



# Compilers

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## Activation Records

- The information needed to manage one procedure activation is called an activation record (AR) or frame
- If procedure F calls G, then G's activation record contains a mix of info about F and G.

F calls G

## Activation Records

- F is “suspended” until G completes, at which point F resumes
- G's AR contains information needed to
  - Complete execution of G
  - Resume execution of F

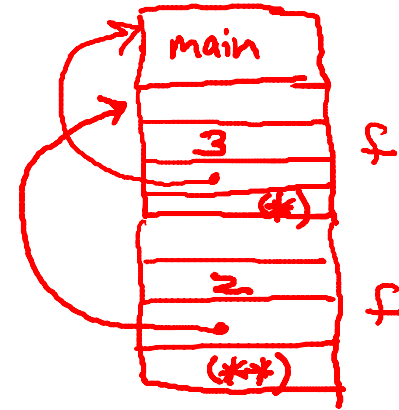
- Space for **G**'s return value
- Actual parameters
- Pointer to the previous activation record
  - The control link; points to AR of caller of **G**
- Machine status prior to calling **G**
  - Contents of registers & program counter
  - Local variables
- Other temporary values

# Activation Records

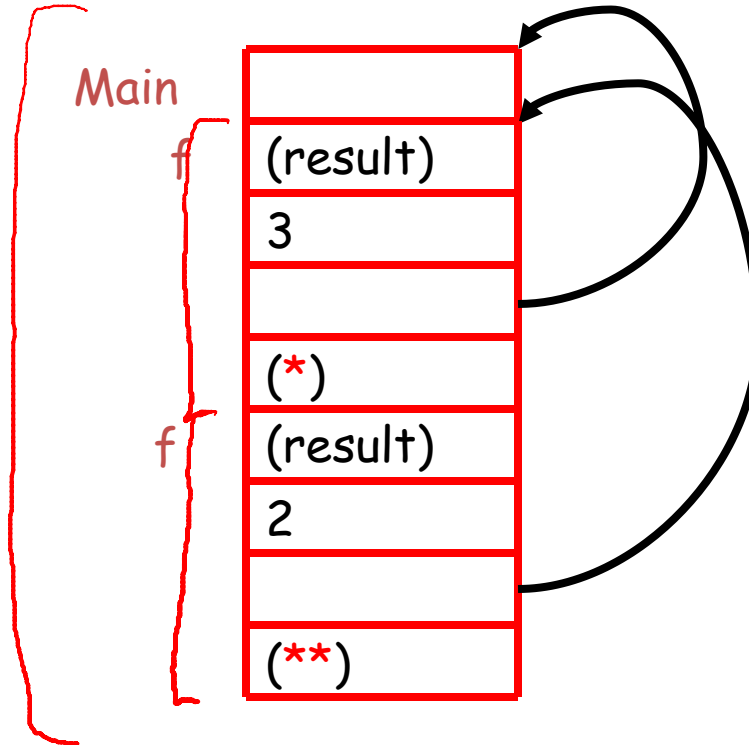
```
Class Main {  
  g() : Int { 1 };  
  f(x:Int):Int {if x=0 then g() else f(x - 1)(**)fi};  
  main(): Int {{f(3); (*)  
  }};};
```

AR for f:

→	<i>result</i>
→	<i>argument</i>
→	<i>control link</i>
→	<i>return address</i>



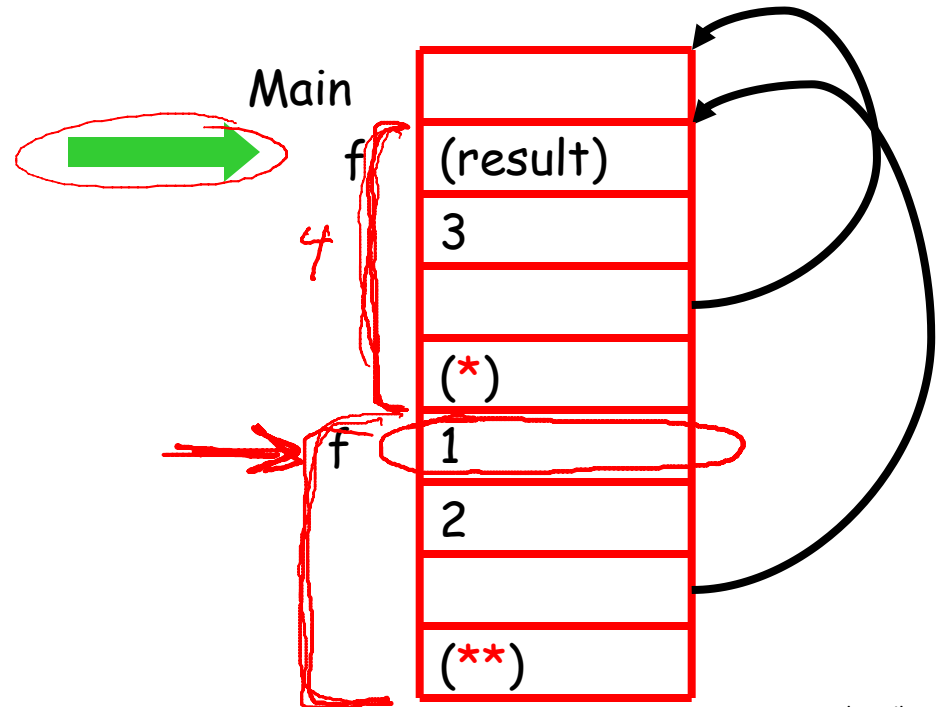
# Activation Records



- **Main** has no argument or local variables and its result is never used; its AR is uninteresting
- (\*) and (\*\*) are return addresses of the invocations of **f**
  - The return address is where execution resumes after a procedure call finishes
- This is only one of many possible AR designs
  - Would also work for C, Pascal, FORTRAN, etc.

# Activation Records

The picture shows the state after the call to the 2nd invocation of **f** returns





- The advantage of placing the return value 1st in a frame is that the caller can find it at a fixed offset from its own frame
- There is nothing magic about this organization
  - Can rearrange order of frame elements
  - Can divide caller/callee responsibilities differently
  - An organization is better if it improves execution speed or simplifies code generation

- Real compilers hold as much of the frame as possible in registers
  - Especially the method result and arguments

The compiler must determine, at compile-time, the layout of activation records and generate code that correctly accesses locations in the activation record

*Thus, the AR layout and the code generator must be designed together!*