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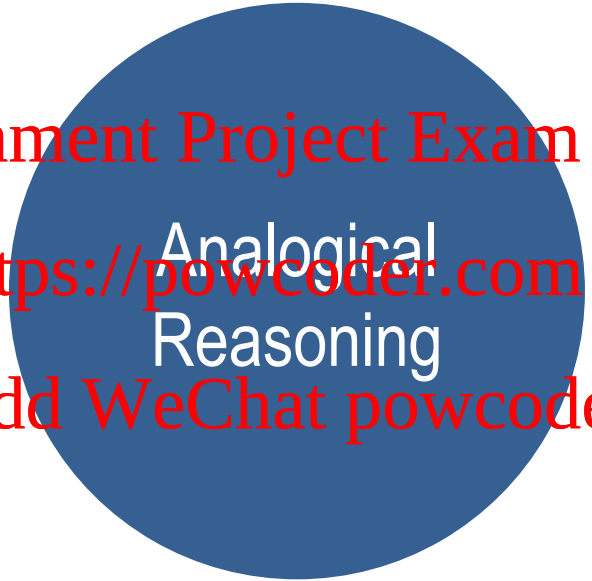
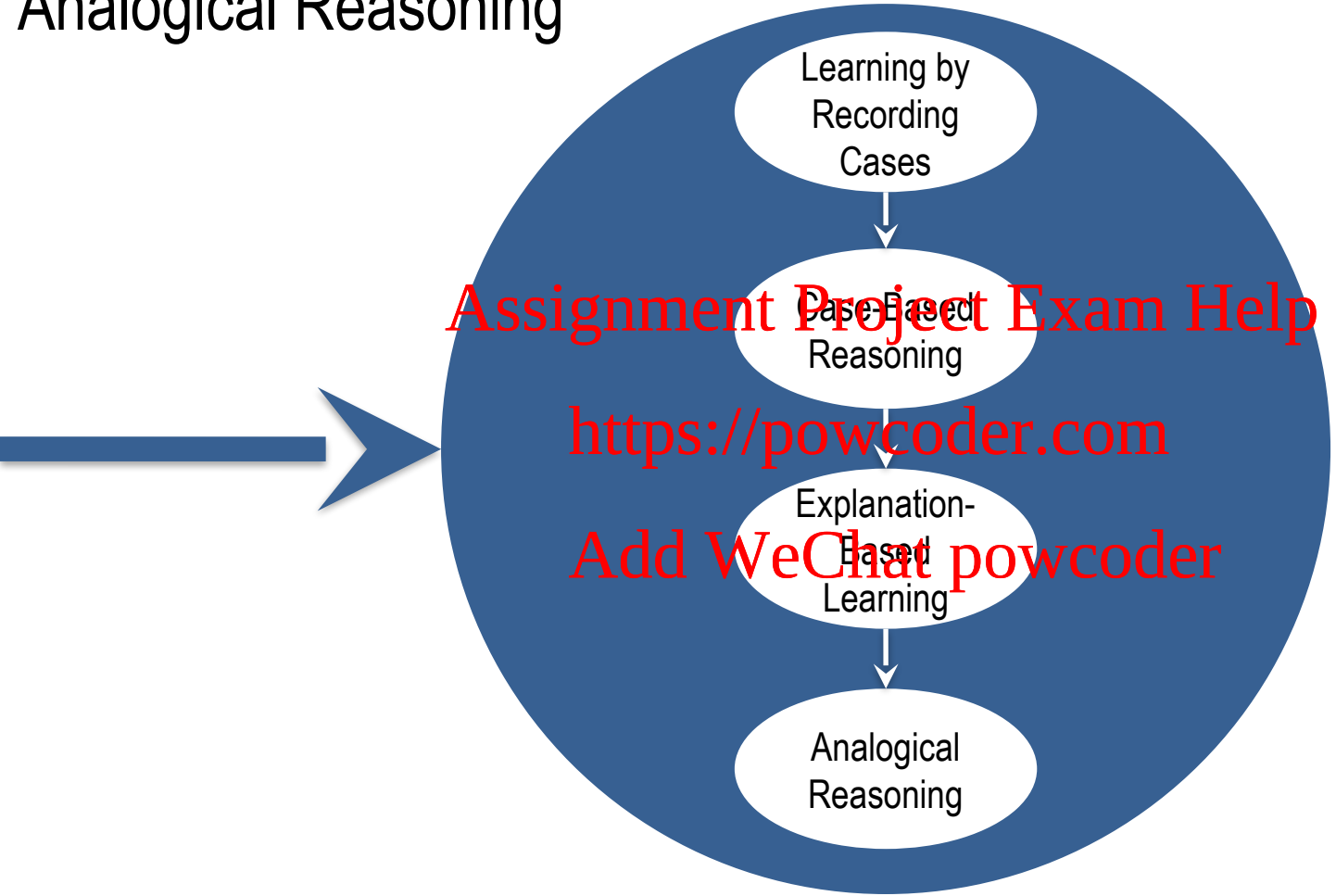


Analogical Reasoning



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Lesson Preview

- Similarity and case-based reasoning
- Process of analogical reasoning
- Design by analogy

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A woman is climbing a ladder.

Which of the situations on the right is most similar to the situation above?

Rank them from 1 (most similar) to 7 (least similar)

2	A woman climbing a set of stairs.
3	An ant walking up the wall.
6	A woman painting a ladder.
4	A woman climbing the corporate ladder.
7	A water bottle sitting on a desk.
1	A woman climbing a step ladder.
5	A plane taking off into the sky.

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Finding the Nearest Neighbor

Given existing case at (x_c, y_c)
and new problem at (x_n, y_n)

$$d = \sqrt{(y_c - y_n)^2 + (x_c - x_n)^2}$$

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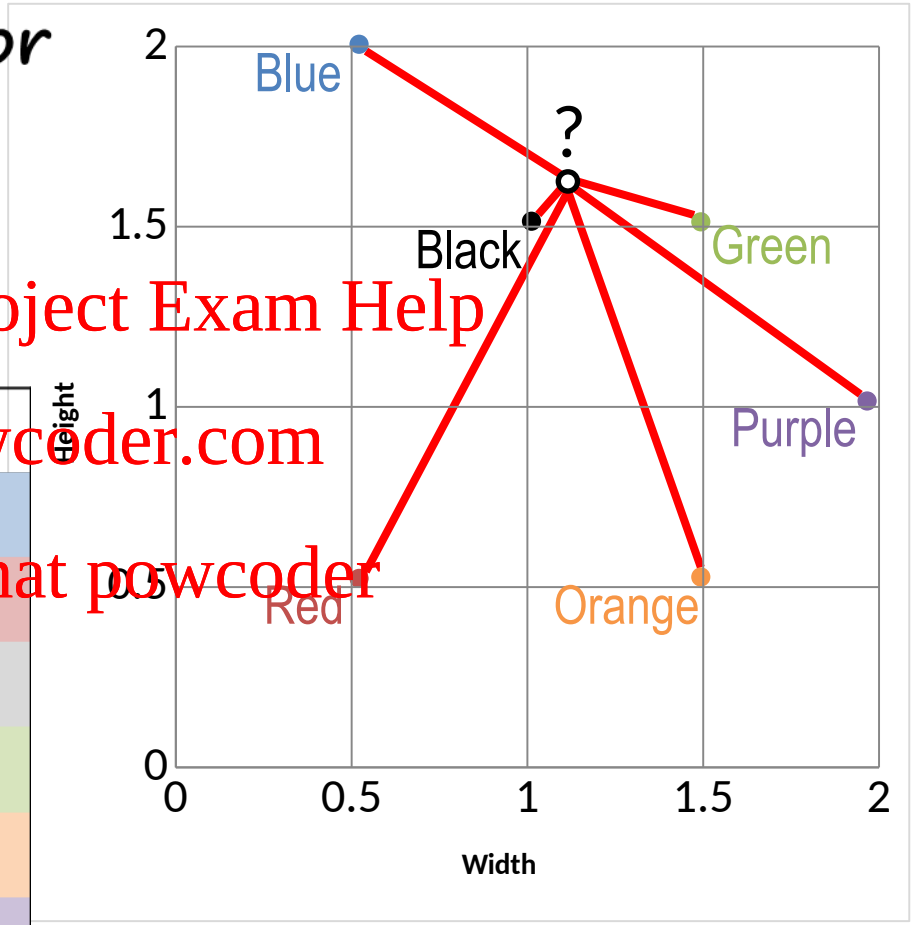
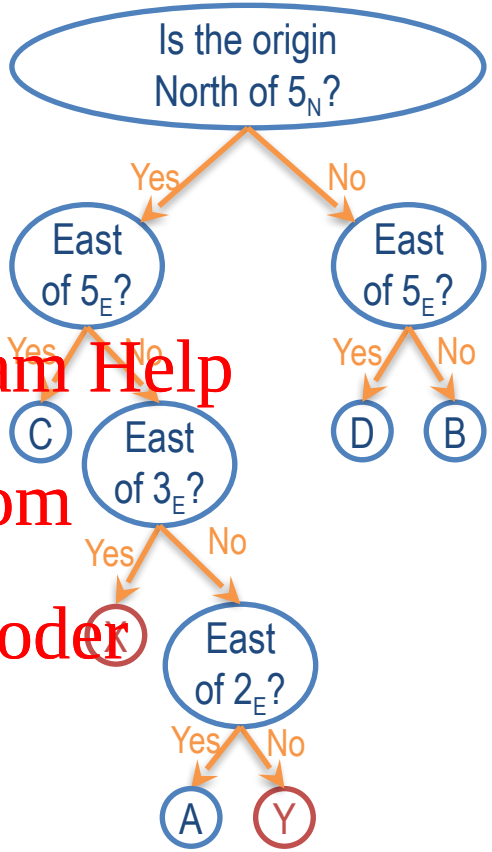
Block	x_c	y_c	x_n	y_n	d
Blue	0.5	2.0	1.1	1.6	0.72
Red	0.5	0.5	1.1	1.6	1.25
Black	**1.0**	**1.5**	**1.1**	**1.6**	**0.14**
Green	1.5	1.5	1.1	1.6	0.41
Orange	1.5	0.5	1.1	1.6	1.17
Purple	2.0	1.0	1.1	1.6	1.08



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



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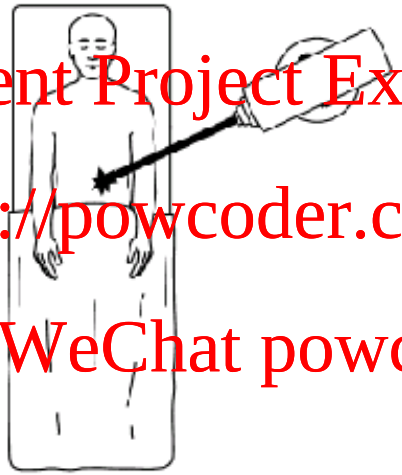

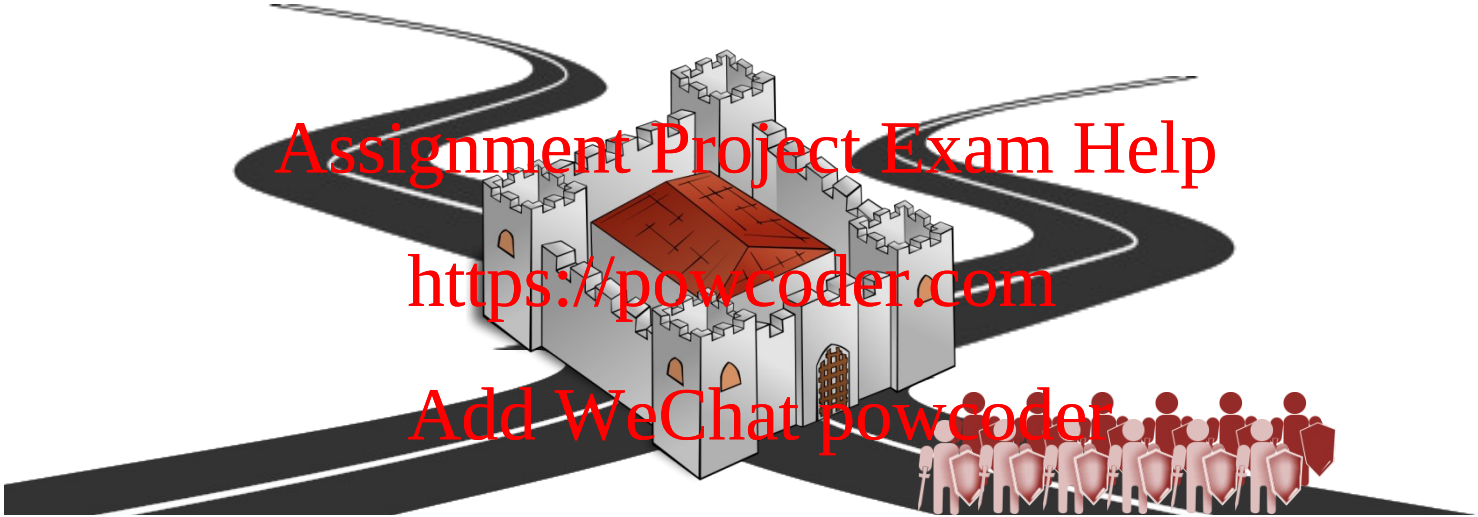

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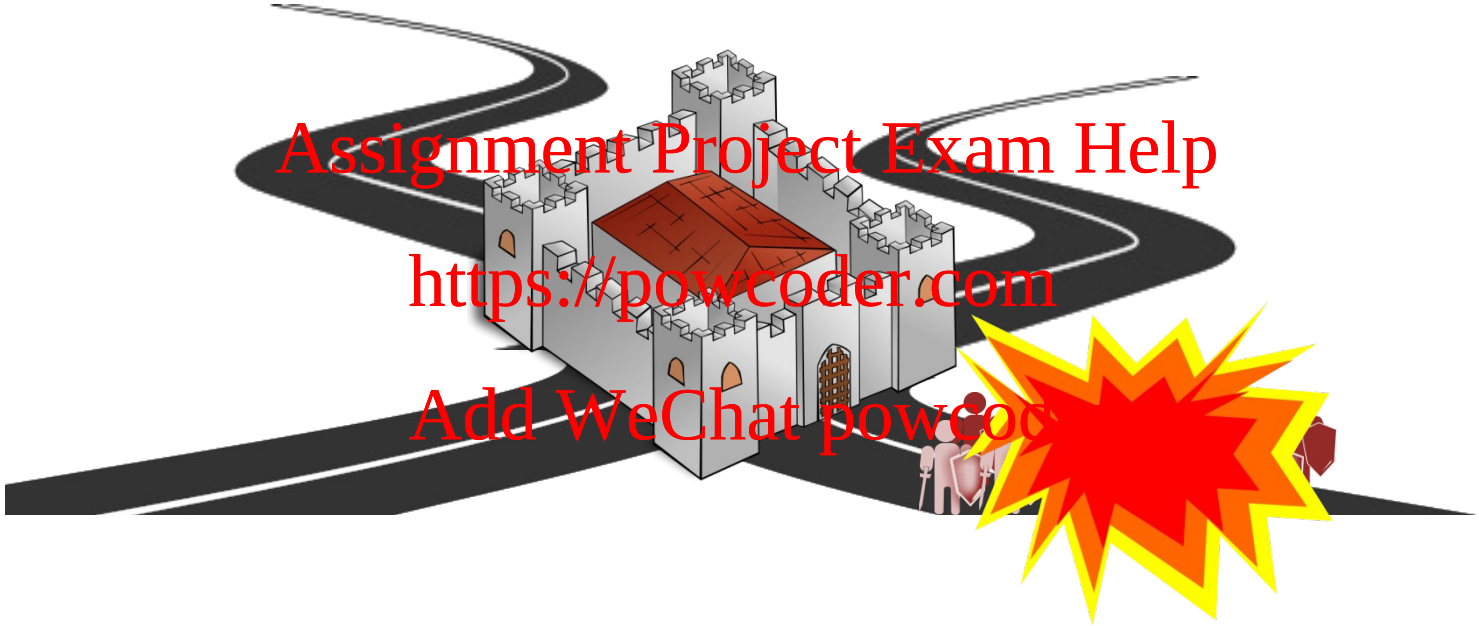

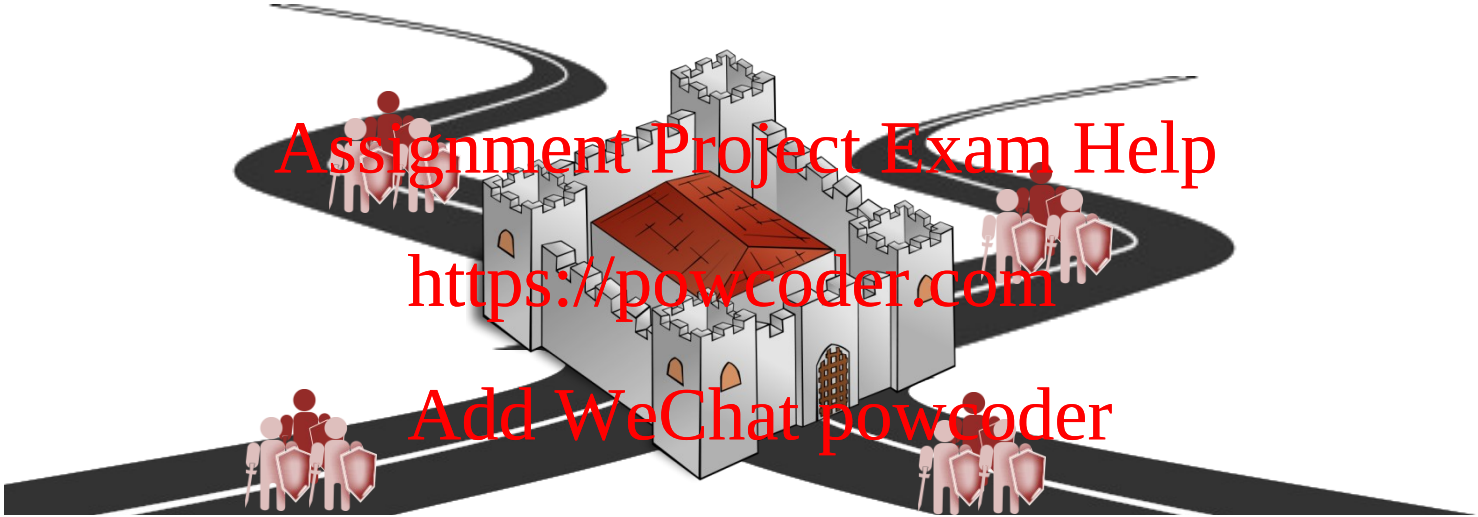

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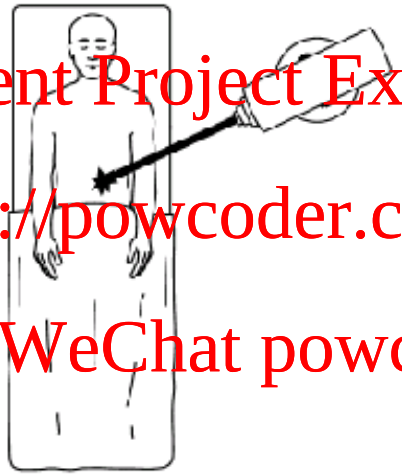

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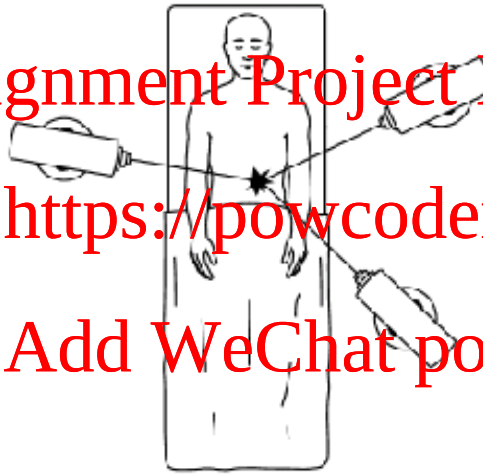

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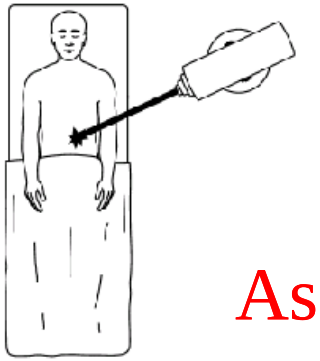

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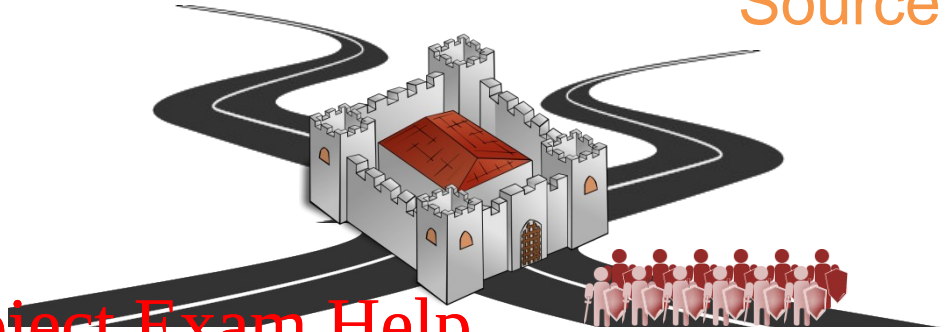

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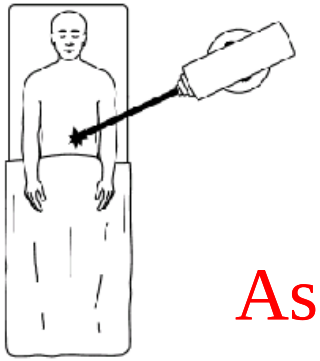

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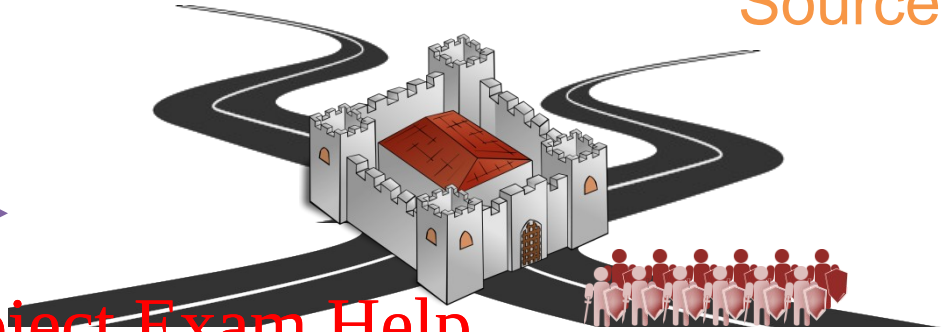

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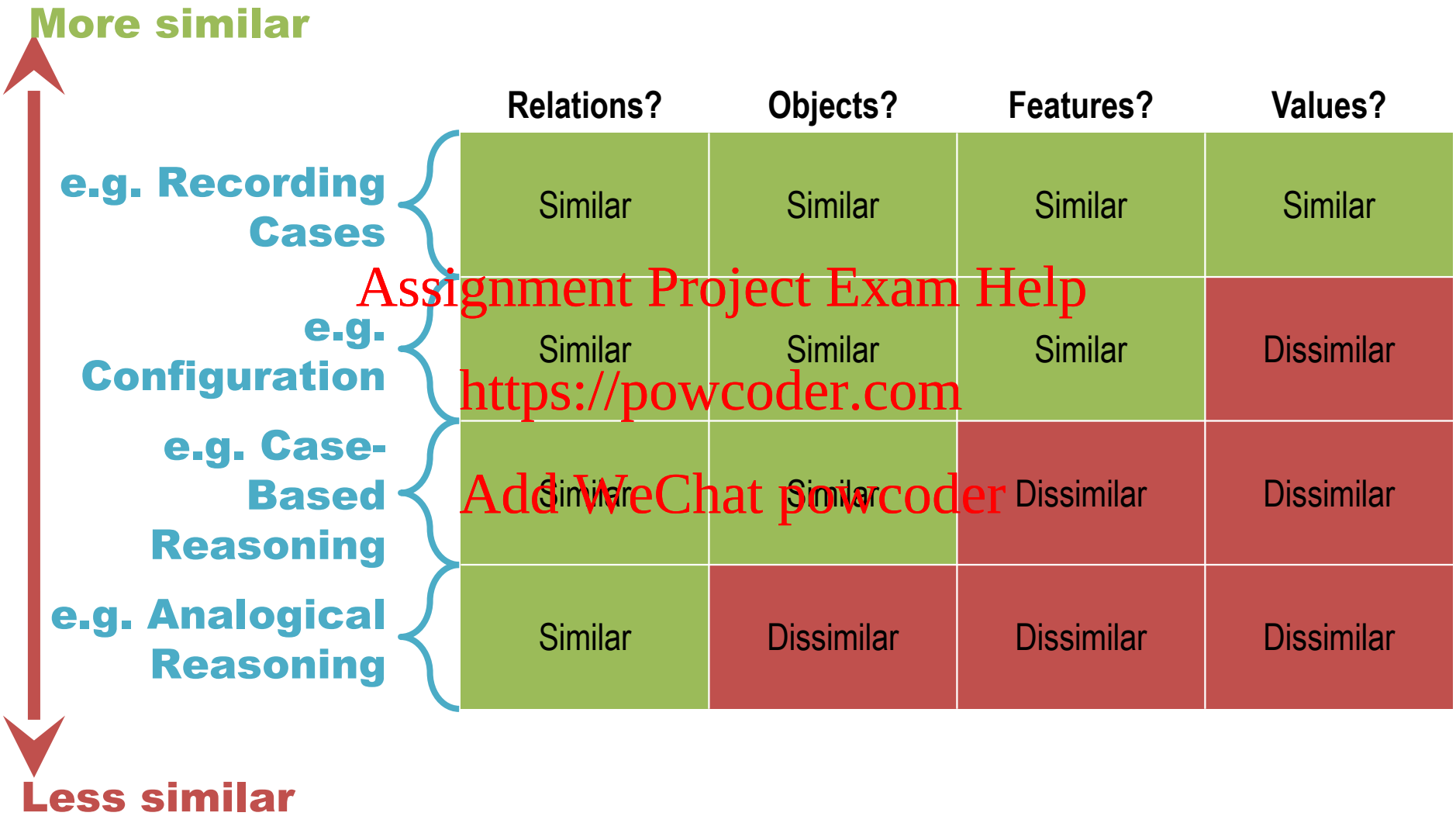

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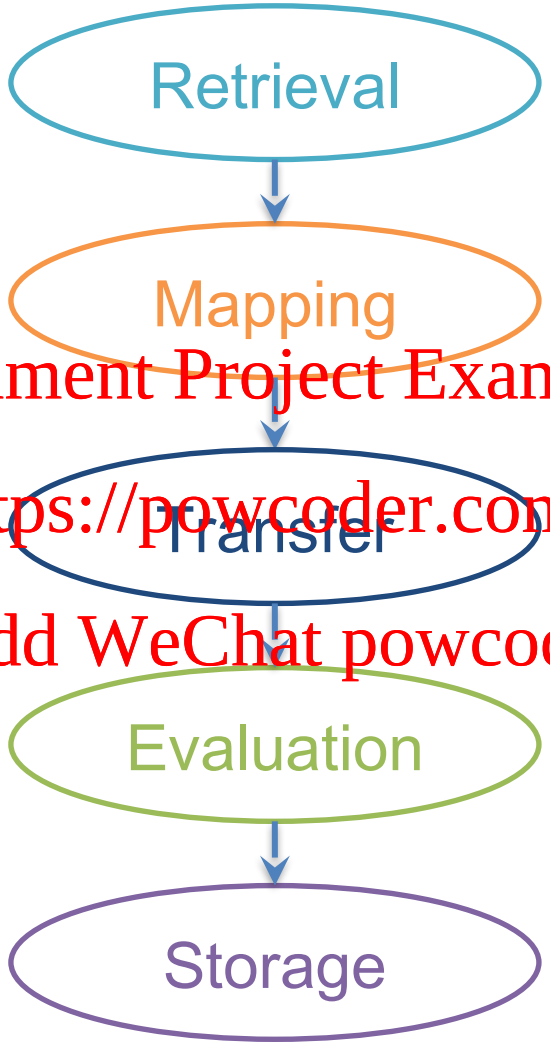

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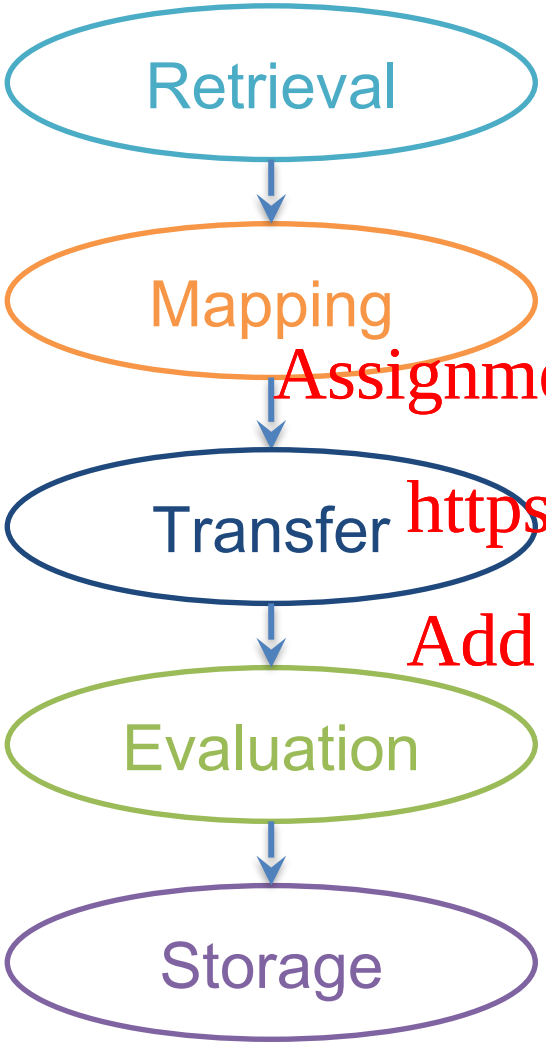

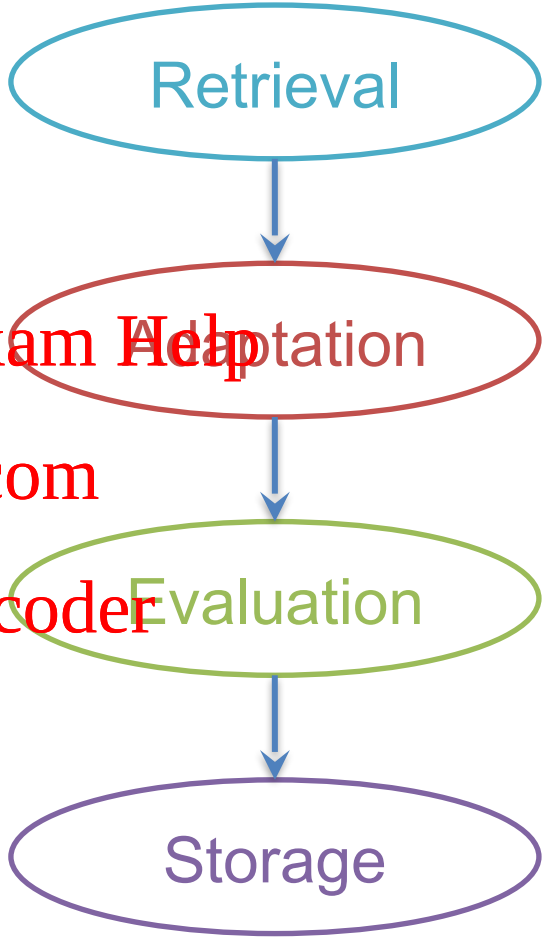

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B	1_E	8_N
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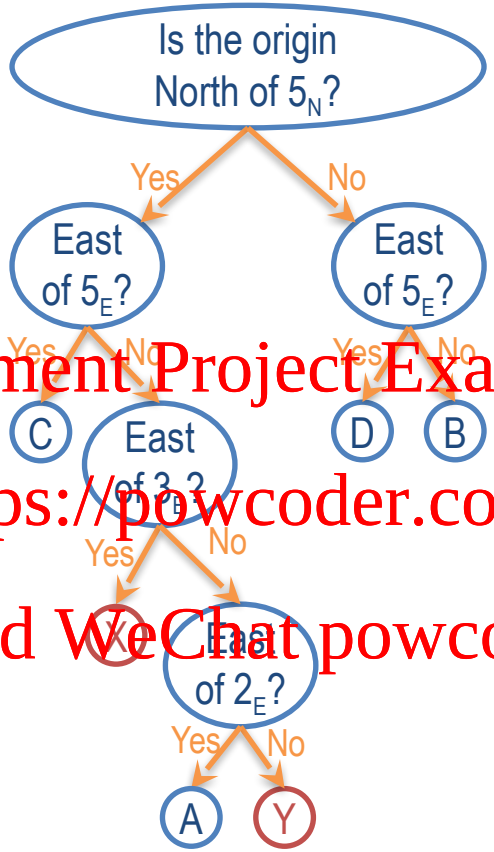
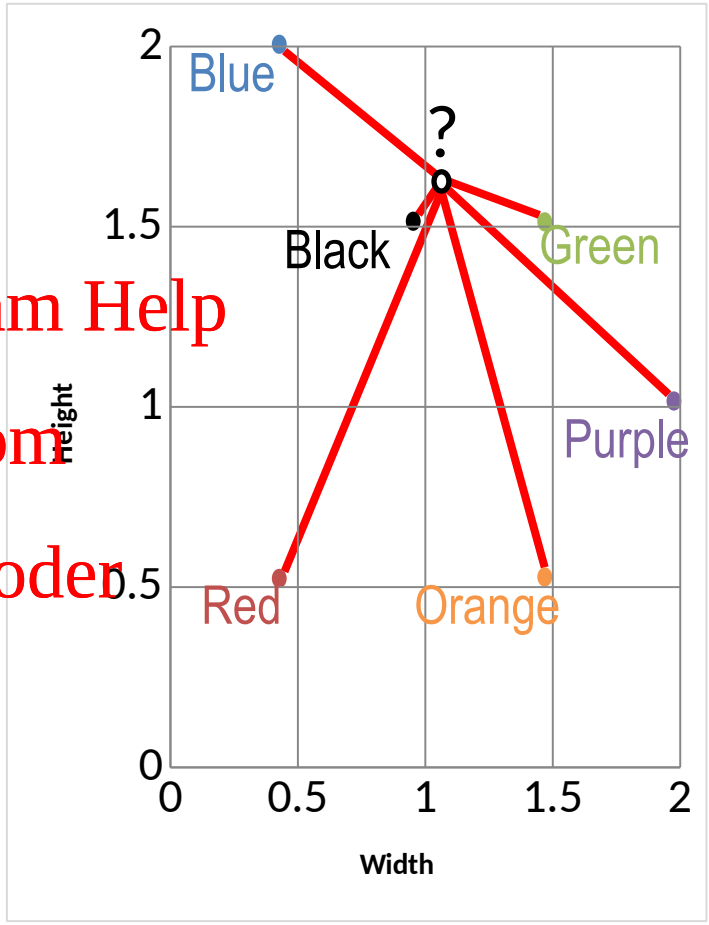
Y	8_E	2_N
Z	1_E	9_N





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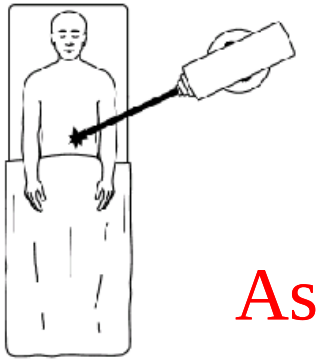

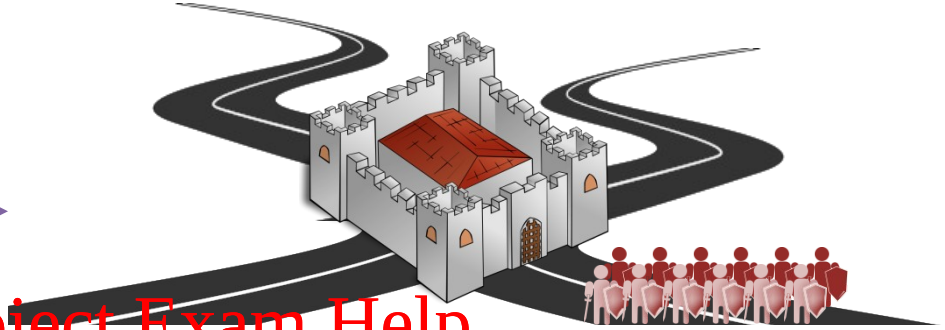

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Superficial Similarity

- Features
- Counts
- Objects

Deep Similarity

- Relationships between objects
- Relationships between relationships

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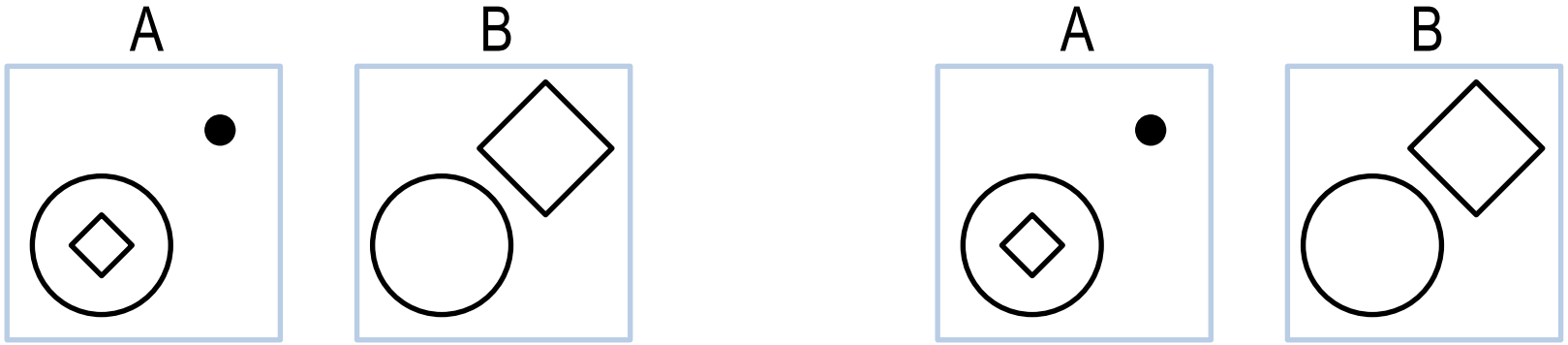

Types of Similarity

Semantic	Pragmatic	Structural
Conceptual similarity between the target problem and the source case.	Similarity of external factors, such as goals.	Similarity between representational structures.

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A woman is climbing a ladder.

Mark whether each situation has deep similarity, superficial similarity, both, or neither with the situation

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Deep	Superficial	Above
o	o	A woman climbing a set of stairs.
o	o	An ant walking up the wall.
o	o	A woman painting a ladder.
o	o	A woman climbing the corporate ladder.
o	o	A water bottle sitting on a desk.

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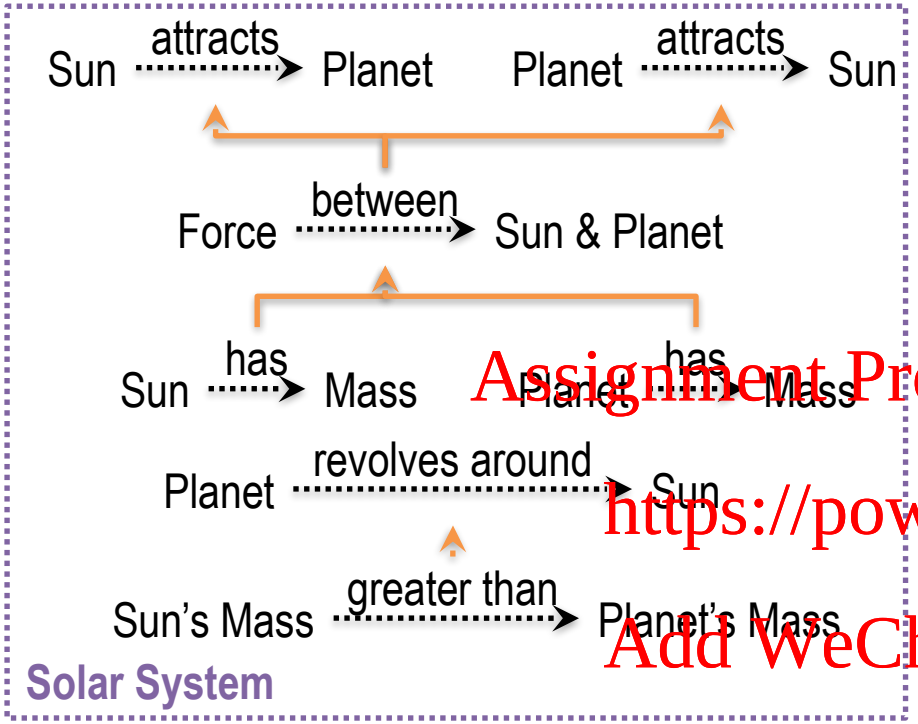

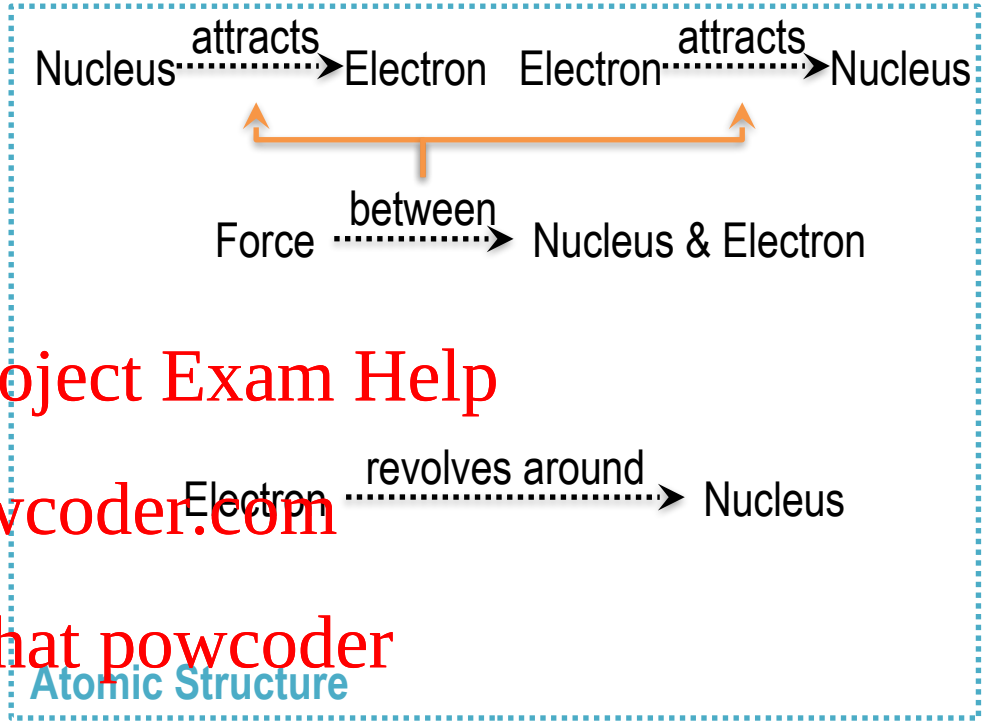

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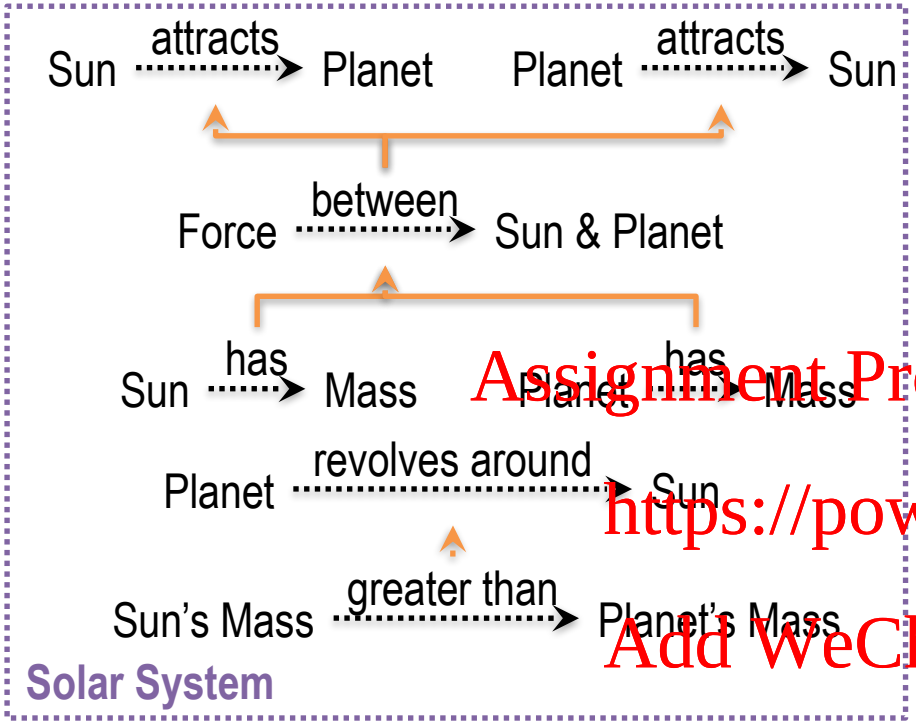

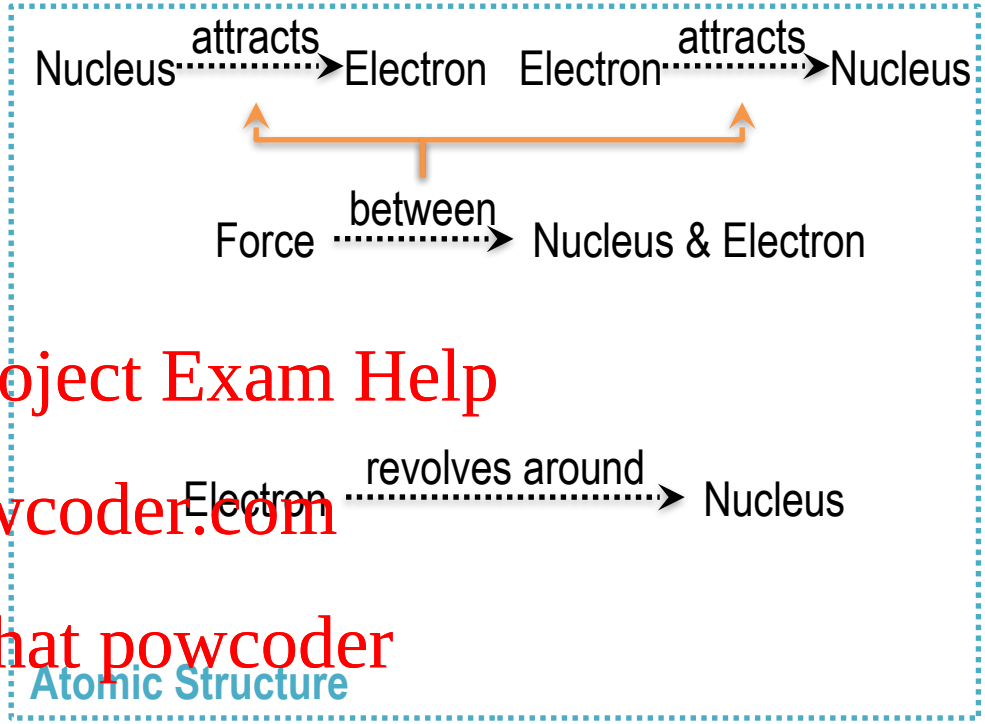

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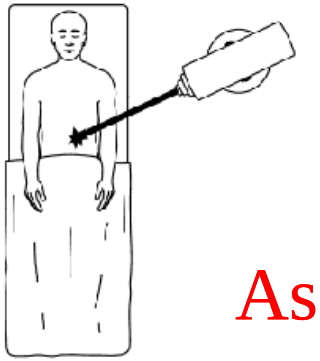
What are the deep similarities between these two models?

- Something revolves around something else.
- Two things each have mass.
- Mass & force are present.
- A force exists between two objects.
- The objects' masses differ.
- Two objects attract each other.

Target



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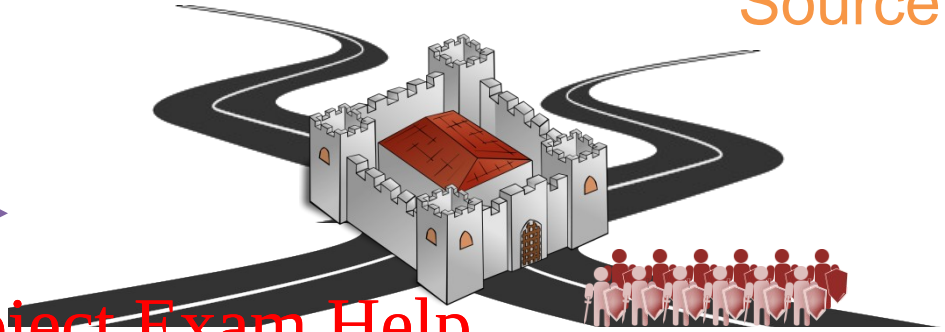

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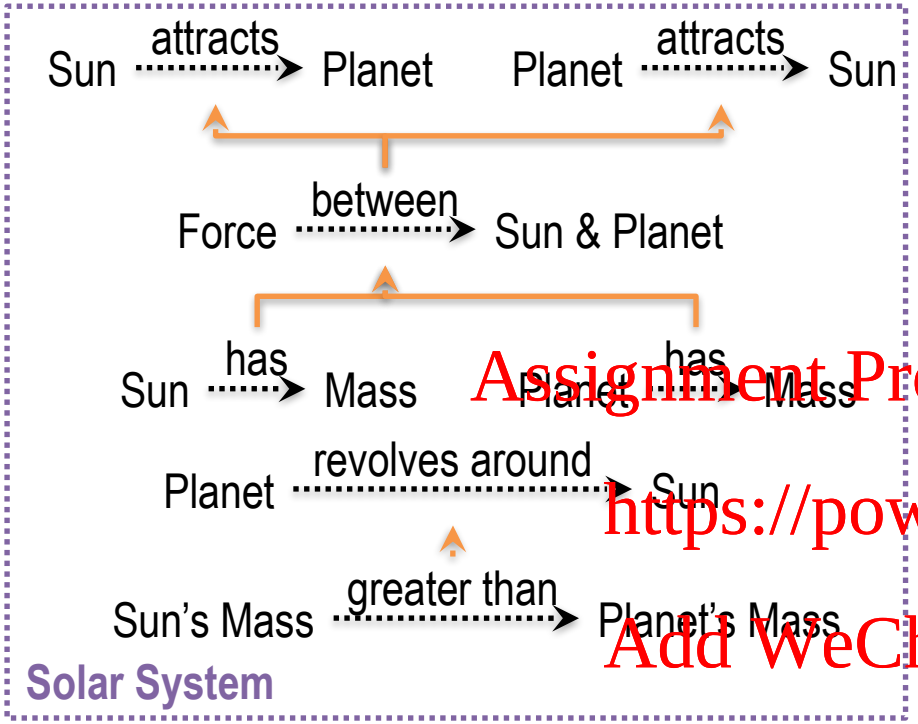

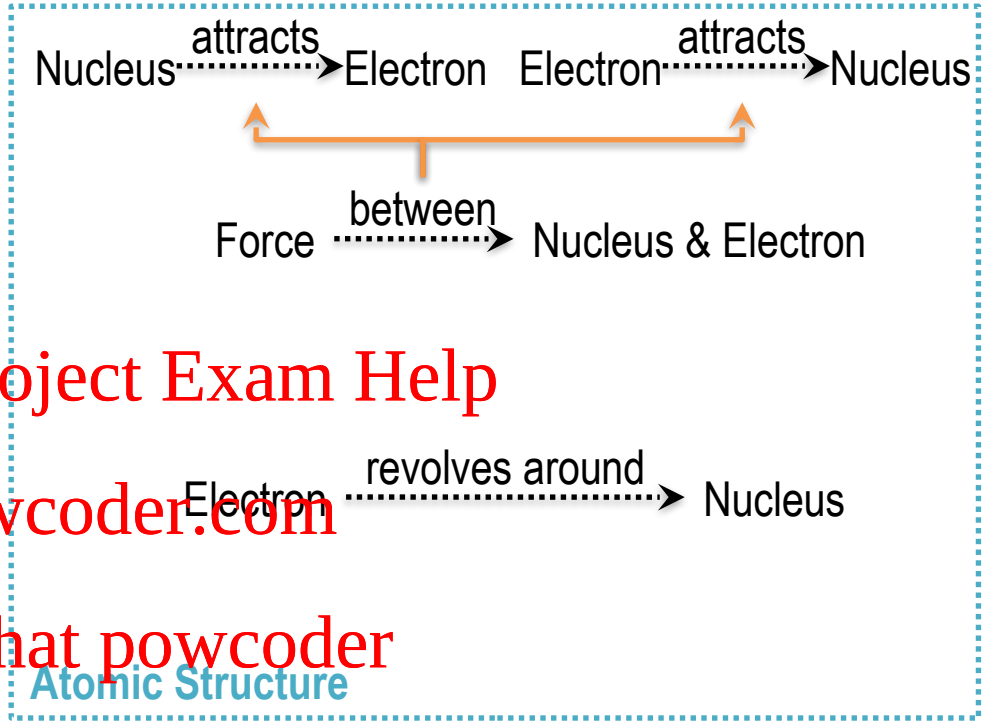

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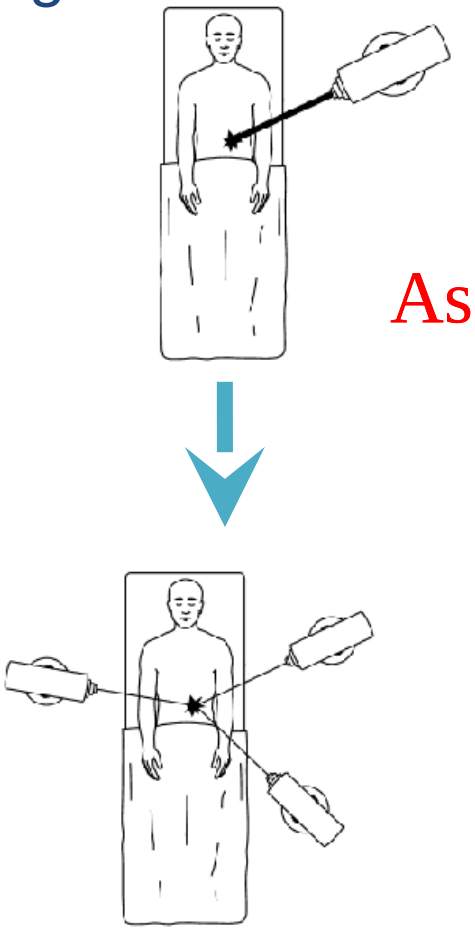
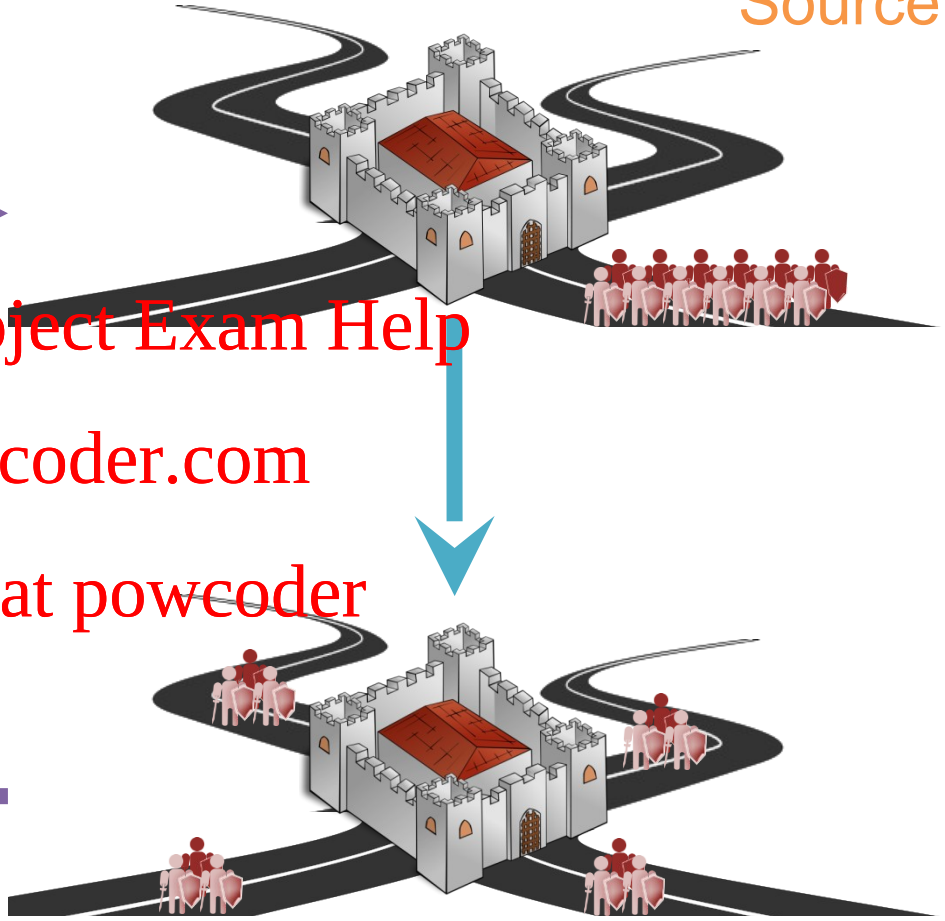
How would you map the solar system to the atomic structure?

- Sun → Nucleus
- Electron → Nucleus
- Nucleus → Sun
- Sun → Planet
- Planet → Electron
- Planet → Sun
- Planet → Nucleus
- Electron → Planet
- Sun → Electron
- Nucleus → Planet

Target

Source





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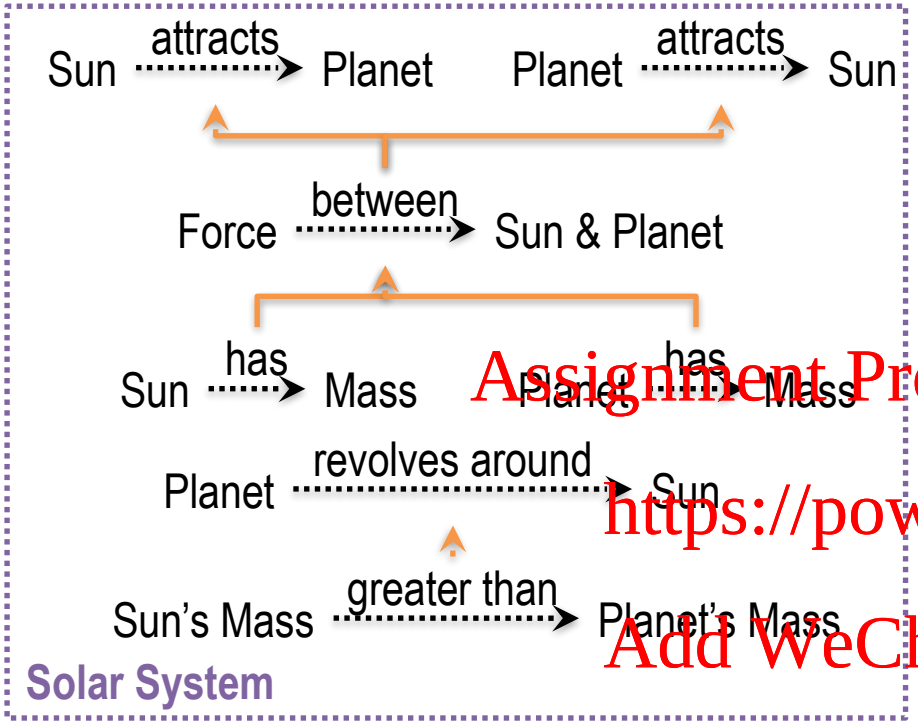

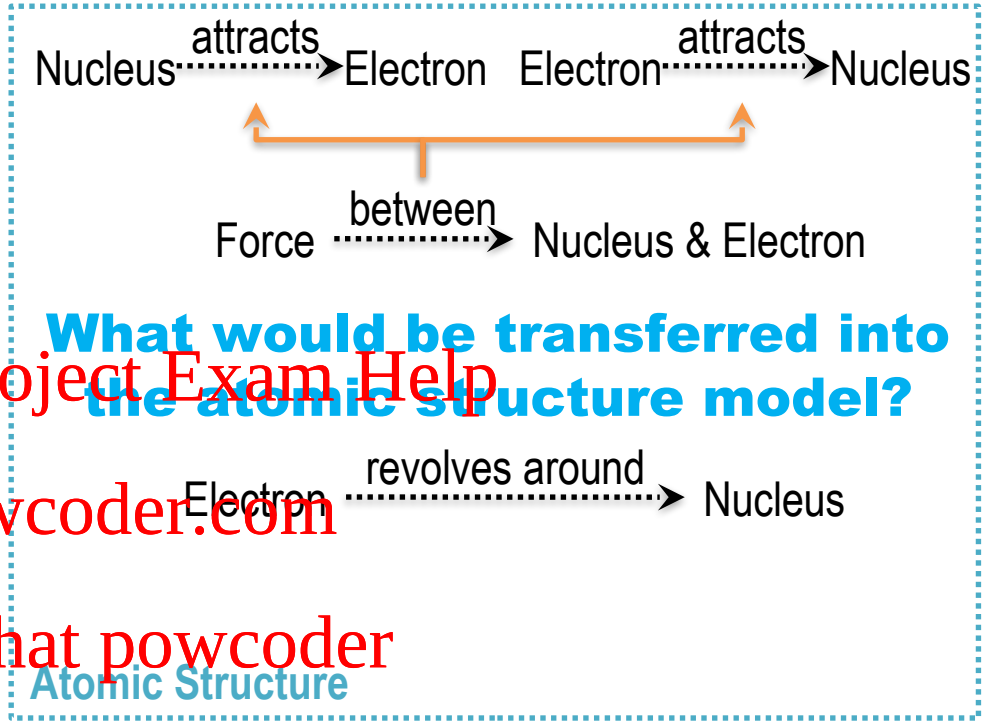

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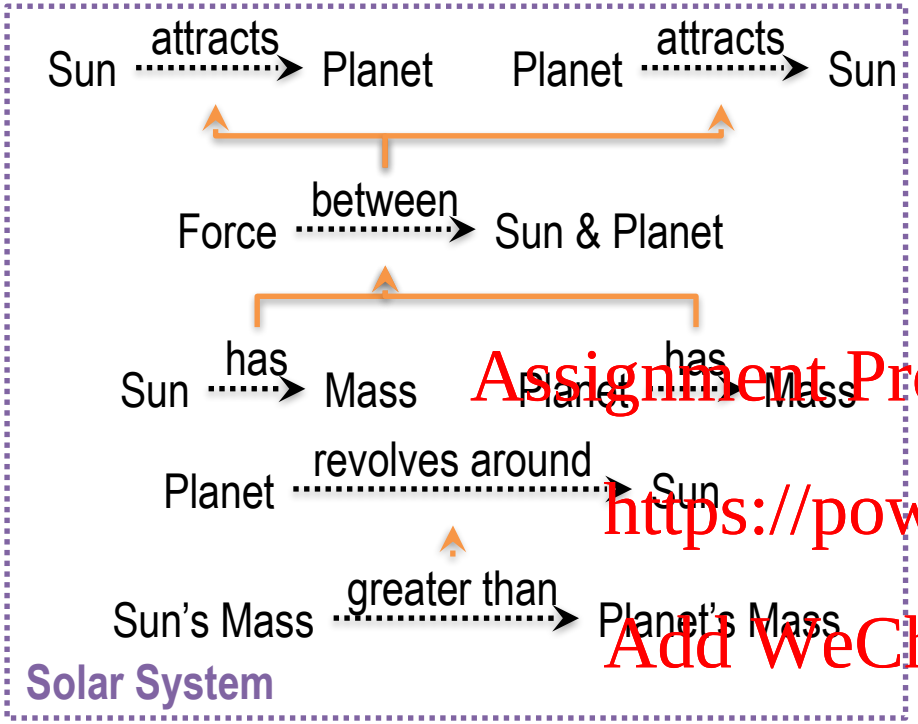
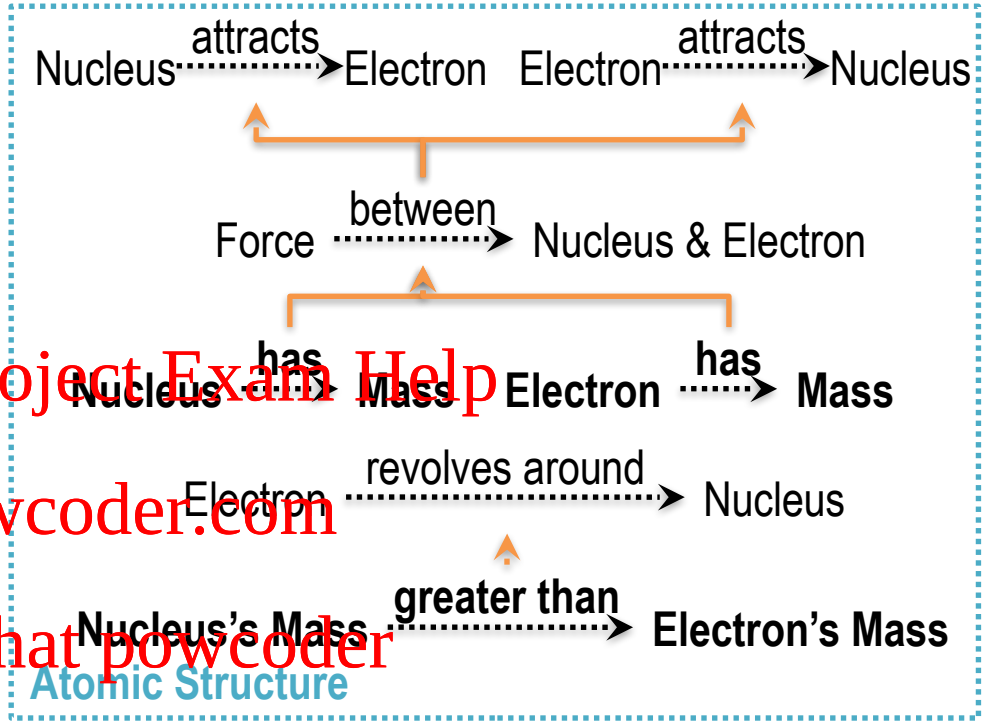
- Nucleus has mass
- Nucleus is a sun
- Nucleus attracts electron
- Electron's mass greater than nucleus's mass

- Electron revolves around nucleus
- Electron has mass
- Electrons are planets
- Nucleus's mass greater than electron's mass





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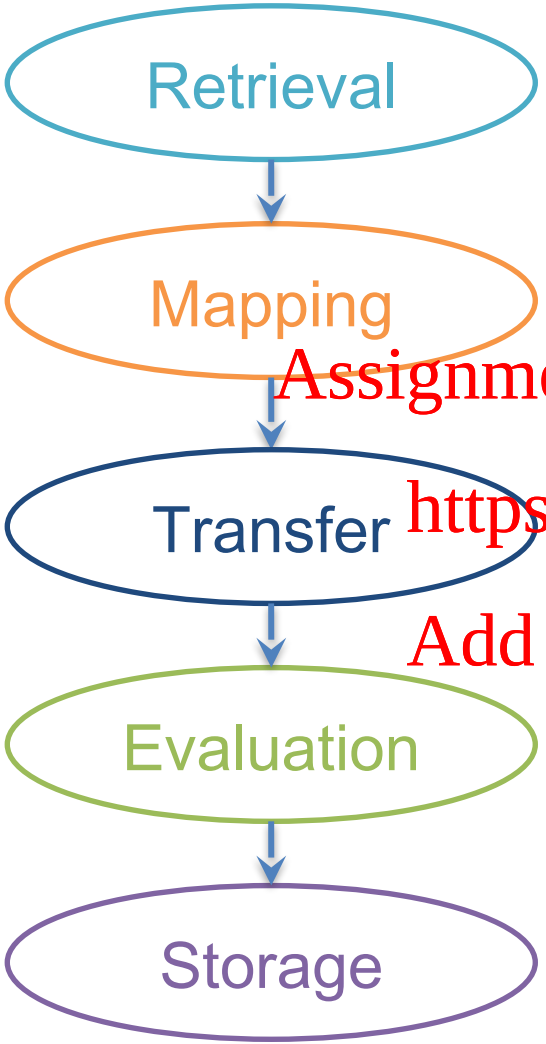

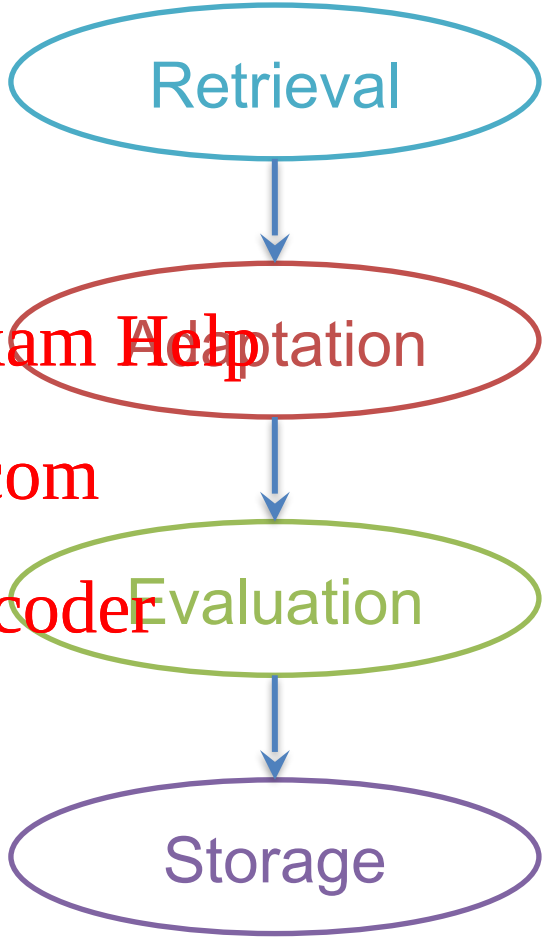

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Target

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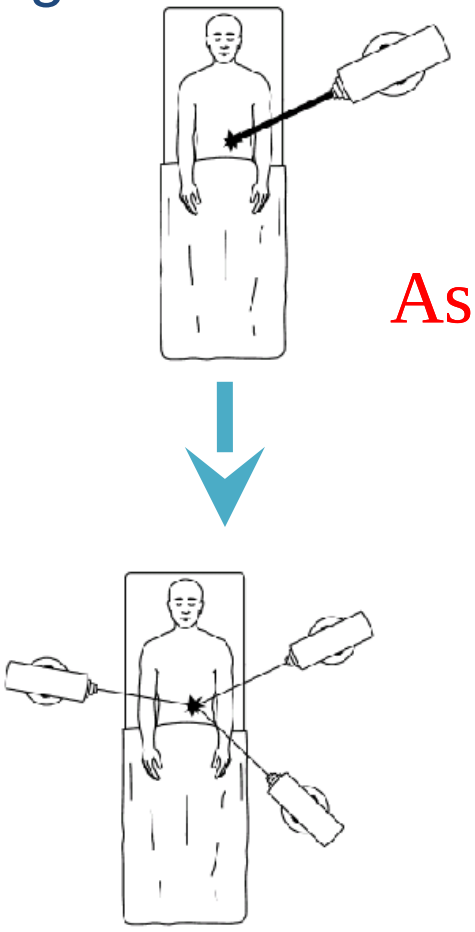

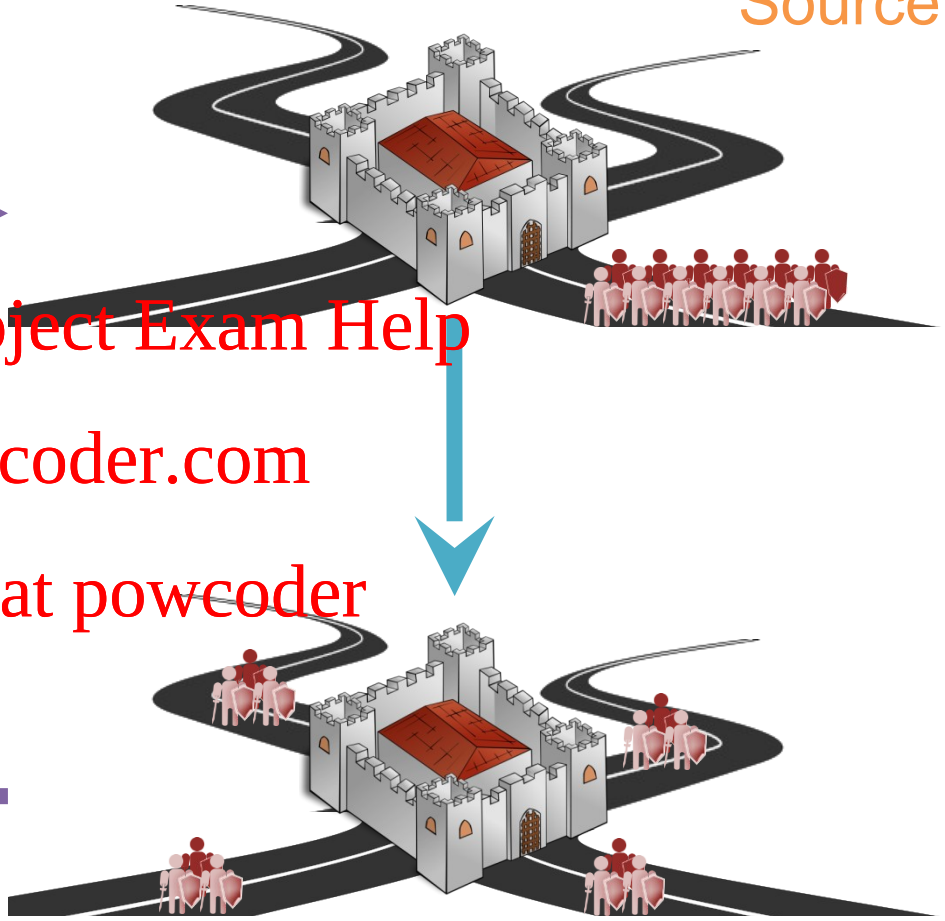

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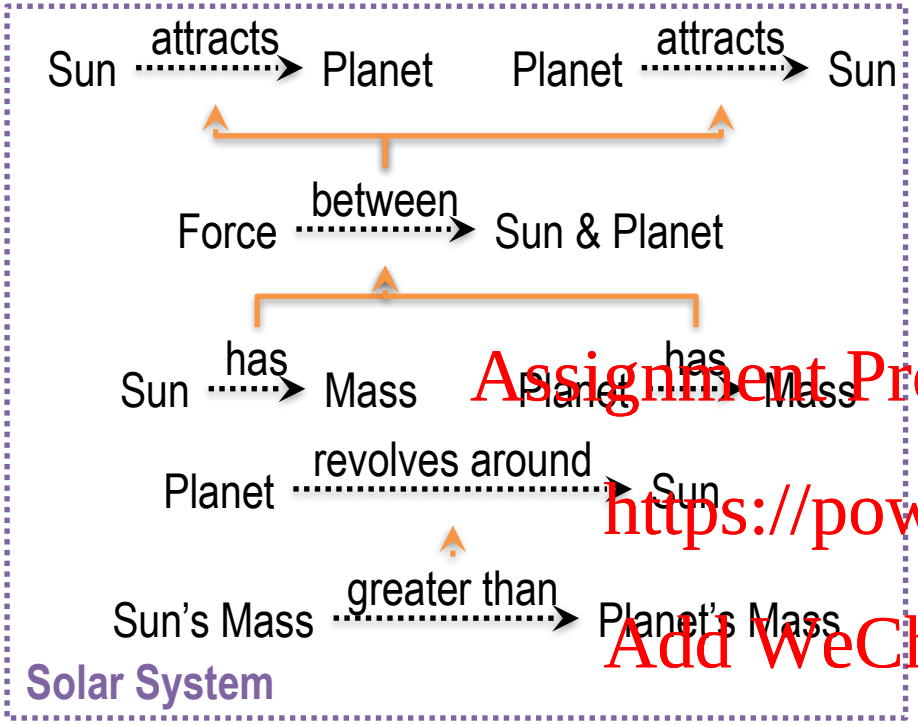

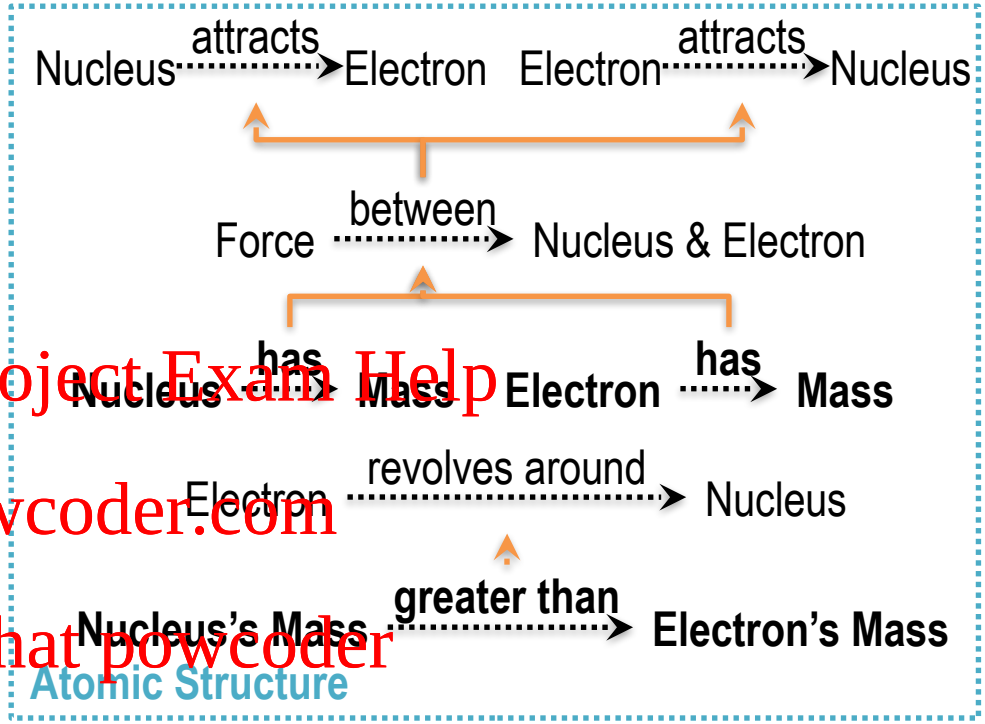

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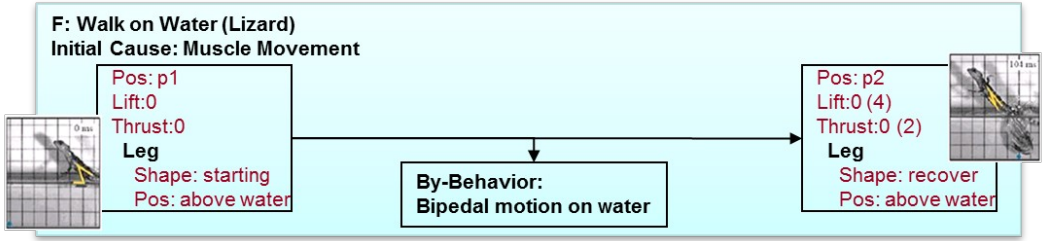

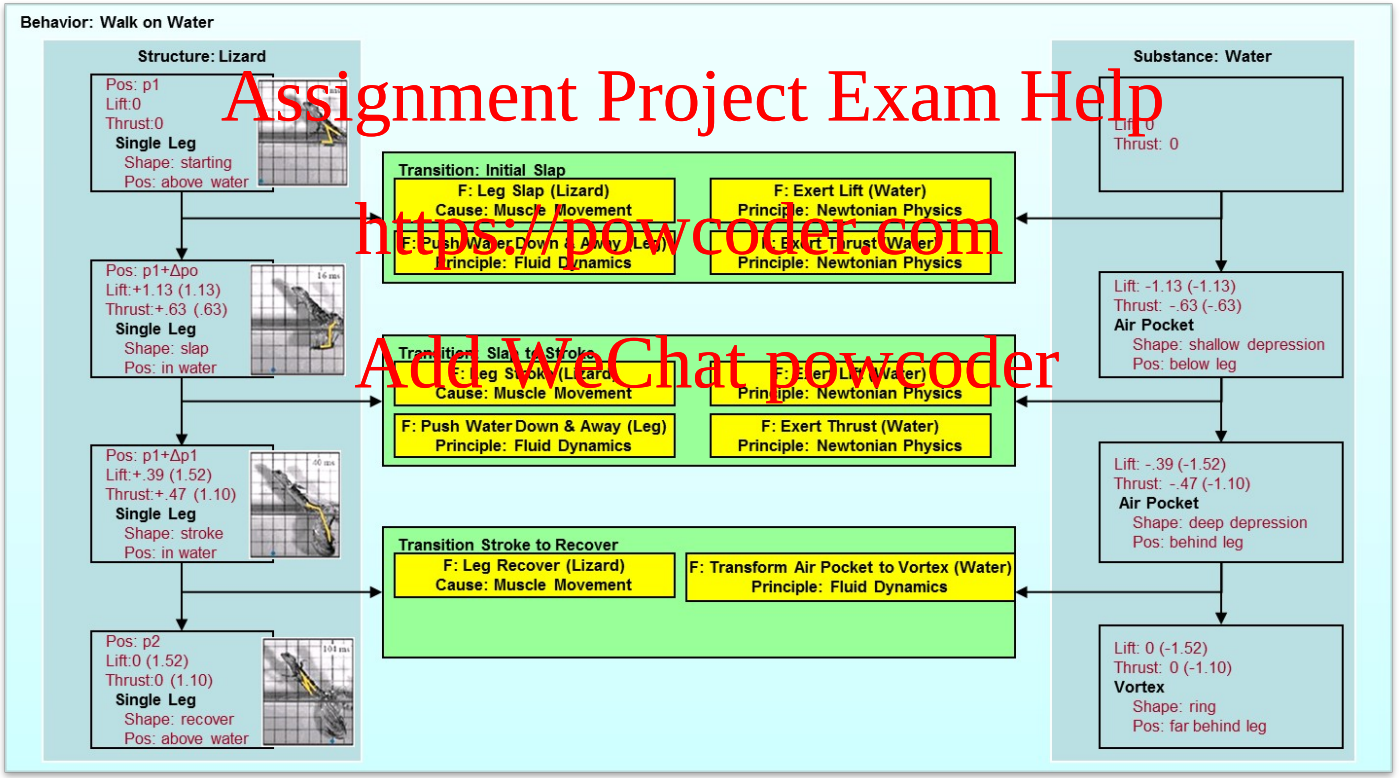

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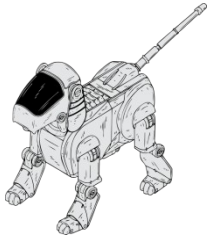

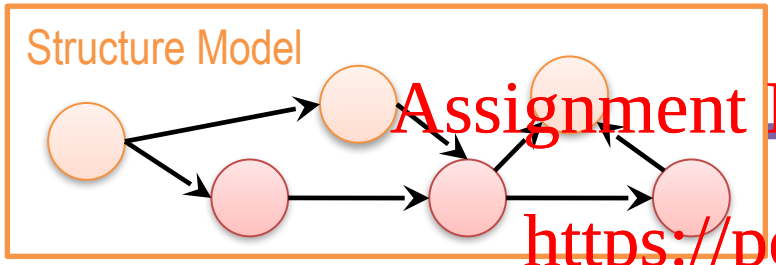

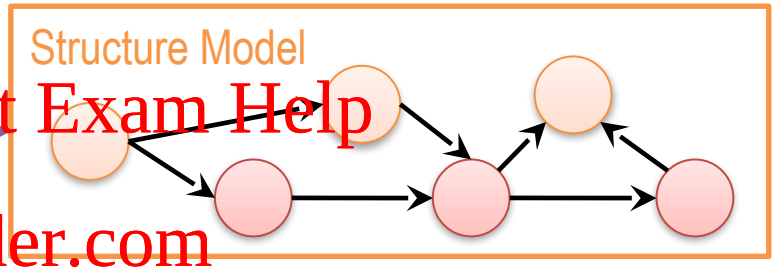

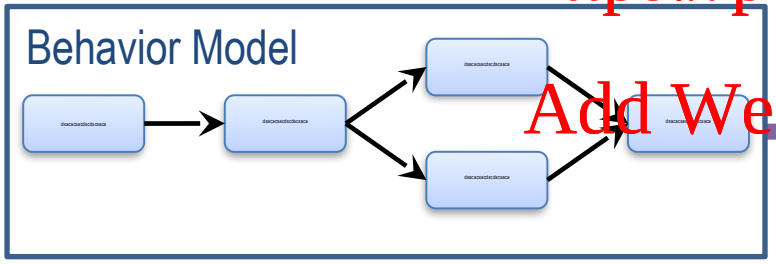

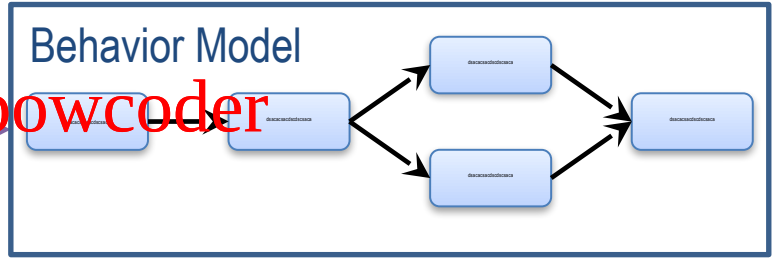

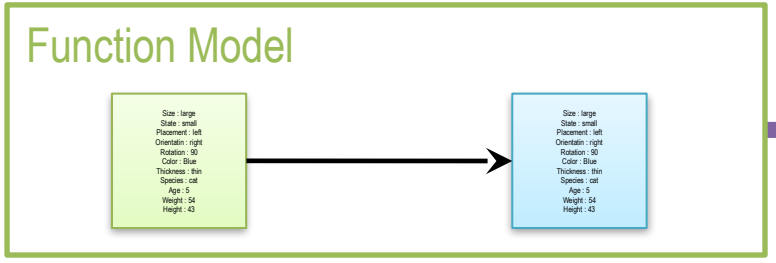

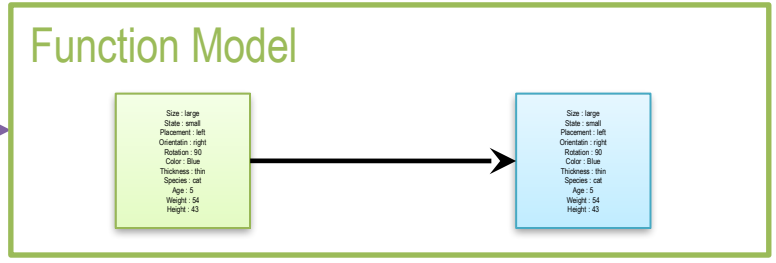

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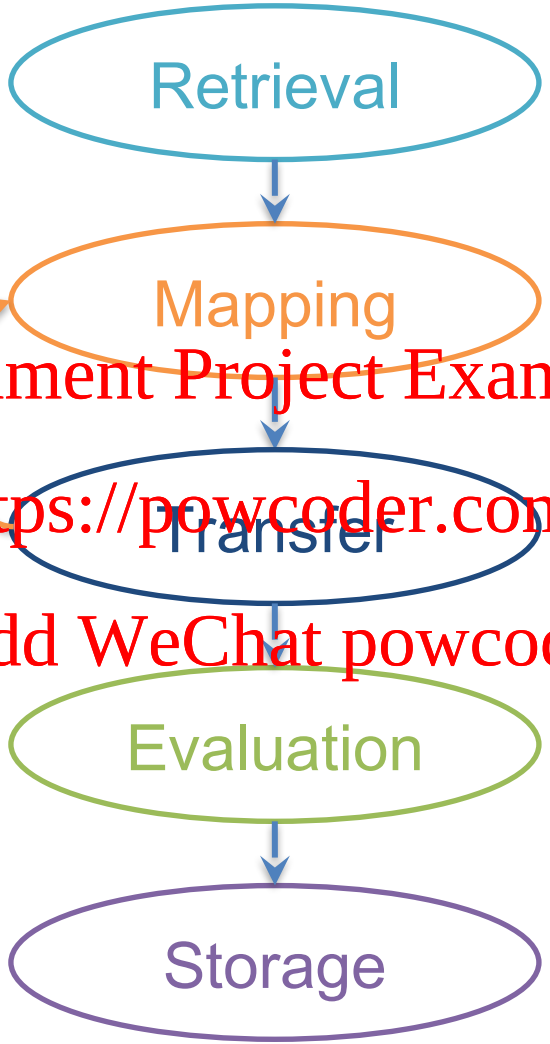

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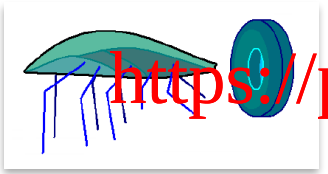

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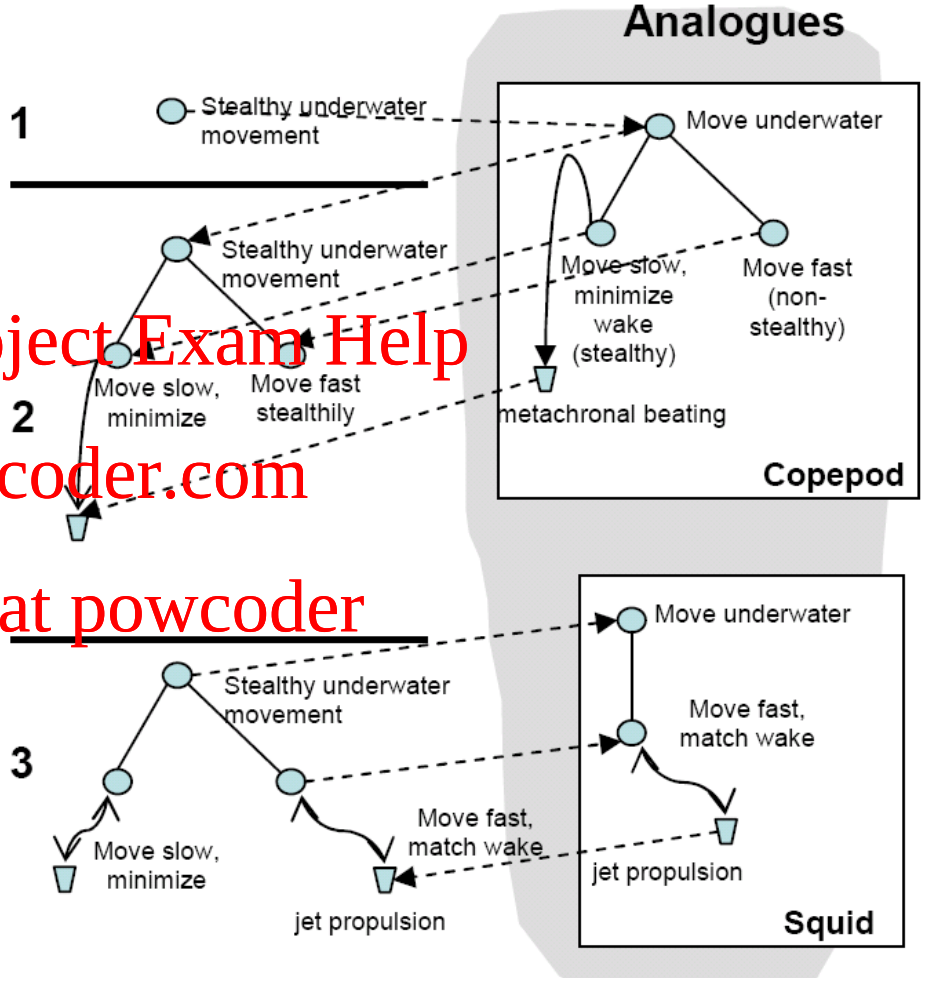

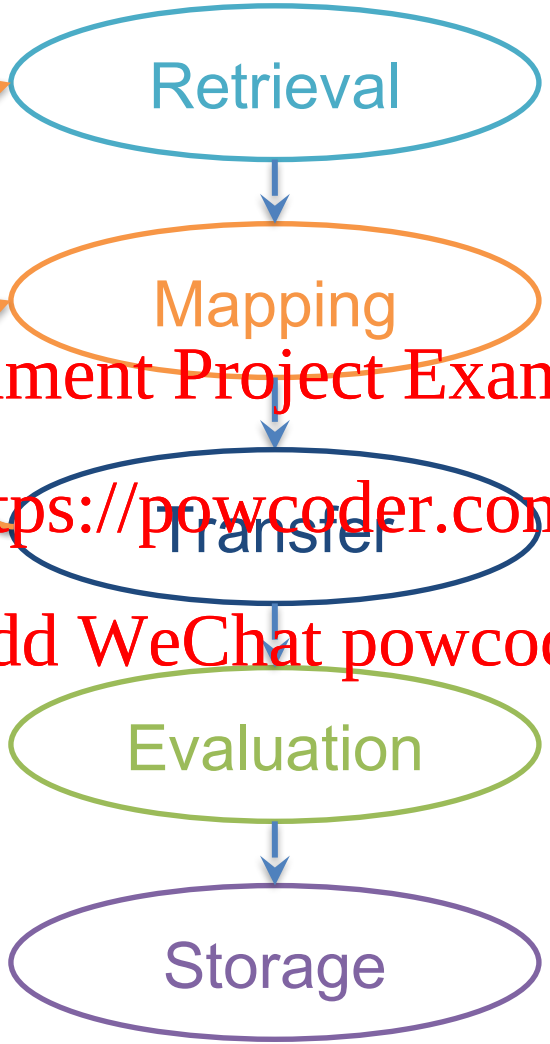

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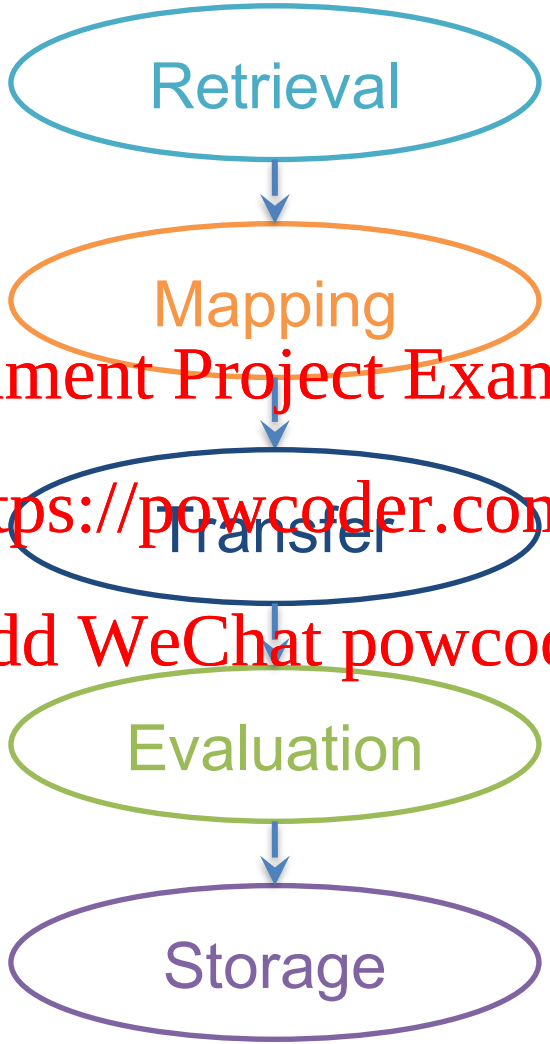

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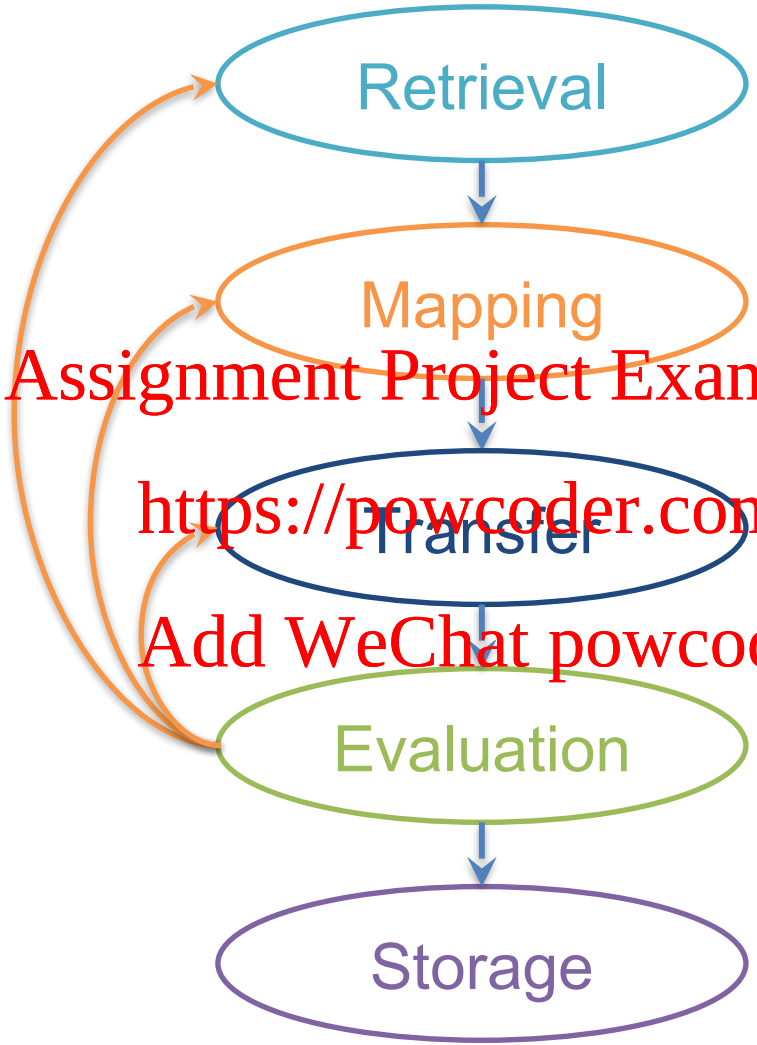

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Advanced questions in analogical reasoning

- Common vocabulary
- Abstraction and transformation
- Compound and compositional analogies
- Visuospatial analogies
- Conceptual combination

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Assignment

How would you use analogical reasoning to design an agent that could answer Raven's progressive matrices?

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To recap…

- Similarity
- Analogical retrieval
- Analogical mapping
- Analogical transfer
- Evaluation and storage
- Design by analogy

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