G54FOP: Lecture 6 Operational Semantics III: State

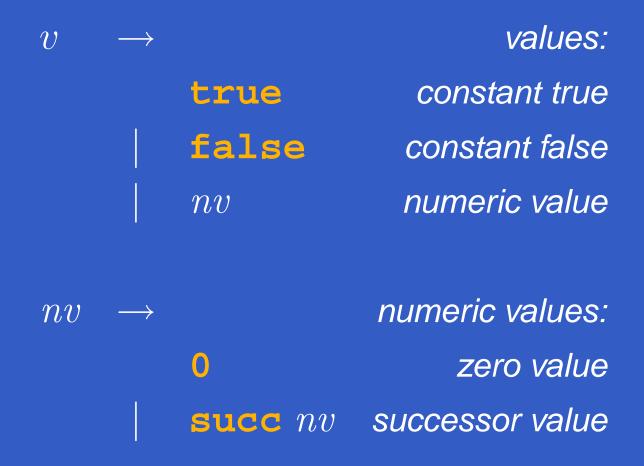
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Small Expression Language: Terms

```
terms:
                       constant true
true
false
                       constant false
if t then t else t
                          conditional
                       constant zero
succ t
                          successor
pred t
                        predecessor
iszero t
                           zero test
```

Small Expression Language: Values



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- $[l \mapsto v]\mu$: Update; like μ except $([l \mapsto v]\mu)(l) = v$

Small Imperative Language (1)

New terms; extends the terms of Small Expression Language:

```
terms:
unit constant unit
new t
          allocation
       dereferencing
t = t assignment
       store location
t , t sequencing
```

Small Imperative Language (2)

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```
v 	o values: \ \dots \ | \ unit \ unit value \ | \ l \ store location
```

Note: Still an expression language in that every term is an expression that evaluates to a value, even if some expressions have side effects. No separate category of commands.

Homework Lecture 6 (1)

1. Consider the Small Imperative Language. Add a loop construct:

Provide evaluation rule(s) for this construct, assuming the usual semantics of a while loop: repetition of loop body **zero** or more times as long as loop condition is true.

Hint: Make use of what you have!

Homework Lecture 6 (2)

- 2. As mentioned, our language is still an expression language where expressions may have side effects. Design a new language (syntax and op. sem.) by separating the terms into
 - expressions: do not have side effects
 - commands: have side effects

and making any other changes you see fit.
Don't worry too much if the resulting language isn't "useful" (the Small Imperative Language isn't really). Can the evaluation rules for expressions somehow be simplified by exploiting that expressions do not have side effects?