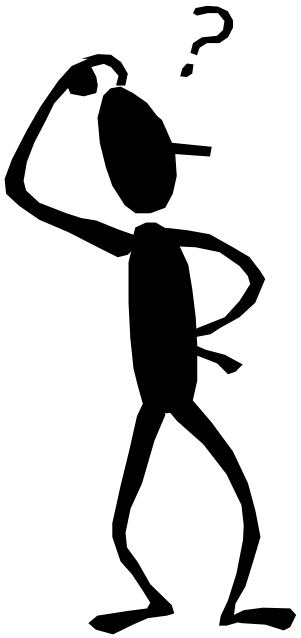
Knowledge representation
Part 3

Constructing statements - how to use the formal grammar



FormalSentence ⇒ Statement **if** FormalConditions
FormalSentence ⇒ Statement
Statement ⇒ Cause **Causes** Effect where Causes is an element of the set:{**causes1way**,**causes2way**}
Statement ⇒ AttributeStatement
Statement ⇒ **not**(AttributeStatement)
Statement ⇒ **link**(influence,Thing,Thing)
Statement ⇒ **link**(Link,Object,Object)
Statement ⇒ **link**(Link,ProcessBit,ProcessBit)
Statement ⇒ **link**(Link,ProcessBit,Object)
Statement ⇒ **comparison**(Attribute,Object,Comparison,Object)
FormalConditions ⇒ FormalConditions **and** FormalConditions
FormalConditions ⇒ FormalConditions **or** FormalConditions
FormalConditions ⇒ Statement
FormalConditions ⇒ ActionBit
FormalConditions ⇒ ProcessBit
AttributeStatement ⇒ **att_value**(Object,Attribute,Value)
AttributeStatement ⇒ **att_value**(ProcessBit,Attribute,Value)
AttributeStatement ⇒ **att_value**(ActionBit,Attribute,Value)
Cause ⇒ AttributeStatement
Cause ⇒ ProcessBit
Cause ⇒ ActionBit
Cause ⇒ Object
Cause ⇒ **not**(Cause)
ActionBit ⇒ **action**(Action,Object,Object)
ActionBit ⇒ **action**(Action,Object)
Effect ⇒ AttributeStatement
Effect ⇒ ProcessBit
Effect ⇒ ActionBit
Effect ⇒ **not**(Effect)
Process_bit ⇒ **process**(Process)
Process_bit ⇒ **process**(Object,Process)
Process_bit ⇒ **process**(Object,Process,Object)
Thing ⇒ Object
Thing ⇒ ProcessBit
Attribute ⇒ atom
Process ⇒ atom
Link ⇒ atom
Object ⇒ atom
Object ⇒ **part**(Object,Object)
Action ⇒ atom
Comparison ⇒ Atom where Atom is an element of the set:{**greater_than**, **less_than,** **same_as**, **different_from**}
Value ⇒ Atom Where Atom is an element of the set:{**increase**, **decrease**, **change**, **no_change**}
Value ⇒ Atom
Value ⇒ Number Where Number is either a floating point number or an integer
Value ⇒ **range**(Value,Value)

Reserved terms in AKT5

- Terms that define the statement type:
  - **att_value**
    - e.g., att_value(rice,growth_rate,fast))
  - **causes1way**, **causes2way**
    - e.g., action(harvesting,rice) causes1way att_value(birds,presence_on_farms,increase)
    - e.g., att_value(action(harvesting,rice),frequency, increase) causes2way att_value(birds,presence_on_farms,increase)
  - **comparison**
    - e.g., comparison(growth_rate,rice,greater_than,maize)
  - **link**
    - e.g., link(attracts,heather_flowers,bees)

More reserved terms

- Other terms used within statements:
  - **process**
    - e.g., process(water,infiltrating,soil)
  - **action**
    - e.g., action(harvesting,rice)
  - **part**
    - used with objects, e.g. stem of rice = part(rice,stem)*
  - **range** *(appears in value section of an attribute value statement)*
    - e.g., between 100 and 110 days to flowering = att_value(process(plant,flowering),time,range('100_days','110_days'))
  - **If** *(conditions of a statement)*
  - **not**
    - e.g., not(action(harvesting,rice))

*Note: Put main object first and 'part of' object second

Special terms

The following terms mean something in AKT already and are for use in either attribute value statements, comparison statements, link statements or calendar

- Values in attribute value statements
  - increase, decrease, change, no_change, range
- Values in comparison statements
  - greater_than, less_than, same_as, different_from
- Link
  - Influence
- Calendar months
  - ‘January’, ‘February’, ‘March’ ….and so on (capitalised months)

Punctuation

- Brackets, commas etc. **must** be in the right places
- Lower case is used for most words
- Capital letters
  - are used for botanical names and other *proper* names
  - formal terms starting with a capital letter (usually Latin names or names of places) must be in inverted commas e.g. ‘Acacia mearnsii’
- Underscore
  - is used instead of a space for formal terms consisting of multiple words e.g. black_soil
- Numbers
  - formal terms that start with a number must also be in inverted commas e.g. ‘40cm’, ‘3 tonnes per hectare’

Let’s try a simple statement:

Inga vera leaves are soft

Inga vera leaves are soft

FormalSentence $\Rightarrow$ Statement **if** FormalConditions

FormalSentence $\Rightarrow$ Statement

Inga vera leaves are soft

Statement ⇒ Cause **Causes** Effect where Causes is an element of the set:{**causes1way**,**causes2way**}
Statement ⇒ AttributeStatement
Statement ⇒ **not**(AttributeStatement)
Statement ⇒ **link**(influence,Thing,Thing)
Statement ⇒ **link**(Link,Object,Object)
Statement ⇒ **link**(Link,ProcessBit,ProcessBit)
Statement ⇒ **link**(Link,ProcessBit,Object)
Statement ⇒ **comparison**(Attribute,Object,Comparison,Object)

Inga vera leaves are soft

AttributeStatement ⇒ **att_value**(Object,Attribute,Value)
AttributeStatement ⇒ **att_value**(ProcessBit,Attribute,Value)
AttributeStatement ⇒ **att_value**(ActionBit,Attribute,Value)

Inga vera leaves are soft

Object $\Rightarrow$ atom
Object $\Rightarrow$ **part**(Object,Object) 

Inga vera leaves are soft

- So…your formal statement should look like this:

att_value(part(‘Inga vera’,leaves),texture,soft)

object object attribute value

Let’s try another one:

Burning stubble causes a decrease in pest numbers

Burning stubble causes a decrease in pest numbers

FormalSentence $\Rightarrow$ Statement **if** FormalConditions

FormalSentence $\Rightarrow$ Statement

Burning stubble causes a decrease in pest numbers

Statement ⇒ Cause **Causes** Effect where Causes is an element of the set:{**causes1way**,**causes2way**}
Statement ⇒ AttributeStatement
Statement ⇒ **not**(AttributeStatement)
Statement ⇒ **link**(influence,Thing,Thing)
Statement ⇒ **link**(Link,Object,Object)
Statement ⇒ **link**(Link,ProcessBit,ProcessBit)
Statement ⇒ **link**(Link,ProcessBit,Object)
Statement ⇒ **comparison**(Attribute,Object,Comparison,Object)

Burning stubble causes a decrease in pest numbers

Cause ⇒ AttributeStatement
Cause ⇒ ProcessBit
Cause ⇒ ActionBit
Cause ⇒ Object
Cause ⇒ **not**(Cause)

Burning stubble causes a decrease in pest numbers

ActionBit $\Rightarrow$ **action**(Action,Object,Object)
ActionBit $\Rightarrow$ **action**(Action,Object) 

Burning stubble causes a decrease in pest numbers

Effect $\Rightarrow$ AttributeStatement
Effect $\Rightarrow$ ProcessBit
Effect $\Rightarrow$ ActionBit
Effect $\Rightarrow$ **not**(Effect)

Burning stubble causes a decrease in pest numbers

AttributeStatement ⇒ **att_value**(Object,Attribute,Value)
AttributeStatement ⇒ **att_value**(ProcessBit,Attribute,Value)
AttributeStatement ⇒ **att_value**(ActionBit,Attribute,Value)

Burning stubble causes a decrease in pest numbers

So…your formal statement should look like this:

action(burning,stubble) causes1way att_value(pest, numbers, decrease)

action object

object attribute value

…and finally:

An increase in soil temperature causes an increase in the rate of decomposition of organic matter

An increase in soil temperature causes an increase in the rate of decomposition of organic matter

FormalSentence $\Rightarrow$ Statement **if** FormalConditions

FormalSentence $\Rightarrow$ Statement

An increase in soil temperature causes an increase in the rate of decomposition of organic matter

Statement ⇒ Cause **Causes** Effect where Causes is an element of the set:{**causes1way**,**causes2way**}
Statement ⇒ AttributeStatement
Statement ⇒ **not**(AttributeStatement)
Statement ⇒ **link**(influence,Thing,Thing)
Statement ⇒ **link**(Link,Object,Object)
Statement ⇒ **link**(Link,ProcessBit,ProcessBit)
Statement ⇒ **link**(Link,ProcessBit,Object)
Statement ⇒ **comparison**(Attribute,Object,Comparison,Object)

An increase in soil temperature causes an increase in the rate of decomposition of organic matter

Cause $\Rightarrow$ AttributeStatement
Cause $\Rightarrow$ ProcessBit
Cause $\Rightarrow$ ActionBit
Cause $\Rightarrow$ Object
Cause $\Rightarrow$ **not**(Cause)

An increase in soil temperature causes an increase in the rate of decomposition of organic matter

AttributeStatement ⇒ **att_value**(Object,Attribute,Value)

AttributeStatement ⇒ **att_value**(ProcessBit,Attribute,Value)

AttributeStatement ⇒ **att_value**(ActionBit,Attribute,Value)

An increase in soil temperature causes an increase in the rate of decomposition of organic matter

Effect $\Rightarrow$ AttributeStatement
Effect $\Rightarrow$ ProcessBit
Effect $\Rightarrow$ ActionBit
Effect $\Rightarrow$ **not**(Effect)

An increase in soil temperature causes an increase in the rate of decomposition of organic matter

AttributeStatement $\Rightarrow$ **att_value**(Object,Attribute,Value)
AttributeStatement $\Rightarrow$ **att_value**(ProcessBit,Attribute,Value) 
AttributeStatement $\Rightarrow$ **att_value**(ActionBit,Attribute,Value)

An increase in soil temperature causes an increase in the rate of decomposition of organic matter

Process_bit ⇒ **process**(Process)

Process_bit ⇒ **process**(Object,Process)

Process_bit ⇒ **process**(Object,Process,Object)

An increase in soil temperature causes an increase in the rate of decomposition of organic matter

So, your formal statement should look like this:

att_value(soil,temperature,increase) causes2way

att_value(process(organic_matter,decomposition),rate,increase)

See…it's easy when you know how….