SZÉCHENYI TUDOMÁNYOS EST

2010.Szeptember 8.

TUDOMÁNY GYŐRBEN MINDENKINEK

KÖSZÖNTJÜK HALLGATÓINKAT!

Önök

Kóczy László

Intelligens informatikai modelek és alkalmazásuk c.

előadását hallhatják!

Befektetés a jövőbe

Új Magyarország FEJLESZTÉSI TERV

SZÉCHENYI ISTVÁN EGYETEM
TUDÁSMENEDZSMENT KÖZPONT

UNIVERSITAS-GYŐR NONPROFIT Kft.

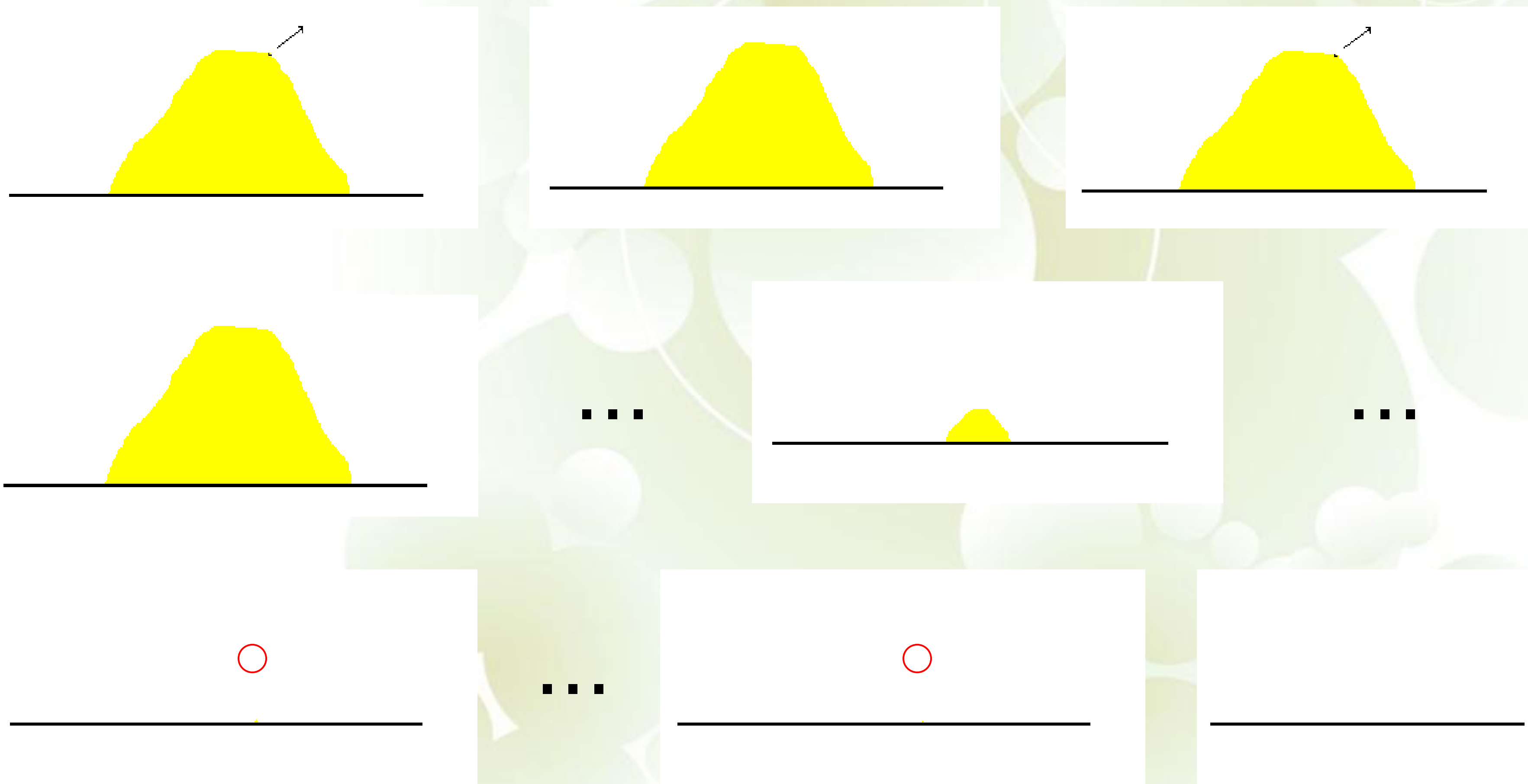
Tartalom

Fuzzy modelek és alkalmazásuk

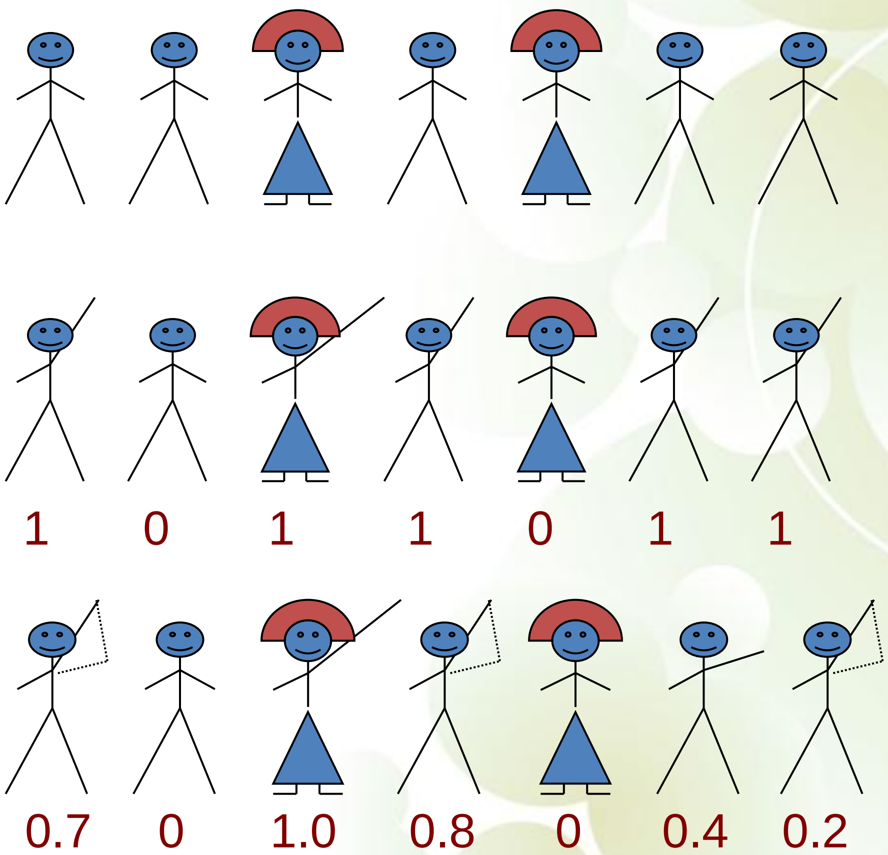
1. Klasszikus fuzzy szabálybázisos modelek
2. Interpolációs szabálybázisok
3. Hierarchikus fuzzy szabálybázisok
4. Hierarchikus fuzzy szabálybázisok interpolációja

1. Klasszikus fuzzy szabályalapú modellek

A homokkupac-paradoxon



Egy példa



- A hallgatóság (E.G. M.Sc. Students taking „Fuzzy Theory”)
- Az univerzum: X

- “Kinek van jopgositványa?”
- A subset of X = A (Crisp) Set
- χ(X) = karakterisztikus függvény

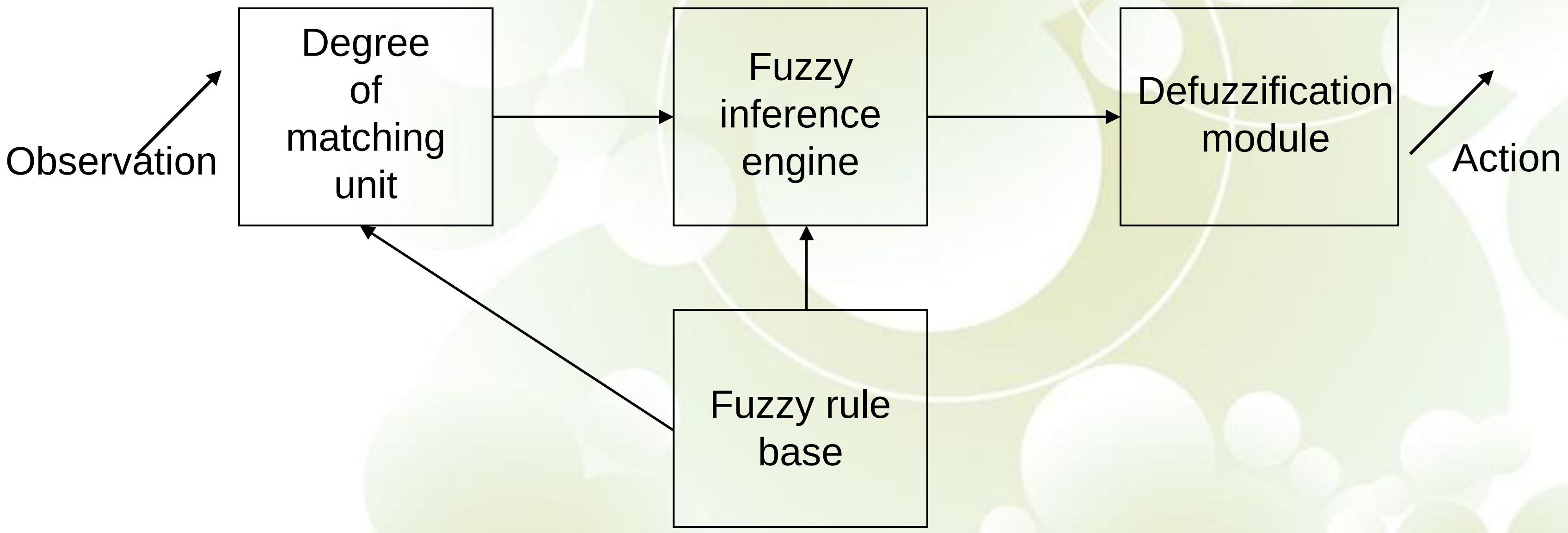
- “Ki a jó autóvezető?”
  μ(X) = tagsági függvény

FUZZY halmaz

A fuzzy elmélet története

- Fuzzy sets & logic: Zadeh 1964/1965-
- Fuzzy algorithm: Zadeh 1968-(1973)-
- Fuzzy control by linguistic rules: Mamdani & Al. ~1975-
- Industrial applications: Japan 1987- (Fuzzy boom), Korea
  Home electronics
  Vehicle control
  Process control
  Pattern recognition & image processing
  Expert systems
  Military systems (USA ~1990-)
  Space research
- Applications to very complex control problems: Japan (Sugeno) 1991-
  E.G. helicopter autopilot

Fuzzy rendszer általános vázlata



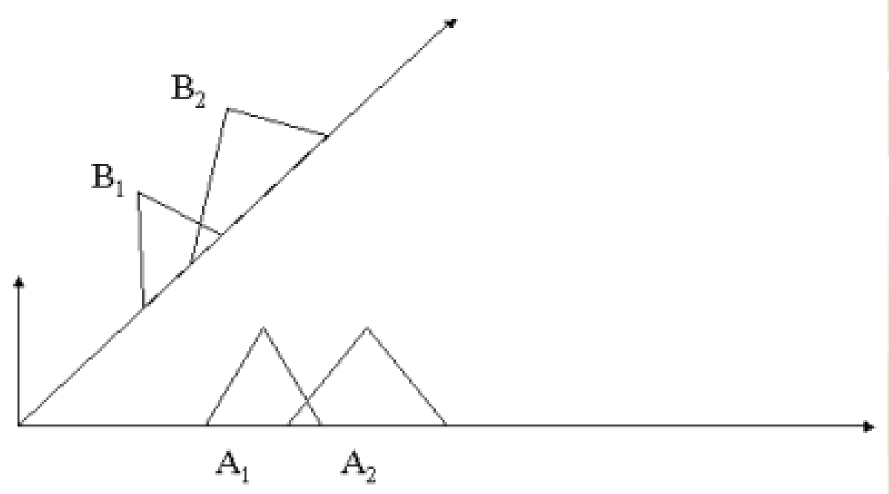
Nyelvi szabályok

IF x = A **THEN** y = B

A is the rule antecedent, B is the rule consequent

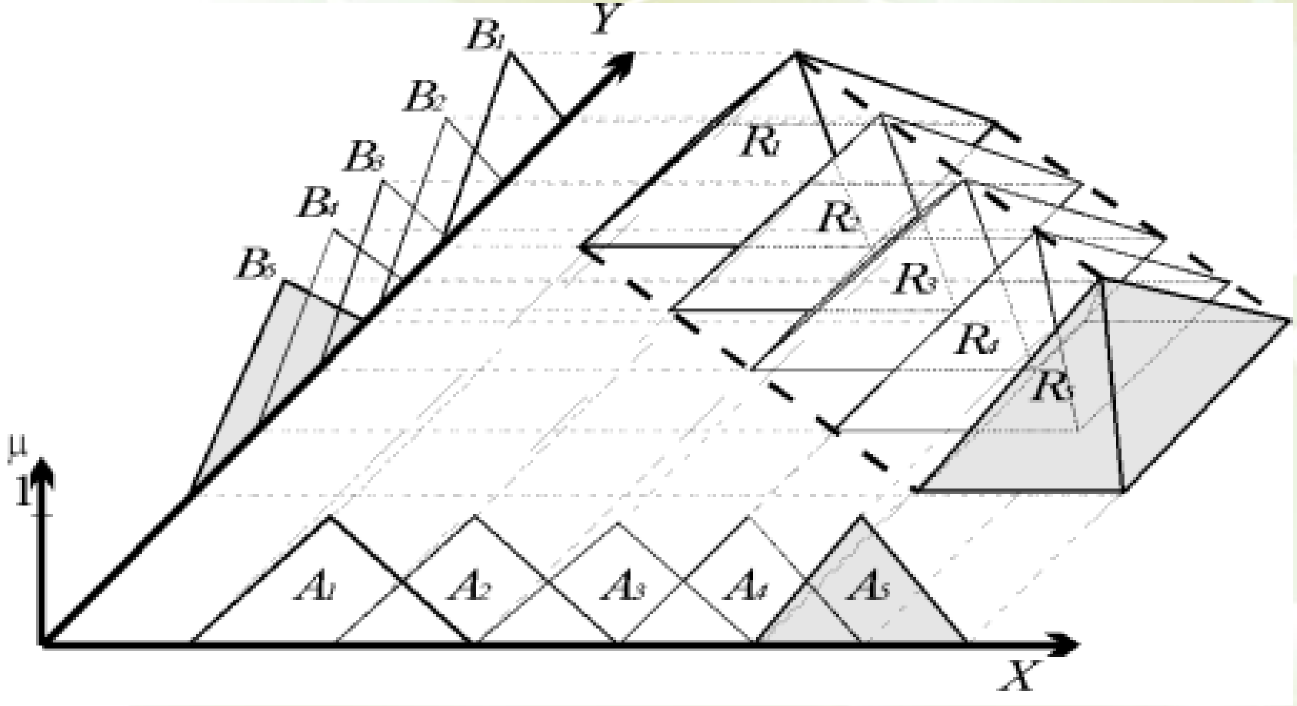
Example: „**IF** traffic is heavy in this direction **THEN** keep the green light longer"

If x = A **then** y = B "*fuzzy point*" A×B
If $x = A_i$ **then** $y = B_i$ i = 1,...,r "*fuzzy graph*"
Fuzzy rule = fuzzy relation (R_i)
Fuzzy rule base = fuzzy relation (R), is the union (s-norm) of the fuzzy rule relations R_i:



Fuzzy rule base relation R containing two fuzzy rules $A_1 \rightarrow B_1$, $A_2 \rightarrow B_2$ (R_1, R_2)

Fuzzy szabályalapú kapcsolat



$$\mu_{R(x,y)}(x,y)=\max_{i=1}^{r}(\mu_{R_i(x,y)}(x,y)) \qquad \mu_{R_i(x,y)}(x,y)=\min(\mu_{A_i(x)}(x),\mu_{B_i(y)}(y))$$

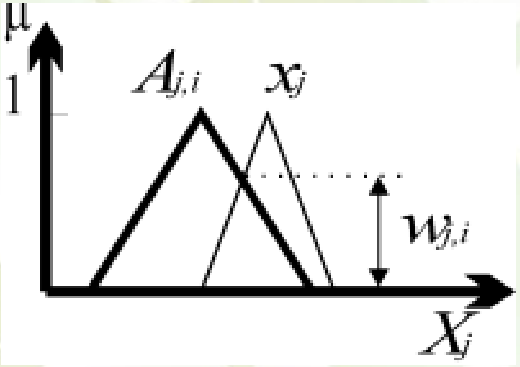
more dimensional case:

$$\mu_{R_i(x_1,x_2,\dots,x_n,y)}(x_1,x_2,\dots,x_n,y)=\min(\mu_{A_{1,i}(x_1)}(x_1),\dots,\mu_{A_{n,i}(x_n)}(x_n),\mu_{B_i(y)}(y))$$

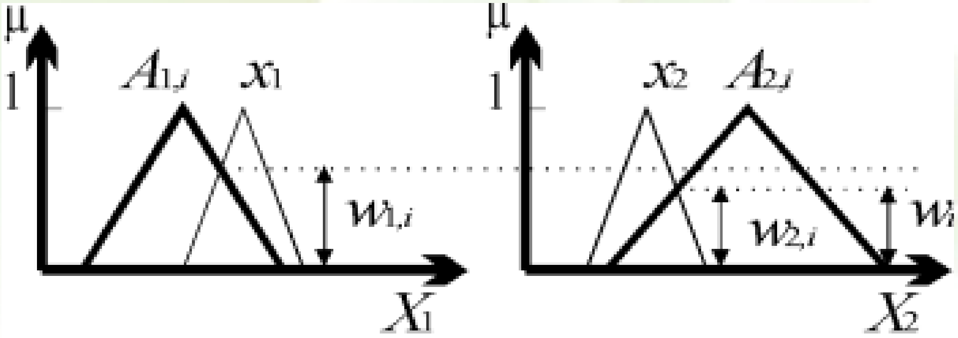
Fuzzy következtető mechanizmus (Mamdani)

- **If** $x_1 = A_{1,i}$ **and** $x_2 = A_{2,i}$ **and...and** $x_n = A_{n,i}$ **then** $y = B_i$

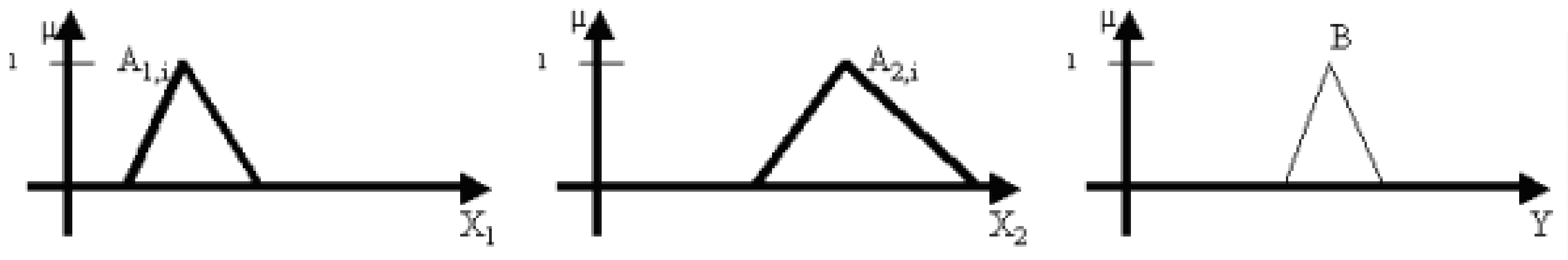
The weighting factor w_{ji} characterizes, how far the input x_j corresponds to the rule antecedent fuzzy set $A_{j,i}$ in one dimension



The weighting factor w_i characterizes, how far the input x fulfils to the antecedents of the rule R_i.

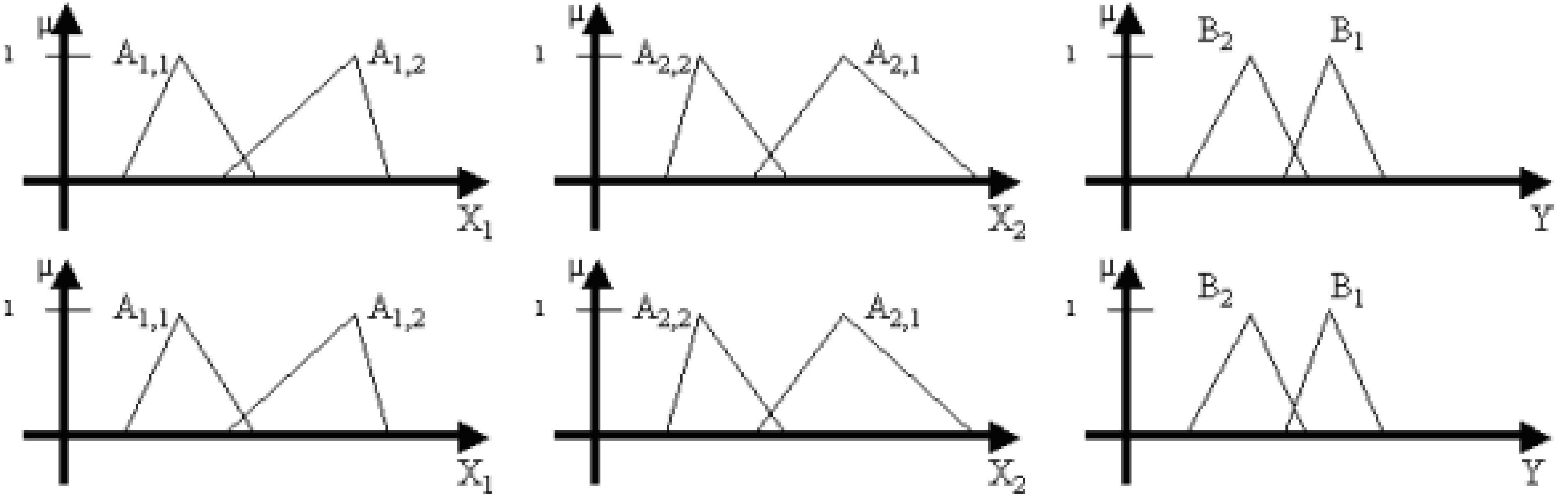


Következtetés

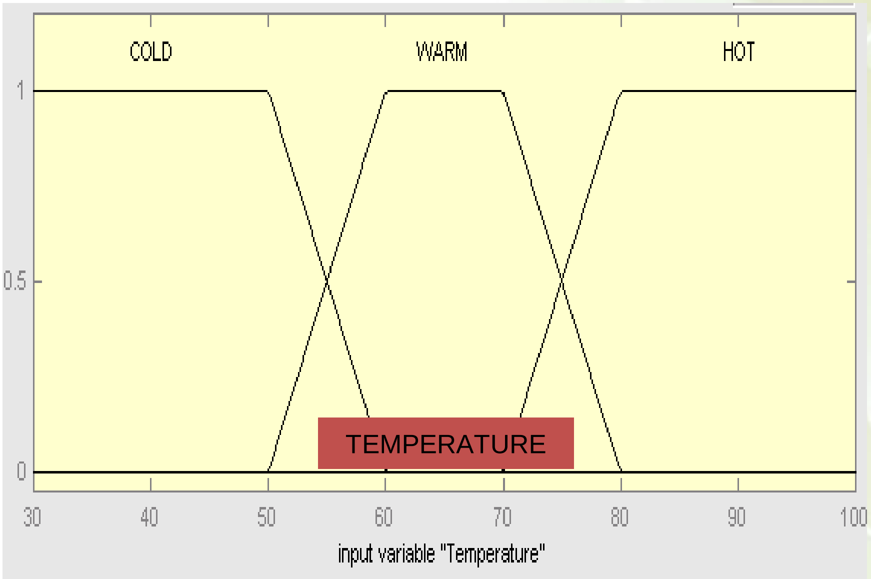


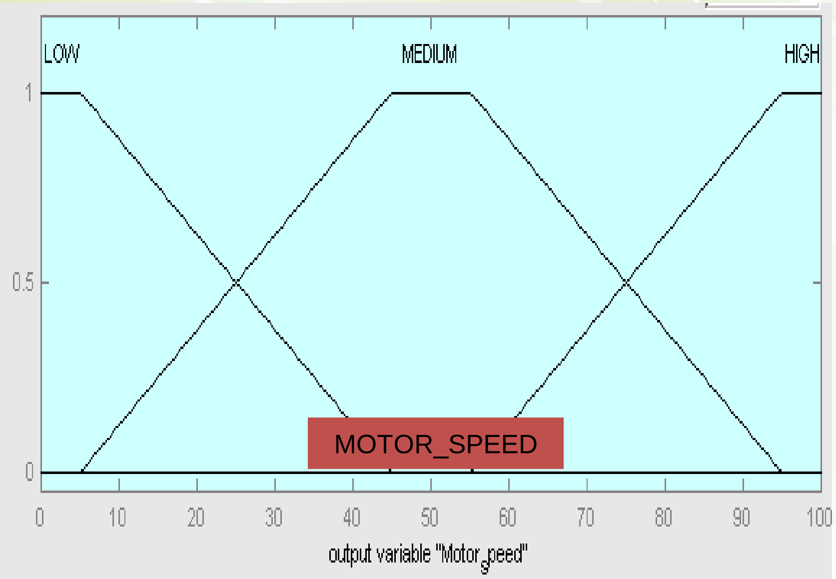
The conclusion of rule R_i for a given x observation is y_i

A teljes következtetési séma



Fuzzy rendszerek: példa

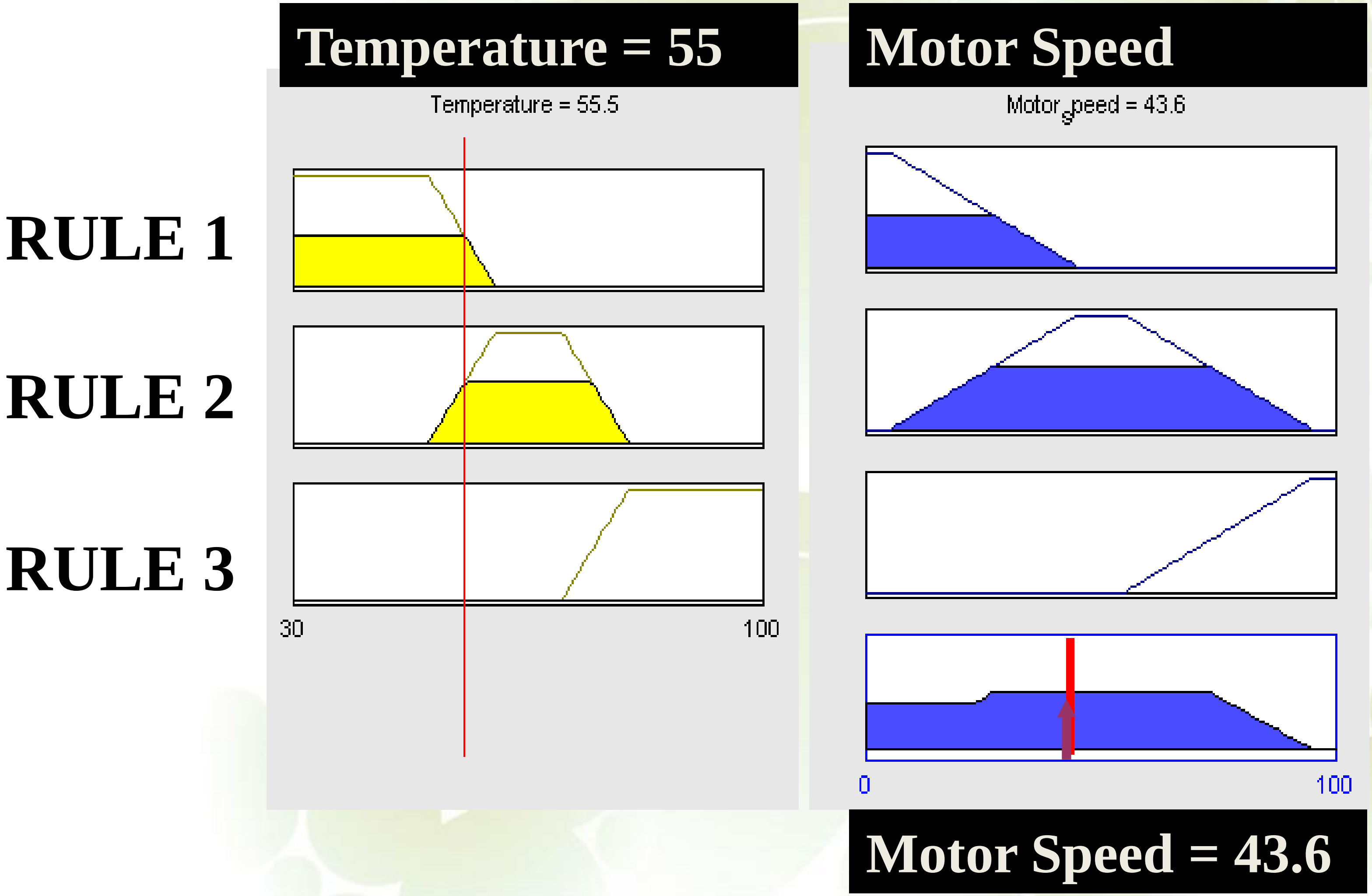




Fuzzy systems operate on fuzzy rules:

IF *temperature* is COLD **THEN** *motor_speed* is LOW
IF *temperature* is WARM **THEN** *motor_speed* is MEDIUM
IF *temperature* is HOT **THEN** *motor_speed* is HIGH

Következtető mechanizmus (Mamdani)

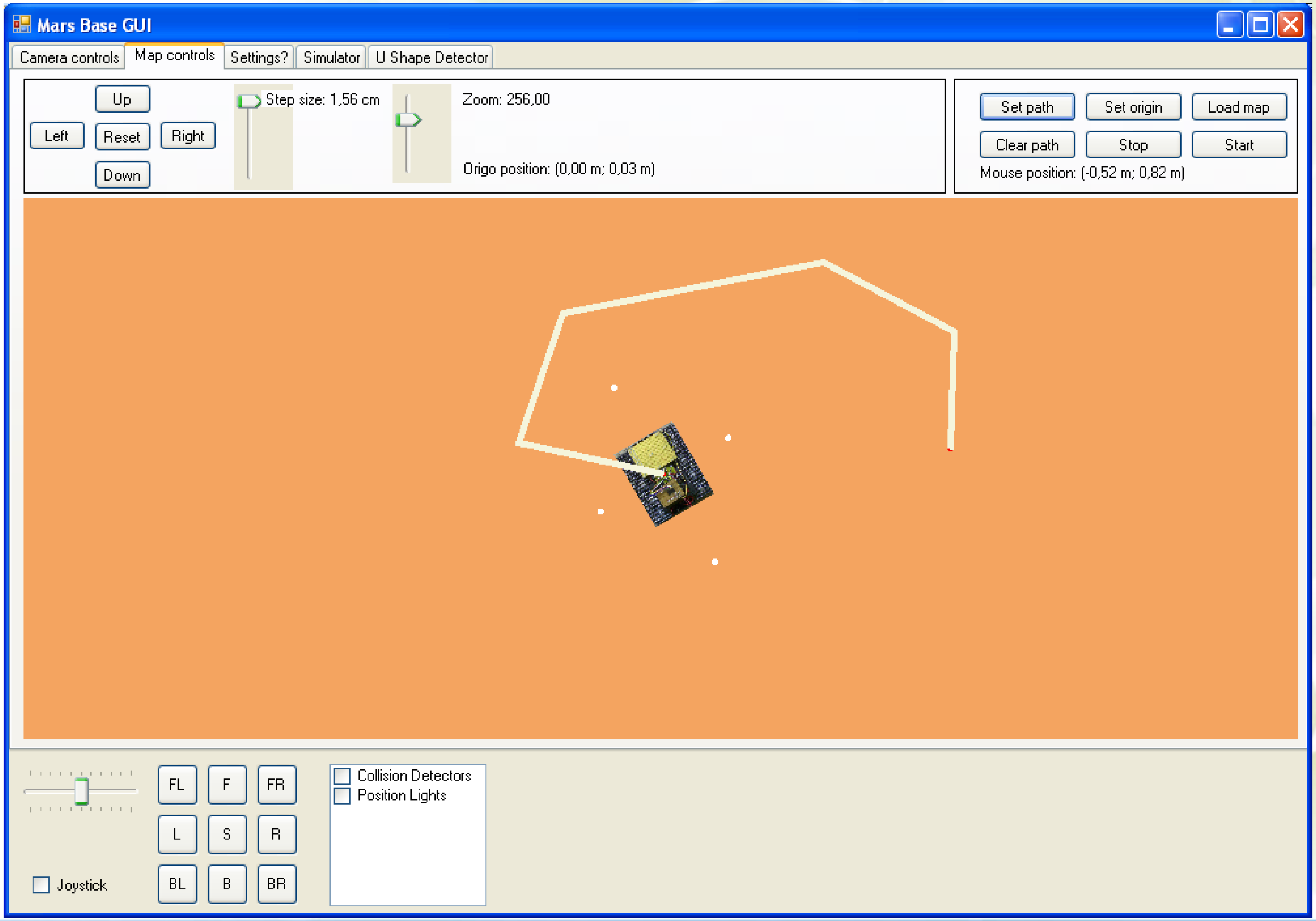


Példa: Hernyótalpas jármű irányítása

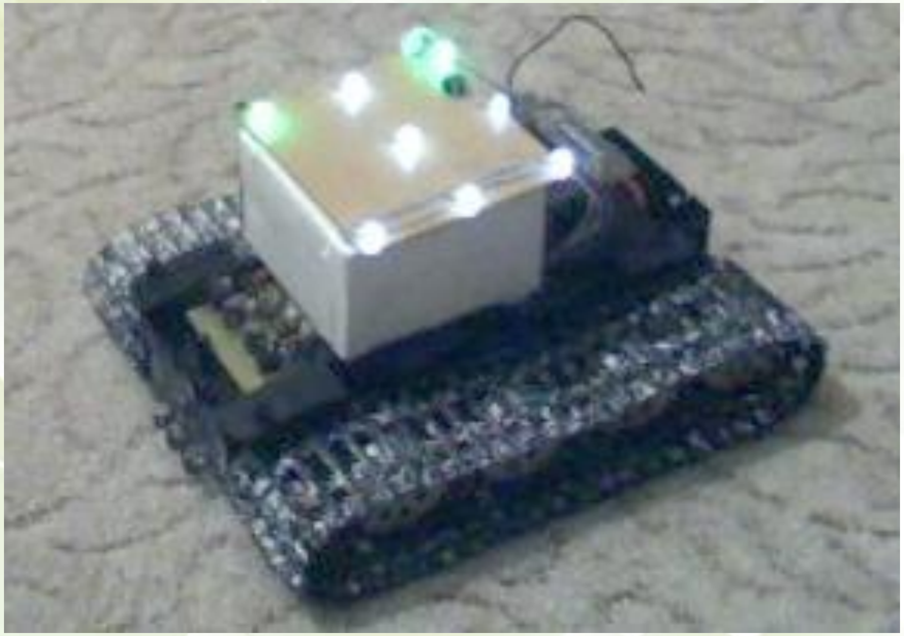
(M.Sc. hallgatói csoport, Pápai et al.)

- Kis „Marsjáró” jármű, amelyik tereplemezen mozog
- Rögzitett alapállomás és mozgó jármű
- Alapja egy játéktank
- Irányitója asztali PC, amelyen C# .NET szoftware fut
- A járművet Mamdani fuzzy irányitó vezérli, útkeresés és akadáykerülés szintjén is

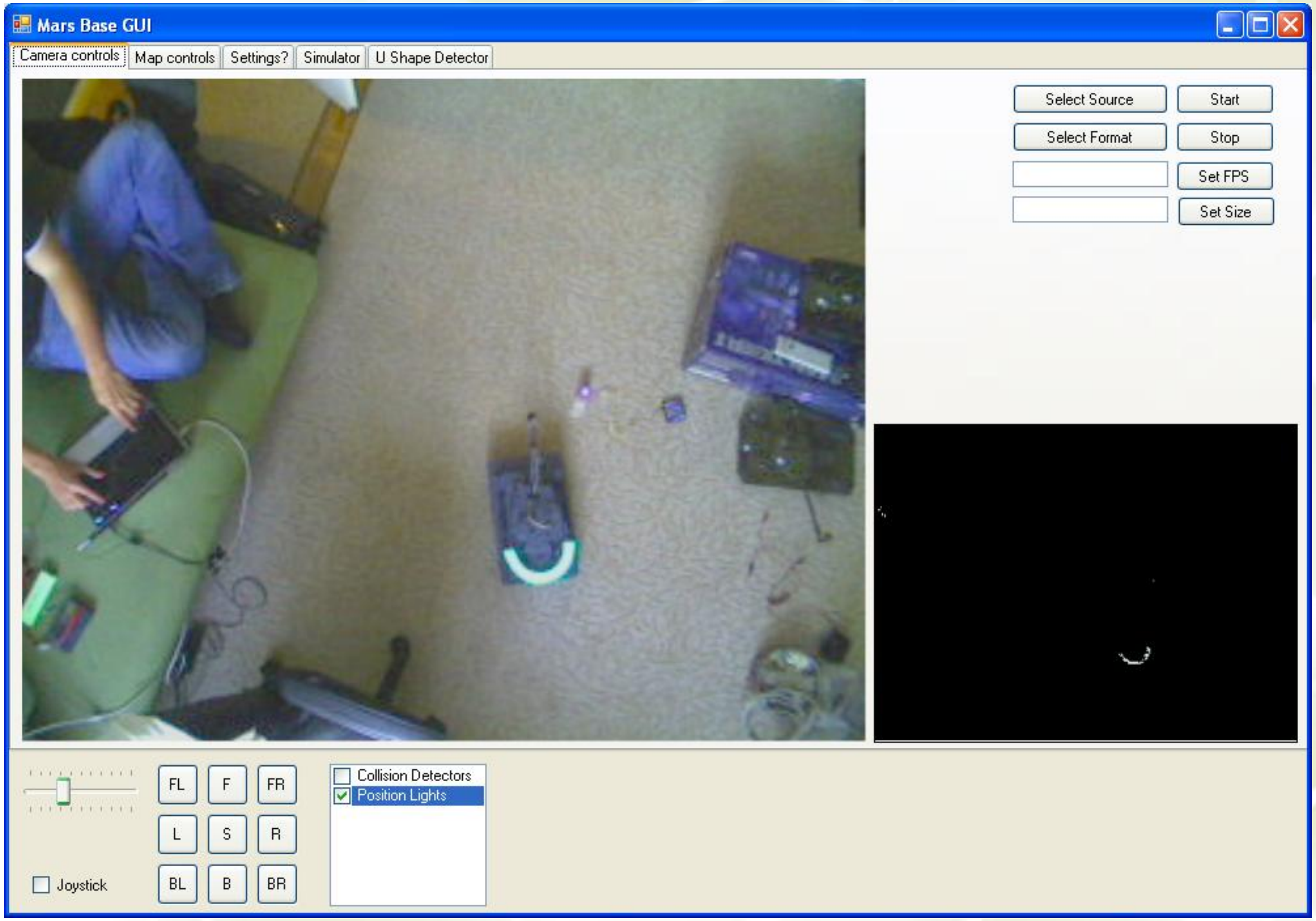
Szimulátor kisérlet



A mozgó egység



Tesztelés

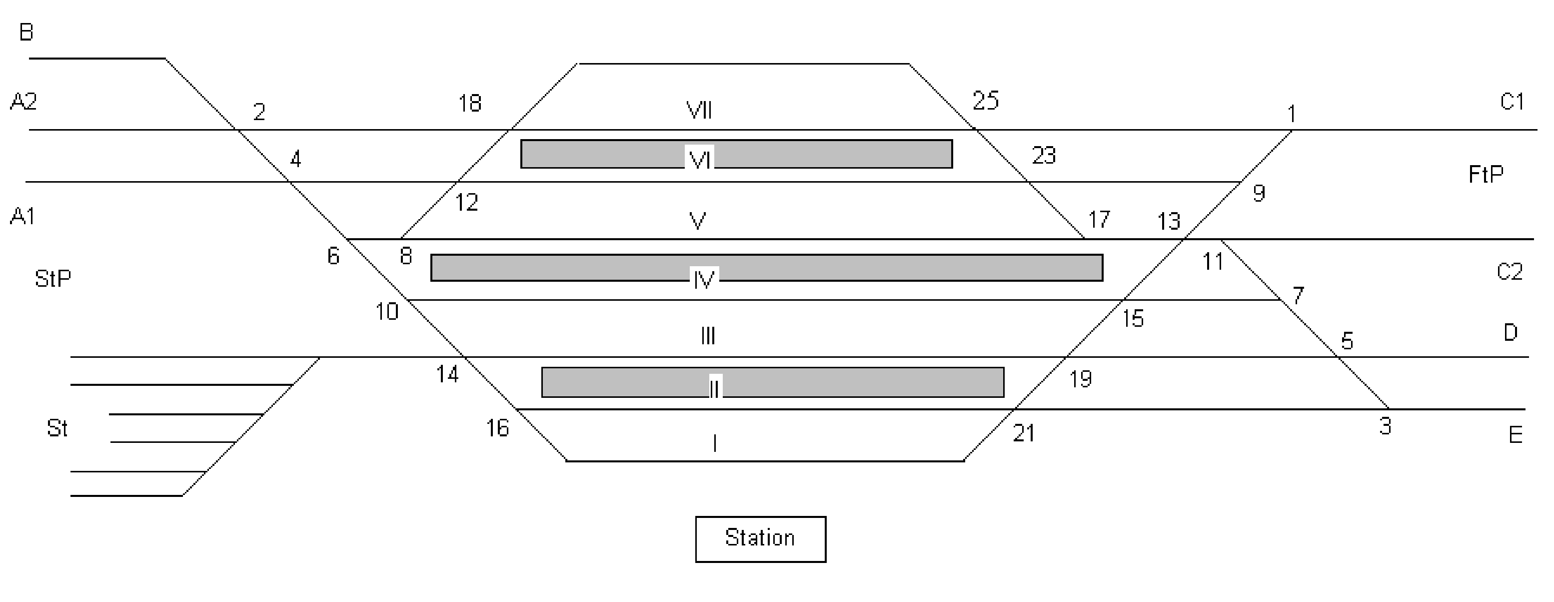

Mars Base GUI
Camera controls
Map controls
Settings?
Simulator
U Shape Detector
Select Source
Start
Select Format
Stop
Set FPS
Set Size
FL
F
FR
L
S
R
BL
B
BR
Joystick
Collision Detectors
Position Lights

A verseny

Egy másik példa: Vasúti menetrendi eltérésekből adódó problémák feloldása

Africon 2009, Héray, Rózsa et al.

- Az állomás



A vizsgált vonatok menetrendi adatai

Departures ⇒ / Arrivals ⇓				Dir.	to	to	to	to	to	to	to	to	to	to
				Line	A	A	C1	A	C2	A	C1	A	B	A
				Train	F4	F5	F6	F7	S23	S24	S25	F9	S26	S27
				Platf.	VII	V	VI	VII	III	I	IV	VII	II	V
				Waiting	0:10	0:10	0:10	0:10	0:15	0:15	0:15	0:10	0:15	0:15
Dir.	Line	Train	Platf.	Time	8:11	8:28	8:19	8:43	8:47	8:48	9:25	9:42	9:45	9:48
from	C2	S2	V	7:17	**0:54**									
from	A	F2	VI	7:20			**0:59**							
from	C1	S3	II	7:23	**0:48**									
from	A	F3	VI	7:26										
from	A	S4	V	7:40			**0:39**							
from	C1	F4	VII	8:09	0:02		**0:10**		**0:38**	**0:39**				
from	A	S5	I	8:10			**0:09**		**0:37**	**0:38**				
from	D	S6	III	8:11		**0:17**	**0:08**	**0:32**	**0:36**	**0:37**				
from	C2	F5	V	8:14		0:14	**0:05**		**0:33**	**0:34**				
from	A	F6	VI	8:17		**0:11**	0:02		**0:30**	**0:31**				
from	B	S7	II	8:20		**0:08**		**0:23**	**0:27**	**0:28**				
from	C1	S8	IV	8:31				**0:12**	**0:16**	**0:17**	**0:54**			
from	D	F7	VII	8:41				0:02	**0:06**	**0:07**	**0:44**			
from	C2	S9	II	8:43					**0:04**	**0:05**	**0:42**	**0:59**		
from	E	F8	VI	8:49							**0:36**	**0:53**	**0:56**	**0:59**
from	B	S10	V	8:52							**0:33**	**0:50**	**0:53**	**0:56**
from	A	S11	V	9:10							**0:15**		**0:35**	**0:38**
from	E	S12	II	9:34									**0:11**	**0:14**
from	C1	F9	VII	9:40								0:02	**0:05**	**0:08**

A csatlakozási probléma paramétereinek tapasztalt értékei

- CT – connections time
- ID – incoming delay
- OD – outcoming delay

CT		t[min]
very short	VS	1…2
short	SH	4…8
medium	M	10…15
long	L	18…25
very long	VL	> 30

ID		t[min]
appr. zero	AZ	0
very small	VS	3..5
small	SM	8…11
medium	M	14…19
large	LA	22…27
very large	VL	> 30

OD		t[min]
appr. zero	AZ	0
small	SM	2..4
medium	M	6…8
large	LA	10…15
very large	VL	12…15
very-very l.	VVL	14...15
re evaluate	RE	*

A konfliktust feloldó szabálybázis

- Level 1

Outgoing delay for departing trains (OD_i). Rule base S_1:
(Slow train, normal weather)

Delay of arriving train ID [min]		Connection time categories CT [min]				
		VS 1 … 2	SH 4 … 8	M 10 … 15	L 18 … 25	VL > 30
AZ	< 1,5	0	0	0	0	0
VS	3 … 5	M	SM	0	0	0
SM	8 … 11	VL	L	M	0	0
M	14 … 19	VVL	VVL	VL	L	0
LA	22 … 27	0	0	VVL	VL	0
VL	> 30	0	0	0	VVL	RE

A konfliktust feloldó szabálybázis

- Level 2

Rule base S_2 of delays for departing trains						
Number of occurencies	Biggest OD_i on the grounds of S_1					
	AZ	SM	M	LA	VL	VVL
1	AZ	SM	M	LA	VL	VVL
2	AZ	M	LA	VL	VVL	VVL
3	SM	M	VL	VL	VVL	VVL
≥4	SM	LA	VL	VVL	VVL	VVL

2. Szabályinterpoláció

(közös kutatás, Dr. h. c. Prof. Hirota K., Hosei U. & TIT; M.Sc. és Ph. D. projektek)

„A dimenziószám átka” a fuzzy irányitásban

If there are *k* input state variables, and in each there are (max) *T* terms, the number of rules covering the space densely is

$$r = T^k$$

How to decrease this expression?

1. Decrease *T*

   Sparse rule bases, rule interpolation (Kóczy and Hirota, 1990)

2. Decrease *k*

   Hierarchical structured rule bases (Sugeno, 1991)

3. Decrease both *T* and *k*

   Interpolation of hierarchical rule bases (Kóczy and Hirota, 1993)

T csökkentése

SYMBOLIC EXPERT CONROL

↓

FUZZY CRI/ MAMDANI CONTROL

↓

FUZZY INTERPOLATIVE CONTROL

T csökkentése

érett

éretlen

??? (sárga)

A lineáris interpoláció alapegyenlete és ennek megoldása B*-ra

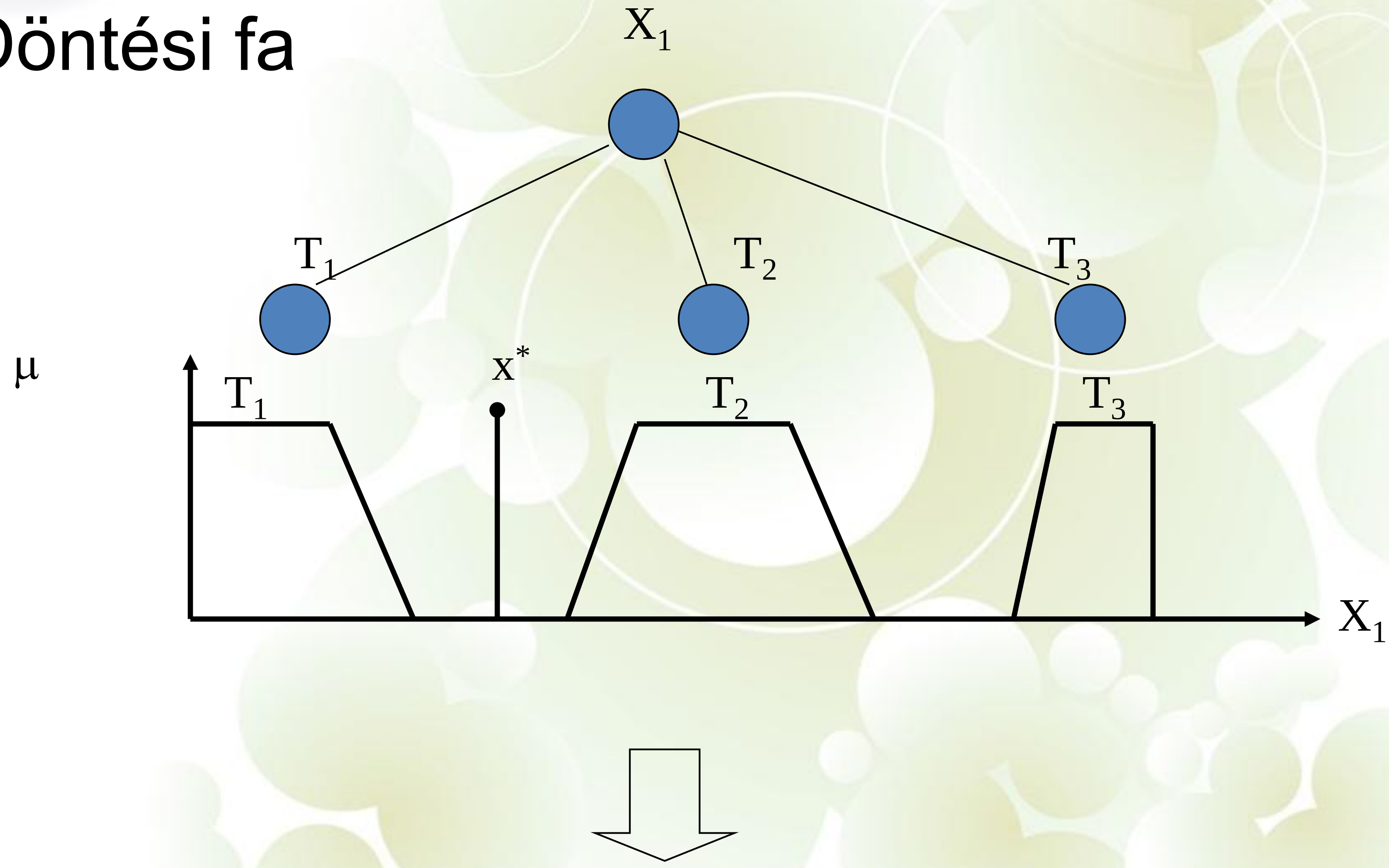
$$R_1 = A_1 \to B_2, \qquad \text{where} \quad A_1 \prec A^* \prec A_2$$

$$R_2 = A_2 \to B_2, \qquad B_1 \prec B_2$$

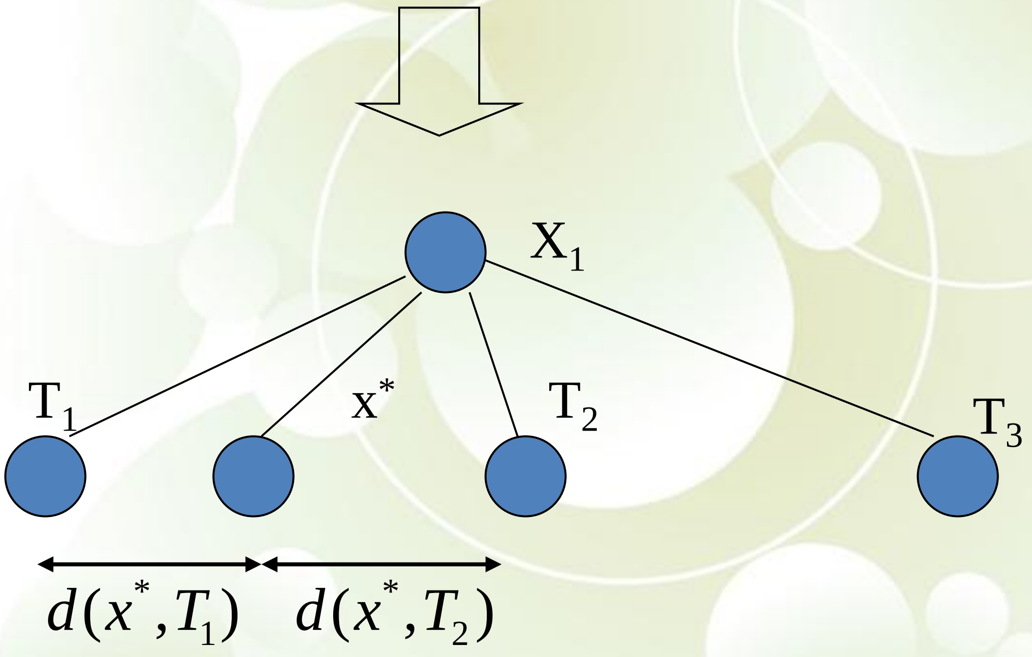
$$D(A^*, A_1) : D(A^*, A_2) = D(B^*, B_1) : D(B^*, B_2)$$

$$\inf\{B_\alpha^*\} = \frac{\dfrac{\inf\{B_{1\alpha}\}}{d_{\alpha L}(A_{1\alpha}, A_\alpha^*)} + \dfrac{\inf\{B_{2\alpha}\}}{d_{\alpha L}(A_{2\alpha}, A_\alpha^*)}}{\dfrac{1}{d_{\alpha L}(A_{1\alpha}, A_\alpha^*)} + \dfrac{1}{d_{\alpha L}(A_{2\alpha}, A_\alpha^*)}} \qquad \sup\{B_\alpha^*\} = \frac{\dfrac{\sup\{B_{1\alpha}\}}{d_{\alpha U}(A_{1\alpha}, A_\alpha^*)} + \dfrac{\sup\{B_{2\alpha}\}}{d_{\alpha U}(A_{2\alpha}, A_\alpha^*)}}{\dfrac{1}{d_{\alpha U}(A_{1\alpha}, A_\alpha^*)} + \dfrac{1}{d_{\alpha U}(A_{2\alpha}, A_\alpha^*)}}$$

Döntési fa



Egy „nemlétező” ágon kell haladni

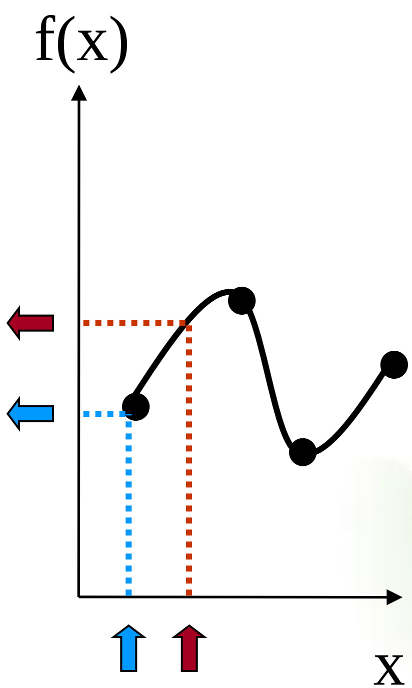


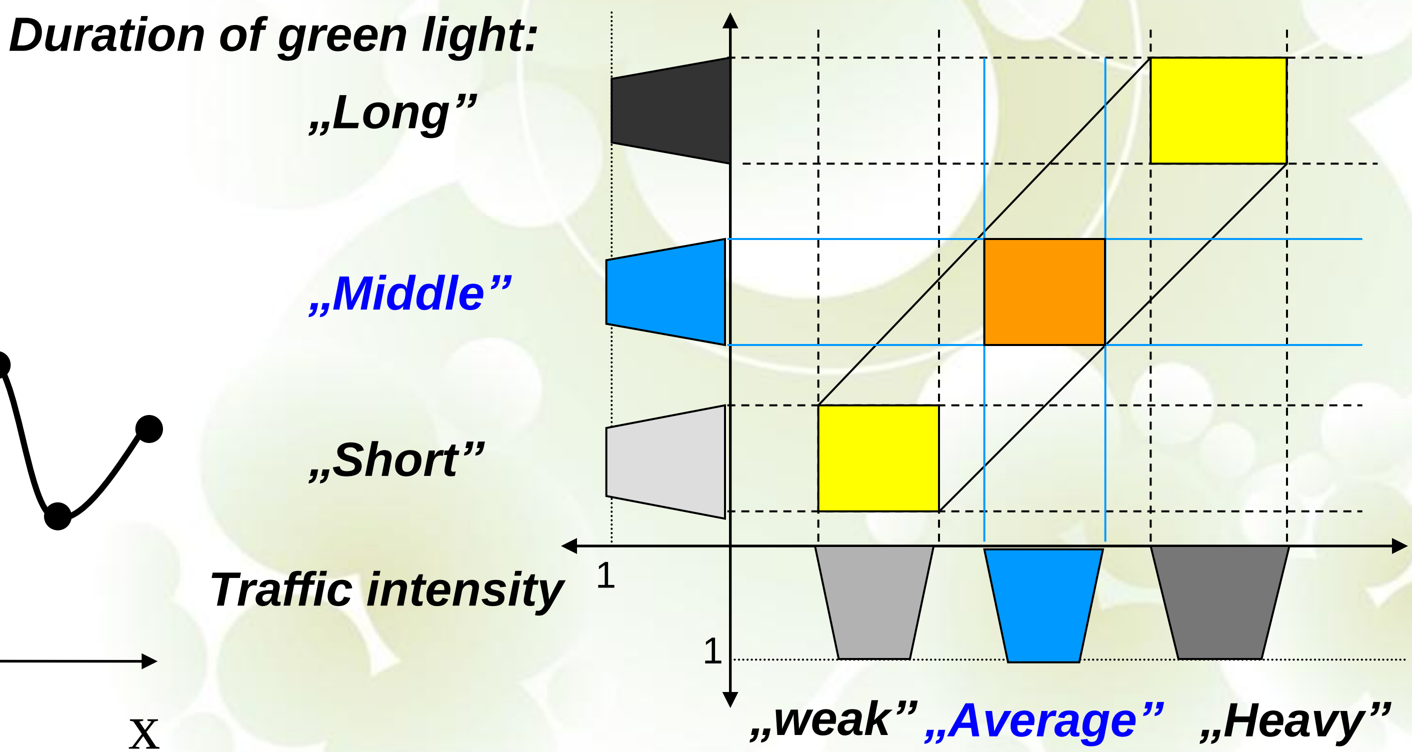
Fundamental Equation of Fuzzy Interpolation

Szabályinterpoláció

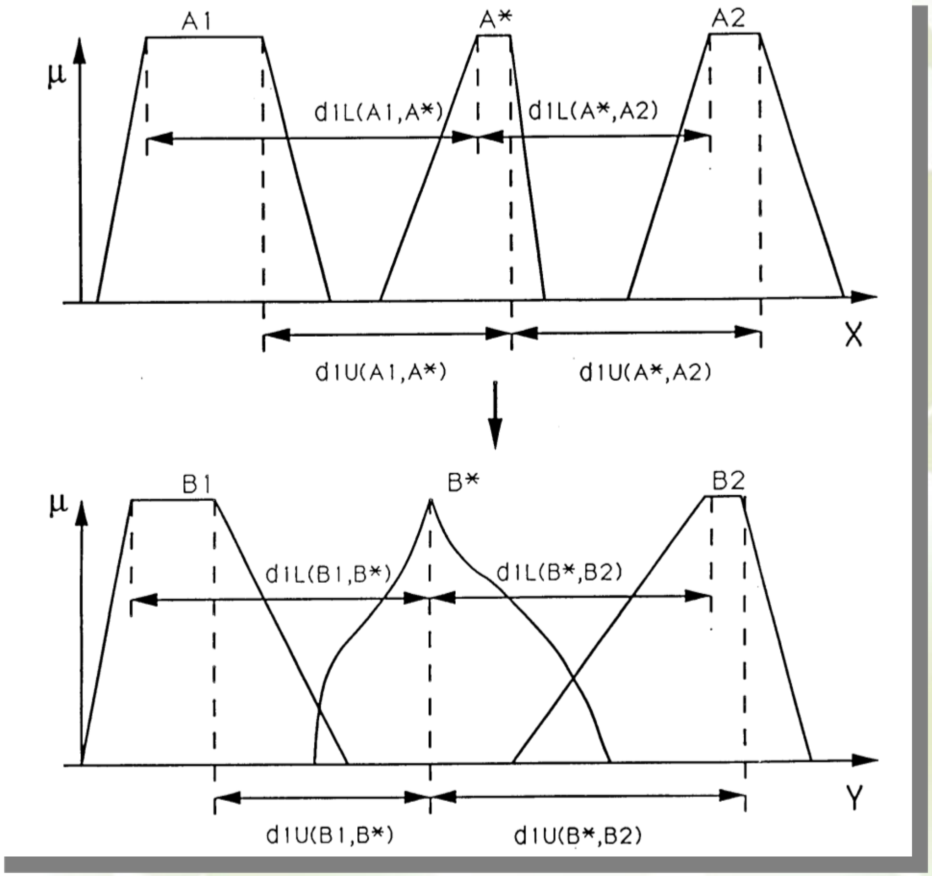
Interpolation between different points

Interpolation of fuzzy rules

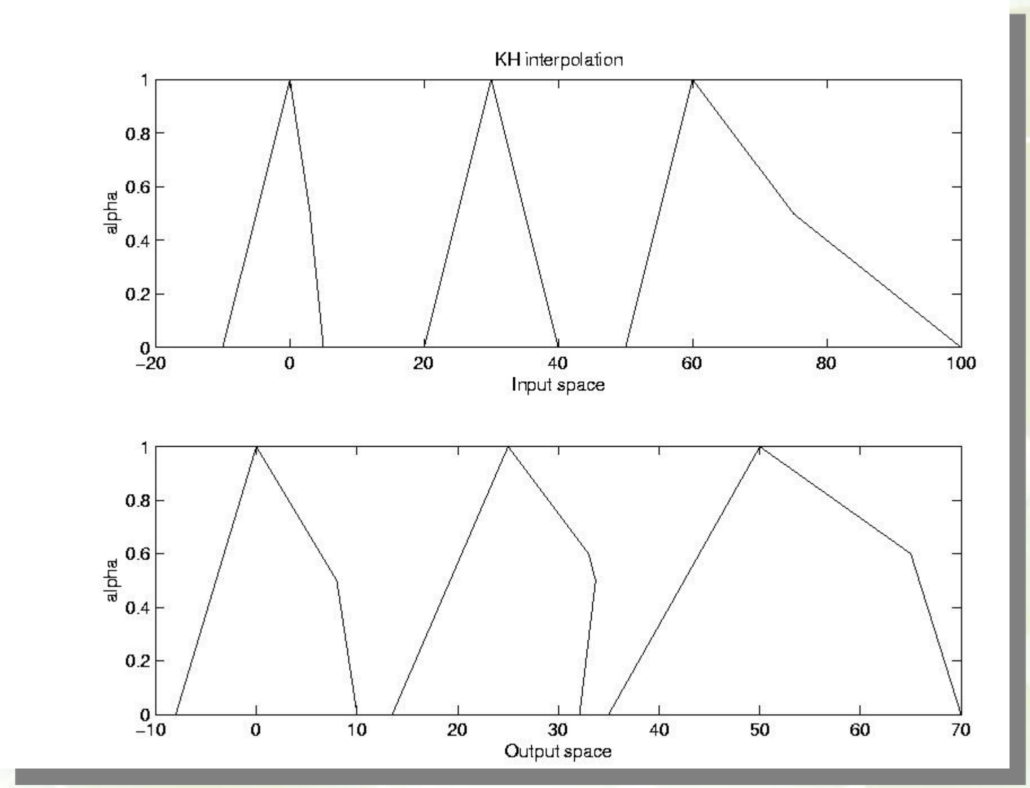




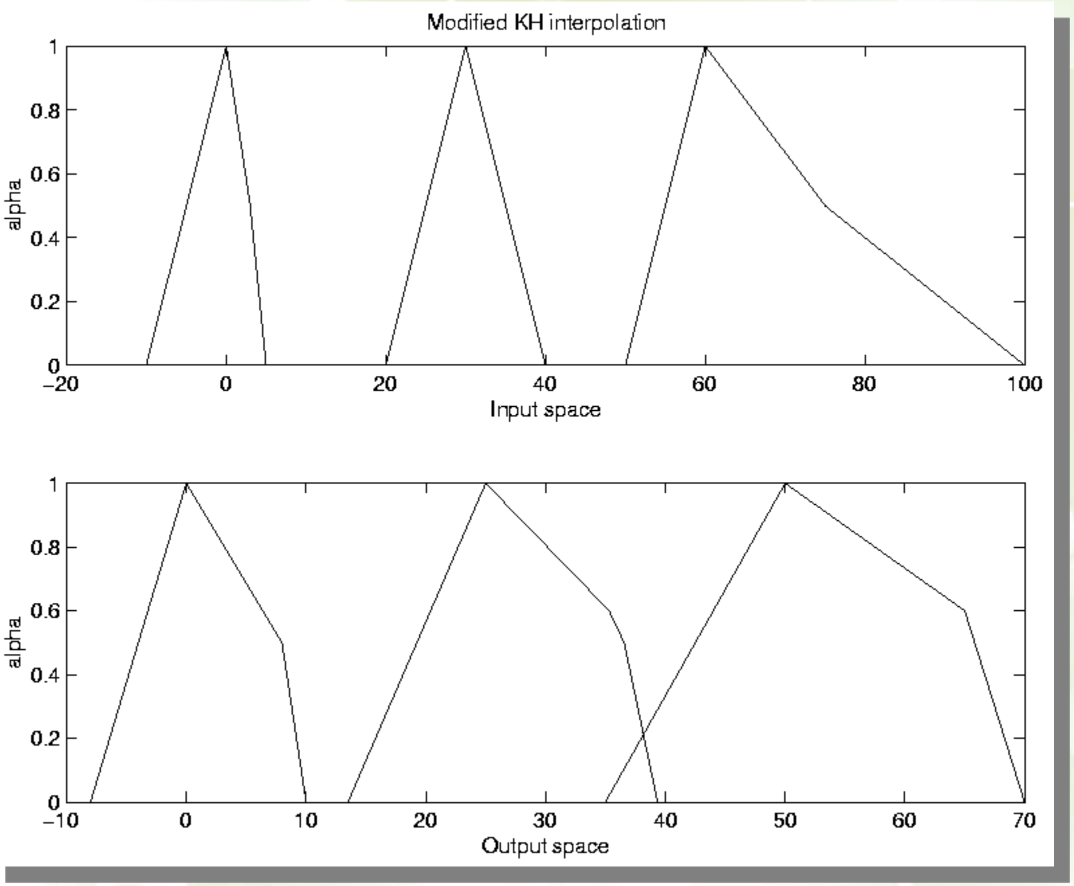
A lineáris interpolációs módszer eredménye nem mindig értelmes



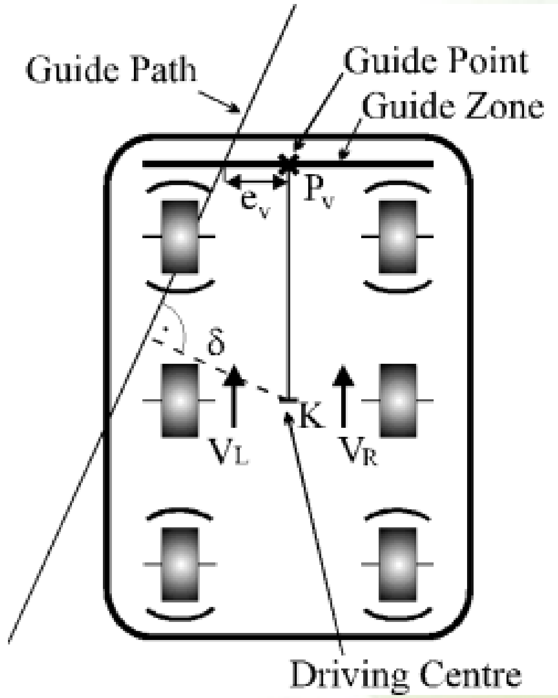
Példa abnormális eredményre



Módositott interpoláció – az előző példa helyes megoldása



Egy újabb példa: Nyomkövetés automata targoncával (AGV) (Ph. D., Kovács)



e_v: the distance between the guide path and the guide point
δ: the estimated momentary path tracking error

V_L is the contour speed of the left wheel
V_R is the contour speed of the right wheel

Speed: $V_a=(V_L+V_R)/2$
Steering: $V_d=V_L-V_R$

Rules describing the steering (V_d):
If $e_v = A_{1,i}$ **and** $\delta = A_{2,i}$ **then** $V_d = B_i$

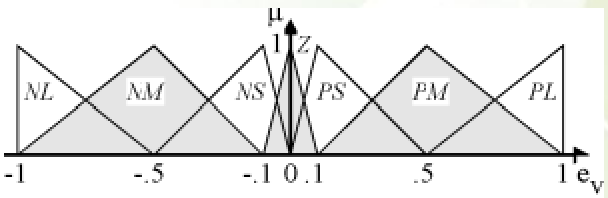
Rules describing the speed (V_a):
If $e_v = A_{1,i}$ **and** $\delta = A_{2,i}$ **then** $V_d = B_i$

An example rule:
If the distance between the guide path and the guide point (e_v) is *Positive Middle* **and** estimated path tracking error (δ) is *Negative Middle* **then** the steering (V_d) is *Zero* **and** the speed (V_a) is *Middle*

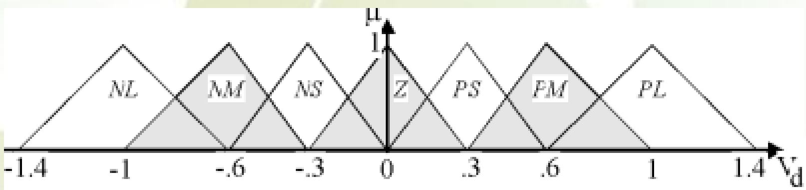
Nyomkövetés automata targoncával (AGV)
(folytatás)

- Fuzzy partitions for the linguistic variables:

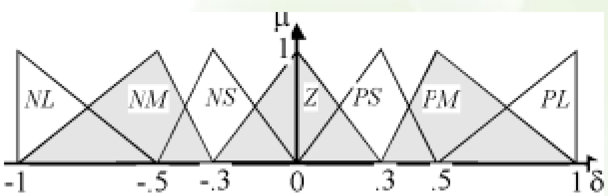
e_v



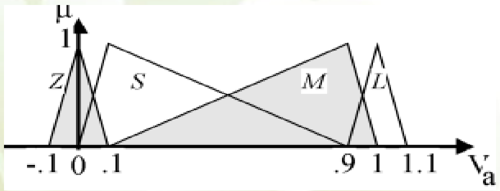
V_d



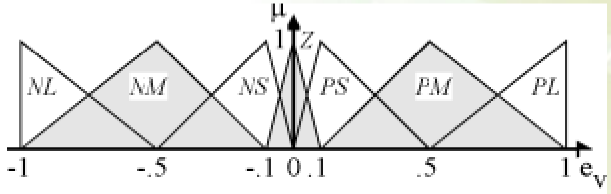
δ

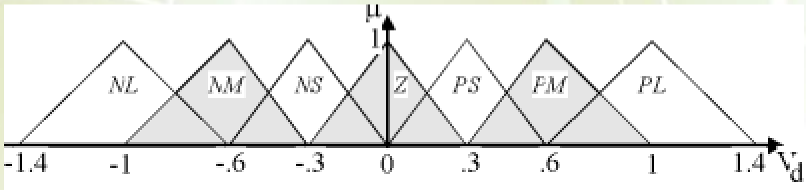


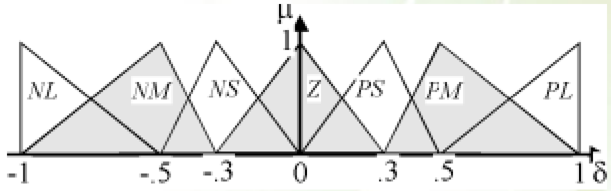
V_a

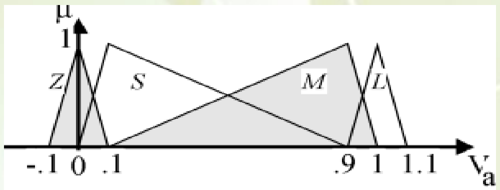


Komoly redukció a szabályszámban









V_d

δ / e_v	NL	NM	Z	PM	PL
NL				NL	
NM	PL		PS	PS	NL
Z		PL		NL	
PM	PL	NS	NS		NL
PL		PL			

V_a

δ / e_v	NL	NM	Z	PM	PL
NL					Z
NM					
Z	S		L		S
PM					
PL	Z				

3. Hierarchikus fuzzy szabálybázisok

„A dimenziószám átka" a fuzzy irányitásban

$$r = T^k$$

If there are k input state variables, and in each there are (max) T terms, the number of rules covering the space densely is

How to decrease this expression?

1. Decrease T

   Sparse rule bases, rule interpolation (Kóczy and Hirota, 1990)

2. Decrease k

   Hierarchical structured rule bases (Sugeno, 1991)

3. Decrease both T and k

   Interpolation of hierarchical rule bases (Kóczy and Hirota, 1993)

SZÉCHENYI TUDOMÁNYOS EST

SZÉCHENYI ISTVÁN EGYETEM
TUDÁSMENEDZSMENT KÖZPONT

Hogyan csökkenthető *k* ténylegesen?

”Divide and conquer” algorithms/ Sugeno’s helicopter

Hierarchically structured rule bases with locally reduced variable sets

State space: $X = X_1 \times X_2 \times ... \times X_k$

Z_0

Partitioned subspace: $Z_0 = X_1 \times X_2 \times ... \times X_{k_0}, k_0 < k$

In : $\prod = \{D_1, D_2, ..., D_n\},$ $\bigcup_{i=1}^{n} D_i = Z_0$

In each D_i a sub-rule base R_i is defined, reduction works if in each sub-rule base the input variable space X_i is a sub-space of

$$X / Z_0 = X_{k_0+1} \times X_{k_0+2} \times ... \times X_k$$

Sugeno fuzzy helikoptere

Hierarchikus fuzzy szabálybázis

In these cases complexity is still $O(T^k)$, as the size of R_0 is $O(T^{k_1})$ and each R_i, $i > 0$, is of order $O(T^{k-k_1})$, so $O(T^{k_1}) \times O(T^{k-k_1})=O(T^k)$

In some concrete applications:

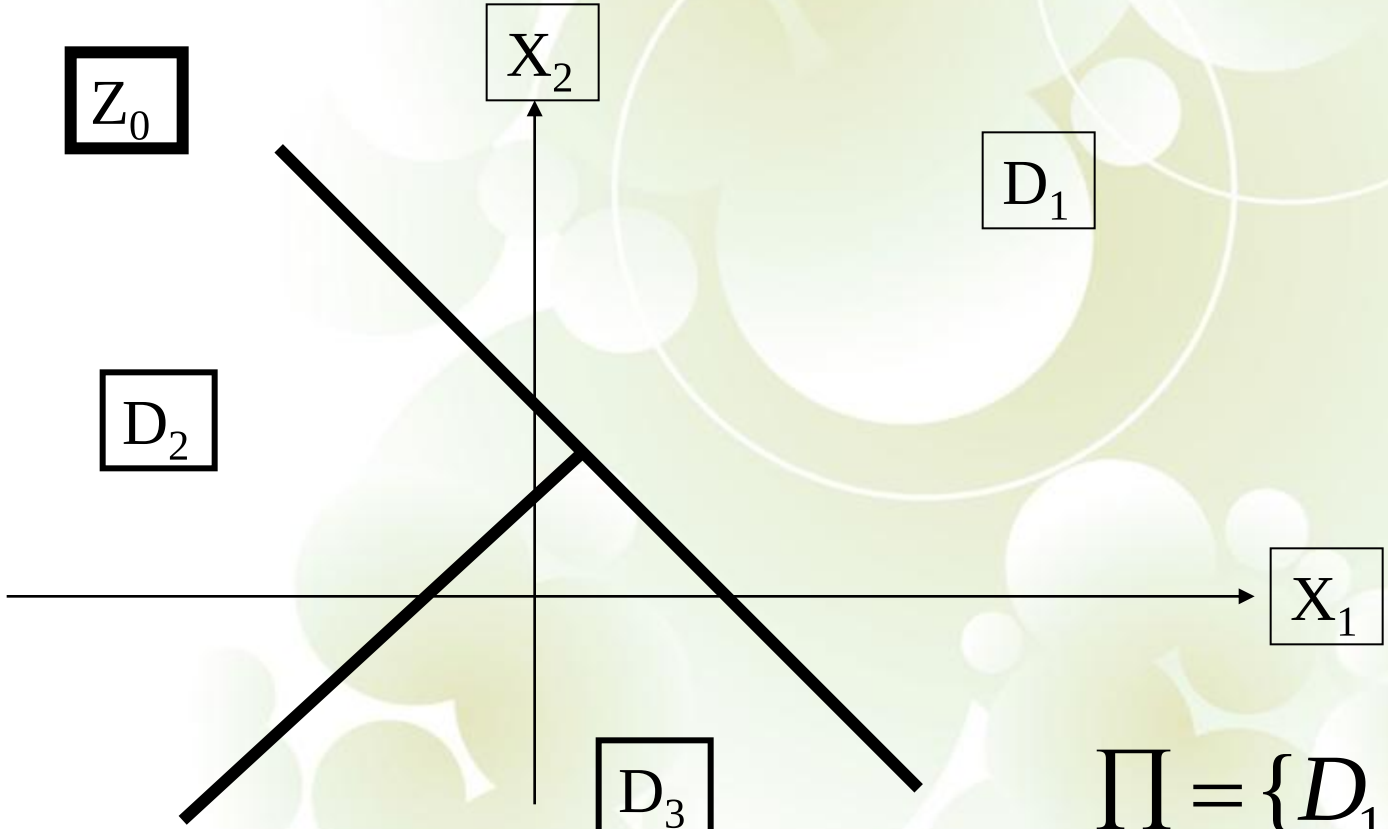
In each D_i a proper subset of $\{X_{k_1+1},\ldots,X_k\}$ can be found so that each R_i contains only $k_i < k - k_0$ input variables $\Rightarrow$ if

$$\max_{i=1}^{n}\{k_i\} = K < k - k_0,$$

then the resulting complexity will be, $O(T^{k_0+K}) < O(T^k)$

Often it is impossible to find Π so that $k_i < k - k_0$, $i=1,\ldots,n$ because such a partition does not exist.

A döntési tér (Z_0) felosztása



$$\prod = \{D_1, D_2, D_3\}$$

A hierarchikus szabálybázis csökkentése

$$(\neg\exists i : X_i = X / Z_0)$$

$R_0(z_0 \in Z_0)$: **If** z_0 **is** D_1 **then use** R_1

If z_0 **is** D_2 **then use** R_2

…

If z_0 **is** D_n **then use** R_n

$R_1(z_1' \in Z_1 \mid X / Z_0)$:

If z_1' **is** A_{11} **then** y **is** B_{11}

If z_1' **is** A_{12} **then** y **is** B_{12}

…

If z_1' **is** A_{1m_1} **then** y **is** B_{1m_1}

A hierarchikus szabálybázis csökkentése (folyt.)

$$(\neg\exists i : X_i = X / Z_0)$$

$R_2(z_2' \in Z_2 \mid X / Z_0):$ **If** z_2' **is** A_{21} **then** y **is** B_{21}

If z_2' **is** A_{22} **then** y **is** B_{22}

…

If z_2' **is** A_{2m_2} **then** y **is** B_{2m_2}

… … …

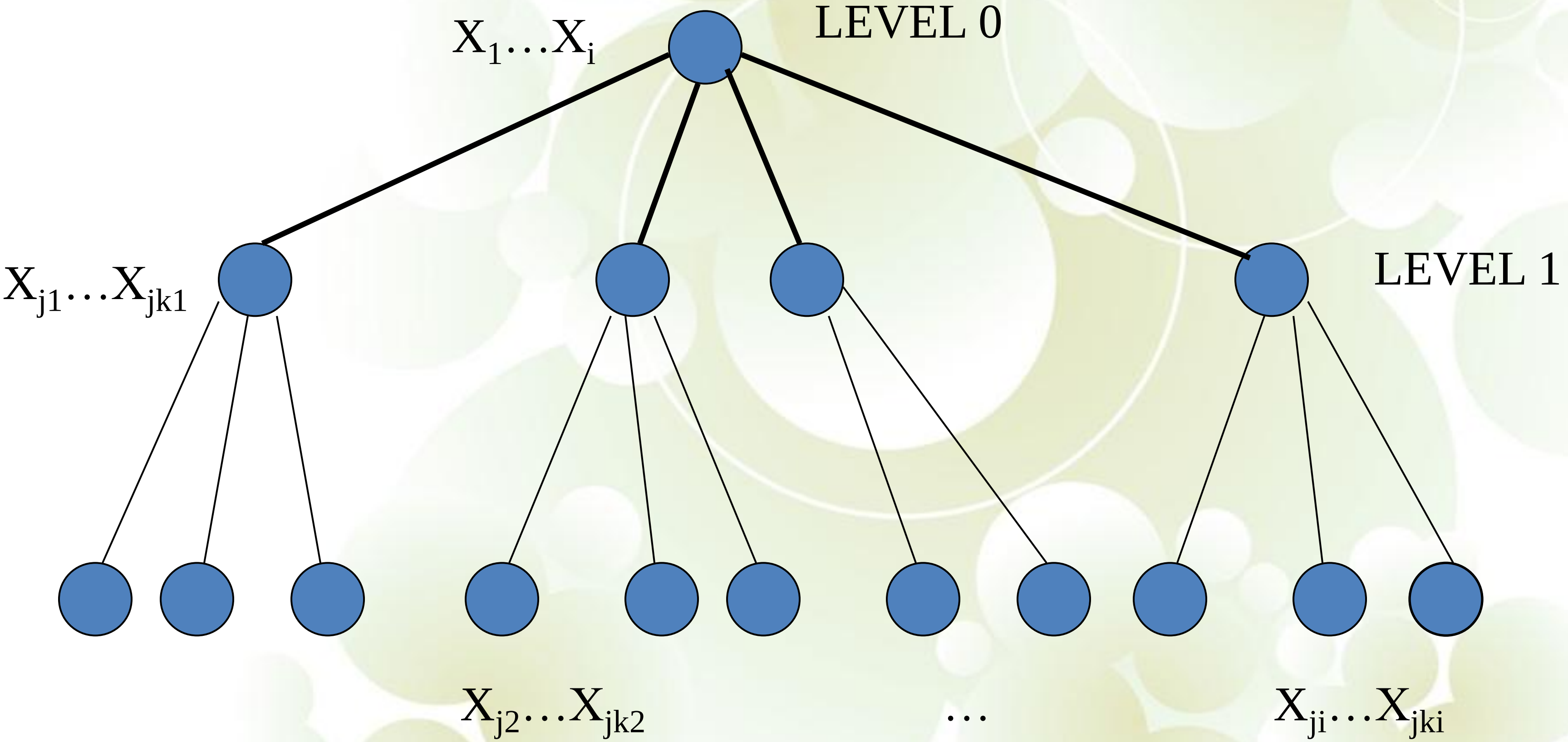
$R_n(z_n' \in Z_n \mid X / Z_0):$ **If** z_n' **is** A_{n1} **then** y **is** B_{n1}

If z_n' **is** A_{n2} **then** y **is** B_{n2}

…

If z_n' **is** A_{nm_n} **then** y **is** B_{nm_n}

Hierarchikus döntés



$j_1 \ldots j_{k1}, j_2 \ldots j_{k2}, \ldots, j_i \ldots j_{ki} \in \{k_0 + 1 \ldots k\}$

4. Interpoláció a hierarchikus szabálybázisban

„A dimenziószám átka” a fuzzy irányitásban

If there are *k* input state variables, and in each there are (max) *T* terms, the number of rules covering the space densely is

$$r = T^k$$

How to decrease this expression?

1. Decrease *T*

   Sparse rule bases, rule interpolation (Kóczy and Hirota, 1990)

2. Decrease *k*

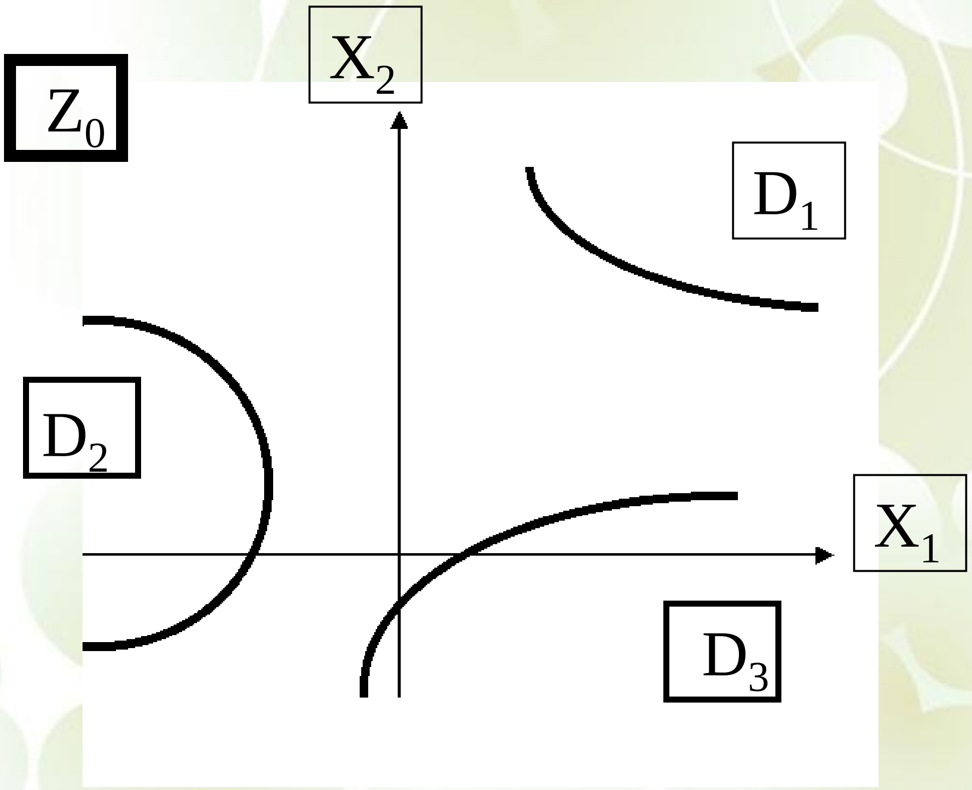
   Hierarchical structured rule bases (Sugeno, 1991)

3. Decrease both *T* and *k*

   Interpolation of hierarchical rule bases (Kóczy and Hirota, 1993)

PROBLÉMA(i)

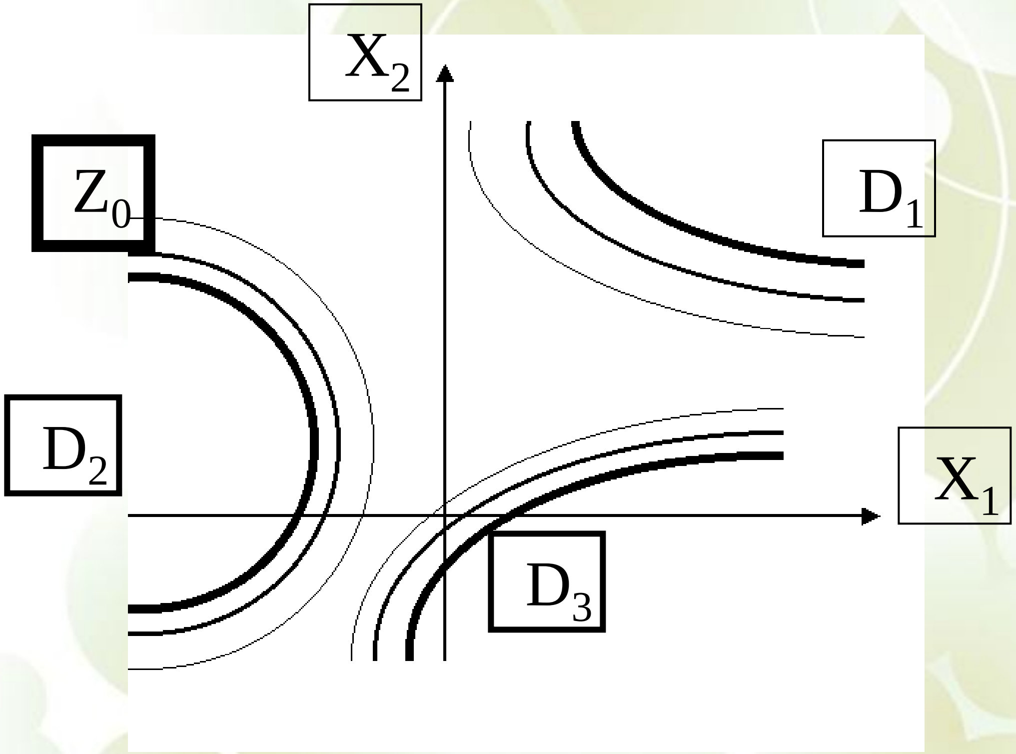
Partition Π usually does not exist because it is not possible to separate the areas of influence for the subsets of variables ⟹ ”Sparse partition” Θ



$$\Theta = \{D_1, D_2, D_3\},\ Z_0 - \Theta \neq \varnothing$$

PROBLÉMA(iia)

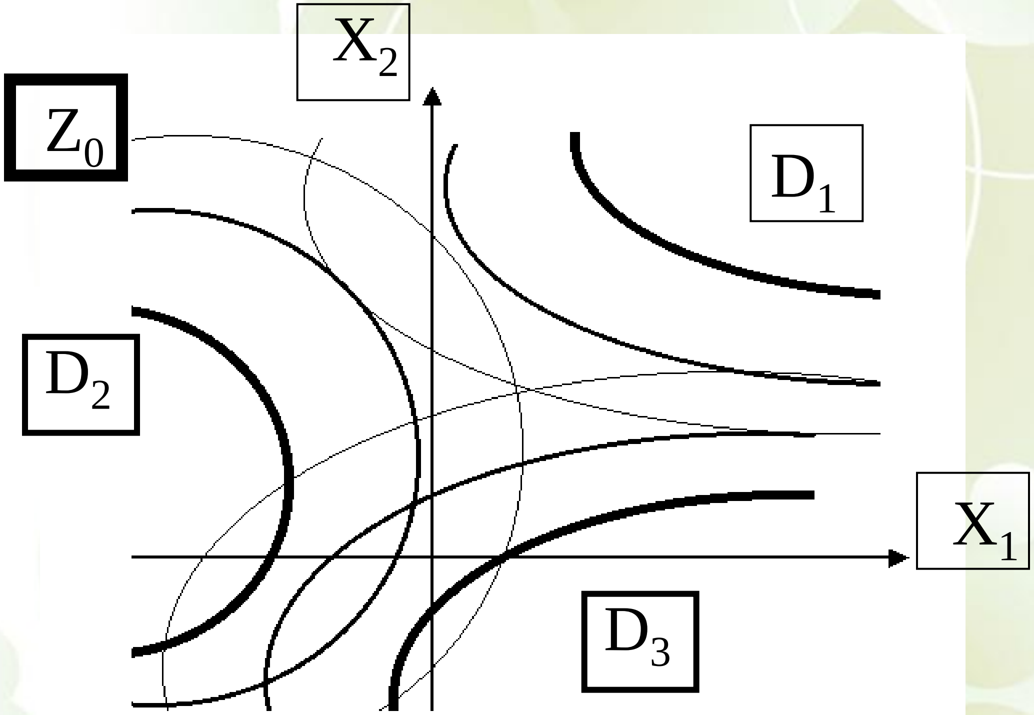
The elements of partition Θ are usually not crisp sets as the influence of each variable subset is fading away gradually when getting farther from the core ⇨ ”Fuzzy partition”



$$\Theta = \{D_1, D_2, D_3\},\ Z_0 - \bigcup_{i=1}^{3} \mathrm{supp}(D_i) \neq \varnothing$$

PROBLÉMA(ii)

The elements of partition Θ are usually not crisp sets as the influence of each variable subset is fading away gradually when getting farther from the core ⟹ ”Fuzzy partition” Θ

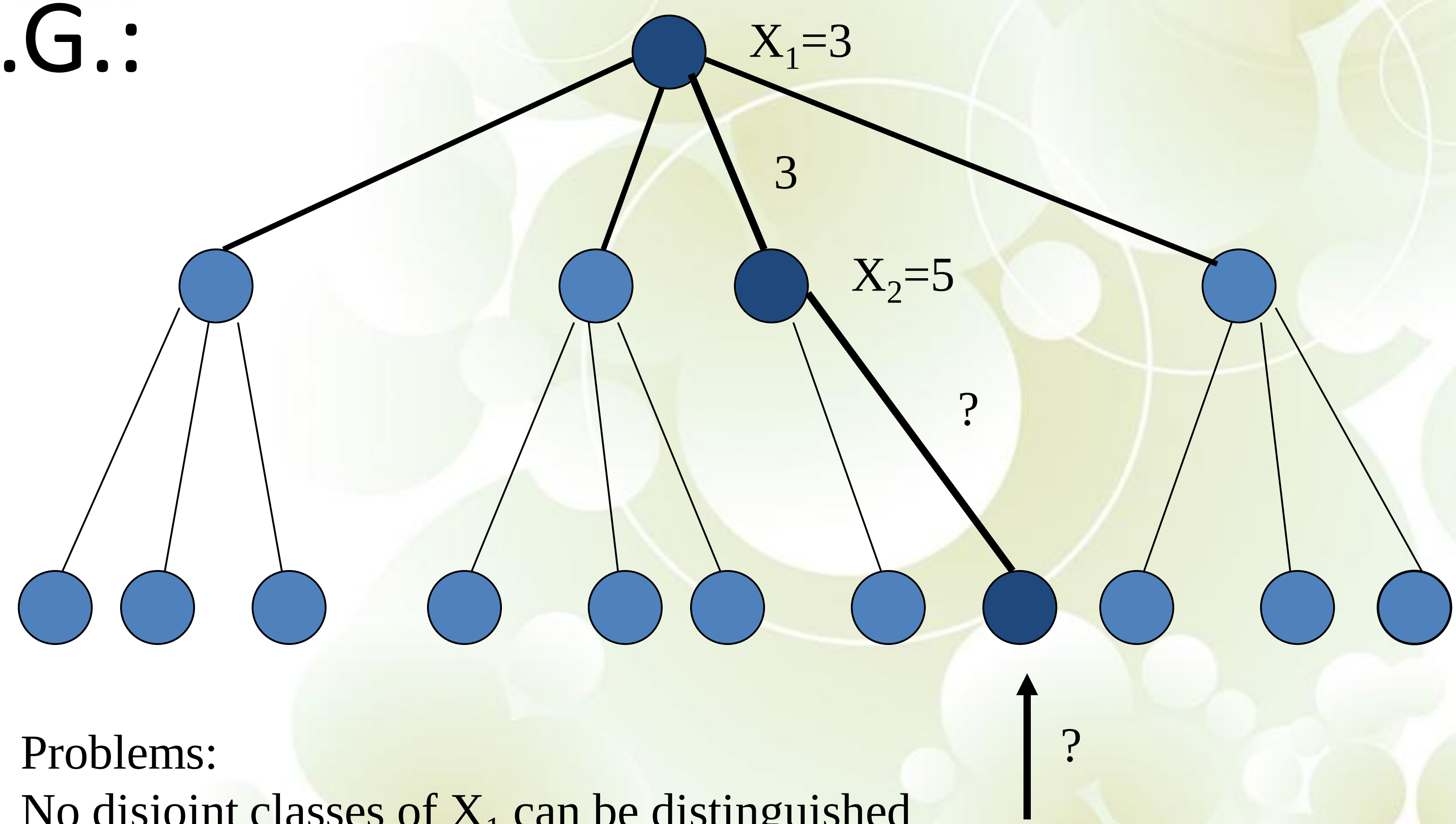


$$\Theta = \{D_1, D_2, D_3\},\ Z_0 - \bigcup_{i=1}^{3} \mathrm{core}(D_i) \neq \varnothing$$

SZÉCHENYI TUDOMÁNYOS EST

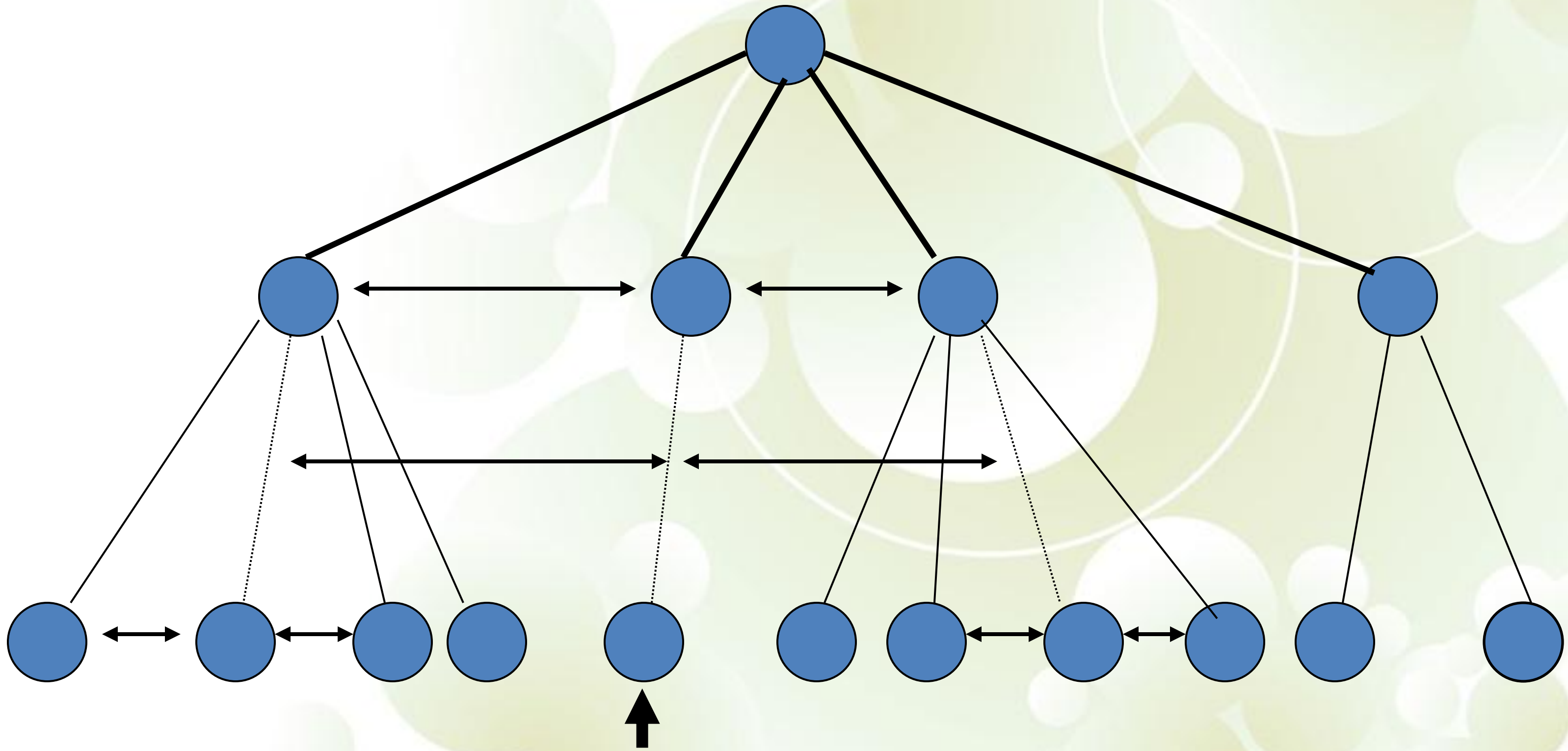
SZÉCHENYI ISTVÁN EGYETEM
TUDÁSMENEDZSMENT KÖZPONT

E.G.:



Problems:
No disjoint classes of X_1 can be distinguished
Fuzzy values for X_1 are known
How to resolve this?

A hierarchikus interpoláció ábrája



Interpolation of rules + rule bases

Possibly different subsets of variables

Interpoláció a hierarchikus szabálybázisban

Algorithm:

1.Determine the projection A_0^* of the observation A^* to the subspace of the fuzzy partition $\hat{\prod}$. Find the flanking elements in $\hat{\prod}$.

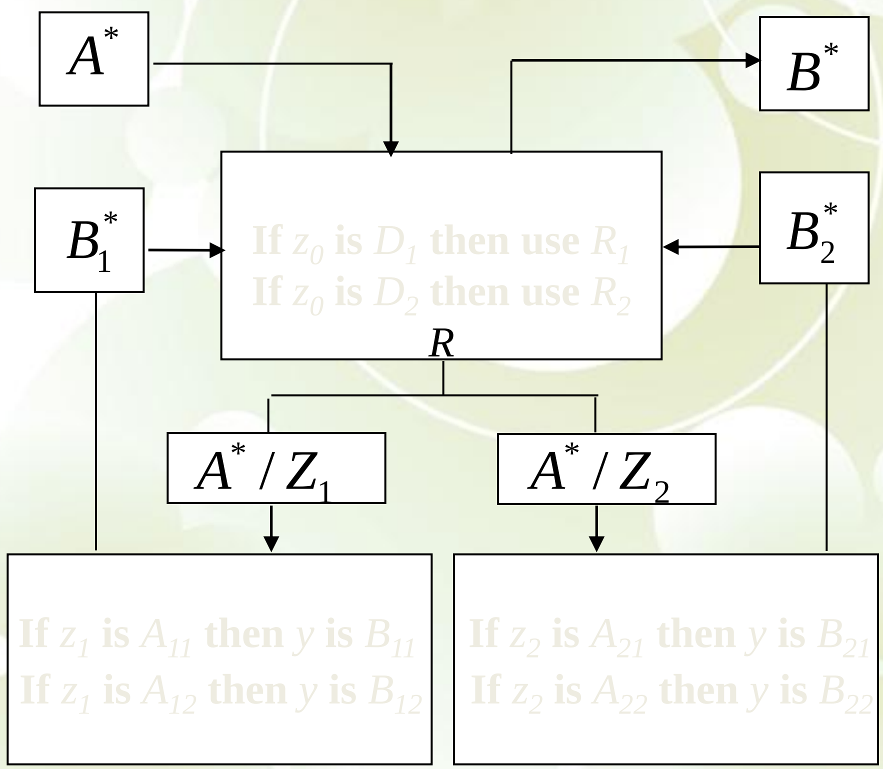
2.Determine the degrees of similarity (reciprocal distances or dissimilarities) for each D_i in $\hat{\prod}$. These will be w_i.

3.For each R_i, where $w_i \neq 0$, determine A^*_i the projection of A^* to Z_i. Find the flanking elements in each R_i.

4. Determine the sub-conclusions B^* for each sub-rule base R_i.

Replace the sub-rule bases by the sub-conclusions in the meta-rule base R_0 and calculate the final conclusion B^* by applying w_i as degrees of similarity.

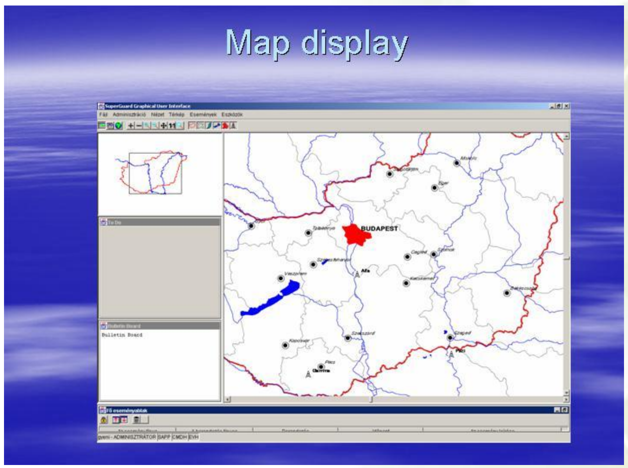
Interpoláció a hierarchikus szabálybázisban példa

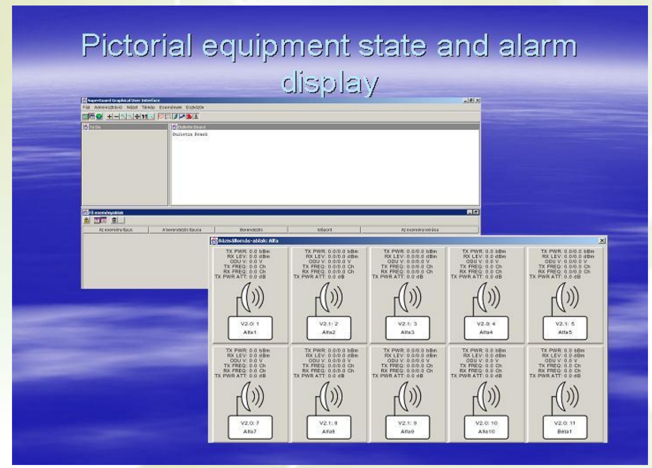


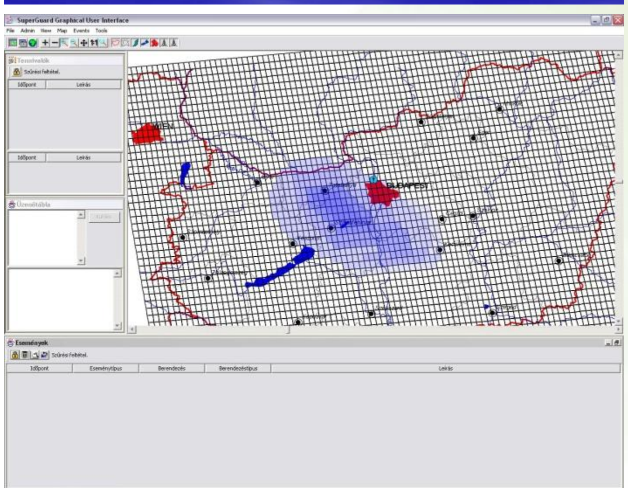
Alkalmazások

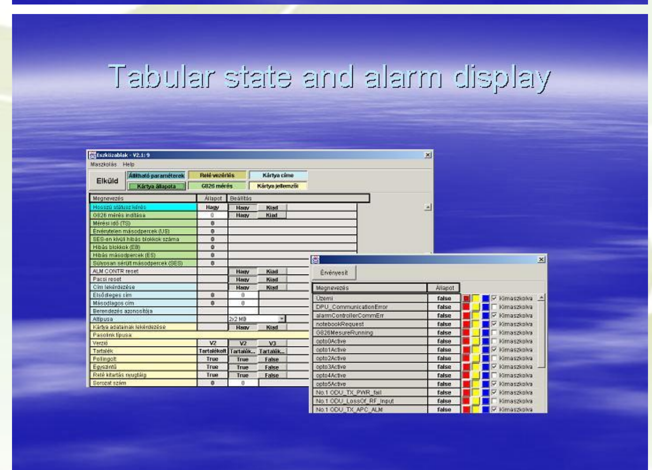
- Intelligents távközlési felügyeleti rendszer (LiNECom Ltd., supported by Ministry of Education, ~EUR 450.000)
- Internetes álláskereső és kináló rendszer (Solware Ltd., supported by Ministry of Education ~EUR 170.000)
- Intelligens közlekedési lámpairányitó rendszer, egyszerű kereszteződés, úthálózatok

Intelligens időjárásfigyelő alkalmazás (Mobil távközlés-felügyelet - Linecom Ltd.)

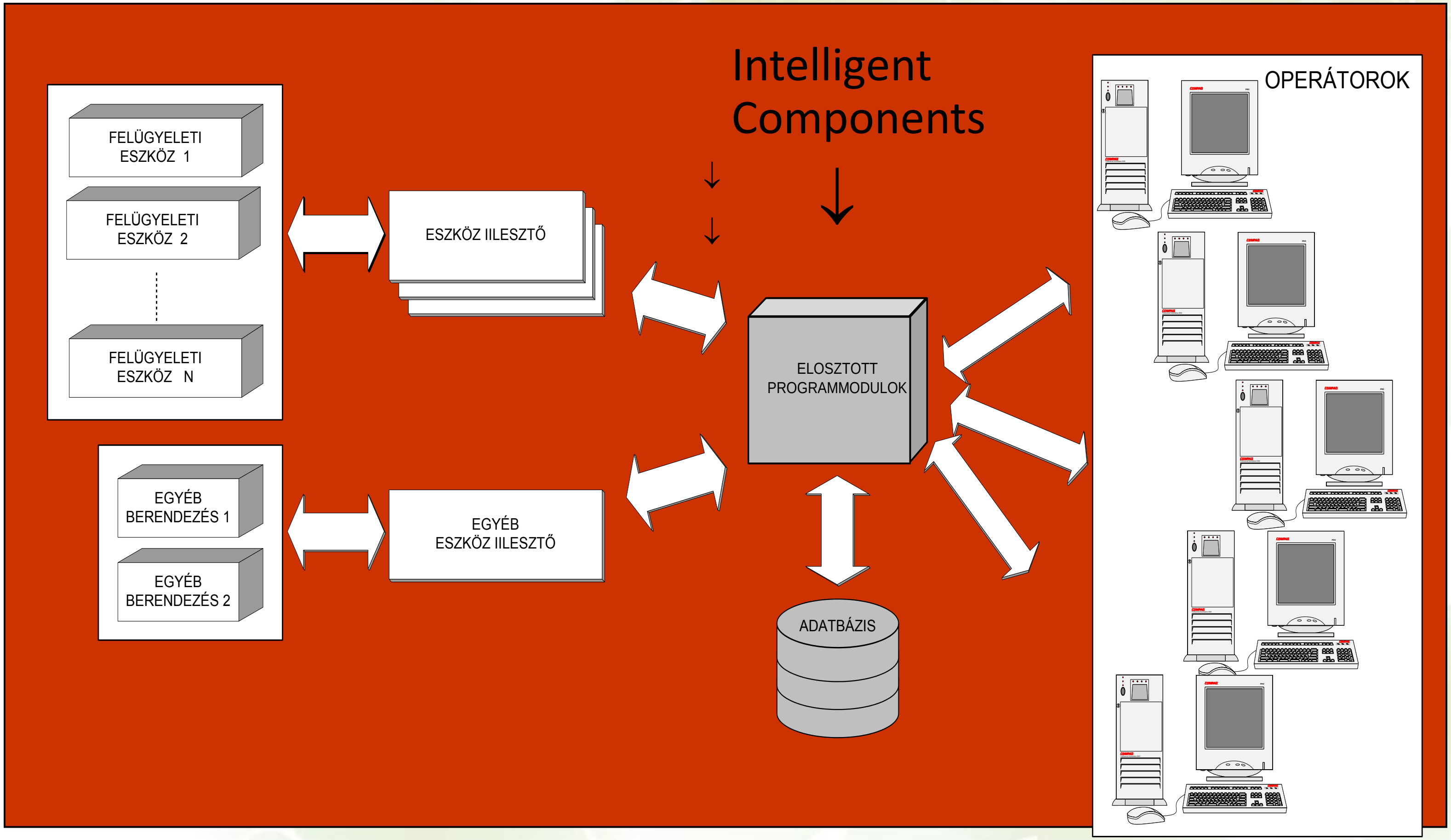








Rendszerstruktúra

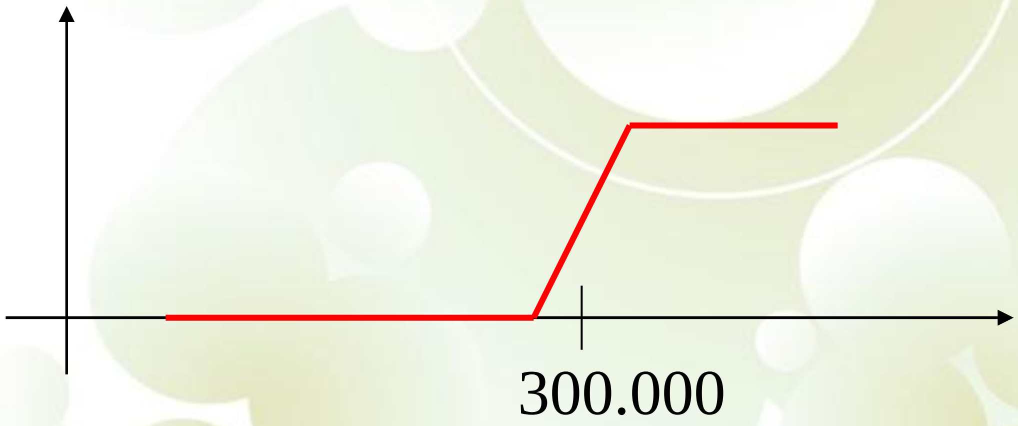


Intelligens álláskereső (Solware Ltd.)

- Arbitrary variety of hierarchically structured features is possible
- Degree of relevance, importance can be given by number or pictorial representation
- Various fuzzy connectives can be used for combination
- Verbal input is transformed into fuzzy membership functions

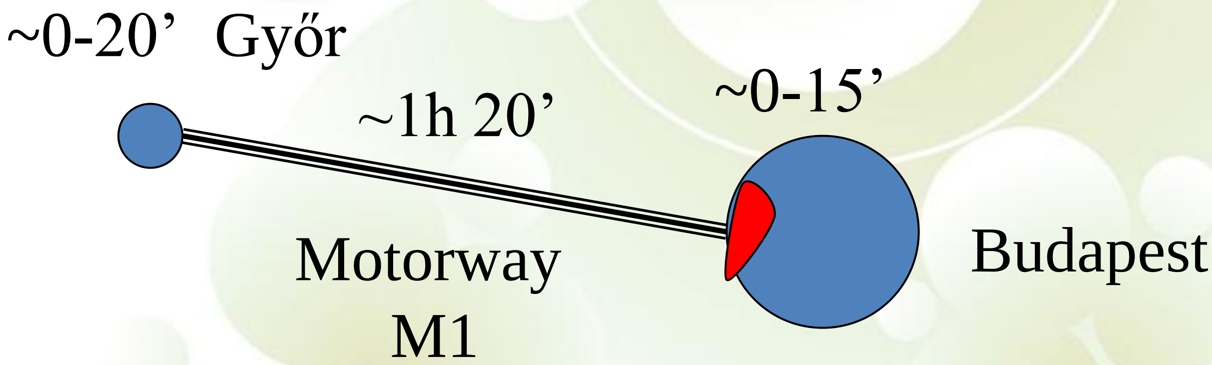
Példa

- "At least HUF 300.000/month expected"



Példa

- Applicant for job has zip code 96xx
- Job location has zip code 111x

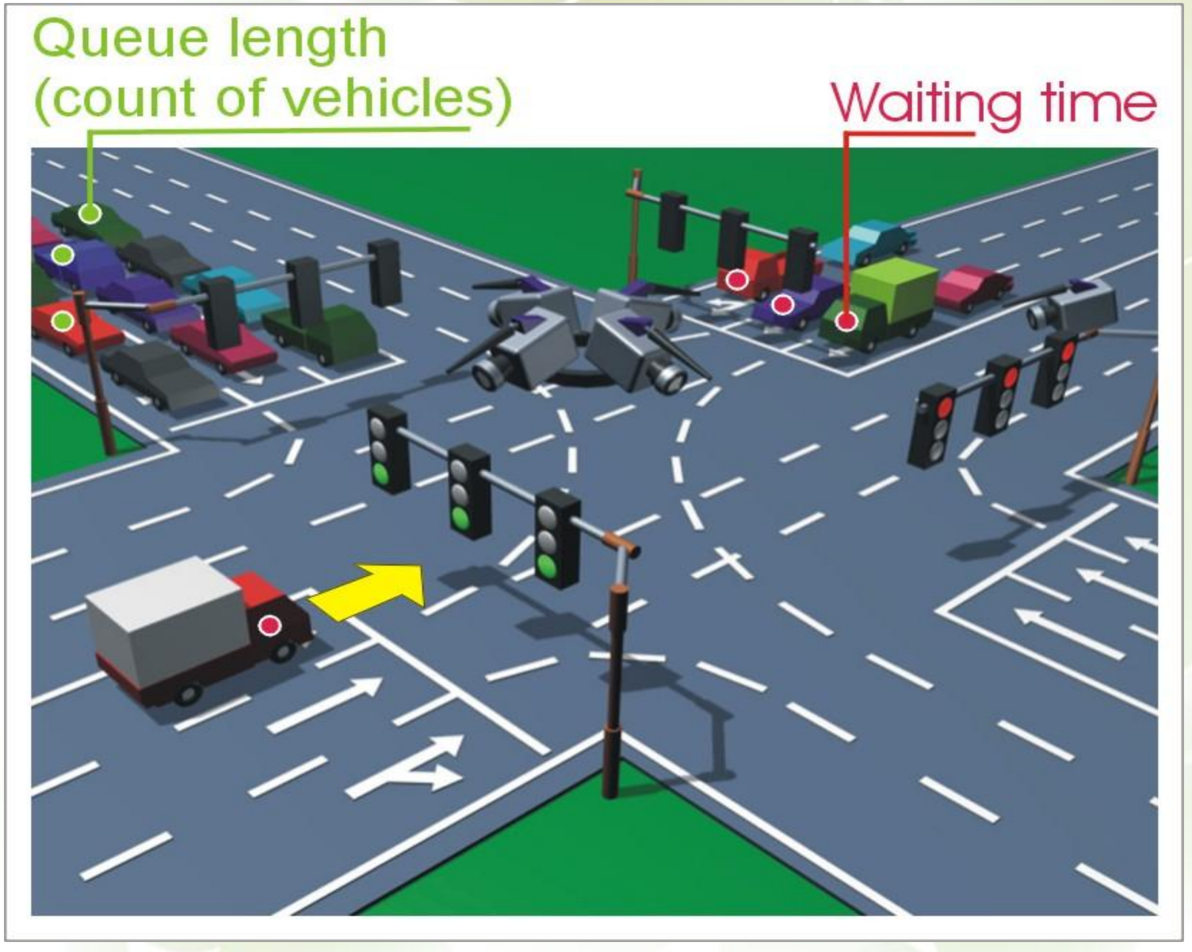


1h 20’- 1h 55’ = “quite far but daily commuting is possible”

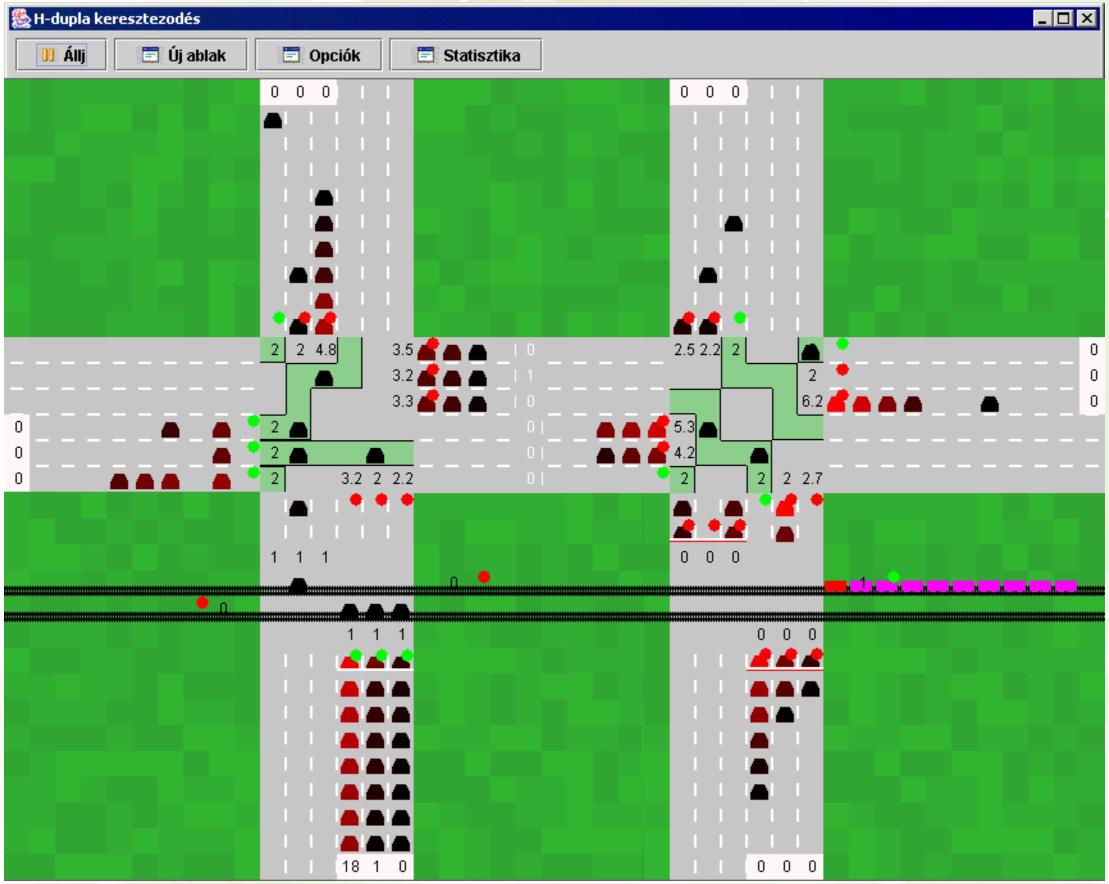
Forgalomirányitás

- Detecting traffic situation with sensors (e.g. camera, inductive loop)
- Determining proper action suitable for the traffic situation handling using available information
- Intervene using traffic lights or other tools

A szituáció

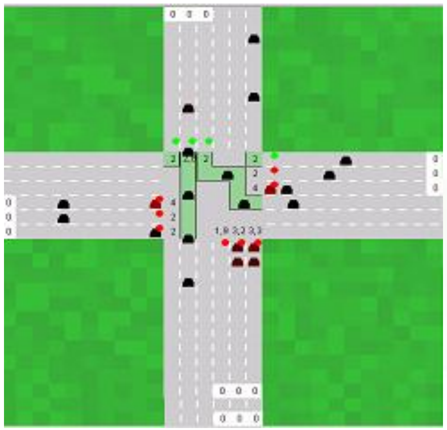


Első változat

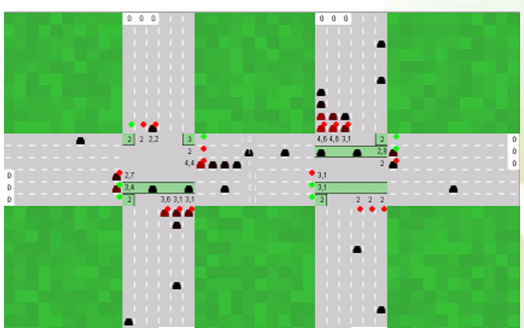


Különböző esetek

Road intersection



- complex intersection
- different lanes by direction



Road railroad intersection

- railroad has always priority
- High railroad traffic (suburb situations)

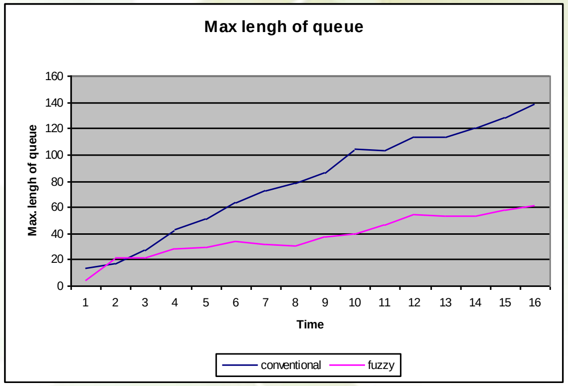
More, connected intersections

- very complex situations
- importance of using interpolative and hierarchical methods

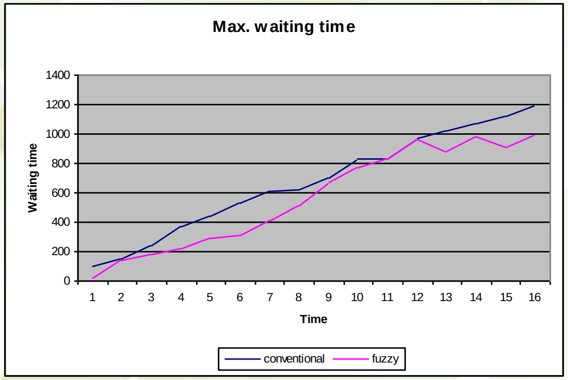
A hagyományos és a fuzzy irányitás összevetése

with high traffic distributed equally in the different directions

Maximum length of queues

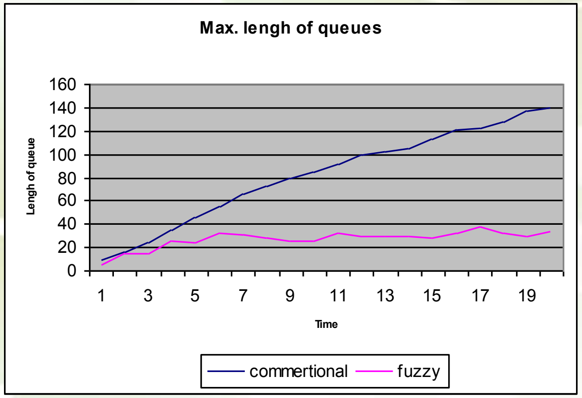


Maximum waiting time

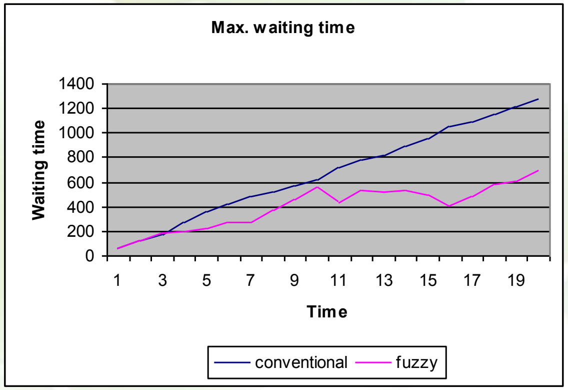


if the traffic is large in one particular direction

Maximum length of queues

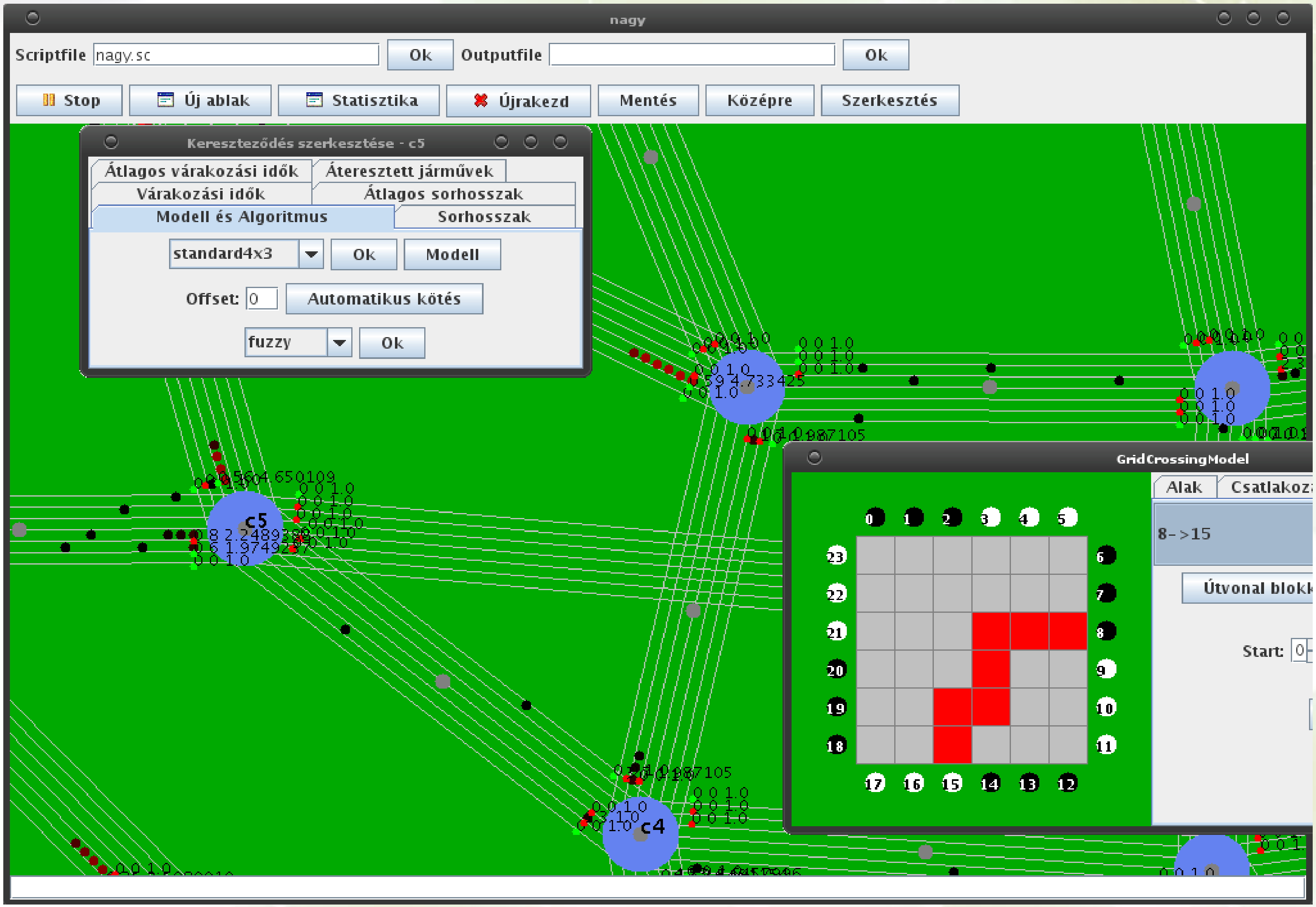


Maximum waiting time



Forgalomszimulátor (második verzió, M.Sc. Project, Hajdú)

- Graph based roadnetwork model
- Cellular automaton based road segments
- Online changeable traffic control per junction
- O-D matrix based traffic generation
- Maps stored in XML format
- Graphical User Interface
- Scriptable scenarios for programmed simulations
- Data visualization online or offline with JFreeChart

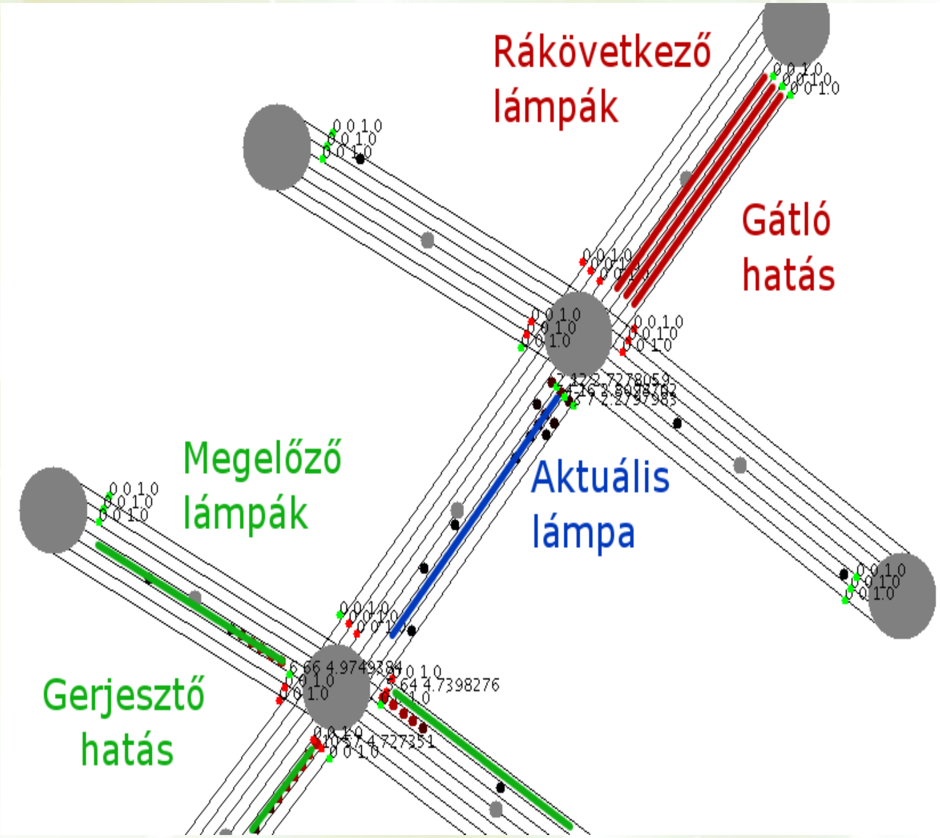

nagy
Scriptfile
nagy.sc
Ok
Outputfile
Ok
Stop
Új ablak
Statisztika
Újrakezd
Mentés
Középre
Szerkesztés
Kereszteződés szerkesztése - c5
Átlagos várakozási idők
Áteresztett járművek
Várakozási idők
Átlagos sorhosszak
Modell és Algoritmus
Sorhosszak
standard4x3
Ok
Modell
Offset:
0
Automatikus kötés
fuzzy
Ok
c5
c4
GridCrossingModel
Alak
8->15
Start:

Problems

- Local information is not sufficient
- Detecting traffic congestion
- Creating green waves is a target
- Priority handling (vehicles, routes)
- Handling of the pedestrian traffic lights
- Utilizing the timing component of the traffic control

Effects of the sorrounding junctions

- Traffic light's importance is affected by nearby traffic lights' traffic
- Adjacent junctions share information with communication



Egy érdekes és komplex alkalmazás Intelligens robotok kontextusfüggő fuzzy kommunikációja (Gedeon, ANU és Ph. D. téma, Ballagi)

- Emberek közötti kommunikáció
- Kevés informécióból sok minden rekonstruálható
- Hasznos lehet ennek a kiterjesztése ember-gép és gépek közötti kommunikációra is

Mi a fuzzy kommunikáció?

- Ellentmondó értelmezések:
  - A pontos információk hiánya: akár katasztrofális félreértések
  - LIFE: használjunk fuzzy elemeket a hatékony és gyors kommunikáció céljából

Negative példa (The University of Montana Rural Institute, Flaherty)

- *Ernie, az új igazgató zártkörűvé nyilvánitja a pénzügyi kérdések tárgyalását és megtiltja az igyen kávé és pogácsa biztositását a cégnél*

- *Thelma, az egyik igazgatóhelyettes arra gondol, hogy a cég pénzügyi helyzete megromlott*

Negativ példa

A hiányzó hiteles információ helyét feltételezések és félelmek töltik be, ami téves következtetésekhez vezet

Pozitiv példa (LIFE, Terano & al.)

- Director Tanaka receives a new secretary, Ms. Sato, on Monday. When Mr. Tanaka returns from lunch, he calls Ms. Sato and the next conversation follows:
  - *'Ms. Sato, I would like to have a cup of tea.'*
  - *'Yes, Mr. Tanaka. Do you prefer hot or cold tea?'*
  - *'Hot tea, please.'*
  - *'Do you prefer black or green tea?'*
  - *'Give me black tea.'*
  - *'Do you need sugar?'*
  - *'No sugar, please.'*
  - *'Any milk to the tea?'*
  - *'No, thank you.'*

- So, Ms. Sato prepares the tea according to the request.

LIFE példa

- On Tuesday, after lunch the director calls Ms. Sato again.
  - *'May I have a cup of tea?'*
  - *'Yes, Mr. Tanaka. Black tea, again?'*
  - *'Yes.'*
  - *'No sugar, no milk?'*
  - *'Exactly as you say.'*

- Now fewer questions led to the same action by the secretary.
- On Wednesday, when Mr. Tanaka arrives, he does not say anything but
  - *'May I?'*
  - *'The usual tea?'*
  - *'Yes.'*
- On Thursday, when the director comes in after lunch, Ms. Sato asks him:
  - *'May I prepare your usual tea?'*
  - *'Yes, thank you.'*

LIFE példa

- One day Mr. Tanaka arrives from lunch and Ms. Sato asks the everyday question:
  - *'May I prepare your usual tea?'*
- This time the answer is:
  - *'No, today I prefer coffee.”*
  - *'Do you drink it long or short?”*
  - *'Short please.'*
  - *'Any sugar?'*
  - *'No, thank you.'*
  - *'Any milk?'*
  - *'Yes, some milk, please.'*

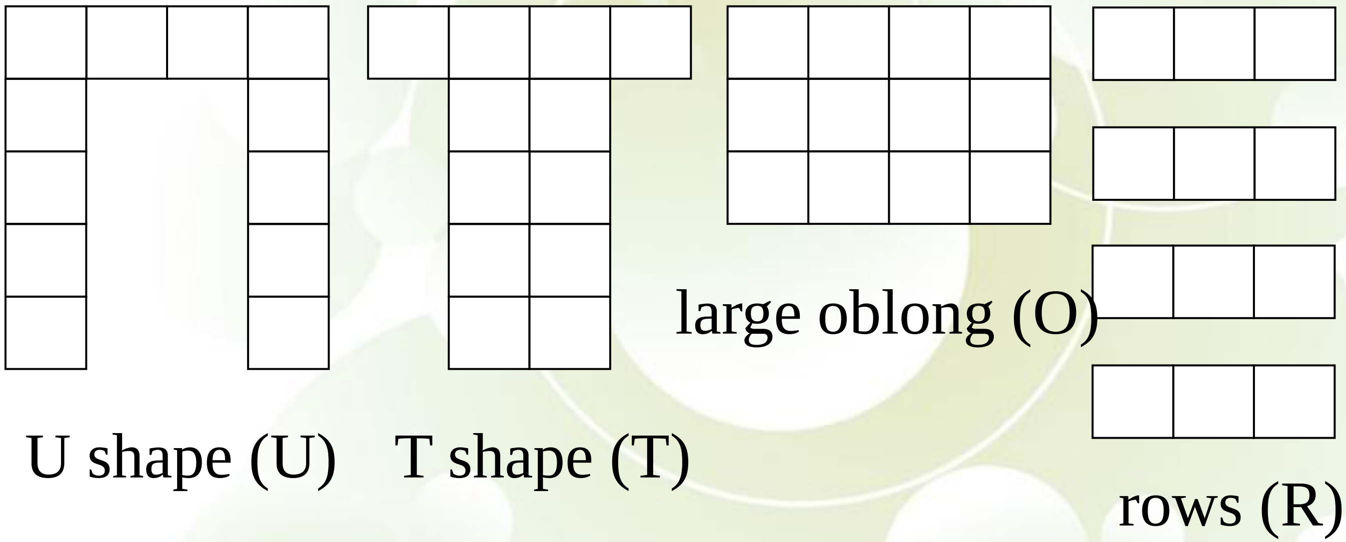
LIFE példa

- Another time Mr. Tanaka requests a glass of mineral water after drinking his (otherwise not too frequent) cup of coffee. This brings in a third option in the codebook of Ms. Sato, concerning cold drinks after lunch (and possibly after the coffee).
- The codebook might never be completed, it should be continuously adapted.

Scenario (LIFE)

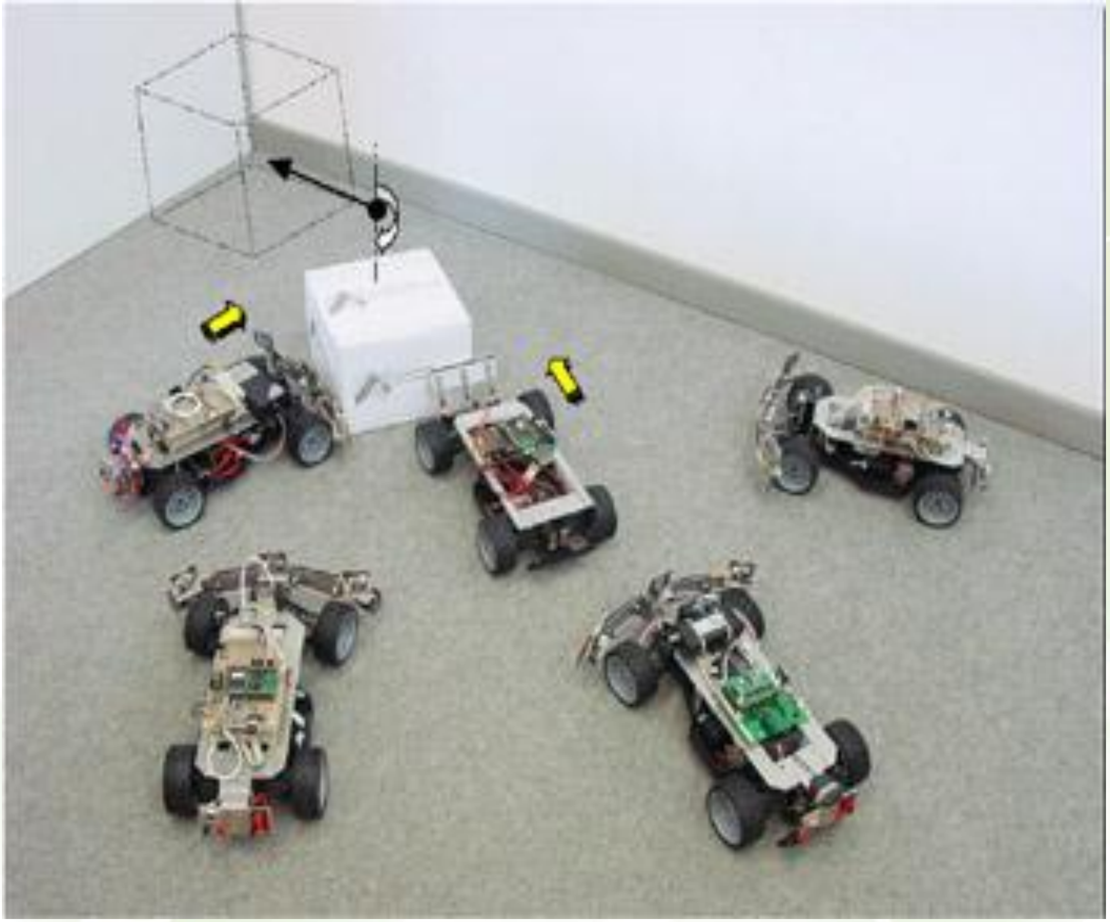
Viszlát, Ms. Sato…

Asztalok rendezése (LIFE)



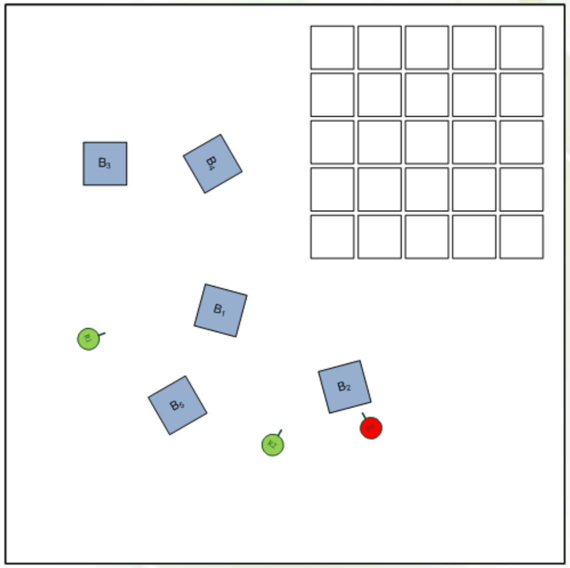
- directions are described by N, E, S, W
- the sides of the tables are always parallel with the N-S and E-W axes

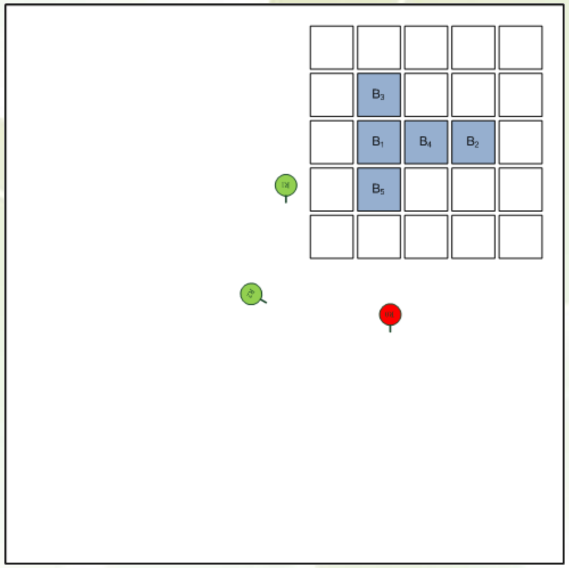
Kooperáló intelligens robotok



Hogyan gondolkoznak a robotok?

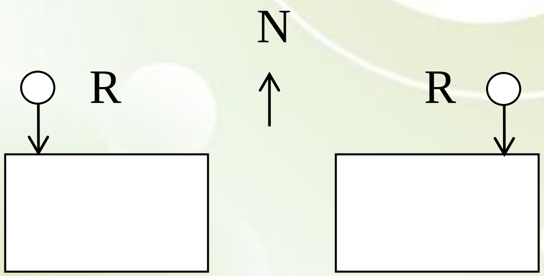
- The group of autonomous intelligent mobile robots are supposed to solve transportation problems according to the exact instruction given to the Robot Foreman (R_0). The other robots have no direct communication links with R_0 and all others, but can solve the task by intention guessing from the actual movements and positions of other robots, even though they might not be unambiguous.



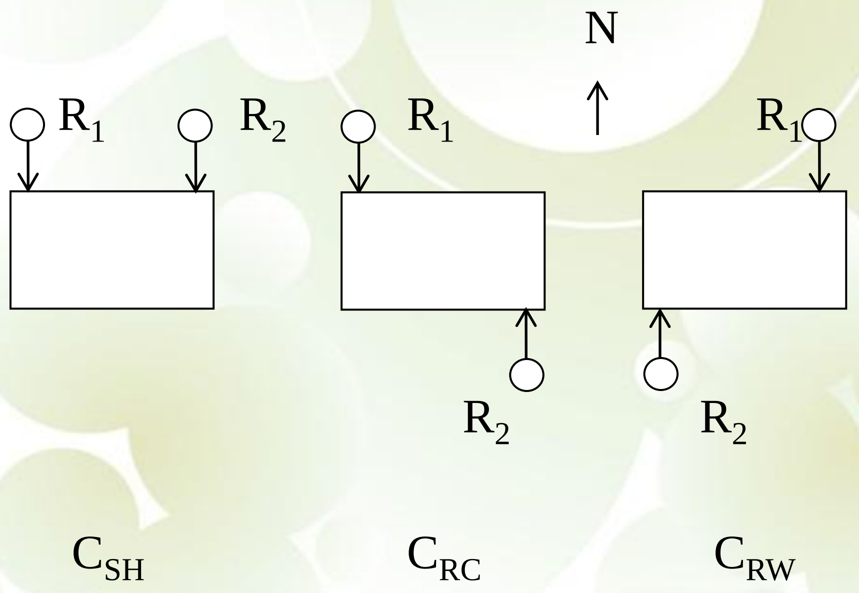


Robot-helyzetek

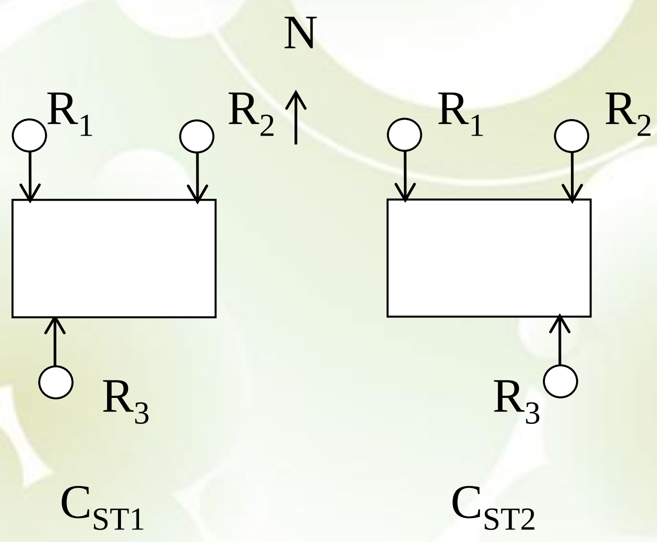
- two robots are needed for pushing or turning a table
- at each side of the tables, two spaces are available for the robots manipulating them
  - P_{CC}: “counterclockwise position”
  - P_{CW} stands for “clockwise position”
  - R denotes the robot in question



- three essentially different combinations:
  - C_{SH}: “shifting combination”, when two robots (R_1 and R_2) are side by side at the same side of the table
  - C_{RC}: “counterclockwise rotation combination”
  - C_{RW}: “clockwise rotation combination”

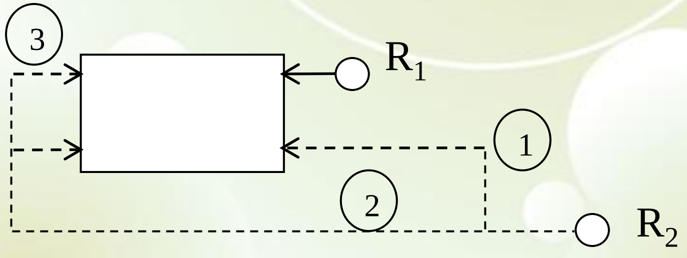


- C_{ST1} and C_{ST2} are both essentially three robot combinations, where either R_1 and R_2 are attempting a shift and R3 positions itself to prevent it, or R_2 and R_3 / R_1 and R_3 are starting a rotation and R_1 and R_2 prevent it, knowing that the intended move is wrong from the point of view of the goal configuration

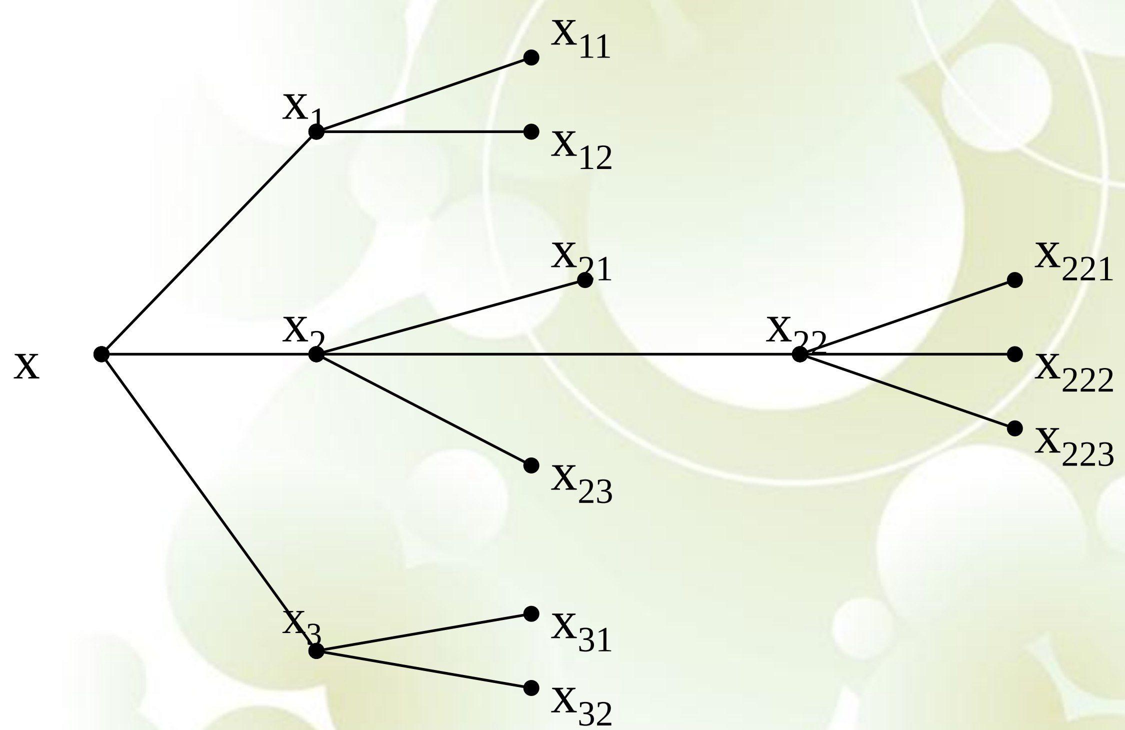


Hogyan épül a robotok tudástára?

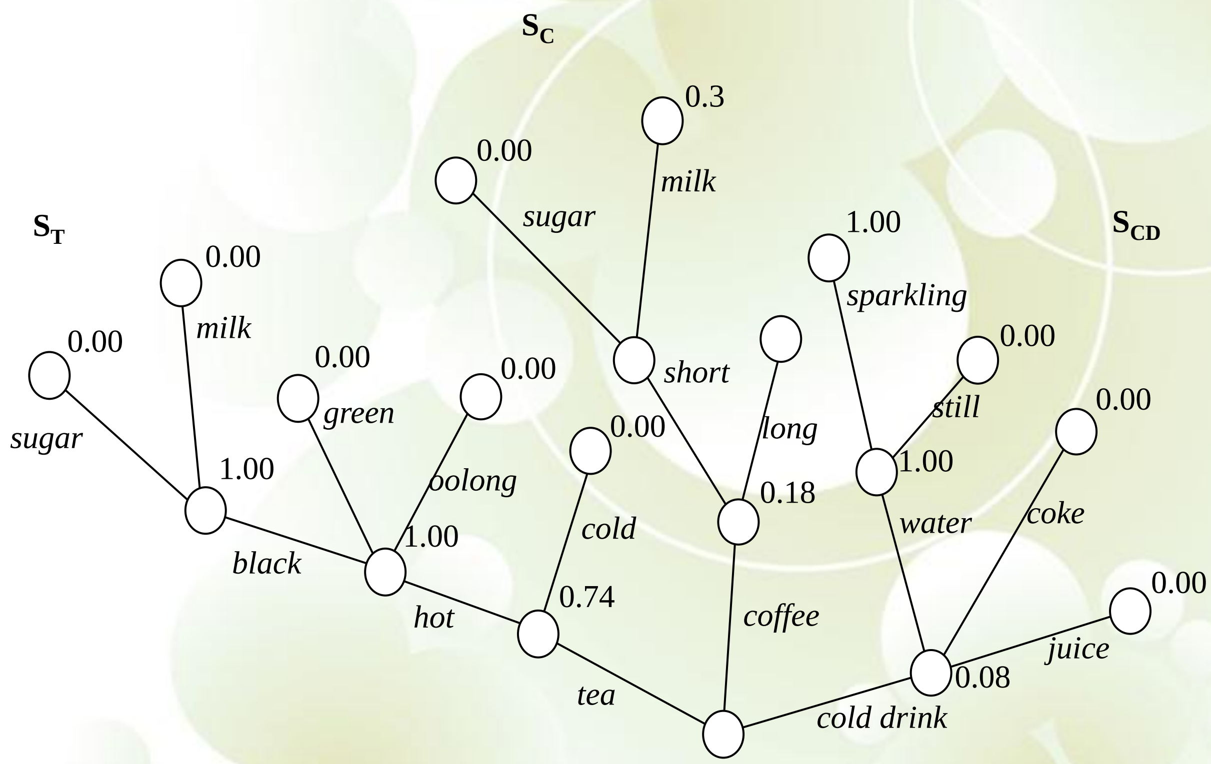
- Example:
  - a robot (R_1) is taking up a P_{CC} position at the East side of a table
  - robot (R_2) is the nearest free robot that will go to the same table to help



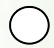
A használt matematikai elem: fuyzzy szignatúra



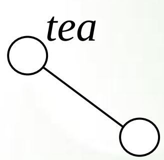
Ms. Tanaka tudástára



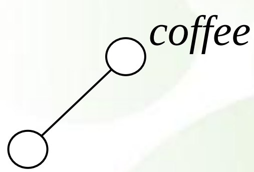
Communication elements in the Tanaka scenario



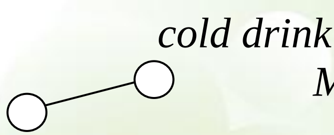
Mr. Tanaka arrives after lunch



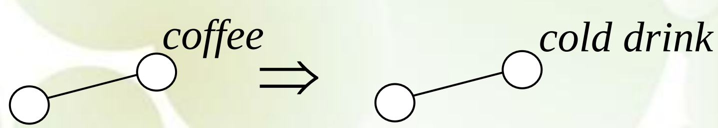
Mr. T. requests tea



Mr. T. requests coffee

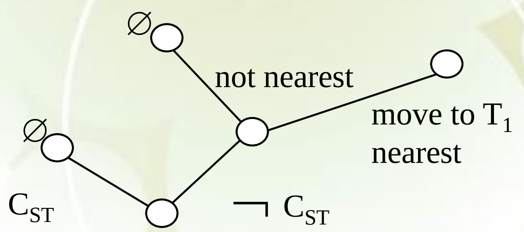


Mr. T. requests a cold drink (water)

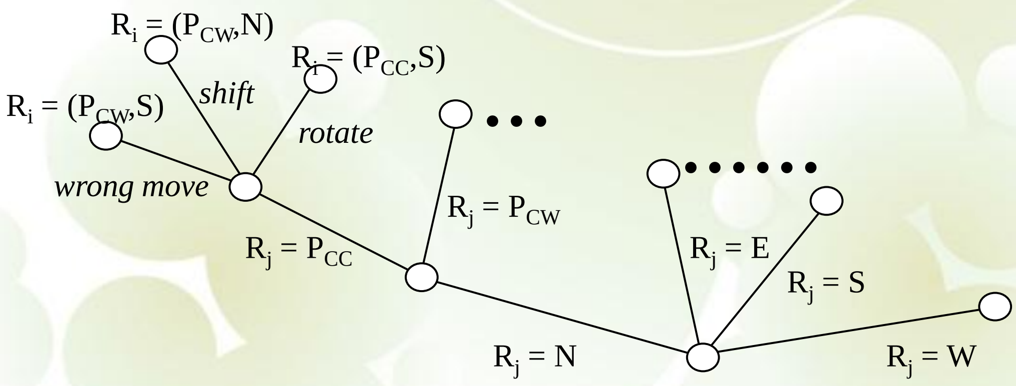


A robotok tudástára

decision tree for R_i when R_j has taken up position P_k at table T_l:

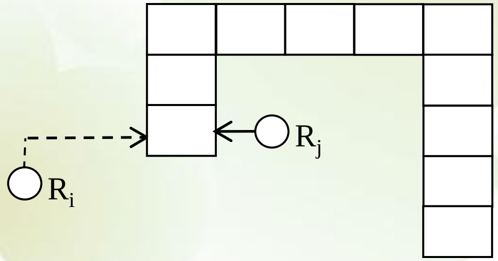


some signatures for R_i depending on R_j's position P_k at table T_l:



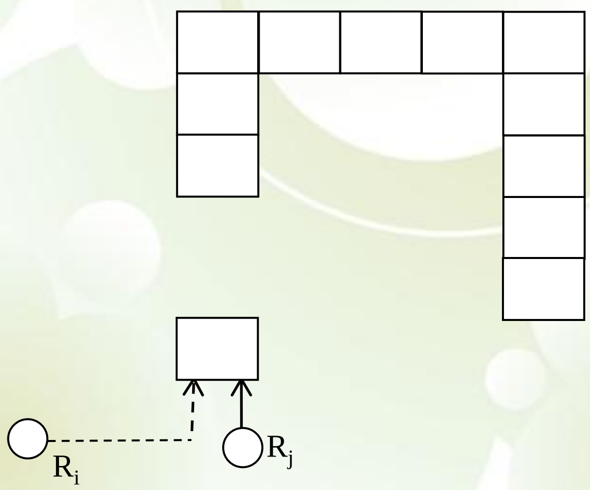
Robotos példa

- The actions of R_i are described by membership degrees
  - μ_{St} (Stop combination)
  - μ_{Sh} (Shift combination)
  - μ_{Ro} (Rotate combination)
- if R_j very likely prepares to destroy an almost ready "U" configuration, then R_i will raise the membership degree μ_{St} high (e. g. to 0.8), and lower the other two (to 0.1 each). Then it will follow the most likely good action and take up the position (W, P_{CC}) for stopping the erroneous action.



Másik példa

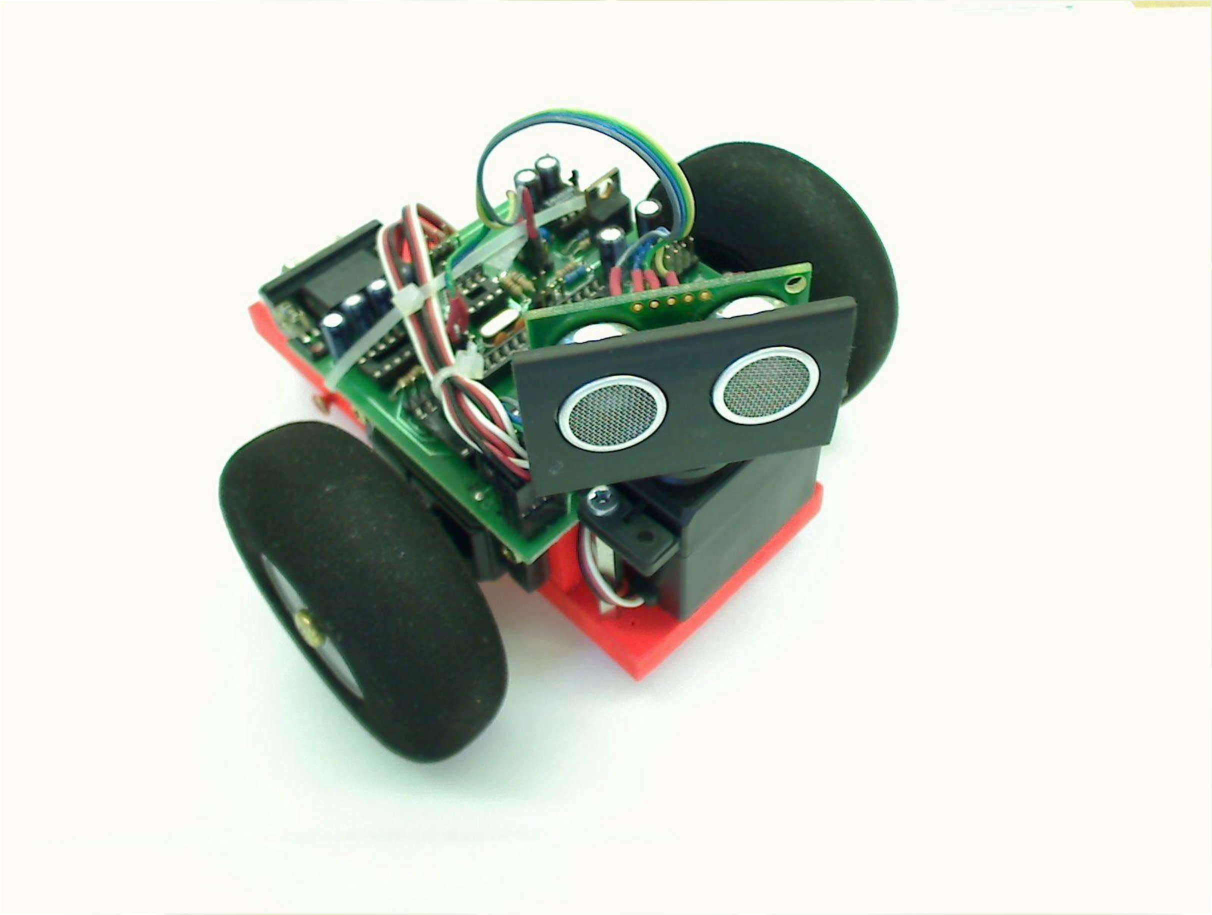
- a likely good move is increasing the degree of the likeliness of the Shift move
- R_i will move to (S,P_{CW}) at the table in question.



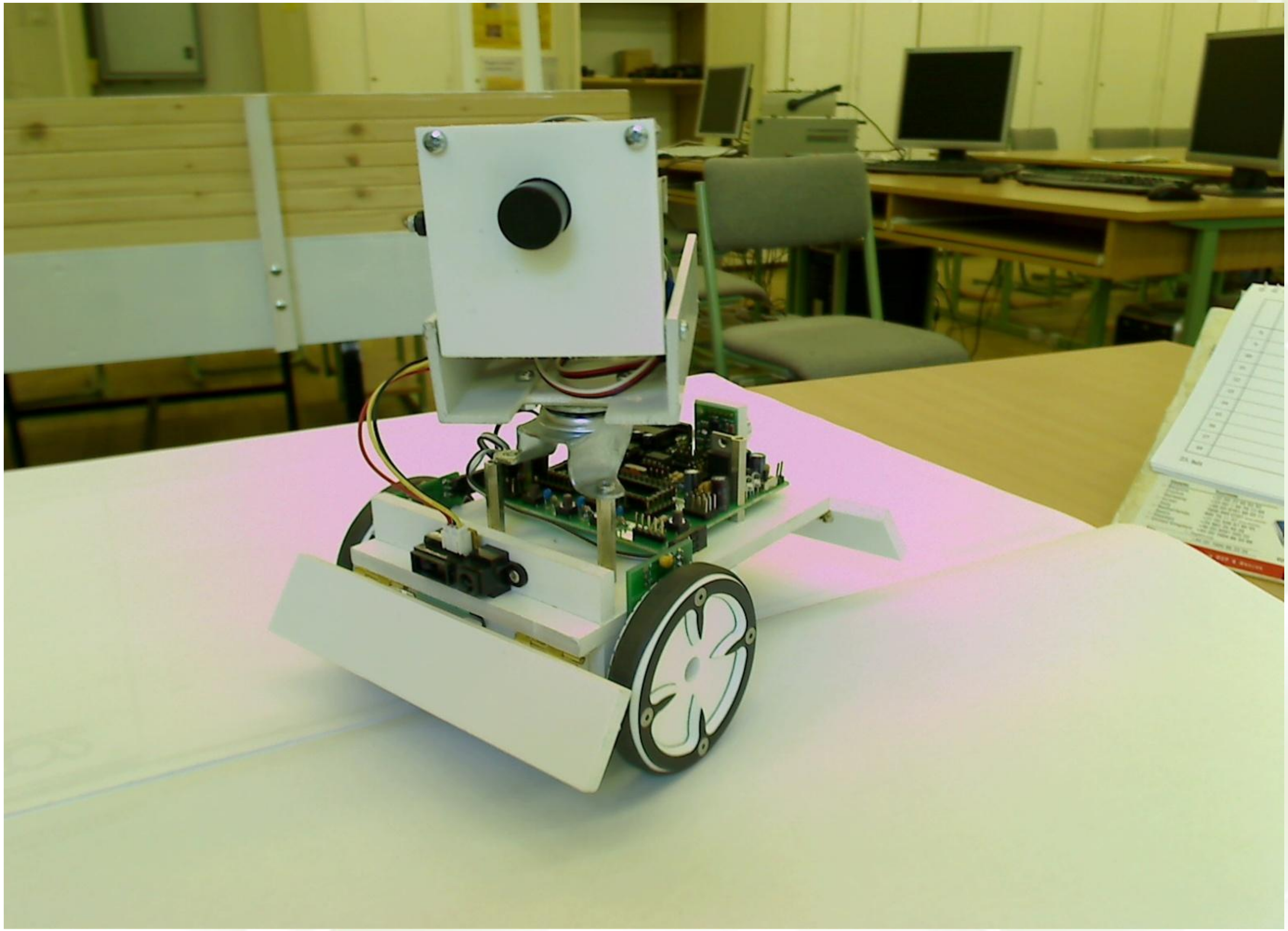
Hardver robotos kisérletek

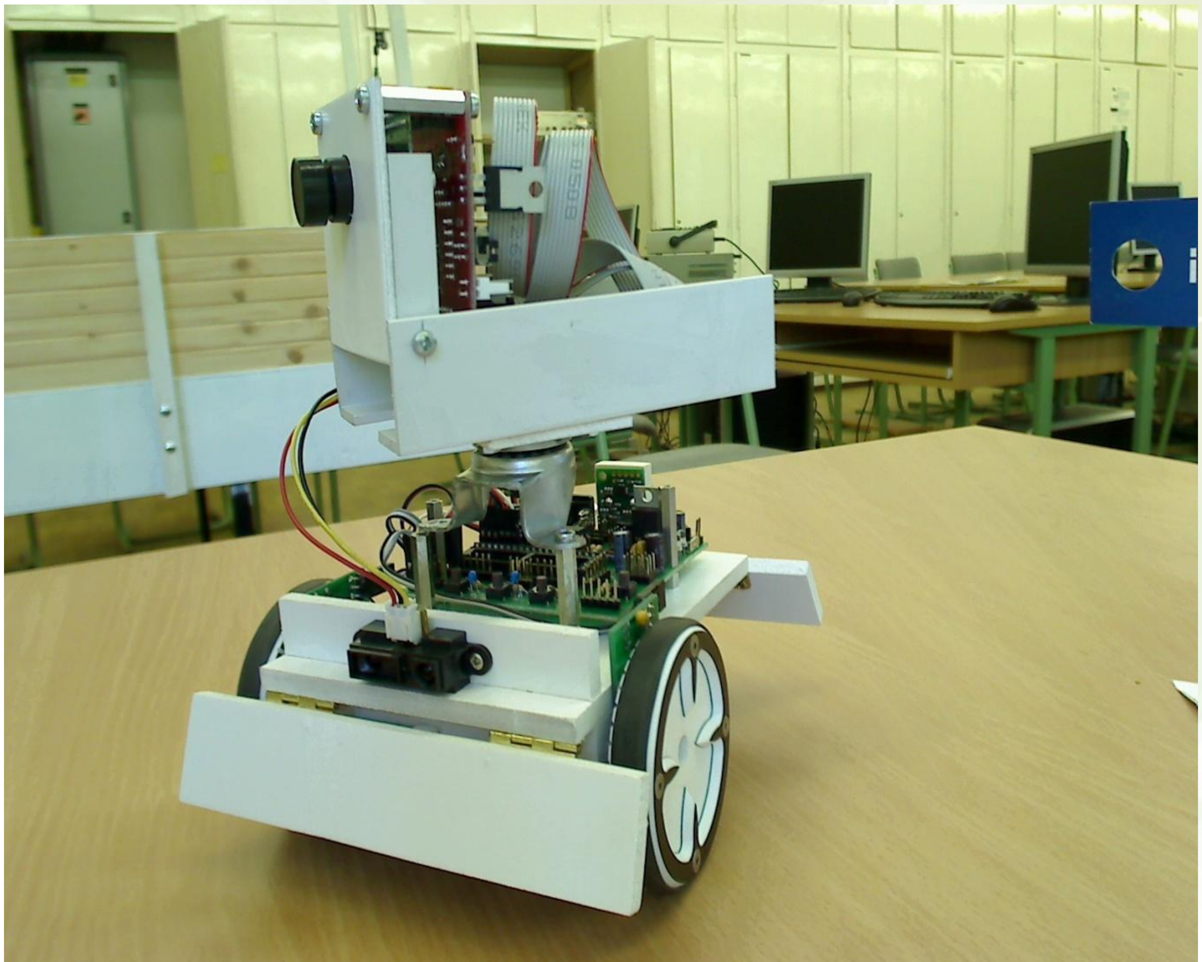
- Speciális kis robotokat épitünk
- Kész robotokat is használunk
- Csak most kezdtük...

Első robot

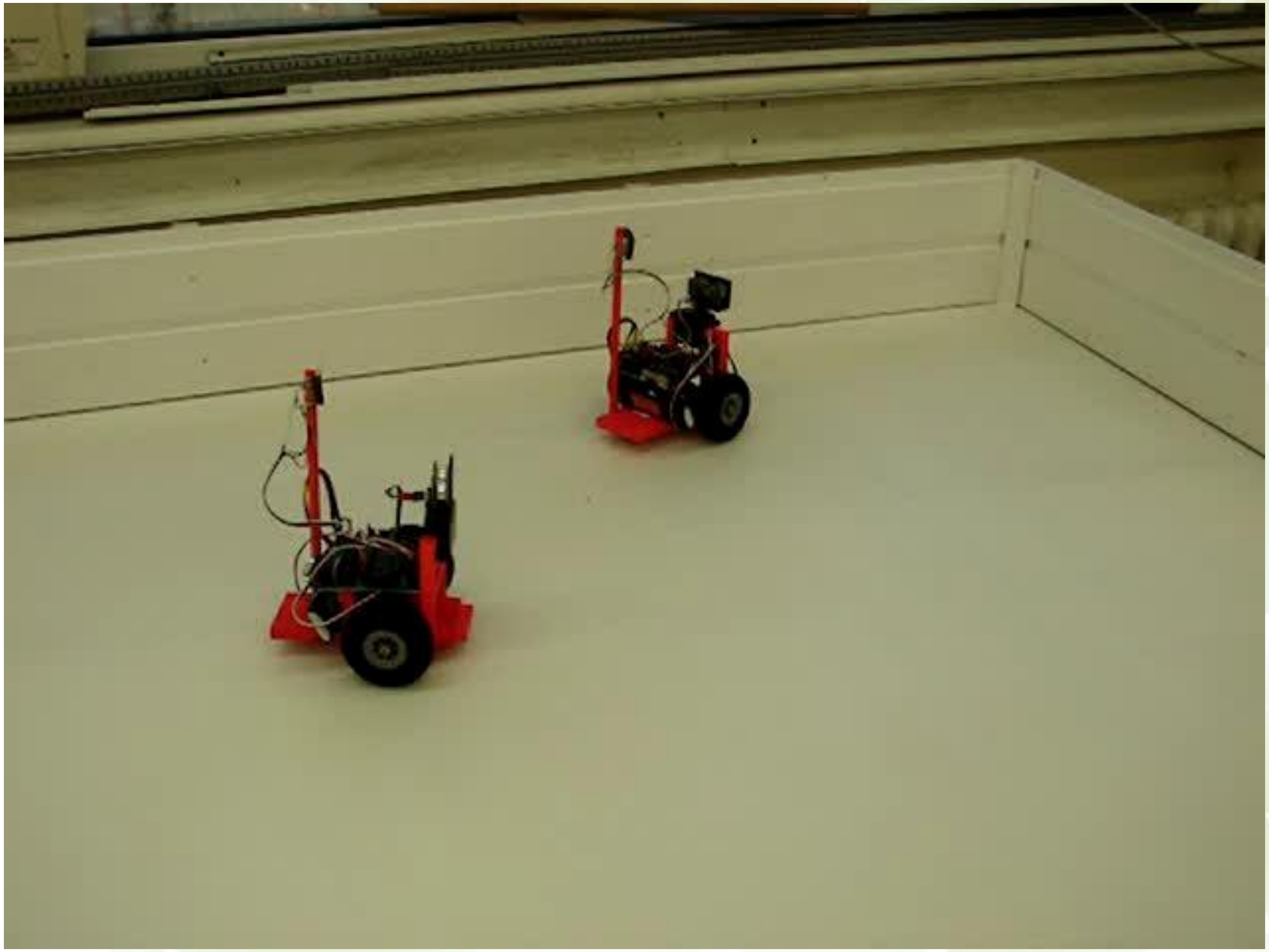


Második robot

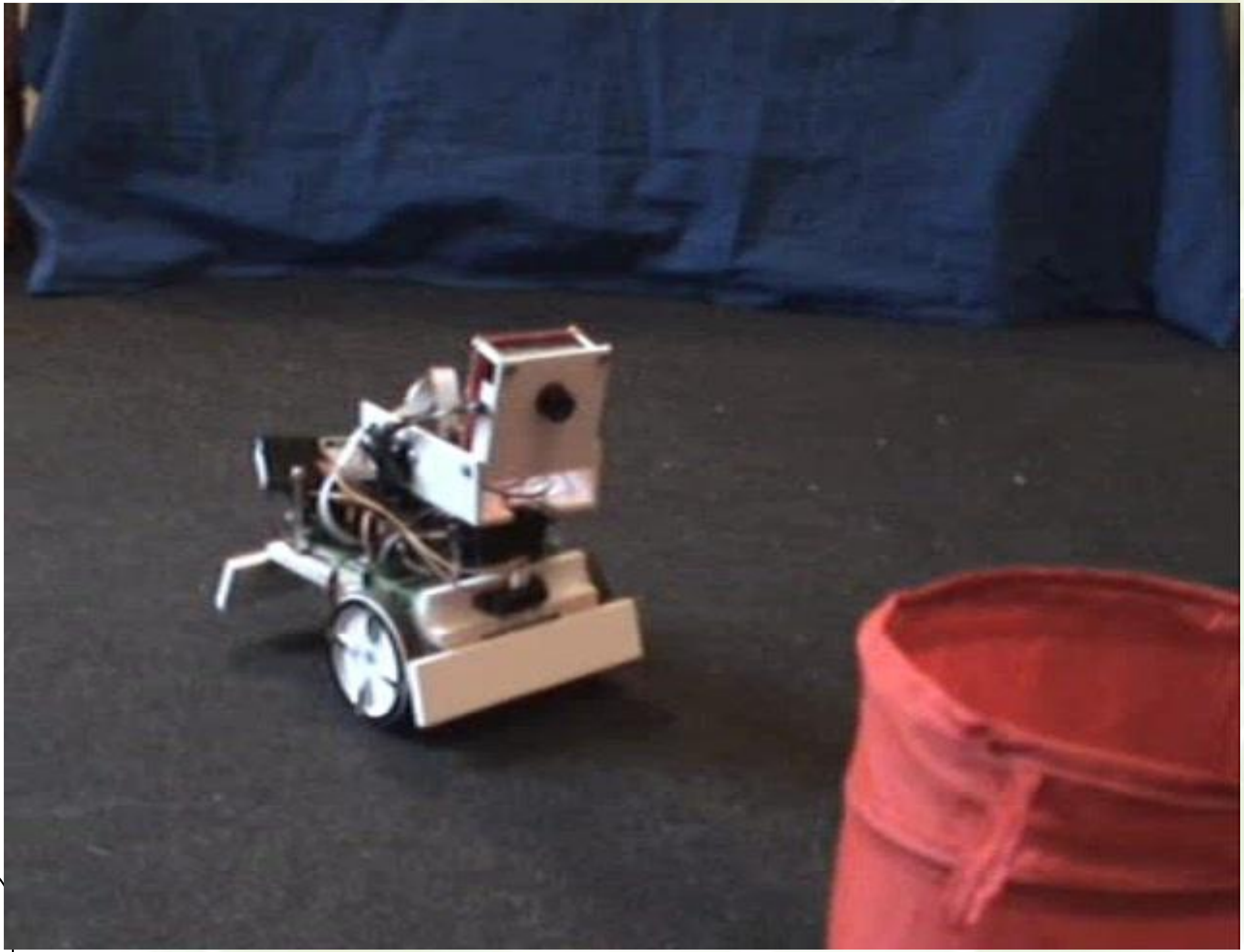




Akadályelkerülés

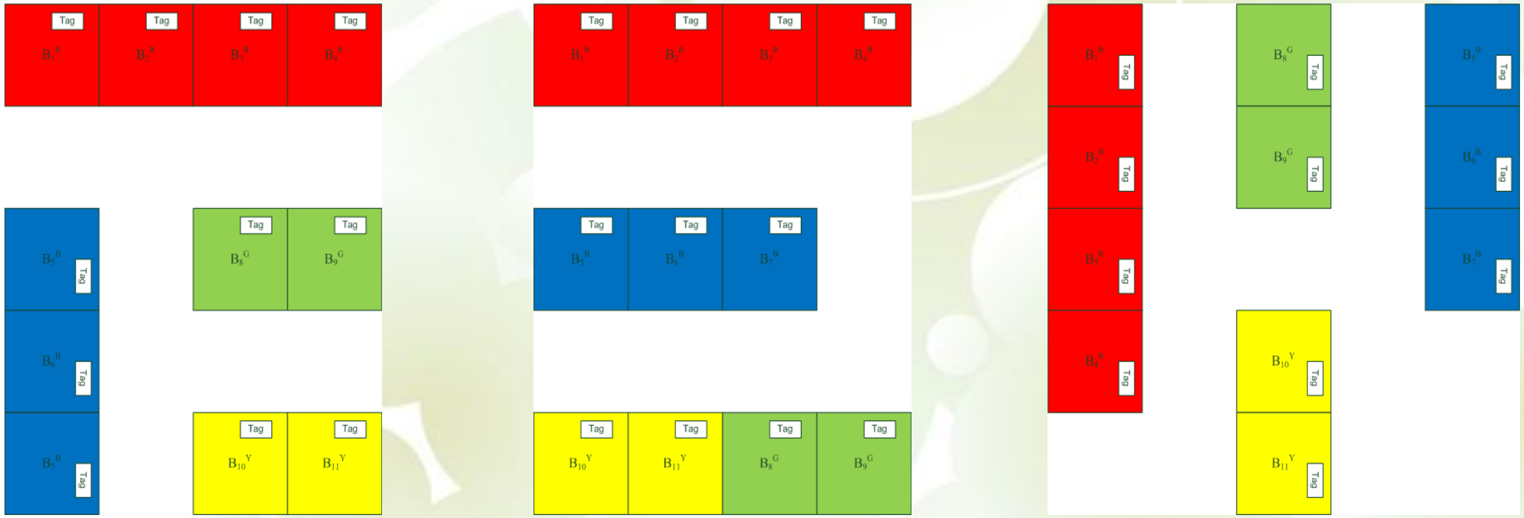


Szinfelismerés



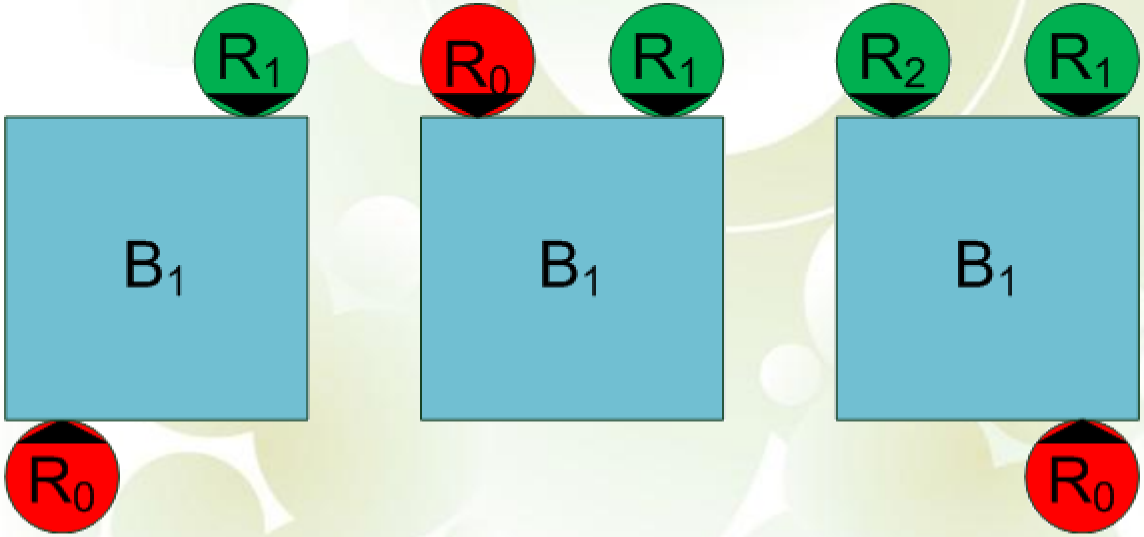
Példák ládák elrendezésekre

- The base idea of this example has come partly from LIFE and from real industrial problems.
- There is a warehouse where some square boxes wait for ordering. Various configurations can be made from them, based on their color and tags.

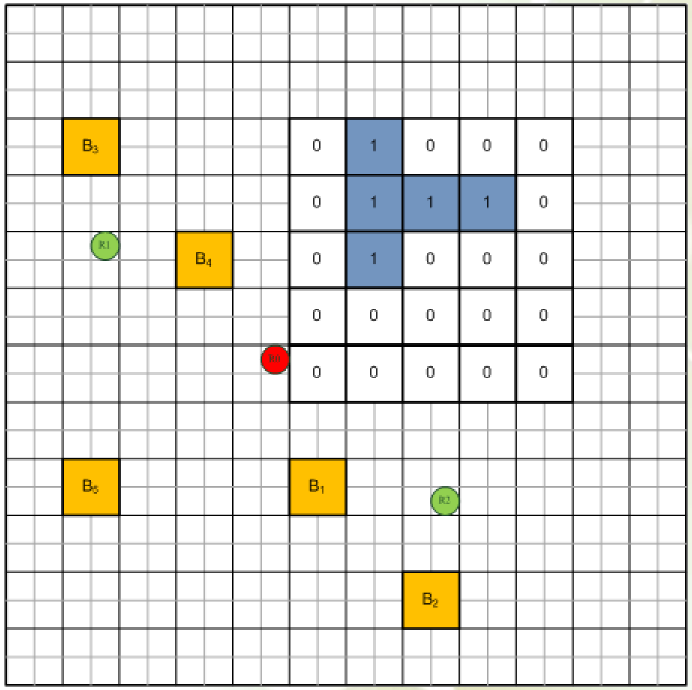


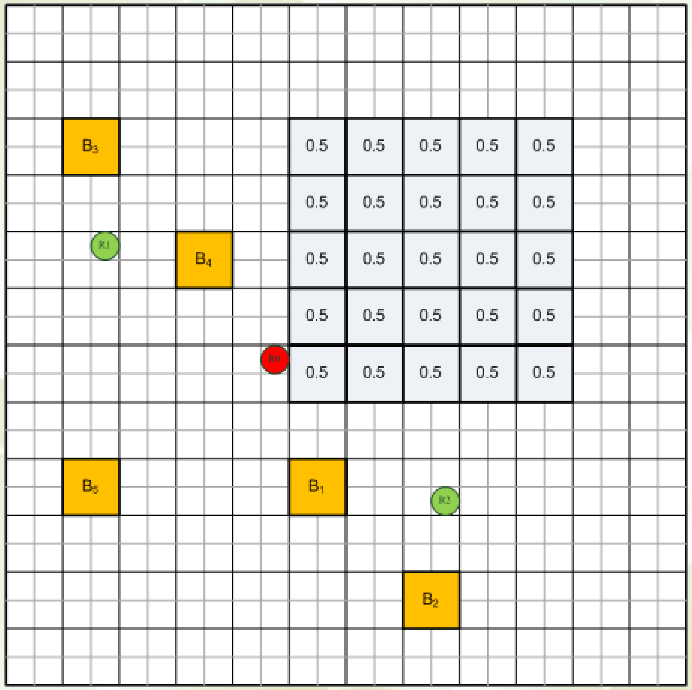
Robotkombinációk

- Eltolás és forgatás

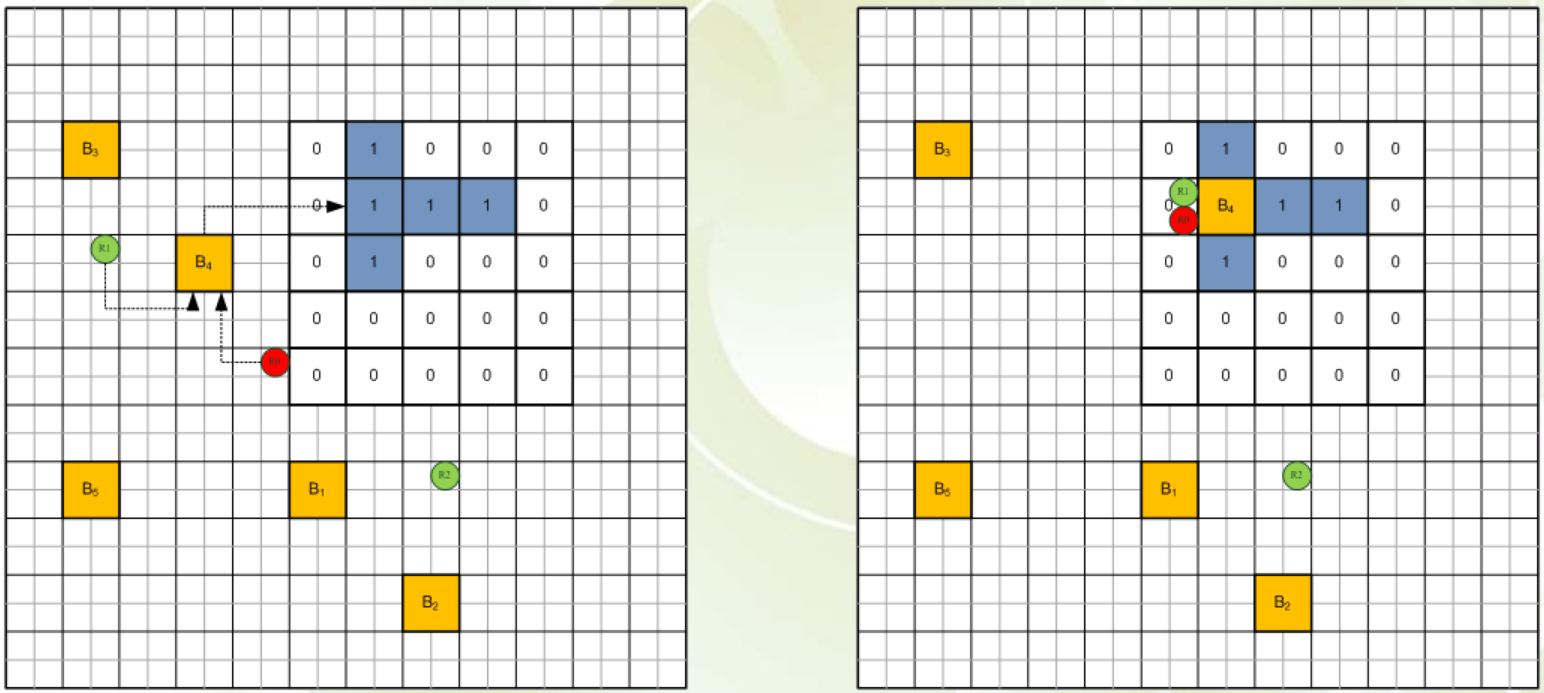


A robotok fuzzy gondolkodása



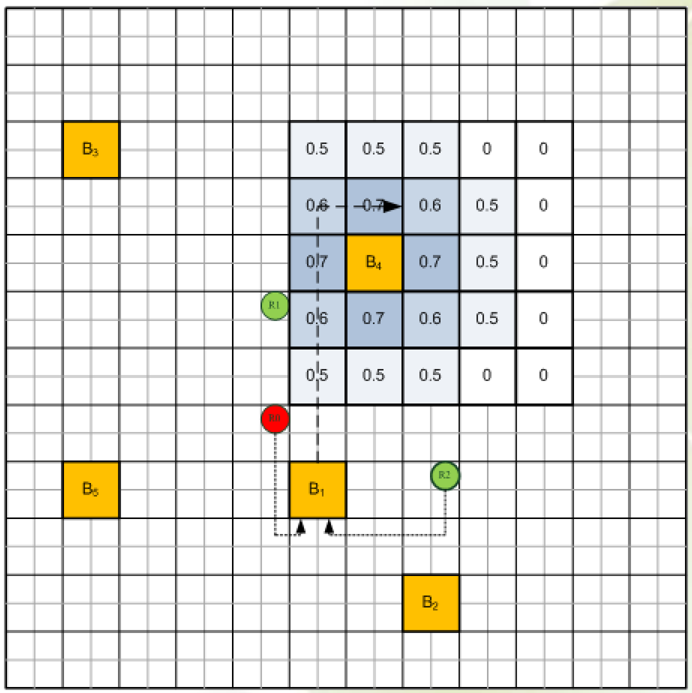


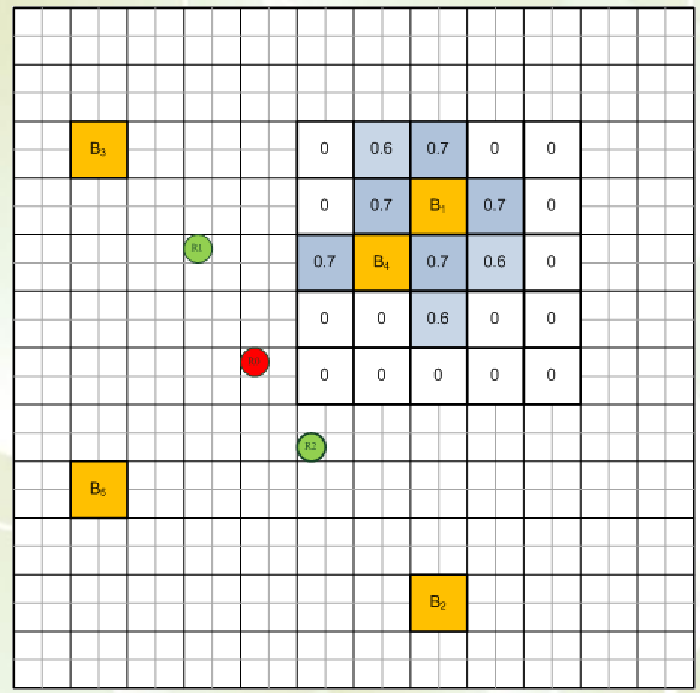
Hogy módosul a robotok „agya”?



Széchenyi Tudományos Est

Széchenyi István Egyetem
Tudásmenedzsment Központ





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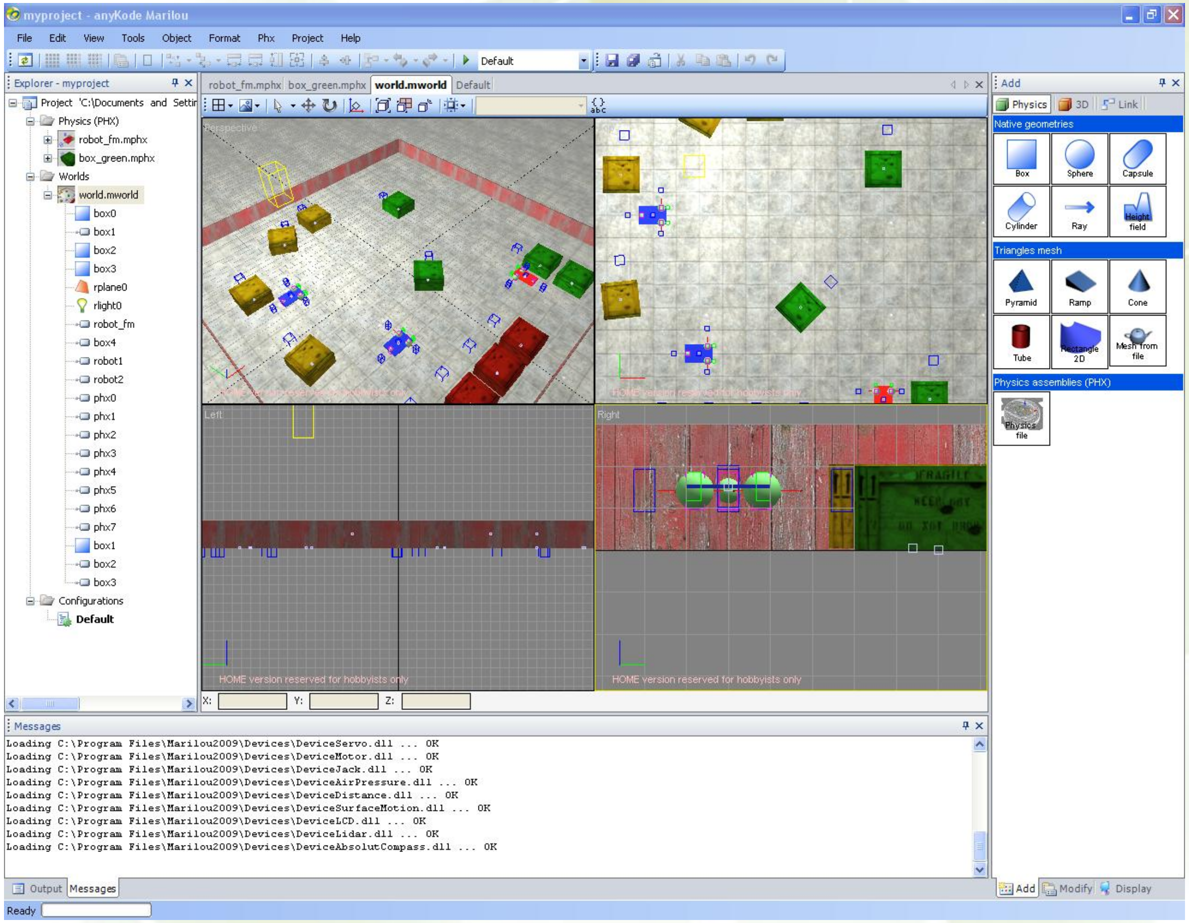
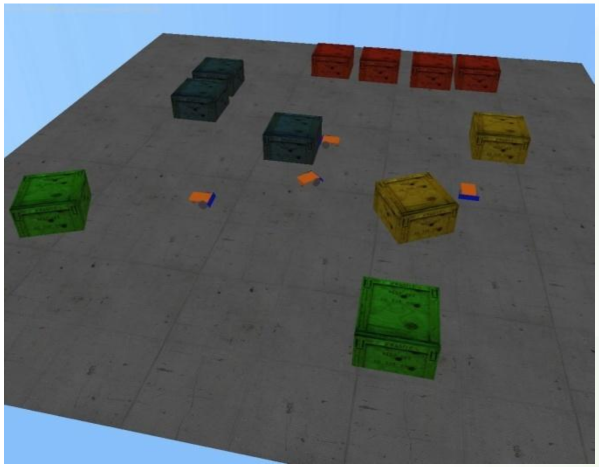
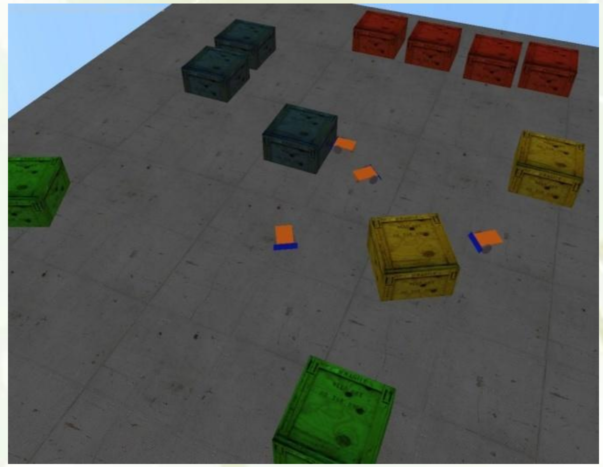
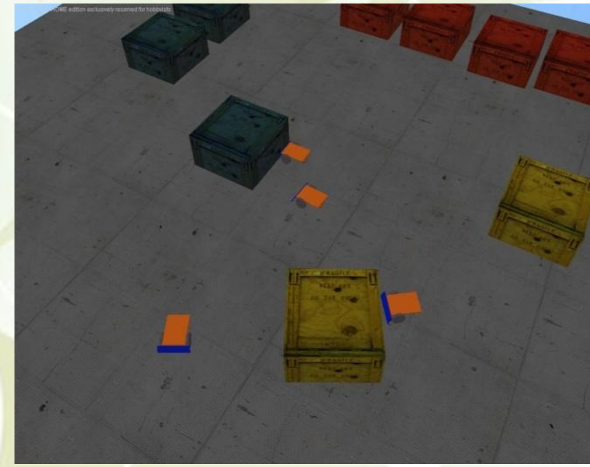
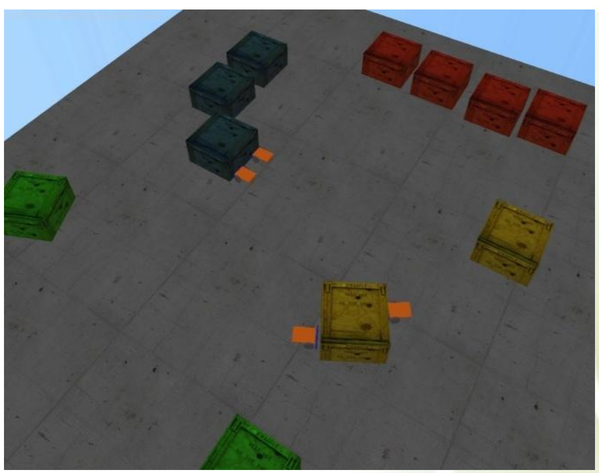
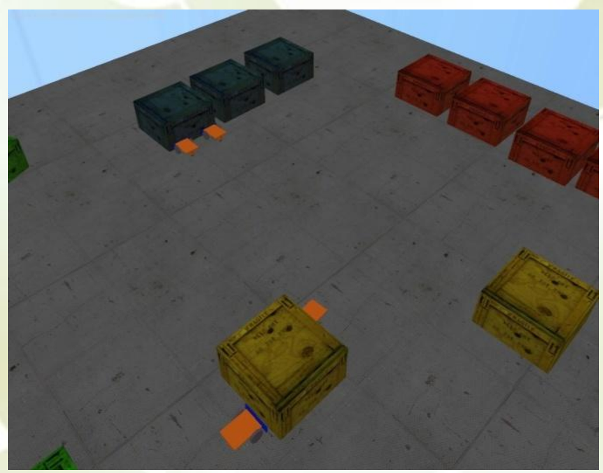
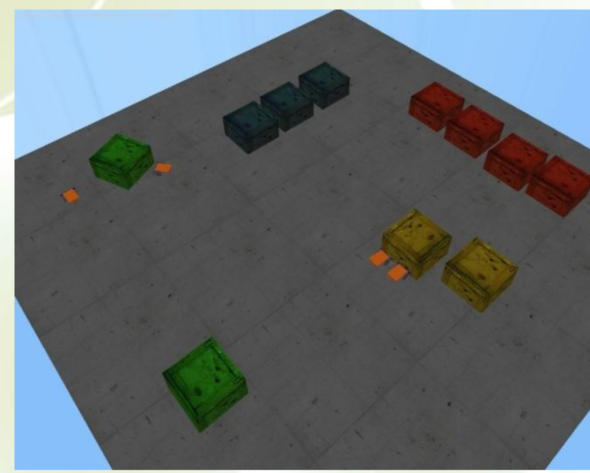
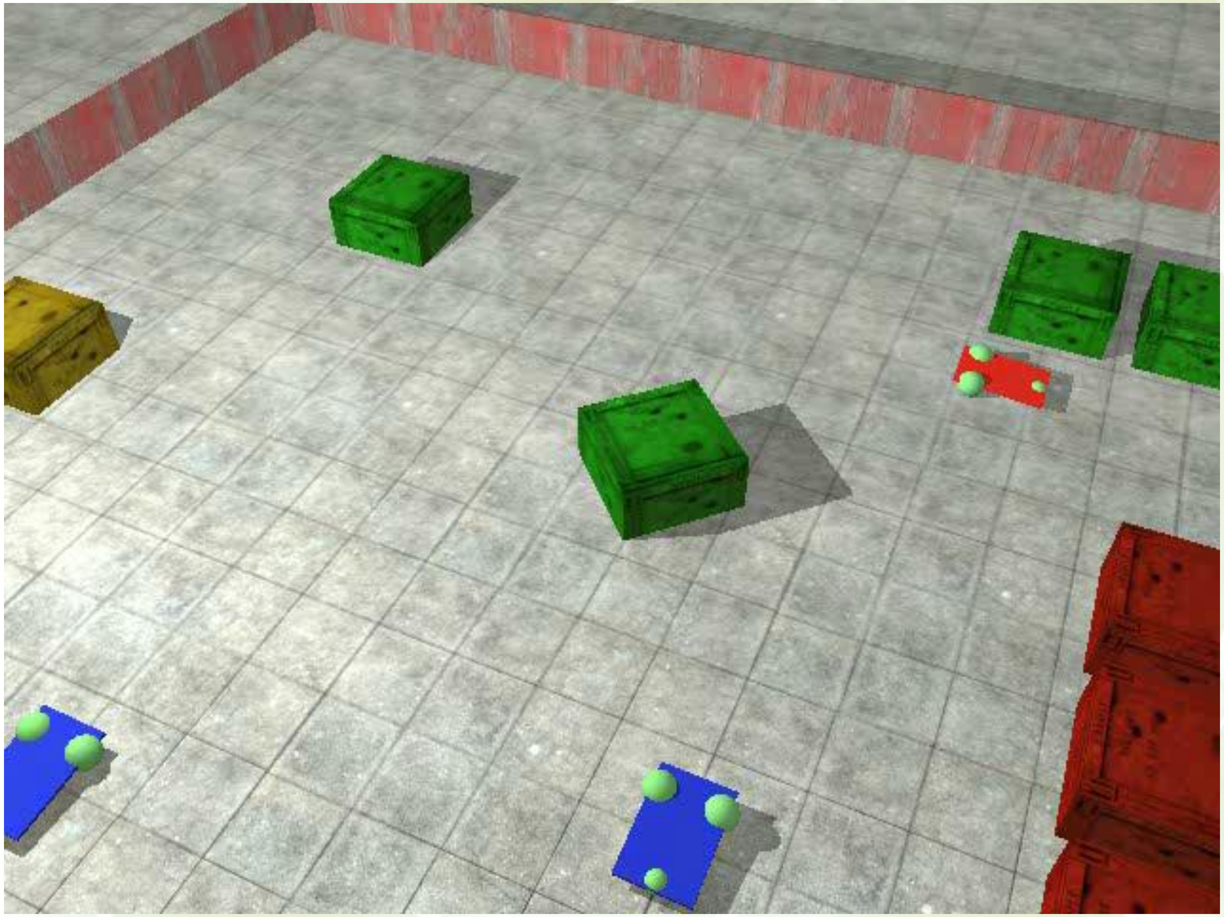
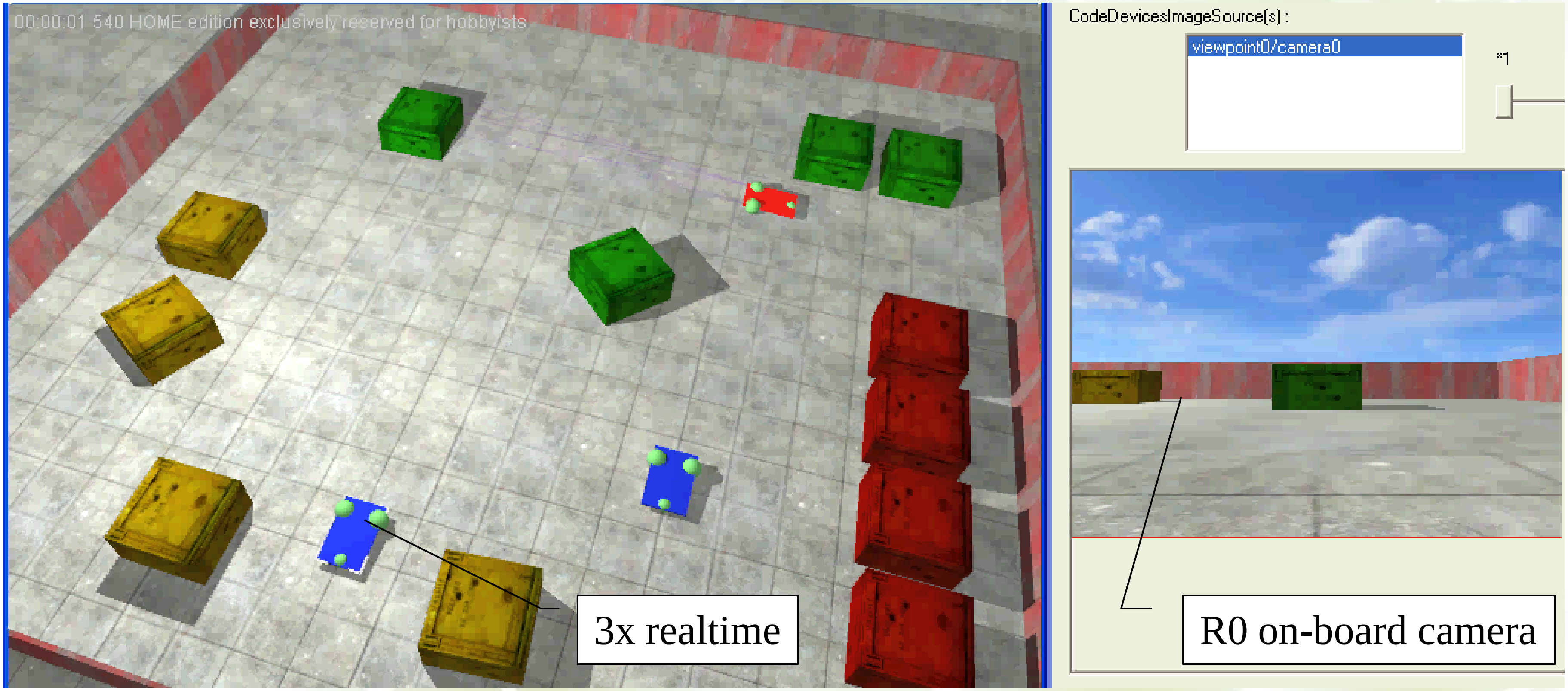


Szimulált jelenet



Fedélzeti kamerás szimuláció



A következő előadásunk:

2010.október 13.
Dr. Budai István
Segitenék. (Hogyan) segíthetek?

SZÉCHENYI TUDOMÁNYOS EST

TÁMOP-4.2.3-08/1-2008-0011

TUDOMÁNY GYŐRBEN MINDENKINEK

KÖSZÖNJÜK MEGTISZTELŐ FIGYELMÜKET!

A rendezvény a „SZiENCE4YOU – Tudás- és tudomány disszemináció a Széchenyi István Egyetemen” című projekt keretében valósult meg.

A program szervezői, támogatói:

SZÉCHENYI ISTVÁN EGYETEM
SZE-GYŐR
TUDÁSMENEDZSMENT KÖZPONT

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