Activation Records

CS132

March 7, 2011

CS132

Static Allocation

```
      PROGRAM TEST
       COMMON MAXSIZE
       REAL TABLE(10), TEMP
       MAXSIZE = 10
       READ *, TABLE(1), TABLE(2), TABLE(3)
       CALL QUADMEAN(TABLE, 3, TEMP)
       PRINT *, TEMP
      END

      SUBROUTINE QUADMEAN(A,SIZE,QMEAN)
       COMMON MSIZE
       INTEGER SIZE, K
       REAL A(SIZE), QMEAN, TEMP
       TEMP = 0.0
       IF ((SIZE.GT.MSIZE).OR.(SIZE.LT.1)) GOTO 99
       DO 10 K = 1, SIZE
         TEMP = TEMP + A(K) * A(K)
10     CONTINUE
99     QMEAN = SQRT(TEMP/SIZE)
       RETURN
      END
```

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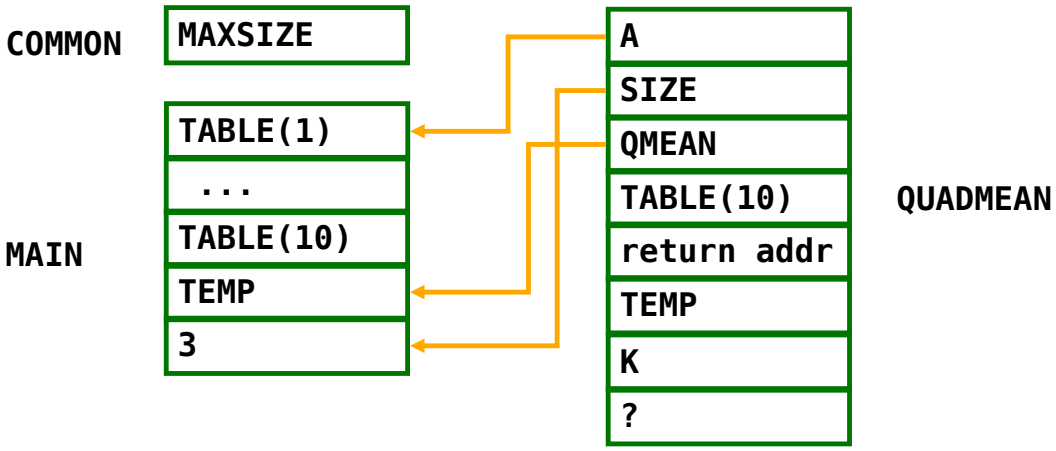
Memory Layout



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Typical Fortran Style

```
SUBROUTINE SSYEVD(JOBZ, UPLO, N, A, LDA, W, WORK, LWORK, IWORK, LIWORK, INFO )

*  .. Scalar Arguments ..
   CHARACTER JOBZ, UPLO
   INTEGER INFO, LDA, LIWORK, LWORK, N

*  .. Array Arguments ..
   INTEGER IWORK( * ) REAL A( LDA, * ), W( * ), WORK( * )

*  A      (input/output) REAL array, dimension (LDA, N)
*         On entry, the symmetric matrix A.
*  WORK   (workspace/output) REAL array, dimension (LWORK)
*         On exit, if INFO = 0, WORK(1) returns the optimal LWORK.
*
*  LWORK  (input) INTEGER
*         The dimension of the array WORK.
*         If N <= 1,            LWORK must be at least 1.
*         If JOBZ = 'N' and N > 1, LWORK must be at least 2*N+1.
*         If JOBZ = 'V' and N > 1, LWORK must be at least
*                                  1 + 6*N + 2*N**2.
```

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Stack Allocation

```
#include <stdio.h>

int x,y;

int gcd(int u, int v) {
  if (v == 0)
    return u;
  else
    return gcd(v, u % v);
}

int main() {
  scanf("%d%d", &x, &y);
  printf("%d\n", gcd(x,y));
  return 0;
}
```

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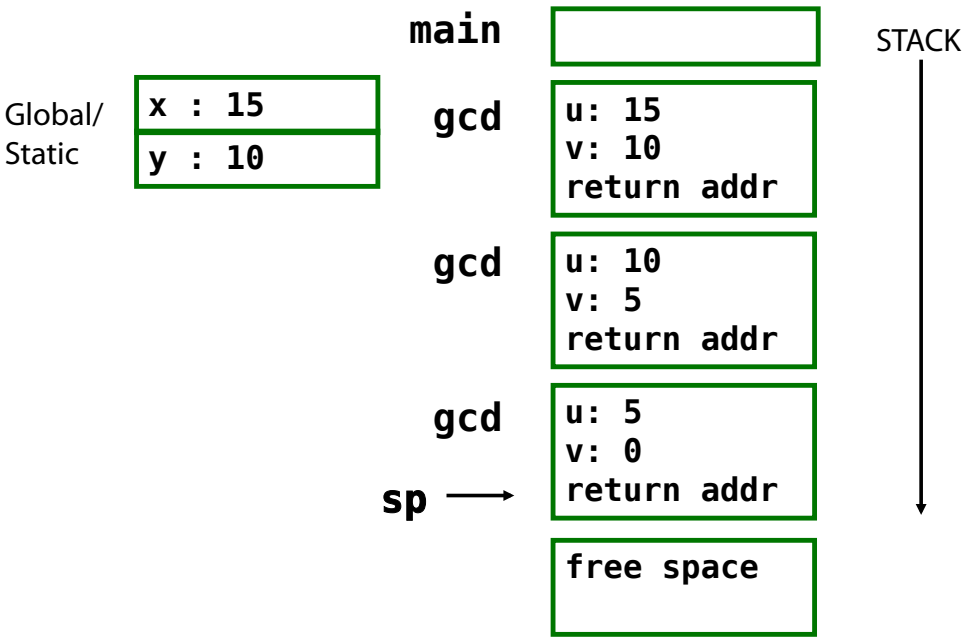
Possible Memory Layout



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Stack Allocation

```
int g(int n) {
  int a[n++];
  for (int i = 0; i < n; ++i)
     a[i] = i;
  int sum = 0;
  for (int i = 0; i < n; ++i)
     sum += a[i];
  return sum;
}

int main() {
  int m;
  scanf("%d", &m);
  printf("%d\n", sum(m));
  return 0;
}
```

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Stack Allocation

```
int open2 (char *str1, char *str2, int flags, int mode)
{
  char *name =
    (char *) alloca (strlen(str1) + strlen(str2) + 1);
  strcpy (name, str1);
  strcat (name, str2);
  return open (name, flags, mode);
}
```

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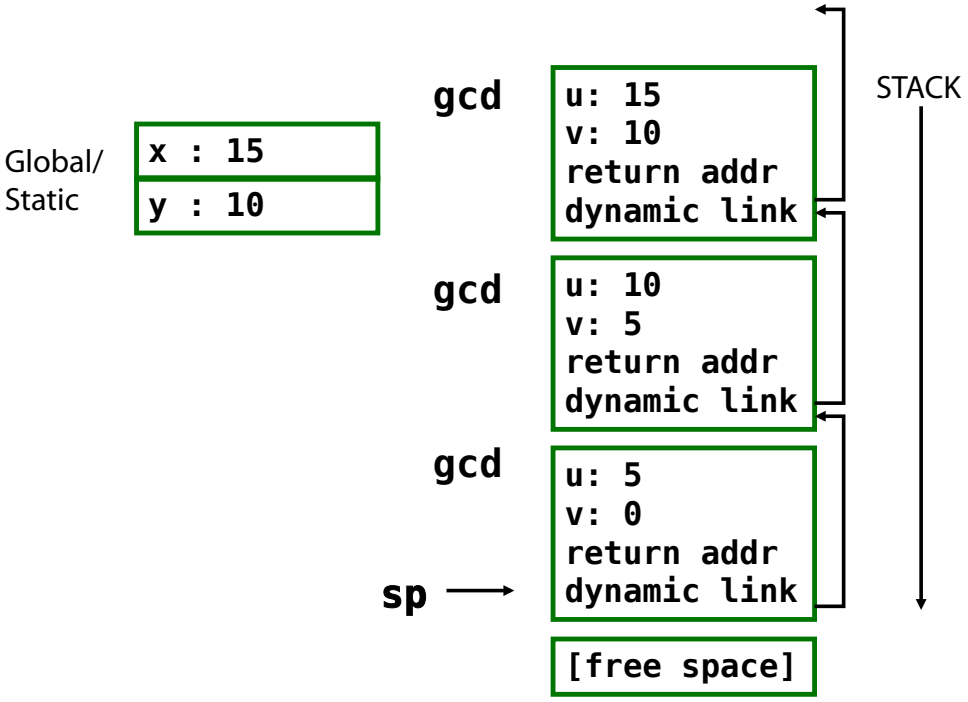
Memory Layout



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Nested Functions

```
procedure p;
    var n: integer;

    procedure q;
    begin
       n := n+1;
    end;

    procedure r(n:integer);
    begin
       if n>1 then r(n-1); else q;
    end;

begin
  n := 17;
  r(2);
end;
```

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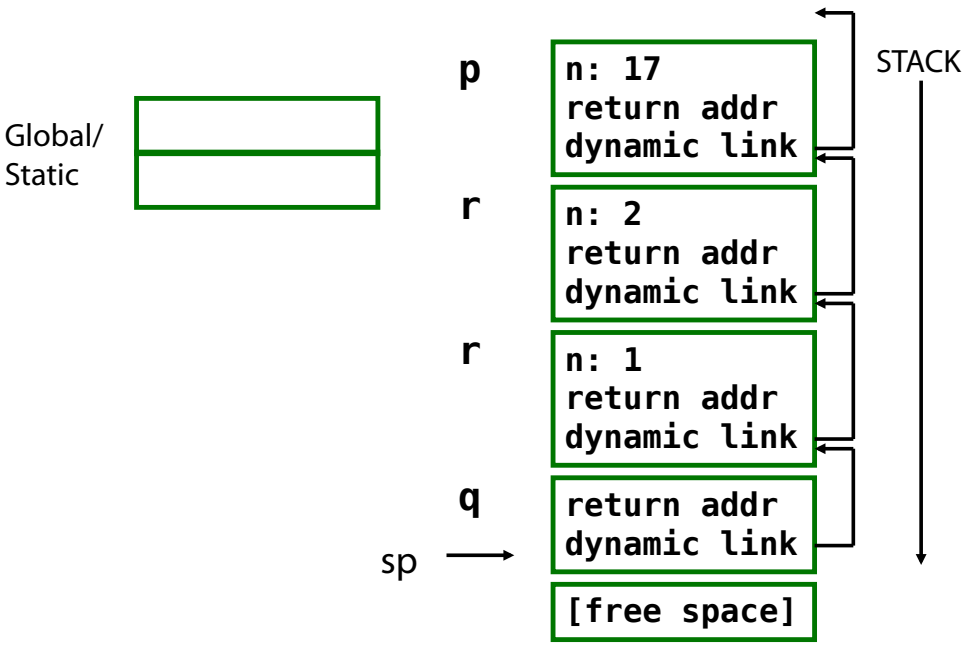
Memory Layout?



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Does This Work?

At compile time, can we generate code to find each variable?

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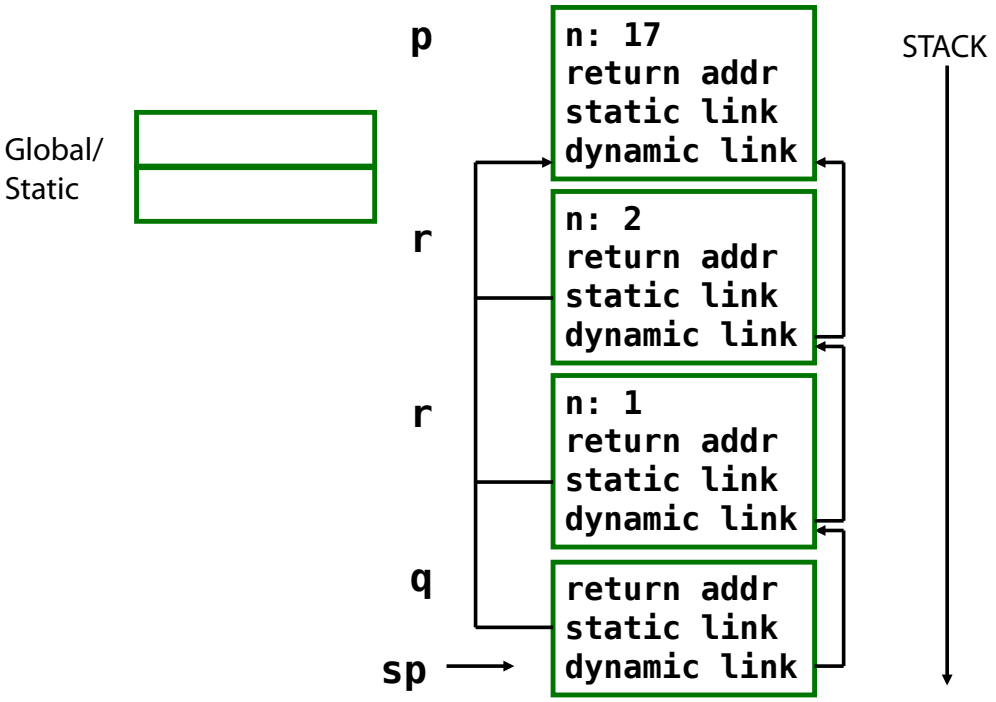
Option 1: Static Links



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Does This Work?

At compile time, can we generate code to find each variable?

How can we figure out what the static link should be when each frame is created?

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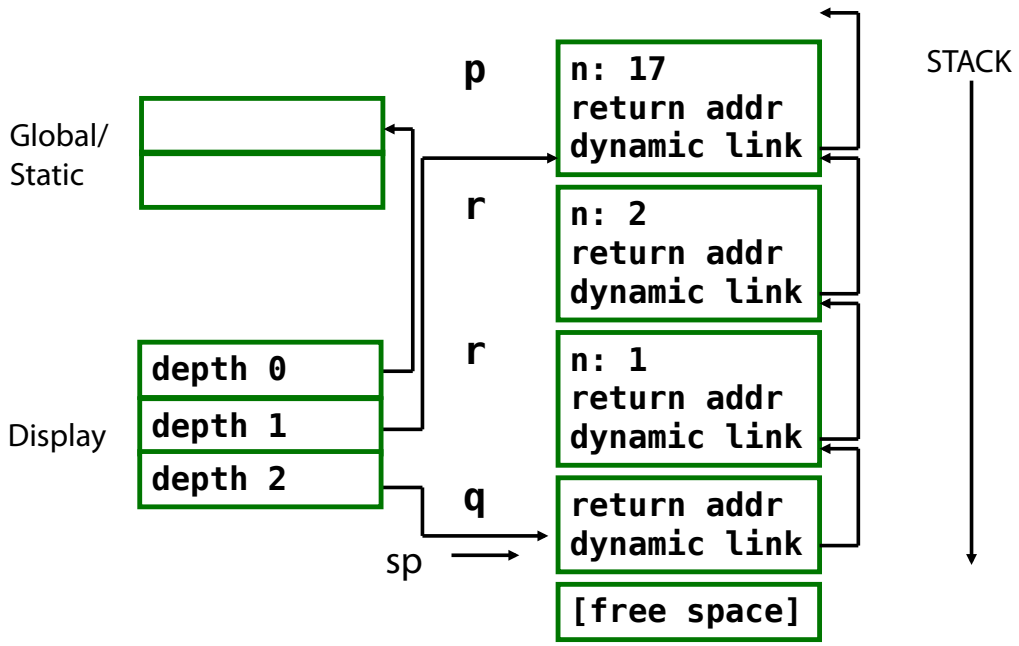
Option 2: Displays



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Does This Work?

At compile time, can we generate code to find each variable?

How can we figure out what the static link should be?

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Procedures as Parameters

```
procedure p(procedure a);
  begin
     a
  end;

procedure q;
  var x :integer;

  procedure r;
    var z : int
    begin
      z := 1;
      writeln(x+z)
    end;

  begin
    x := 2;
    p(r)
  end;
```

How does **r** find **x**?

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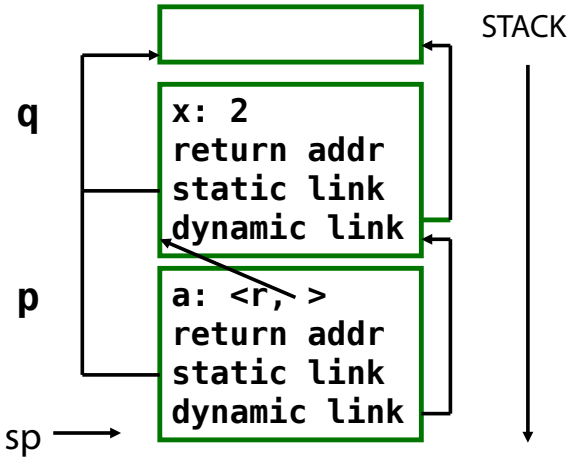
Before Call to **a**



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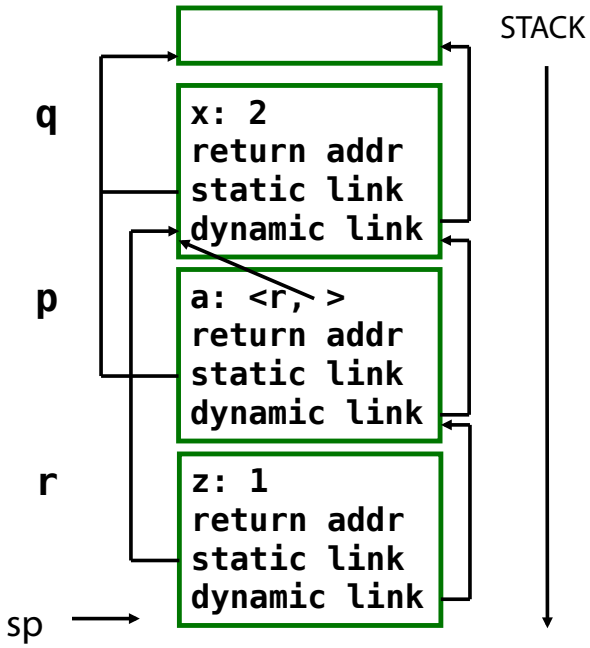
During Call to **a**



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Procedures as *Results*

```
let
   add x =
     let
        s = "abc...z"
        f y = x+y
     in
        f
   id = add 0
   g() = id 2
in
   g()
```

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Before **`add 0`** Returns