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ISSIQLIK ALMASHINISH QURILMASIDAGI HARORATNI INTELEKTUAL TIZIMLAR ASOSIDA BOSHQARISH

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Annotatsiya. Ushbu maqolada issiqlik almashinish qurilmasidagi haroratni intelektual boshqarish tizimlarini qo'llanilgan. Python dasturlash tilida boshqarish dasturi tuzilgan.

Kalit so'zlar. Issiqlik almashinish qurilmasi, intelektual boshqarish tizimlari, Python, Rasberry Pi 3 Model.

Kirish. Neftni qayta ishlash texnologik tizimidagi issiqlik almashinish qurilmasining haroratni rostlash dasturini Python dasturlash tilida tuzamiz. Rasberry Pi 3 Model B mikrokontrolleri ushbu tilda ishlash imkoniyatiga ega. Dasturni joriy etish quyidagi bosqichlarni o'z ichiga oladi. Mikrokontroller uchun boshqaruvchi dasturni shaxsiy kompyuterda bajaramiz va quyidagi bosqichlarni amalga oshiramiz:

-dasturning matnini tayyorlash,
-matnni mashina kodiga translyatsiyalash va sintaktik xatolarni tuzatish,
-dasturni sozlash (mantiqiy xatoliklarni tuzatish),
-mikrokontrollerni yakuniy dasturlashtirish [1].

Nazariy qism. Jarayonni mikrokontroller asosida boshqarishni tashkil etish uchun boshqarish algoritmini va dasturini ishlab chiqamiz. Jarayonni boshqarish algoritmi bizga unga asoslangan holda boshqarish dasturini ishlab chiqishga imkon beradi. Algoritmni ishlab chiqishda biz texnologik jarayonda ishtirok etadigan issiqlik almashinish qurilmasida kechadigan quyidagi holatlarni inobatga olishimiz kerak: Issiq agent yuqori haroratli benzin bug'lari, sovuq agent neftgazkondensat bo'lib, harorati 10÷30 ^{0}C gacha va sarf esa 1÷3 kg/s gacha o'zaradi. Neftgazkondensatning chiqish harorati shartli ravishda 30 ^{0}C deb qabul qilgan holda mikrokontroller uchun dastur tuzamiz.

Dastur listingi

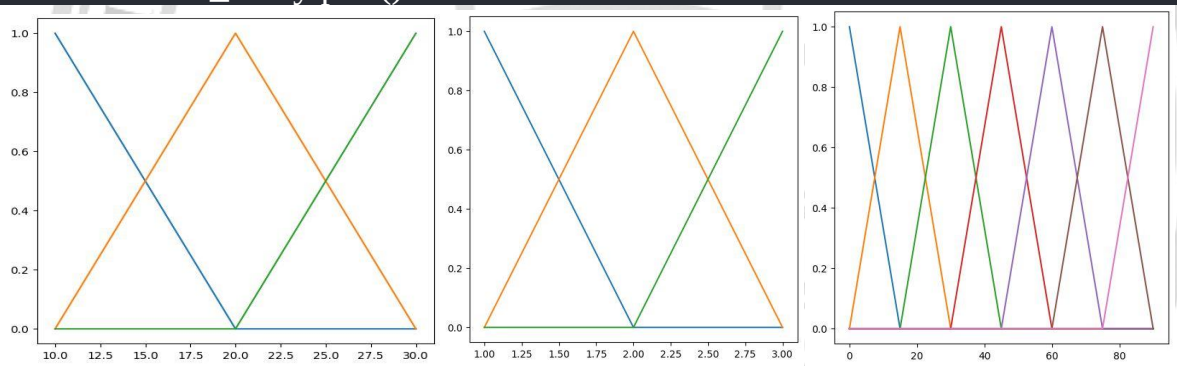
```
from matplotlib import pyplot
from fuzzylogic.classes import Domain, Set
from fuzzylogic.functions import (triangular, S,R)
temp = Domain("Temperature", 10, 30)
temp.cold = triangular(0,20, c=10)
temp.normal = triangular(10,30, c=20)
temp.hot = triangular(20,40, c=30)
pyplot.rc("figure", figsize=(6, 6))
temp.cold.plot()
temp.normal.plot()
temp.hot.plot()
sarf = Domain("Sarf", 1, 3)
sarf.few = triangular(0,2, c=1, c_m=1, no_m=0)
sarf.normal = triangular(1,3, c=2, c_m=1, no_m=0)
```


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```
sarf.many = triangular(2,4, c=3, c_m=1, no_m=0)
sarf.few.plot()
sarf.normal.plot()
sarf.many.plot()
burchak = Domain("Buralish burchagi", 0, 90)
burchak.minimal = S(0,15)
burchak.lesser = triangular(0,30, c=15)
burchak.less = triangular(15,45, c=30)
burchak.normal = triangular(30,60, c=45)
burchak.many = triangular(45,75, c=60)
burchak.more_many = triangular(60,90, c=75)
burchak.maximal = R(75,90)
pyplot.rc("figure", figsize=(6, 6))
burchak.minimal.plot()
burchak.lesser.plot()
burchak.less.plot()
burchak.normal.plot()
burchak.many.plot()
burchak.more_many.plot()
```



1.1-rasm. Pythonda dasturida horarat, sarf va burchak o‘zgarishi qiymatlarini noaniqlikka o‘tkazish grafigi.

```
from fuzzylogic.classes import Domain, Set, Rule
from fuzzylogic.hedges import very
from fuzzylogic.functions import triangular, S,R
def gradirovka_temp(x):
    return 5+1.25*x
def gradirovka_sarf(y):
    return 1/2+1/8*y
def gradirovka_tok(z):
    return (z+22.5)/5.625
temp = Domain("Temperature", 10, 30)
sarf = Domain("Sarf", 1, 3)
burchak = Domain("Buralish burchagi", 0, 90)
temp.cold = triangular(0,20, c=10)
temp.normal = triangular(10,30, c=20)
```

```
 temp.hot = triangular(20,40, c=30)
 sarf.few = triangular(0,2, c=1, c_m=1, no_m=0)
 sarf.normal = triangular(1,3, c=2, c_m=1, no_m=0)
 sarf.many = triangular(2,4, c=3, c_m=1, no_m=0)
 burchak.minimal = S(0,15)
 burchak.lesser = triangular(0,30, c=15)
 burchak.less = triangular(15,45, c=30)
 burchak.normal = triangular(30,60, c=45)
 burchak.many = triangular(45,75, c=60)
 burchak.more_many = triangular(60,90, c=75)
 burchak.maximal = R(75,90)
 R1 = Rule({(temp.cold, sarf.few): burchak.many})
 R2 = Rule({(temp.cold, sarf.normal): burchak.more_many})
 R3 = Rule({(temp.cold, sarf.many): burchak.maximal})
 R4 = Rule({(temp.normal, sarf.few): burchak.lesser})
 R5 = Rule({(temp.normal, sarf.normal): burchak.less})
 R6 = Rule({(temp.normal, sarf.many): burchak.normal})
 R7 = Rule({(temp.hot, sarf.few): burchak.less})
 R8 = Rule({(temp.hot, sarf.normal): burchak.lesser})
 R9 = Rule({(temp.hot, sarf.many): burchak.minimal})
 rules = Rule({(temp.cold, sarf.few): burchak.many,
               (temp.cold, sarf.normal): burchak.more_many,
               (temp.cold, sarf.many): burchak.maximal,
               (temp.normal, sarf.few): burchak.lesser,
               (temp.normal, sarf.normal): burchak.less,
               (temp.normal, sarf.many): burchak.normal,
               (temp.hot, sarf.few): burchak.less,
               (temp.hot, sarf.normal): burchak.lesser,
               (temp.hot, sarf.many): burchak.minimal
              })
 rules == R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 == sum([R1, R2, R3, R4, R5, R6,
R7, R8, R9])
 values = {sarf: gradirovka_sarf(6), temp: gradirovka_temp(17)}
 print(R1(values), R2(values), R3(values), R4(values), R5(values), R6(values),
R7(values), R8(values), R9(values), "=>", rules(values))
 print(f"{round(rules(values))}\u00b0")
 tok = rules(values)
 print(f"{round(gradirovka_tok(tok))} mA")
```

Xulosa. Texnologik jarayonlarni boshqarishda intelektual tizimlarni qo‘llash orqali qaror qabul qilishda optimal echimlarni taklif etadi. Yuqoridagi misloda ham kiruvchi paramertlarning qiymatiga qarab chiquvchi mahsulotni berilgan reglament bo‘yicha ushlab turish uchun kiruvchi mahsulotlar yo‘lida o‘rnatilagan ijrochi mexanizmni buralish burchagining optimal qiymatini taklif etyapti [1,2].

Adabiyotlar.

1. Nikola K.Kasabov “Founfations of neural networks, fuzzy sytems and knowledge engineering” A Bradford Book The MIT Press Cambridge, Massachusetts London, England.
2. Abdurakhmonov O.R. Sadullayev A.N “Mathematical modeling of oil heating process” arcticle, 2022-y.