Davranış seçme işlevinde dopaminin etkisine ilişkin dinamik bir model

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Davranış seçme işlevinde dopaminin etkisine ilişkin dinamik bir model

- Dinamik model nedir?
- C-BG-TH döngüsünü nasıl modelleyeceğiz?
- Biraz da matematik gerekmiyor mu?
- Davranmanın dinamik modelini nasıl oluşturduk?
- Davranış seçme işlevinin dinamik modelini nasıl elde ettik?
- Bu modeli Stroop testi için nasıl kullandık?
- Ne elde ettik, nasıl yorumladık?

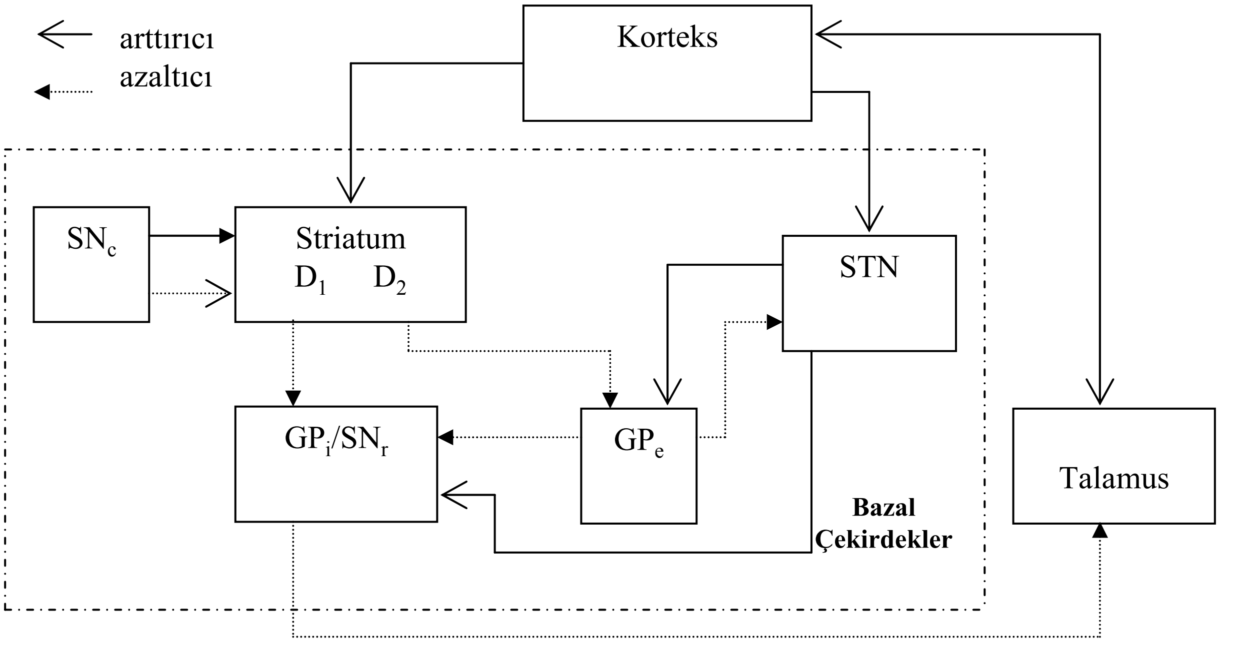
Dinamik Model

- Amacımız, bilişsel süreçler nasıl oluşuyor, neden oluşuyor anlamak.
- İki yol tutabilirdik......

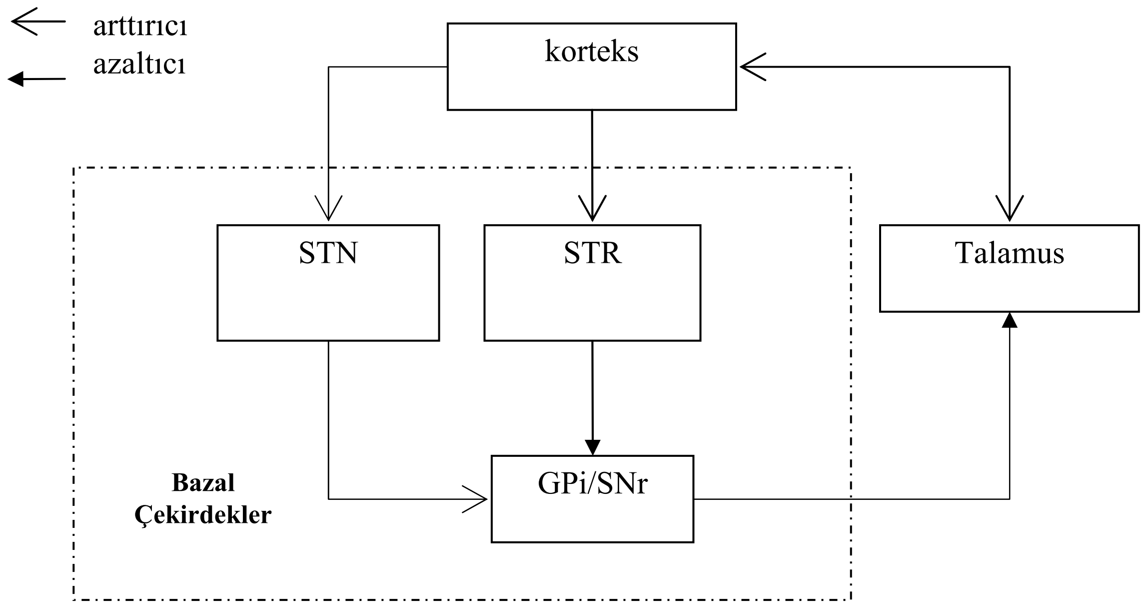
  * hücre seviyesi

  * sistem seviyesi
- Ama biz.......

Korteks-Bazal Çekirdekler-Talamus Döngüsü



Korteks-Bazal Çekirdekler-Talamus Döngüsü



Kim demiş “nigrostriatal dopamin sistemi bilişsel işlevleri de etkiler” diye?

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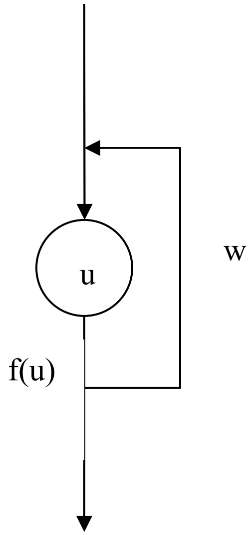
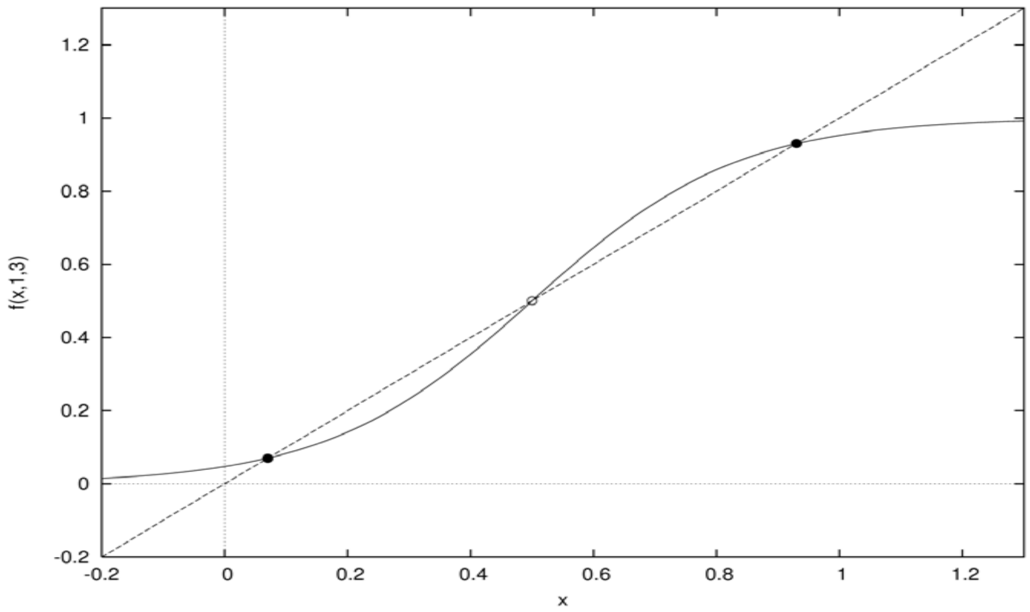
- Djurfeldt M., Ekeberg Ö., &Graybiel A.M., (2001) “Cortex-basal ganglia interaction and attractor states”. Neurocomputing, 38-40, 573-579.

Biraz da Matematik

$$u(t+1) = w \cdot f(u(t)) \qquad , \quad f(u) \hat{=} \tanh(u)$$

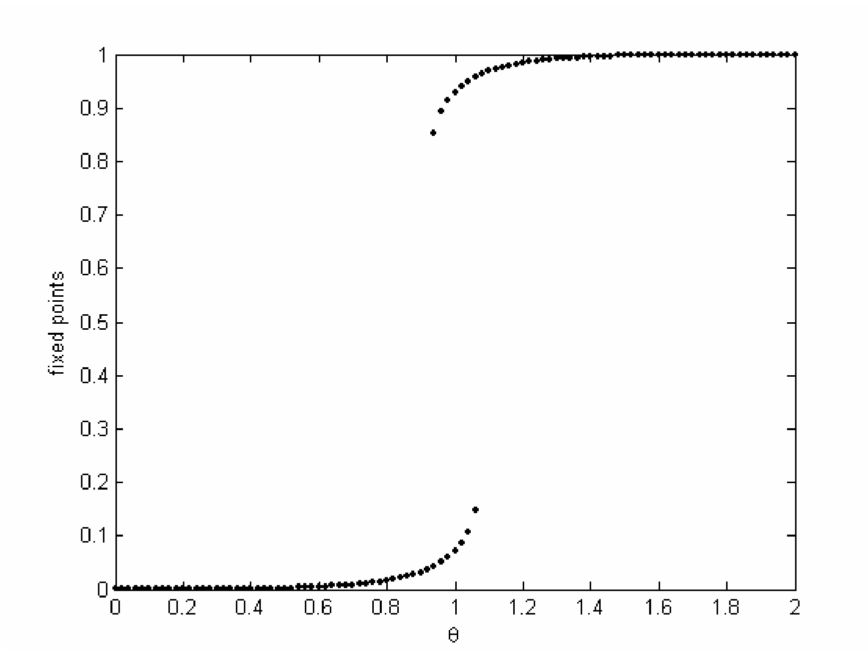


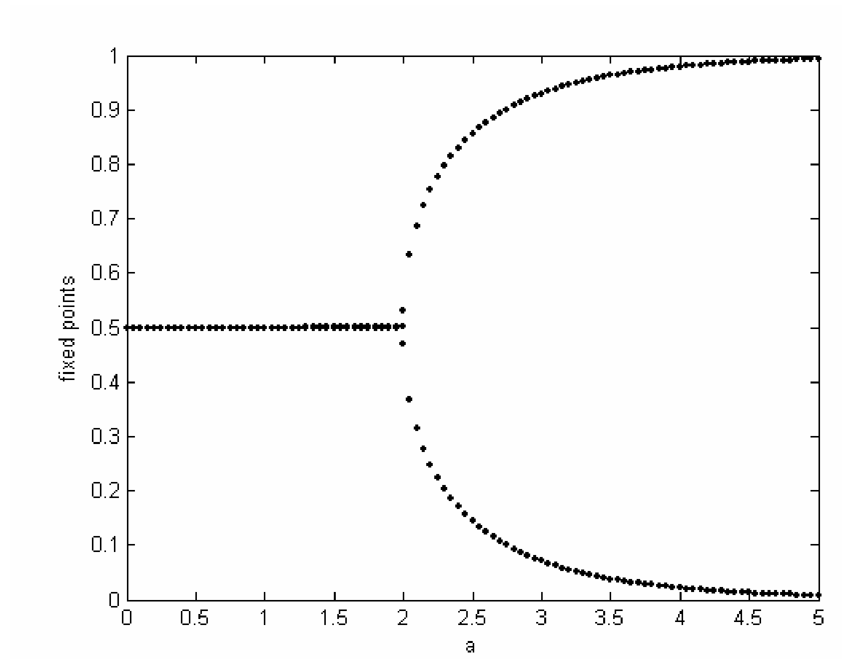
Geri beslemeli
sinir hücresi



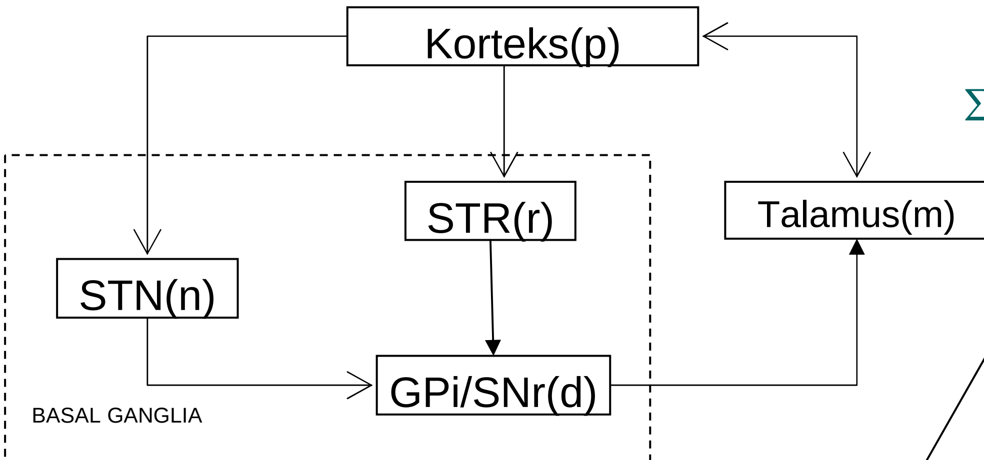
Biraz daha matematik

dallanma diyagramları





Şimdi de davranış



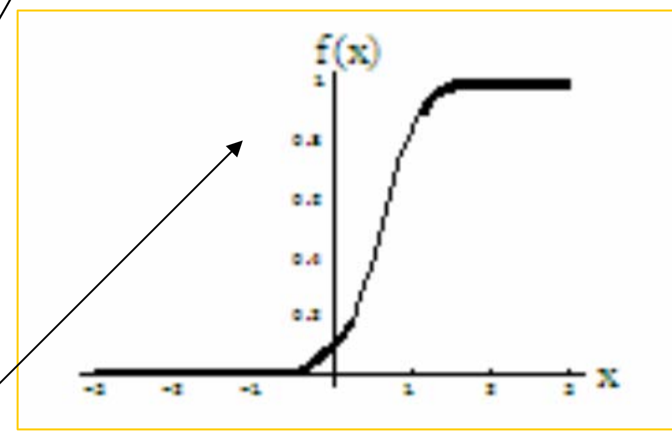
$$\Sigma_1: \qquad x(k+1) = \Gamma x(k) + \Lambda F(x(k))$$

C-BG-TH-C çevrimi

AZALTICI BAĞLANTILAR →

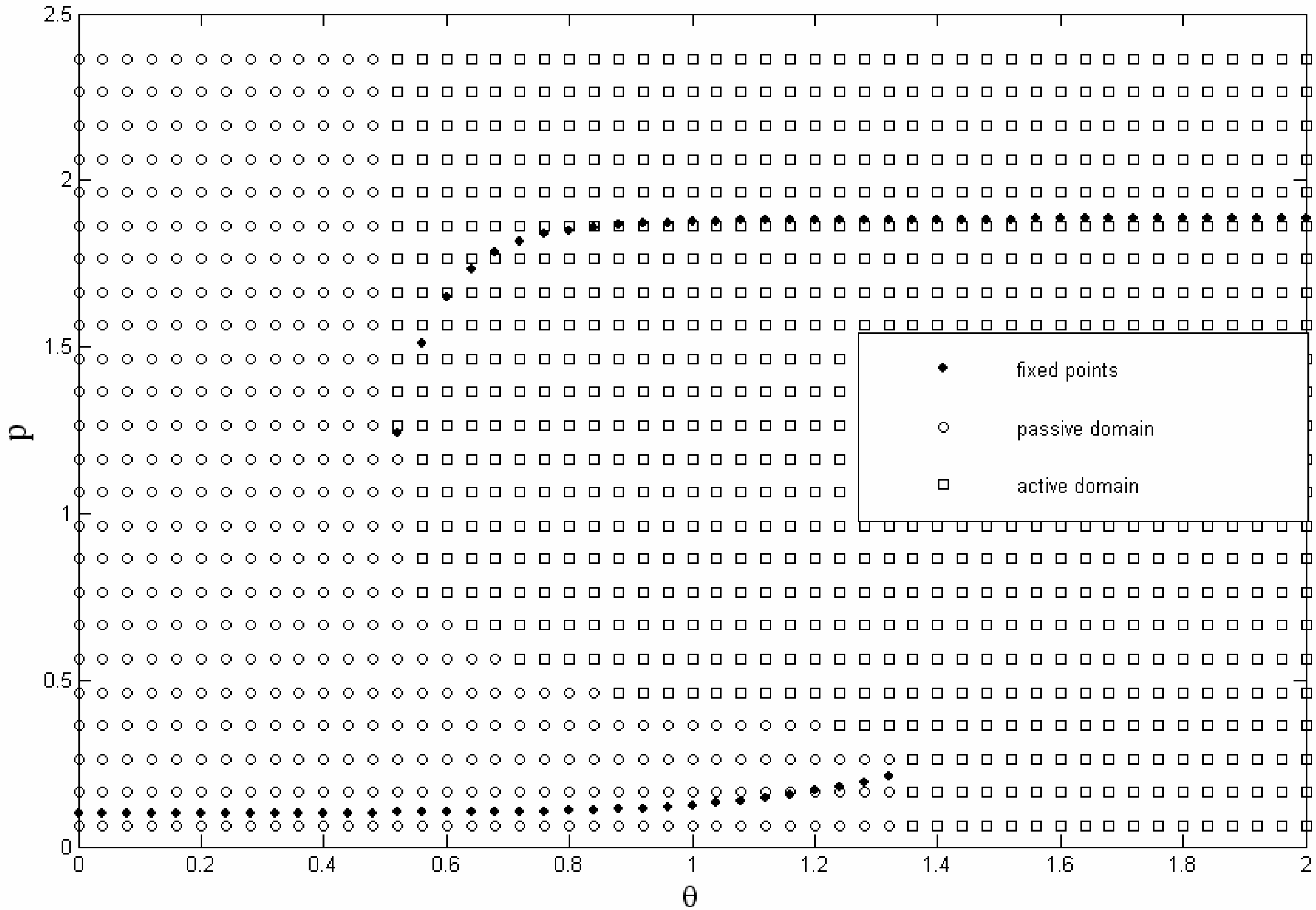
ARTTIRICI BAĞLANTILAR →

$$\begin{bmatrix} p(k+1) \\ m(k+1) \\ r(k+1) \\ n(k+1) \\ d(k+1) \end{bmatrix} = \begin{bmatrix} \lambda & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} p(k) \\ m(k) \\ r(k) \\ n(k) \\ d(k) \end{bmatrix} + \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & -1 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 1 & 0 \end{bmatrix} \cdot \begin{bmatrix} f(p(k),\theta_p,a_p) \\ f(m(k),\theta_m,a_m) \\ f(r(k),\theta_r,a_r) \\ f(n(k),\theta_n,a_n) \\ f(d(k),\theta_d,a_d) \end{bmatrix}$$



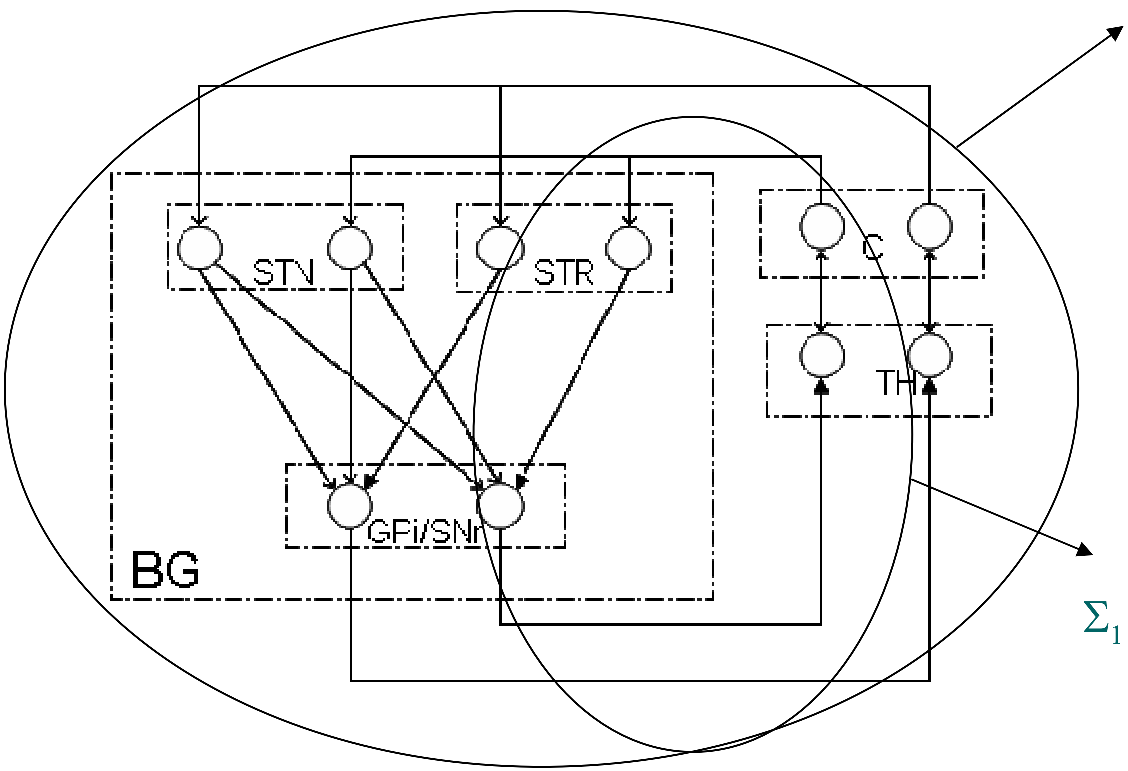
Bir hücrenin aktivasyon fonksiyonu
ve doyma bölgeleri

… yapılıyor mu, yapılmıyor mu?



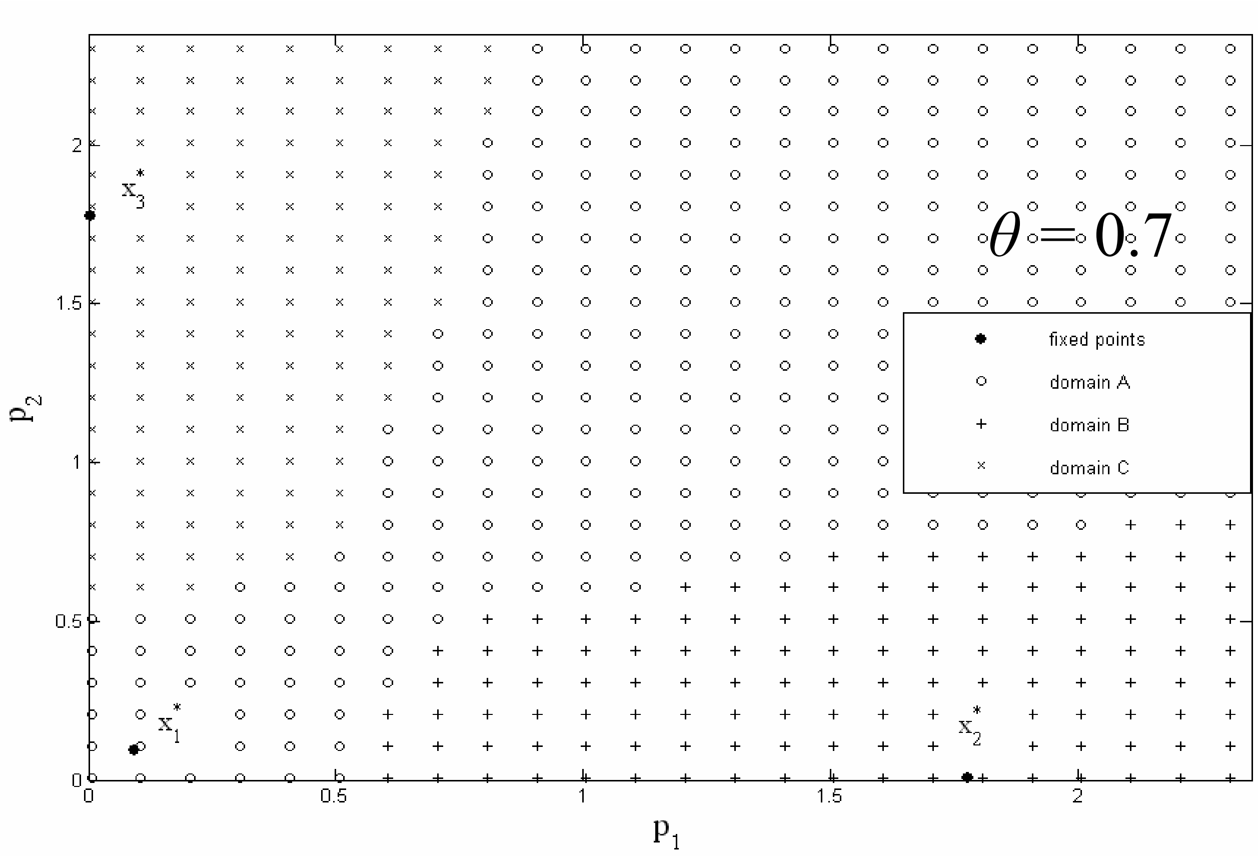
İki davranışdan birini nasıl seçeriz?

$$\Sigma_2: \quad \begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} \Gamma & 0 \\ 0 & \Gamma \end{bmatrix} \cdot \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} \Lambda & \Pi \\ \Pi & \Lambda \end{bmatrix} \cdot \begin{bmatrix} F(x_1(k), \theta) \\ F(x_2(k), \theta) \end{bmatrix}$$

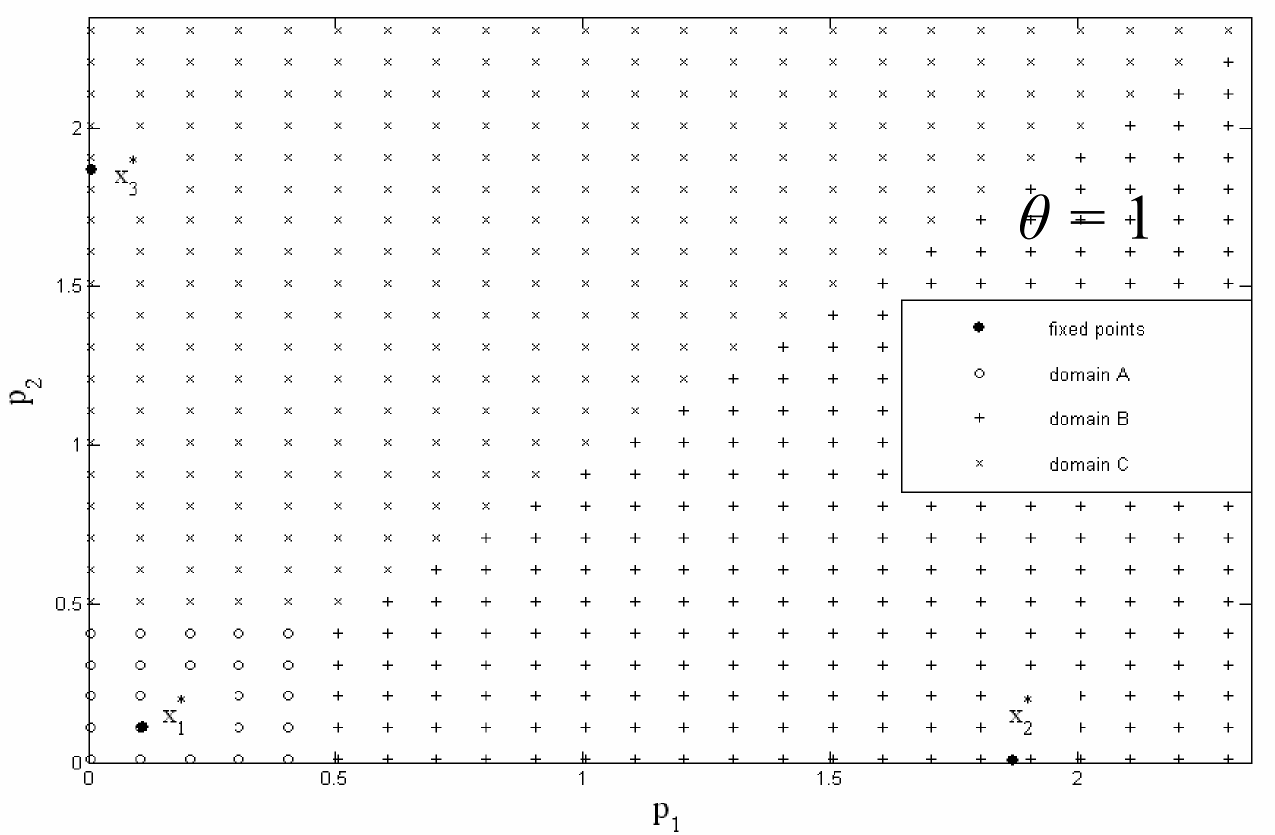


$$\Sigma_1: \quad x(k+1) = \Gamma x(k) + \Lambda F(x(k))$$

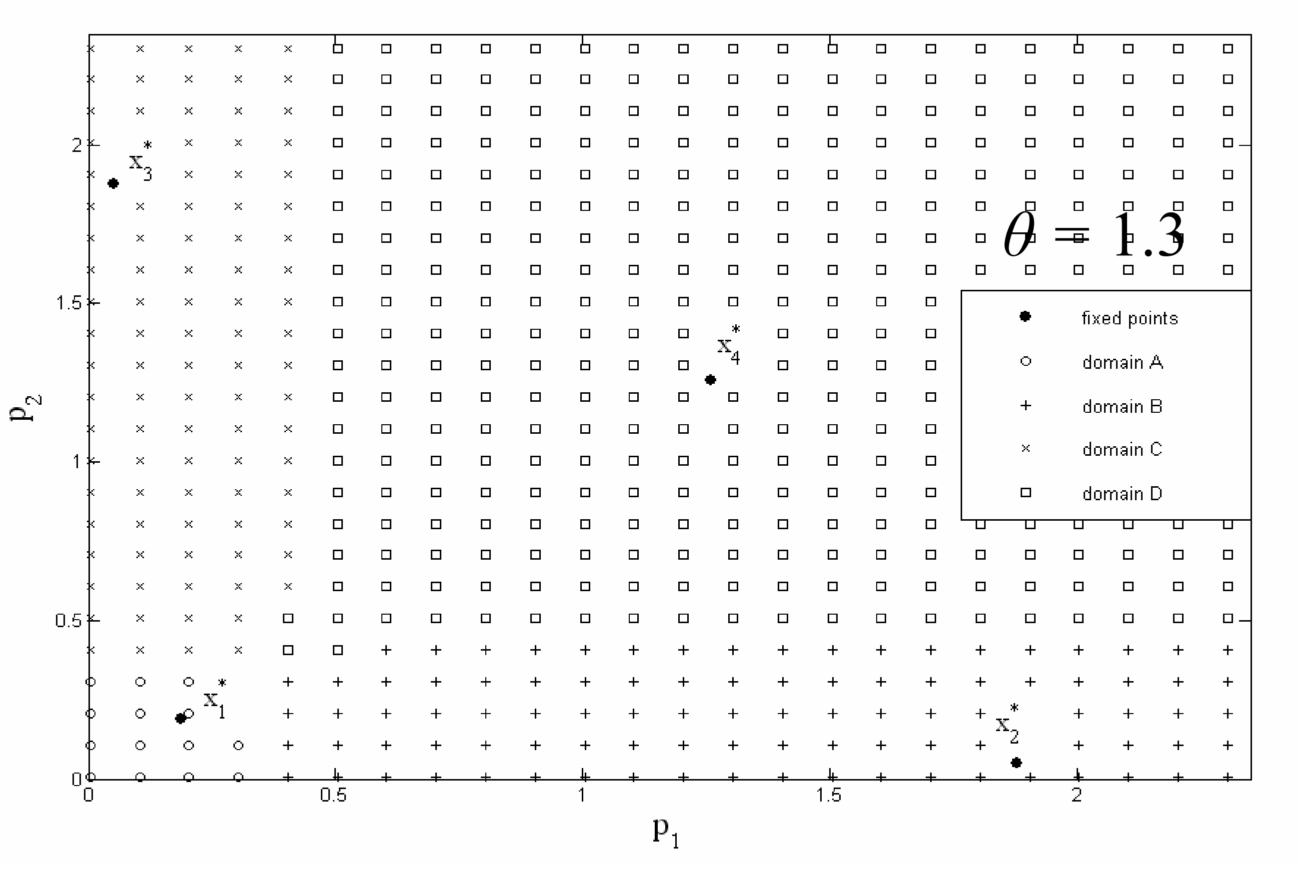
İki davranışdan birini nasıl seçeriz?



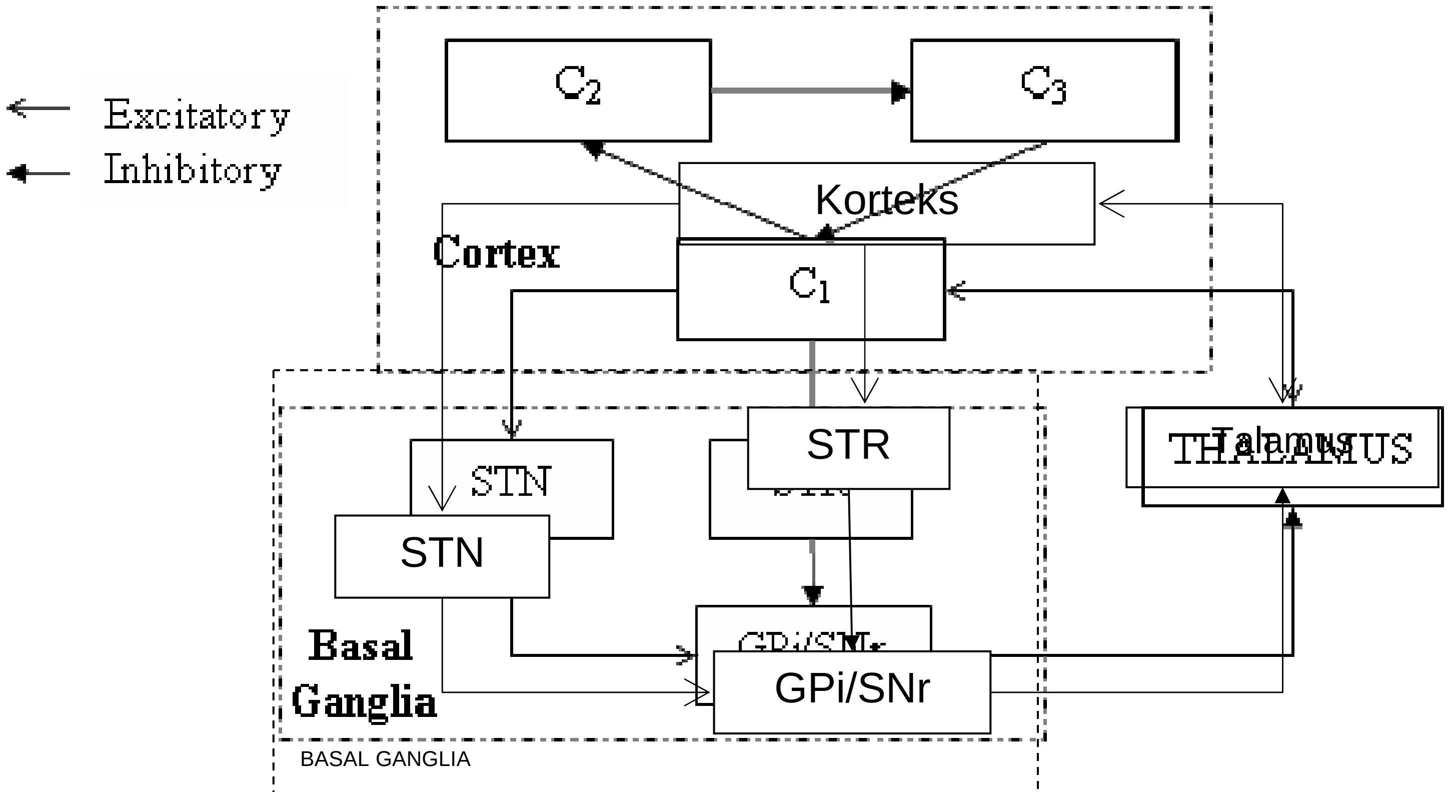
İki davranışdan birini nasıl seçeriz?



İki davranışdan birini nasıl seçeriz?

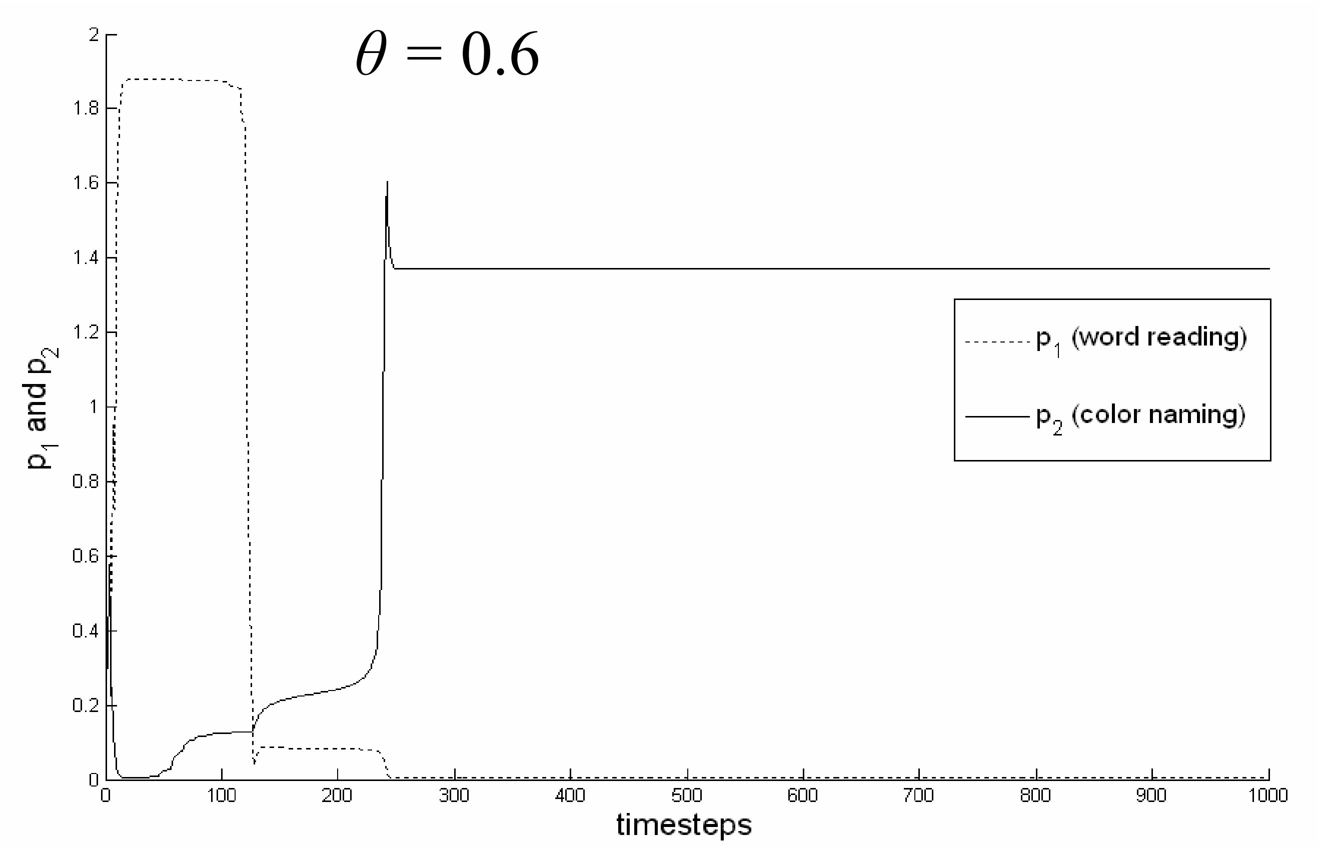


Stroop testi için ne yaptık?

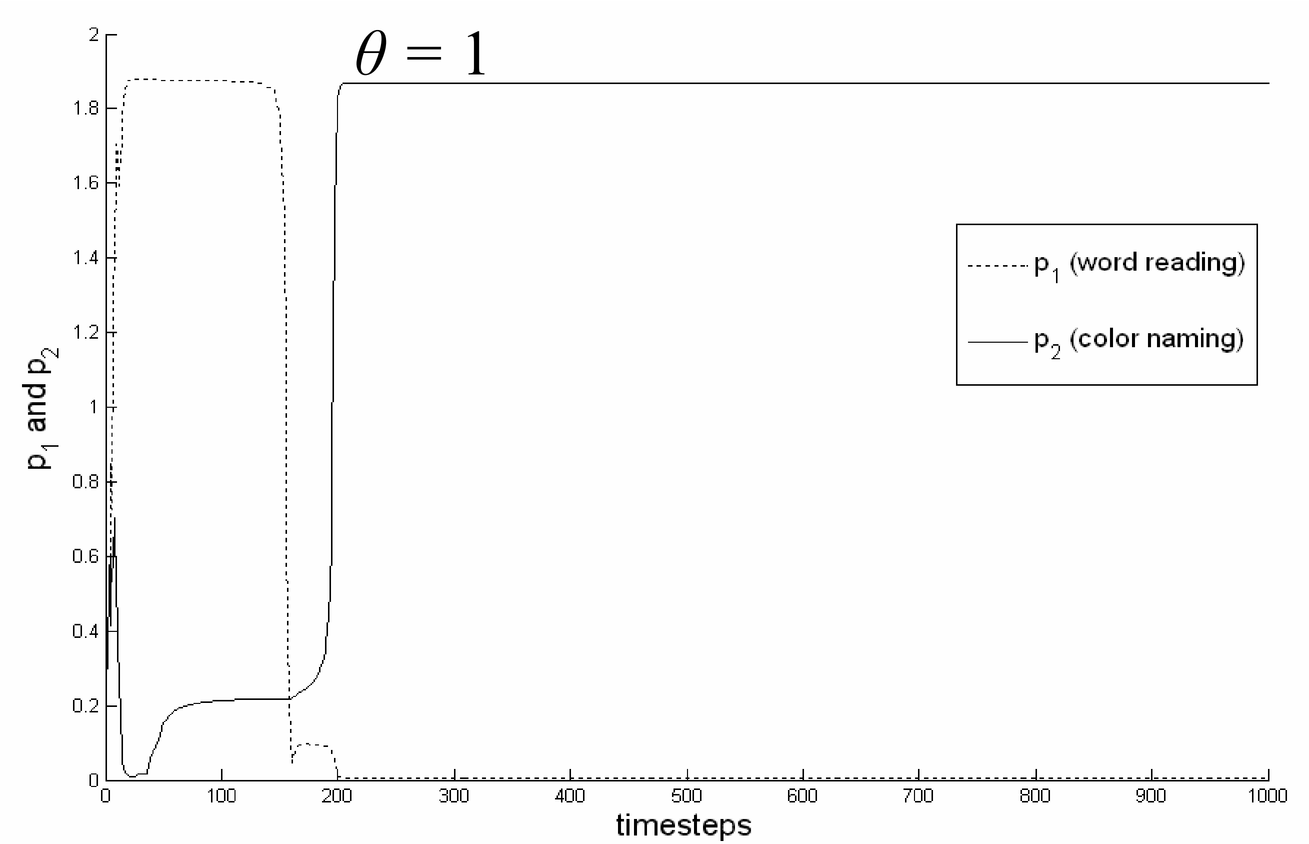


C-BG-TH-C çevrimi

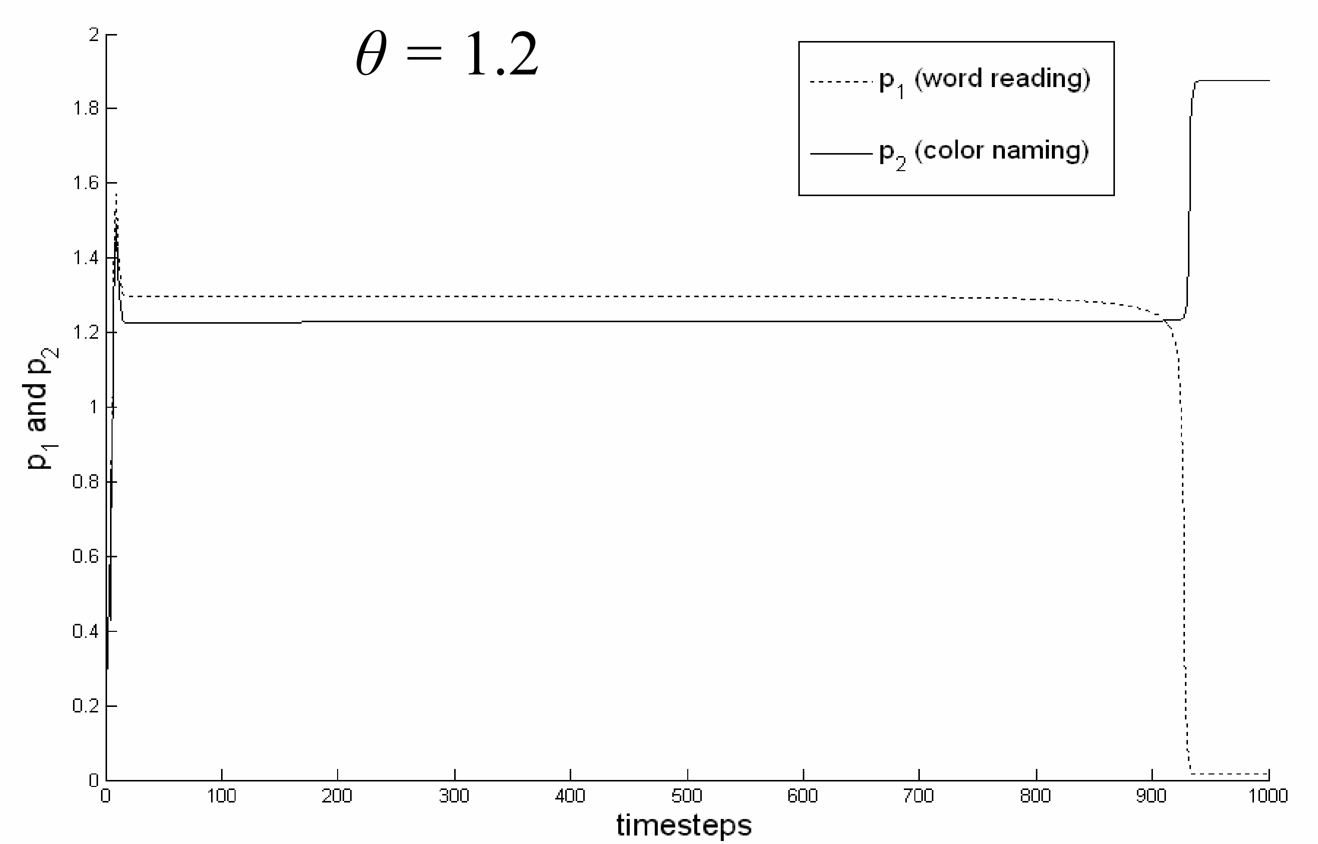
Ne elde ettik …..



Ne elde ettik ……



Ne elde ettik ......



....nasıl yorumladık?

Dopamin	Dopamin seviyesi (θ_{sel})	Hata	Doğru yanıt süresi
↗	2	–	> 30000
	1.6	–	1396
	1.4	–	1261
	1.2	–	1129
→	1	–	396
↙	0.8	–	390
	0.6	+	405
	0.55	+	440
	0.5	+	> 30000

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teşekkürler

Daha fazla denklem isterseniz

$$p(k+1) = \lambda \cdot p(k) + f(m(k))$$

$$m(k+1) = f(p(k)) - f(d(k))$$

$$r(k+1) = g(p(k), \theta_{att})$$

$$n(k+1) = f(p(k))$$

$$d(k+1) = -g(r(k), \theta_{sel}) + f(n(k))$$

$$c_2(k)=\begin{cases} t-f\left(c_1(k-5)\right) & , \quad k=10,20,30,\ldots \\ c_2(k-1) & , \quad other \end{cases}$$

$$c_3(k)=\begin{cases} A\cdot f\left(c_2(k-1)\right) & , \quad k=11,21,31,\ldots \\ c_3(k-1) & , \quad other \end{cases}$$

$$\theta_{att}(k)=\begin{cases} \theta_{att}(k-1)+0.1\cdot c_3(k-1)\cdot\left(2-\min\left(\left\|\theta_{att}(k-1)-\begin{pmatrix}1\\1\end{pmatrix}\right\|\right)\right) & , \quad k=12,22,32,\ldots \\ \theta_{att}(k-1) & , \quad other \end{cases}$$