

1-15-06-CS8650-Wed-P2

Introduction to Expert Systems

CS8650

Introduction to AI & Robotics

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Class

Will

Start

Momentarily...

- This is an AI technology
- One of the AI areas that has matured to the point of common usage.
- Concept: “capture” human intelligence in a set of rules with logic, so that a computer can do what the human would do in the same situation.
- A rule is a set of conditions, followed by an action to be taken if those conditions are true.
- Rules can be dependent upon other rules.
- Facts can be recorded.

- Two basic approaches:
- Forward Chaining
 - From known facts, reason or deduce new knowledge based on existing knowledge
 - Rules are new facts that can be deduced based on specific other knowledge.
 - Computer works through all rules, trying to arrive at new conclusions.

- Forward Chaining
- Example of the logic process:
 - Fact: door is open
 - Fact: outsidetemp is hot
 - Rule: if the door is open and the outsidetemp is hot, then conclude that inside will get hot.
- The computer will examine every rule.
- If any rule's preconditions are met, then the conclusion will be entered into the fact base as a known.
- Note the standard IF ... AND ... THEN ... structure

- In some circumstances, many rules will be examined, some will be true (fire) and new facts stored in the factbase, which may not be helpful in finding the solution to a problem.
- Some rules can be given a higher precedence to explore – to try to direct the behavior of the machine more closely.

- Backward Chaining is also known as goal-directed reasoning.
- Start from a goal.
- Examine rules that can allow you to make a conclusion about the goal
- Examine the conditions needed for those rules.
- Examine rules that allow you to conclude about the pre-conditions needed to conclude about the goal. Etc.
- Multiple levels deep of chaining backward from the goal.
- Some rules will ask questions of the user for needed data.

- Example:
- Goal: is the engine running?
- Rule:
 - if the ignition is on
 - And gas is in the tank
 - Then the engine is running.
- Rules:
 - Query “is the ignition on?” (t ignition is on)
- Fact:
 - Gas is in the tank

- We will use CLIPS, an popular expert system available freely over the internet in a variety of forms.
- Its not fast, or the easiest to work with.
- It is based on pattern matching (like LISP).
- Looks for equivalent character sequences.
 - ‘engine is running’
 - Does not understand anything about what it is doing – merely mechanically matching character patterns to complete rules.
 - Is this intelligence?
- There is a jclips available that runs on the Java VM.

- Jclips is an enhancement to Clips that allows Clips to be incorporated in a Java program.
- Substantial content on how to do this is on the web.
- This greatly enhances the utility of clips, by creating a possible embedded expert system inside an application.

- Search on the web for different versions of jclips.
- Select one, download, and install on your machine (use one of the development virtual machines if you are using Parallels.)
- Experiment with it.
- Your choice as to which version to use for the project in this course.

```
test1 - Notepad
File Edit Format Help
;first test CLIPS program
;check to see which if x is greater than y

(deffacts initial-facts
  "This is a set of facts needed prior to execution"
  (refrigerator-light on)
  (refrigerator-door open)
  (num1 5)
  (num2 7)
)

(defrule example-rule "This is an example of a simple rule"
  (refrigerator-light on)
  (refrigerator-door open)
  =>
  (assert (refrigerator food spoiled))
  (fprintout t "food is spoiled" crlf)
)

(defrule num1is
  (num1 ?value)
  =>
  (fprintout t "num1 is " ?value crlf)
)

(defrule num2is
  (num2 ?value)
  =>
  (fprintout t "num2 is " ?value crlf)
)

(defrule greater-than
  (num1 ?valnum1)
  (num2 ?valnum2)
  (test (>= ?valnum1 ?valnum2))
  =>
  (fprintout t "num1 is greater than num2" crlf)
)

(defrule less-than
  (num1 ?valnum1)
  (num2 ?valnum2)
  (test (< ?valnum1 ?valnum2))
  =>
  (fprintout t "num1 is less than num2" crlf)
)
```

```
C:\CLIPS\CLIPS.EXE
CLIPS (v4.20 4/29/88)
CLIPS> (load "test1.clp")
*****
CLIPS> (reset)
CLIPS> (run)
num2 is 7
num1 is less than num2
num1 is 5
food is spoiled
4 rules fired
CLIPS> _
```

(deffacts initial-facts

"This is a set of facts needed prior to execution"

(refrigerator-light on)

(refrigerator-door open)

(num1 5)

(num2 7)

)

(defrule example-rule "This is an example of a simple rule"

(refrigerator-light on)

(refrigerator-door open)

=>

(assert (refrigerator food spoiled))

(fprintout t "food is spoiled" crlf)

)

```
CLIPS>
```

```
CLIPS> (load "test1.clp")
```

```
$*****
```

```
CLIPS> (reset)
```

```
CLIPS> (run)
```

**End
Of
Today's
Lecture.**