A Programming Language for Future Interests

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In this talk

- We made a thing
- How it works
- Why it matters

Collaborators

- Shrutarshi Basu (Harvard CS)
- Nate Foster (Cornell CS)
- Shan Parikh (Cornell ’21)
- Ryan Richardson (Cornell ’21)

I. We made a thing

Two kinds of Property students

- "Future interests don't make any sense."
- "Future interests are the only part of this course that makes any sense."

A common intuition

- Estates and future interests are different
  - Super-bright-line rules
  - Highly mechanical
  - Rigid syntax
- Like learning a foreign language …
  - … or like learning a *programming* language

Demo

What was *that?*

- We taught a computer to how to interpret conveyances of future interests
- Live online at https://conveyanc.es
- *Property Conveyances as a Programming Language* (Onward 2019), and *A Programming Language for Future Interests* (in submission)

II. How it works

Orlando:
a language

Littleton:
an interpreter

Three big ideas

- *Syntax* for the language of conveyances
- A *data structure* for the state of title
- *Semantics* to update in response to events

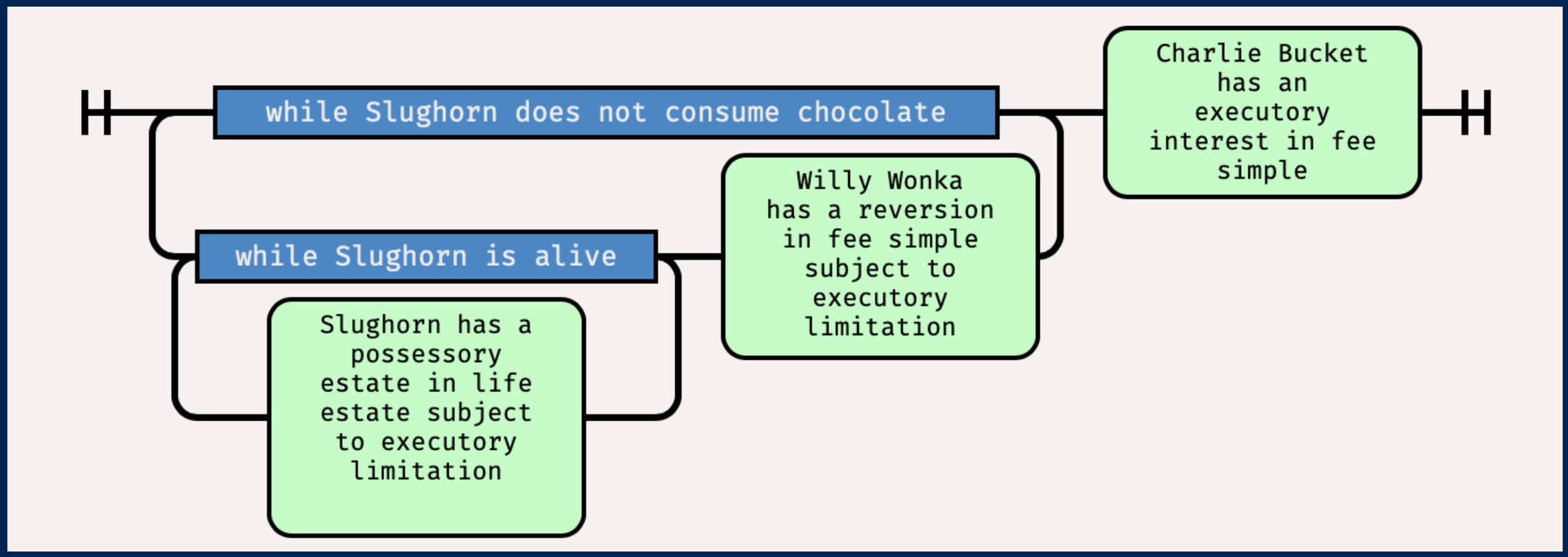
Syntax: a formal grammar

```
grant     -> to person duration
grant     -> grant, then grant

person    -> Alice
person    -> Bob

duration  -> for life
duration  -> and pronoun heirs
```

Parsing a conveyance

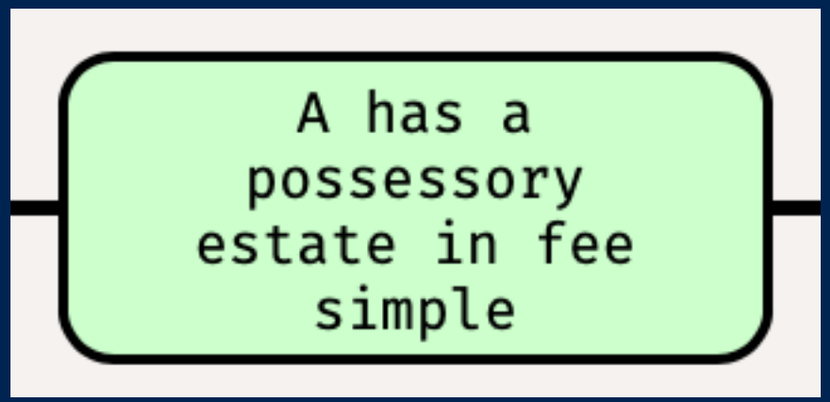
```
to Alice for life, then to Bob and his heirs
to person for life, then to Bob and his heirs
to person duration, then to Bob and his heirs
grant, then to Bob and his heirs
grant, then to person and his heirs
grant, then to person and pronoun heirs
grant, then to person duration
grant, then grant
grant
```

A data structure: title trees



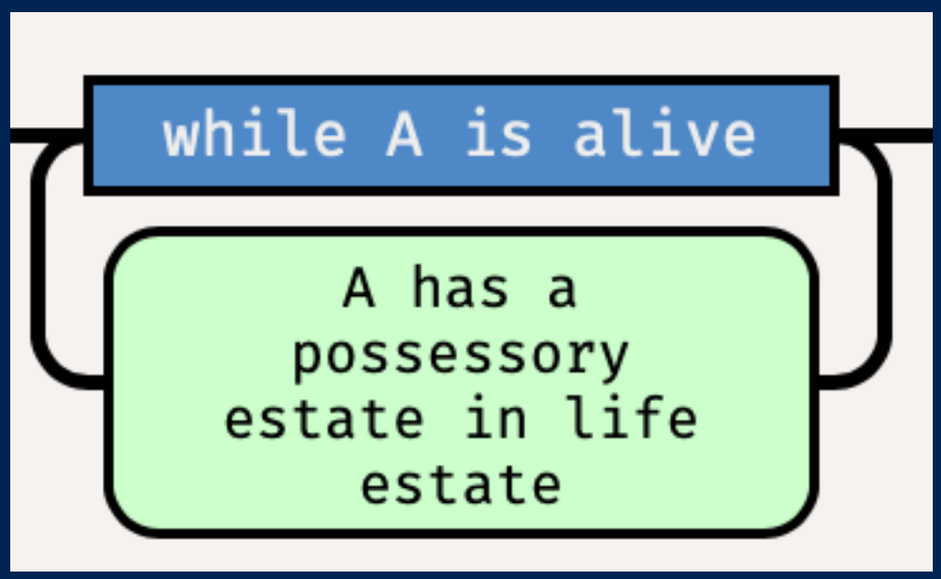
Translating conveyances

to A

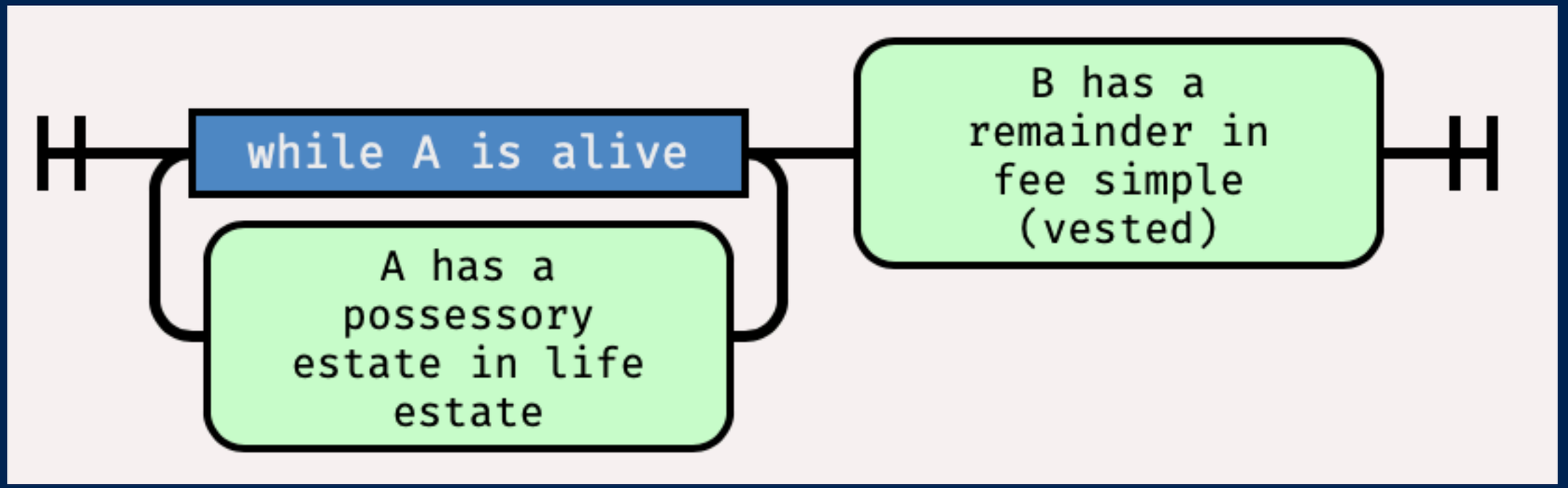


for life

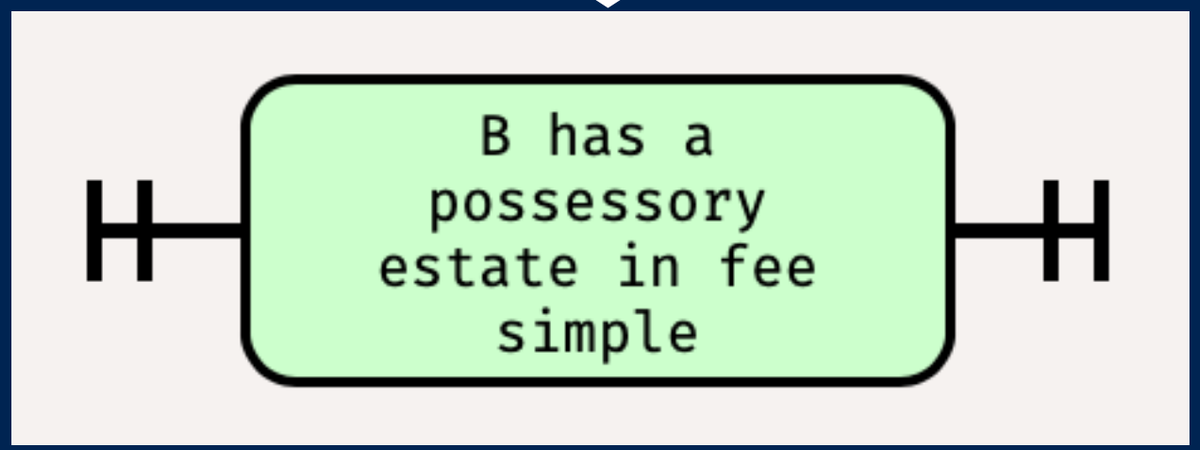
to A for life



Semantics



A dies



Math under the hood

$$
\begin{aligned}
\delta(\textbf{to } p) &= \textbf{to } p \\
\delta(\bot) &= \bot \\
\delta(t \textbf{ while } c) &= \begin{cases} \delta(t) \textbf{ while } c & \text{if } \models c \text{ and } \delta(t) \neq \bot \\ \bot & \text{if } \not\models c \\ \bot & \text{if } \delta(t) = \bot \end{cases} \\
\delta(\textbf{if } c \textbf{ then } t_1 \textbf{ else } t_2) &= \begin{cases} \delta(t_1) & \text{if } \models c \\ \delta(t_2) & \text{if } \not\models c \end{cases} \\
\delta(t_1 \to t_2) &= \begin{cases} \delta(t_1) \to t_2 & \text{if } \delta(t_1) \neq \bot \\ \delta(t_2) & \text{if } \delta(t_1) = \bot \end{cases}
\end{aligned}
$$

Modeling property law

- Quanta: fee simple, fee tail, life estate, term of years
- Special limitations, conditions precedent, conditions subsequent, executory limitations
- Implied reversions, multiple conveyances
- Naming, vesting, and the Rule Against Perpetuities

III. Why it matters

A mirror of property law

- There's a reason future interests are so arid
  - The way they're taught, they're close to a programming language already
- The grammar of future interests is:
  - Recursive
  - Modular

Programming languages and legal language

- Orlando captures the linguistic structure of property conveyances: a flexible set of basic elements combined according to fixed rules
- Some areas of law are well-suited to this:
  - Contracts
  - Tax
  - Statutory drafting

Applications

- Teaching tool
  - Easy visualization
  - Highly interactive
- Foundation for future scholarship
- Foundation for future practitioner tools

Discussion