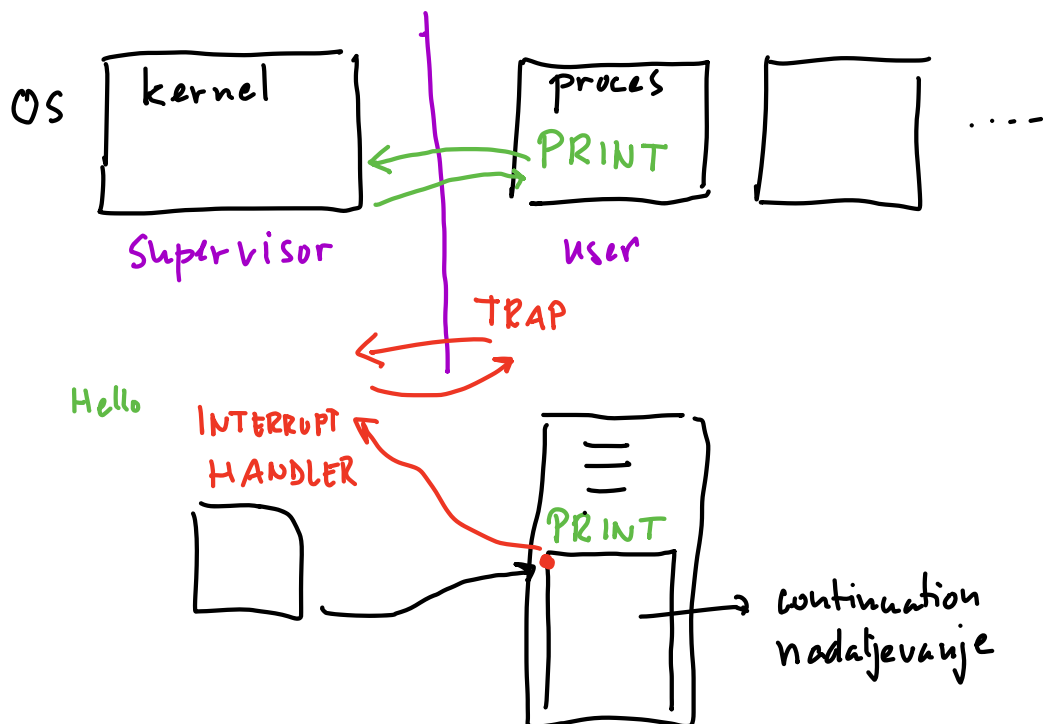


Algebraični računski učinki

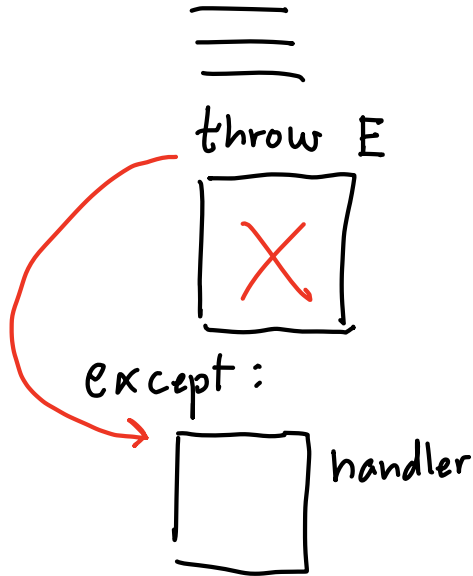
Operacije:

- `print` : `string` \rightarrow `unit`
- `read` : `unit` \rightarrow `string`
- `lookup` / `update` `set` / `get`
- `raise` / `throw` / `abort`
- `choose` / `select` — nedeterminizem
 `choose(x,y)`
- `flip` : `unit` \rightarrow `bool` "naključni" bit



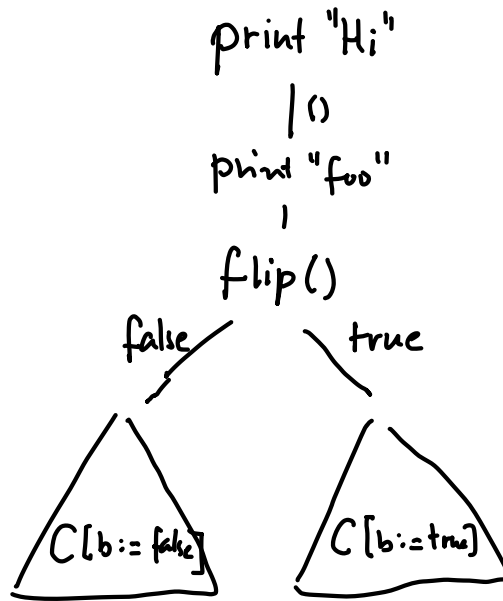
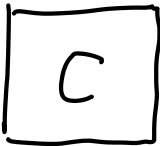
Izjeme:

try:

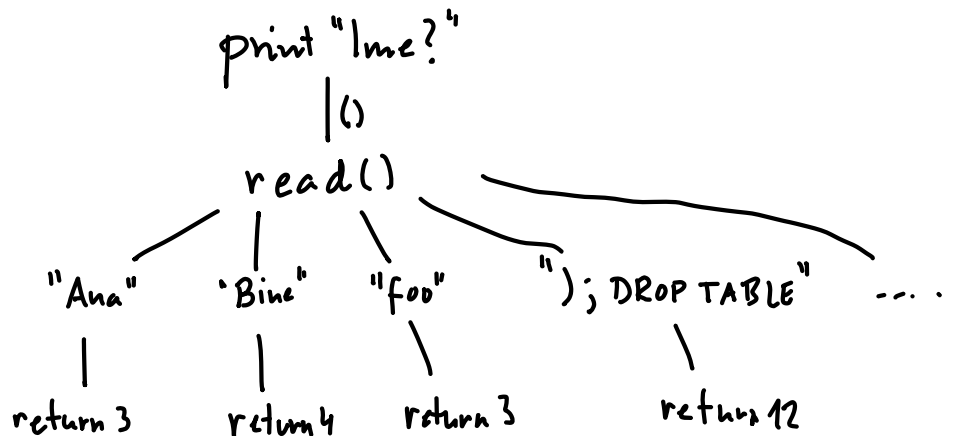


Drevo izračuna

```
print "Hi";  
print "foo";  
b = flip();
```



```
print "Ime?";  
s = read();  
return len(s)
```



Algebra :

operacije + x -
 konstante 0 1

$$x - y = x + (-y)$$

enačbe/aksiomi : $(x+y)+z = x+(y+z)$

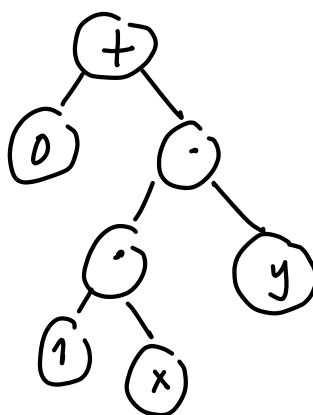
$$x+0 = x$$

$$x \cdot 1 = x$$

$$x+(-x) = 0$$

⋮

$$0 + (1 \cdot x) \cdot y$$



Primer :

operacija *

dvojista

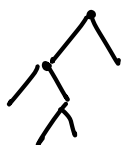
data Tree =

konstanta e

| Node Tree Tre.

| Empty

$$(e * (e * e)) * e$$



Enačbe v računskih učinkih ?

Enačbe za stanje :

množica/tip stanj S

get : unit \rightarrow S

put : S \rightarrow unit

```
put 5;  
put 6;  
x = get();  
return x
```

=

```
put 6;  
x = get();  
return x
```

=

```
put 6;  
return 6
```

```
a = put 5;  
b = put 6;  
x = get();  
return x
```

$\text{put}(5, \lambda a. \text{put}(6, \lambda b. \text{get}(), \lambda x. \text{return } x)))$

$\text{put}(5, K) = \text{izvedi operacijo put 5}$
 $\text{in nato izvedi } K$

ENACĀBE { $\text{put}(a, \lambda_. \text{put}(b, K)) = \text{put}(b, K)$
 $\text{get}(\lambda x. \text{put}(x, K)) = \text{get}(\lambda x. K())$
+2