SimpliPy: A notional machine for learning Python

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Notional Machine for Python with Conditionals

Syntax

- A block is an interval of locations

- New statement: if then else
  - test expression
  - then block
  - else block

```
0  x = 5
1  if x < 10:
2      z = 0
3  else:
4      z = 1
5
```

Control Transfer Functions: `true` and `false`

```
0  x = 5
1  if x < 10:
2      z = 0
3  else:
4      z = 1
5
```

Loc	next	true	false	err
0	1	-	-	5
1	-	2	4	5
2	5	-	-	5
3	-	-	-	-
4	5	-	-	5
5	-	-	-	-

Control Flow Graph

```
0  x = 5
1  if x < 10:
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```

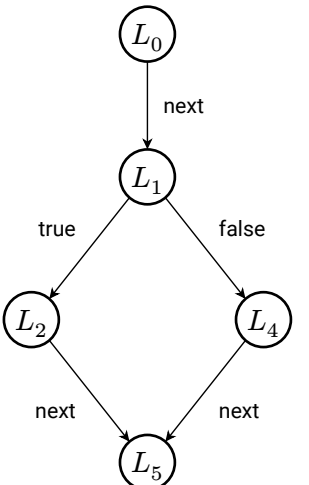

State of the Machine

No changes need to be made to the state to accommodate conditionals.

$$\text{State} = \text{Loc} \times \text{Env}$$

if exp: transition

$$(i, e) \xrightarrow{\text{tick}} \begin{cases} (\text{true}(i), e) & \text{if res} = \text{true} \\ (\text{false}(i), e) & \text{if res} = \text{false} \\ (\text{err}(i), e) & \text{otherwise} \end{cases}$$

$$\text{if}$$

$$P_i ::= \text{if exp}$$

$$\text{where}$$

$$\text{res} = \text{eval}(\text{exp}, e)$$

Note that this transition does not modify the environment.

Run of the Machine

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Execution Diagram

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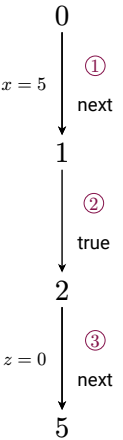

$$e = \begin{cases} x \mapsto 5 \ ① \\ z \mapsto 0 \ ③ \end{cases}$$

Example with error: Control Transfer Functions

```
0  x = 5
1  if x > 10:
2      y = 10
3  else:
4      z = 20
5  x = y + z
6  z = x
7
```

Loc	next	true	false	err
0	1	-	-	7
1	-	2	4	7
2	5	-	-	7
3	-	-	-	-
4	5	-	-	7
5	6	-	-	7
6	7	-	-	7
7	-	-	-	-

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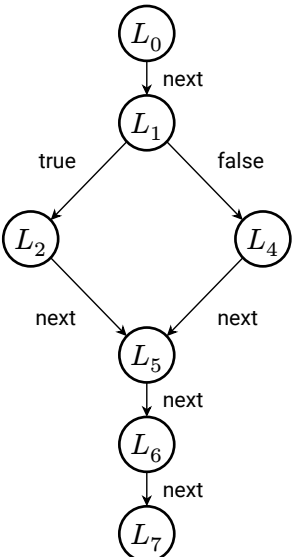

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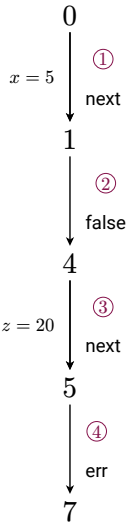

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Summary

- `ifte` statement
- `true` and `false` control transfer functions
- `if exp` transition