Unit1 Model Code Description

This document (and the corresponding documents for future units) will describe any ACT-R commands used in the models which are not described in the main unit text, the Lisp code that controls the experiments for the model, and how ACT-R is interfaced to those experiments.

For this unit there are no experiments and all of the models run without any interaction with a real or virtual world. They start with a predefined goal and a given set of declarative memories, and the result is a modification of the goal chunk representing the cognition that took place. Later units will 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 one was to write for unit1:

```
(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>
      state error
==>
   =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
      ten1 =num1
      ten2 =num2
      carry 1
      ten-ans busy
   =retrieval>
      ISA addition-fact
      addend1 =num1
      addend2 =num2
      sum =sum
==>
   =goal>
      carry nil
   +retrieval>
      ISA addition-fact
      addend1 1
      addend2 =sum
)
(goal-focus goal)
)
```

There is 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.

The commands for creating chunk-types (**chunk-type**), declarative memory chunks (**add-dm)**, and productions (**p**) as well as the command to place a chunk into the **goal** buffer (**goal-focus**) were described in the main unit text. Here we will describe the other commands in the models.

Clear-all

The **clear-all** command is used to set the ACT-R software to its initial state. It removes all models that may be defined and restores all settings to their default values. If a model (or group 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.

Clear-all also records the name of the file that contains it when it is loaded. After that point, the ACT-R command **reload** can be used to load that file again, which is often faster than using the load command or the menu options to do so.

Define-model

The **define-model** command takes one required parameter which is the name of a new model to create and an arbitrary number of other commands. The name should be a symbol and must be unique with respect to other models that are currently defined. When **reset** is called, all of the commands specified inside of the **define-model** are reevaluated for that model. An important feature of ACT-R 6.0 is that more than one model can be defined simultaneously. Each call to **define-model** creates a new model which is independent of the other models and all of those models will run in parallel when the **run** command is called. We will not be using more than one model at a time in the tutorial units, but you are free to experiment with that if you like and more information can be found in the ACT-R 6.0 reference manual.

SGP

The **sgp** command is used to set or show the parameters for a model (it stands for set/show general parameters). If you call **sgp** at the Lisp prompt with no parameters it will print out all of the parameters for all of the modules in the current model with their current values, the default values and a short description of each parameter. The parameters for the modules control many different things. Some are used in equations that control the performance of the model and others are there to help the modeler with debugging or extending a model by changing some of the general ACT-R mechanisms. The details of all the parameters for the default ACT-R 6.0 modules 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 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 are specifying that retrieval requests will always take 50ms, but other than that 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 this model. 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 REQUESTED 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           MODULE-REQUEST RETRIEVAL
0.050    PROCEDURAL           MOD-BUFFER-CHUNK GOAL
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           MODULE-REQUEST RETRIEVAL
0.150    PROCEDURAL           MOD-BUFFER-CHUNK GOAL
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           MODULE-REQUEST RETRIEVAL
0.250    PROCEDURAL           MOD-BUFFER-CHUNK GOAL
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           MODULE-REQUEST RETRIEVAL
0.350    PROCEDURAL           MOD-BUFFER-CHUNK GOAL
```

```
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 REQUESTED 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
```

We no longer see the individual conditions and actions of the productions in the trace. Now, here is the same model run with a **low** setting for **:trace-detail**:

```
   0.000   GOAL                    SET-BUFFER-CHUNK GOAL GOAL REQUESTED 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 runs, only in how the trace is displayed to the modeler.