

## Unit 1 Code Description

This document (and the `_code` documents in future units) will describe: any ACT-R commands used in the unit's models which are not described in the main unit text, general information about the code that implements the task/experiment for the models in that unit, how ACT-R is interfaced with the task/experiment, and additional commands that one can use interactively when working with ACT-R (most of the information available through the tools of the Environment can also be obtained directly from commands). For this unit there are no tasks for the models and all of them run simply by using the ACT-R run command. They start with a predefined goal that is specifically placed into the goal buffer, they have a given set of declarative memories, and the result is a modification of the goal chunk representing the processing that took place. Later units will include tasks which have much more involved perception and action, but for this unit all of the models have the same basic structure as shown here in a solution to the multi-column addition model assignment from the unit1 text:

```
(clear-all)

(define-model tutor-model

  (sgp :esc t :lf .05 :trace-detail medium)

  ;; Add Chunk-types here

  (chunk-type addition-fact addend1 addend2 sum)
  (chunk-type add-pair one1 ten1 one2 ten2 ten-ans one-ans carry)

  ;; Add Chunks here

  (add-dm
   (fact17 isa addition-fact addend1 1 addend2 7 sum 8)
   (fact34 isa addition-fact addend1 3 addend2 4 sum 7)
   (fact67 isa addition-fact addend1 6 addend2 7 sum 13)
   (fact103 isa addition-fact addend1 10 addend2 3 sum 13)
   (goal isa add-pair ten1 3 one1 6 ten2 4 one2 7))

  ;; Add productions here

  (p start-pair
    =goal>
    ISA add-pair
    one1 =num1
    one2 =num2
    one-ans nil
    ==>
    =goal>
    one-ans busy
    +retrieval>
    ISA addition-fact
    addend1 =num1
    addend2 =num2)

  (p add-ones
    =goal>
    ISA add-pair
```

```

    one-ans busy
    one1 =num1
    one2 =num2
=retrieval>
    ISA addition-fact
    addend1 =num1
    addend2 =num2
    sum =sum
==>
=goal>
    one-ans =sum
    carry busy
+retrieval>
    ISA addition-fact
    addend1 10
    sum =sum)

(p process-carry
=goal>
    ISA add-pair
    ten1 =num1
    ten2 =num2
    carry busy
    one-ans =ones
=retrieval>
    ISA addition-fact
    addend1 10
    sum =ones
    addend2 =remainder
==>
=goal>
    carry 1
    ten-ans busy
    one-ans =remainder
+retrieval>
    ISA addition-fact
    addend1 =num1
    addend2 =num2)

(p no-carry
=goal>
    ISA add-pair
    ten1 =num1
    ten2 =num2
    one-ans =ones
    carry busy
?retrieval>
    buffer failure
==>
=goal>
    carry nil
    ten-ans busy
+retrieval>
    ISA addition-fact
    addend1 =num1
    addend2 =num2)

(p add-tens-done
=goal>
    ISA add-pair
    ten-ans busy
    carry nil
=retrieval>

```

```

        ISA addition-fact
        sum =sum
==>
    =goal>
        ten-ans =sum)

(p add-tens-carry
  =goal>
    ISA add-pair
    carry 1
    ten-ans busy
  =retrieval>
    ISA addition-fact
    sum =sum
==>
    =goal>
        carry nil
    +retrieval>
        ISA addition-fact
        addend1 1
        addend2 =sum)

(goal-focus goal)
)

```

It starts with a call to a function called **clear-all** followed by a call to the command **define-model**. Inside the call to **define-model** there is a call to a command called **sgp**, then all of the components of the model are defined (chunk-types, chunks, and productions) and finally the starting goal chunk gets set using the **goal-focus** command.

Most of these commands were described in the main unit text, which also described some tools in the ACT-R Environment for inspecting and debugging models. Here we will provide some additional details for some of those commands, describe the **sgp** command, and show how one can also perform some of the actions that were done using the Environment tools from the prompt in the ACT-R window. In later units, we will also show how those commands can be accessed remotely using the included Python module as an example.

## Additional ACT-R command details

### Clear-all

The **clear-all** command is used to set the ACT-R software to its initial state. It removes all of the models that are currently defined, returns the clock to time 0, and removes any events which are on the event queue. If a model (or set of models) is contained within a single file, then one probably should call **clear-all** in that file to make sure ACT-R is initialized before defining the model components.

An additional side effect of the **clear-all** command is that it records the name of the file that contains it when it is loaded. That is how the **reload** command and “Reload” button in the ACT-R Environment know which file to load.

## Define-model

The **define-model** command takes one required parameter which is the name of a new model to create and then an arbitrary number of other parameters which are the commands that create the initial conditions for the model. The name should be a symbol and must be unique with respect to other models that are currently defined. When a **reset** happens, all of the commands specified inside of the **define-model** are reevaluated for that model in the order they were specified. Each call to **define-model** creates a new model which is independent of the other models, but all of the models will run in parallel when the **run** command is called.

## SGP

The **sgp** command is used to set or show a model's parameters (it stands for set/show general parameters). The parameters for a model control many different things. Some are used in equations that control the performance of the model's cognitive modules, others are there to help the modeler with debugging by changing the outputting of information or the seed of the pseudorandom number generator, and others are available to provide ways that the modeler can extend or modify internal ACT-R mechanisms. The details of all of the parameters can be found in the reference manual.

When using **sgp** to set parameters the syntax is to specify a parameter and then the new value you want to assign to that parameter. Any number of parameters and values may be specified in a single call to **sgp**. All of the parameters in ACT-R begin with a ":" (in Lisp syntax they are called keywords). All of the unit1 models have a call to **sgp** similar to this:

```
(sgp :esc t :lf .05 :trace-detail medium)
```

That is setting three parameters: **:esc**, **:lf**, and **:trace-detail**. The first two together are specifying that retrieval requests will always take 50ms to complete, but further details on those are beyond the scope of this unit and will be discussed fully in later units. The third parameter being set, **:trace-detail**, controls how much information is shown in the trace when a model runs. The default value is **medium**, and that is also how it is being set in the example above. The other values that it can have are **high** and **low**. When it is set to **high**, effectively every action the model does shows in the trace. Here is the trace of the two-digit addition model with **:trace-detail** set to **high**:

|       |             |                                   |
|-------|-------------|-----------------------------------|
| 0.000 | GOAL        | SET-BUFFER-CHUNK GOAL GOAL NIL    |
| 0.000 | PROCEDURAL  | CONFLICT-RESOLUTION               |
| 0.000 | PROCEDURAL  | PRODUCTION-SELECTED START-PAIR    |
| 0.000 | PROCEDURAL  | BUFFER-READ-ACTION GOAL           |
| 0.050 | PROCEDURAL  | PRODUCTION-FIRED START-PAIR       |
| 0.050 | PROCEDURAL  | MOD-BUFFER-CHUNK GOAL             |
| 0.050 | PROCEDURAL  | MODULE-REQUEST RETRIEVAL          |
| 0.050 | PROCEDURAL  | CLEAR-BUFFER RETRIEVAL            |
| 0.050 | DECLARATIVE | start-retrieval                   |
| 0.050 | PROCEDURAL  | CONFLICT-RESOLUTION               |
| 0.100 | DECLARATIVE | RETRIEVED-CHUNK FACT67            |
| 0.100 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT67 |
| 0.100 | PROCEDURAL  | CONFLICT-RESOLUTION               |

|       |             |   |
|-------|-------------|---|
| 0.100 | PROCEDURAL  | PRODUCTION-SELECTED ADD-ONES              |
| 0.100 | PROCEDURAL  | BUFFER-READ-ACTION GOAL                   |
| 0.100 | PROCEDURAL  | BUFFER-READ-ACTION RETRIEVAL              |
| 0.150 | PROCEDURAL  | PRODUCTION-FIRED ADD-ONES                 |
| 0.150 | PROCEDURAL  | MOD-BUFFER-CHUNK GOAL                     |
| 0.150 | PROCEDURAL  | MODULE-REQUEST RETRIEVAL                  |
| 0.150 | PROCEDURAL  | CLEAR-BUFFER RETRIEVAL                    |
| 0.150 | DECLARATIVE | start-retrieval                           |
| 0.150 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.200 | DECLARATIVE | RETRIEVED-CHUNK FACT103                   |
| 0.200 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT103        |
| 0.200 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.200 | PROCEDURAL  | PRODUCTION-SELECTED PROCESS-CARRY         |
| 0.200 | PROCEDURAL  | BUFFER-READ-ACTION GOAL                   |
| 0.200 | PROCEDURAL  | BUFFER-READ-ACTION RETRIEVAL              |
| 0.250 | PROCEDURAL  | PRODUCTION-FIRED PROCESS-CARRY            |
| 0.250 | PROCEDURAL  | MOD-BUFFER-CHUNK GOAL                     |
| 0.250 | PROCEDURAL  | MODULE-REQUEST RETRIEVAL                  |
| 0.250 | PROCEDURAL  | CLEAR-BUFFER RETRIEVAL                    |
| 0.250 | DECLARATIVE | start-retrieval                           |
| 0.250 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.300 | DECLARATIVE | RETRIEVED-CHUNK FACT34                    |
| 0.300 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT34         |
| 0.300 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.300 | PROCEDURAL  | PRODUCTION-SELECTED ADD-TENS-CARRY        |
| 0.300 | PROCEDURAL  | BUFFER-READ-ACTION GOAL                   |
| 0.300 | PROCEDURAL  | BUFFER-READ-ACTION RETRIEVAL              |
| 0.350 | PROCEDURAL  | PRODUCTION-FIRED ADD-TENS-CARRY           |
| 0.350 | PROCEDURAL  | MOD-BUFFER-CHUNK GOAL                     |
| 0.350 | PROCEDURAL  | MODULE-REQUEST RETRIEVAL                  |
| 0.350 | PROCEDURAL  | CLEAR-BUFFER RETRIEVAL                    |
| 0.350 | DECLARATIVE | start-retrieval                           |
| 0.350 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.400 | DECLARATIVE | RETRIEVED-CHUNK FACT17                    |
| 0.400 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT17         |
| 0.400 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.400 | PROCEDURAL  | PRODUCTION-SELECTED ADD-TENS-DONE         |
| 0.400 | PROCEDURAL  | BUFFER-READ-ACTION GOAL                   |
| 0.400 | PROCEDURAL  | BUFFER-READ-ACTION RETRIEVAL              |
| 0.450 | PROCEDURAL  | PRODUCTION-FIRED ADD-TENS-DONE            |
| 0.450 | PROCEDURAL  | MOD-BUFFER-CHUNK GOAL                     |
| 0.450 | PROCEDURAL  | CLEAR-BUFFER RETRIEVAL                    |
| 0.450 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.450 | -----       | Stopped because no events left to process |

That can be very useful when debugging a model but it can be a bit too much at other times. Here is the same model running with a **medium** level of **:trace-detail** (which is the default value):

|       |             |                                   |
|-------|-------------|-----------------------------------|
| 0.000 | GOAL        | SET-BUFFER-CHUNK GOAL GOAL NIL    |
| 0.000 | PROCEDURAL  | CONFLICT-RESOLUTION               |
| 0.050 | PROCEDURAL  | PRODUCTION-FIRED START-PAIR       |
| 0.050 | PROCEDURAL  | CLEAR-BUFFER RETRIEVAL            |
| 0.050 | DECLARATIVE | start-retrieval                   |
| 0.050 | PROCEDURAL  | CONFLICT-RESOLUTION               |
| 0.100 | DECLARATIVE | RETRIEVED-CHUNK FACT67            |
| 0.100 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT67 |
| 0.100 | PROCEDURAL  | CONFLICT-RESOLUTION               |
| 0.150 | PROCEDURAL  | PRODUCTION-FIRED ADD-ONES         |
| 0.150 | PROCEDURAL  | CLEAR-BUFFER RETRIEVAL            |
| 0.150 | DECLARATIVE | start-retrieval                   |

|       |             |   |
|-------|-------------|---|
| 0.150 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.200 | DECLARATIVE | RETRIEVED-CHUNK FACT103                   |
| 0.200 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT103        |
| 0.200 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.250 | PROCEDURAL  | PRODUCTION-FIRED PROCESS-CARRY            |
| 0.250 | PROCEDURAL  | CLEAR-BUFFER RETRIEVAL                    |
| 0.250 | DECLARATIVE | start-retrieval                           |
| 0.250 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.300 | DECLARATIVE | RETRIEVED-CHUNK FACT34                    |
| 0.300 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT34         |
| 0.300 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.350 | PROCEDURAL  | PRODUCTION-FIRED ADD-TENS-CARRY           |
| 0.350 | PROCEDURAL  | CLEAR-BUFFER RETRIEVAL                    |
| 0.350 | DECLARATIVE | start-retrieval                           |
| 0.350 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.400 | DECLARATIVE | RETRIEVED-CHUNK FACT17                    |
| 0.400 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT17         |
| 0.400 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.450 | PROCEDURAL  | PRODUCTION-FIRED ADD-TENS-DONE            |
| 0.450 | PROCEDURAL  | CLEAR-BUFFER RETRIEVAL                    |
| 0.450 | PROCEDURAL  | CONFLICT-RESOLUTION                       |
| 0.450 | -----       | Stopped because no events left to process |

In that trace we no longer see the individual condition tests and only some of the actions of the productions. Now, here is the same model run with a **low** setting for **:trace-detail**:

|       |             |   |
|-------|-------------|---|
| 0.000 | GOAL        | SET-BUFFER-CHUNK GOAL GOAL NIL            |
| 0.050 | PROCEDURAL  | PRODUCTION-FIRED START-PAIR               |
| 0.100 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT67         |
| 0.150 | PROCEDURAL  | PRODUCTION-FIRED ADD-ONES                 |
| 0.200 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT103        |
| 0.250 | PROCEDURAL  | PRODUCTION-FIRED PROCESS-CARRY            |
| 0.300 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT34         |
| 0.350 | PROCEDURAL  | PRODUCTION-FIRED ADD-TENS-CARRY           |
| 0.400 | DECLARATIVE | SET-BUFFER-CHUNK RETRIEVAL FACT17         |
| 0.450 | PROCEDURAL  | PRODUCTION-FIRED ADD-TENS-DONE            |
| 0.450 | -----       | Stopped because no events left to process |

At **low** we only see production firings and buffer settings. The setting of **:trace-detail** does not change how the model actually runs. It only affects how the trace is displayed to the modeler and which events are available to “step” to using the Stepper tool in the ACT-R Environment.

If one wants to completely turn off the model trace, there is another parameter which can be set to do so, and that will be described in a future unit.

To get a parameter’s current value using **sgp** only the name of the parameter (or parameters) should be specified. When all of the values passed to **sgp** are the names of parameters it will print out the details of those parameters and return a list of their current values. Typically that is not necessary when defining a model (with one exception which can be very helpful for debugging a model and that will be described in a later unit), but it can be used at the ACT-R prompt to inspect the model settings (there is also an inspector in the Environment for doing so). Here is an example which is checking the values of the **:trace-detail** and **:lf** parameters:

```
? (sgp :trace-detail :lf)
```

```
:TRACE-DETAIL MEDIUM (default MEDIUM) : Determines which events show in the
trace
:LF 0.05 (default 1.0) : Latency Factor
```

If no parameters are provided to **sgp** then it will print out all of the parameters and their details.

## Interacting with a model

In this unit we used the ACT-R Environment tools to load, run, reset, and inspect the model components. Most of the GUI tools in the Environment are using commands which are also available to the modeler for interacting with the model from the command prompt and in the code to create a task. Here we will describe some of the commands that correspond to the Environment tools used for this unit with respect to using them from the ACT-R command prompt (as was shown above for **sgp**). In future units we will discuss how those commands can also be used in tasks written in Lisp or Python<sup>1</sup>.

### Loading a model

To load the models in this unit we used the “Load ACT-R code” button to pick a file to load. There is a command in ACT-R which can also be used to load a model file which is called **load-act-r-model**. It requires one parameter which is a string specifying the pathname of the file to load. Typically, the full pathname of the file must be specified, but it does accept a simplified specification for files located in the directory containing the ACT-R files which is based on the Lisp logical pathname convention. The format for those relative pathnames is to start with ACT-R: and then follow that with the file name or subdirectories separated by semicolons and then the file name. Here is an example of loading the count.lisp model from the default ACT-R distribution:

```
? (load-act-r-model "ACT-R:tutorial;unit1;count.lisp")
T
```

The **T** printed after the call is the return value from the command, and **T** is the Lisp symbol for true, which for this command means it was successful in loading the file. If the file is not found or there is an error in loading it then it will print a warning indicating the issue and the return value would be **nil** instead.

### Resetting and Reloading

---

<sup>1</sup> There are examples of connecting other languages included in the examples/connections directory, but those are just simple examples and would need to be extended to provide sufficient support to be able to implement the tutorial tasks. The documentation on the protocol for remote connections is in the docs directory if one is interested in extending those examples.

Instead of pressing the buttons to reset or reload a model one can call the corresponding commands, which are named `reset` and `reload`. They require no parameters and will return **T** if successful:

```
? (reset)
T
? (reload)
T
```

## Running the model

There are multiple commands which can be used to run a model which differ in how they determine when to stop running. The one that corresponds to the button on the Control Panel is called **run**. It requires one parameter which is the maximum number of seconds to run the model, but it will stop earlier if the model has no more actions to perform. In later units we will introduce more of the running commands and show them being used in creating tasks that automatically run the model as needed. Here is an example of using the **run** command at the prompt after loading the semantic model:

```
? (run 1)
0.000 GOAL SET-BUFFER-CHUNK GOAL G1 NIL
0.000 PROCEDURAL CONFLICT-RESOLUTION
0.050 PROCEDURAL PRODUCTION-FIRED INITIAL-RETRIEVE
0.050 PROCEDURAL CLEAR-BUFFER RETRIEVAL
0.050 DECLARATIVE start-retrieval
0.050 PROCEDURAL CONFLICT-RESOLUTION
0.100 DECLARATIVE RETRIEVED-CHUNK P14
0.100 DECLARATIVE SET-BUFFER-CHUNK RETRIEVAL P14
0.100 PROCEDURAL CONFLICT-RESOLUTION
0.150 PROCEDURAL PRODUCTION-FIRED DIRECT-VERIFY
0.150 PROCEDURAL CLEAR-BUFFER RETRIEVAL
0.150 PROCEDURAL CONFLICT-RESOLUTION
0.150 ----- Stopped because no events left to process
0.15
24
NIL
```

After the trace there are multiple return values shown from the `run` command which indicate how long it ran (in model time), how many events occurred during the run, and whether it ended unexpectedly or not (a value of **nil** means a successful ending because it was not unexpected).

## Inspecting model components

During the unit we inspected the contents of the buffers, the model's declarative memory, and checked why productions did not match. All of those can also be done using commands.

### *Buffers*

You can use the command named **buffer-chunk** to find the names of the chunks in the buffers and inspect their contents. Calling it without any parameters will show all of the buffers and the chunks they contain returning a list of lists with a buffer name and the



name of the chunk in that buffer if it has one. Here is an example after running the semantic model:

```
? (buffer-chunk)
AURAL: NIL
AURAL-LOCATION: NIL
GOAL: GOAL-CHUNK0
IMAGINAL: NIL
IMAGINAL-ACTION: NIL
MANUAL: NIL
PRODUCTION: NIL
RETRIEVAL: NIL
TEMPORAL: NIL
VISUAL: NIL
VISUAL-LOCATION: NIL
VOCAL: NIL
((AURAL) (AURAL-LOCATION) (GOAL GOAL-CHUNK0) (IMAGINAL) (IMAGINAL-ACTION)
(MANUAL) (PRODUCTION) (RETRIEVAL) (TEMPORAL) (VISUAL) (VISUAL-LOCATION)
(VOCAL))
```

If you call it with the name of a buffer (or multiple buffers), then it will print out the chunks in the named buffers and return a list of the names of the chunks in those buffers in the order they were provided (or nil if it does not have a chunk):

```
? (buffer-chunk retrieval goal)
RETRIEVAL: NIL
GOAL: GOAL-CHUNK0
GOAL-CHUNK0
  OBJECT CANARY
  CATEGORY BIRD
  JUDGMENT YES
(NIL GOAL-CHUNK0)
```

### ***Declarative Memory***

You can also inspect declarative memory from the command prompt. The command **dm** will print out all of the chunks in the model's declarative memory and return a list with the names of those chunks. You can also specify the names of chunks as parameters to the **dm** command and only those chunks will be printed. Here are some examples using the count model:

```
? (dm)
FIRST-GOAL
  START TWO
  END FOUR

FIVE
  NUMBER FIVE

FOUR
  NUMBER FOUR
  NEXT FIVE
```

```
THREE
  NUMBER THREE
  NEXT FOUR
```

```
TWO
  NUMBER TWO
  NEXT THREE
```

```
ONE
  NUMBER ONE
  NEXT TWO
```

```
(FIRST-GOAL FIVE FOUR THREE TWO ONE)
```

```
? (dm four one)
FOUR
  NUMBER FOUR
  NEXT FIVE
```

```
ONE
  NUMBER ONE
  NEXT TWO
```

```
(FOUR ONE)
```

It is also possible to search declarative memory using the command **sdm**. Its parameters are a chunk specification just as one would specify in a retrieval request in a production, but without the `+retrieval>` indicator at the beginning. It prints out only those chunks from the model's declarative memory which match that specification and returns the list of their names. Here are some examples using the semantic model:

```
? (sdm object shark)
P1
  OBJECT SHARK
  VALUE TRUE
  ATTRIBUTE DANGEROUS
```

```
P2
  OBJECT SHARK
  VALUE SWIMMING
  ATTRIBUTE LOCOMOTION
```

```
P3
  OBJECT SHARK
  VALUE FISH
  ATTRIBUTE CATEGORY
```

```
(P1 P2 P3)
```

```
? (sdm - attribute category - attribute nil)
P1
  OBJECT SHARK
  VALUE TRUE
  ATTRIBUTE DANGEROUS
```

```
P2
  OBJECT SHARK
  VALUE SWIMMING
  ATTRIBUTE LOCOMOTION
```

P4  
OBJECT SALMON  
VALUE TRUE  
ATTRIBUTE EDIBLE

P5  
OBJECT SALMON  
VALUE SWIMMING  
ATTRIBUTE LOCOMOTION

P7  
OBJECT FISH  
VALUE GILLS  
ATTRIBUTE BREATHE

P8  
OBJECT FISH  
VALUE SWIMMING  
ATTRIBUTE LOCOMOTION

P10  
OBJECT ANIMAL  
VALUE TRUE  
ATTRIBUTE MOVES

P11  
OBJECT ANIMAL  
VALUE TRUE  
ATTRIBUTE SKIN

P12  
OBJECT CANARY  
VALUE YELLOW  
ATTRIBUTE COLOR

P13  
OBJECT CANARY  
VALUE TRUE  
ATTRIBUTE SINGS

P15  
OBJECT OSTRICH  
VALUE FALSE  
ATTRIBUTE FLIES

P16  
OBJECT OSTRICH  
VALUE TALL  
ATTRIBUTE HEIGHT

P18  
OBJECT BIRD  
VALUE TRUE  
ATTRIBUTE WINGS

P19  
OBJECT BIRD  
VALUE FLYING  
ATTRIBUTE LOCOMOTION

(P1 P2 P4 P5 P7 P8 P10 P11 P12 P13 P15 P16 P18 P19)

One thing to note about the second example is that it specifies both that the attribute slot is not category and also not nil (which means the chunk must have some value for the slot). Here is what it returns if it were to only specify that the attribute slot is not category:

```
? (sdm - attribute category)
...
(G1 G2 G3 P1 P2 P4 P5 P7 P8 P10 P11 P12 P13 P15 P16 P18 P19 SHARK DANGEROUS
LOCOMOTION SWIMMING FISH SALMON EDIBLE BREATHE GILLS ANIMAL MOVES SKIN CANARY
COLOR SINGS BIRD OSTRICH FLIES HEIGHT TALL WINGS FLYING TRUE FALSE)
```

In this case it also finds all of the chunks which do not have an attribute slot because chunks without the slot fail the “attribute category” test and thus the negation of that is then true. That is something to be careful about when using the negation modifier in specifying retrieval requests in your productions as well.

### *Testing why not? for productions*

The command to test whether a production matches the current state is called **whynot**. If you pass it no parameters it will print out each production in the model’s procedural memory along with either an indication that it matches or a reason why it does not match. You can also provide it with specific production names to test. It returns a list of the names of the productions which do match the current state. Here is an example using productions from the semantic model after it has been reset:

```
? (whynot direct-verify fail)
```

```
Production DIRECT-VERIFY does NOT match.
```

```
(P DIRECT-VERIFY
=GOAL>
  OBJECT =OBJ
  CATEGORY =CAT
  JUDGMENT PENDING
=RETRIEVAL>
  OBJECT =OBJ
  ATTRIBUTE CATEGORY
  VALUE =CAT
==>
=GOAL>
  JUDGMENT YES
)
```

```
It fails because:
The GOAL buffer is empty.
```

```
Production FAIL does NOT match.
```

```
(P FAIL
=GOAL>
  OBJECT =OBJ1
  CATEGORY =CAT
  JUDGMENT PENDING
?RETRIEVAL>
  BUFFER FAILURE
==>
```

```

=GOAL>
    JUDGMENT NO
)
It fails because:
The GOAL buffer is empty.
NIL

```

## Other model commands

Any of the commands that are specified in the model definition can also be called from the ACT-R command prompt. The **add-dm** and **p** commands are not usually called from the prompt since you want that knowledge to be included in the model when it starts running, but a command like **goal-focus** can occasionally be useful if you want to change the goal chunk for a model and run it again. That could have been convenient for the semantic model because instead of changing the file and reloading it to switch the goals one could have run the different goals sequentially by just calling goal-focus to change the chunk in the goal buffer and then run it again:

```

? (run 1)
0.000    GOAL                SET-BUFFER-CHUNK GOAL G1 NIL
0.000    PROCEDURAL          CONFLICT-RESOLUTION
0.050    PROCEDURAL          PRODUCTION-FIRED INITIAL-RETRIEVE
0.050    PROCEDURAL          CLEAR-BUFFER RETRIEVAL
0.050    DECLARATIVE         start-retrieval
0.050    PROCEDURAL          CONFLICT-RESOLUTION
0.100    DECLARATIVE         RETRIEVED-CHUNK P14
0.100    DECLARATIVE         SET-BUFFER-CHUNK RETRIEVAL P14
0.100    PROCEDURAL          CONFLICT-RESOLUTION
0.150    PROCEDURAL          PRODUCTION-FIRED DIRECT-VERIFY
0.150    PROCEDURAL          CLEAR-BUFFER RETRIEVAL
0.150    PROCEDURAL          CONFLICT-RESOLUTION
0.150    -----            Stopped because no events left to process

0.15
24
NIL
? (goal-focus g2)
G2
? (run 1)
0.150    GOAL                SET-BUFFER-CHUNK GOAL G2 NIL
0.150    PROCEDURAL          CONFLICT-RESOLUTION
0.200    PROCEDURAL          PRODUCTION-FIRED INITIAL-RETRIEVE
0.200    PROCEDURAL          CLEAR-BUFFER RETRIEVAL
0.200    DECLARATIVE         start-retrieval
0.200    PROCEDURAL          CONFLICT-RESOLUTION
0.250    DECLARATIVE         RETRIEVED-CHUNK P14
0.250    DECLARATIVE         SET-BUFFER-CHUNK RETRIEVAL P14
0.250    PROCEDURAL          CONFLICT-RESOLUTION
0.300    PROCEDURAL          PRODUCTION-FIRED CHAIN-CATEGORY
0.300    PROCEDURAL          CLEAR-BUFFER RETRIEVAL
0.300    DECLARATIVE         start-retrieval
0.300    PROCEDURAL          CONFLICT-RESOLUTION
0.350    DECLARATIVE         RETRIEVED-CHUNK P20
0.350    DECLARATIVE         SET-BUFFER-CHUNK RETRIEVAL P20
0.350    PROCEDURAL          CONFLICT-RESOLUTION
0.400    PROCEDURAL          PRODUCTION-FIRED DIRECT-VERIFY
0.400    PROCEDURAL          CLEAR-BUFFER RETRIEVAL
0.400    PROCEDURAL          CONFLICT-RESOLUTION
0.400    -----            Stopped because no events left to process

0.25

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36
NIL
? (goal-focus g3)
G3
? (run 1)
  0.400    GOAL          SET-BUFFER-CHUNK GOAL G3 NIL
  0.400    PROCEDURAL   CONFLICT-RESOLUTION
  0.450    PROCEDURAL   PRODUCTION-FIRED INITIAL-RETRIEVE
  0.450    PROCEDURAL   CLEAR-BUFFER RETRIEVAL
  0.450    DECLARATIVE  start-retrieval
  0.450    PROCEDURAL   CONFLICT-RESOLUTION
  0.500    DECLARATIVE  RETRIEVED-CHUNK P14
  0.500    DECLARATIVE  SET-BUFFER-CHUNK RETRIEVAL P14
  0.500    PROCEDURAL   CONFLICT-RESOLUTION
  0.550    PROCEDURAL   PRODUCTION-FIRED CHAIN-CATEGORY
  0.550    PROCEDURAL   CLEAR-BUFFER RETRIEVAL
  0.550    DECLARATIVE  start-retrieval
  0.550    PROCEDURAL   CONFLICT-RESOLUTION
  0.600    DECLARATIVE  RETRIEVED-CHUNK P20
  0.600    DECLARATIVE  SET-BUFFER-CHUNK RETRIEVAL P20
  0.600    PROCEDURAL   CONFLICT-RESOLUTION
  0.650    PROCEDURAL   PRODUCTION-FIRED CHAIN-CATEGORY
  0.650    PROCEDURAL   CLEAR-BUFFER RETRIEVAL
  0.650    DECLARATIVE  start-retrieval
  0.650    PROCEDURAL   CONFLICT-RESOLUTION
  0.700    DECLARATIVE  RETRIEVAL-FAILURE
  0.700    PROCEDURAL   CONFLICT-RESOLUTION
  0.750    PROCEDURAL   PRODUCTION-FIRED FAIL
  0.750    PROCEDURAL   CLEAR-BUFFER RETRIEVAL
  0.750    PROCEDURAL   CONFLICT-RESOLUTION
  0.750    -----
0.35
48
NIL
Stopped because no events left to process

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