Production Systems

- Set of production rules
- Working memory
- Recognize-act cycle
- Conflict resolution
- Backtracking (possible)

Production Rules

- **Condition-Action** pair that defines a single chunk of problem solving knowledge
- *Condition*: Pattern that determines when that rule may be applied to a problem instance
- *Action*: Associated problem solving step

Working memory

- Description of **current state of the world**.
- It is data against which the condition part of a production rule may be applied.
- It is modified by the action part of a production rule.

Recognize-act cycle

- The control structure of a production system.
- Working memory is initialized with a representation of the start state of a problem.
- Productions are matched against patterns.
- This may produce a set of productions that can be applied (fired), called the *conflict set*.

Recognize-act cycle

- One of the productions from the conflict set is selected.
- This process is called *conflict resolution*.
- This production is applied (fired).
- The cycle terminates when no more rules apply or when some goal is satisfied.

Conflict resolution

- As simple as selecting the first rule found.
- As complex as adding meta productions so as to add state information that may be used to reduce the conflict set.
- As complex as maintaining several sub-states in the working set.
- Middle of the road: Heuristics to select among productions.

Fig 6.1 A production system. Control loops until working memory pattern no longer matches the conditions of any productions.

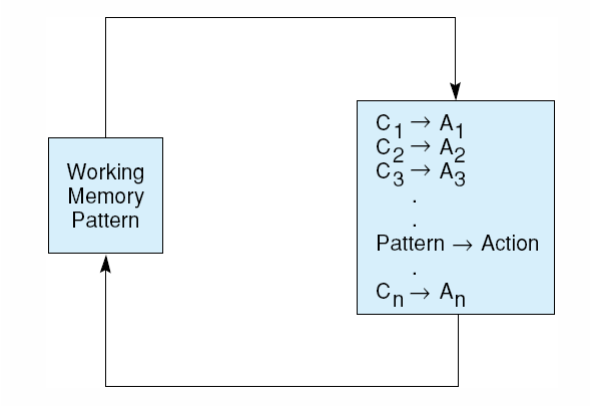


Fig 6.2 Trace of a simple production system.

Production set:

1. ba → ab
2. ca → ac
3. cb → bc

Iteration #	Working memory	Conflict set	Rule fired
0	cbaca	1, 2, 3	1
1	cabca	2	2
2	acbca	2, 3	2
3	acbac	1, 3	1
4	acabc	2	2
5	aacbc	3	3
6	aabcc	Ø	Halt

Fig 6.3 The 8-puzzle as a production system.

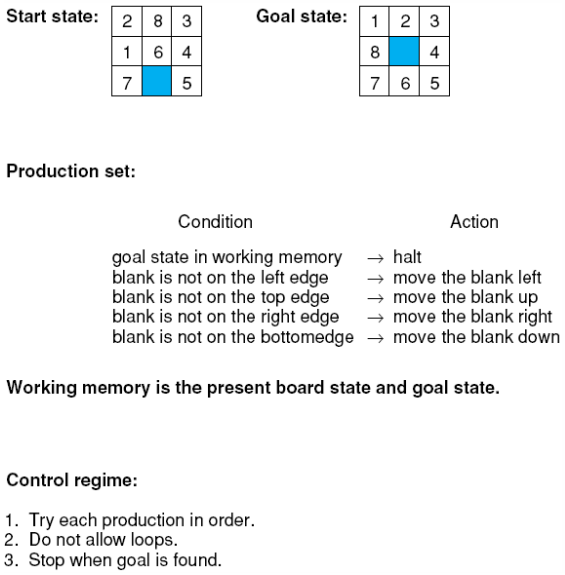
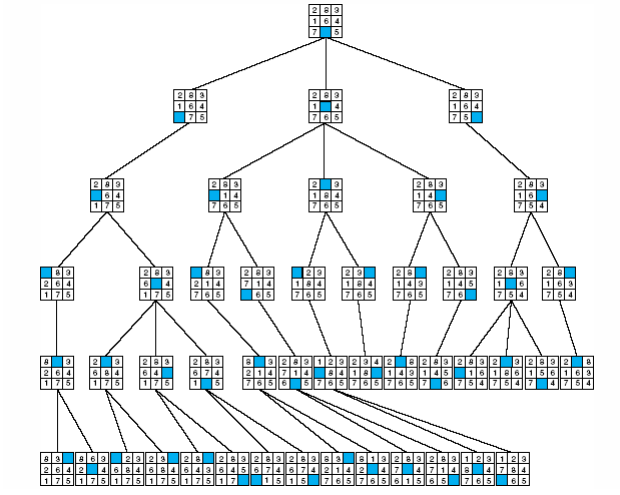


Fig 6.4 The 8-puzzle searched by a production system with loop detection and depth-bound , from Nilsson (1971).



Major advantages of production systems for artificial intelligence

- Separation of Knowledge and Control
- A Natural Mapping onto State Space Search
- Modularity of Production Rules
- Pattern-Directed Control
- Opportunities for Heuristic Control of Search
- Tracing and Explanation
- Language Independence
- A Plausible Model of Human Problem-Solving