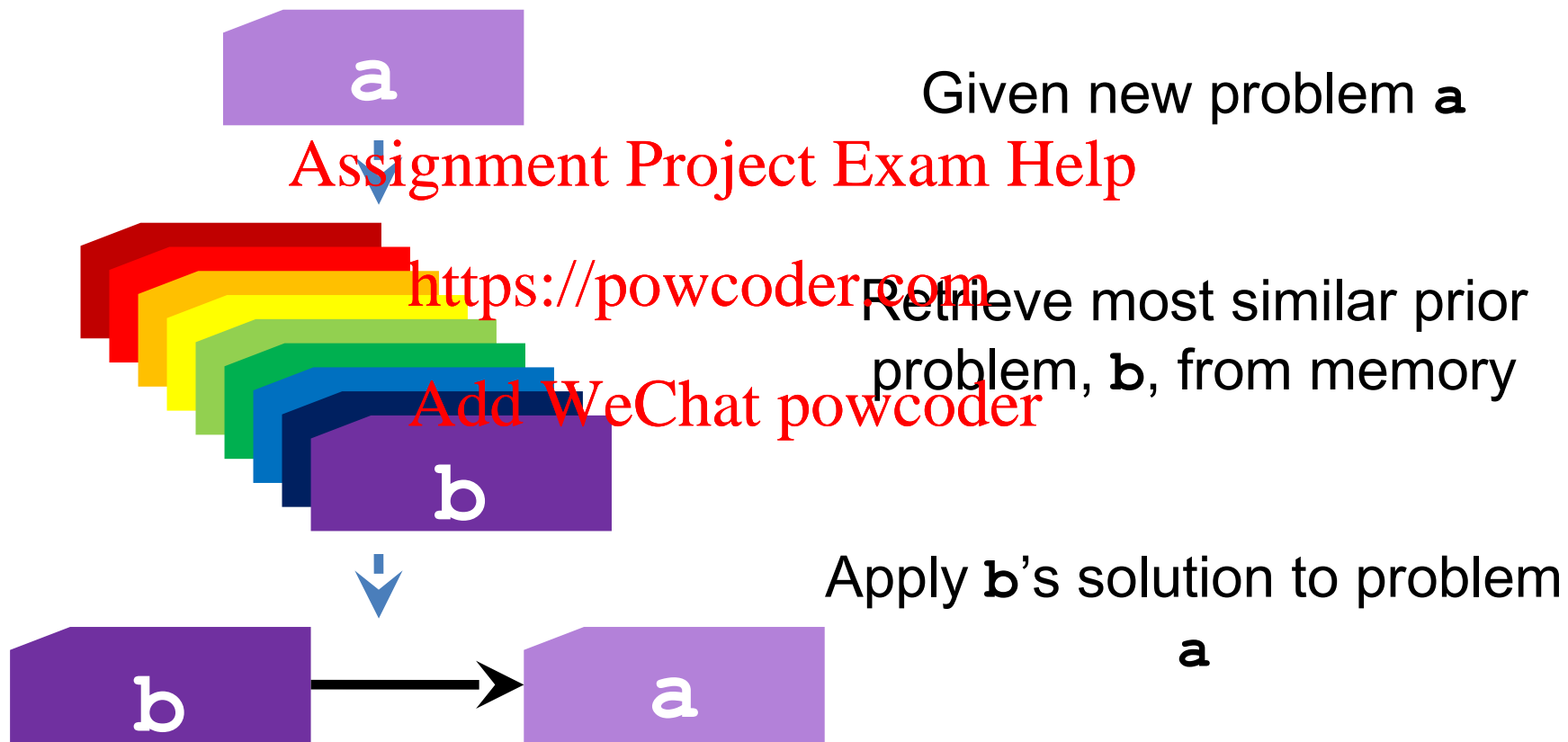
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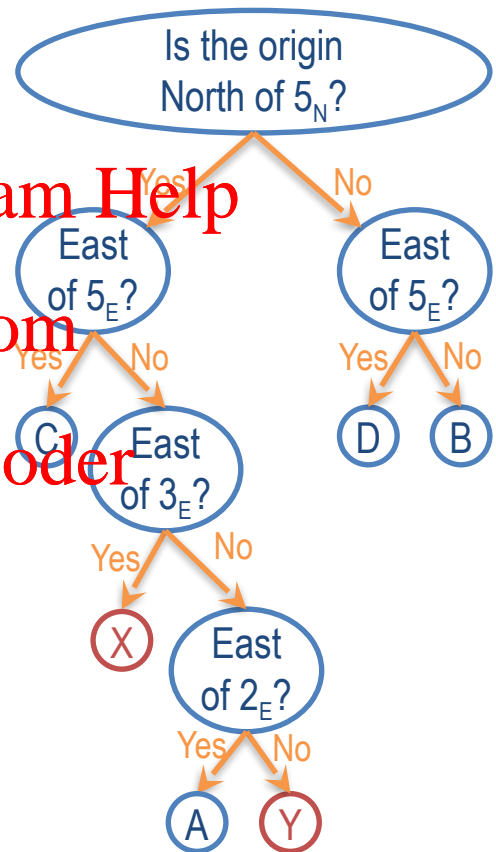


Principle #2: Learning in KBAI agents is often incremental.

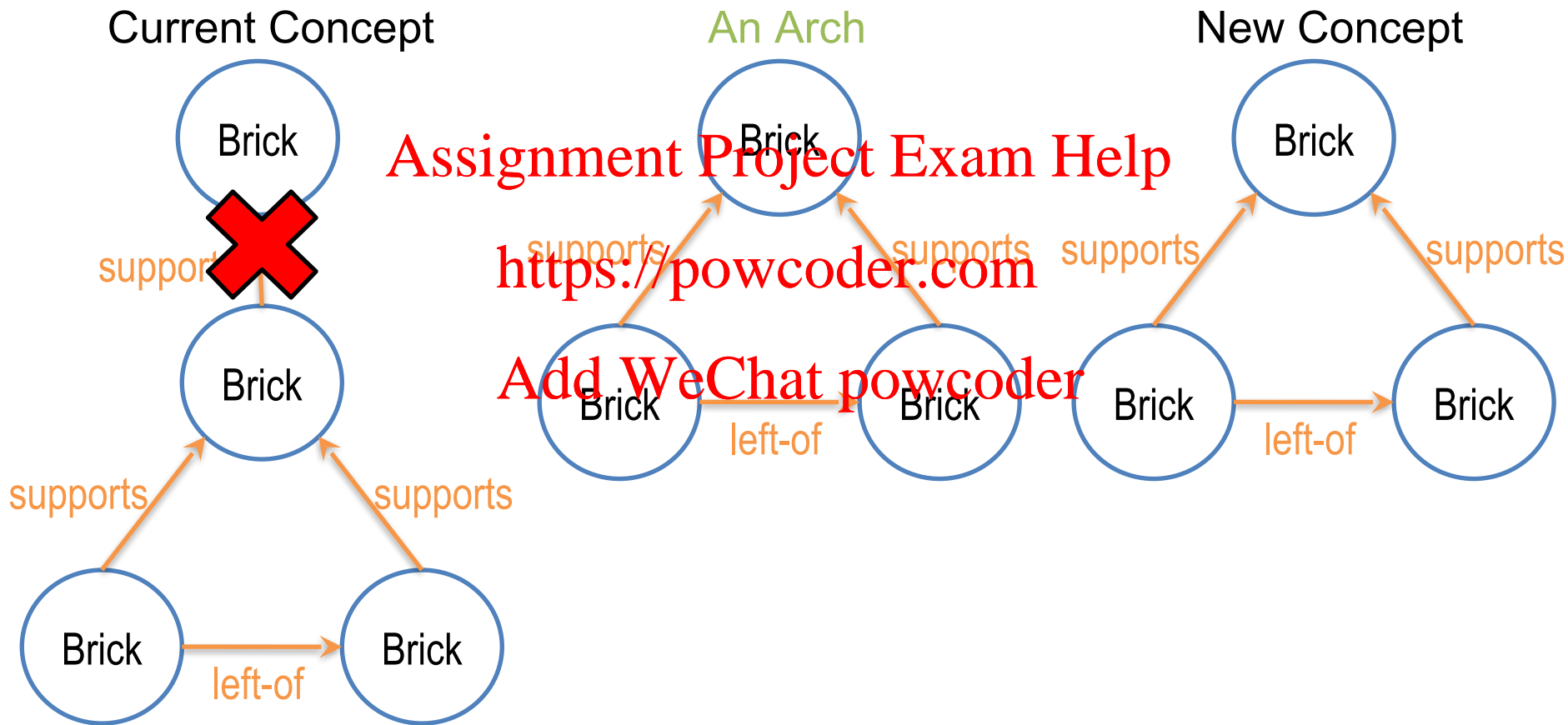


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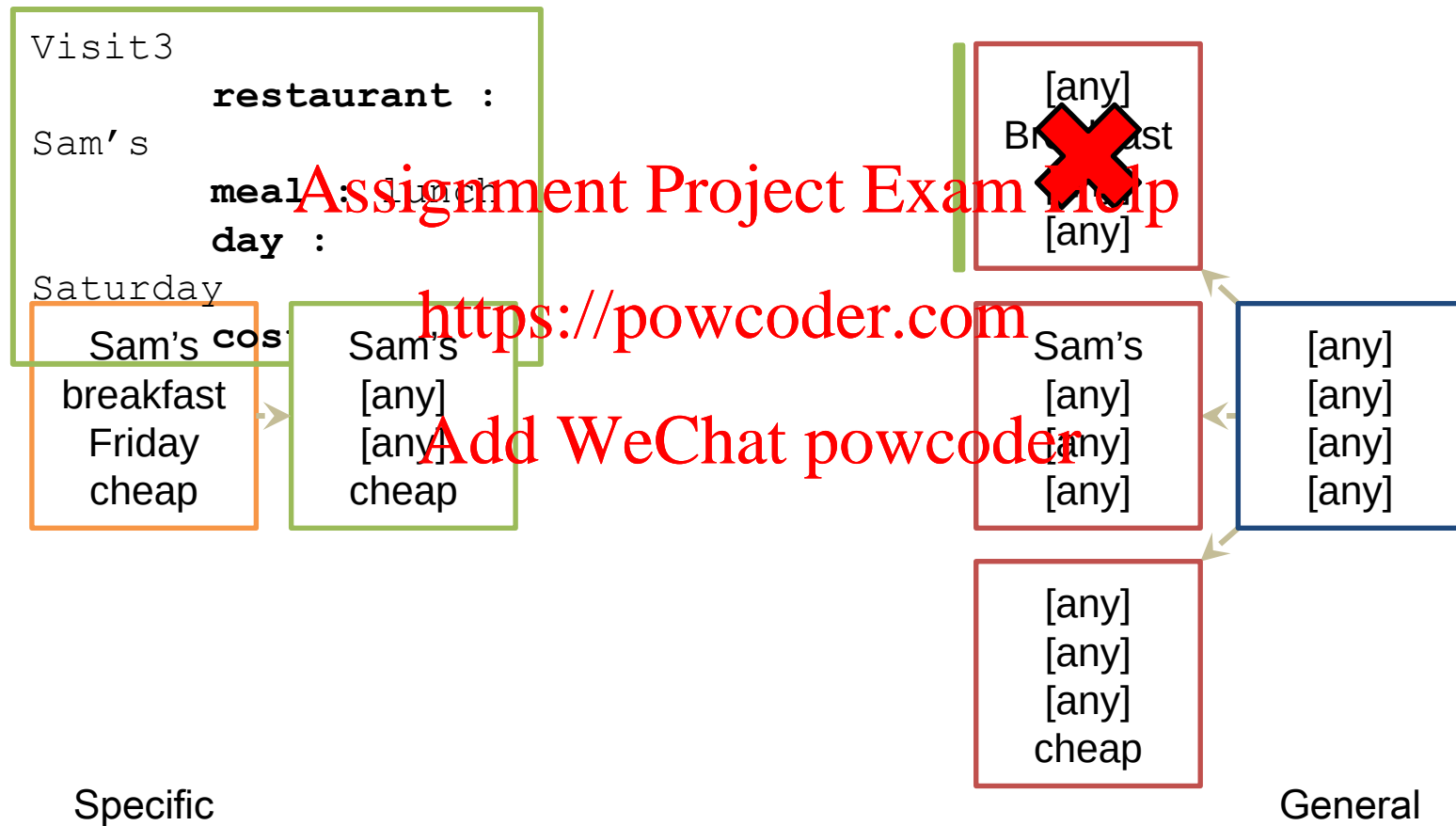
Route	Destination _x	Destination _y
A	10 _E	8 _N
B	1 _E	8 _N
C	10 _E	4 _N
D	2 _E	1 _N
X	8 _E	2 _N
Y	8 _E	2 _N
Z	1 _E	9 _N



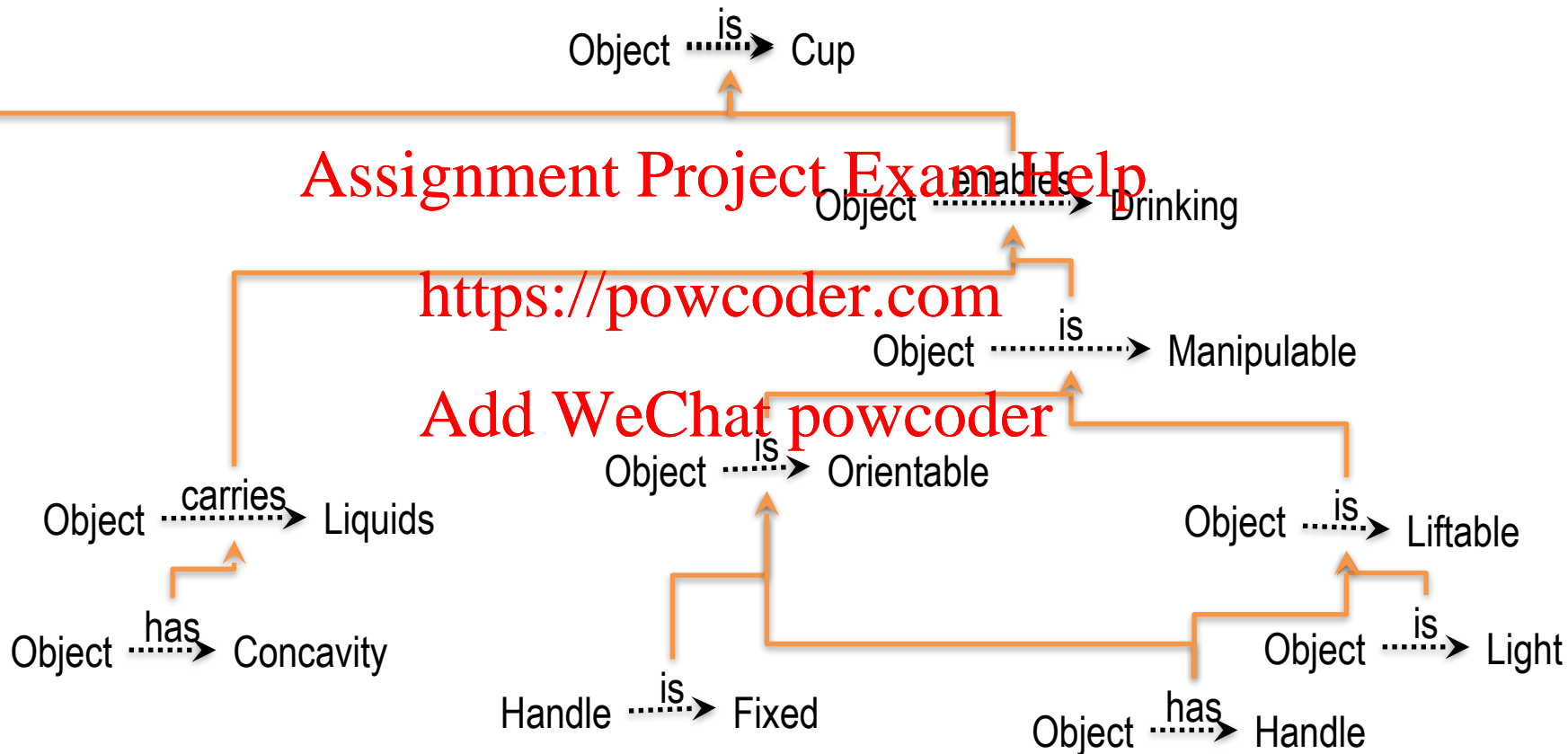
Principle #2: Learning in KBAI agents is often incremental.



Principle #2: Learning in KBAI agents is often incremental.



Principle #2: Learning in KBAI agents is often incremental.



Principle #3: Reasoning in KBAI agents is top-down as well as bottom-up.

Angela ate lasagna with
her dad last night at Olive
Garden.

Ate

subject : Angela
object : lasagna
location : Olive Garden
time : night
utensils :
object-alive : false
object-is : in-subject
subject-mood : happy

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Principle #3: Reasoning in KBAI agents is top-down as well as bottom-up.

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Principle #3: Reasoning in KBAI agents is top-down as well as bottom-up.

S = Ashok; P = Olive Garden; W = Andrew

Action Frame
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part : body
destination : sitting

Action Frame
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object : Ashok

Action Frame
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object : Andrew
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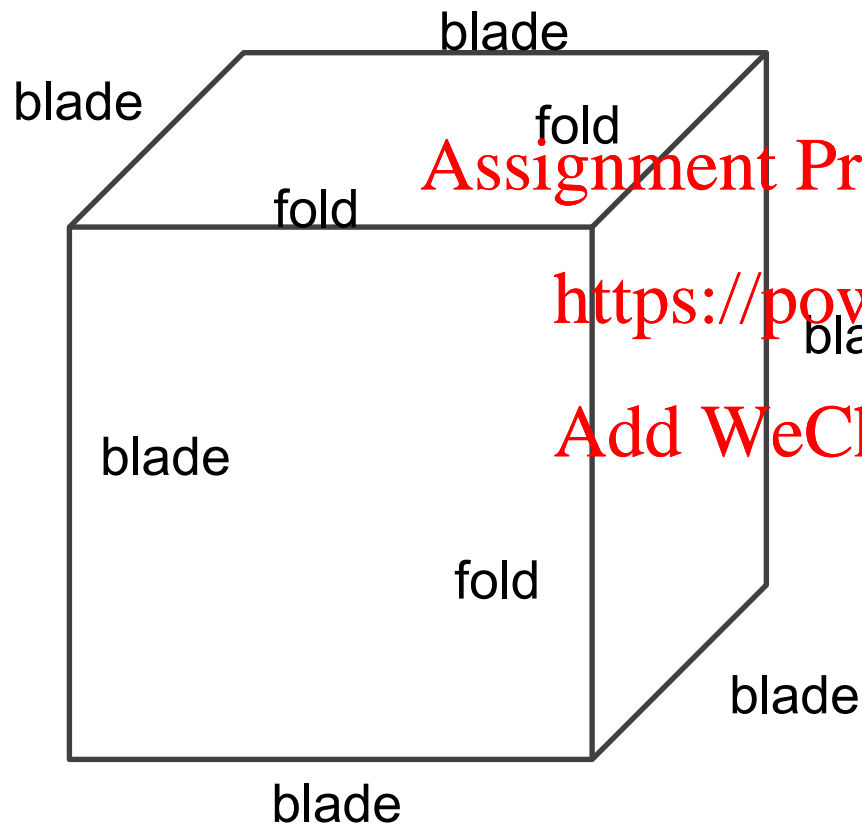
Action Frame
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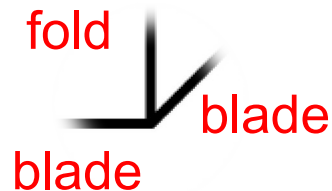
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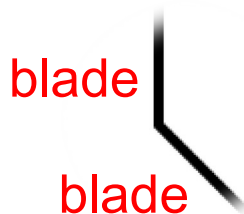
Y-Constraint



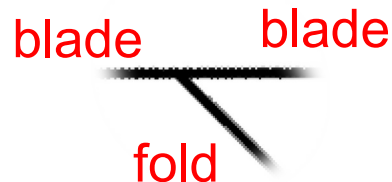
W-Constraint



L-Constraint



T-Constraint

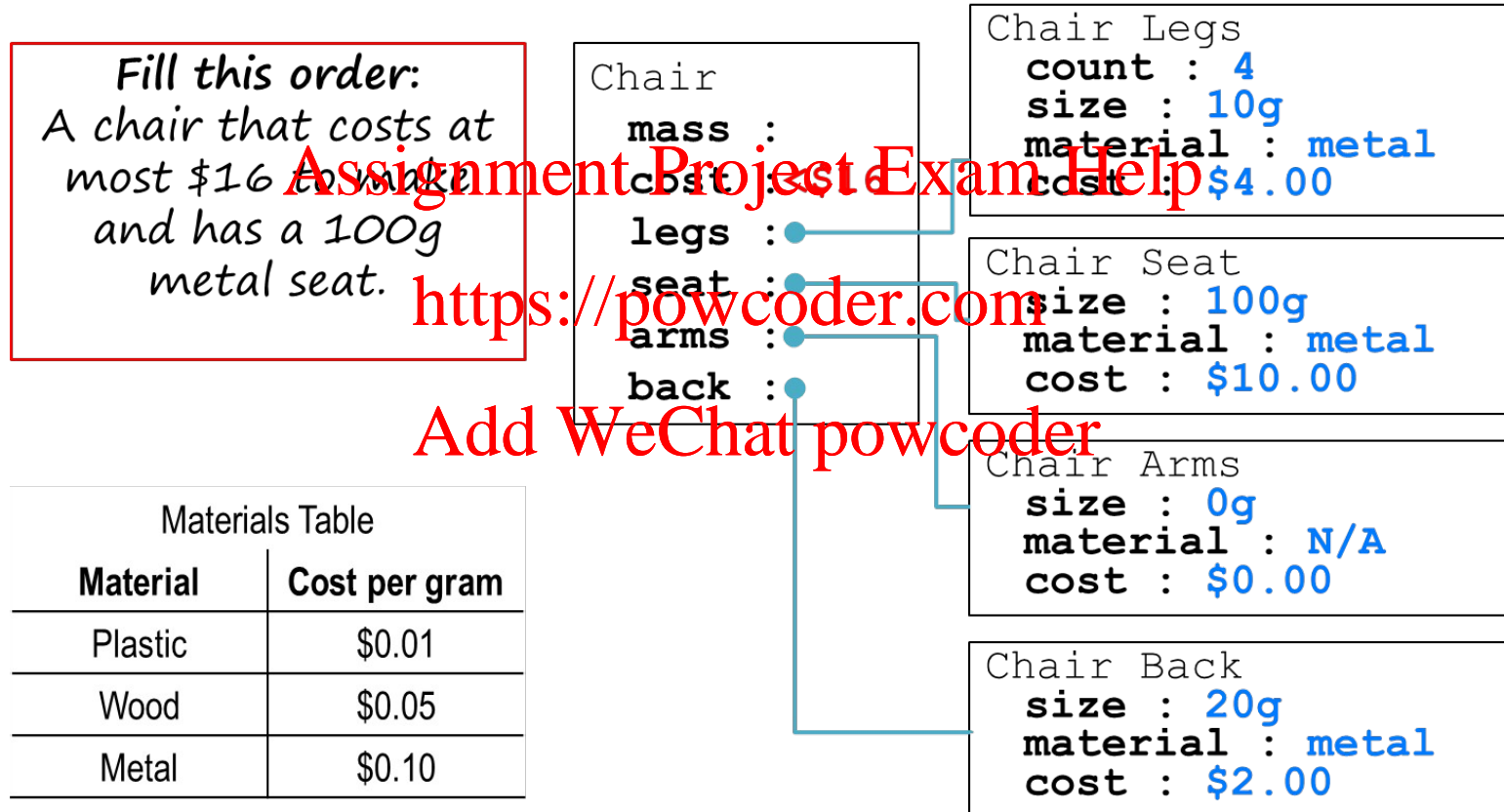


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Principle #3: Reasoning in KBAI agents is top-down as well as bottom-up.



Principle #4: KBAI agents match methods to tasks.

Methods

Generate & Test
Means-Ends Analysis
Problem Reduction
Production Systems
Case-Based Reasoning
Planning
Analogical Reasoning

Tasks

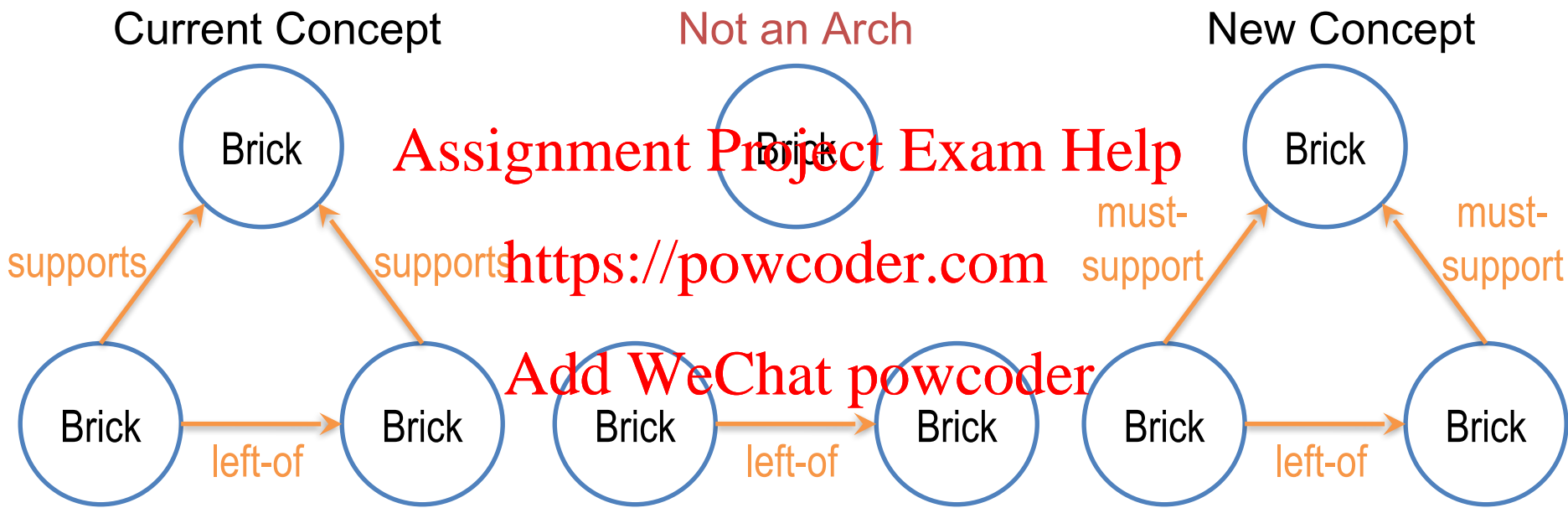
Configuration
Diagnosis
Design
Meta-Reasoning
Creativity
Classification
Systems Thinking

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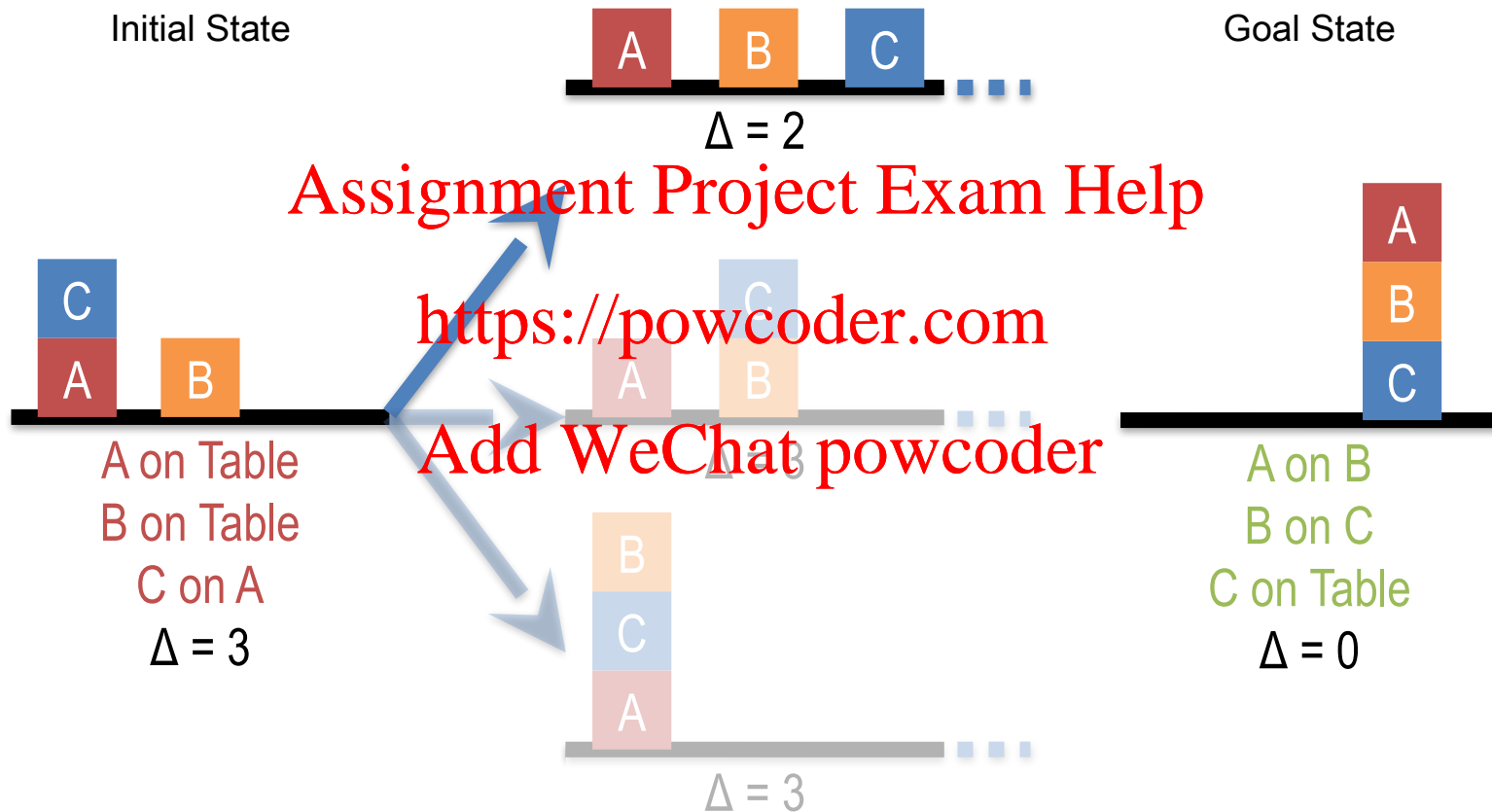
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Principle #5: KBAI agents use heuristics to find solutions that are good enough, though not necessarily optimal.

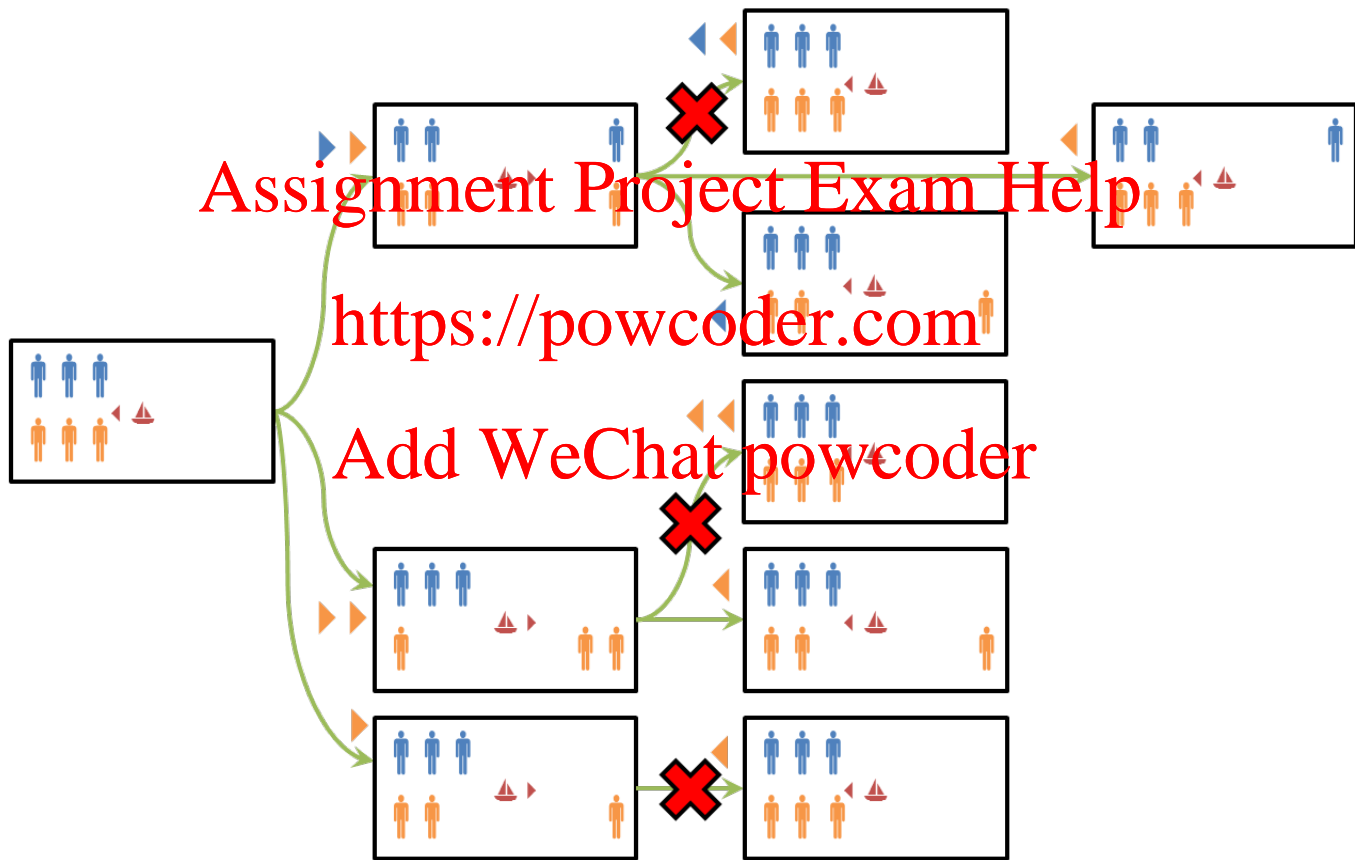


“require-link” heuristic

Principle #5: KBAI agents use heuristics to find solutions that are good enough, though not necessarily optimal.



Principle #5: KBAI agents use heuristics to find solutions that are good enough, though not necessarily optimal.



Principle #6: KBAI agents make use of recurring patterns in the problems they solve.

Block World

Red

Orange

Blue

Black

Green

Purple

What color is this block?

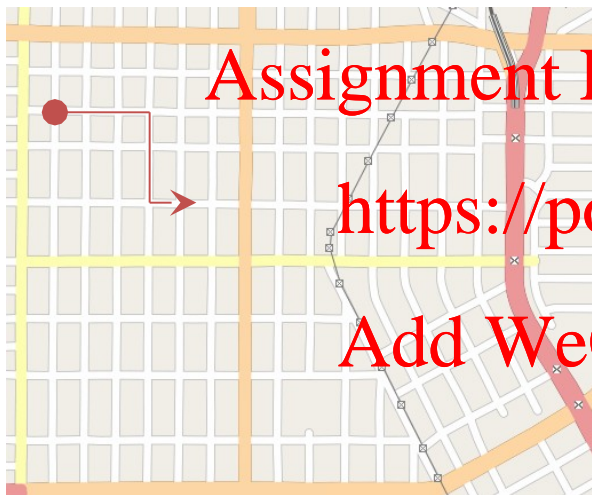
?

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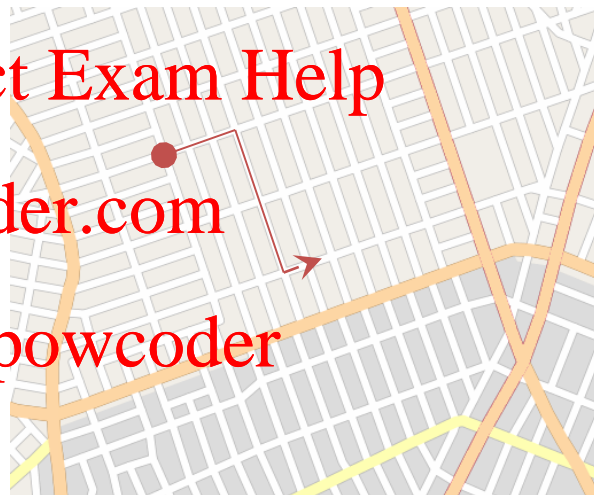
Principle #6: KBAI agents make use of recurring patterns in the problems they solve.



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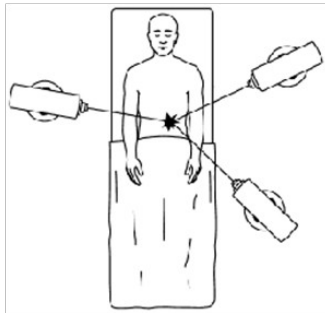
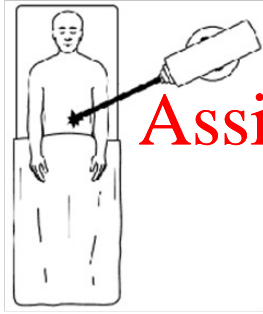
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Principle #6: KBAI agents make use of recurring patterns in the problems they solve.

Target



Source



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Principle #6: KBAI agents make use of recurring patterns in the problems they solve.

Fill this order:
A chair that costs at
most \$16 to make
and has a 100g
metal seat.

Chair
mass :
cost :
legs :
seat :
arms :
back :

Chair Legs
count : 4
size : 10g
material : metal
cost : \$4.00

Chair Seat
size : 100g
material : metal
cost : \$10.00

Chair Arms
size : 0g
material : N/A
cost : \$0.00

Chair Back
size : 20g
material : metal
cost : \$2.00

Materials Table	
Material	Cost per gram
Plastic	\$0.01
Wood	\$0.05
Metal	\$0.10

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Principle #6: KBAI agents make use of recurring patterns in the problems they solve.

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part : body
destination : sitting

Action Frame
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Action Frame
prim. : move-object
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object : Andrew
destination : Ashok

Action Frame
prim. : move-object
agent : Andrew
object : menu
destination : Ashok

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Principle #7: The architecture of KBAI agents enables reasoning, learning, and memory to support and constrain each other.

```
inning : 5th
portion : bottom
game : 131
weather : windy
runners : 1st, 3rd
outs : 1
batter : Pierzynski
average : .283
bats : left-handed
score : 1-4
goal : pitch
pitch : throw-fast-ball
result : homerun
```

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(r8) If two operators selected and one has an episode with **result**
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then prefer other operator

“chunking”

Principle #7: The architecture of KBAI agents enables reasoning, learning, and memory to support and constrain each other.

If an animal flies and is not a
bird, it is a bat.

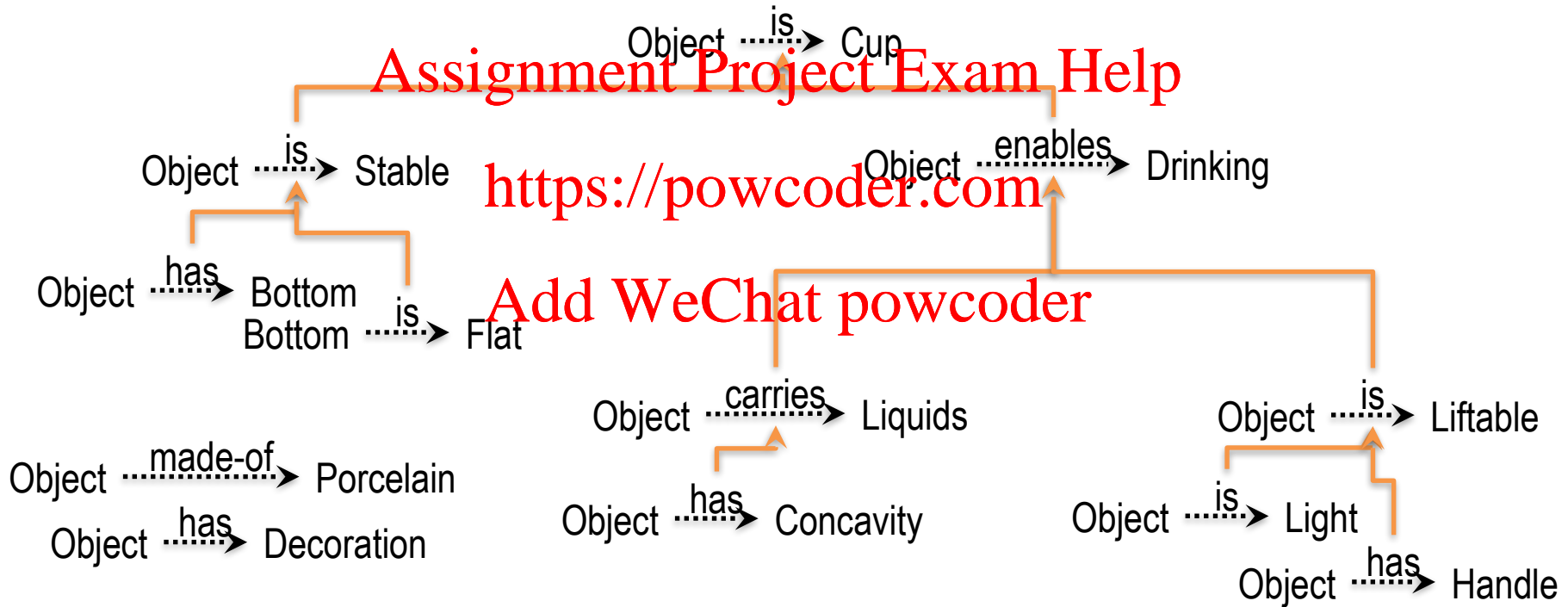
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```
If Flies (animal)  $\wedge$   
     $\neg$ Bird (animal) :  
    Then Bat (Animal)
```

Principle #7: The architecture of KBAI agents enables reasoning, learning, and memory to support and constrain each other.



CALO:

“Cognitive Assistant that
Learns and Organizes”

VITA:

A computational model of
visual thinking in autism,
based on RPM.

Cyc and OMCS:

Knowledgebases of everyday
common sense knowledge

Dramatis:

A computational model of
suspense and drama in
stories.

Wolfram Alpha:

A computational knowledge
and answer engine.

DANE:

Support for design based on
analogies to natural systems.

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What are some things Watson must be able to do to participate in Jeopardy? Write each on its own line

below:
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Read the clue

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Search its knowledge base

Decide on an answer

Properly phrase that answer

Fundamental Conundrums of Artificial Intelligence

- Intelligent agents have limited resources.
- Computation is local, but problems have global constraints.
- Logic is deductive, but many problems are not.
- The world is dynamic, but knowledge is limited.
- Problem solving, reasoning, and learning are complex, but explanation and justification are even more complex.

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Characteristics of AI Problems

- Knowledge often arrives incrementally.
- Problems exhibit recurring patterns.
- Problems have multiple levels of granularity.
- Many problems are computationally intractable.
- The world is dynamic, but knowledge of the world is static.
- The world is open-ended, but knowledge is limited.

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Characteristics of AI Agents

- Agents have limited computing power.
- Agents have limited sensors.
- Agents have limited attention.
- Computational logic is fundamentally deductive.
- AI agents' knowledge is incomplete relative to the world.

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Deliberation

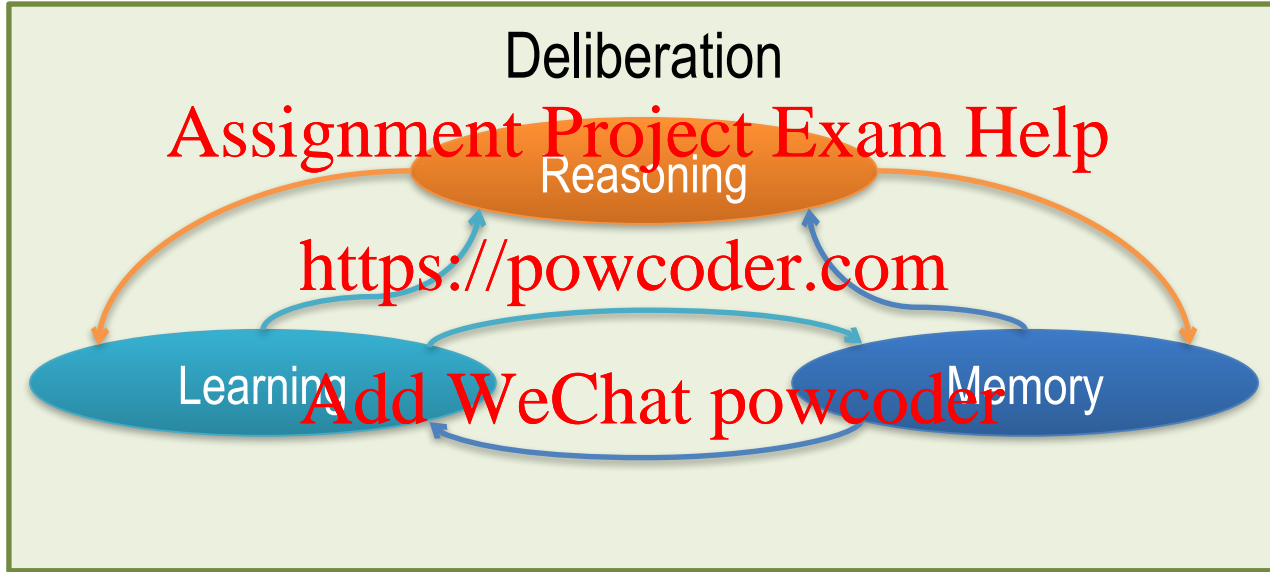
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Reasoning

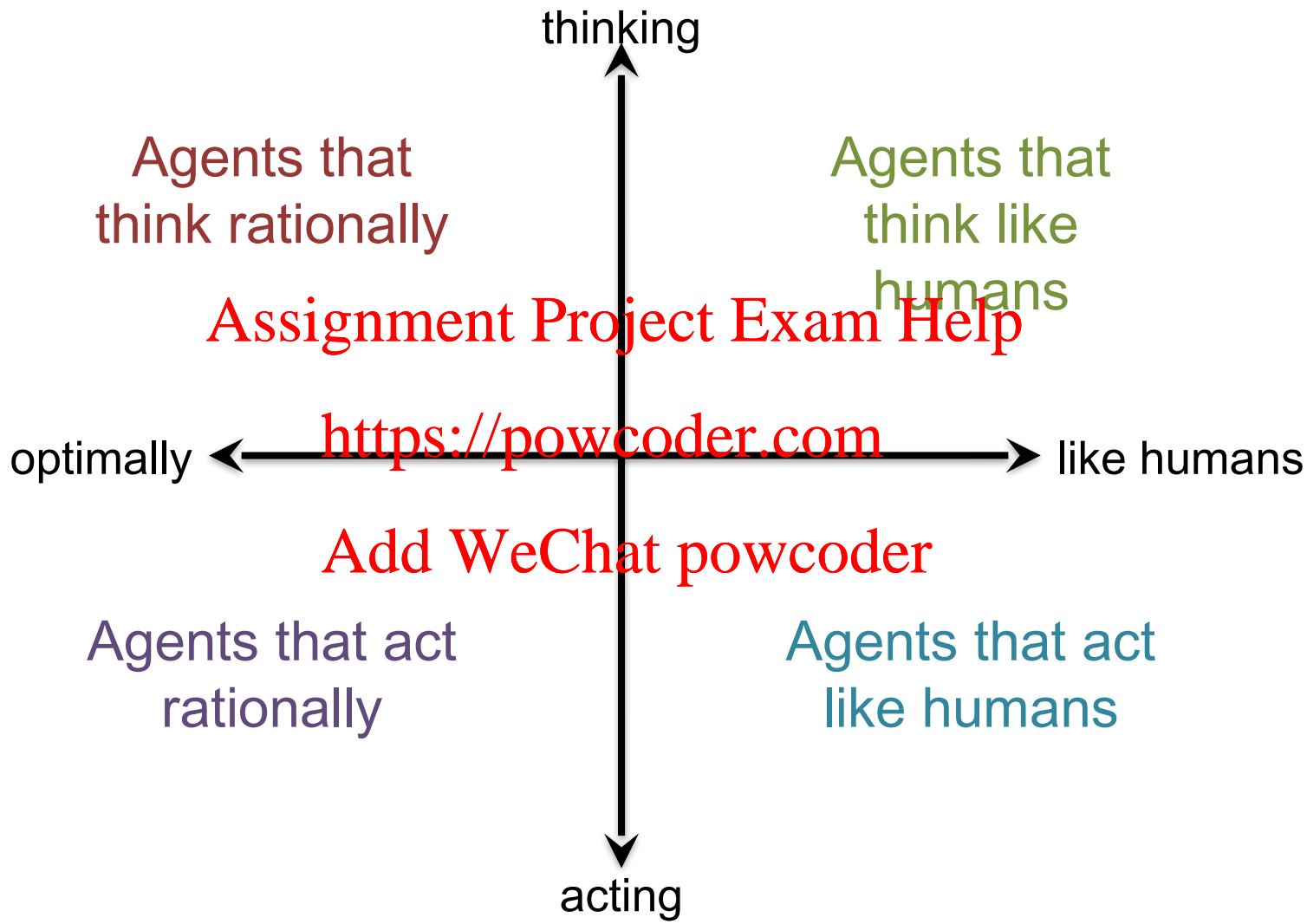
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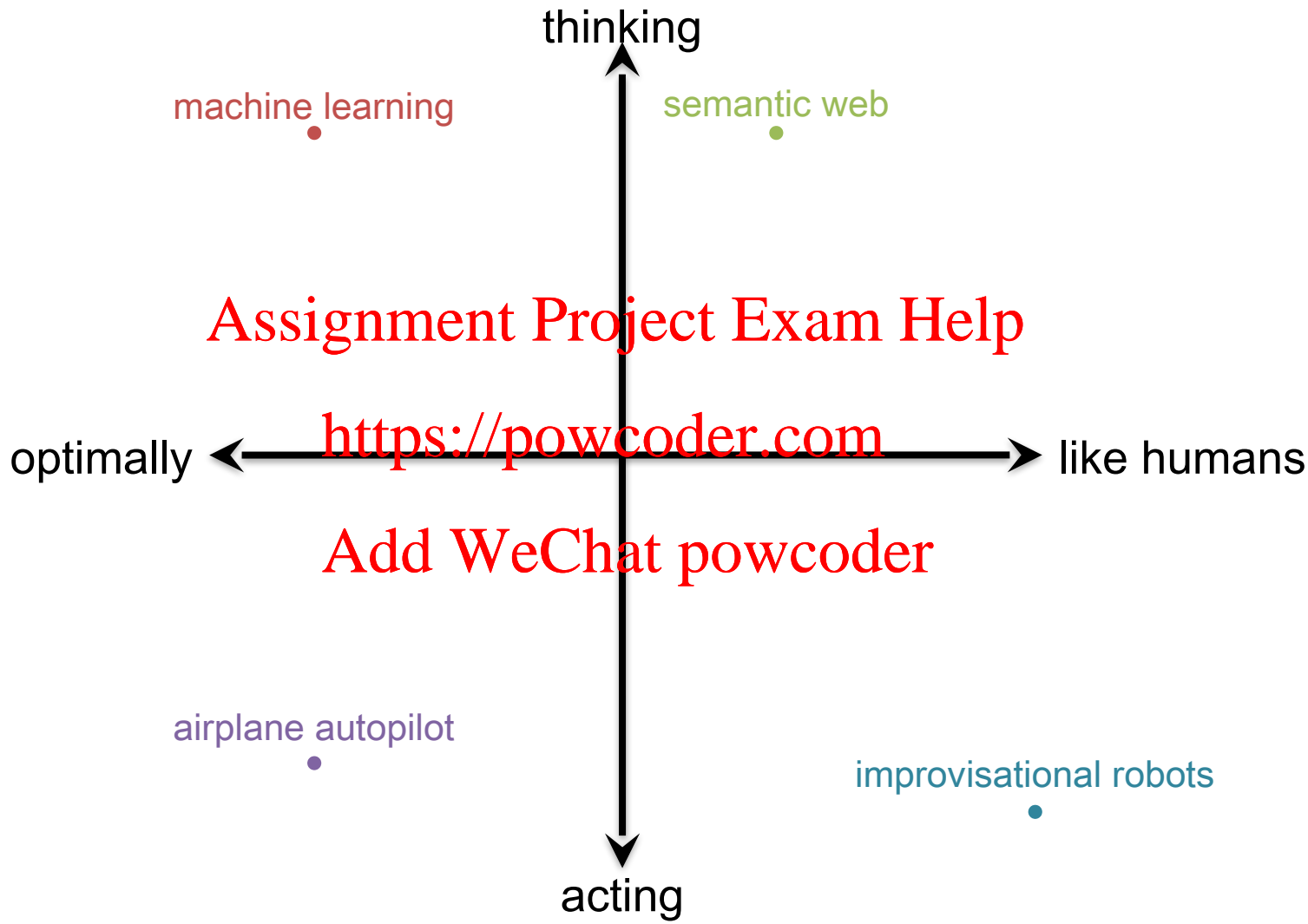
Learning

Memory

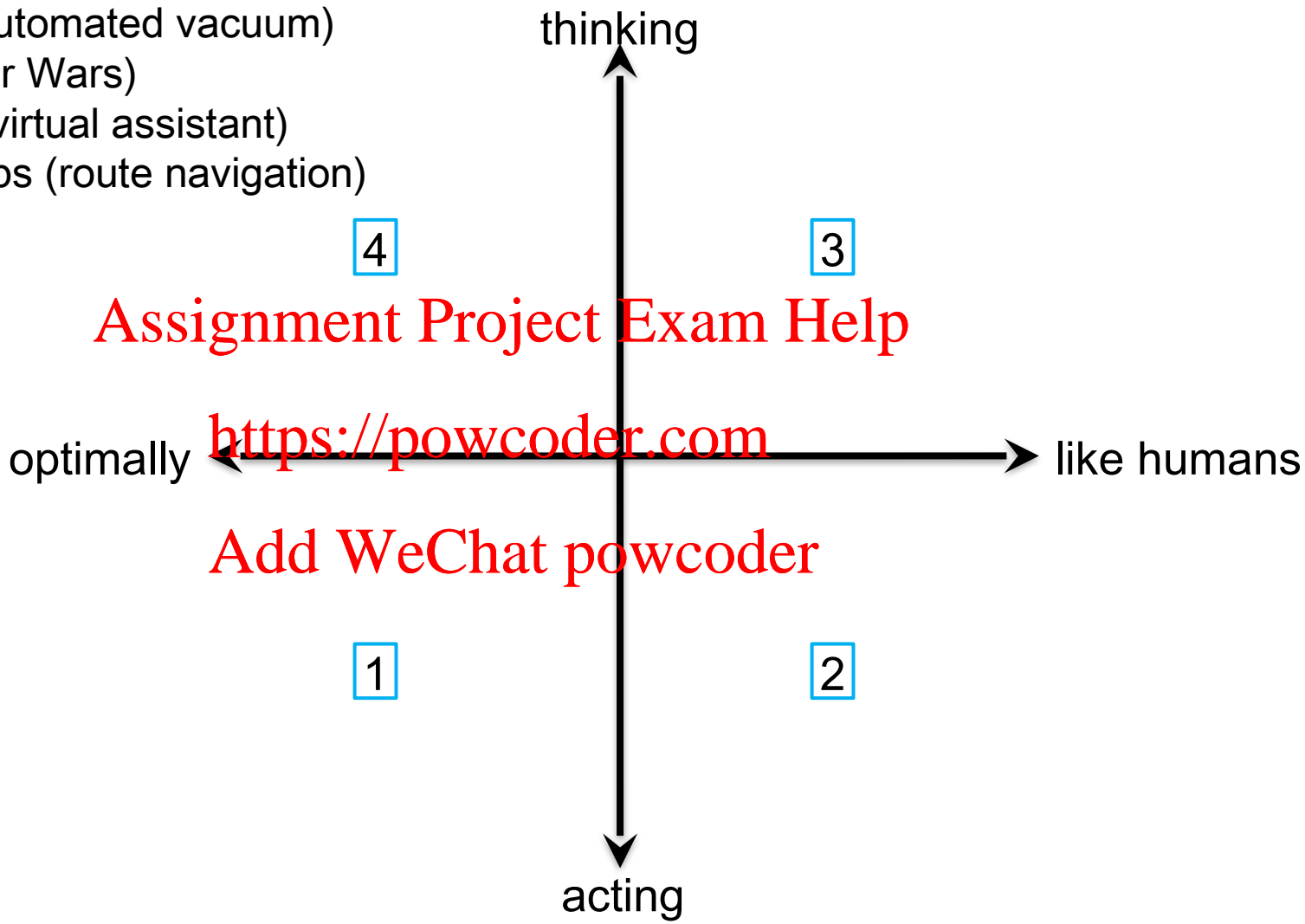
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1. Roomba (automated vacuum)
2. C-3PO (Star Wars)
3. Siri (Apple virtual assistant)
4. Google Maps (route navigation)

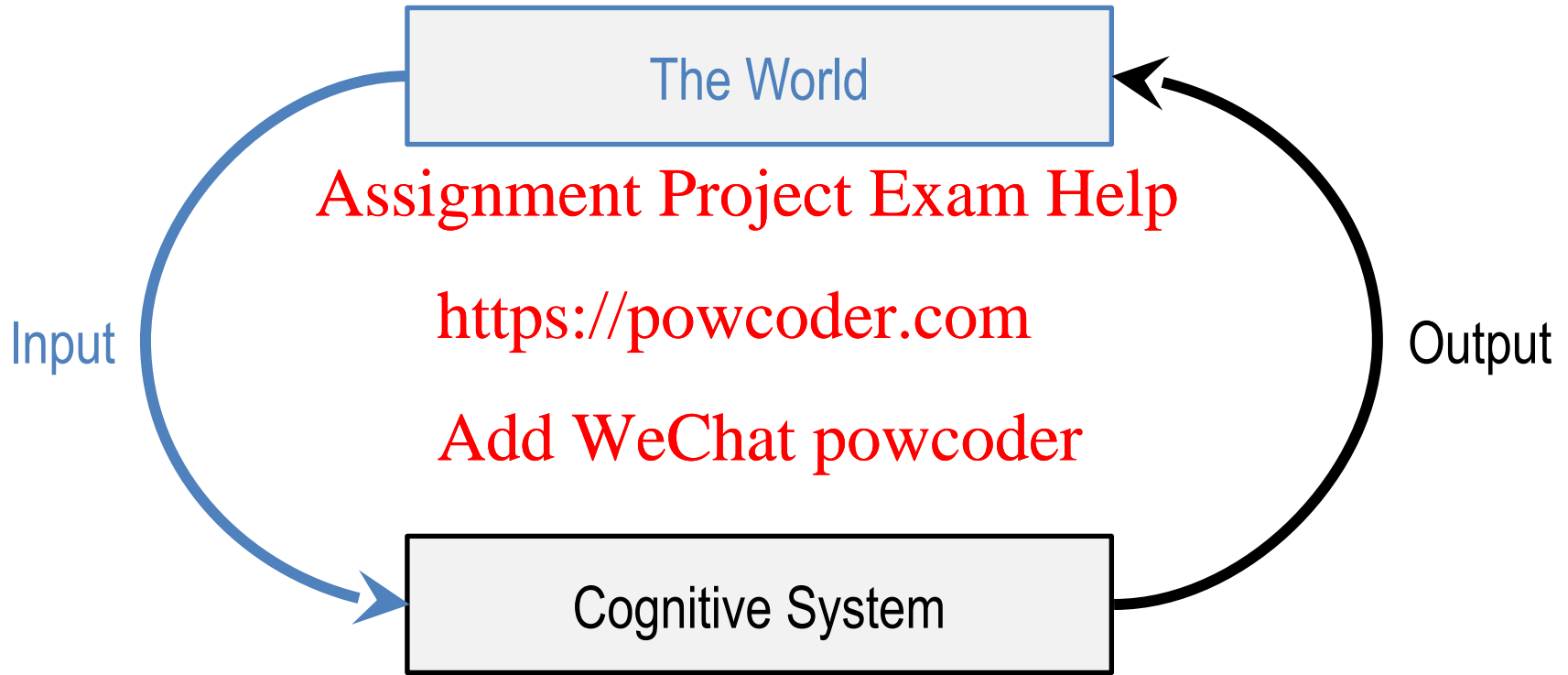


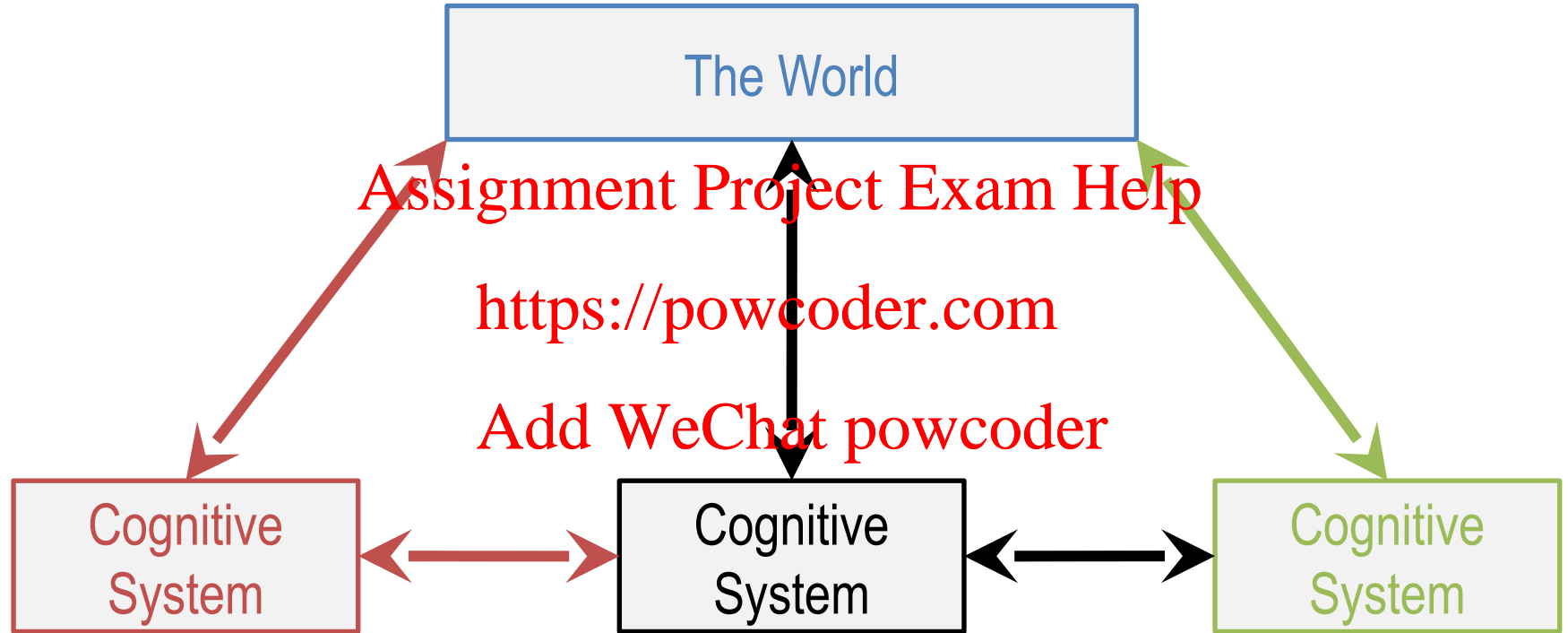
What are cognitive systems?

Cognitive: dealing with human-like intelligence.

Systems: multiple interacting components such as learning, reasoning, and memory.

Cognitive Systems: Systems that exhibit human-like intelligence through processes like learning, reasoning, and memory.





Cognitive System

Metacognition

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Reasoning

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Learning

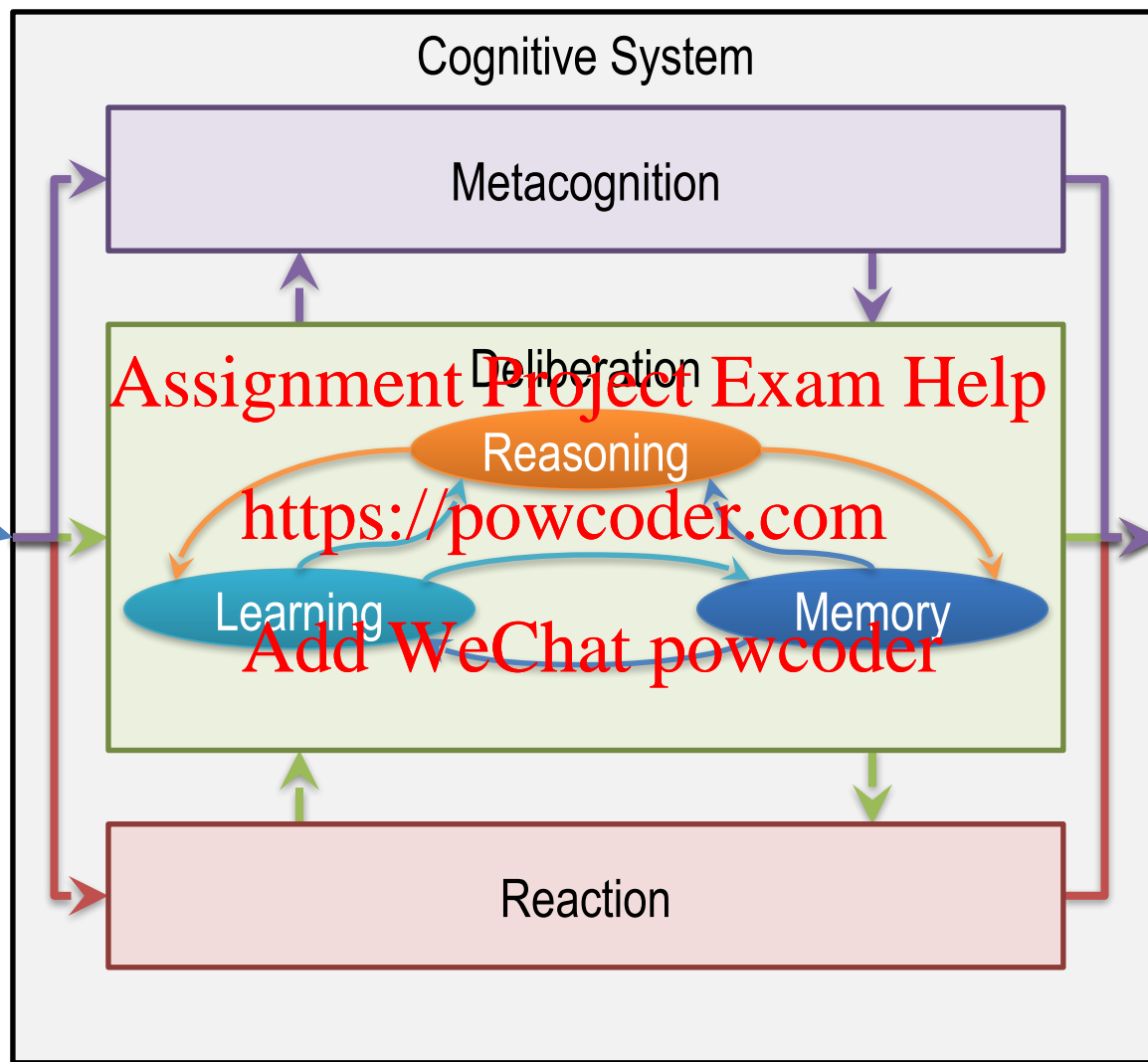
Memory

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Reaction

Input

Output



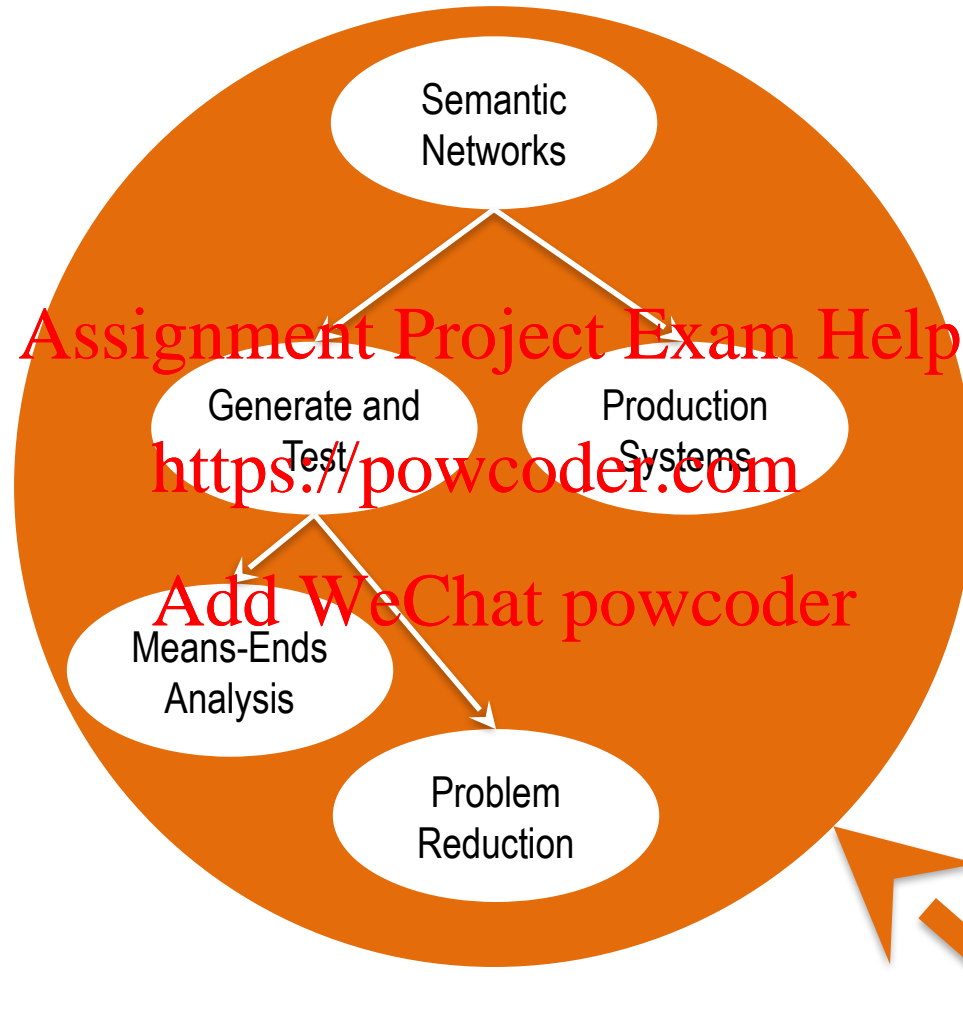


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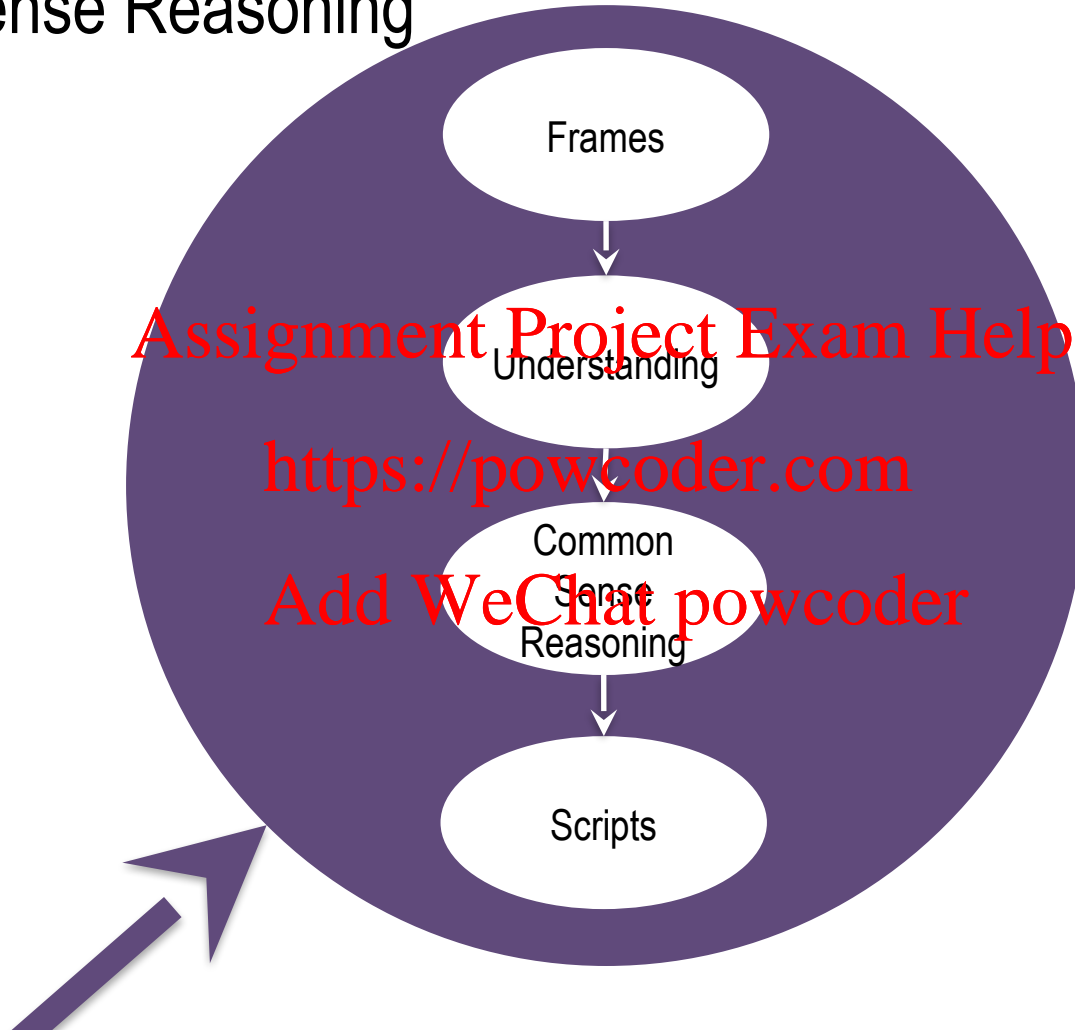
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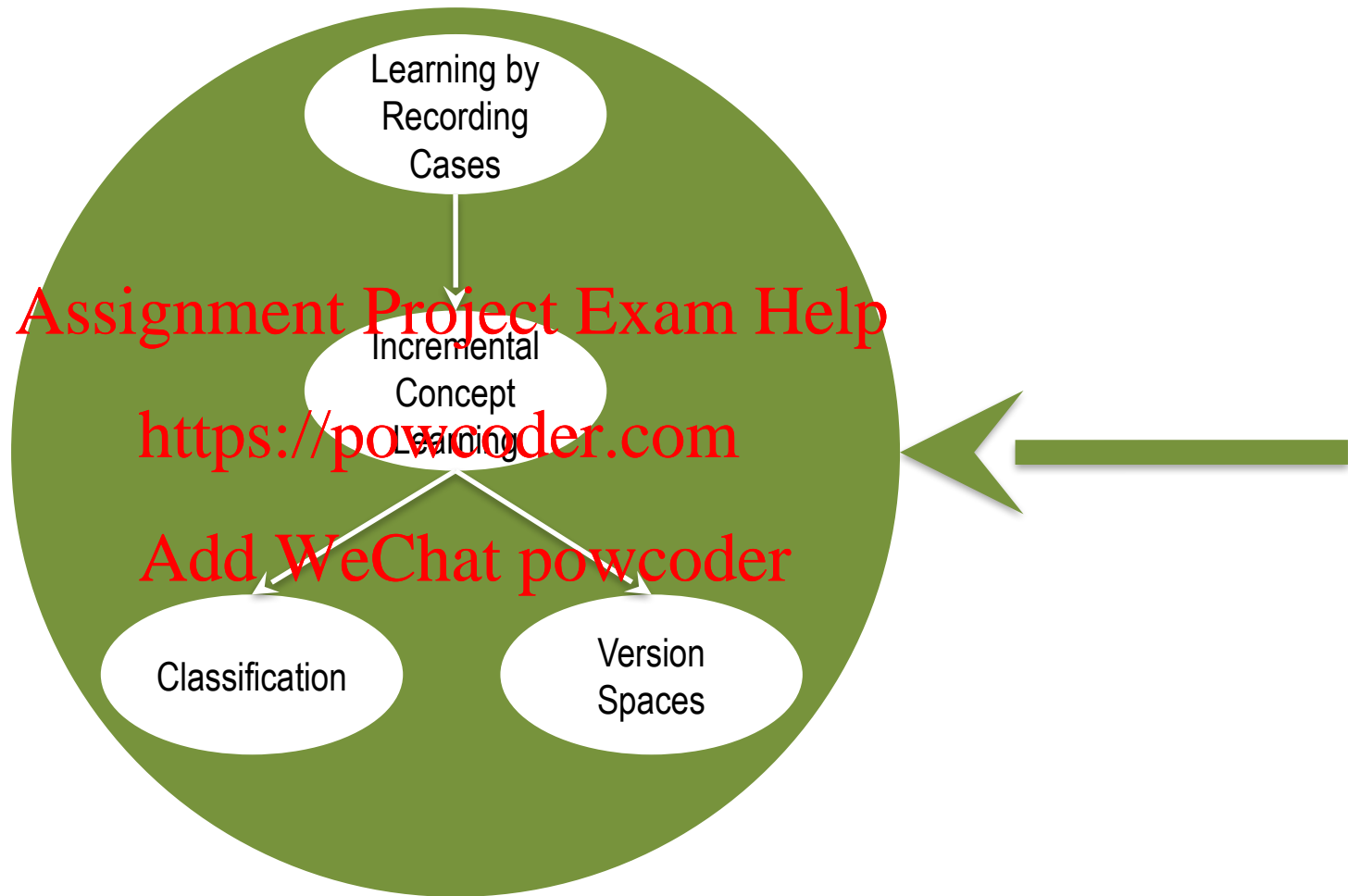
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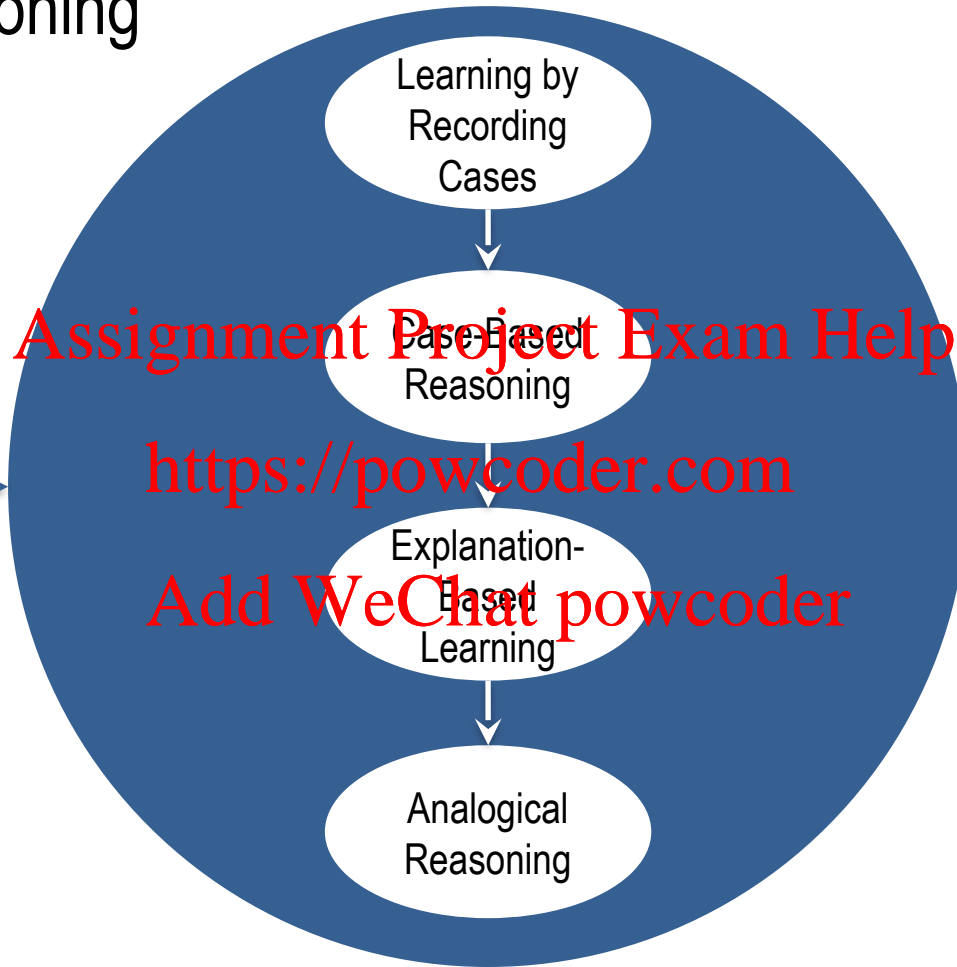
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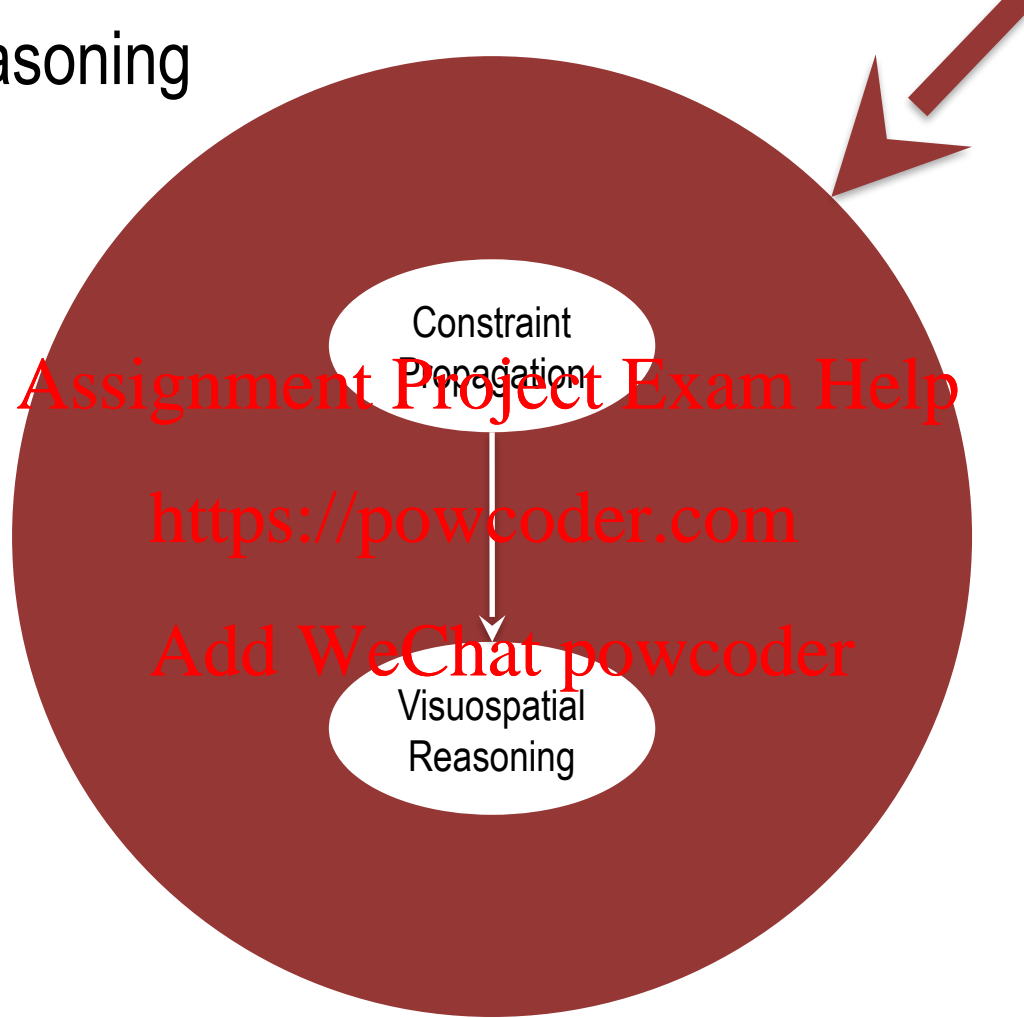
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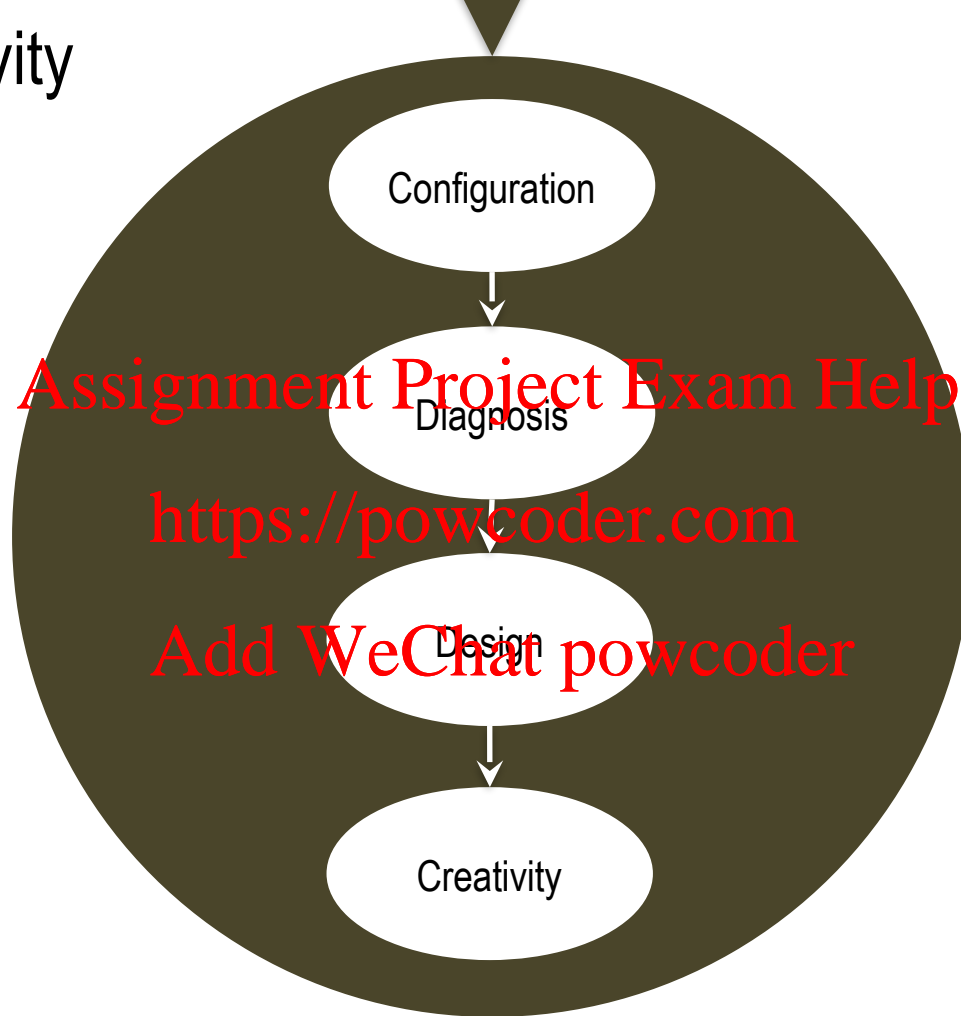
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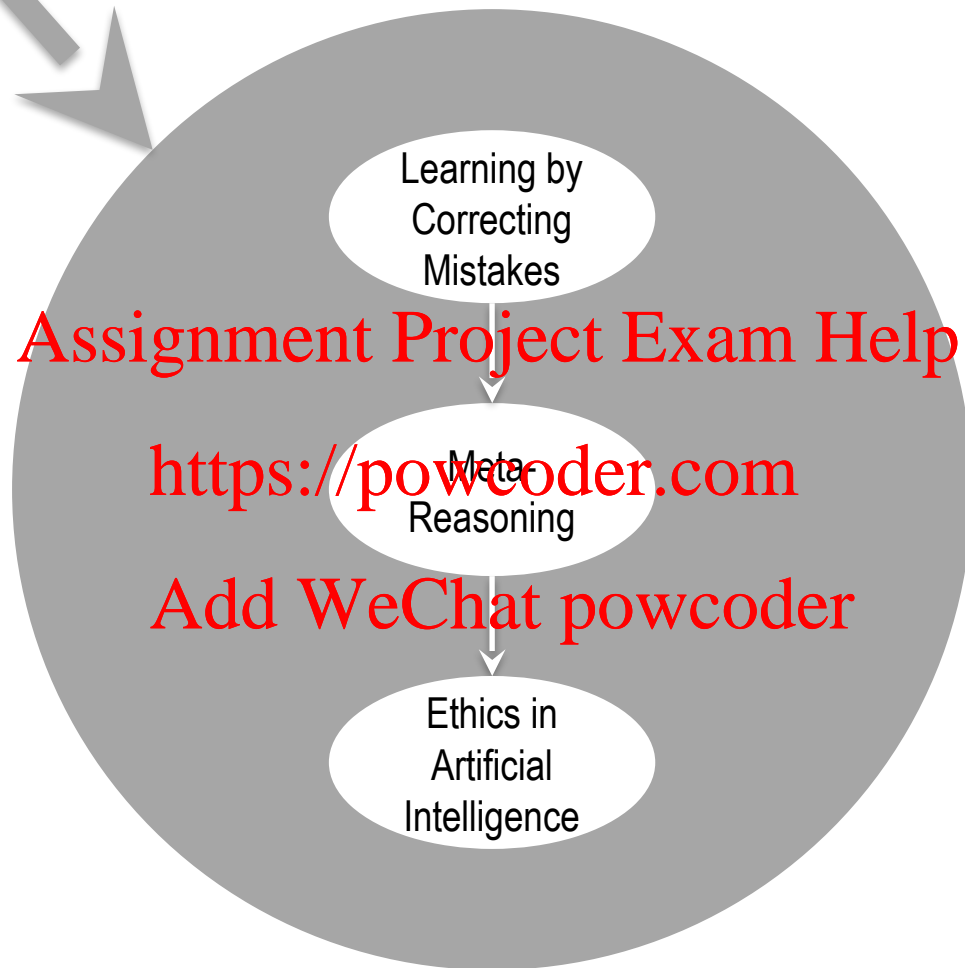
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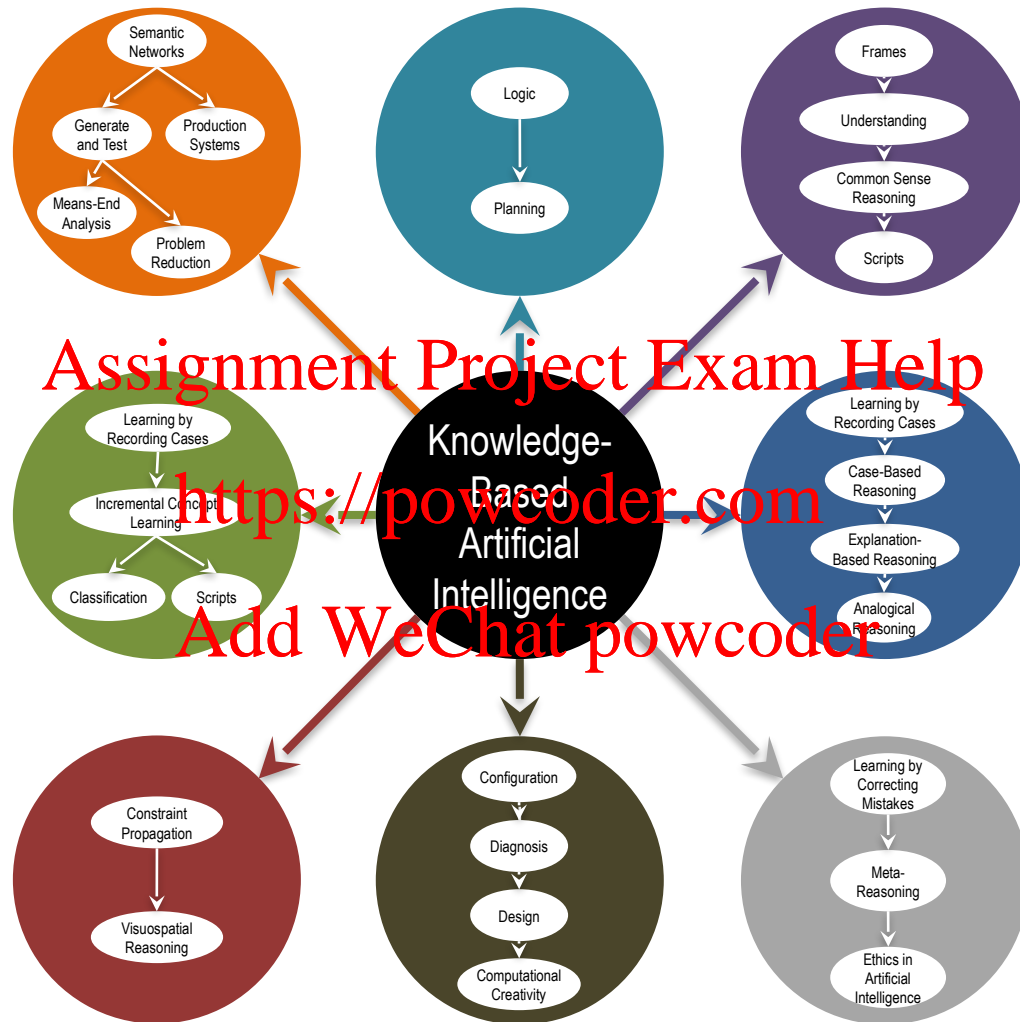


Design & Creativity



Metacognition





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To recap...

- Conundrums and characteristics
- Four schools of AI
- What is KBAI?
- Cognitive Systems
- Topics in AI

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Introduction
<https://powcoder.com>
to CS7637

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Lesson Preview

- Class goals, outcomes, and strategies
 - Class projects and assessments
 - Computational psychometrics
 - Raven's Progressive Matrices
 - Principles of CS7637
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You will learn...

- Core methods of knowledge-based AI
- Tasks addressed by knowledge-based AI
- How knowledge-based AI agents use these methods to address these tasks
- The relationship between AI and human cognition

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You will be able to...

- Design and implement a knowledge-based AI agent
- Use these strategies and agents to address complex, practical problems
- Use the design and results of these agents to reflect on human cognition

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You will learn by...

- Learning by Example
- Learning by Doing
- Project-Based Learning
- Personalization
- Learning by Reflection

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You will complete...

- Projects
- Short assignments
- Tests
- Exercises
- Discussions

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Raven's Progressive Matrices

- Test written in the 1930s to examine general intelligence.
- Consists of 60 multiple-choice visual analogy problems.
- Unique in that problems are strictly visual.
- Widespread usage as a valid test for intelligence.

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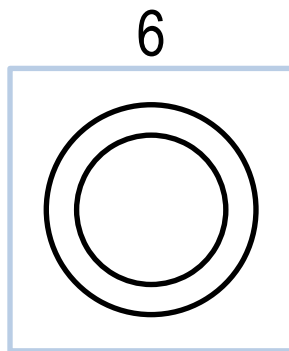
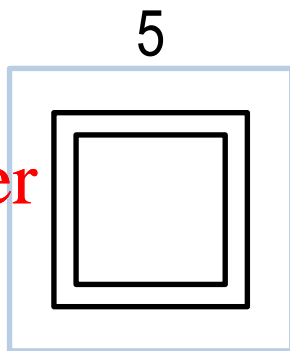
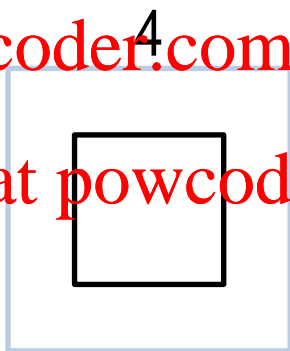
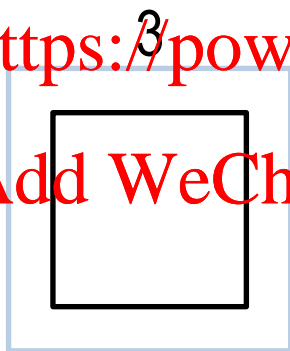
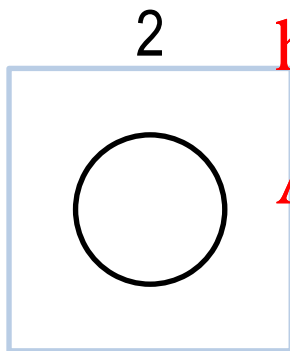
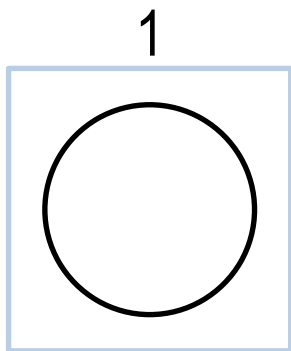
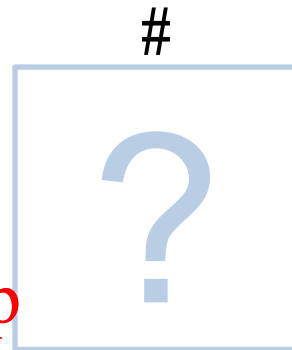
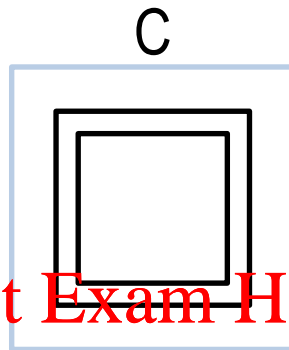
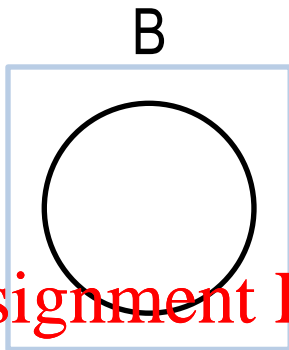
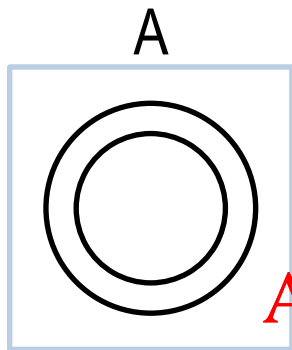
Problems

- 2x1 matrix problems
- 2x2 matrix problems
- 3x3 matrix problems

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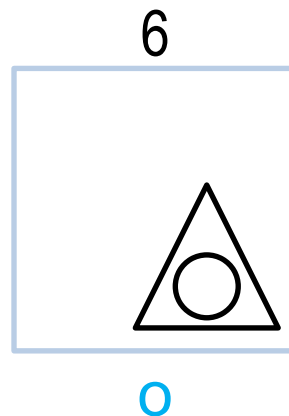
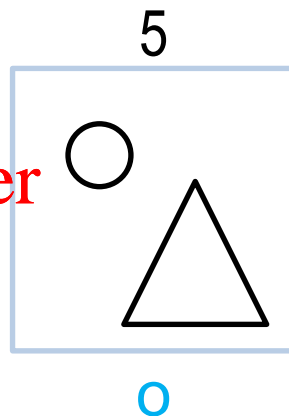
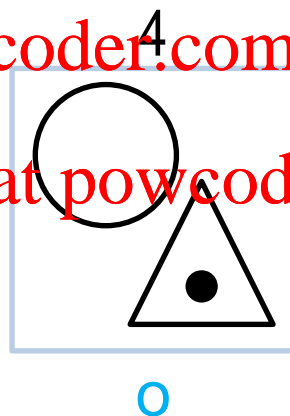
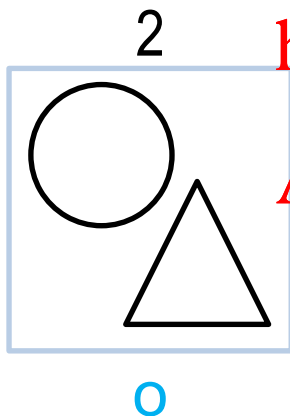
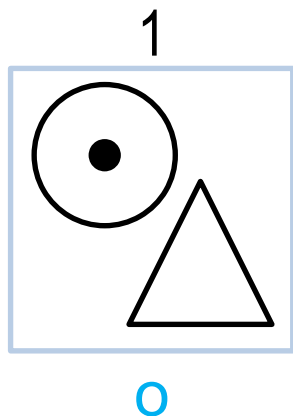
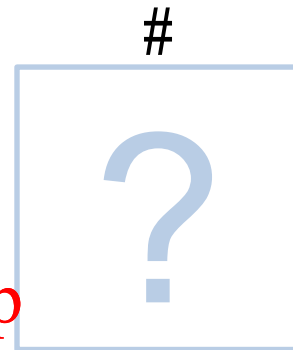
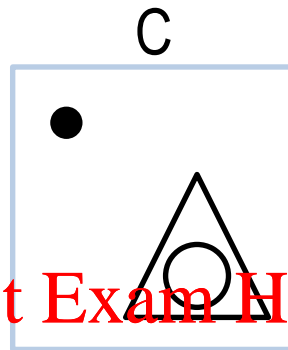
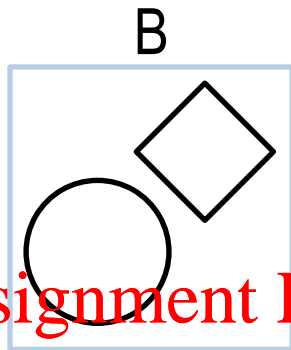
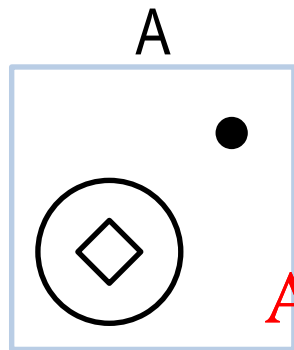
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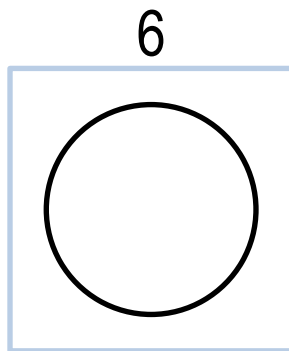
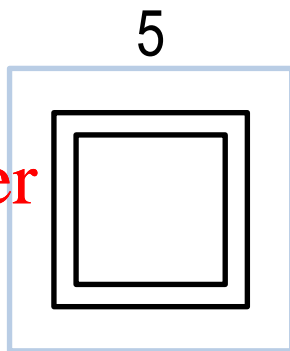
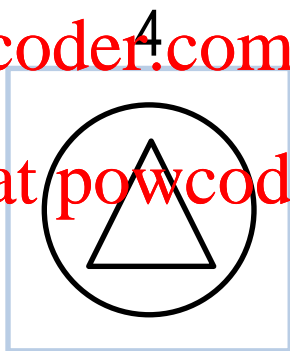
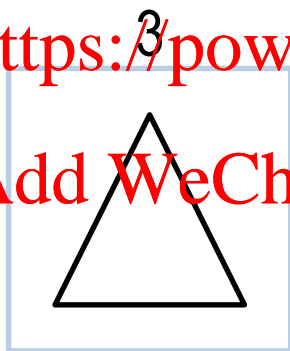
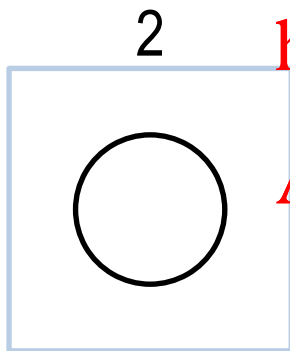
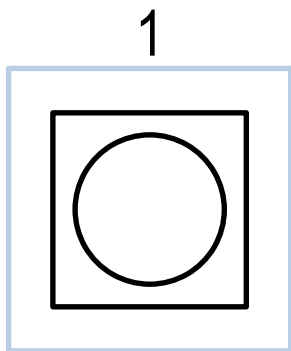
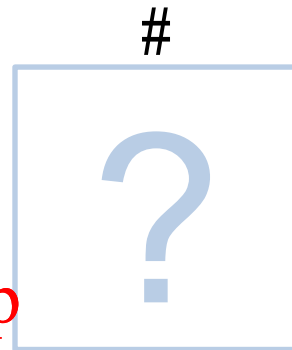
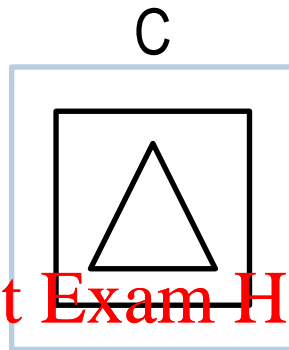
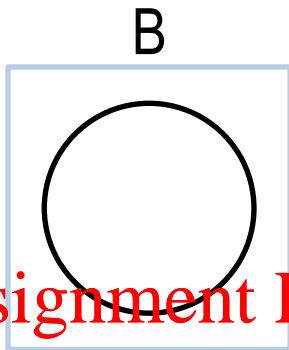
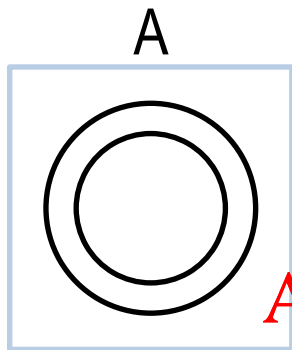
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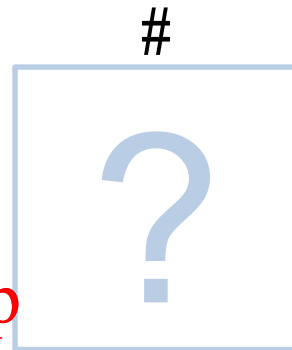
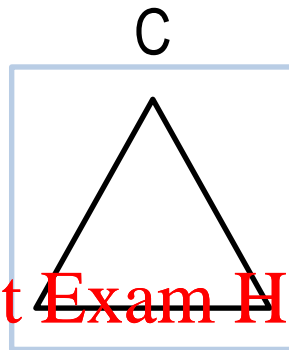
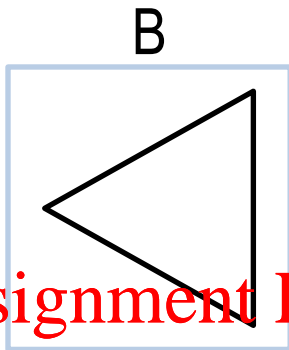
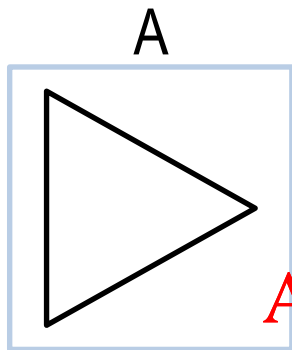
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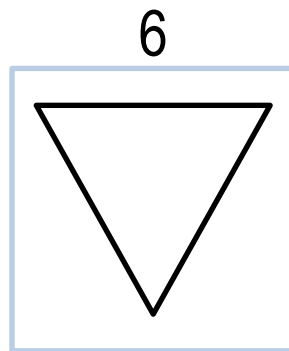
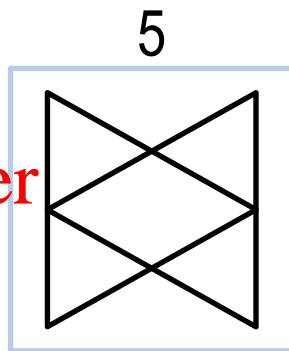
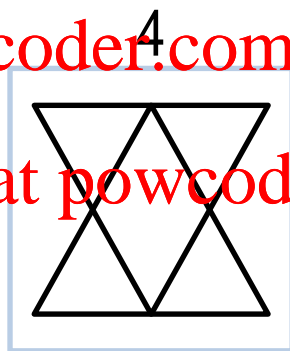
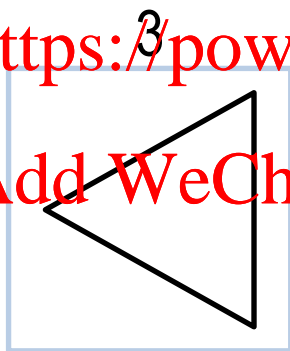
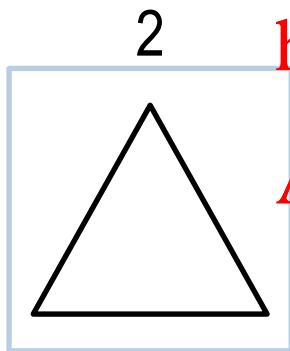
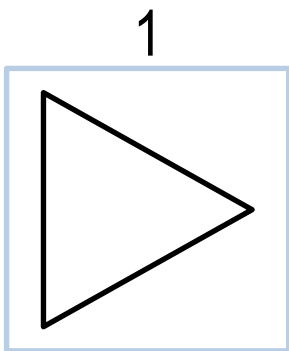
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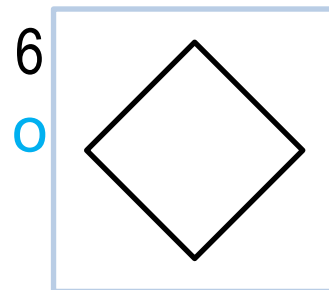
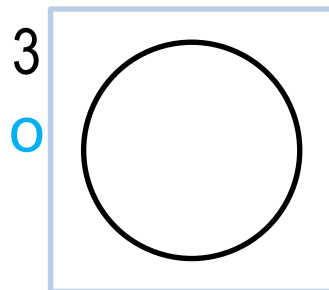
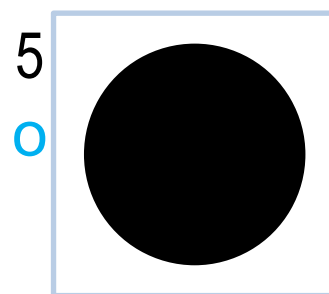
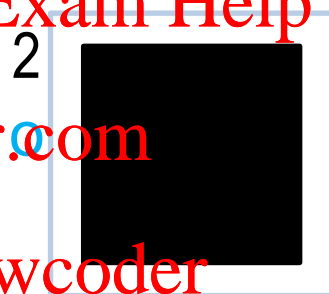
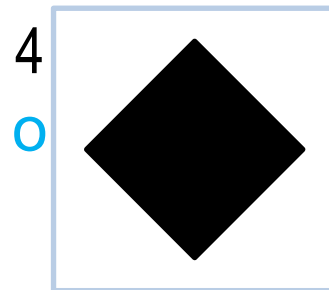
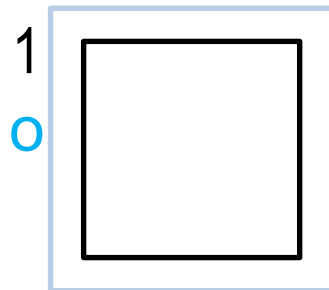
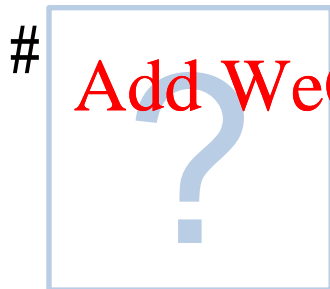
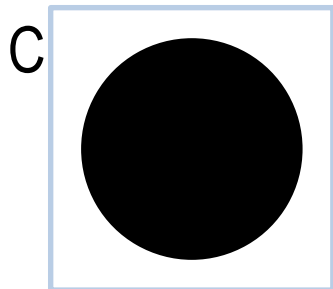
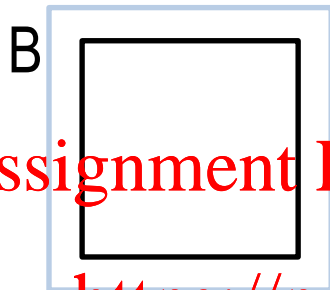
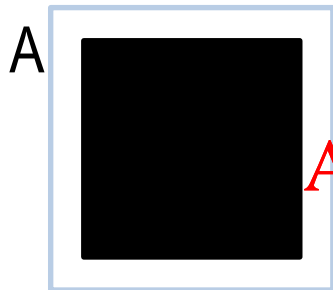
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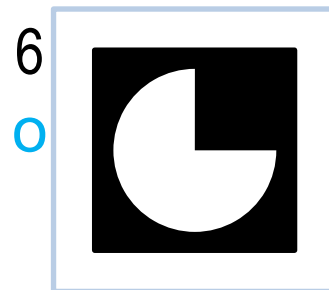
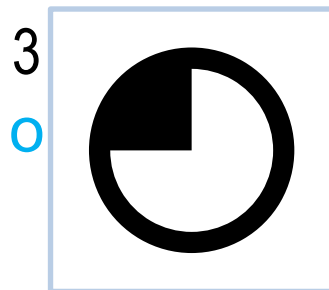
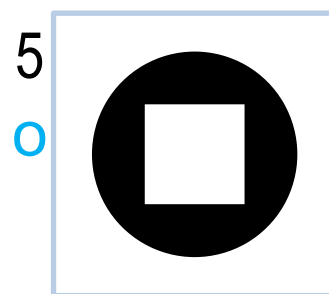
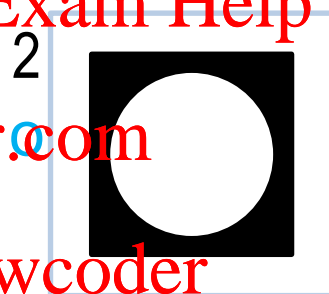
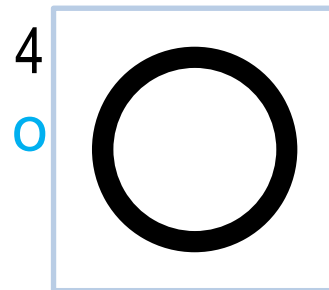
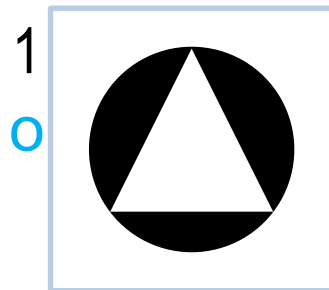
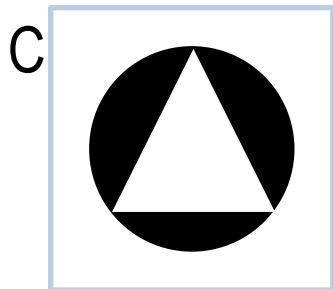
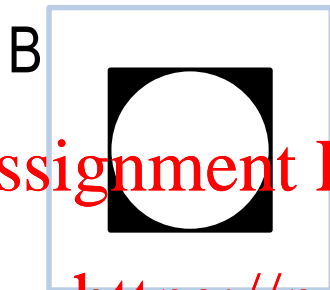
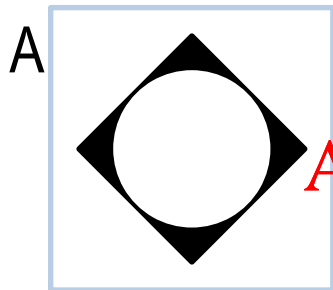
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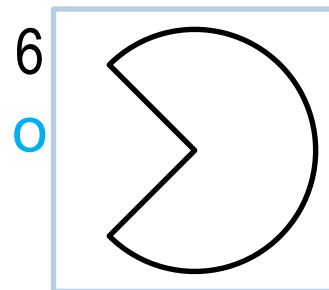
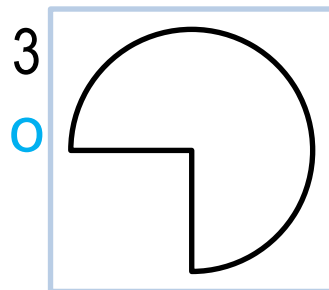
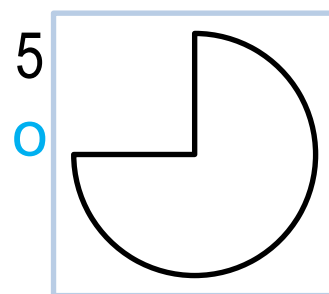
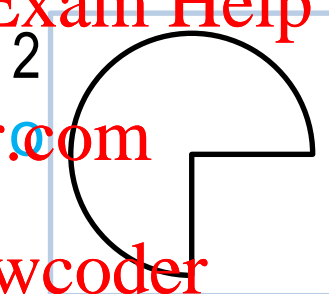
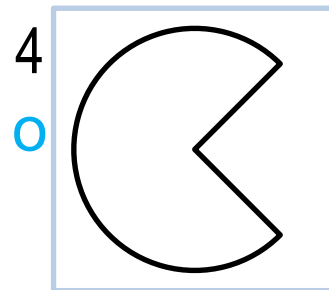
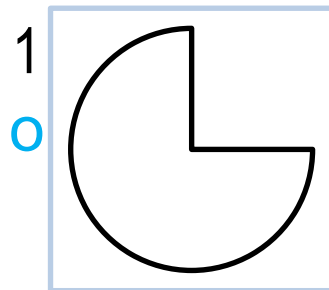
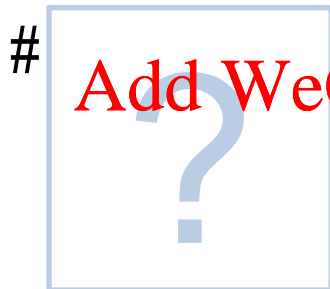
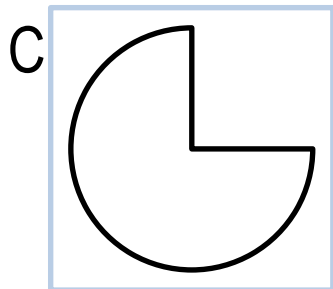
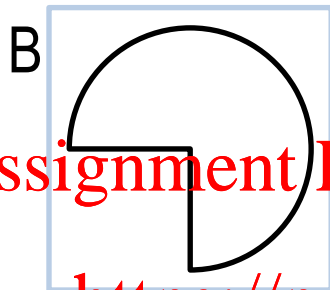
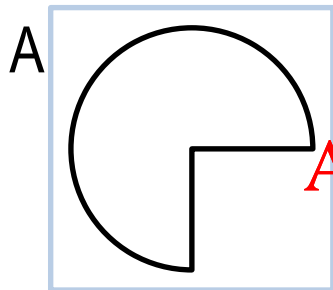
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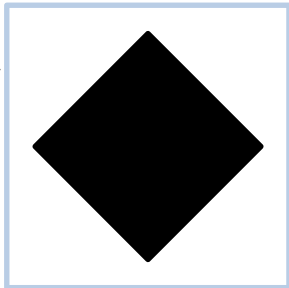


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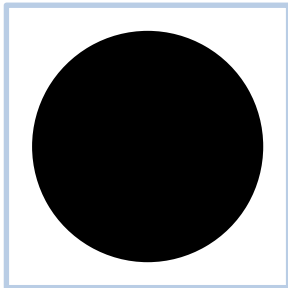
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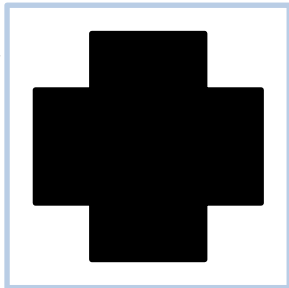
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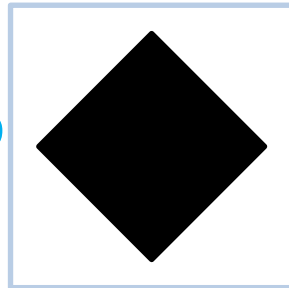


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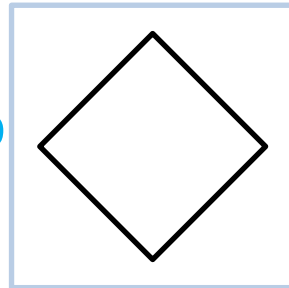
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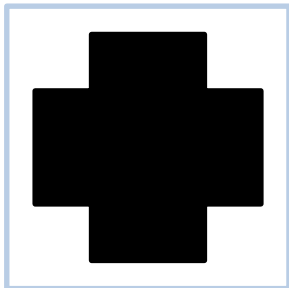


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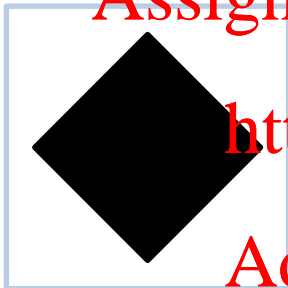
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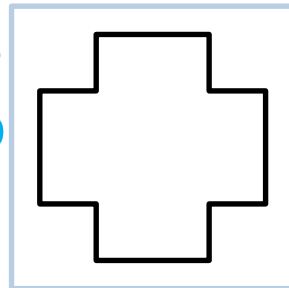
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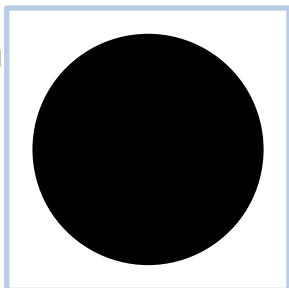


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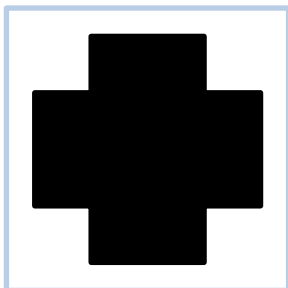
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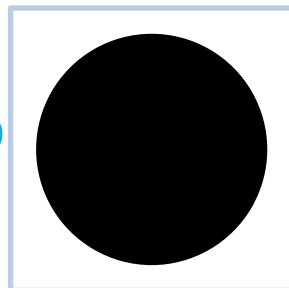


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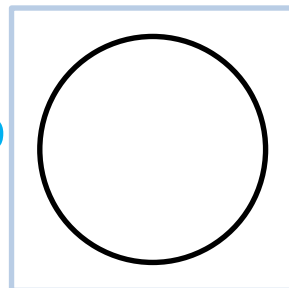
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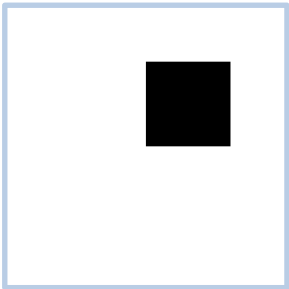


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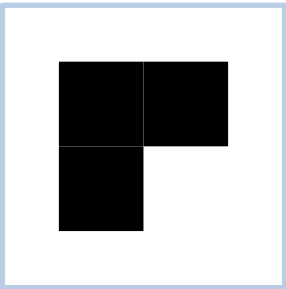
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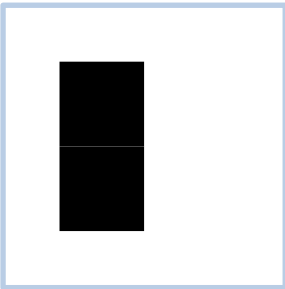
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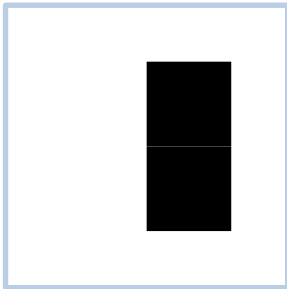
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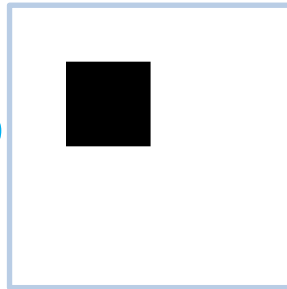
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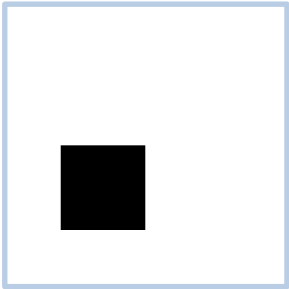
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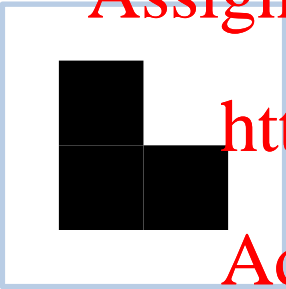
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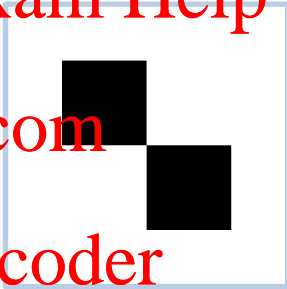
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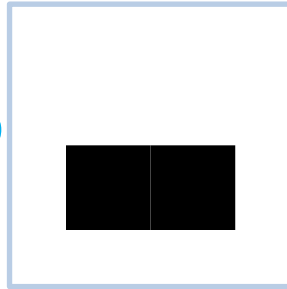
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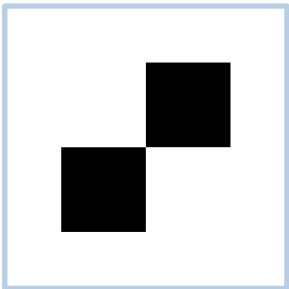
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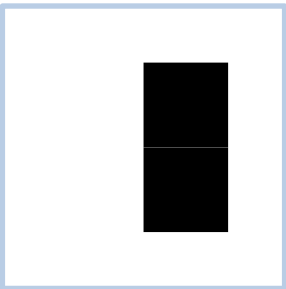
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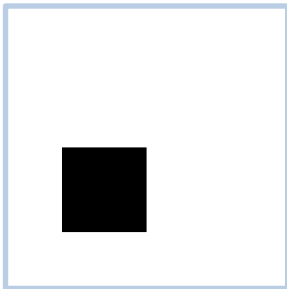
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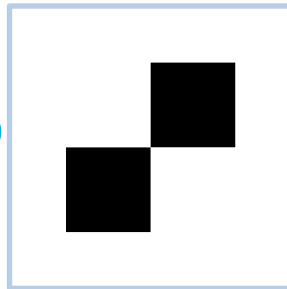
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Principles of CS7637

1. KBAI agents represent and organize knowledge into knowledge structures to guide and support reasoning.
2. Learning in KBAI agents is often incremental.
3. Reasoning in KBAI agents is top-down as well as bottom-up.
4. KBAI agents match methods to tasks.
5. KBAI agents use heuristics to find solutions that are good enough, though not necessarily optimal.
6. KBAI agents make use of recurring patterns in the problems they solve.
7. The architecture of KBAI agents enables reasoning, learning, and memory to support and constrain each other.

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Frequently-used readings

- Artificial Intelligence by Patrick Winston
- Knowledge Systems by Mark Stefik
- Artificial Intelligence by Elaine Rich and Kevin Knight
- Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig

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To recap...

- Class goals, outcomes, and strategies
- The Project: Raven's Progressive Matrices
- Principles of CS7637

Assignment Project Exam Help

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