

Production Systems

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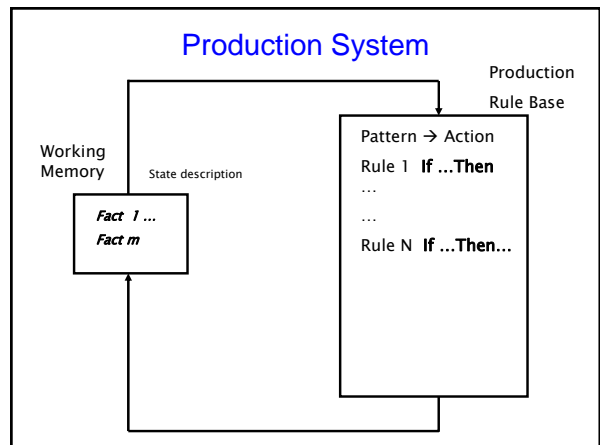
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Production Systems

- Components of a production system
 - Working memory
 - Set of production rules
 - Rule interpreter
- Example: shapes knowledge base
- Example contexts

A Production System

1. Working memory
 - Current state of the world
2. Set of production rules (KB)
 - Condition action pairs (IF THEN)
 - Condition part matched against working memory
 - Action part defines the associated problem solving step if the condition is true
3. Recognize-Act Cycle (Algorithm/Interpreter)
 - Initialize working memory with problem start
 - Repeat examining rules and taking action until the problem is solved or nothing new can be concluded



Example Rule Interpreter Algorithm

1. If the **context contains** an attribute-value pair whose attribute is the **goal attribute**, then stop and **output the associated value**.
2. Find all productions (rules) whose antecedent attribute-value pairs are **in the context** and **mark them applicable**.
3. **Deactivate** any production which **will not add a new attribute-value** pair to the context.
4. If **no productions are applicable** then stop and print the message: "Identification unknown".
5. **Execute the action** of the lowest numbered (or only) applicable production.
6. **Reset** the applicability of all productions and return to Step 1.

Shape Rules

1. (IF (sides parallel)
THEN (family parallelogram))
2. (IF (sides skew)
THEN (shape trapezoid))
3. (IF (sides curved)
THEN (family ellipsoid))
4. (IF (angles right)
THEN (family rectangle))
5. (IF (family parallelogram)
(angles skew) (lengths equal)
THEN (shape rhombus))

Shape Rules (cont)

6. (IF (family parallelogram) (angles skew) (lengths unequal) THEN (shape parallelogram))
7. (IF (family rectangle) (lengths equal) THEN (symmetrical t) (shape square))
8. (IF (family rectangle) (lengths unequal) THEN (shape rectangle) (symmetrical t))
9. (IF (family ellipsoid) (axes unequal) THEN (shape ellipse))
10. (IF (family ellipsoid) (axes equal) THEN (symmetrical t) (shape circle))

Shape Rule Base

1. (IF (sides parallel) THEN (family parallelogram))
2. (IF (sides skew) THEN (shape trapezoid))
3. (IF (sides curved) THEN (family ellipsoid))
4. (IF (angles right) THEN (family rectangle))
5. (IF (family parallelogram) (angles skew) (lengths equal) THEN (shape rhombus))
6. (IF (family parallelogram) (angles skew) (lengths unequal) THEN (shape parallelogram))
7. (IF (family rectangle) (lengths equal) THEN (symmetrical t) (shape square))
8. (IF (family rectangle) (lengths unequal) THEN (shape rectangle) (symmetrical t))
9. (IF (family ellipsoid) (axes unequal) THEN (shape ellipse))
10. (IF (family ellipsoid) (axes equal) THEN (symmetrical t) (shape circle))

Shape Contexts

1. (sides parallel) (angles right) (lengths equal)
2. (sides curved) (lengths equal)
3. (angles right) (sides parallel) (lengths unequal)
4. (sides curved) (color red) (axes equal)

Rules for Animal Identification

1. (IF (covering hair) THEN (subclass mammal))
2. (IF (milk t) THEN (subclass mammal))
3. (IF (covering feathers) THEN (subclass bird))
4. (IF (flies t) (eggs t) THEN (subclass bird))
5. (IF (eats meat) THEN (order carnivore))
6. (IF (teeth pointed) (claws t) (eyes forward) THEN (order carnivore))
7. (IF (subclass mammal) (hoofs t) THEN (order ungulate))
8. (IF (subclass bird) (flies t) THEN (order ratiite))
9. (IF (subclass mammal) (eats cud) (antlers none) THEN (order ungulate))
10. (IF (subclass mammal) (eats cud) (antlers hornlike) THEN (order ruminant))
11. (IF (subclass mammal) (eats cud) (antlers branching) THEN (order ruminant))
12. (IF (order ruminant) (antlers hornlike) THEN (toes even) (suborder pecora))
13. (IF (suborder pecora) THEN (stomachs several))
14. (IF (order ratiite) (feet webbed) (wings swimming) THEN (type penguin))
15. (IF (subclass mammal) (order carnivore) (color tawny) (spots dark) THEN (type cheetah))
16. (IF (subclass mammal) (order carnivore) (color tawny) (stripes black) THEN (type tiger))
17. (IF (order ungulate) (neck long) (legs long) (spots dark) THEN (type giraffe))
18. (IF (order ungulate) (stripes black) THEN (type zebra))
19. (IF (order ratiite) (neck long) (legs long) (color black-white) THEN (type ostrich))
20. (IF (subclass bird) (flies t) THEN (type albatross))

Contexts for Animal Rule Base

1. (covering feathers) (swims t) (wings swimming) (feet webbed) (flies t)
2. (covering hair) (eats cud) (legs long) (color tawny) (spots dark) (antlers none) (neck long)
3. (covering hair) (eats meat) (color tawny) (teeth pointed) (claws t) (eyes forward)
4. (eats cud) (milk t) (toes even) (antlers hornlike)
5. (covering hair) (eats meat) (color tawny) (spots dark)