

Collective behaviour

the animat framework

Obstaja v času in prostoru,
obkrožena z neživimi in živimi predmeti – svet

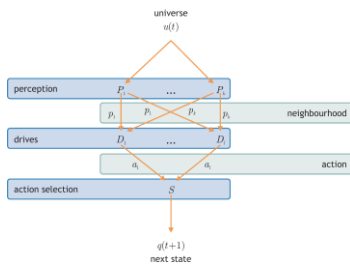
Sposobno zaznavanja
(angl. *perception*) stanja sveta
- v odvisnosti od notranjega stanja je
le del zaznanih podatkov pomemben;
predstavlja pozitivne dražljaje

Sposobno izvajanja akcij,
s katerimi lahko vpliva
na svoje notranje stanje in stanje sveta
- njegova težnja (angl. *drive*) je izvajanje akcij,
ki bodo optimizirale pojavljanje
pozitivnih dražljajev

sintetično bitje

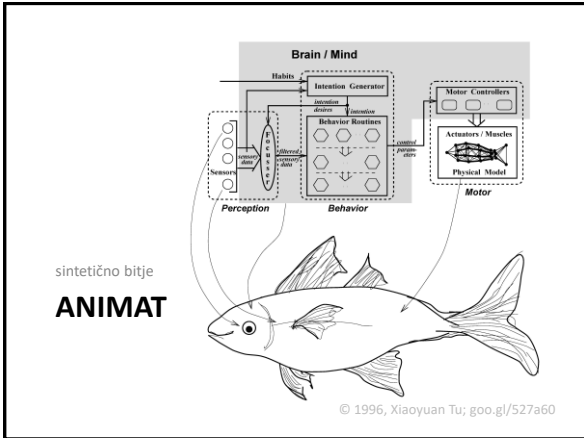
ANIMAT

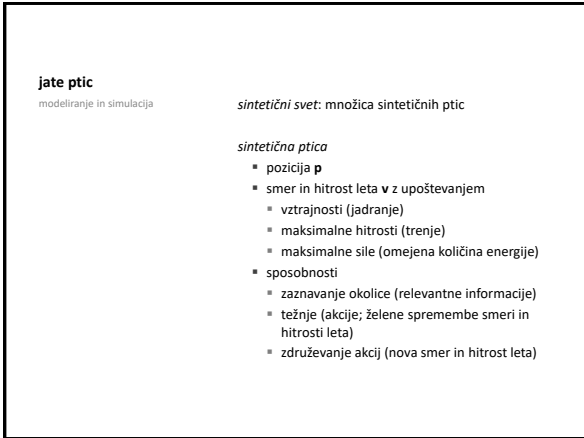
Izvaja sekvence mišično-skeletnih
premikov, ki dosežejo uresničitev
kombinacije zelenih akcij
– izbira akcije (angl. *action selection*)

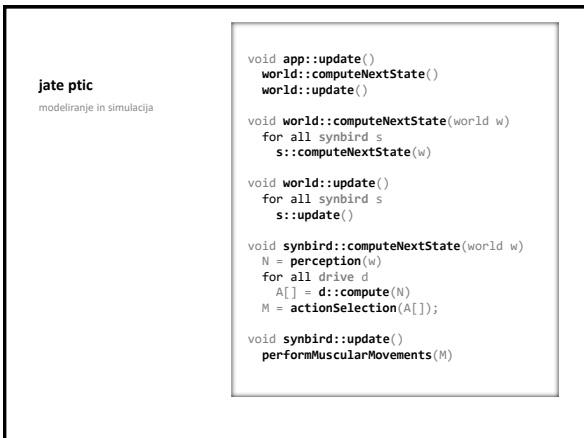


sintetično bitje

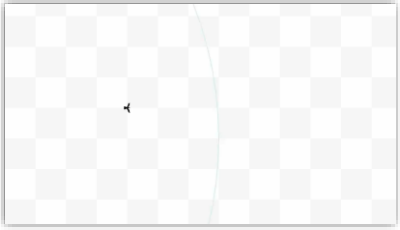
ANIMAT





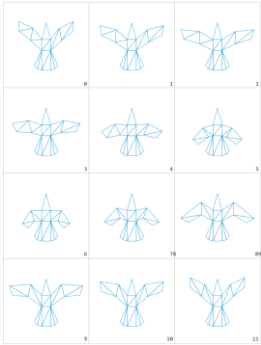


jate ptic
modeliranje in simulacija
let ptice




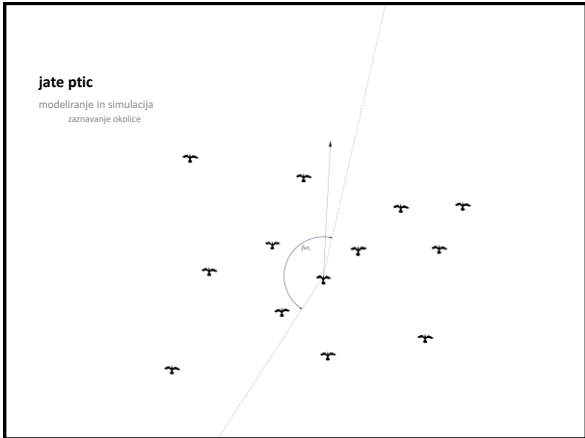
$a = F/m, v += a\Delta t, p += v\Delta t$

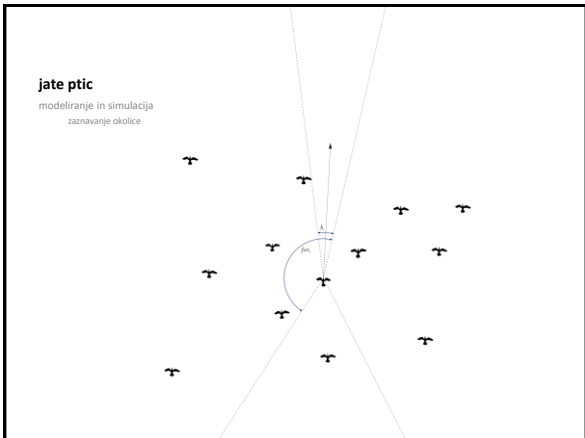
jate ptic
modeliranje in simulacija
animacija kril

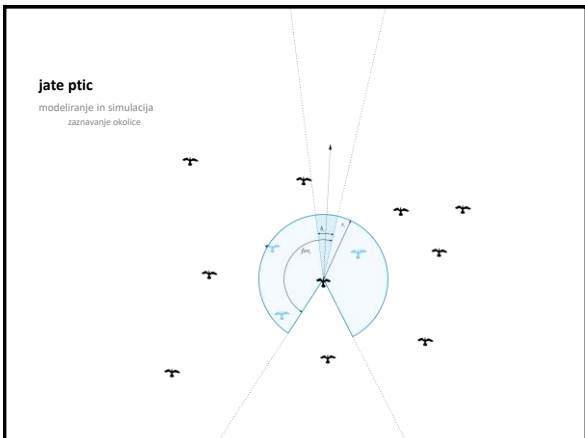


jate ptic
modeliranje in simulacija
zaznavanje okolice









jate ptic
 modeliranje in simulacija
 zaznavanje okolice

$$h = \frac{v}{|v|} \cdot a_i = p_i - p$$

$$a_i \cdot a_i \leq r_i^2$$

$$\frac{a_i}{|p_i|} \cdot h > \cos \text{fov}_i$$

jate ptic
 modeliranje in simulacija
 težnje

težnja bližine

- cilj: leteti čim bližje zaznamim sosedom
- posledica: tvorba jat; sintetične ptice se združujejo v jate

težnja razdalje

- cilj: leteti čim bolj stran od svojih najbližjih sosedov
- posledica: izogibanje trkov s sosedi

težnja usklajenosti

- cilj: leteti v isti smeri in z isto hitrostjo kot sosedje
- posledica: izogibanje trkom, tvorba in ohranjanje jate

jate ptic
 modeliranje in simulacija
 težnja bližine

$$F_A = \left[\left(\frac{1}{n} \sum_i D_i \right) - p \right]^0$$

jate ptic
 modeliranje in simulacija
 težnja razdalje

$$F_R = \left[\sum_i \frac{p - p_i}{|p - p_i|^2} \right]^0$$

jate ptic
 modeliranje in simulacija
 težnja usklajenosti

$$F_P = \left[\left(\frac{1}{n} \sum_i v_i \right) - v \right]^0$$

jate ptic
 modeliranje in simulacija

rezultat posamezne težnje je akcija; sila, ki povzroči željeno spremembo smeri in hitrosti leta

- težnja bližine – F_A
- težnja razdalje – F_R
- težnja usklajenosti – F_P
- težnja po zadrževanju v področju – F_O

združevanje akcij je preprosta utežena vsota ustreznih sil

- $F = w_A F_A + w_R F_R + w_P F_P (+ w_O F_O)$

MEHKA LOGIKA

jate ptic

modeliranje in simulacija
težnja bližine

v splošnem *ohrani* smer in hitrost leta;

če je sosed *dovolj blizu*,
ohrani smer in hitrost leta;

če je sosed *predaleč in spredaj*,
pospeši let;

če je sosed *predaleč* in kjerkoli *levo ali zadaj*,
se *usmeri proti njemu* in *upočasni* let;

če je sosed *predaleč* in kjerkoli *desno ali zadaj*,
se *usmeri proti njemu* in *upočasni* let.

jate ptic

modeliranje in simulacija
težnja bližine

```

if (distance is too far)
  then (flight speed is keep speed),
if (distance is too far)
  then (flight direction is keep direction),
if (distance is close enough)
  then (flight speed is keep speed),
if (distance is close enough)
  then (flight direction is keep direction),
if (distance is too far) and (position is in front)
  then (flight speed is accelerate),
if (distance is too far) and (position is left or behind)
  then (flight speed is decelerate),
if (distance is too far) and (position is left or behind)
  then (flight direction is turn left),
if (distance is too far) and (position is right or behind)
  then (flight speed is decelerate),
if (distance is too far) and (position is right or behind)
  then (flight direction is turn right).
```

mehka logika
 regulacija sobne temperature

če je temperatura *ustrezna*
ne spreminjaj;

če je temperatura *prenizka*
zvišaj gretje;

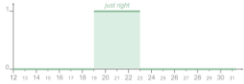
če je temperatura *previsoka*
zmanjšaj gretje;

mehka logika
 regulacija sobne temperature

če je temperatura *ustrezna*
ne spreminjaj;

če je temperatura *prenizka*
zvišaj gretje;

če je temperatura *previsoka*
zmanjšaj gretje;



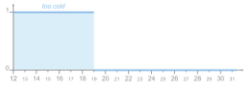
$just\ right = \{x \in \mathbb{R}; 19 \leq x \leq 23\}$

mehka logika
 regulacija sobne temperature

če je temperatura *ustrezna*
ne spreminjaj;

če je temperatura *prenizka*
zvišaj gretje;

če je temperatura *previsoka*
zmanjšaj gretje;



$too\ cold = \{x \in \mathbb{R}; x < 19\}$

mehka logika
regulacija sobne temperature

če je temperatura *ustrezna*
ne spreminjaj;

če je temperatura *prenizka*
zvišaj gretje;

če je temperatura *previsoka*
zmanjšaj gretje;

$too\ hot = \{x \in \mathbb{R}; 23 < x\}$

mehka logika
regulacija sobne temperature

```

if (temperature > 12) && (temperature < 19)
  then (heating += 1),
if (temperature > 23) && (temperature < 32)
  then (heating -= 1).
    
```

mehka logika
regulacija sobne temperature

```

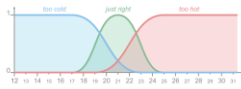
if (temperature is too cold)
  then (heating += 1),
if (temperature is too hot)
  then (heating -= 1).
    
```

mehka logika

regulacija sobne temperature
mehke množice

```

if (temperature is just right)
  then (heating is is),
if (temperature is too cold)
  then (heating is increase),
if (temperature is too hot)
  then (heating is decrease).
    
```

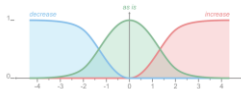


mehka logika

regulacija sobne temperature
mehke množice

```

if (temperature is just right)
  then (heating is is),
if (temperature is too cold)
  then (heating is increase),
if (temperature is too hot)
  then (heating is decrease).
    
```



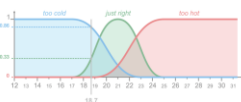
mehka logika

regulacija sobne temperature
mehke množice
mehko sklepanje

```

if (temperature is just right)
  then (heating is is),
if (temperature is too cold)
  then (heating is increase),
if (temperature is too hot)
  then (heating is decrease).
    
```

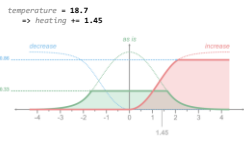
temperature = 18.7



mehka logika

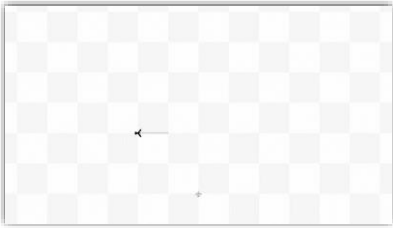
regulacija sobne temperature
mehka množice
mehka sklepanje

```
if (temperature is just right)
  then (heating is is),
if (temperature is too cold)
  then (heating is increase),
if (temperature is too hot)
  then (heating is decrease).
```



jate ptic

modeliranje in simulacija
težnja bližine



jate ptic

modeliranje in simulacija
težnja razdalje



