

ΑΝΑΠΤΥΞΗ ΔΙΑΔΙΚΑΣΤΙΚΩΝ  
ΚΛΕΙΔΙΩΝ ΑΠΟΚΛΕΙΣΜΟΥ ΜΕ  
ΕΜΠΕΙΡΑ ΣΥΣΤΗΜΑΤΑ

ΔΗΜΗΤΡΗΣ ΑΡΓΙΑΛΑΣ

## Προβλήματα στη Φωτοερμηνεία

- διαδικαστικό πλαίσιο
- αρχάριοι φωτοερμηνευτές
- στρατηγική επίλυσης
- χρονοβόρα διαδικασία,
- υψηλό κόστος
- ικανότητα/δεξιότητες - πρακτική

# Περιορισμοί της γνώσης

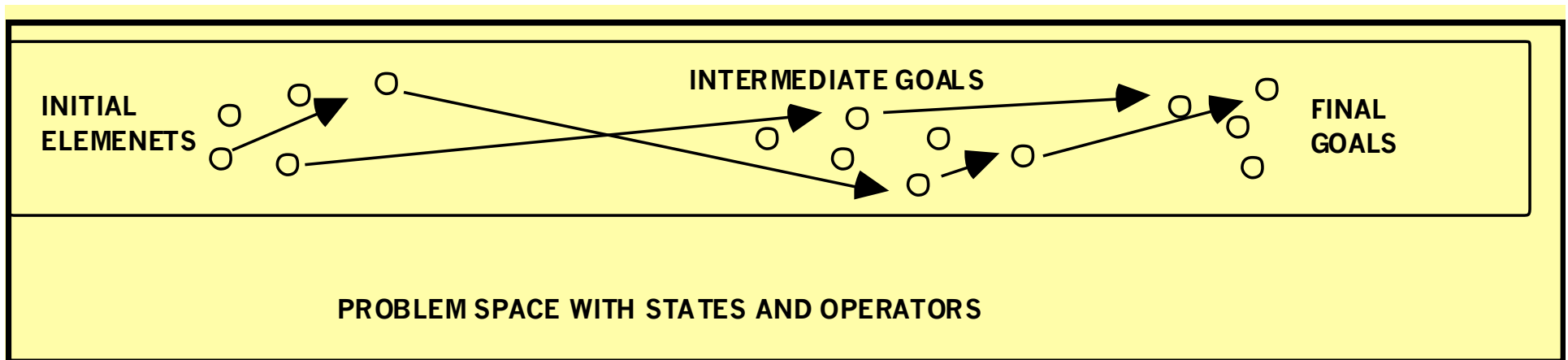
- Η γνώση **δεν είναι καταγεγραμμένη** σε συγκεκριμένη πηγή με άμεσο τρόπο.
- Οι χωρικές σχέσεις είναι **έμμεσα ενσωματωμένες** σε περιγραφές που αφορούν τις γεωμορφολογικές διεργασίες και
- η βήμα προς βήμα διαδικασία επίλυσης **απουσιάζει** από την βιβλιογραφία

# Φωτοερμηνεία – Φωτοερμηνευτικά Κλειδιά

- Η **φωτοερμηνεία** εμπεριέχει διάφορα επίπεδα **πολυπλοκότητας**.
- Η διαδικασία της φωτοερμηνείας διευκολύνεται από την χρήση “**Φωτοερμηνευτικών Κλειδιών**”.
- Η μεθοδολογία των “συγκλινουσών” ενδείξεων ως μέσο αύξησης της ακρίβειας και του βαθμού λεπτομέρειας της Φωτοερμηνείας.
- Ο βαθμός επιτυχίας της στηρίζεται, κατά το μεγαλύτερο μέρος της, στην εκπαίδευση και την εμπειρία του φωτοερμηνευτή.

# Ανάγκη

- μελέτης της διαδικασίας φωτοερμηνείας και εξαγωγής συμπερασμάτων



# ΣΚΟΠΟΣ

- καλύτερη κατανόηση,
- ανάπτυξη συστηματικού πλαισίου αναγνώρισης
- τυποποίηση φωτοερμηνευτικής διαδικασίας
- ανακάλυψη δένδρων απόφασης φωτοερμηνείας

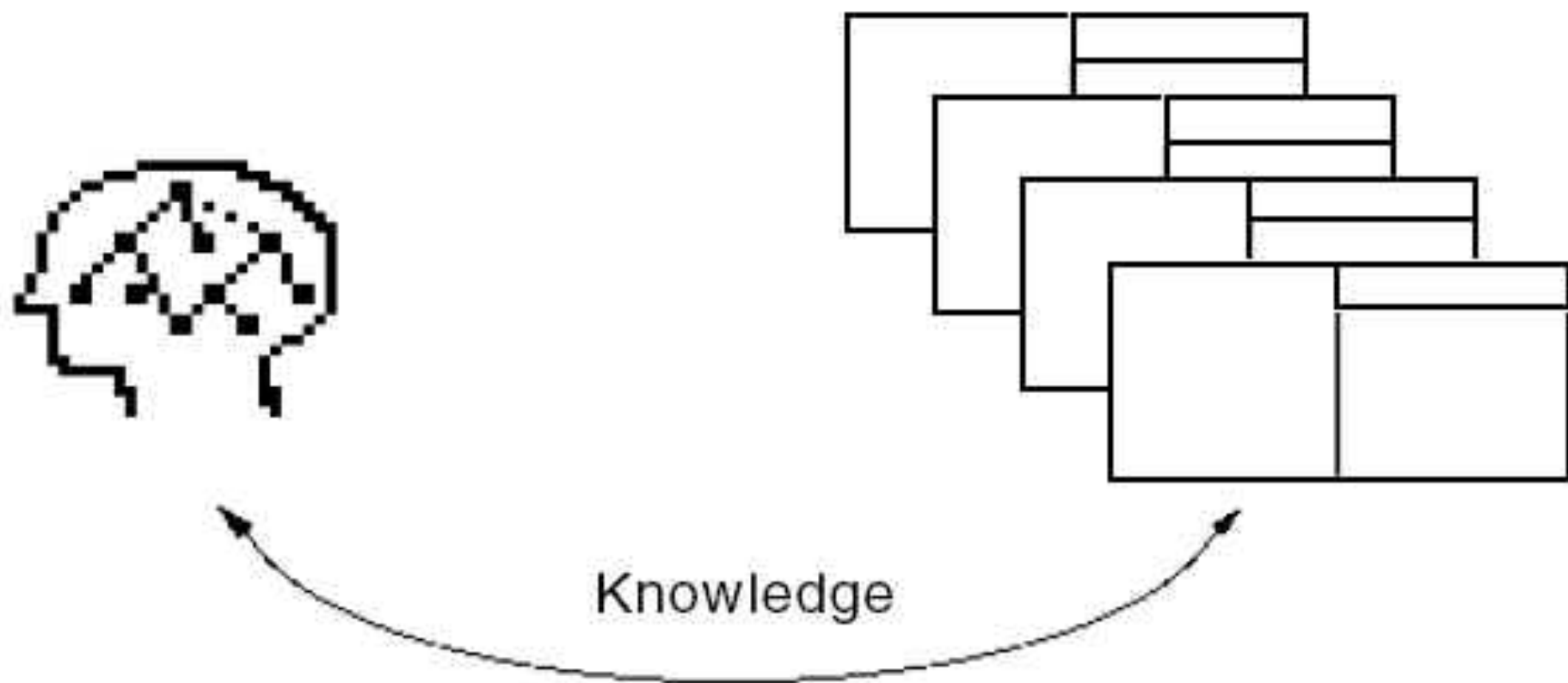
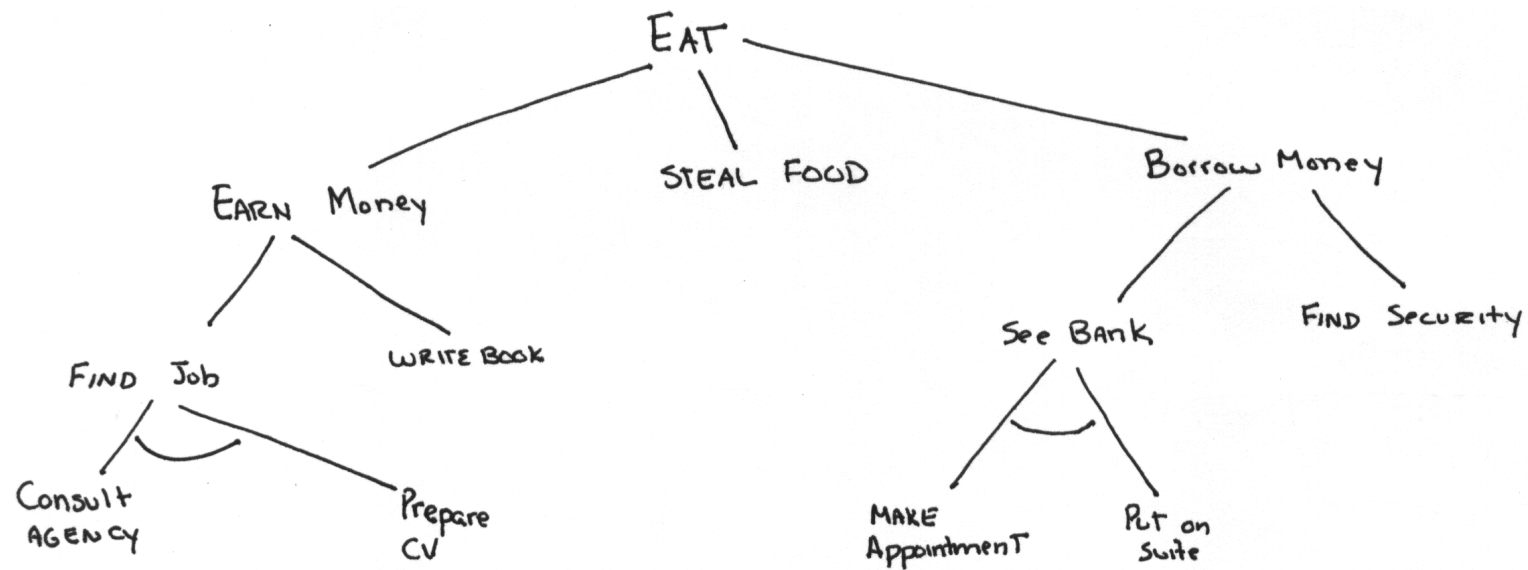


Figure 1-73 Transferring Knowledge

# And/Or Trees and Explanations

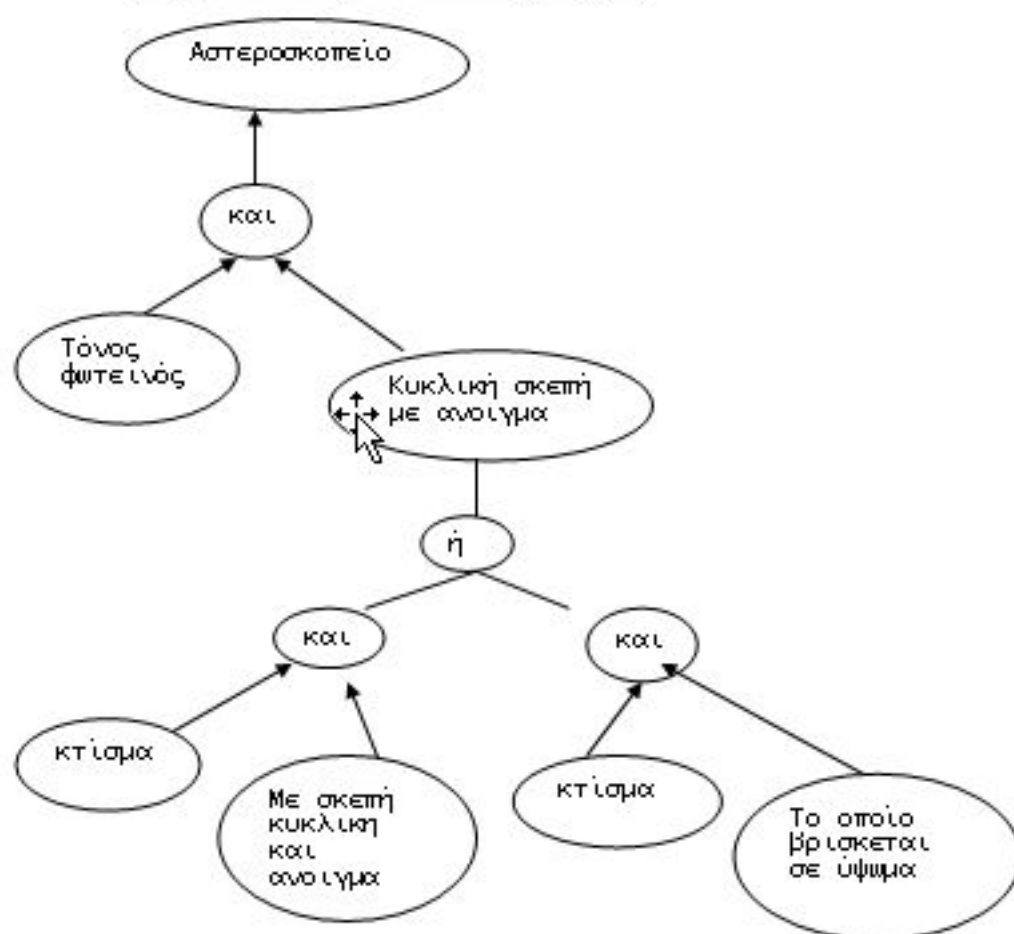




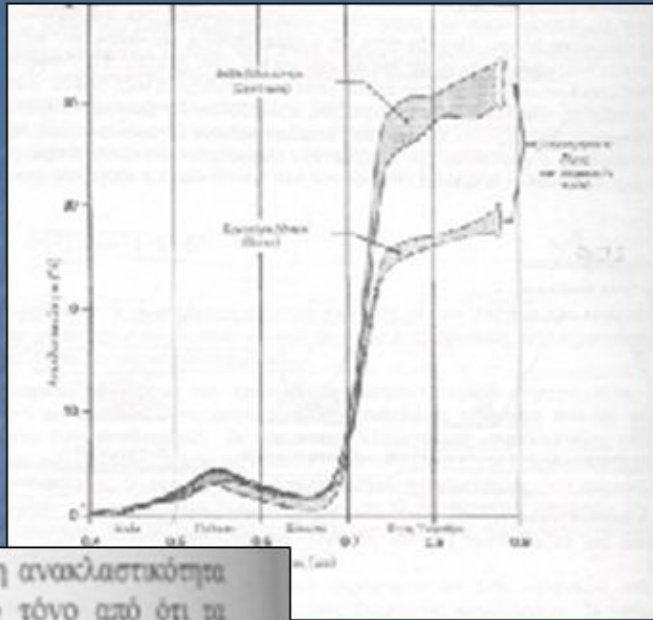
### Αστεροσκοπείο

Κατηγορία Φωτοερμηνηυτικού Στοιχείου	Φωτοερμηνηυτικό Στοιχείο	Τμή του Φωτοερμηνηυτικού Στοιχείου
Θαμνωδής σχέση Στοιχεία προτύπου	Ένα ένα είδος Υψος	κτίσματος Παρουσίαξη
Στοιχεία προτύπου Στοιχεία προτύπου	Τονος Πιο διακριτό χαρακτηριστικό	Φωτεινός ομοιόμορφος Σφαιρική στέγη με ανοίγμα στη κυρτή πλευρά
Θαμνωδείς σχέσεις Τοπικό περιβάλλον	Πιθανός δείκτης Βρισκεται ψηλότερα(δετόξη)	Πρωτεύουσών κρατών Του γύρω χώρου
Τοπικό περιβάλλον	Βρισκεται κοντά	Σε αστικές περιοχές

### Σημασιολογικό διάγραμμα



<b>FORESTS</b>
<b>height &gt; 5m</b>
<b>trees = yes</b>
<b>CONIFEROUS TREES</b>
<b>covering &gt; 75%</b>
<b>RGB composite 4,3,2 = dark red</b>
<b>BROAD - LEAVED TREES</b>
<b>covering &gt; 75%</b>
<b>RGB composite 4,3,2 = light red</b>



υπέρυθρες φωτογραφίες, τα φυλλοβόλα δέντρα (έχοντας υψηλότερη υπέρυθρη ανακλαστικότητα από ότι τα κωνοφόρα δέντρα) γενικά εμφανίζονται με πολύ φωτεινότερο τόνο από ότι τα κωνοφόρα. Αυτό φαίνεται στο Σχήμα 1.9, το οποίο μας δείχνει συστάδες κωνοφόρων δέντρων.



<b>Class 3.1 Forests</b>	9. Deciduous woodland	Bright red
Areas occupied by forests and wood	10. Coniferous woodland	Brown-red
exotic coniferous and/or deciduous		

timber or other forest products. The forest trees are under normal climatic conditions higher than 5 m with a canopy closure of 30 % at least. In case of young plantation, the minimum cut-off-point is 500 subjects by ha.

**312 Coniferous forest**

**Vegetation formation composed principally of trees, including shrub and bush understoreys, where coniferous species predominate.**

**Extension:**  
 Coniferous trees represent more than 75 % of the formation. In case of young plants or seedlings, the proportion of coniferous plants to be considered is at least 75 % of the total amount of plants and their texture is very similar to a surrounding coniferous forest texture.

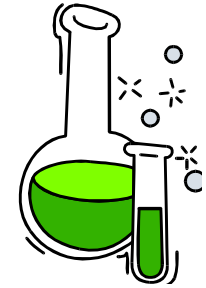




## PSEUDO CODE RULES

1. **IF**      **The customer's income is less than 25,000.**  
    **THEN** **The customer's line of credit is denied.**
  
2. **IF** **The customer's income is at least 25,000.**  
    **and**   **The customer's credit rating is excellent.**  
    **THEN** **The customer's line of credit is approved.**
  
3. **IF**      **The customer's income is at least 25,000.**  
    **and**    **The customer's credit rating is good.**  
    **and**    **The customer has been in their present job less than 2.5 years.**  
    **THEN** **The customer's line of credit is denied.**
  
4. **IF**      **The customer's income is at least 25,000.**  
    **and**    **The customer's credit rating is good.**  
    **and**    **The customer has been in their present job at least 2.5 years.**  
    **THEN** **The customer's line of credit is approved.**
  
5. **IF**      **The customer's income is at least 25,000.**  
    **and**    **The customer's credit rating is poor.**  
    **THEN** **The customer's line of credit is denied.**

# A diagnostic rule



**IF** there are spots on leaves, and  
the color of spots is pale  
yellow, gray, or purple, and  
the shape of spots is bounded  
making acute angle with  
veins, and the season is spring

**Then** the disease is downy mildew -  
probability = 0.9

# A treatment rule



**IF** the disease is downy mildew

**THEN** the treatment method is chemical  
spraying, and the material used  
is redomil+copper

# Έμπειρα συστήματα

- πεδίο της τεχνητής νοημοσύνης
- **αντιμετωπίζουν σύνθετες και εξειδικευμένες διαδικασίες επίλυσης** οι οποίες απαιτούν μοναδική εμπειρία

# ΕΜΠΕΙΡΑ ΣΥΣΤΗΜΑΤΑ

- Τα **έμπειρα συστήματα** είναι **προγράμματα ηλεκτρονικού υπολογιστή**, τα οποία, χρησιμοποιώντας **τεχνικές της τεχνητής νοημοσύνης**, είναι σε θέση να συμπαρασταθούν ουσιαστικά στον άνθρωπο (ή και να τον υποκαταστήσουν πλήρως) σε διαδικασίες **επίλυσης προβλημάτων** (συναγωγή χρήσιμων συμπερασμάτων, παροχές συμβουλών, κ.τ.λ)
- Για την αναπαράσταση της γνώσης χρησιμοποιούν: **κανόνες παραγωγής, τάξεις, αντικείμενα.**



# Έμπειρα Συστήματα

- “...έξυπνα προγράμματα, τα οποία χρησιμοποιούν τη γνώση σε συνδυασμό με μηχανισμούς αιτιολόγησης προκειμένου να επιλύσουν προβλήματα τόσο περίπλοκα ώστε να απαιτούν επαρκή ανθρώπινη εμπειρία για την αντιμετώπισή τους”. (*Pr. Edward Feigenbaum – Stanford University*)
- Τα Ε.Σ. αποτελούν τμήμα του ευρύτερου επιστημονικού πεδίου της Τεχνητής Νοημοσύνης.
- Οι τεχνολογίες των Ε.Σ. αποτελούν ένα νέο πρότυπο που προεκτείνει τις τεχνικές του παραδοσιακού προγραμματισμού ώστε να συναντούν τις γνωσιολογικά προσανατολισμένες διεργασίες.

# Έμπειρα συστήματα - 1

- αναπαριστούν την γνώση με αντικείμενα και συστήματα παραγωγής
- προσφέρουν μεθόδους και εργαλεία για την αναπαράσταση τόσο
  - γεγονότων (δεδομένα, υποθέσεις, αντικείμενα), όσο και
  - της διαδικασίας επίλυσης ενός προβλήματος και έτσι
- μπορούν να βοηθήσουν στην ανακάλυψη και τυποποίηση των δένδρων απόφασης για την φωτοερμηνεία γεωμορφών.

# Έμπειρα συστήματα αναπαριστούν γνώση

- γεγονότα  $\implies$  αντικείμενα
- διαδικασία επίλυσης  $\implies$  κανόνες  
= συστήματα παραγωγής

# Στάδια ανάπτυξης εμπείρων συστημάτων

- Τοποθέτηση του προβλήματος
- Εννοιολογική σύλληψη και αναπαράσταση
- Τυποποίηση της γνώσης
- Υλοποίηση
- Έλεγχος και αξιολόγηση

# Σύλληψη

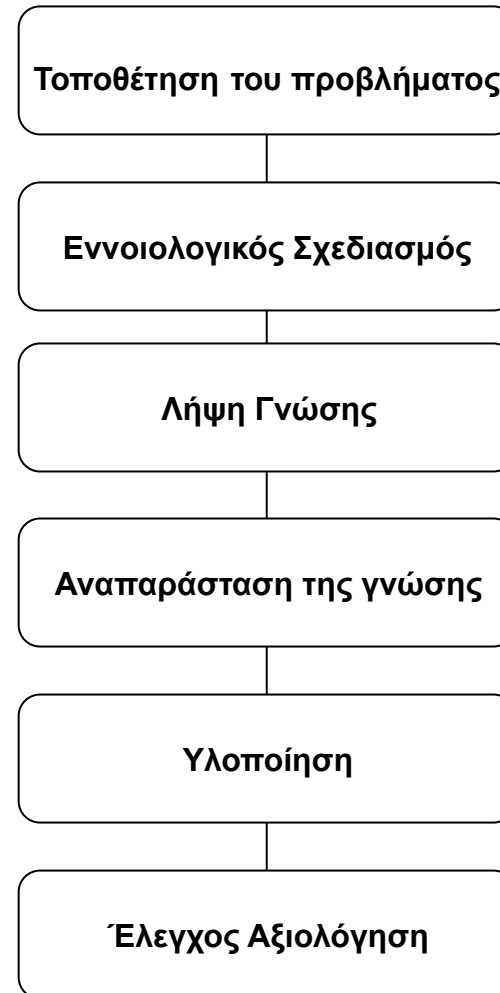
- αποκάλυψη των κύριων εννοιών
- αποκάλυψη των σχέσεων μεταξύ τους
- τυποποίηση της περιγραφής της γνώσης

# Εννοιολογικό πλαίσιο αναπαράστασης της γνώσης

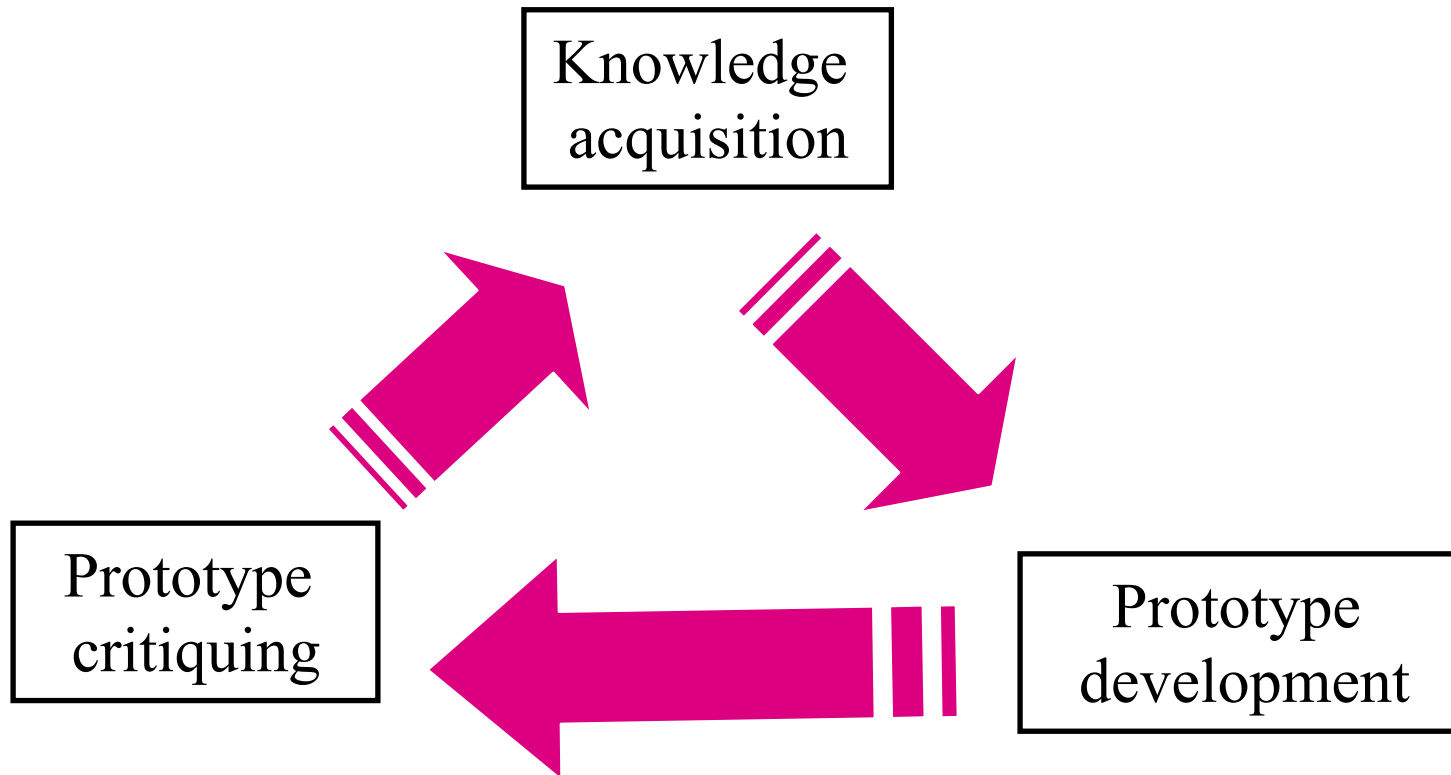
- γεγονότα,
- δομική διάρθρωση των αντικειμένων
- διαδικαστική γνώση

# Κύκλος ζωής του Ε.Σ.

Γραφική Αναπαράσταση



# Cyclical development





# Το εργαλείο ανάπτυξης εμπείρων συστημάτων Smart Elements

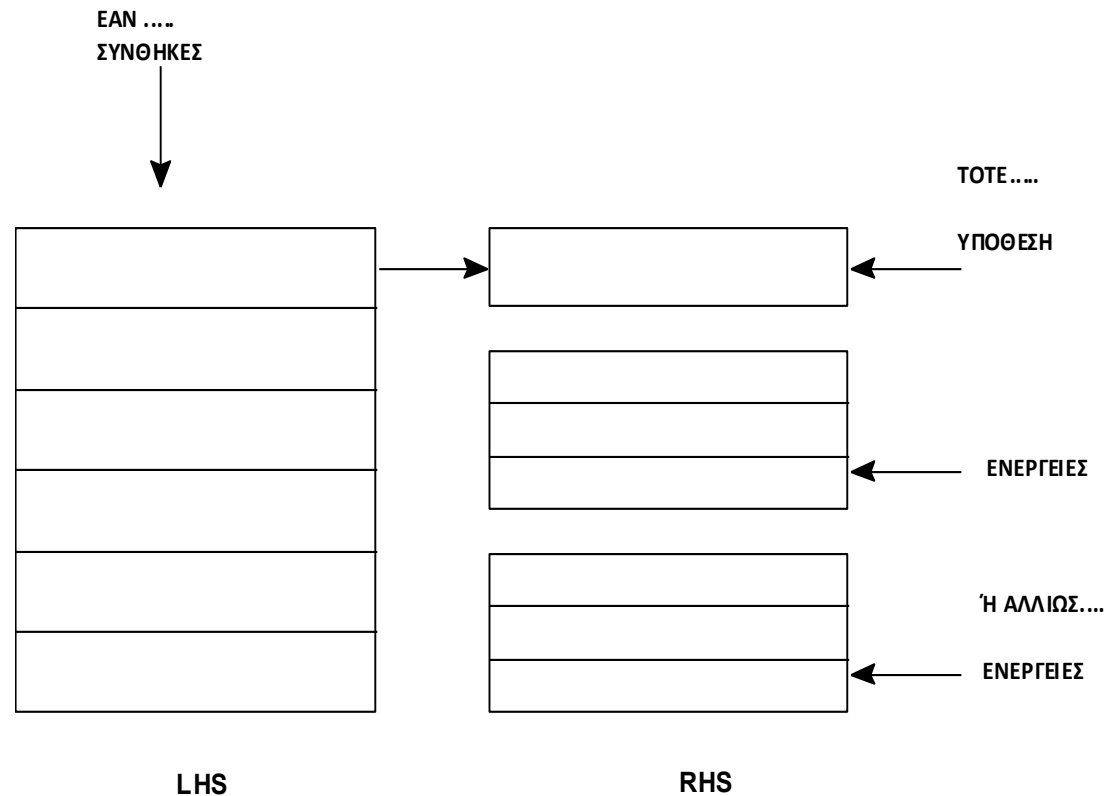
- Χρησιμοποιεί **τάξεις – υποτάξεις – αντικείμενα, κανόνες παραγωγής.**
- Επιτρέπει τη **γραφική αναπαράσταση τάξεων και των κανόνων.**
- Επιτρέπει **την αμφίδρομη φορά της συλλογιστικής αλυσίδας.**

# Μορφή κανόνων παραγωγής

- Η μορφή των κανόνων παραγωγής είναι:

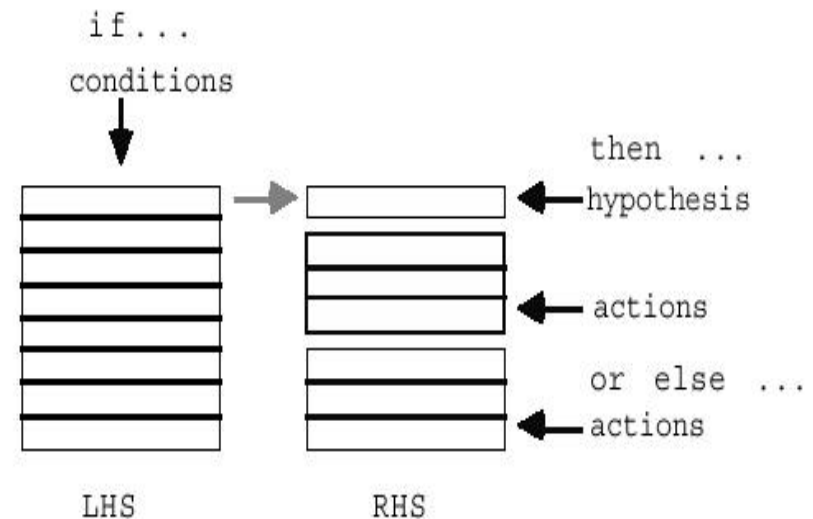
**ΕΑΝ ...ΤΟΤΕ ΥΠΟΘΕΣΗ  
ΑΛΗΘΕΥΕΙ ...ΤΟΤΕ ΚΑΝΕ...  
Η ΑΛΛΙΩΣ ΚΑΝΕ...**

**(IF ...THEN HYPOTHESIS  
TRUE... THEN DO...OR  
ELSE DO...)**



# Δομή Κανόνων Παραγωγής

- Το μέρος If... ανήκει στην αριστερή πλευρά του χεριού ή LHS (Left Hand Side) και περιλαμβάνει όλες τις προϋποθέσεις που απαιτούνται για να ισχύσει ο κανόνας.
- Το μέρος Then... ή RHS (Right Hand Side), περιλαμβάνει:
  - Το όνομα της υπόθεσης ή του στόχου ο οποίος γίνεται αληθής όταν πραγματοποιηθούν όλες οι προϋποθέσεις του LHS.
  - Όλες τις ενέργειες που θα λάβουν χώρα μετά την αληθή έκβαση του κανόνα.



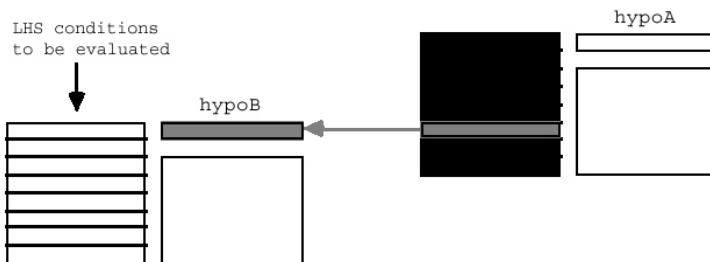
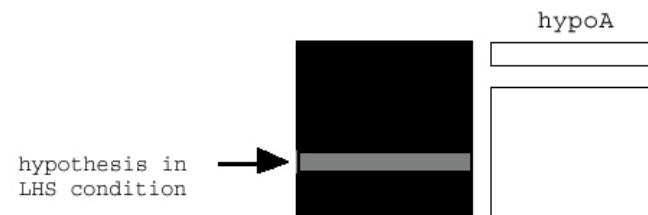
# Μηχανισμός αξιολόγησης των κανόνων παραγωγής

- Περιπτώσεις Δομής κανόνων παραγωγής



Η πιο απλή μορφή κανόνα παραγωγής. Το LHS αποτελείται από ιδιότητες και τις τιμές αυτών. Οι προϋποθέσεις πληρούνται οπότε ο κανόνας αληθεύει.

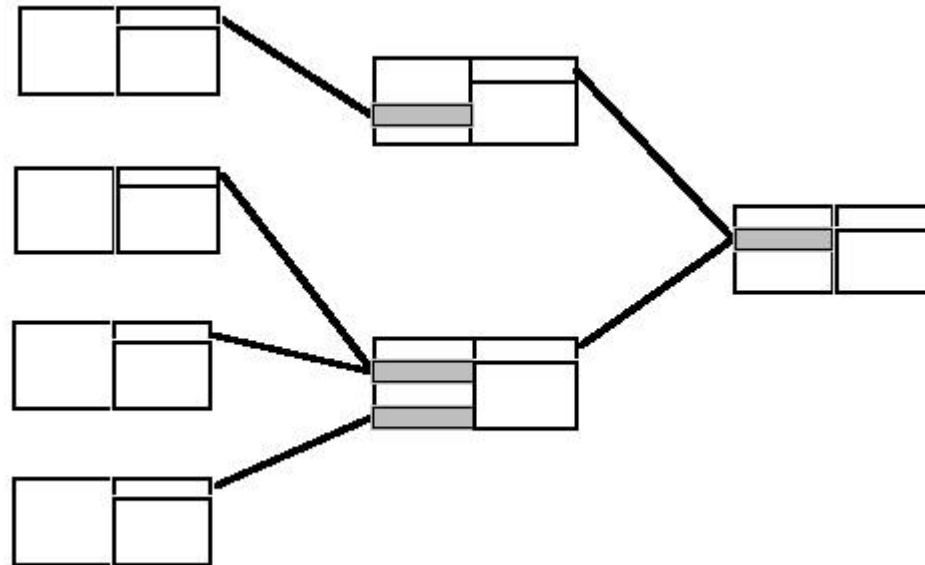
Η **υπόθεση** ως προϋπόθεση για την επιτυχή έκβαση του κανόνα παραγωγής.



Η πορεία που ακολουθεί το σύστημα προκειμένου να αξιολογήσει την τιμή της υπόθεσης (αληθής ή ψευδής).

# Κανόνες Παραγωγής – Διαζεύξεις

- **Μορφή Διάζευξης**



Ανάστροφη συλλογιστική αλυσίδα με πολλαπλές υποθέσεις

# Παράθυρο δημιουργίας κανόνων

The screenshot displays the 'Rule Editor' window with a menu bar (File, Edit, Expert, Browsers, Reports, Windows, Rule) and a toolbar on the left. The main workspace is divided into several sections:

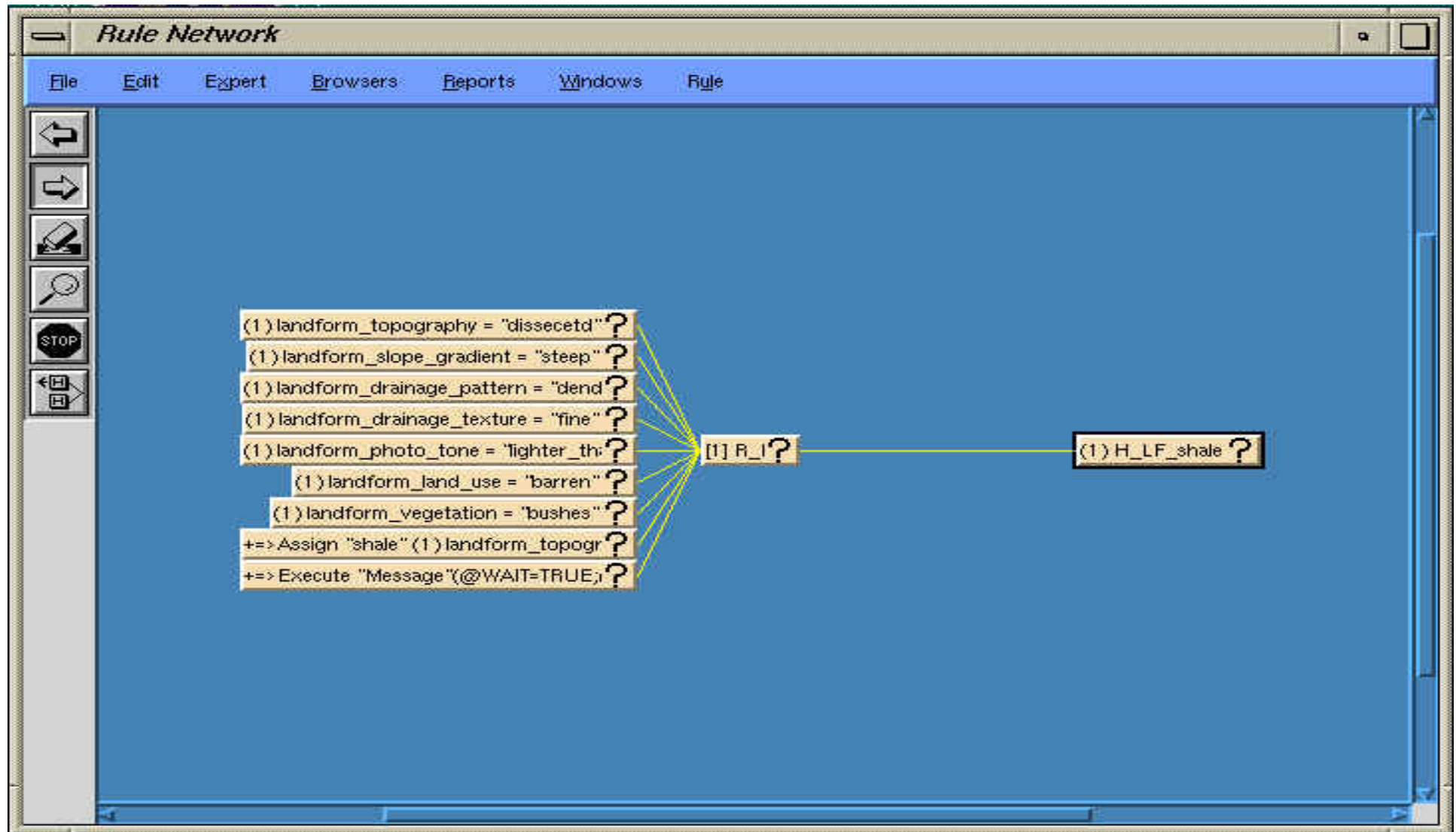
- Rule:** A text field containing 'R\_H\_LF\_shale'.
- KB:** A text field containing 'landslide6\_31\_1.kb'.
- Condition Table:** A table under the 'If' heading with 7 rows and 3 columns. The first row is highlighted.
- Target:** A text field containing 'H\_LF\_shale'.
- Actions Table:** A table under the 'Then Do' heading with 2 rows and 3 columns. The first row is highlighted.
- Else Do Table:** An empty table under the 'Else Do' heading.
- Comments:** A text field.
- Why:** A text field.
- Priority:** Fields for 'Inf. Priority Num.' (containing '1') and 'Inf. Priority Slot'.

On the right side, there is a vertical navigation pane with buttons labeled 'a-b', 'c-d', 'e-f', 'g-h', 'i-l', 'k-l', 'm-n', 'o-p', 'q-r', 's-t', 'u-v', 'w-x', and 'y-z'.

Condition	Value
landform_topography	"dissectd"
landform_slope_gradient	"steep"
landform_drainage_pattern	"dendritic"
landform_drainage_texture	"fine"
landform_photo_tone	"lighter_than"
landform_land_use	"barren"
landform_vegetation	"bushes"

Action	Value	Target
Assign	"shale"	landform_to
Execute	"Message"	@WAIT=TRU

# Γραφική αναπαράσταση κανόνα



 **RULE EDITOR**



**New**   **Modify**   **Copy**   **Delete**   **OK**   **Cancel**   **Check**   **Quit**

**Rule Name**

**If**

Yes	H_is_LU_Permanen	
Is	Shape	"polygon"
Is	Texture	"smooth"
Is	RGB4_tone	"dark"
Is	Soil_slope	"none"
Is	Irrigation_system	"flood"
Is	soil_drain	"bad"

->

**Actions**


**Inf. Priority Number**

**Inf. Priority Slot**

**Comments**

**Why**



- ab
- cd
- ef
- gh
- ij
- kl
- mn
- op
- qr
- st
- uv
- wx
- yz
- ?



 RULE EDITOR



New    Modify    Copy    Delete    OK    Cancel    Check    Quit

Rule Name

If

Yes	p_contains_parking	
Yes	p_contains_structur	
Yes	p_contains_transpo	
>	p_percentage_of_st	80
Is	p_RGB_Composite	"blue_or_
Is	p_RGB_Composite	"white"
Is	p_existance_of_per	"exception

->

Actions


Inf. Priority Number  Inf. Priority Slot

Comments  Why

ab  
cd  
ef  
gh  
ij  
kl  
mn  
op  
qr  
st  
uv  
wx  
yz  
?



# LIST OF RULES



## Rule R\_H\_2 (#5)

*If*

p\_color\_RGB\_345 is "white blue"

*And* p\_color\_RGB\_432 is "blue grey"

*And* p\_color\_RGB\_453 is "white"

*And* p\_height is "tall"

*And* p\_location\_near is "city centers"

*And* p\_pattern is "buildings\_roads"

*And* p\_shape\_of\_elements is "ortho"

*And* p\_structure is "homogeneous"

*And* p\_tone is "light"

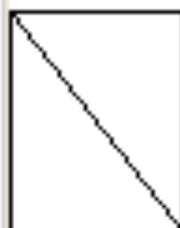
*And* p\_density\_of\_impermeable is greater than or equal to 80

*And* there is evidence of H\_is\_lu\_urban\_fabric

*Then* **H\_is\_lu\_continuous\_urban\_fabric**

is confirmed.

*And* Create Object o\_village\_Anthili(lu\_continuous\_urban\_fabric)



ab

cd

ef

gh

ij

kl

mn

op

qr

st

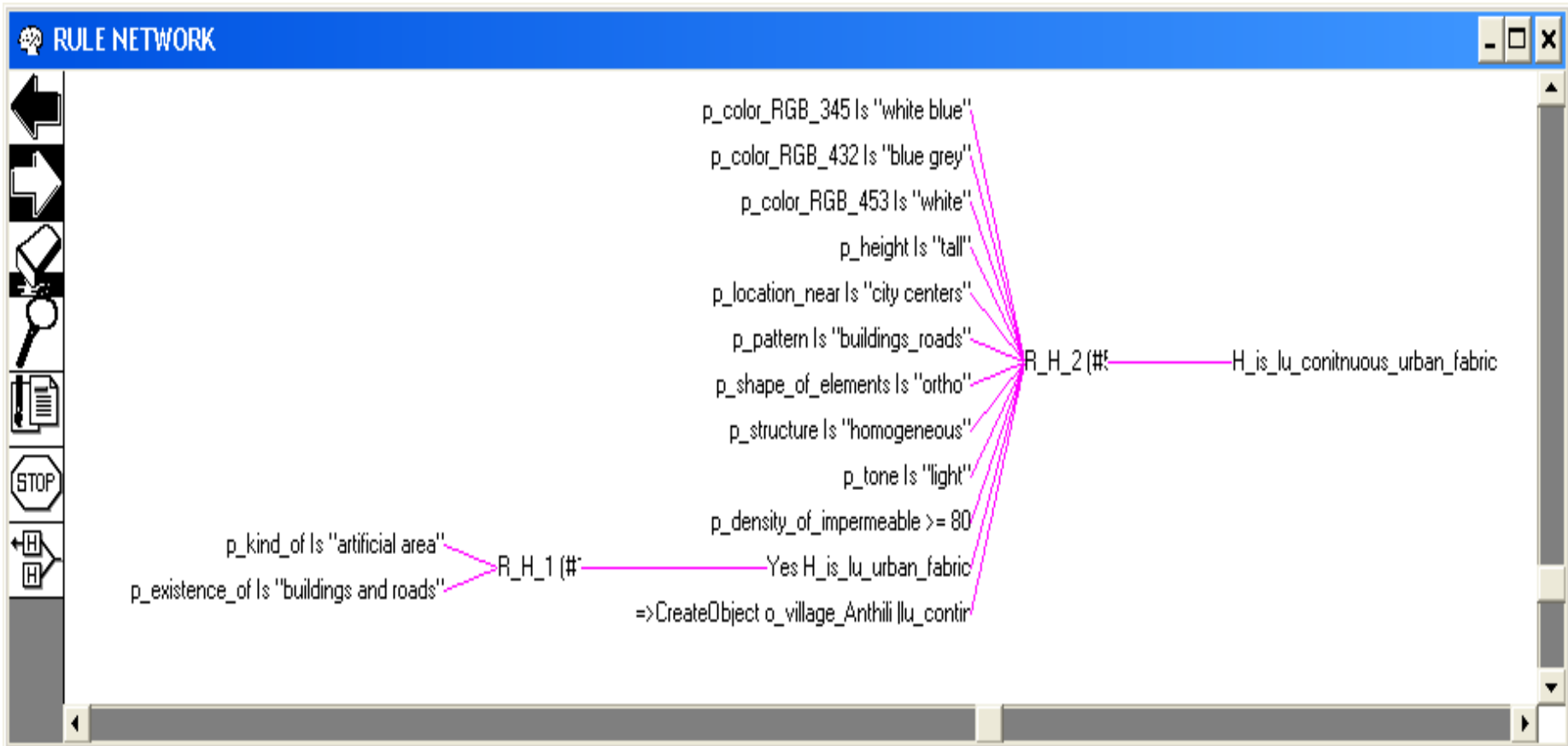
uv

wx

yz

?







# RULE OVERVIEW



 **RULE EDITOR**



**New** | **Modify** | **Copy** | **Delete** | **OK** | **Cancel** | **Check** | **Quit**

**Rule Name**

**If**

Is	location_of_termina	"next_t
Yes	transport_network	
Is	Segment_greenery	"limited
Is	mountains_around	"not_hi
Yes	existence_of_teleco	
Is	material_mainly_us	"aspha
Yes	exitence_of_slight	
Is	Segment_texture	"hetero

**Actions**


**Inf. Priority Number**  **Inf. Priority Slot**

**Comments**  **Why**



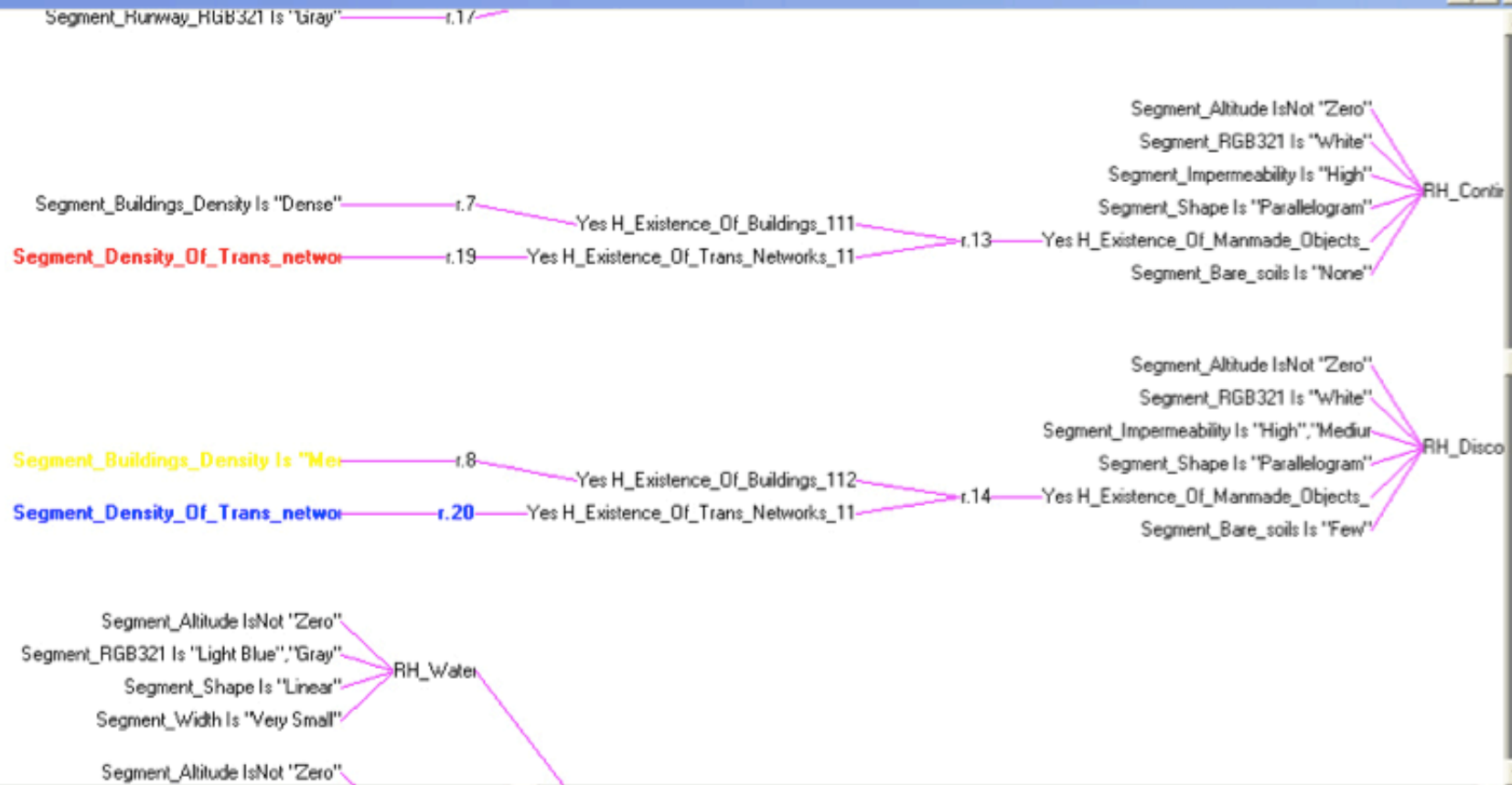
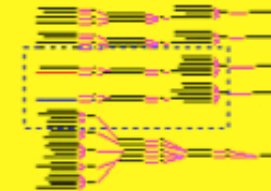
ab  
cd  
ef  
gh  
ij  
kl  
mn  
op  
qr  
st  
uv  
wx  
yz  
?



What is the Value of Segment\_Buildings\_Density ?

Medium	OK
Dense	
Medium	
Sparse	

NOTKNOWN







```
(@RULE= R_H_Natural_Pasture
  (@LHS=
    (Is (texture) ("smooth"))
    (Is (shape) ("irregular"))
    (< (Height) ("2200m"))
    (IsNot (Pattern) ("fences"))
    (Is (Photo_tone) ("light"))
    (Is (Occurs_adjacent_to) ("agriculture cultivations"))
  )
  (@HYPO= H_Natural_Pasture)
)
```

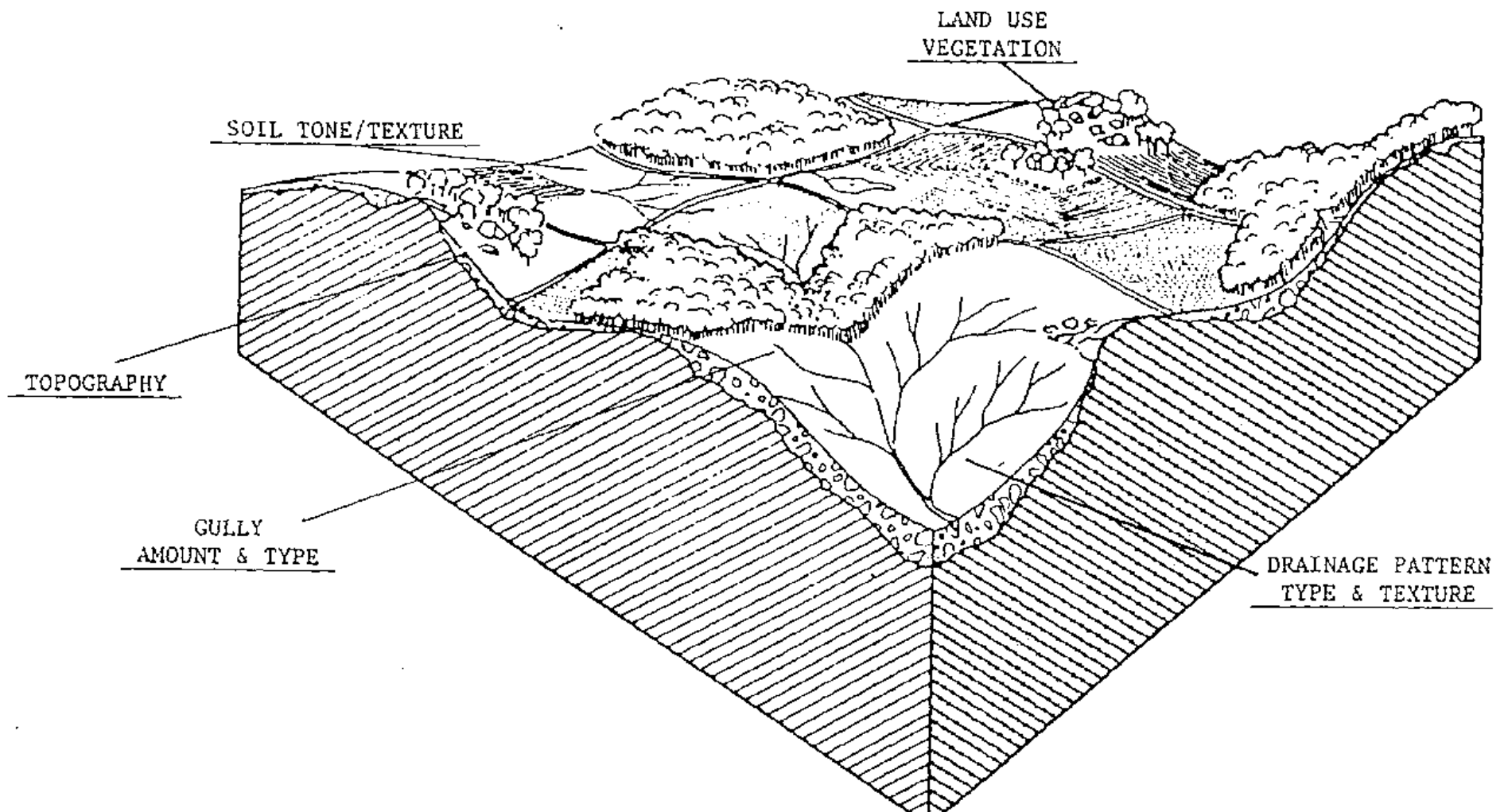
```
(@RULE= R_H_Riparian_Vegetation
  (@LHS=
    (Is (texture) ("rough"))
    (Is (shape) ("irregular"))
    (Is (Occurs_next_to) ("River Banks"))
    (Is (colour) ("green"))
  )
  (@HYPO= H_Riparian_Vegetation)
)
```

```
(@RULE= R_H_Shrubs_Heath
  (@LHS=
    (Is (texture) ("smooth"))
    (< (Height) ("800m"))
    (Is (shape) ("irregular"))
    (Yes (H_Occurs_to_hilly_areas))
    (Is (contains) ("bushes"))
    (< (Height_of_trees) ("3m"))
  )
  (@HYPO= H_Shrubs_heath)
)
```

```
(@RULE=      R_H_Quarry
  (@LHS=
    (Is (Photo_Tone) ("very_bright","bright"))
    (Is (H_Texture) ("trachea"))
    (Is (Color_in_RGB_false_colour) ("white"))
    (Is (photo_tone_uniformity) ("homogeneous"))
    (Is (Boundary_tone_type) ("asafws diakrito"))
    (Is (Shape_2D) ("vague"))
    (Is (Shape_3D) ("parallilepipedal","hmikwniko"))
    (Yes (H_Number_of_embedded_edges_is_high))
    (Yes (H_Contains_Worksites))
  )
  (@HYPO=      H_Quarry)
)
```



# BLOCK DIAGRAM OF A LANDFORM



```
(@RULE=      R_alluvial_fan
  (@LHS=
    (ls  (LF_topographic_form_PE)  ("fan-shaped","semi-circular"))
    (ls  (LF_drainage_pattern_PE)  ("dichotomic"))
    (ls  (LF_vegetation_type_PE) ("grass","reeds","shurbs"))
    (ls  (LF_landuse_landcover_PE) ("barren","cultivated","natural cover"))
  )
  (@HYPO=      H_alluvial_fan)
  (@RHS=
    (Execute ("message") (@STRING="@TEXT=Possibly is an alluvial fan.,\
@OK";))
  )
)
```

```

(@RULE=    R_alluvial_fan
  (@LHS=
    (ls (LF_topographic_form_PE)  ("fan-shaped","semi-circular"))
    (ls (LF_drainage_pattern_PE)  ("dichotomic"))
    (ls (LF_phototone_intensity_PE) ("light gray","medium gray"))
    (ls (LF_gully_density_PE)    ("none","few"))
    (ls (LF_vegetation_density_PE) ("none","sparse"))
    (ls (LF_drainage_texture_PE)  ("coarse"))
    (ls (LF_gully_shape_PE)      ("V-shaped","U-shaped","longitudinal"))
    (ls (LF_phototone_texture_PE) ("uniform","interlaced"))
    (ls (LF_vegetation_type_PE)  ("grass","reeds","shurbs"))
    (ls (LF_geomorphic_process_GM) ("fluvial","fluvial deposition"))
    (ls (LF_landuse_landcover_PE) ("barren","cultivated","natural cover"))
    (ls (LF_topographic_curvature_PE) ("plain","concave radially and convex transversely"))
    (ls (LF_climate_type_GM)    ("arid"))
  )
  (@HYPO=    H_alluvial_fan)
  (@RHS=
    (Execute ("message") (@STRING="@TEXT=Logically is an alluvial fan.,\
@OK";))
  )
)

```

```

(@RULE=    R_delta
  (@LHS=
    (ls (LF_topographic_form_PE) ("delta outline","arc","estuarine","bird's foot",\
"flat surface with a slight slope toward the water"))
    (ls (LF_drainage_pattern_PE) ("dichotomic","channels","dendritic"))
    (ls (LF_vegetation_type_PE) ("grass","reeds","shurbs"))
    (ls (LF_landuse_landcover_PE) ("natural","natural cover","developed"))
  )
  (@HYPO=    H_delta)
  (@RHS=
    (Execute ("message") (@STRING="@TEXT=Possibly is a Delta.,@OK";\
))
  )
)

(@RULE=    R_delta
  (@LHS=
    (ls (LF_topographic_form_PE) ("delta outline","arc","estuarine","bird's foot",\
"flat surface with a slight slope toward the water"))
    (ls (LF_drainage_pattern_PE) ("dichotomic","channels","dendritic"))
    (ls (LF_phototone_intensity_PE) ("light gray","medium gray"))
    (ls (LF_gully_density_PE) ("none","few associated only with exposed,\
eroded delta formations"))
    (ls (LF_vegetation_density_PE) ("dense"))
    (ls (LF_drainage_texture_PE) ("fine"))
    (ls (LF_gully_shape_PE) ("none"))
    (ls (LF_phototone_texture_PE) ("uniform","interlaced"))
    (ls (LF_vegetation_type_PE) ("grass","reeds","shurbs"))
    (ls (LF_geomorphic_process_GM) ("fluvial","fluvial deposition"))
    (ls (LF_landuse_landcover_PE) ("natural","natural cover","developed"))
    (ls (LF_topographic_curvature_PE) ("plain","concave radially and convex transversely"))
    (ls (LF_climate_type_GM) ("humid"))
  )
  (@HYPO=    H_delta)
  (@RHS=
    (Execute ("message") (@STRING="@TEXT=Logically is a Delta.,@OK";\
))
  )
)

```

```

(@RULE= LF_star_shaped_PE
  (@LHS=
    (Is (topographic_form) ("star shaped hills"))
    (Is (drainage_pattern) ("none"))
    (Is (phototone_intensity) ("bright"))
    (Is (gully_density) ("none"))
    (Is (vegetation_type) ("barren","natural cover"))
  )
  (@HYPO= h_star_shaped)
  (@RHS=
    (Execute ("MESSAGE") (@STRING="@TEXT=Certainly, it is Star Shaped Dune. (The Landform was proved by LF_star\
_shaped_PE.),@OK:;))
    (CreateObject (object_star_shaped_dune) (Istar_shaped_dune1))
    (Show ("star_shaped_dune") (@KEEP=TRUE;@WAIT=TRUE;))
    (Execute ("CONTROLSESSION") (@STRING="@STOP:;))
  )
)

```



```

(@RULE=    LF_Humid_Limestone_PE
  (@LHS=
    (Is (topographic_form) ("karst"))
    (Is (drainage_pattern) ("internal"))
    (Is (phototone_intensity) ("gray"))
    (Is (phototone_texture) ("mottled"))
    (Is (gully_shape) ("short"))
    (Is (gully_density) ("few"))
    (Is (vegetation_type) ("small woodlots"))
    (Is (vegetation_density) ("none","little"))
    (Is (landuse_landcover) ("cultivated"))
    (Is (topographic_curvature) ("rounded sinkholes"))
  )
  (@HYPO=    H_LF_Humid_Limestone)
  (@RHS=
    (Execute ("Message") (@STRING="@TEXT=Logically is a Humid Limestone,\
@OK";))
    (CreateObject (object_LF_Humid_Limestone_PE) (LF_Humid_Limestone_PE))
    (Show ("Humid Limestone") (@KEEP=TRUE;@WAIT=TRUE;))
    (Execute ("ControlSession") (@STRING="@STOP";))
  )
)

```

```

(@RULE=    LF_Humid_Sandstone_PE
  (@LHS=
    (ls (topographic_form) ("massive","bold"))
    (ls (drainage_pattern) ("dendritic"))
    (ls (drainage_texture) ("coarse"))
    (ls (phototone_intensity) ("light"))
    (ls (phototone_texture) ("banded"))
    (ls (gully_shape) ("v-shaped"))
    (ls (gully_density) ("few"))
    (ls (vegetation_type) ("forested"))
    (ls (vegetation_density) ("little"))
    (ls (landuse_landcover) ("agricultural"))
    (ls (topographic_curvature) ("steep slopes"))
  )
  (@HYPO=    H_LF_Humid_Sandstone)
  (@RHS=
    (Execute ("Message") (@STRING="@TEXT=Logically is a Humid Sandstone,\
@OK";))
    (CreateObject (object_LF_Humid_Sandstone_PE) (LF_Humid_Sandstone_PE))
    (Show ("Humid Sandstone") (@KEEP=TRUE;@WAIT=TRUE;))
    (Execute ("ControlSession") (@STRING="@STOP";))
  )
)

```

```
(@RULE= LF_BASALTIC_FLOWS
  (@LHS=
    (ls (topographic_form) ("level plain"))
    (ls (drainage_pattern) ("regional parallel"))
    (ls (phototone_intensity) ("dark"))
    (ls (vegatation_density)("none"))
  )
  (@HYPO= LF_BASALTIC_FLOWS_PE)
  (@RHS=
    (Execute ("message") (@STRING="@TEXT=it is possible that it's a basaltic flow,\
@OK";))
  )
)
```

---

```

(@RULE= LF_GRANITIC_ARID_PE
  (@LHS=
    (ls (topographic_form) ("A-shaped hills"))
    (ls (drainage_pattern) ("dendritic"))
    (ls (drainage_texture) ("fine"))
    (ls (phototone_intensity) ("light"))
    (ls (phototone_texture) ("coarse"))
    (ls (gully_density) ("few","none"))
    (ls (vegetation_density) ("sparse"))
    (ls (vegetation_type) ("grass"))
    (ls (landuse_landcover) ("grazing"))
    (ls (topographic_carvature) ("steep"))
  )
  (@HYPO= LF_GRANITIC_ARID_PE)
  (@RHS=
    (Execute ("message") (@STRING="@TEXT=logically is granitic form in an arid climate proved by PE,\
@OK";))
  )
)

```

```

(@RULE=    LF_VOLCANIC_FORMS_PE
  (@LHS=
    (ls (topographic_form) ("cinder cones"))
    (ls (drainage_pattern) ("radial"))
    (ls (drainage_texture) ("fine"))
    (ls (phototone_intensity) ("dark gray"))
    (ls (phototone_texture) ("rugged"))
    (ls (gully_shape) ("sag"))
    (ls (vegetation_density) ("little"))
    (ls (vegetation_type) ("cultivated"))
    (ls (landuse_landcover) ("cultivations"))
    (ls (topographic_carvature) ("very steep"))
  )
  (@HYPO=    LF_VOLCANIC_FORMS_PE)
  (@RHS=
    (Execute ("message") (@STRING="@TEXT=logically it's a volcanic form proved by PE,\
@OK";))
  )
)

```

```
(@RULE= R7
  (@LHS=
    (Yes (disturbed_daily_life))
  )
  (@HYPO= bad_mood)
)

(@RULE= R2
  (@LHS=
    (Yes (disturbed_daily_life))
  )
  (@HYPO= boredom)
)

(@RULE= R4
  (@LHS=
    (Yes (reduced_contact_with_others))
  )
  (@HYPO= disturbed_daily_life)
)

(@RULE= R5
  (@LHS=
    (Yes (interruption_of_meaningful_activities))
  )
  (@HYPO= disturbed_daily_life)
)
```

```
(@RULE= R3
  (@LHS=
    (Yes (temporal_loss_of_work))
  )
  (@HYPO= disturbed_daily_life)
)
```

```
(@RULE= R6
  (@LHS=
    (Yes (disturbed_daily_life))
  )
  (@HYPO= intense_boredom)
)
```

```
(@RULE= R1
  (@LHS=
    (Yes (disturbed_daily_life))
  )
  (@HYPO= sadness)
)
```

```
(@RULE= R15
  (@LHS=
    (ls (water_colour) ("deep blue"))
    (ls (beach_type) ("tiny pebble"))
    (ls (depth) ("medium"))
    (ls (high_waves) ("absent"))
    (ls (crowding) ("medium"))
    (ls (natural_shading) ("absent"))
    (ls (nudism) ("not allowed"))
    (ls (restaurants) ("present"))
    (ls (accomodation) ("present"))
    (ls (organised_beach) ("present"))
    (ls (douche) ("present"))
    (ls (water_sports) ("absent"))
    (ls (public_transportation) ("present"))
    (ls (access_by) ("car"))
    (ls (free_camping) ("not allowed"))
    (ls (windy) ("absent"))
    (ls (ideal_wind_direction) ("north"))
    (ls (lifeguard) ("absent"))
  )
  (@HYPO= H_Achlia)
)
```



```
(@RULE= R4
  (@LHS=
    (ls (water_colour) ("blue"))
    (ls (beach_type) ("tiny pebble"))
    (ls (depth) ("shallow"))
    (ls (high_waves) ("absent"))
    (ls (crowding) ("heavy"))
    (ls (natural_shading) ("absent"))
    (ls (nudism) ("not allowed"))
    (ls (restaurants) ("present"))
    (ls (accomodation) ("present"))
    (ls (organised_beach) ("present"))
    (ls (douche) ("present"))
    (ls (water_sports) ("present"))
    (ls (public_transportation) ("present"))
    (ls (access_by) ("car"))
    (ls (free_camping) ("not allowed"))
    (ls (windy) ("absent"))
    (ls (ideal_wind_direction) ("north"))
    (ls (lifeguard) ("present"))
  )
  (@HYPO= H_lerapetra)
)
```

```
(@RULE= R2
  (@LHS=
    (Yes (teacher_knowledgeable_on_subject))
    (Yes (teacher_consistent_in_obligations))
    (Yes (teacher_communicative))
    (Yes (teacher_cooperativeness))
    (Yes (teacher_advising))
  )
  (@HYPO= H_good_teacher)
)

(@RULE= R3
  (@LHS=
    (Yes (teacher_starts_lecture_on_time))
    (Yes (teacher_gives_Notes_on_time))
    (Yes (teacher_keeps_office_hours))
    (Yes (teacher_ends_lecture_on_time))
    (Yes (teacher_exams_consistent_with_notes_and_lectures))
  )
  (@HYPO= teacher_consistent_in_obligations)
)
```

```
(@RULE= R2
  (@LHS=
    (Yes (teacher_knowledgeable_on_subject))
    (Yes (teacher_consistent_in_obligations))
    (Yes (teacher_communicative))
    (Yes (teacher_cooperativeness))
    (Yes (teacher_advising))
  )
  (@HYPO= H_good_teacher)
)

(@RULE= R3
  (@LHS=
    (Yes (teacher_starts_lecture_on_time))
    (Yes (teacher_gives_Notes_on_time))
    (Yes (teacher_keeps_office_hours))
    (Yes (teacher_ends_lecture_on_time))
    (Yes (teacher_exams_consistent_with_notes_and_lectures))
  )
  (@HYPO= teacher_consistent_in_obligations)
)
```

```
(@RULE= lake
  (@LHS=
    (Is (observation_surface) ("water"))
    (Is (water_observation_surface) ("inland_water"))
    (Is (inland_water_observation_surface) ("water_bodies"))
    (Is (human_influence) ("false"))
    (Is (boundary_tone_type) ("discrete"))
    (>= (area_square_meters) (15625))
  )
  (@HYPO= H_Lake)
  (@RHS=
    (Execute ("Message") (@STRING="@TEXT=Logically is Lake,@OK;))
    (CreateObject (object_lake) (llake!))
    (Show ("lake") (@KEEP=TRUE;@WAIT=TRUE;))
    (Execute ("ControlSession") (@STRING="@STOP;))
  )
)
```

```

(@RULE= lake
  (@LHS=
    (is (observation_surface) ("not_known"))
    (is (color_in_RGB_321_composite) ("blue","dark_blue"))
    (is (color_in_RGB_432_composite) ("black"))
    (is (water_observation_surface) ("not_known"))
    (is (is_located_on) ("land"))
    (is (inland_water_observation_surface) ("not_known"))
    (is (is_surrounded_by) ("land"))
    (is (human_influence) ("not_known"))
    (is (spatial_arrangement) ("irregular"))
    (is (boundary_tone_type) ("semi_discrete"))
    (is (shape_2D) ("polygonal","rectangular","oblong"))
    (>= (area_square_meters) (15625))
  )
  (@HYPO= H_Lake)
  (@RHS=
    (Execute ("Message") (@STRING="@TEXT=Logically is Lake,@OK";))
    (CreateObject (object_lake) (llake1))
    (Show ("lake") (@KEEP=TRUE;@WAIT=TRUE;))
    (Execute ("ControlSession") (@STRING="@STOP";))
  )
)

```

```

(@RULE= R9
  (@LHS=
    (Is (texture) ("rough"))
    (Yes (H_irrigation_canal))
    (Is (permanently_irrigated_land_contains) ("permanent harvest","periodical harvest"))
    (Yes (tint_is_red_crops_intersected_by_blue_irrigating_grooves_in_LANDSAT_432))
    (Is (pattern) ("polygonal","oblong"))
    (Yes (H_lowland))
    (Yes (irrigation_is_realised_with_flood_techniques_or_deluge_techniques))
    (Yes (shape_consists_of_condominiums_which_are_usually_normally_shaped))
  )
  (@HYPO= H_permanently_irrigated_land)
)

(@RULE= R15
  (@LHS=
    (Is (length) ("long"))
    (Is (shape) ("irregural with normal curves"))
    (Is (color) ("white","grey"))
    (Yes (texture_is_rough))
    (Yes (h_sparsely_populated_area))
  )
  (@HYPO= h_rural_road)
)

(@RULE= R11
  (@LHS=
    (Yes (contains_a_minimum_amount_of_houses_and_short_buildings))
    (Yes (occurs_out_of_the_urban_fabric))
    (IsNot (pattern) ("linear"))
    (Yes (surrounded_by_green))
  )
  (@HYPO= h_sparsely_populated_area)
)

```

```

(@RULE=    R1
  (@LHS=
    (Yes (H_existence_of_Buildings))
    (Yes (H_existence_of_Cars))
  )
  (@HYPO=   H_existence_of_manmade_neighbor_objects)
)

(@RULE=    RH_LU_Urban_Green_Area
  (@LHS=
    (> (IObjectl.Area) (25))
    (Yes (H_LU_Vegetation_like))
    (Yes (H_existence_of_manmade_neighbor_objects))
  )
  (@HYPO=   H_LU_Urban_Green_Area)
  (@RHS=
    (CreateObject (GU1) (ILU_Urban_Green_Areas!))
  )
)

```

```
(@RULE= R1
  (@LHS=
    (IsNot (car.engine_status) ("turns over"))
    (IsNot (car.lights_status) ("comes on"))
  )
  (@HYPO= H_battery_problem)
)

(@RULE= R5
  (@LHS=
    (Is (car.fuel_tank_status) ("petrol present"))
  )
  (@HYPO= H_engine_getting_petrol)
)

(@RULE= R4
  (@LHS=
    (Is (car.engine_status) ("turns over"))
    (Yes (H_engine_getting_petrol))
  )
  (@HYPO= H_problem_with_spark_plugs)
)

(@RULE= R3
  (@LHS=
    (Is (car.lights_status) ("comes on"))
    (IsNot (car.engine_status) ("turns over"))
  )
  (@HYPO= H_starter_problem)
)
```



```
(@RULE= R8
  (@LHS=
    (ls (car.engine_belt_status) ("no wear"))
    (ls (car.engine_hose_status)("no wear"))
    (ls (car.gasoline_smell_status) ("none"))
    (ls (car.transmission_fuel_status) ("full"))
    (ls (car.engine_oil_status) ("full"))
  )
  (@HYPO= H_car_engine_status_fine)
)

(@RULE= R7
  (@LHS=
    (ls (car.standing_status) ("level"))
    (ls (car.doors) ("fit correctly"))
    (ls (car.windows) ("fit correctly"))
    (ls (car.body_status) ("minor dents only"))
    (ls (car.body_rust_status) ("none"))
    (ls (car.tire_pressure_status)("good"))
  )
  (@HYPO= H_car_outside_condition_fine)
)
```

```
(@RULE= R31
  (@LHS=
    (Is (first_time_in_Greece) ("yes"))
    (Is (Season) ("Spring","Autumn"))
    (Is (Transportation) ("Car","Local Transportation"))
    (Is (Interests) ("Cities","Mountain","Nature Activities"))
  )
  (@HYPO= H_Trikala_Kalampaka)
)

(@RULE= R32
  (@LHS=
    (Is (first_time_in_Greece) ("yes"))
    (Is (Season) ("Winter","Autumn","Spring"))
    (Is (Transportation) ("Car","Local Transportation"))
    (Is (Interests) ("Sights"))
  )
  (@HYPO= H_Veria_Vergina)
)

(@RULE= R33
  (@LHS=
    (Is (first_time_in_Greece) ("yes"))
    (Is (Season) ("Winter","Autumn"))
    (Is (Transportation) ("Car","Local Transportation"))
    (Is (Interests) ("Cities","Mountain","Nature Activities"))
  )
  (@HYPO= H_Volos_Pilio)
)

(@RULE= R34
  (@LHS=
    (Is (first_time_in_Greece) ("no"))
    (Is (Season) ("Summer"))
    (Is (Transportation) ("Boat","Airplane"))
    (Is (Interests) ("Sea"))
  )
  (@HYPO= H_Zakynthos)
)
```

```

(@RULE= R25
  (@LHS=
    (Is (first_time_in_Greece) ("yes"))
    (Is (Season) ("Spring","Summer","Autumn"))
    (Is (Transportation) ("Boat"))
    (Is (Interests) ("Sea","Sights"))
  )
  (@HYPO= H_Patmos)
)

(@RULE= R26
  (@LHS=
    (Is (first_time_in_Greece) ("no"))
    (Is (Season) ("Winter","Spring"))
    (Is (Transportation) ("Car","Local Transportation"))
    (Is (Interests) ("Cities","Sights","Mountain","Nature Activities"))
  )
  (@HYPO= H_Patra_Kalavryta)
)

(@RULE= R27
  (@LHS=
    (Is (first_time_in_Greece) ("no"))
    (Is (Season) ("Spring","Summer","Autumn"))
    (Is (Transportation) ("Boat","Airplane"))
    (Is (Interests) ("Sea","Sights","Nature Activities"))
  )
  (@HYPO= H_Rhodes)
)

(@RULE= R28
  (@LHS=
    (Is (first_time_in_Greece) ("no"))
    (Is (Season) ("Spring","Summer","Autumn"))
    (Is (Transportation) ("Boat","Airplane"))
    (Is (Interests) ("Sea","Sights"))
  )
  (@HYPO= H_Santorini)
)

```

```
(@RULE= R17
  (@LHS=
    (Is (first_time_in_Greece) ("yes"))
    (Is (Season) ("Winter","Summer"))
    (Is (Transportation) ("Car","Local Transportation"))
    (Is (Interests) ("Cities","Nature Activities"))
  )
  (@HYPO= H_Methoni_Koroni_Foinikoynta_Pilos)
)
```

```
(@RULE= R18
  (@LHS=
    (Is (first_time_in_Greece) ("no"))
    (Is (Season) ("Winter","Spring"))
    (Is (Transportation) ("Car","Local Transportation"))
    (Is (Interests) ("Mountain","Nature Activities"))
  )
  (@HYPO= H_Metsovo_Zagoroxwria)
)
```

```
(@RULE= R19
  (@LHS=
    (Is (first_time_in_Greece) ("no"))
    (Is (Season) ("Spring","Autumn","Summer"))
    (Is (Transportation) ("Car","Local Transportation"))
    (Is (Interests) ("Sea","Sights"))
  )
  (@HYPO= H_Monemvasia_Mani)
)
```

```
(@RULE= R20
  (@LHS=
    (Is (first_time_in_Greece) ("no"))
    (Is (Season) ("Spring","Summer","Autumn"))
    (Is (Transportation) ("Boat","Airplane"))
    (Is (Interests) ("Sea","Sights"))
  )
  (@HYPO= H_Mykonos_Dilos)
)
```

---





