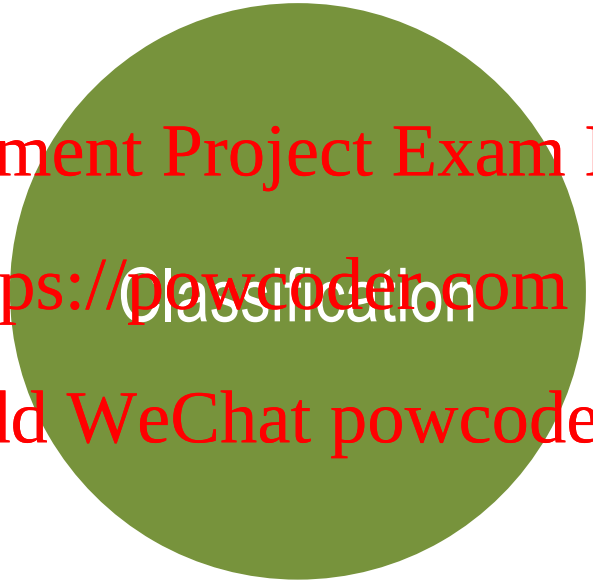
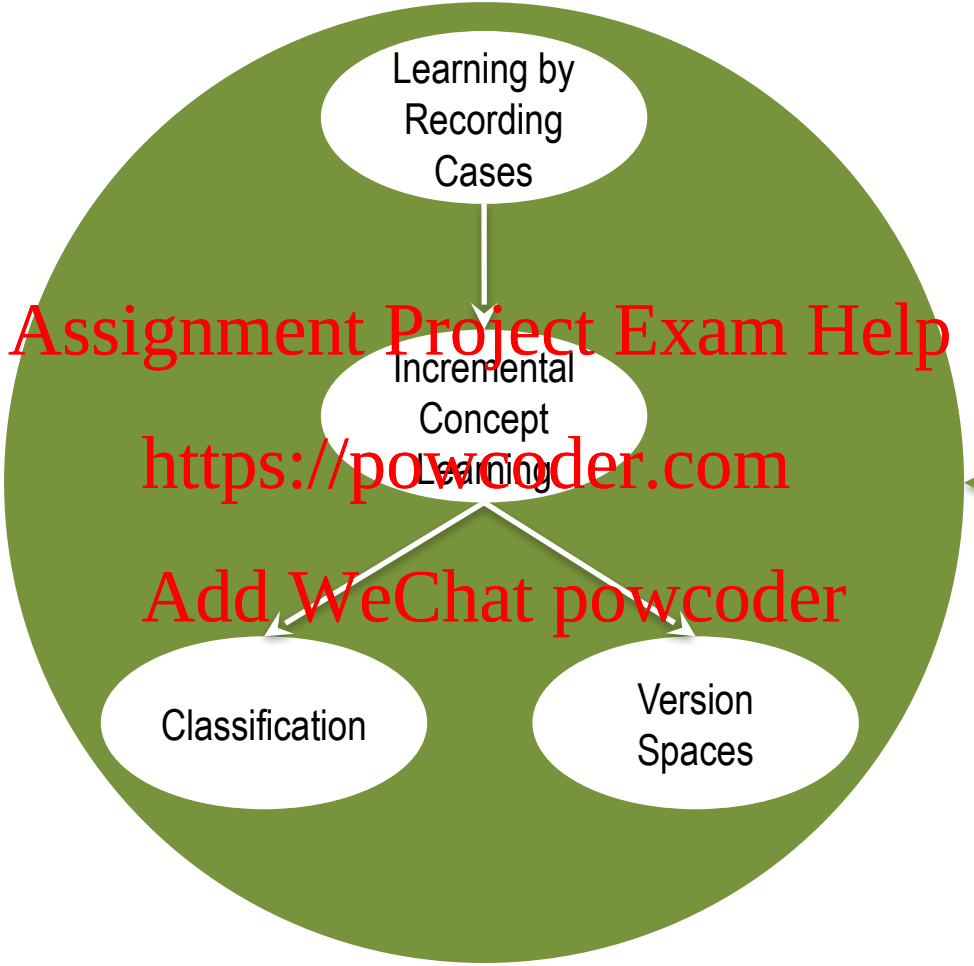


Learning



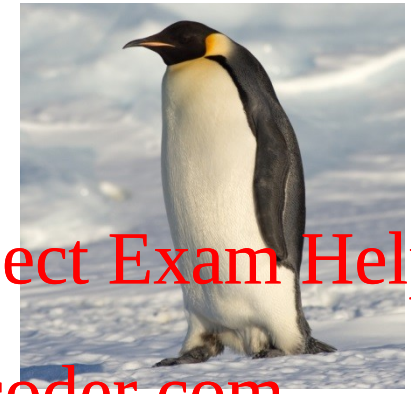
Lesson Preview

- Learning concepts
- Equivalence classes
- Concept hierarchies
- Types of concepts
- Bottom-up search

Which of these are birds?

☐

☐



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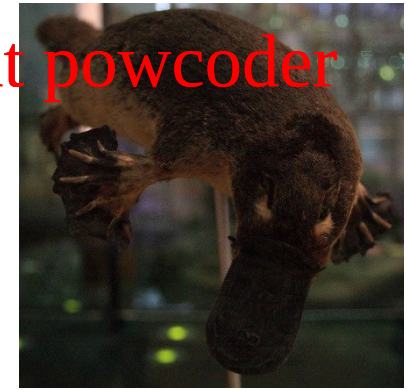

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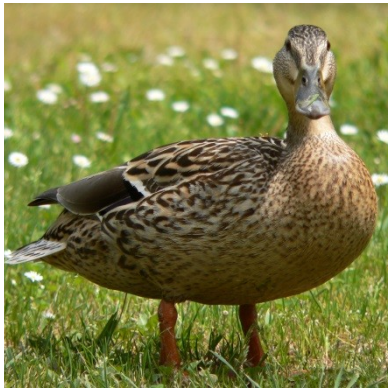
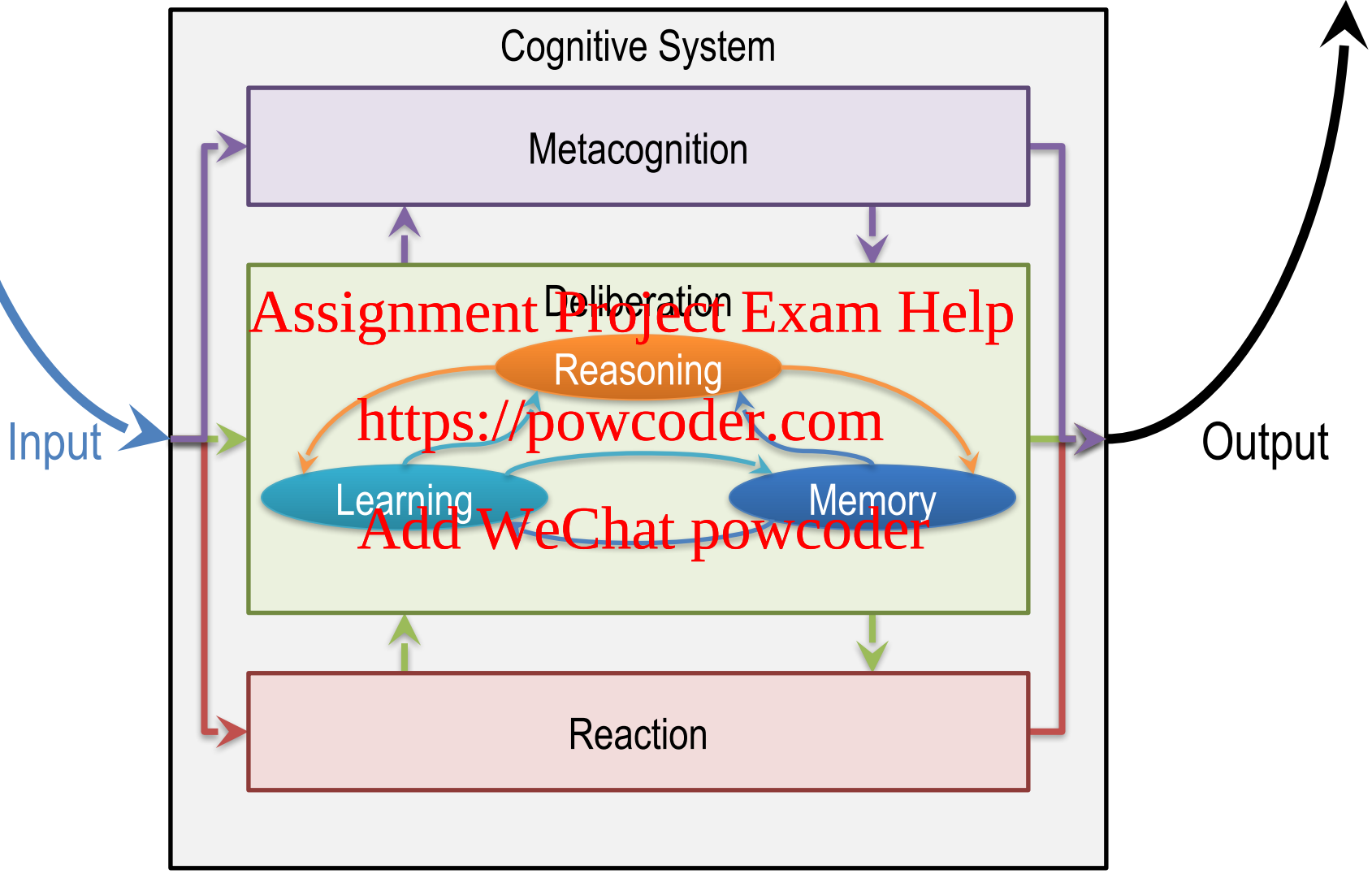
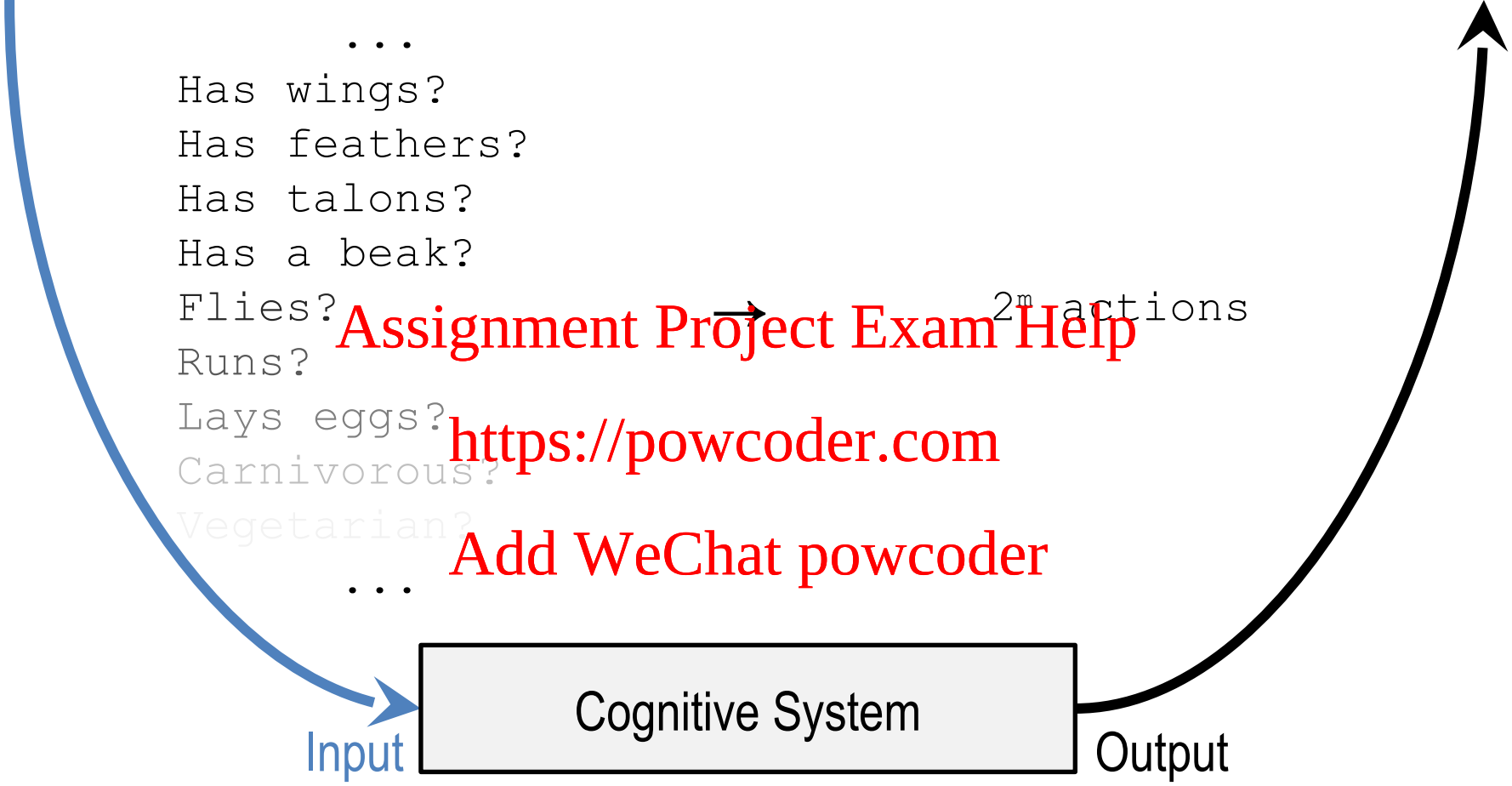


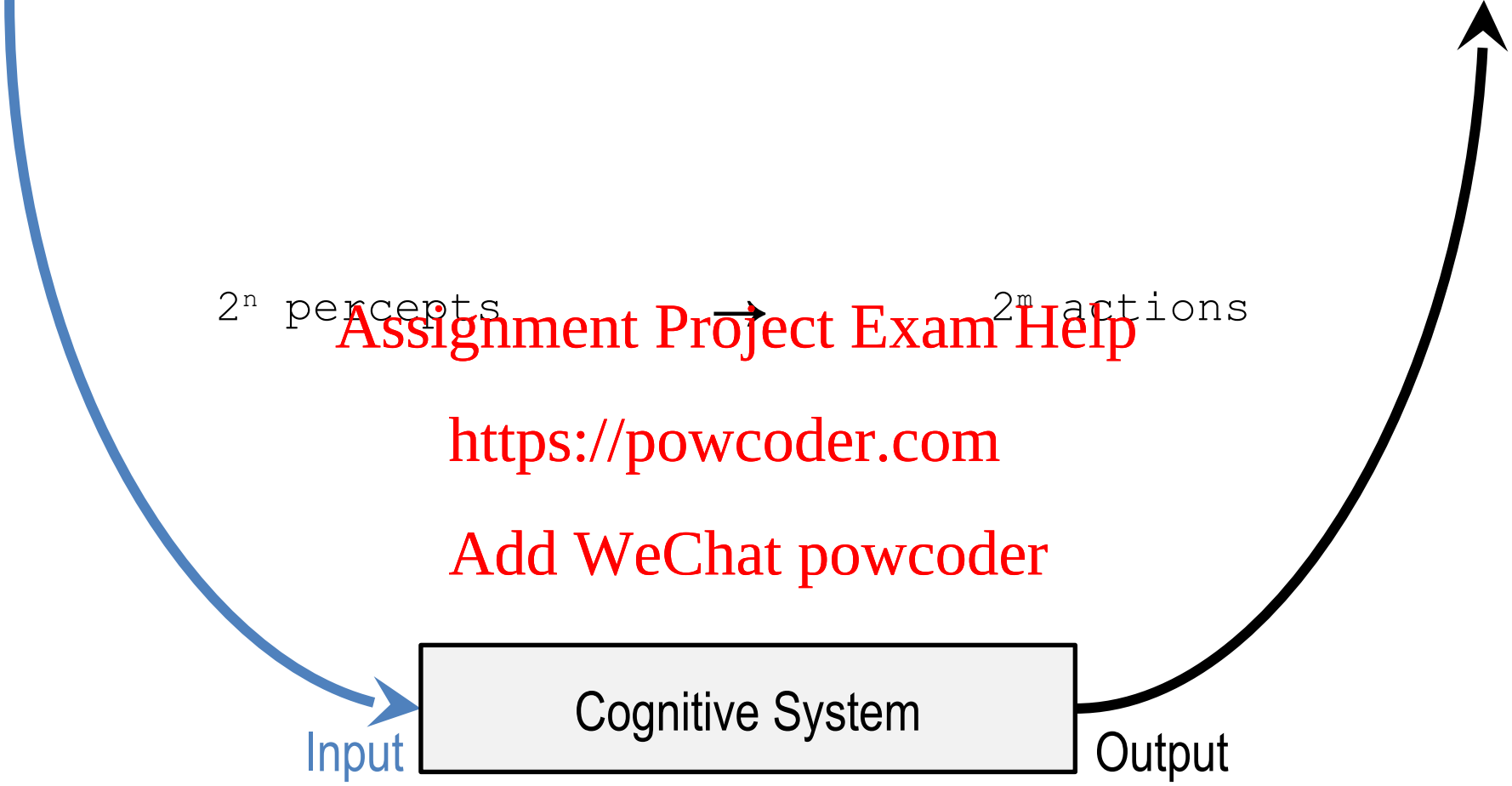
☐

...
Has wings?
Has feathers?
Has talons?
Has a beak?
Flies?
Runs?
Lays eggs?
Carnivorous?
Vegetarian?
Blue?
Red?
Swims?
Builds nests?
...

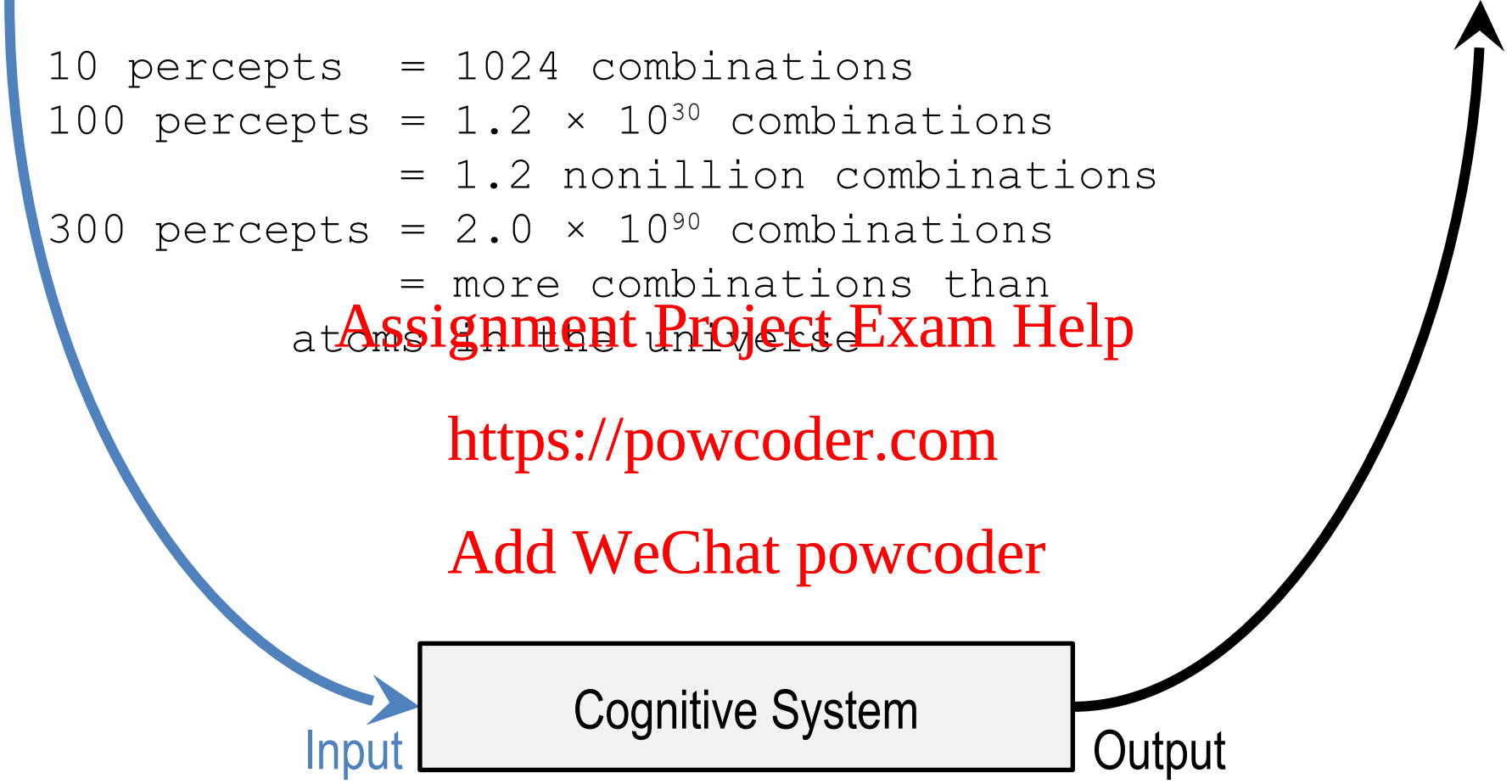


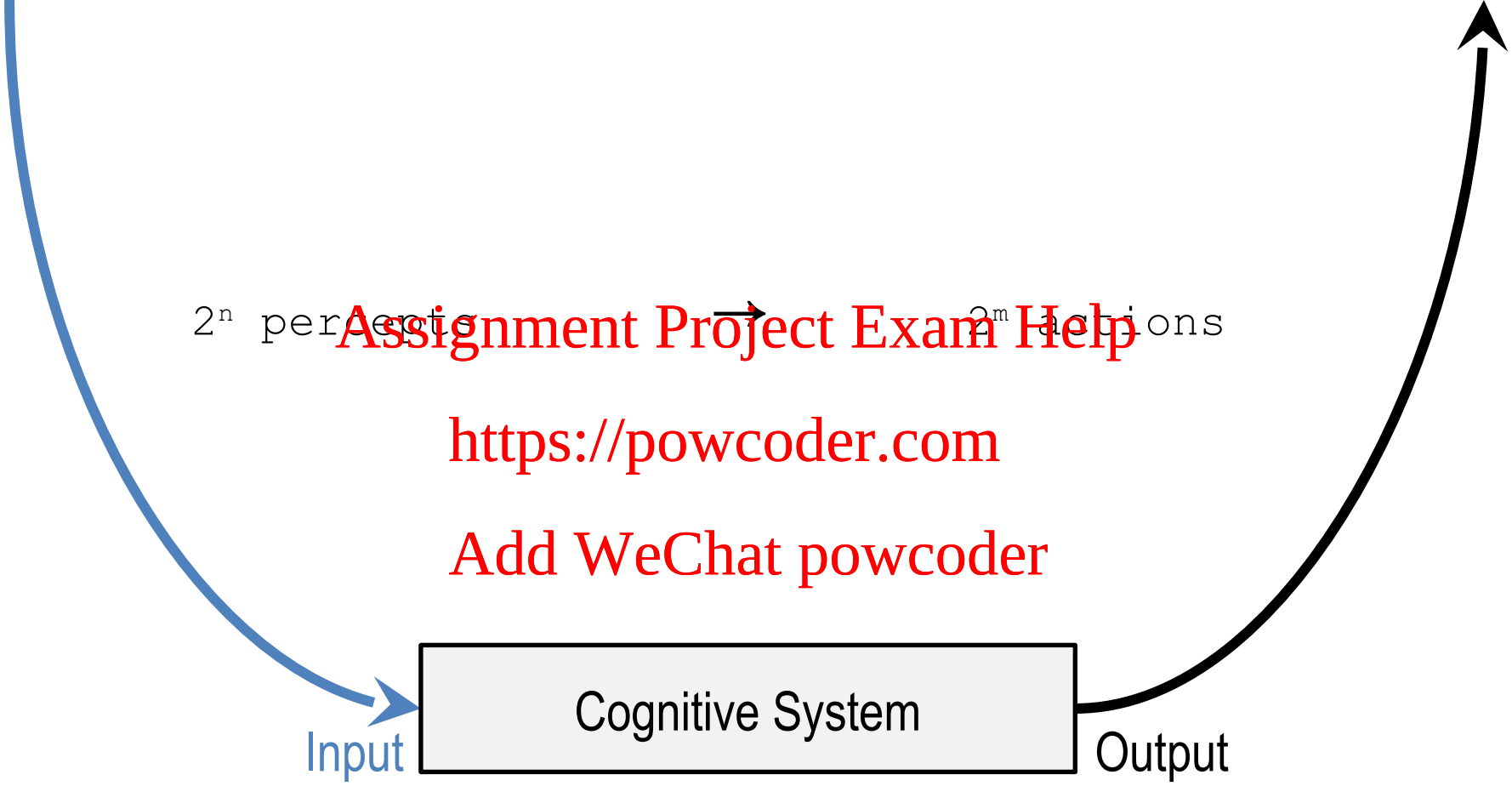


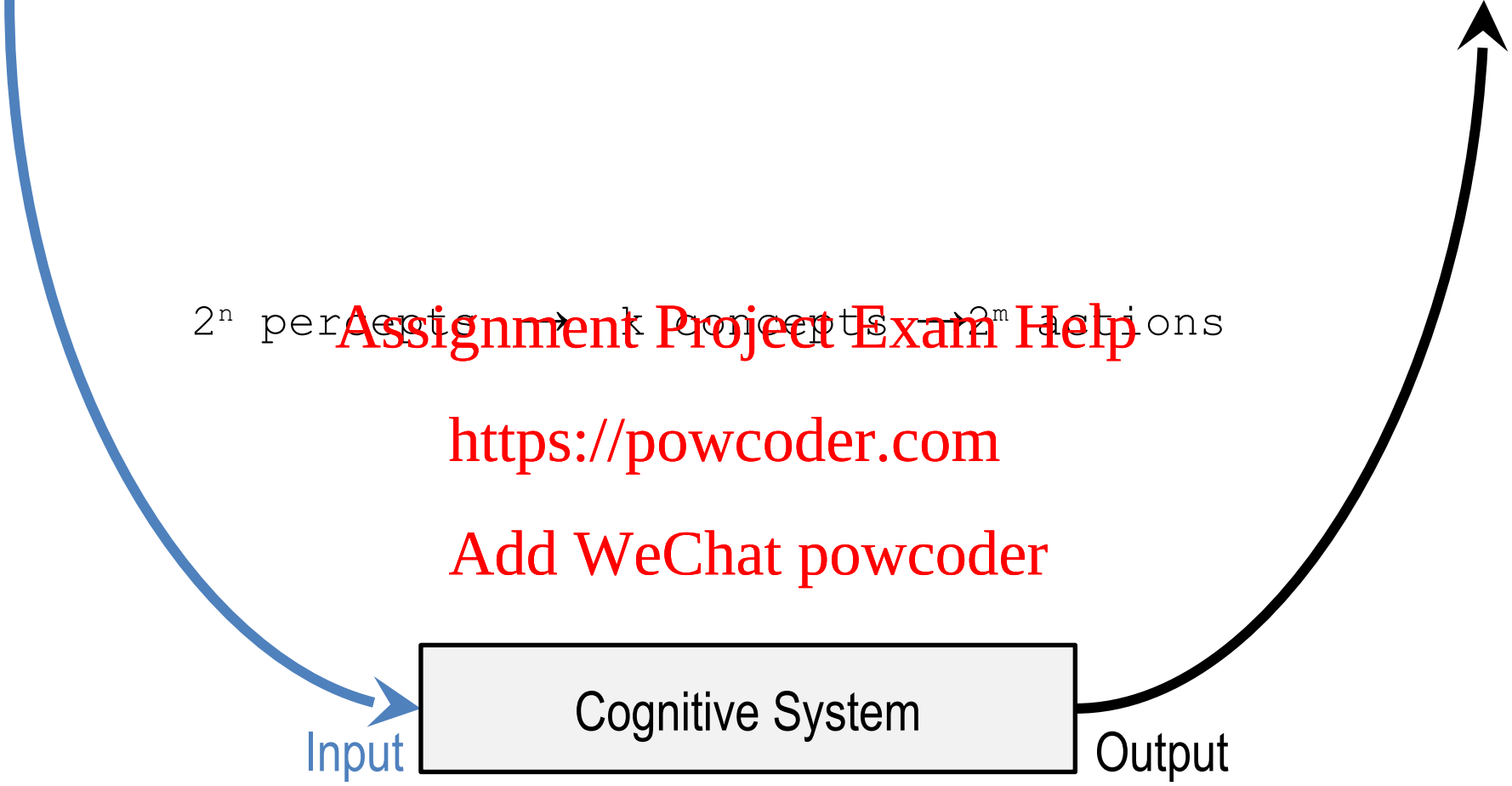
2^n percepts → 2^m actions

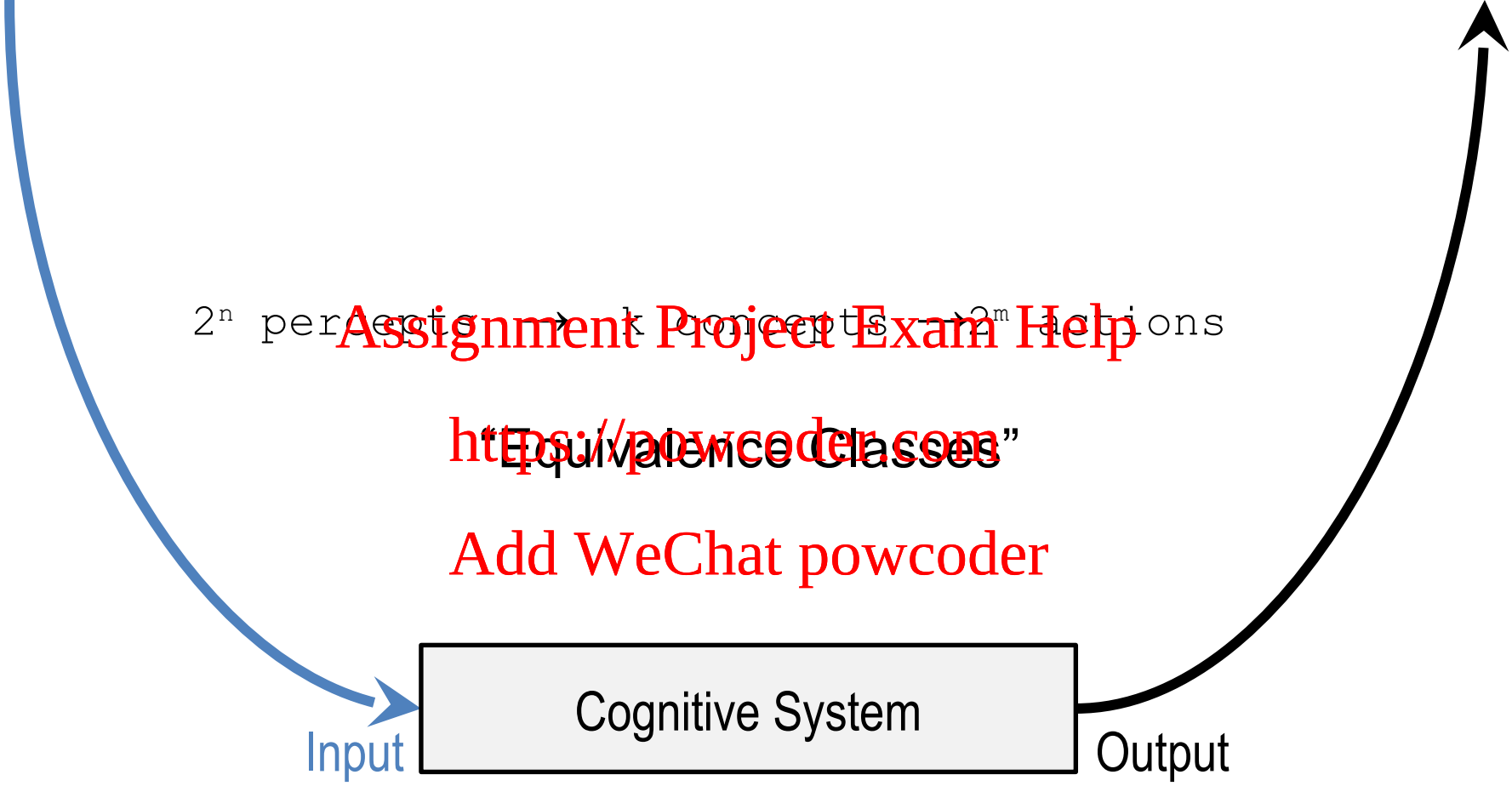


10 percepts = 1024 combinations
100 percepts = 1.2×10^{30} combinations
= 1.2 nonillion combinations
300 percepts = 2.0×10^{90} combinations
= more combinations than
atoms in the universe



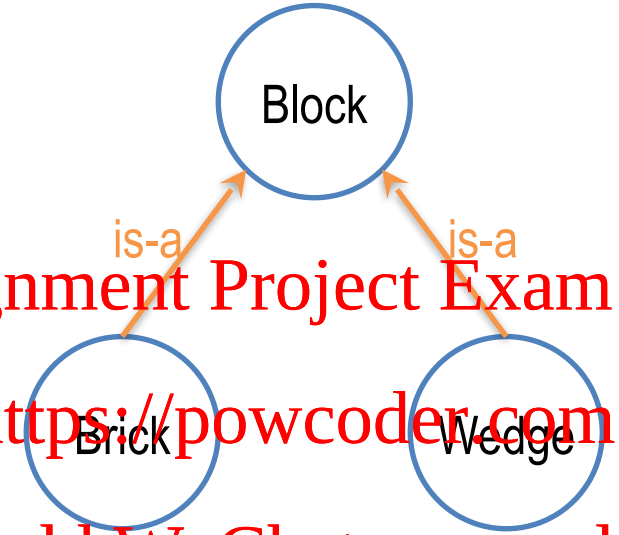


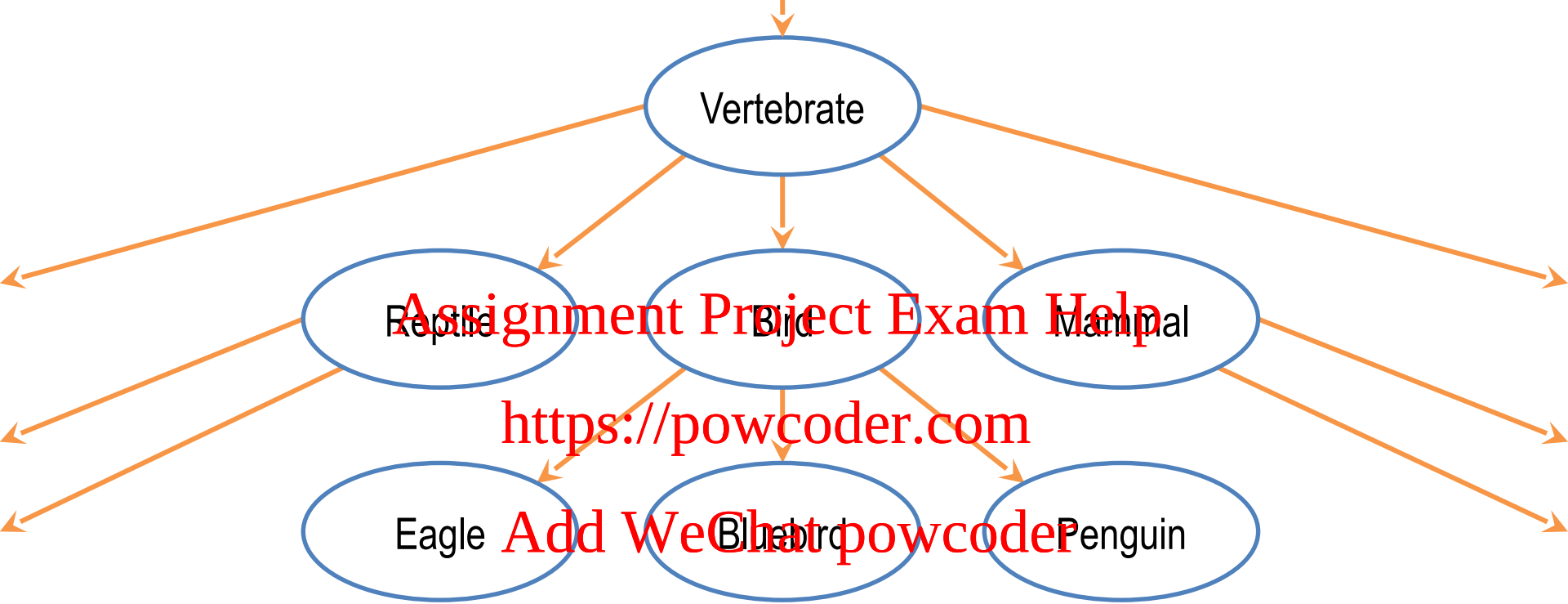




For each of these three animals, choose the value for each percept that applies to that animal.

Eagle	Bluebird	Penguin
Lays eggs?	Lays eggs?	Lays eggs?
o Yes o No o Maybe	o Yes o No o Maybe	o Yes o No o Maybe
Has wings?	Has wings?	Has wings?
o Yes o No o Maybe	o Yes o No o Maybe	o Yes o No o Maybe
Has talons?	Has talons?	Has talons?
o Yes o No o Maybe	o Yes o No o Maybe	o Yes o No o Maybe
Flies?	Flies?	Flies?
o Yes o No o Maybe	o Yes o No o Maybe	o Yes o No o Maybe
Has fur?	Has fur?	Has fur?
o Yes o No o Maybe	o Yes o No o Maybe	o Yes o No o Maybe
Large?	Large?	Large?
o Yes o No o Maybe	o Yes o No o Maybe	o Yes o No o Maybe





How would you characterize the class 'bird' given the characterization of its subclasses below?

Bird

Lays eggs? o Yes o No o Maybe

Has talons? o Yes o No o Maybe

Has fur? o Yes o No o Maybe

Has wings? o Yes o No o Maybe

Flies? o Yes o No o Maybe

Large? o Yes o No o Maybe

Eagle

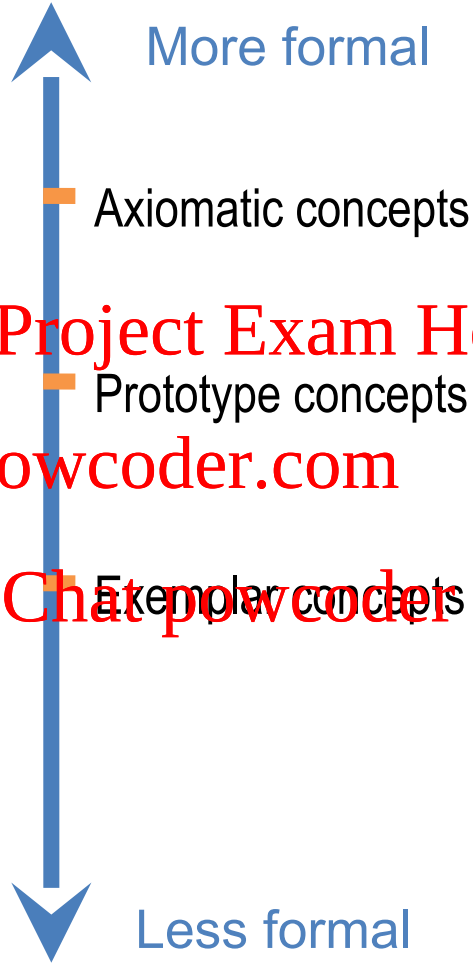
Lays eggs?	**Yes**
Has wings?	**Yes**
Has talons?	**Yes**
Flies?	**Yes**
Has fur?	**No**
Large?	**Yes**

Bluebird

Lays eggs?	**Yes**
Has wings?	**Yes**
Has talons?	**Yes**
Flies?	**Yes**
Has fur?	**No**
Large?	**No**

Penguin

Lays eggs?	**Yes**
Has wings?	**Yes**
Has talons?	**No**
Flies?	**No**
Has fur?	**No**
Large?	**Yes**



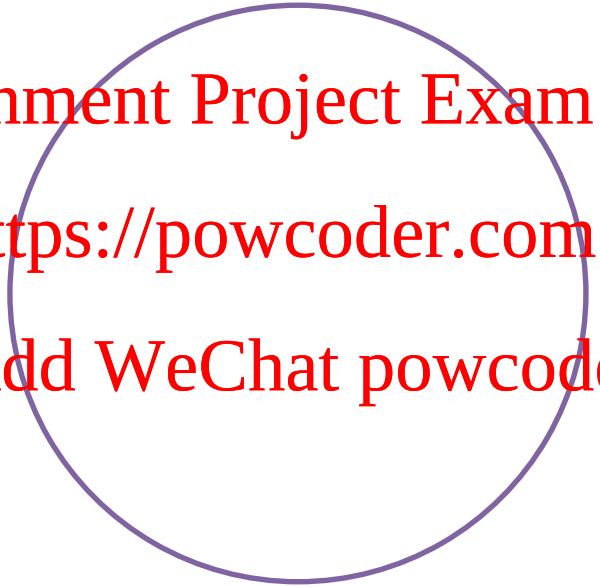
Axiomatic concepts:

Concepts defined by a formal set of necessary and sufficient conditions.

Example: a circle

Axiomatic concepts:

Concepts defined by a formal set of necessary and sufficient conditions.



Circle: all points in a plane that are equidistant from a single point.

Prototype concepts:

Base concepts defined by a typical example with overridable properties.

Example: a chair

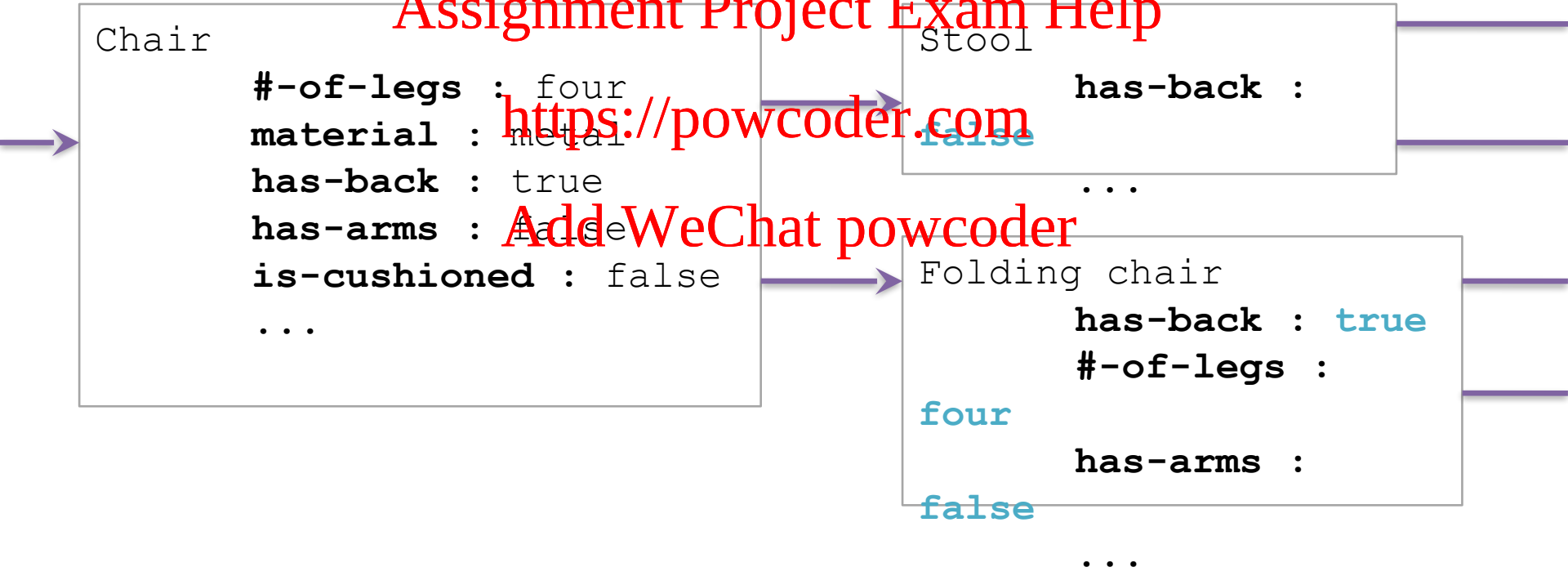
Prototype concepts:

Base concepts defined by a typical example with overridable properties.


```
Chair
        #-of-legs : four
material : metal
        has-back : true
        has-arms : false
        is-cushioned : false
        ...
```

Prototype concepts:

Base concepts defined by a typical example with overridable properties.



Exemplar concepts:

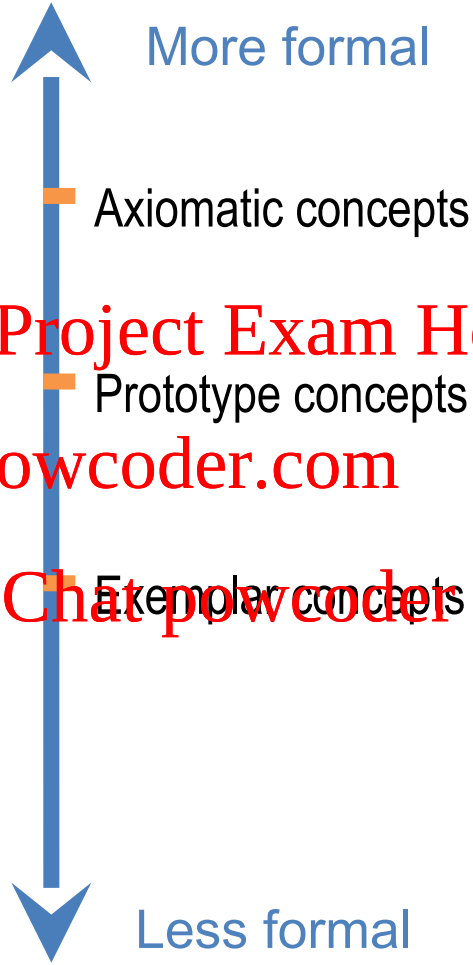
Concepts defined by implicit abstractions of instances, or exemplars, of the concept.

Example: beauty

Exemplar concepts:

Concepts defined by implicit abstractions of instances, or exemplars, of the concept.



More formal

4. Right Triangle

2. Reptile

3. Foo

5. Holiday

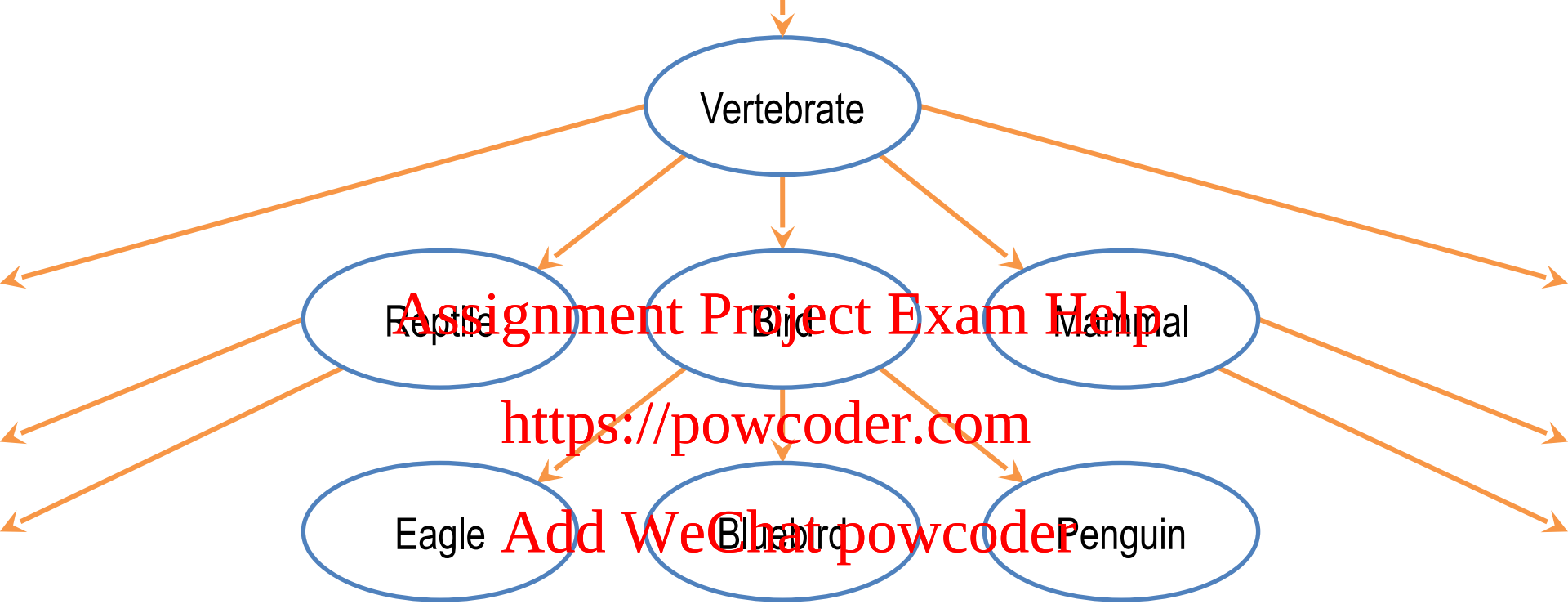
1. Inspirational

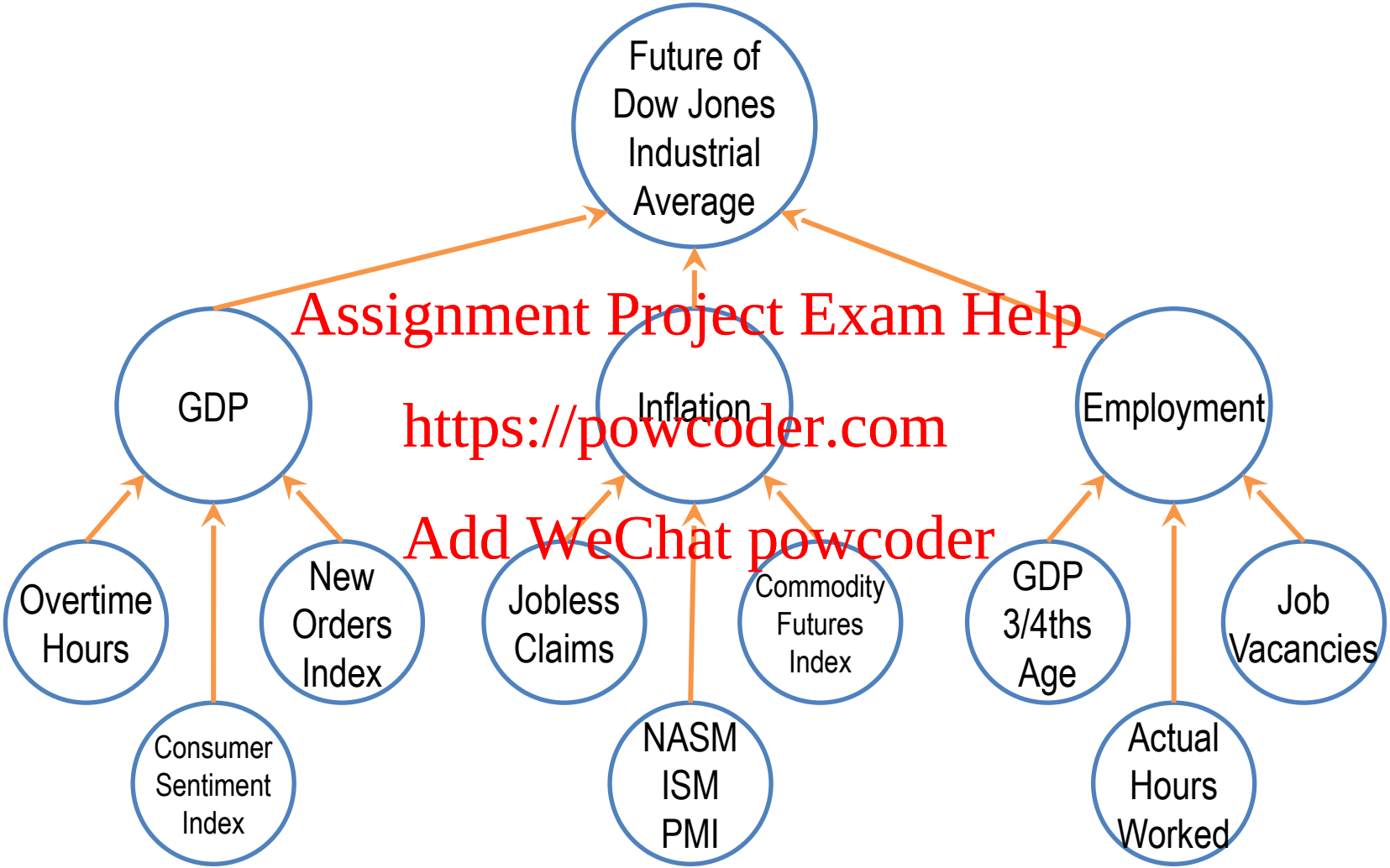
6. Saltiness

Less formal

Rank the following concepts based on their formality:

1. Inspirational
2. Reptile
3. Foo
4. Right Triangle
5. Holiday
6. Saltiness





Assignment

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

To recap…

- Concept learning
- Equivalence classes
- Concept hierarchies
- Axiomatic, prototypical, and exemplar concepts
- Bottom-up search