Abrupt Termination in Java

Reasons for abrupt termination

- `continue` **(with or w/o label)** } **loop (current iteration)**
- `break` **(with or w/o label)** } **loop,** `switch`**, labelled block**
- **exception** } `try-catch` **statement (also: block, loop, method)**
- `return` } **method (also:** `try-catch`**, block, loop)**

Abrupt Termination in Java: Examples

Loop terminated by `break`

```
while (true) {

    if (i==10) break;

    i++;

}
```

Abrupt Termination in Java: Examples

`try-catch-finally` with exception

```
try {
    x=y/z;
 } catch(ArithmeticException e) {
    x = 0;
 } finally {
    z = z+1;
}
```

Integrating Abrupt Termination into DL

- **New semantics for $\langle p \rangle F$:**

  p terminates normally (not abruptly) and F holds in the final state

- **There is no "return value" describing the reason for termination**

Possible Contexts of an Abrupt Termination

- **method**
- **block**
- `switch` **statement**
- `while`, `do-while`, `for` **loops**
- `try-catch-finally` **statement**

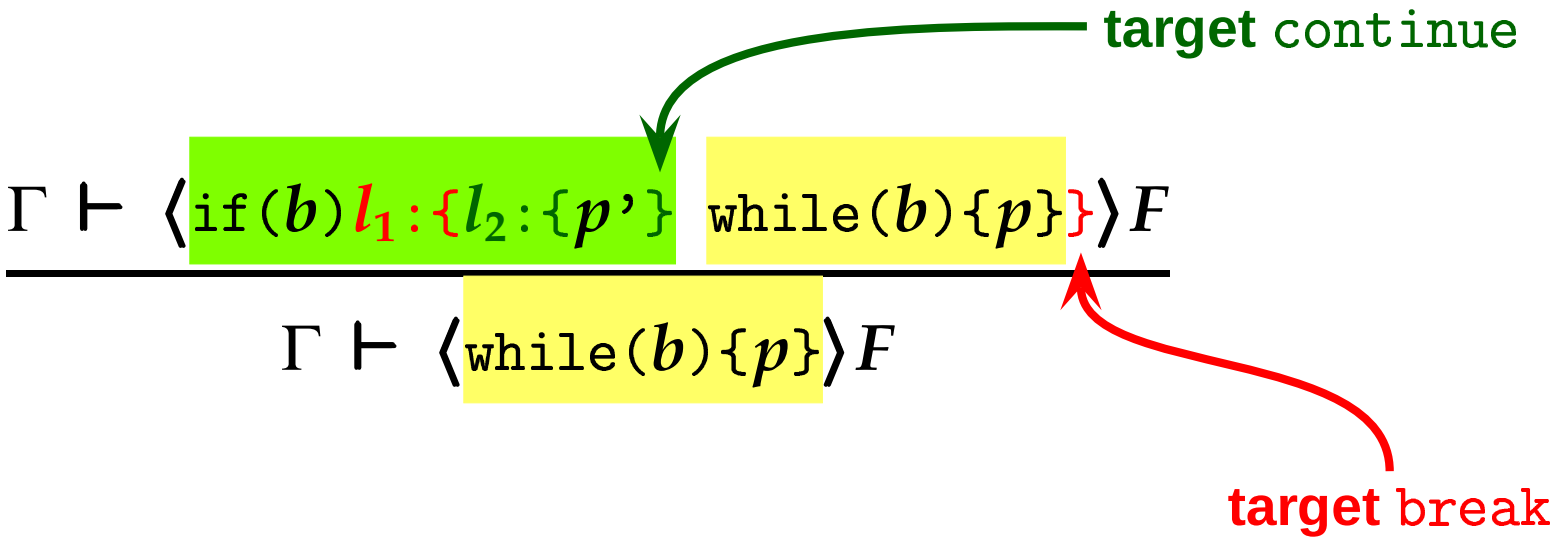
Rule for while Loops

Symbolic execution of one loop iteration

$$\frac{\Gamma \vdash \langle \texttt{if}(b)\, p\ \ \texttt{while}(b)\{p\}\rangle F}{\Gamma \vdash \langle \texttt{while}(b)\{p\}\rangle F}$$

Rule for while Loops

Symbolic execution of one loop iteration



Construction of p':

`break`	$\longrightarrow$	`break` l_1
`continue`	$\longrightarrow$	`break` l_2

Rule for while Loops: Example

```
while (true) {
    if (i==10) break;
    i++;
}
```

$\Big\}\, p$

Rule for while Loops: Example

```
while (true) {
    if (i==10) break;
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}
```

$\}\ p$

$$\frac{\Gamma \vdash \langle \texttt{if(true)l1:\{l2:\{if(i==10) break l1; i++;\}} \texttt{while(true)\{}p\texttt{\}\}} \rangle F}{\Gamma \vdash \langle \texttt{while(true)\{if(i==10) break; i++;\}} \rangle F}$$

Rule for Exception that is Caught

$$\frac{\Gamma \vdash \mathit{instanceof}(\mathit{exc}, T) \qquad \Gamma \vdash \langle \texttt{try\{}e\texttt{=}\mathit{exc}\texttt{; } q\texttt{\}finally\{}r\texttt{\}}\rangle F}{\Gamma \vdash \langle \texttt{try\{throw } \mathit{exc}\texttt{; } p\texttt{\}catch(}T\ e\texttt{)\{}q\texttt{\}finally\{}r\texttt{\}}\rangle F}$$

Rule for Exception that is Caught: Example

```
try {throw exc; return 3;}
catch (Exception e) {return 4;}
finally {return 5;}
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Rule for Exception that is Caught: Example

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Rule for Exception that is Caught: Example

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Rule for Exception that is Caught: Example

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Example

Proof obligation

```
while (true) {
  if (i==10) then break;
  i++;
}
```

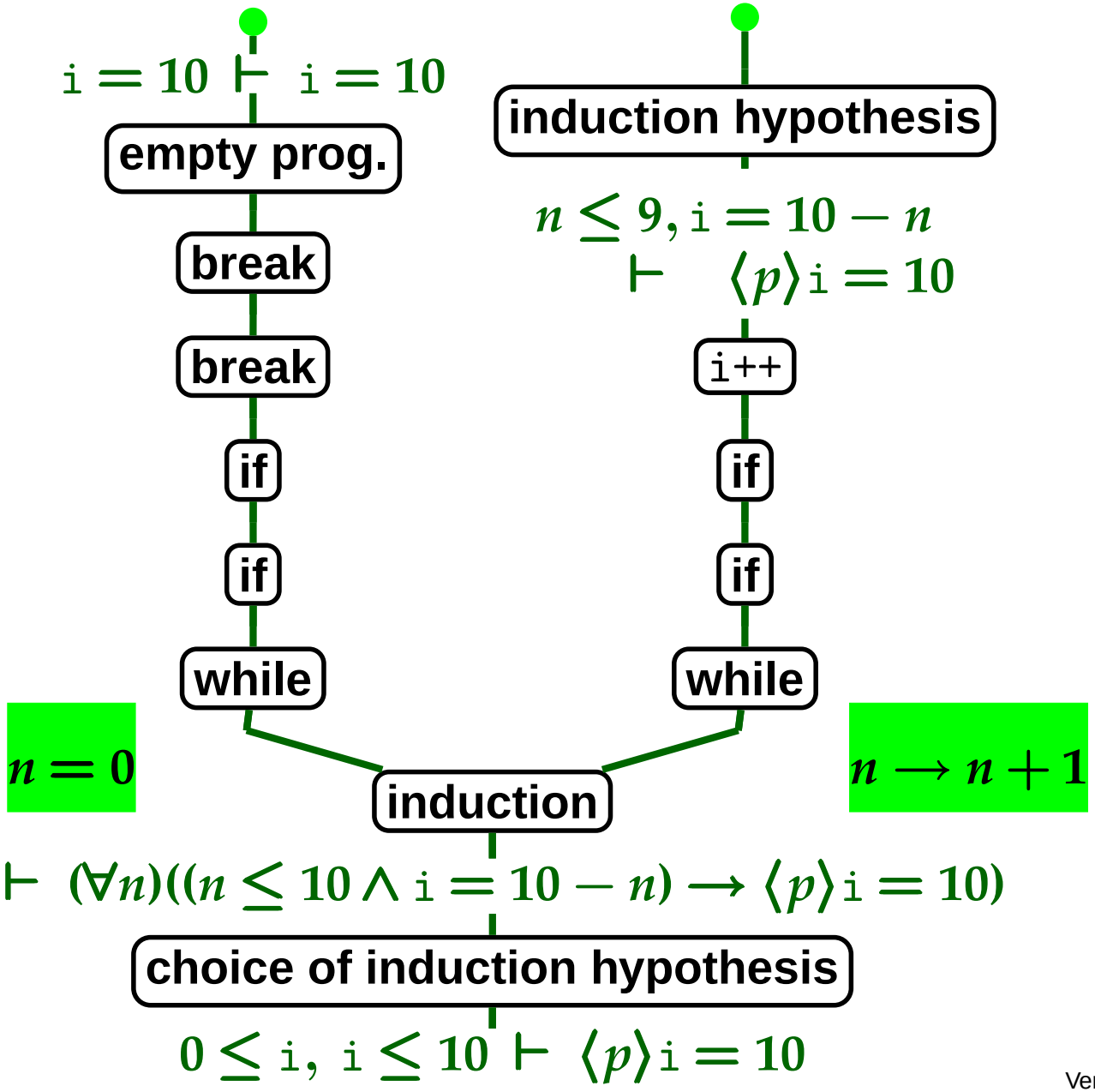
$\Big\}\ p$

terminates with $\mathtt{i} = 10$ if started with $0 \leq \mathtt{i} \leq 10$

Formal

$$0 \leq \mathtt{i},\ \mathtt{i} \leq 10 \vdash \langle p \rangle \mathtt{i} = 10$$

Example




```
while (true) {
  if (i==10) then
    break;
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