Lecture 11

Program Correctness: Strategy

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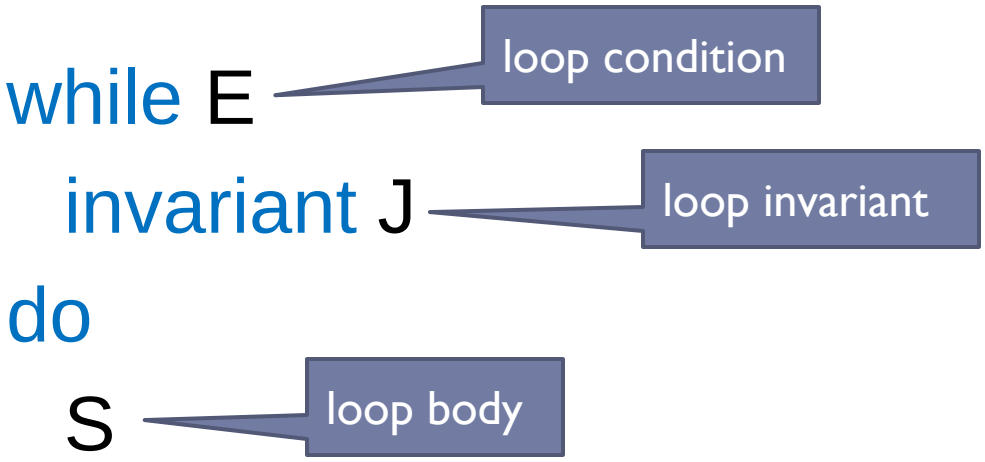
slides acknowledgements: Z. Manna, R. Leino

Last Time

- Procedures
- Loops
- Loop Invariants

While Loop with Invariant



- Loop body S executed as long as loop condition E holds
- Loop invariant J must hold on every iteration
  - J must hold initially and is evaluated before E
  - J must hold even on final iteration when E is false
  - Provided by a user or inferred automatically

Desugaring While Loop Using Invariant

- while E invariant J do S end

assert J;

check that the loop invariant holds initially

havoc x; assume J;

jump to an arbitrary iteration of the loop

where x denotes the assignment targets of S

(

assume E; S; assert J; assume false

□

assume ¬E

)

check that the loop invariant is maintained by the loop body

exit the loop

This Time

- Examples, examples, examples…
- Some strategies for proving correctness

(Dumb) Example: Multiply by 2

```
method Multiply2(n:int) returns (r:int)
{
  r := 0;
  var i:int := 0;
  while (i < n)
  {
    r := r + 2;
    i := i + 1;
  }
}
```

- Specification:
  - Given a non-negative integer **`n`**, function **`Multiply2`** multiplies it by 2

Example: Initialize Array

- Signature:

  `InitializeArray(a:array<int>, e:int)`

- Specification:
  - Initializes elements of array **`a`** to **`e`**

Example: Linear Search

- Signature:

  `LinearSearch(a:array<int>, l:int, u:int, e:int) returns (r:bool)`

- Specification:
  - Returns **`true`** if **`e`** is found in array **`a`** between **`l`** and **`u`**, otherwise returns **`false`**