PPADS MMXXI

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konzultácie elektronicky

mail, discord

LITTLE BOOK OF SEMAPHORES

- Allen B. Downey: The Little Book of Semaphores, Version 2.2.1
- http://greenteapress.com/semaphores/LittleBookOfSemaphores.pdf

LITTLE BOOK OF SEMAPHORES

- Večerajúci filozofi (kapitola 4.4 Dining philosophers)

VEČERAJÚCI FILOZOFI

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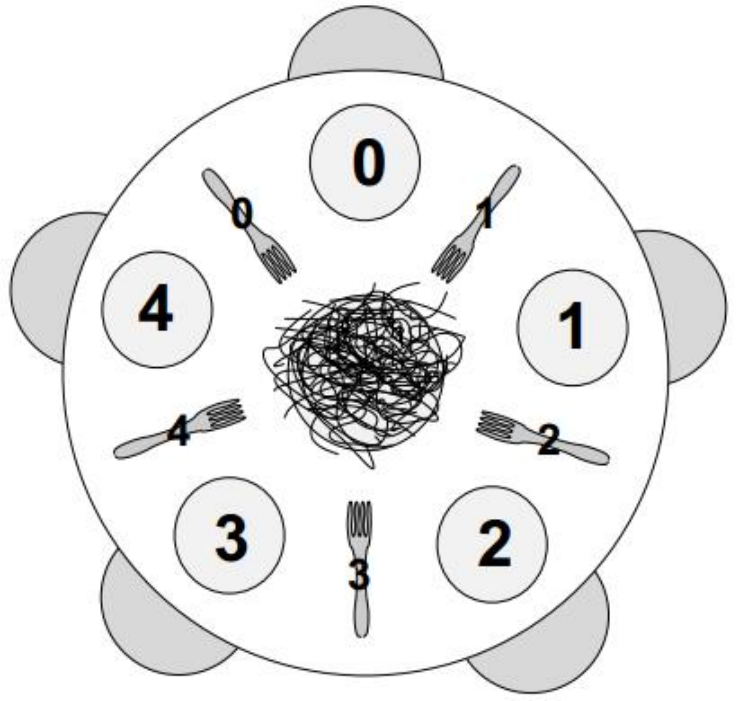
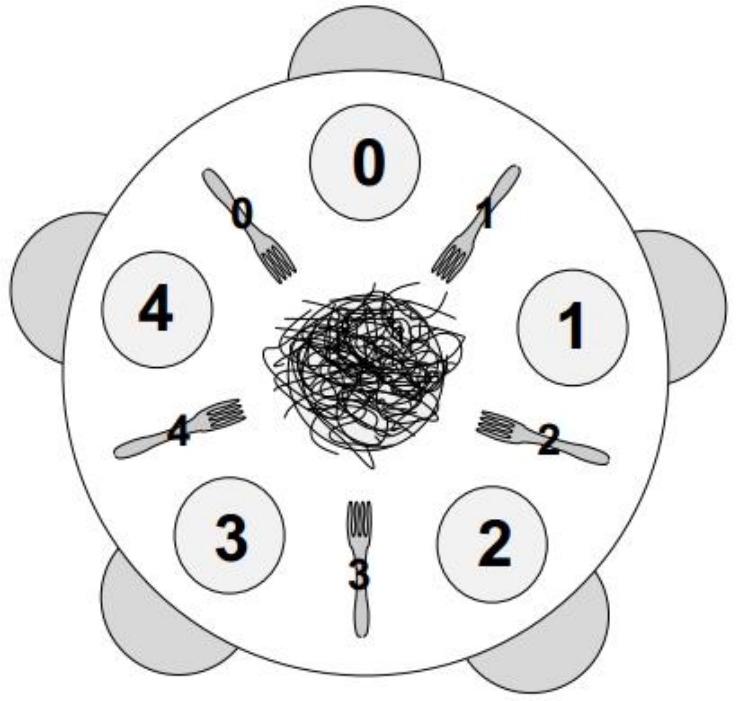


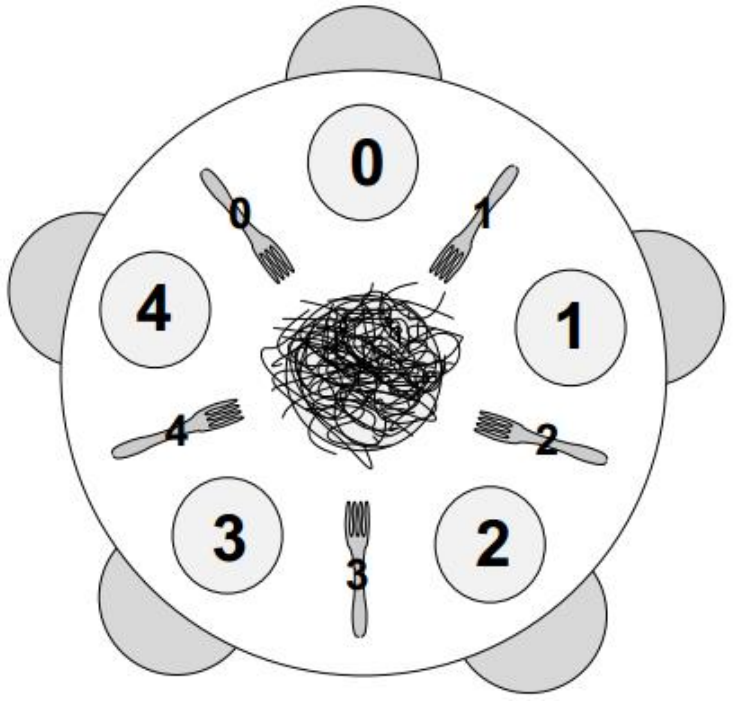
VEČERAJÚCI FILOZOFI

```
1    while True
```



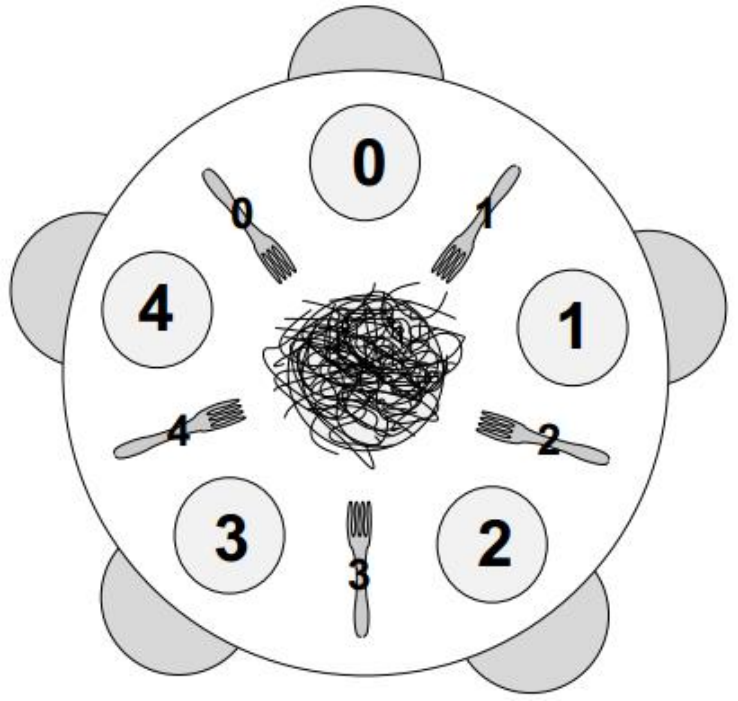
VEČERAJÚCI FILOZOFI

```
1    while True:
2        think()
```



VEČERAJÚCI FILOZOFI

```
1    while True:
2        think()
3        get_forks()
```



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```
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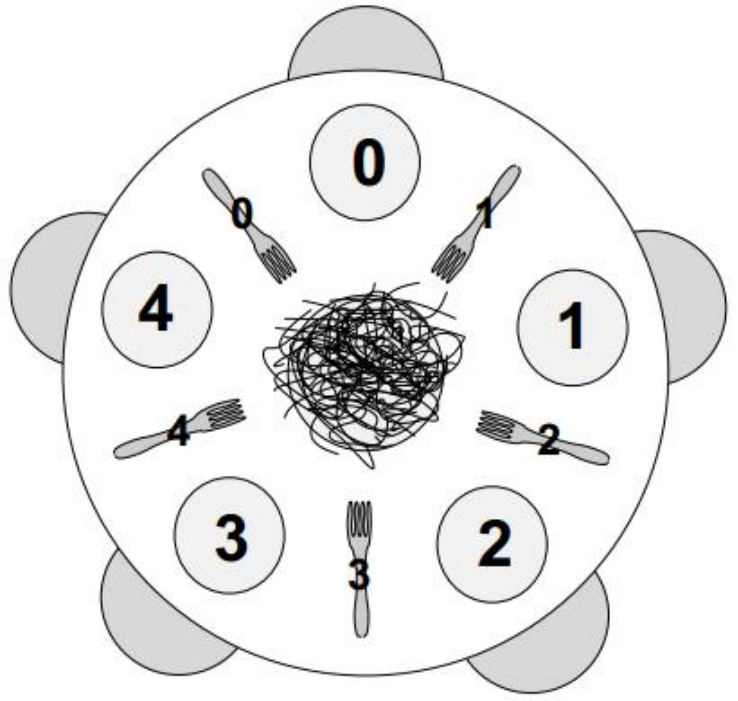

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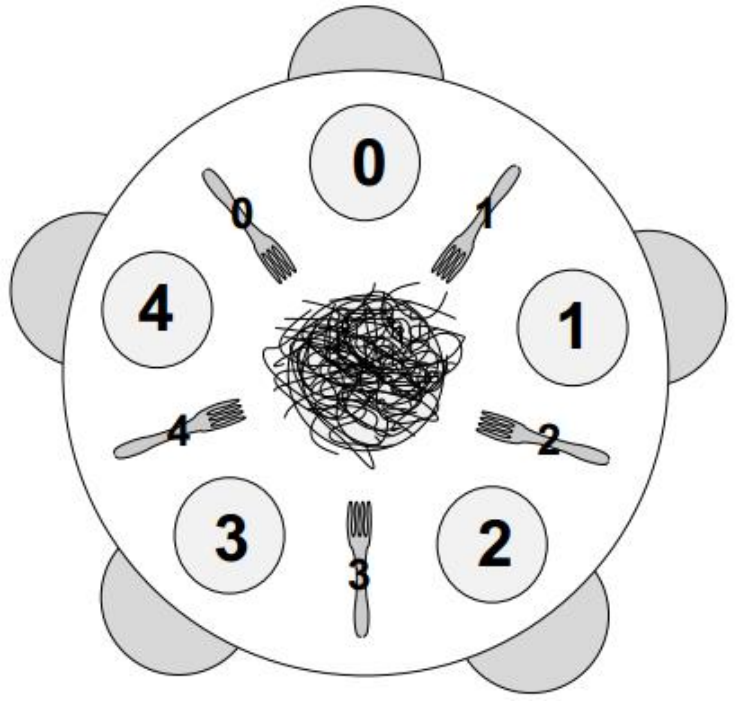

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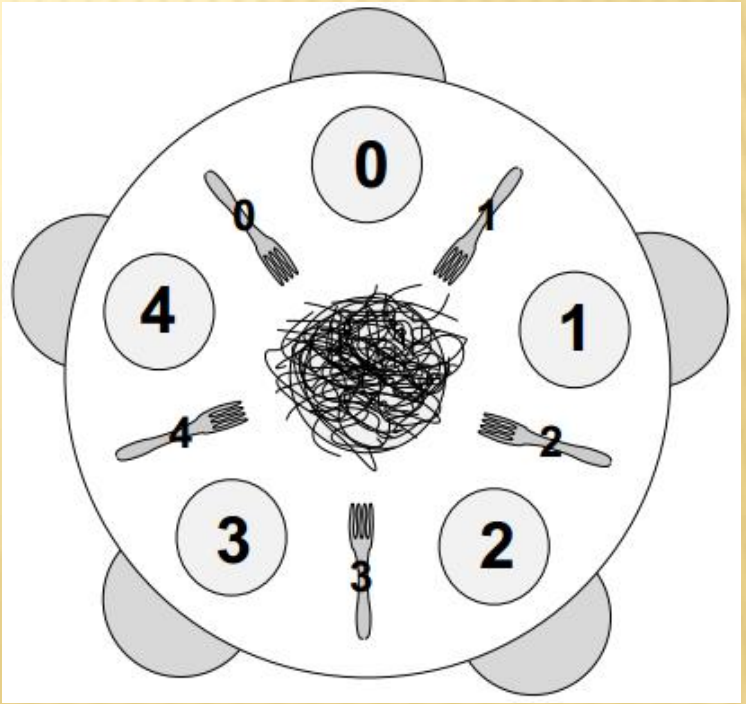
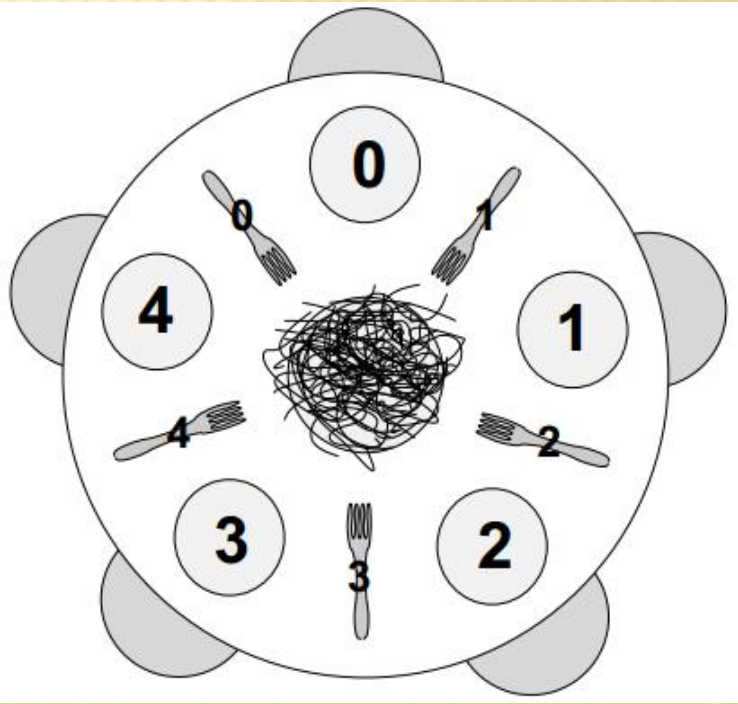


VEČERAJÚCI FILOZOFI

- Filozof → vlákno

```
1    while True:
2        think()
3        get_forks()
4        eat()
5        put_forks()
```



VEČERAJÚCI FILOZOFI

- Filozof → vlákno
- Vidlička → zdroj

```
1    while True:
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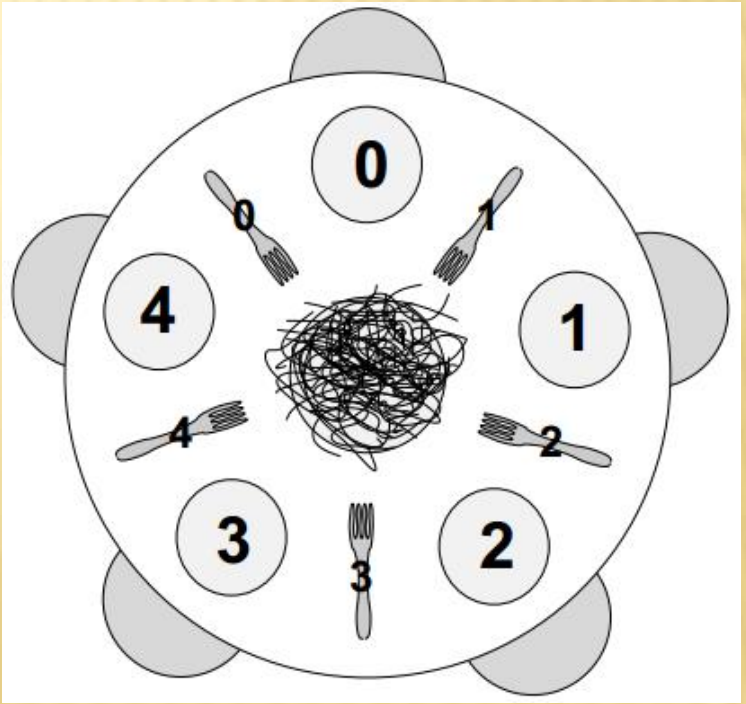
4        eat()
5        put_forks()
```



VEČERAJÚCI FILOZOFI

- Filozof → vlákno
- Vidlička → zdroj
- Čo je divné

```
1    while True:
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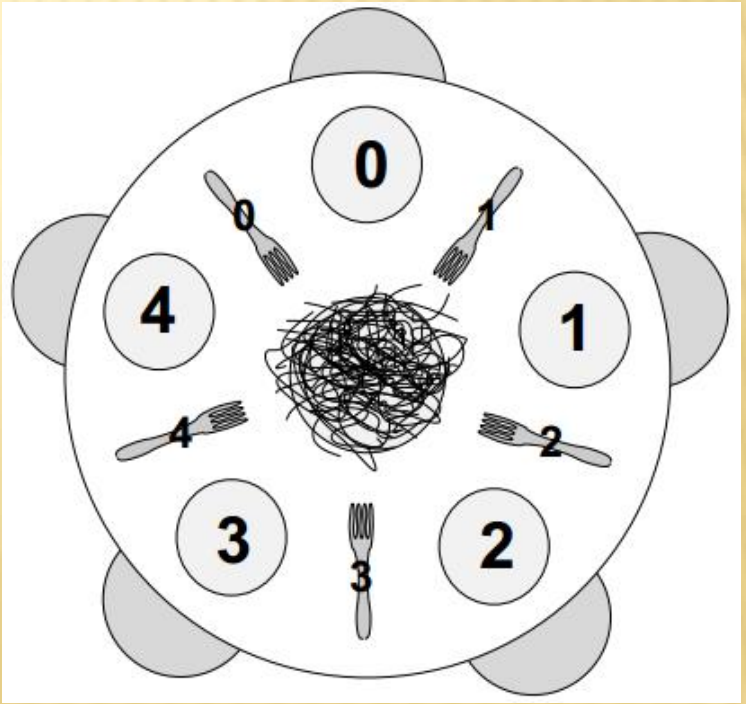
```



VEČERAJÚCI FILOZOFI

- Filozof → vlákno
- Vidlička → zdroj
- Čo je divné
  - Filozof potrebuje 2 vidličky

```
1   while True:
2       think()
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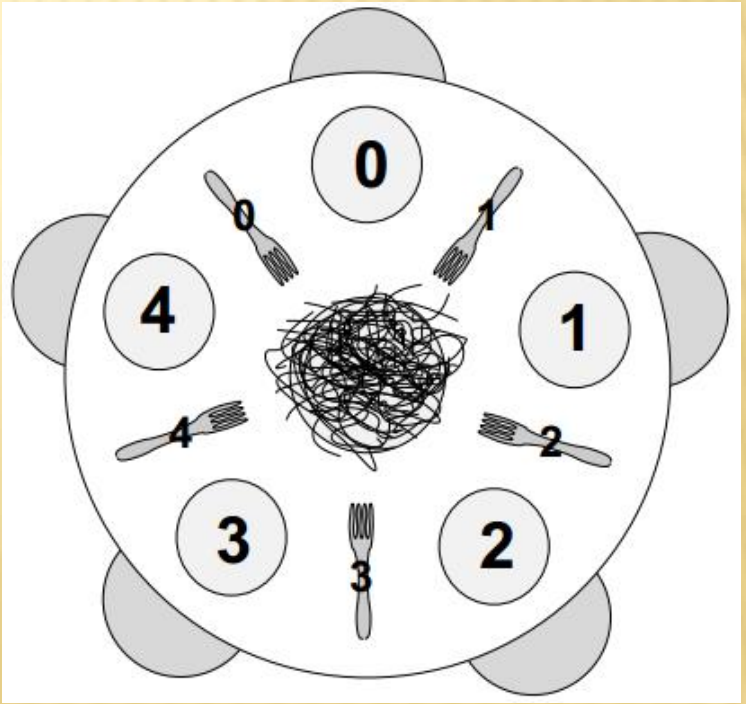
5       put_forks()
```



VEČERAJÚCI FILOZOFI

```
1    while True:
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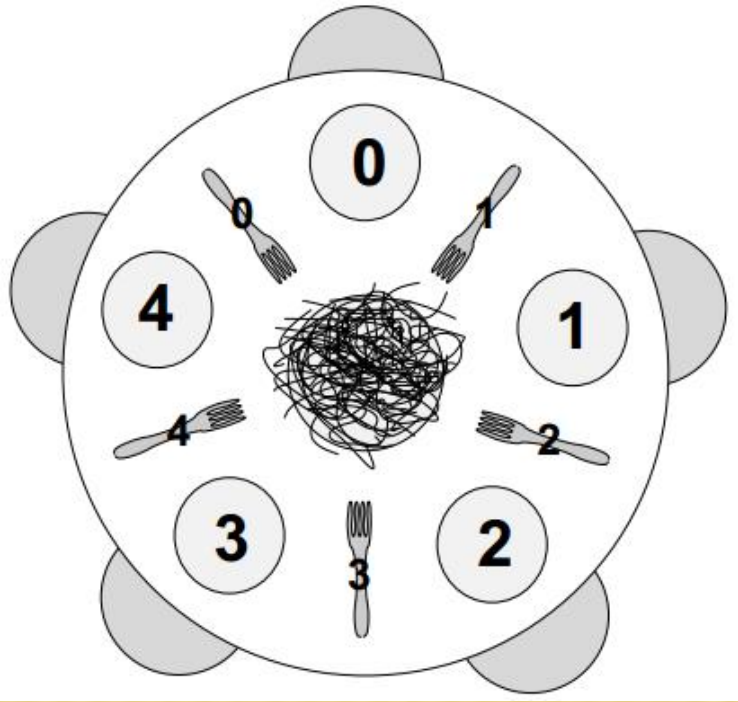
5        put_forks()
```

- Filozof → vlákno
- Vidlička → zdroj
- Čo je divné
  - Filozof potrebuje 2 vidličky
  - Ak má jednu, musí čakať na druhú, aby mohol pokračovat



VEČERAJÚCI FILOZOFI

- Filozof i

```
1    while True:
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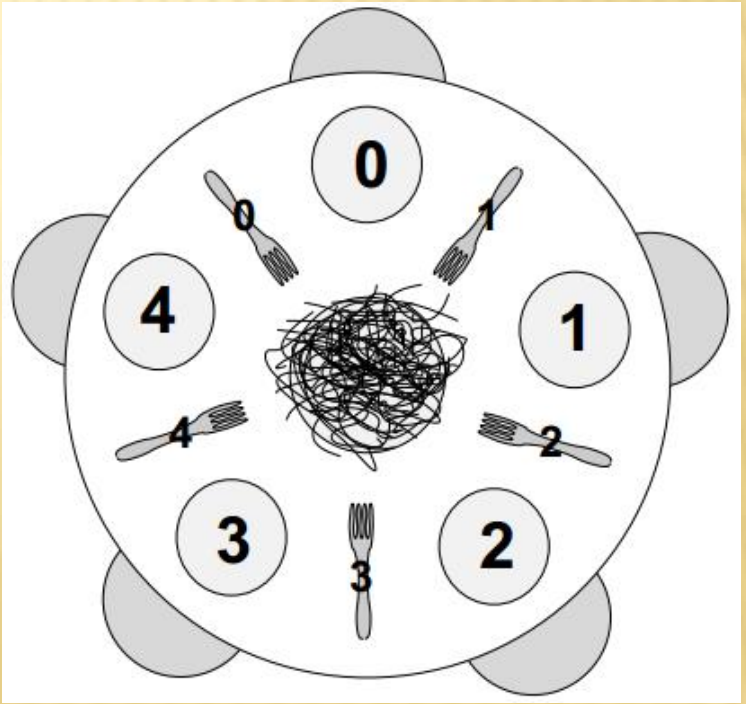
5        put_forks()
```



VEČERAJÚCI FILOZOFI

```
1    while True:
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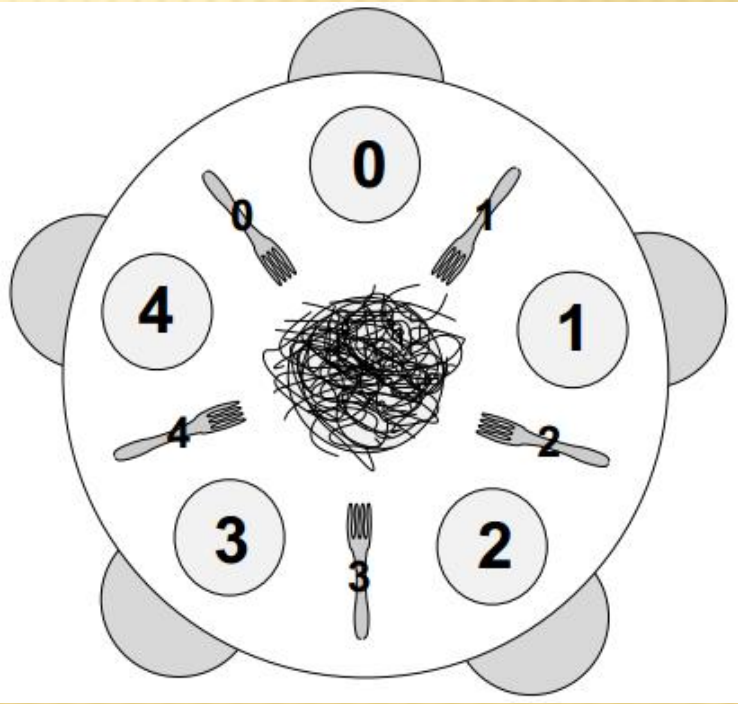
```

- Filozof i
  - Po pravej strane vidličká i



VEČERAJÚCI FILOZOFI

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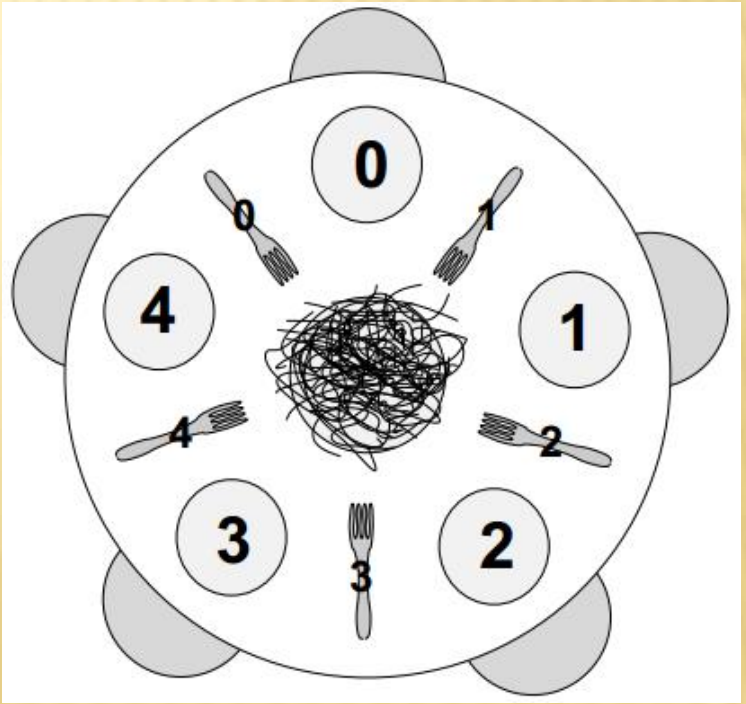
- Filozof i
  - Po pravej strane vidlička i
  - Po ľavej strane vidlička i+1



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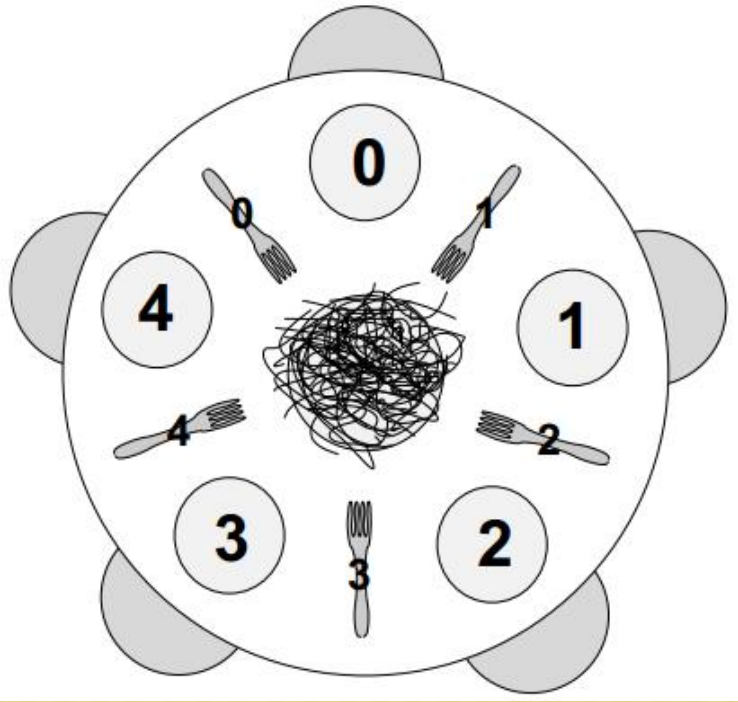
- Filozof i
  - Po pravej strane vidličká i
  - Po ľavej strane vidličká i+1
- i v intervale <0; 4>



VEČERAJÚCI FILOZOFI

```
1    while True:
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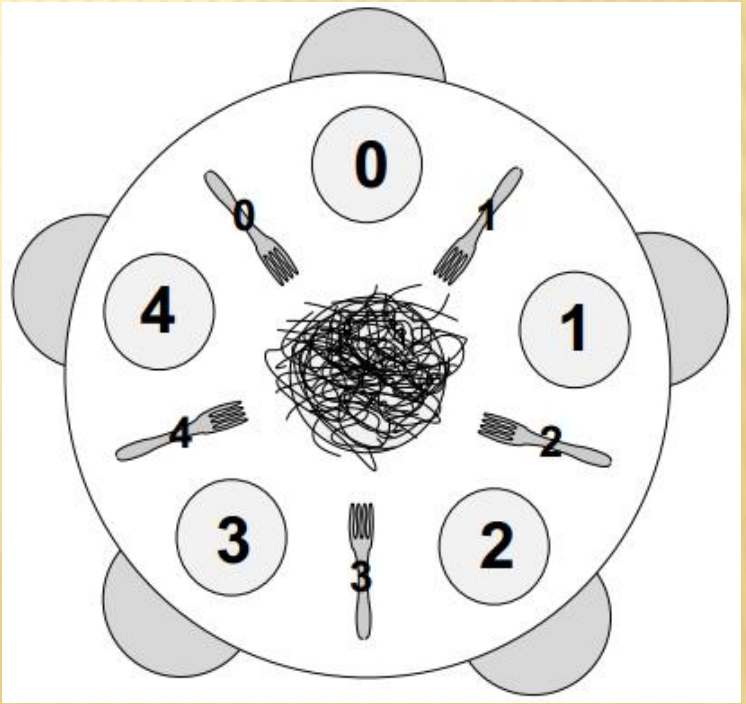
```

- Filozof i
  - Po pravej strane vidlička i
  - Po ľavej strane vidlička i+1
- i v intervale <0; 4>
- Filozof ovláda funkcie
  - think()
  - eat()



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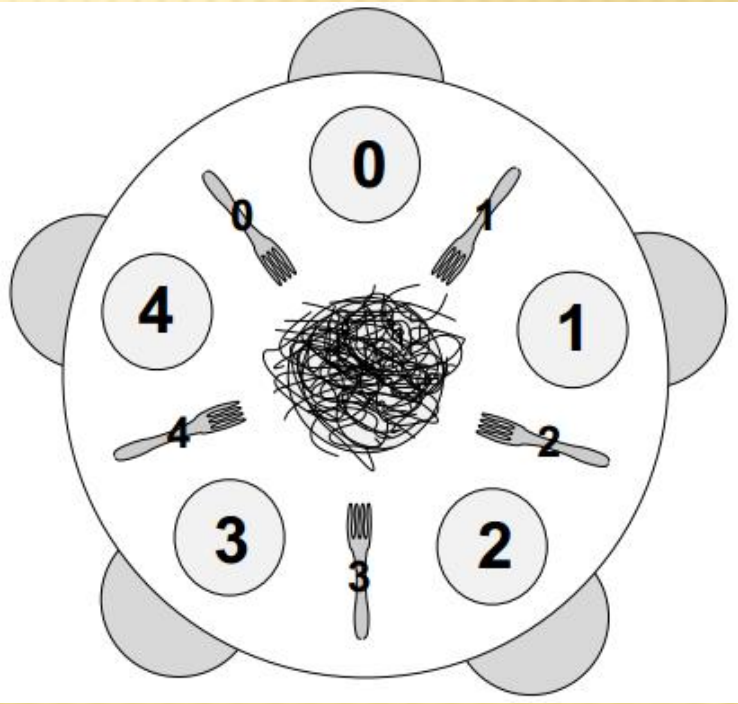
- Naša úloha definovať get() a put() tak, aby:



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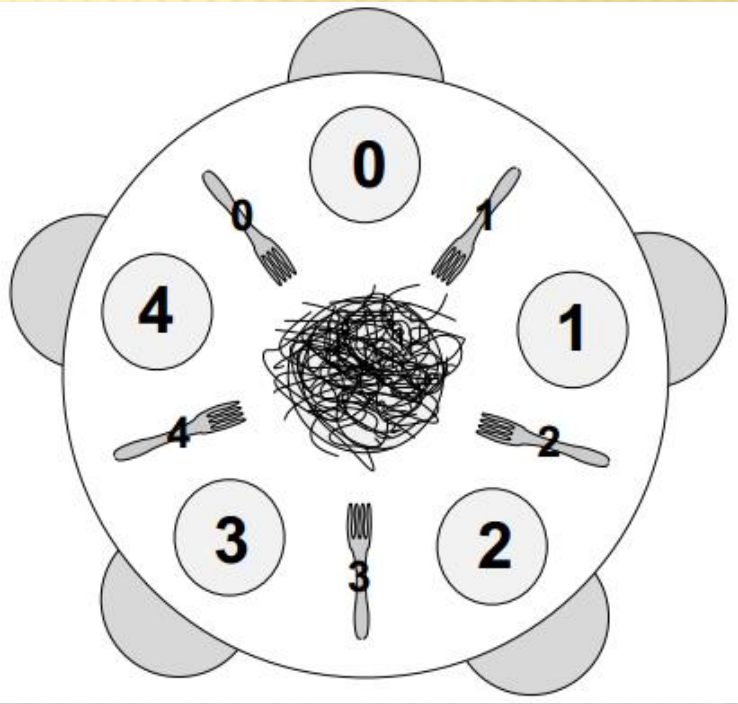
  1. V 1 čase držal vidličku iba jeden filozof



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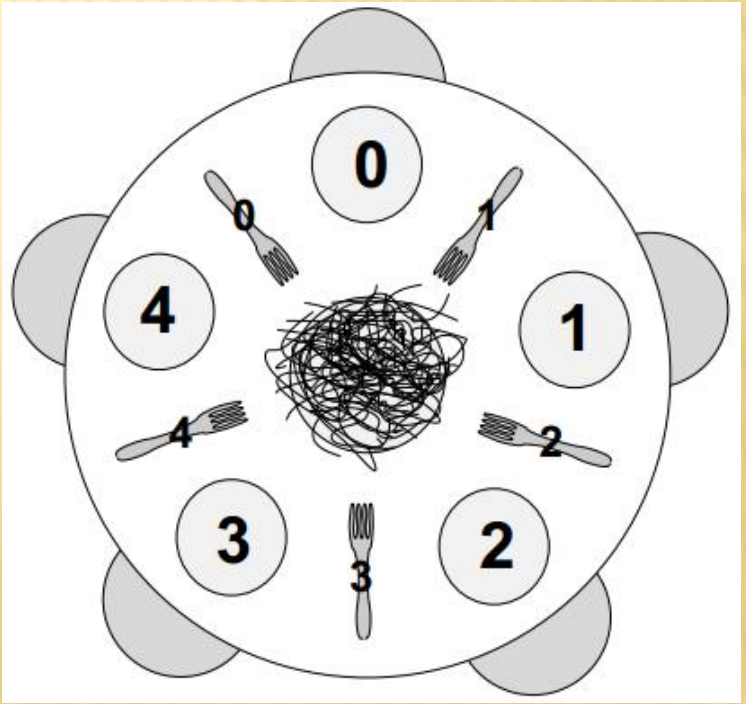
- Naša úloha definovať get() a put() tak, aby:
  1. V 1 čase držal vidličku iba jeden filozof
  2. Nenastalo uviaznutie



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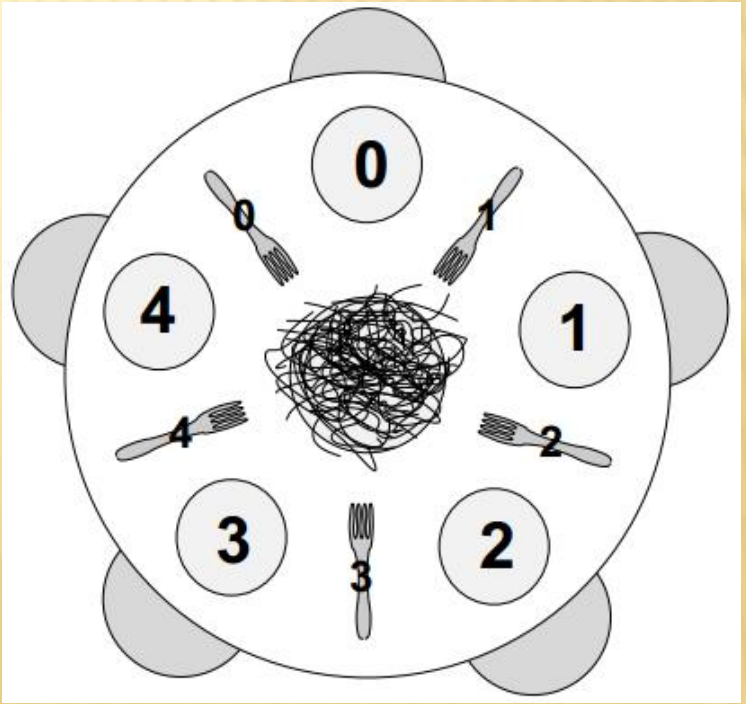
  3. Filozof neumrel od hladu



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  2. Nenastalo uviaznutie
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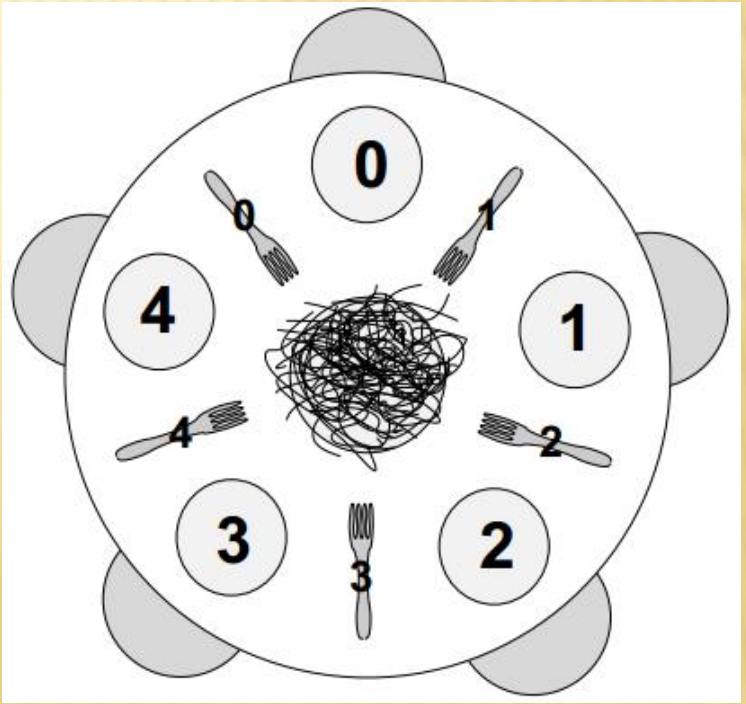
  4. Mohli jesť viacerí filozofi súčasne



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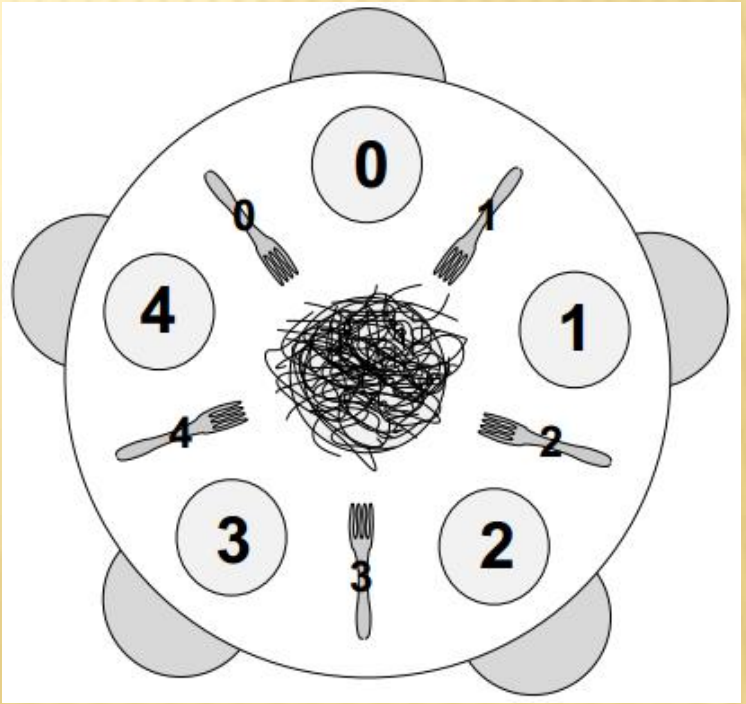

VEČERAJÚCI FILOZOFI

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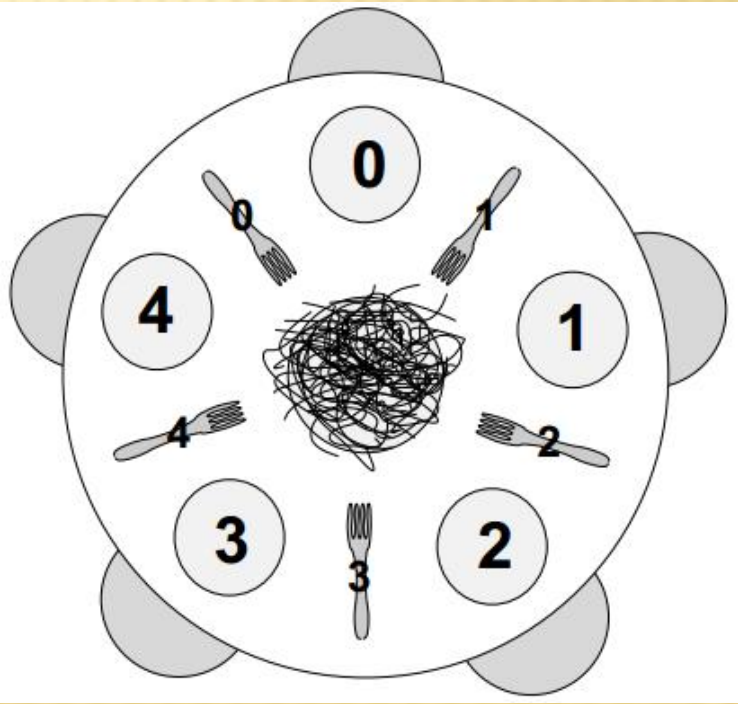
- Nepoznáme funkcie think() a eat()



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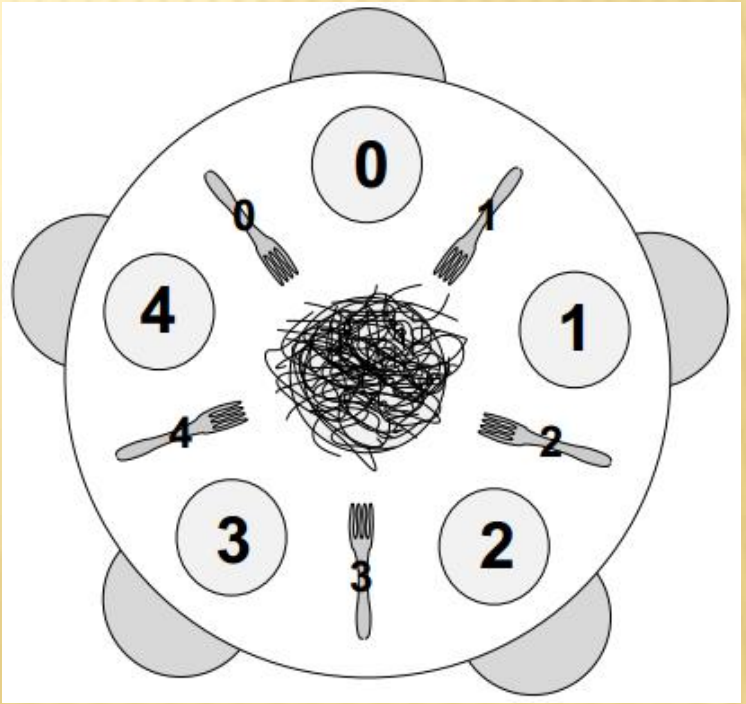
- Nepoznáme funkcie think() a eat(), ale:
  - think() nás z hľadiska synchronizácie nijako nezaujíma



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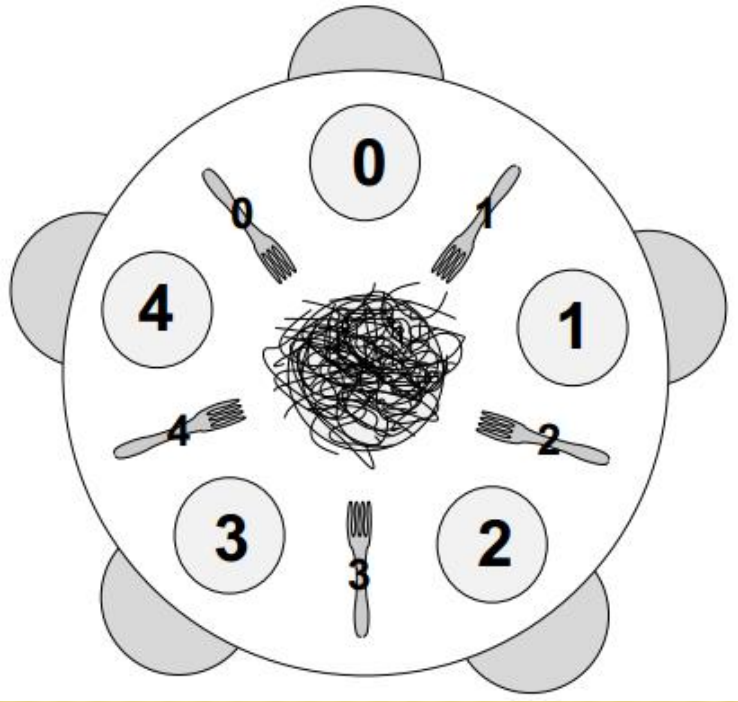

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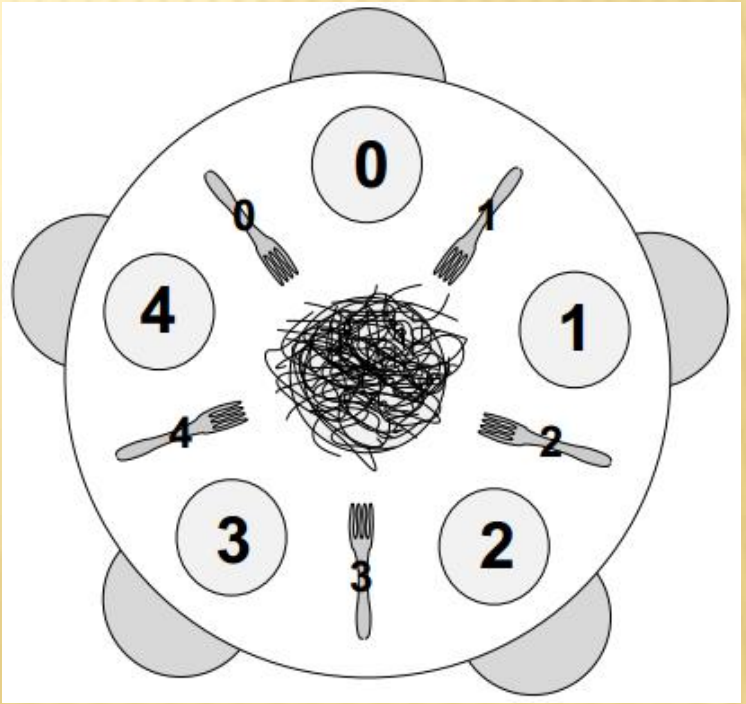
- Nepoznáme funkcie think() a eat(), ale:
  - think() nás z hľadiska synchronizácie nijako nezaujíma
  - eat() musí skončiť v konečnom čase, inak nesplnime podmienku 3!



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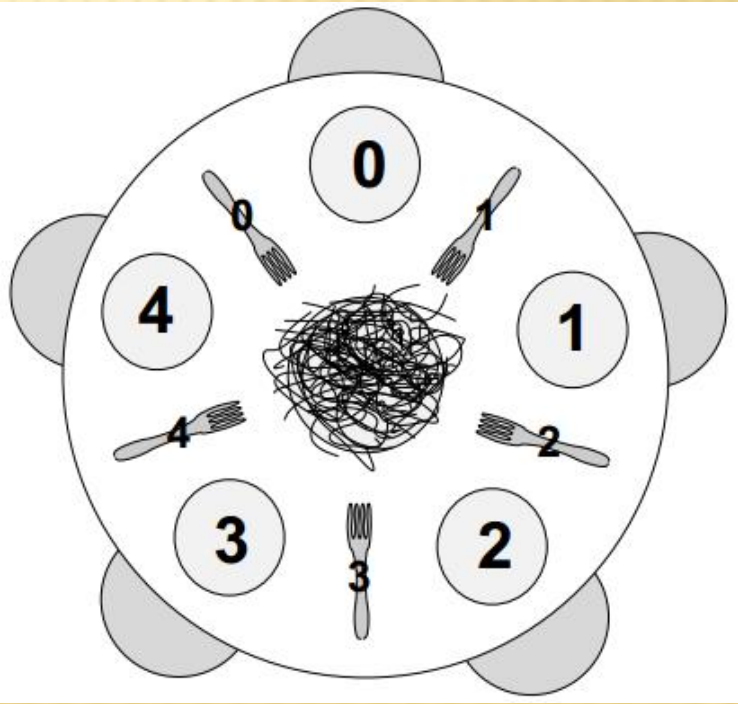
- Definujme pomocné funkcie na určenie id ľavej a pravej vidličky



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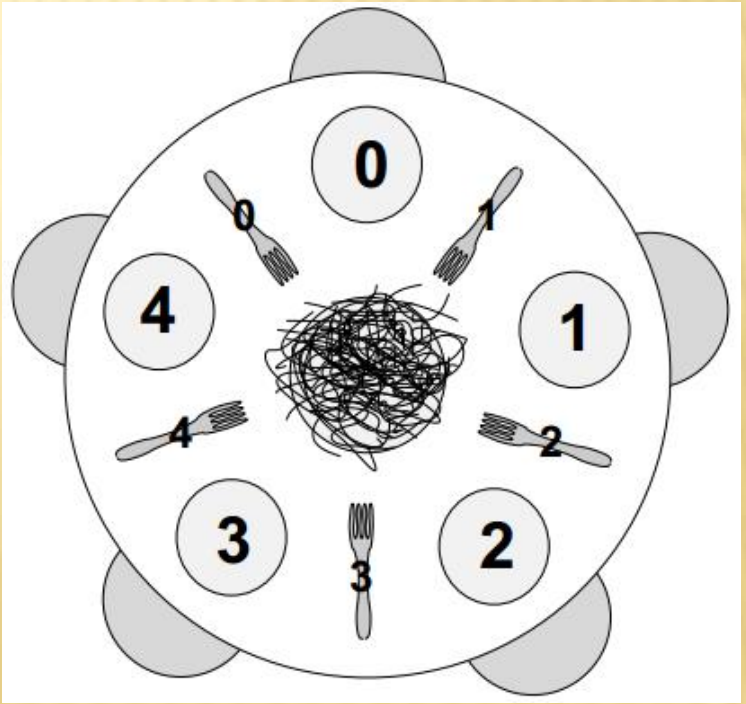
- Definujme pomocné funkcie na určenie id ľavej a pravej vidličky
- Keďže má pre vidličky platiť exkluzívny prístup



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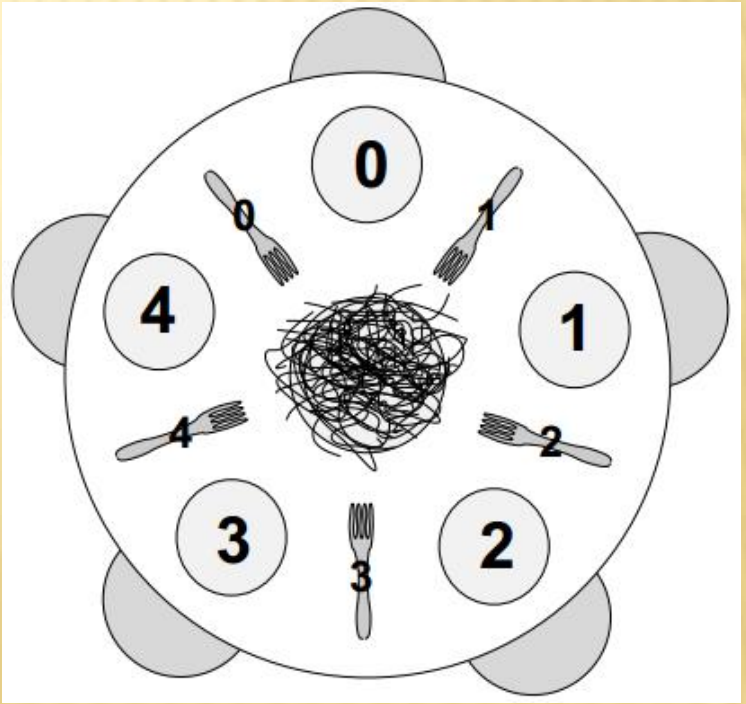
- Definujme pomocné funkcie na určenie id ľavej a pravej vidličky
- Keďže má pre vidličky platiť exkluzívny prístup, pre každú z nich definujme binárny semafor



VEČERAJÚCI FILOZOFI

```
1    while True:
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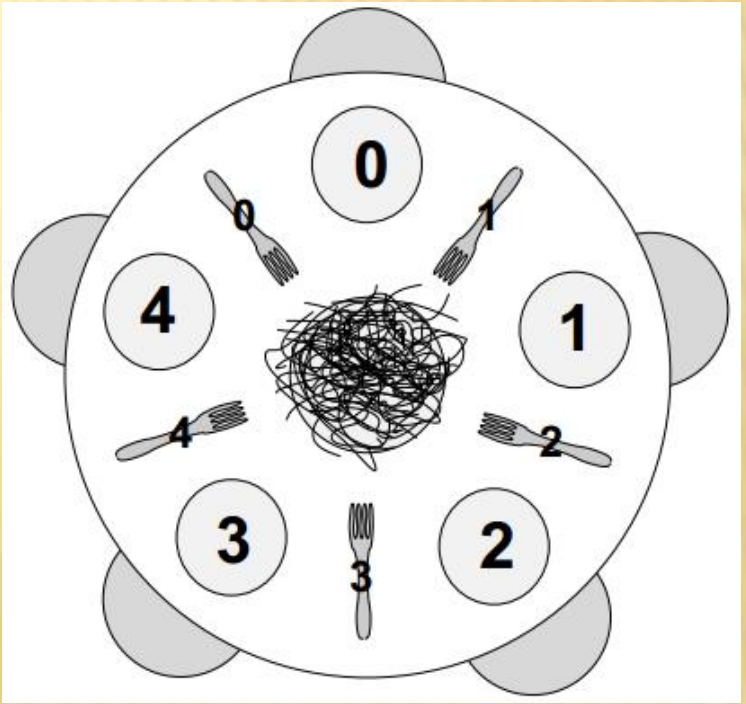
```
1    def right: return i
2    def left: return (i+1) % 5
3
4    forks = [Semaphore(1) for i in range(5)]
```



VEČERAJÚCI FILOZOFI #1

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```

```
   funkcia get_forks
1  def get_forks(i):
2      forks[right(i)].wait()
3      forks[left(i)].wait()
```

```
1  while True:
2      think()
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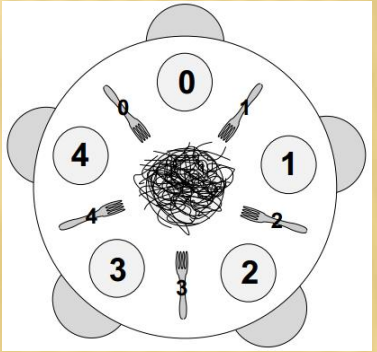

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```
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```
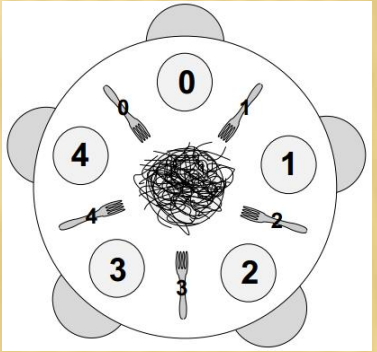

```
     funkcia put_forks
1    def put_forks(i):
2        forks[right(i)].signal()
3        forks[left(i)].signal()
```



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1  while True:
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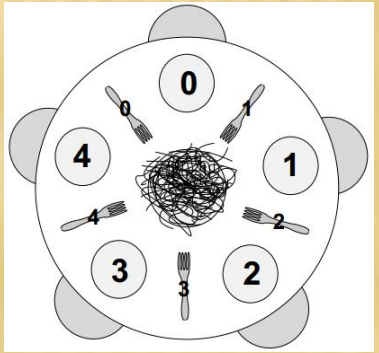

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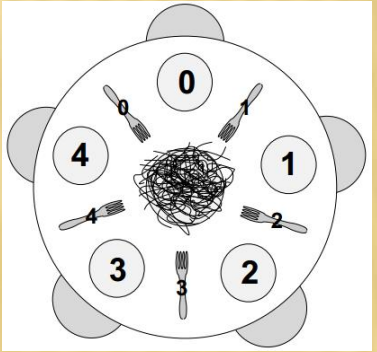
```

- Spĺňame podmienku 1?



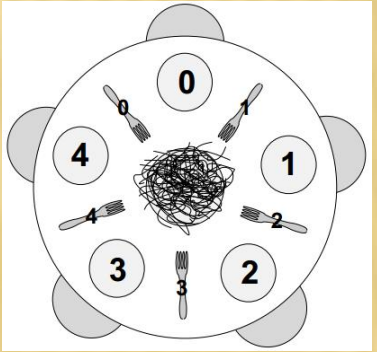
VEČERAJÚCI FILOZOFI #1

```
1   def right: return i
2   def left: return (i+1) % 5
3
4   forks = [Semaphore(1) for i in range(5)]
```

```
    funkcia get_forks
1   def get_forks(i):
2       forks[right(i)].wait()
3       forks[left(i)].wait()
```

```
1   while True:
2       think()
3       get_forks()
4       eat()
5       put_forks()
```

- Spĺňame podmienku 1? (v 1 čase drží vidličku 1 filozof)



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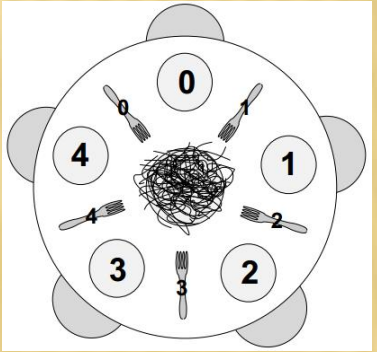
- Spĺňame podmienku 1? (v 1 čase drží vidličku 1 filozof)
- Spĺňame podmienku 2?



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```
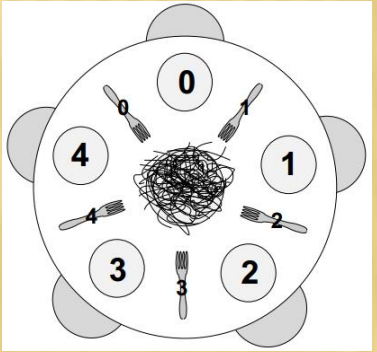

- Spĺňame podmienku 1? (v 1 čase drží vidličku 1 filozof)
- Spĺňame podmienku 2? (nenastane uviaznutie)



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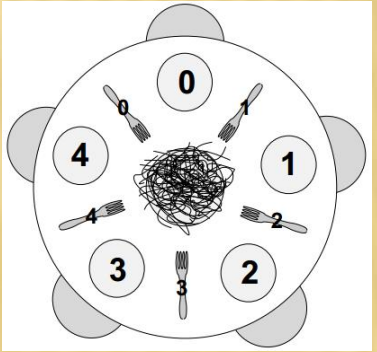
```

- Prečo nastáva uviaznutie?



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1   while True:
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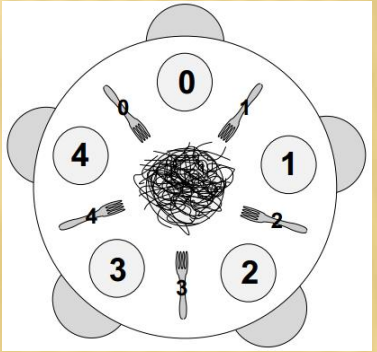
- Prečo nastáva uviaznutie?
  1. Okrúhly stol



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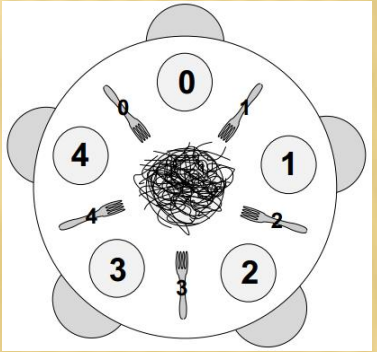
- Prečo nastáva uviaznutie?
  1. Okrúhly stol
  2. Všetci môžu súčasne jesť



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1   while True:
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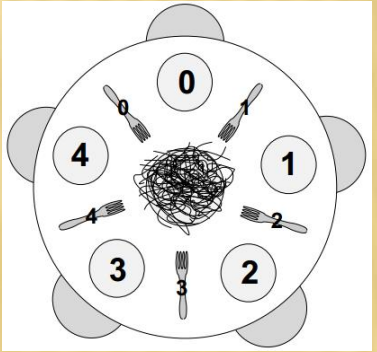
- Prečo nastáva uviaznutie?
  1. Okrúhly stol
  2. Všetci môžu súčasne jesť
  3. Všetci berú najprv pravú vidličku



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```
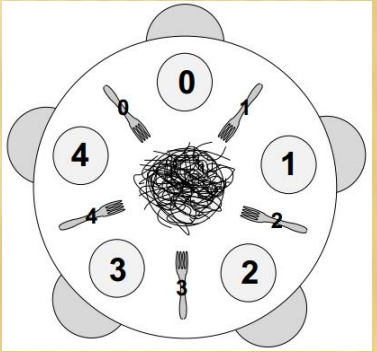

- Ako odstránime uviaznutie?



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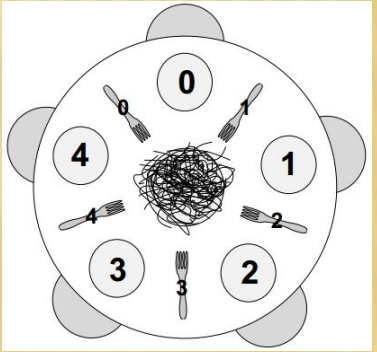
```

- Ako odstránime uviaznutie?
- Zrušíme aspoň **jednu** z podmienok uviaznutia



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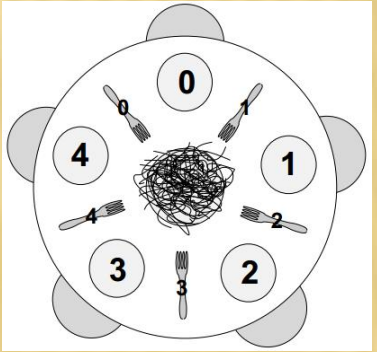
- Ako odstránime uviaznutie?
  - Zmeníme stôl?



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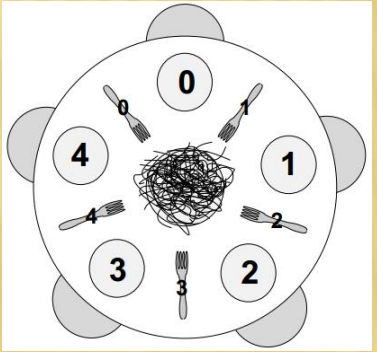
- Ako odstránime uviaznutie?
  - Zmeníme stôl? Asi nie…



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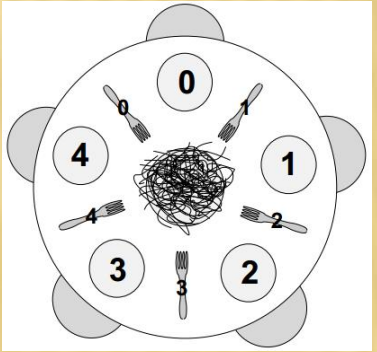
- Ako odstránime uviaznutie?
  - Zmeníme stôl? Asi nie…
  - Umožníme jesť naraz max 4?



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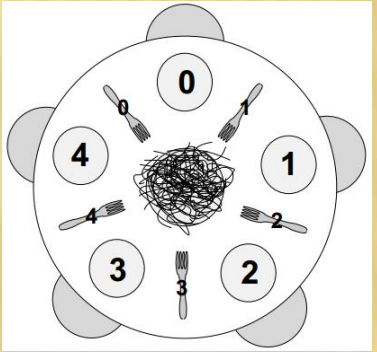

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```
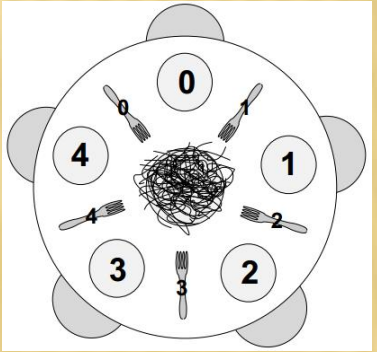

- Ako odstránime uviaznutie?
  - Zmeníme stôl? Asi nie…
  - Umožníme jesť naraz max 4? Ako?
  - Zavedieme ľavákov a pravákov?



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- Ako odstránime uviaznutie?
  - Zmeníme stôl? Asi nie…
  - Umožníme jesť naraz max 4? Ako?
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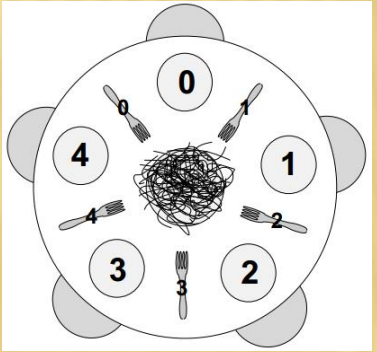

VEČERAJÚCI FILOZOFI #2

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```

```
1   while True:
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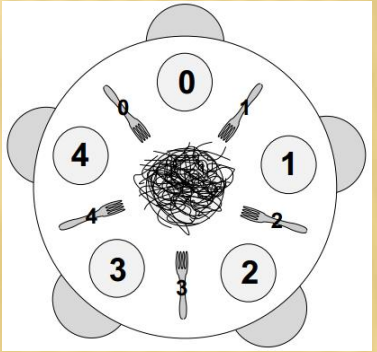
```

- Skúsme riešiť…



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```

```
1   while True:
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4       eat()
5       put_forks()
```
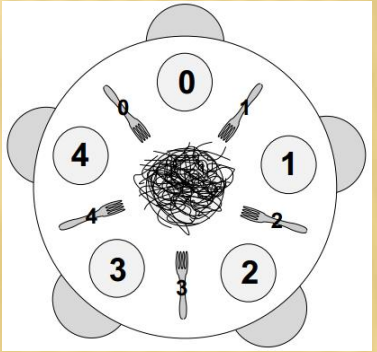

- Skúsme riešiť… obmedzenie max počtu tých, ktorí môžu naraz jesť



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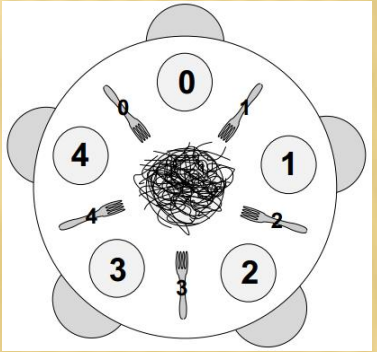
- Zavedieme čašníka (footman)



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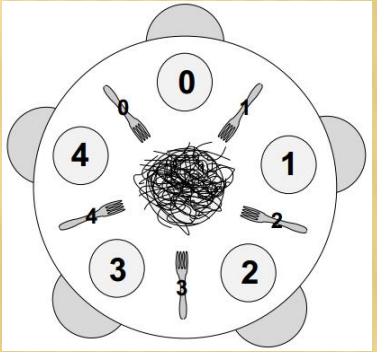
- Zavedieme čašníka (footman)
  - + semafor



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```

```
1   while True:
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3       get_forks()
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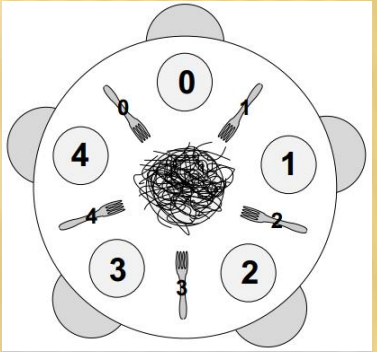
5       put_forks()
```

- Zavedieme čašníka (footman)
  - semafor
  - inicializovaný na max počet naraz jeduvších



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```
   funkcia put_forks
1  def put_forks(i):
2      forks[right(i)].signal()
3      forks[left(i)].signal()
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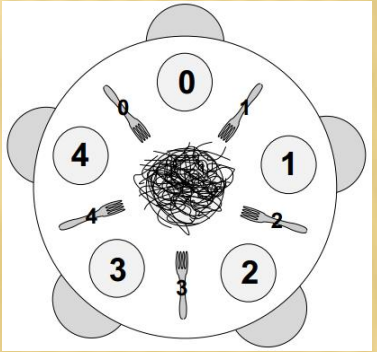
```



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     funkcia get_forks
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3        forks[right(i)].wait()
4        forks[left(i)].wait()
```

```
1    while True:
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4        eat()
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```
     funkcia put_forks
1    def put_forks(i):
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3        forks[left(i)].signal()
4        footman.signal()
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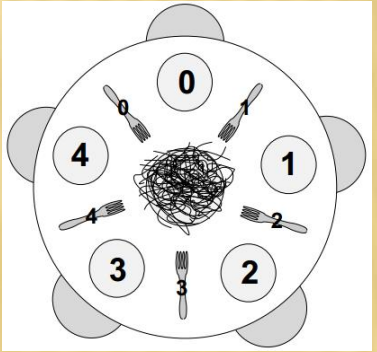

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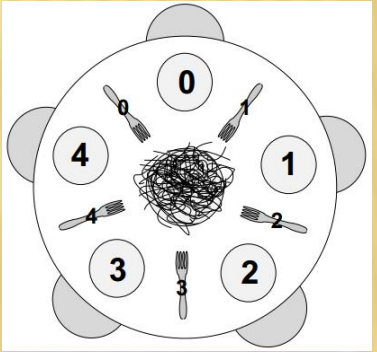
- Podmienka 1 (1 v pre 1 f v 1 c)



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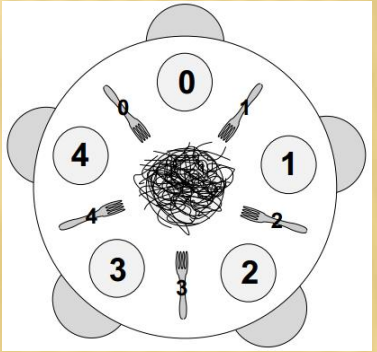
- Podmienka 1 (1 v pre 1 f v 1 c)
- Podmienka 2 (deadlock)



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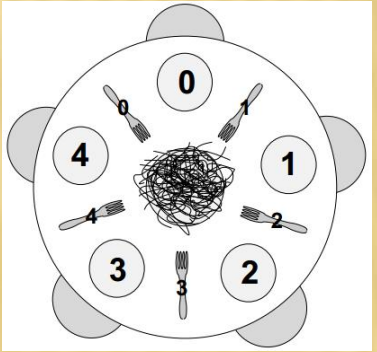
1   while True:
2       think()
3       get_forks()
4       eat()
5       put_forks()
```

- Podmienka 1 (1 v pre 1 f v 1 c)
- Podmienka 2 (deadlock)
- Podmienka 3 (vyhladnutie)



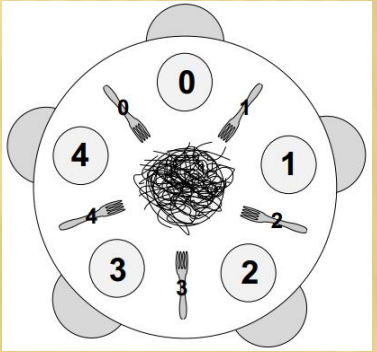
VEČERAJÚCI FILOZOFI #2

```
1  def right: return i
2  def left: return (i+1) % 5
3
4  forks = [Semaphore(1) for i in range(5)]
```

```
   funkcia get_forks
1  def get_forks(i):
2      footman.wait()
3      forks[right(i)].wait()
4      forks[left(i)].wait()
```

```
1  while True:
2      think()
3      get_forks()
4      eat()
5      put_forks()
```

- Podmienka 1 (1 v pre 1 f v 1 c)
- Podmienka 2 (deadlock)
- Podmienka 3 (vyhladnutie)
- Podmienka 4 (konkurentnosť)



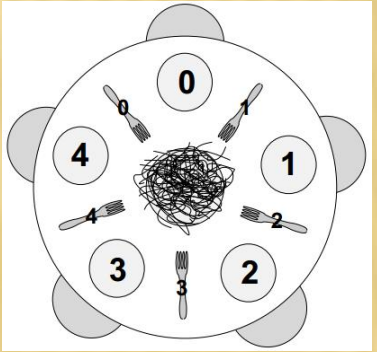
VEČERAJÚCI FILOZOFI #3

```
1  def right: return i
2  def left: return (i+1) % 5
3
4  forks = [Semaphore(1) for i in range(5)]
```

```
   funkcia get_forks
1  def get_forks(i):
2      forks[right(i)].wait()
3      forks[left(i)].wait()
```

```
1  while True:
2      think()
3      get_forks()
4      eat()
5      put_forks()
```

- Ako odstránime uviaznutie?
  - Zmeníme stôl? NIE
  - Umožníme jesť naraz max 4? ÁNO
  - Zavedieme ľavákov a pravákov? Ako?



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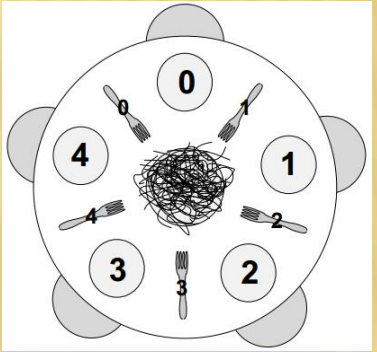
- Ľaváci a praváci



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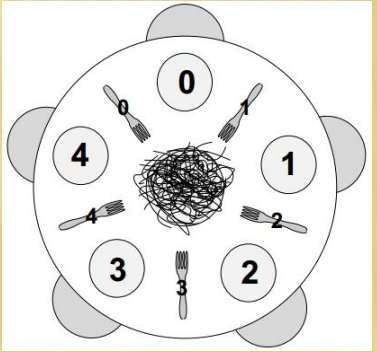
- Ľaváci a praváci
  - Aspoň 1 ľavák, aspoň 1 pravák



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```
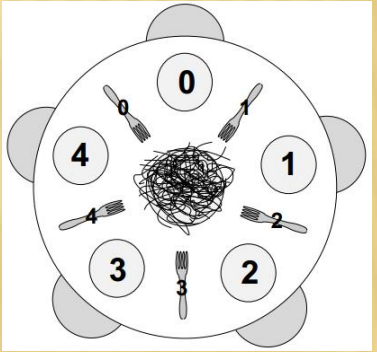

- Ľaváci a praváci
  - Aspoň 1 ľavák, aspoň 1 pravák
  - Ako to funguje?



CVIČENIE

- Prvá časť: obe riešenia problému filozofov
- Druhá časť: analýza a riešenie zápočtového príkladu z roku 2017