APS105
Winter 2012

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Lecture 11
February 8, 2012

Today

- Function declarations
- Parameters
- Scope

- Assignment 2

Using Functions

```
double average(double a, double b)

int getSpeed(void)

void printSquared(int n)

void printHello(void)
```

Side Effects

- `void` functions need a side effect
- Functions with return types may have side effects
- This means you will sometime (intentionally) ignore a return value

`numChars:` 21

```
int numChars = printf("I have a side effect.");
```

```
I have a side effect.
```

```
printf("%d", printf("I have a side effect."));
```

```
I have a side effect.21
```

Functions Without Parameters

- Do the same thing each time
- (Unless they read data from outside world)

```
void printHello(void)
{
    printf("Hello.\n");
}
```

```
printHello();
```
Hello.

```
printHello();
```
Hello.

```
int i = printHello();
```
Error

```
printHello;
```
Legal, but not what you expect

Function Declarations

```
int main(void)
{
    printHello();

    return 0;
}

void printHello(void)
{
    printf("Hello.\n");
}
```

```
warning: conflicting types
for 'printHello'

warning: previous implicit
declaration of 'printHello'
was here
```

Function Declarations

- Functions need to be declared before use

```
int main(void)
{
   printHello();

   return 0;
}

void printHello(void)
{
   printf("Hello.\n");
}
```

Function Declarations

- Functions need to be declared before use

```
void printHello(void)
{
   printf("Hello.\n");
}

int main(void)
{
   printHello();

   return 0;
}
```

Function Declarations

- Functions need to be declared before use

```
void printHello(void);

int main(void)
{
   printHello();

   return 0;
}
void printHello(void)
{
   printf("Hello.\n");
}
```

```
int i;
```

```
int i = 0;
```

Function Declarations

- We call the declaration a "prototype"

```
double average(double a, double b);
void printSquared(int n);
```

`stdio.h` contains the function prototypes for `printf()`, `scanf()`, etc.

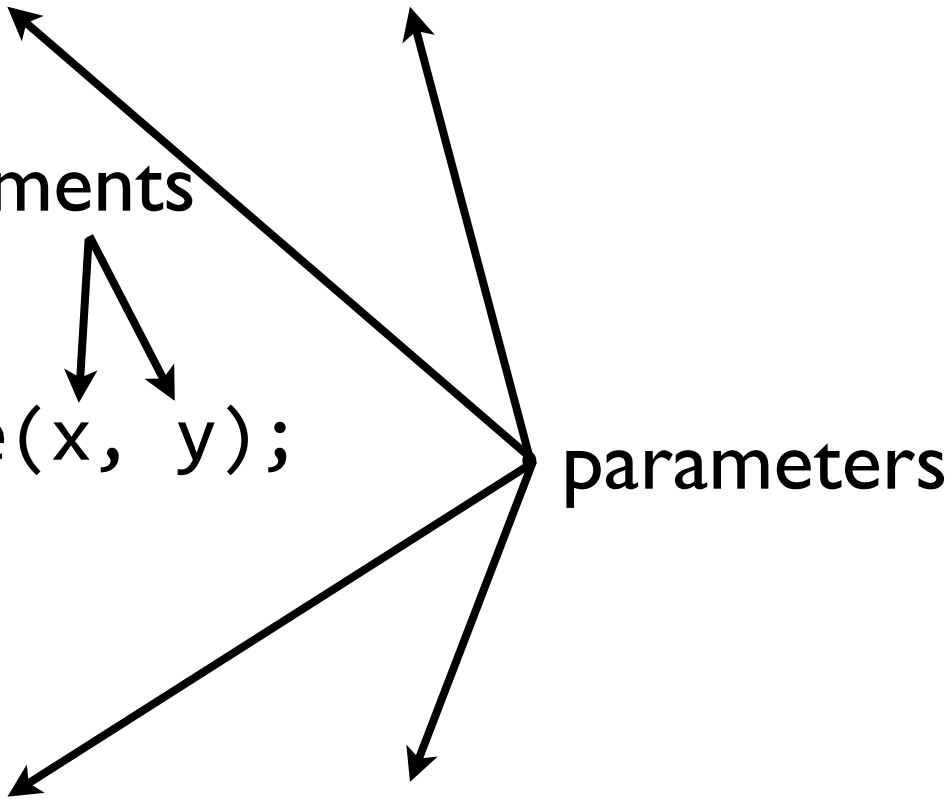
Parameters vs. Arguments

```
double average(double a, double b);

int main(void)
{
   double x = 5.0;
   double y = 15.0;
   double avg = average(x, y);

   return 0;
}

double average(double a, double b)
{
   return (a + b) / 2;
}
```



Parameters

- Get created and set automatically

```
a =  5.0;
b = 15.0;
```

```
double average(double a, double b)
{ double a;
  double b;
    return (a + b) / 2;
}

double average(double a, double b)
{
    double a,b;
    return (a + b) / 2;
}
```

Error

Array Parameters

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

```
int list[] = {1, 2, 3};
int sum = sumArray(list);
```

Array Parameters

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

```
int list[] = {1, 2, 3};
int sum = sumArray(list, 3);
```

Multi-Dimensional Arrays

- Need to specify the length of every dimension other than the first

```
int sumArray(int a[]);
```
Legal
(but it might be impossible to implement)

```
int sum2DArray (int a[][]);
```
Error

```
int sum2DArray (int a[][], int n, int m);
```
Error

```
int sum2DArray (int a[][10], int n);
int sum2DArray (int a[][N], int n);
```
C99 only

```
int sum2DArray (int n, int m, int a[n][m]);
```

return

- Functions with a return type must have `return` *`expression`*
- Function immediately exits

```
double sum(double x, double y)
{
    double sum = x + y;
    return sum;
    sum += x;
    return sum;
}
```

Never executed

return

- Type conversion rules apply

```
int squared(double x)
{
   double squared = x * x;
   return squared;
}
```

```
double result = squared(2.5);
```

6.0

return and void

- void functions can have a return

```
void printHello(void)
{
    printf("Hello.\n");
    return;
    printf("Goodbye.\n");  Never executed
}
void printHello(void)
{
    printf("Hello.\n");
    return 42;
}
```

Error

Function Naming

- Same rules as variables
- Shares same namespace as variables

```
double sum(double a, double b);

int main(void)
{
    int sum;
    ...
}
```

Error

Function Naming

- Doesn't distinguish based on type

```
double sum(double a, double b);

int sum(double a, double b);
```

Error

```
int sum(int a, int b);
```

Error

```
int isum(int a, int b);

double fsum(double a, double b);
```

```
int sumArray(int a[], int n)
{
  int result = 0;
  for (int i = 0; i < n; i++)
  {
    result += a[i];
  }
  return result;
}

int multiplyArray(int a[], int n)
{
  int result = 1;
  for (int i = 0; i < n; i++)
  {
    result *= a[i];
  }
  return result;
}
```

```
int main(void)
{
  int result = 0;
  for (int i = 0; i < n; i++)
  {
    result += a[i];
  }

  int result = 1;
  for (int i = 0; i < n; i++)
  {
    result *= a[i];
  }

  return 0;
}
```

Error

Scope

- The region(s) of a program where a name is valid
- By default, it's the block where a variable is defined
  - Plus any child blocks
  - In C99, only following the declaration

n: 3

```
int n = 3;
int a[n] = {2, 3, 4};

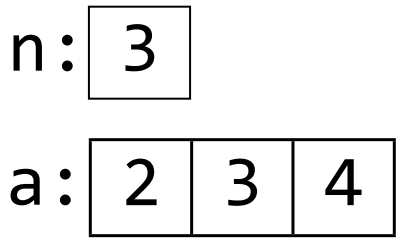
int result = 1;

for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```

```
int n = 3;
int a[n] = {2, 3, 4};

int result = 1;

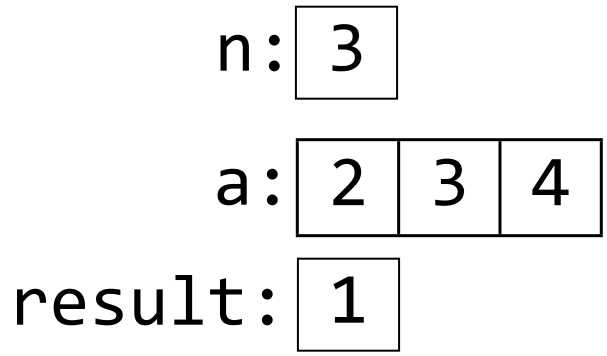
for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



```
int n = 3;
int a[n] = {2, 3, 4};

int result = 1;

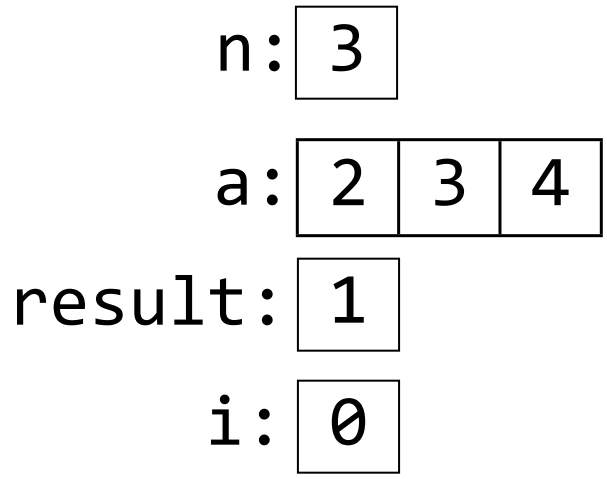
for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



```
int n = 3;
int a[n] = {2, 3, 4};

int result = 1;

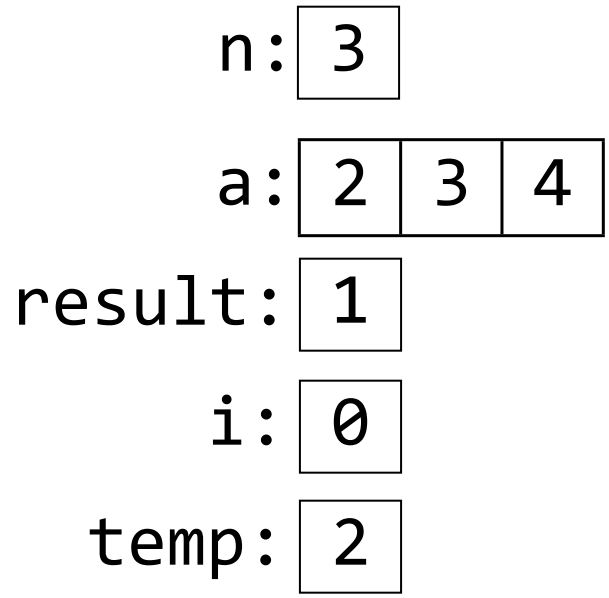
for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



```
int n = 3;
int a[n] = {2, 3, 4};

int result = 1;

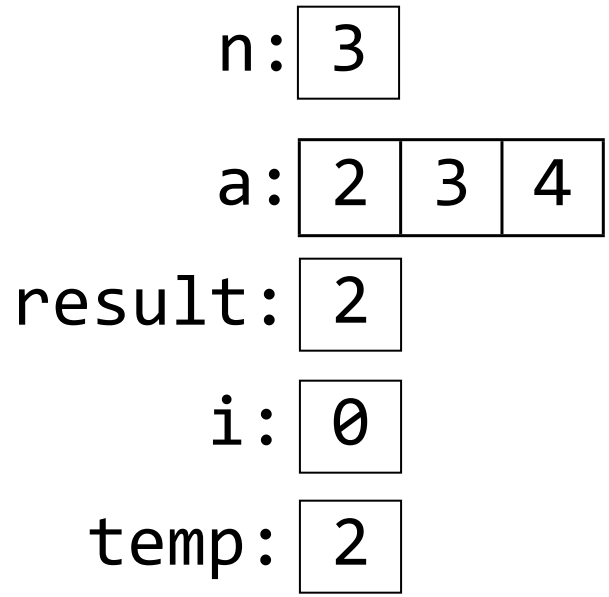
for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



```
int n = 3;
int a[n] = {2, 3, 4};

int result = 1;

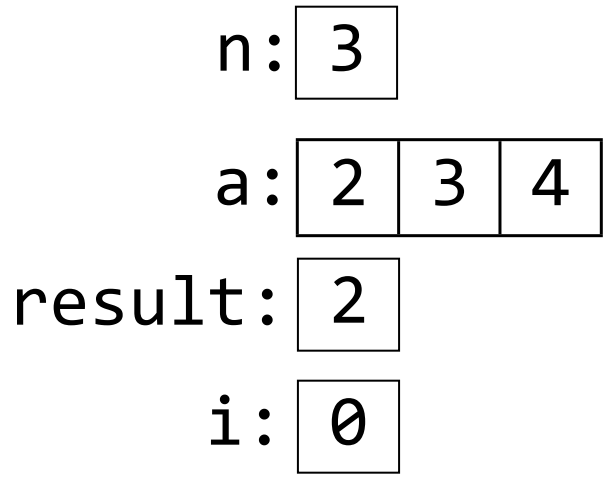
for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



```
int n = 3;
int a[n] = {2, 3, 4};

int result = 1;

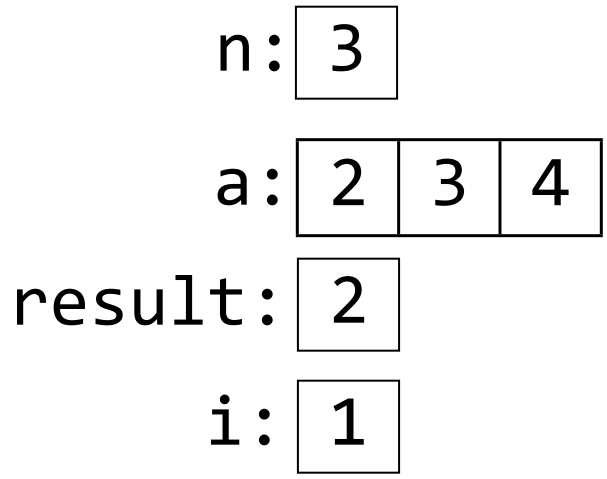
for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



```
int n = 3;
int a[n] = {2, 3, 4};

int result = 1;

for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



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int a[n] = {2, 3, 4};

int result = 1;

for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
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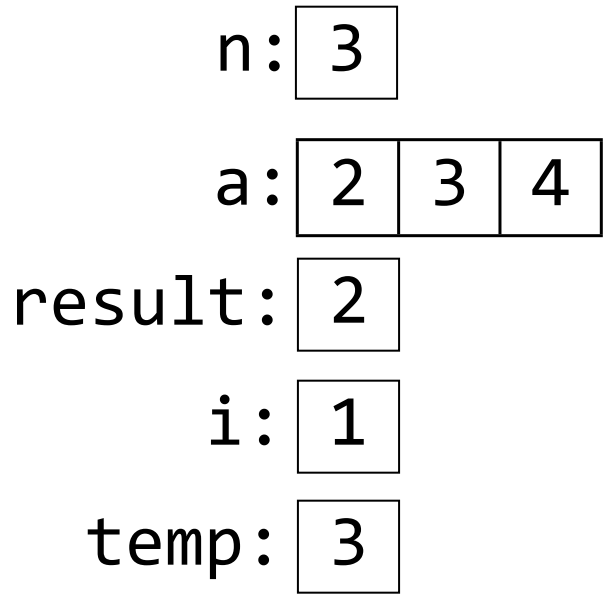

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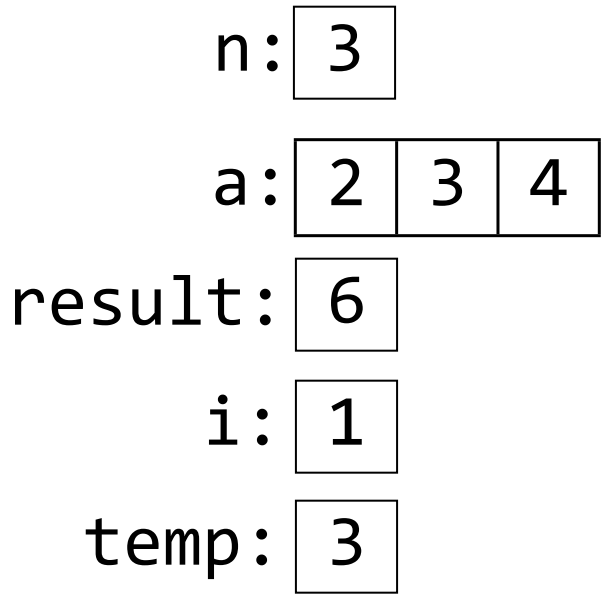
int a[n] = {2, 3, 4};

int result = 1;

for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



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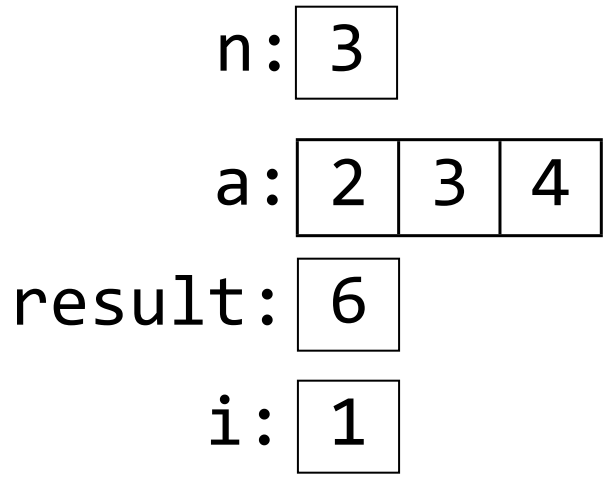
int a[n] = {2, 3, 4};

int result = 1;

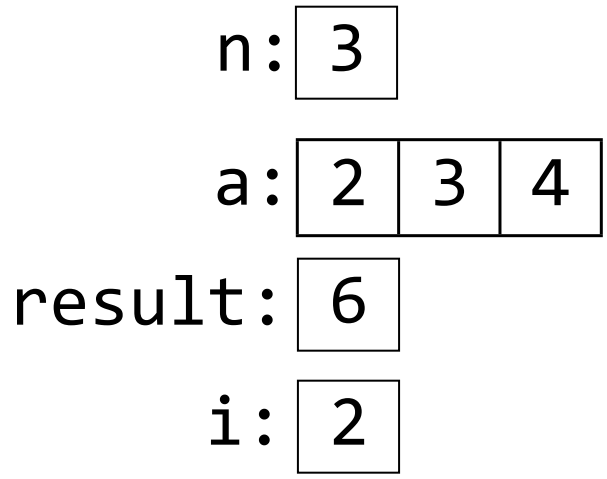
for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



```
int n = 3;
int a[n] = {2, 3, 4};

int result = 1;

for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



```
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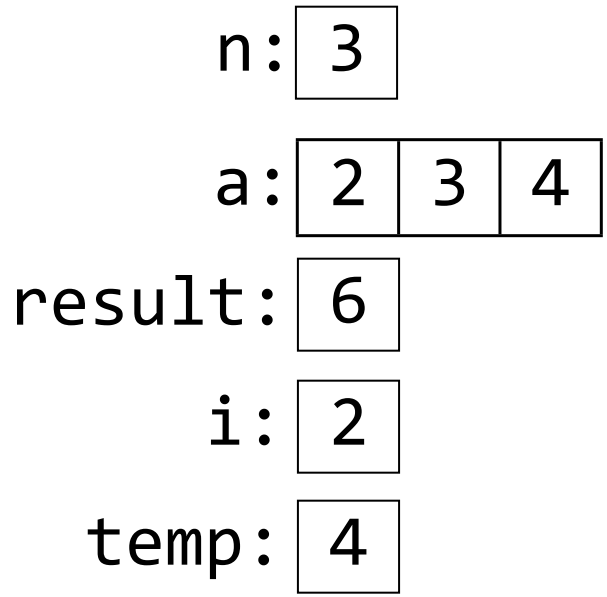
int a[n] = {2, 3, 4};

int result = 1;

for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



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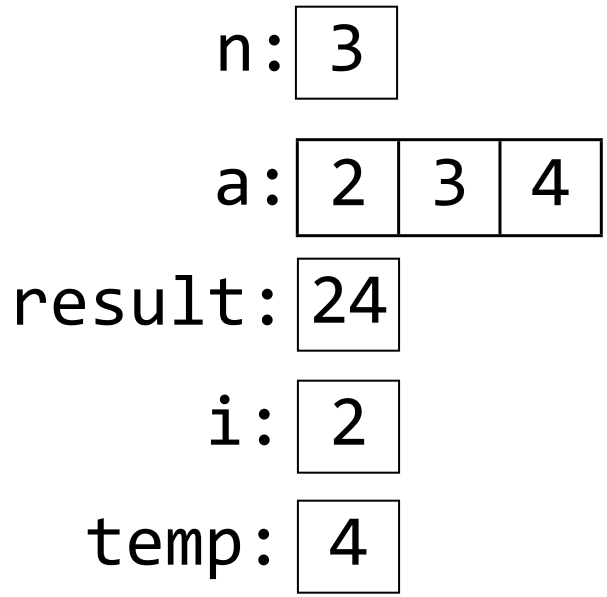

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{
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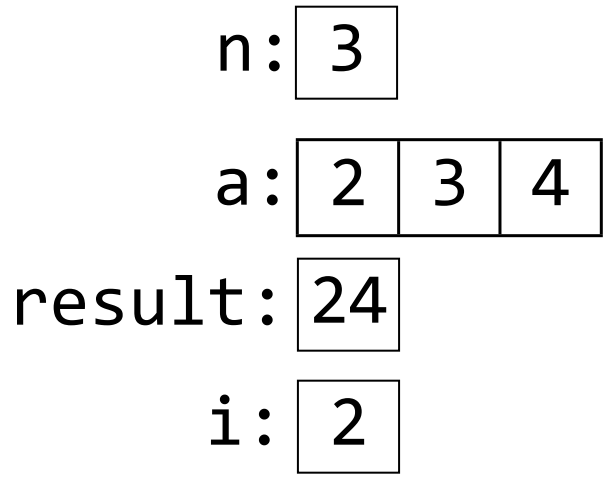

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{
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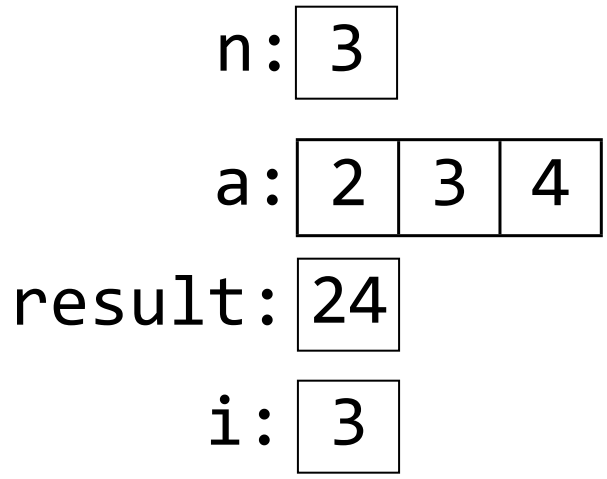
  result *= a[i];
}
```



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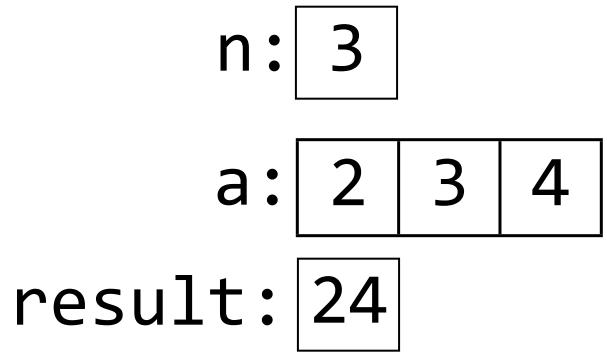
int a[n] = {2, 3, 4};

int result = 1;

for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```



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int a[n] = {2, 3, 4};

int result = 1;

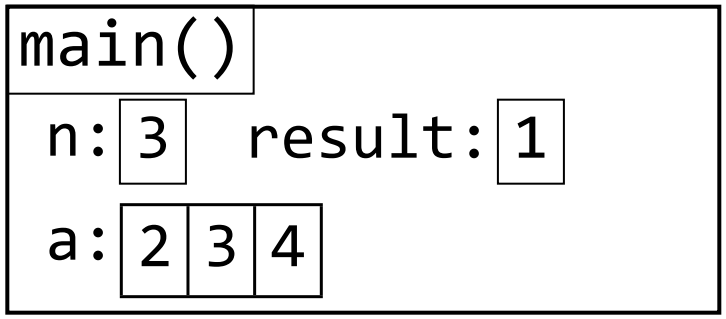
for (int i = 0; i < n; i++)
{
  int temp = a[i];
  result *= a[i];
}
```

```
int main(void)
{
  int n = 3;
  int a[n] = {2, 3, 4};

  int result = 1;

  for (int i = 0; i < n; i++)
  {
    int temp = a[i];
    result *= a[i];
  }

  return 0;
}
```



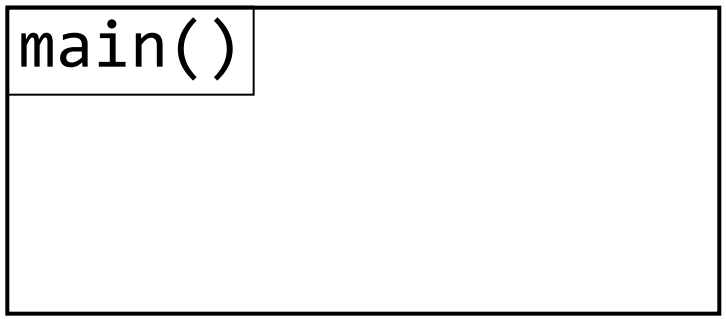
```
double average(double a, double b)
{
  double result = (a + b) / 2.0;
  return result;
}

double square(double a)
{
  double result = a * a;
  return result;
}

void printSquare(double a)
{
  printf("The square of %g is %g", a, square(a));
}
```

```
int main(void)
{
  double x = 2.0;
  double y = 4.0;
  double a = average(x, y);
  printSquare(x);

  return 0;
}
```



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  return 0;
}
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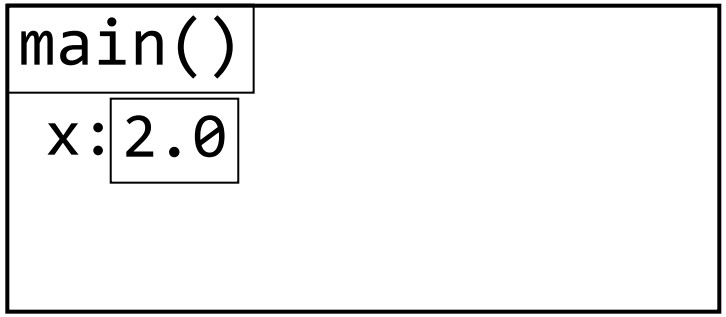

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  double a = average(x, y);
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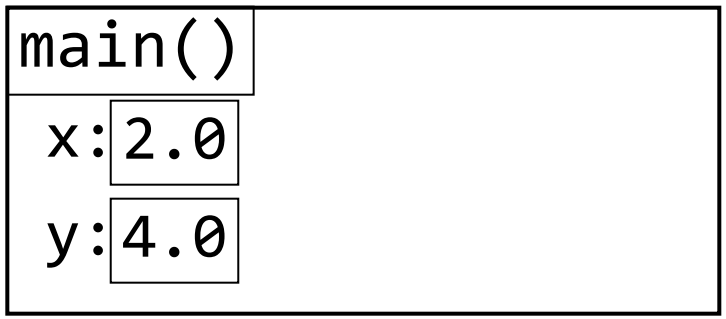
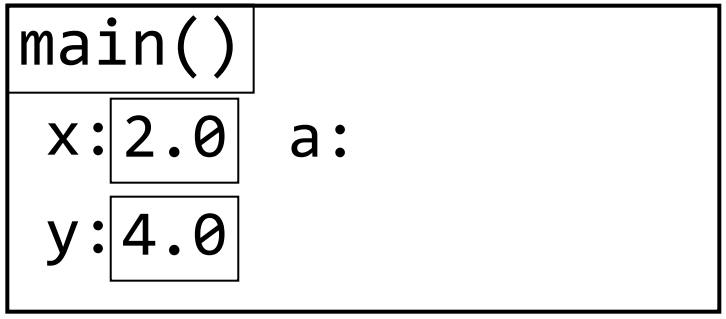
  return 0;
}
```



```
double average(double a, double b)
{
  double result = (a + b) / 2.0;
  return result;
}
```

```
int main(void)
{
  double x = 2.0;
  double y = 4.0;
  double a = average(x, y);
  printSquare(x);

  return 0;
}
```



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{
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  return result;
}
```

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  double x = 2.0;
  double y = 4.0;
  double a = average(x, y);
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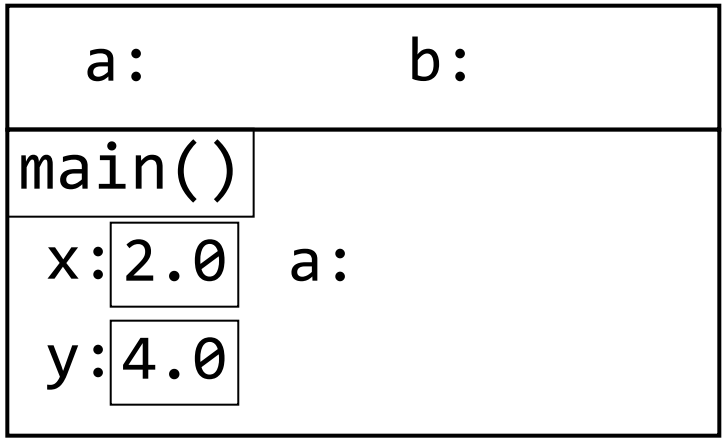
  return 0;
}
```



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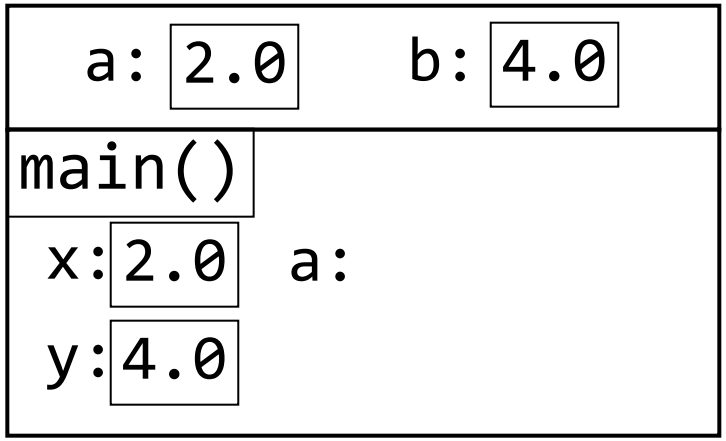

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}
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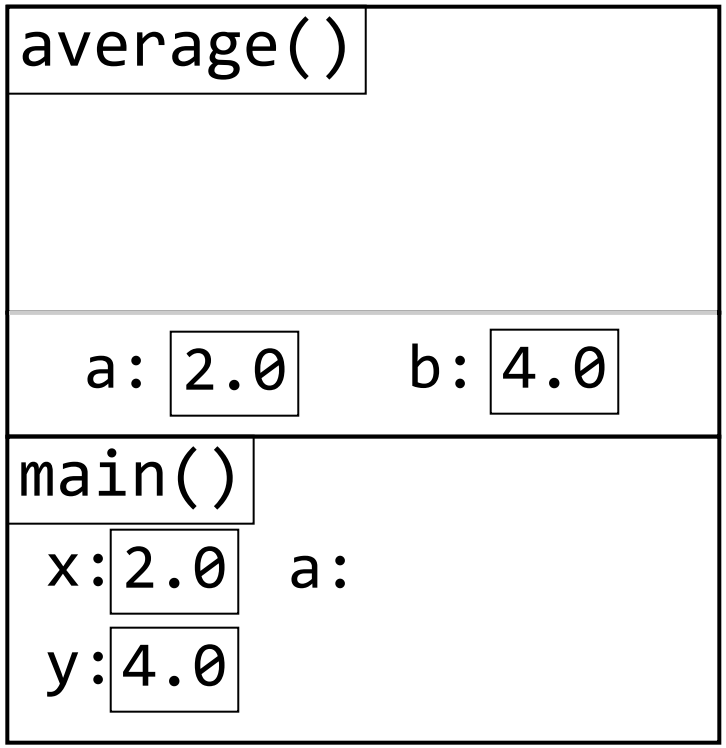
  double x = 2.0;
  double y = 4.0;
  double a = average(x, y);
  printSquare(x);

  return 0;
}
```



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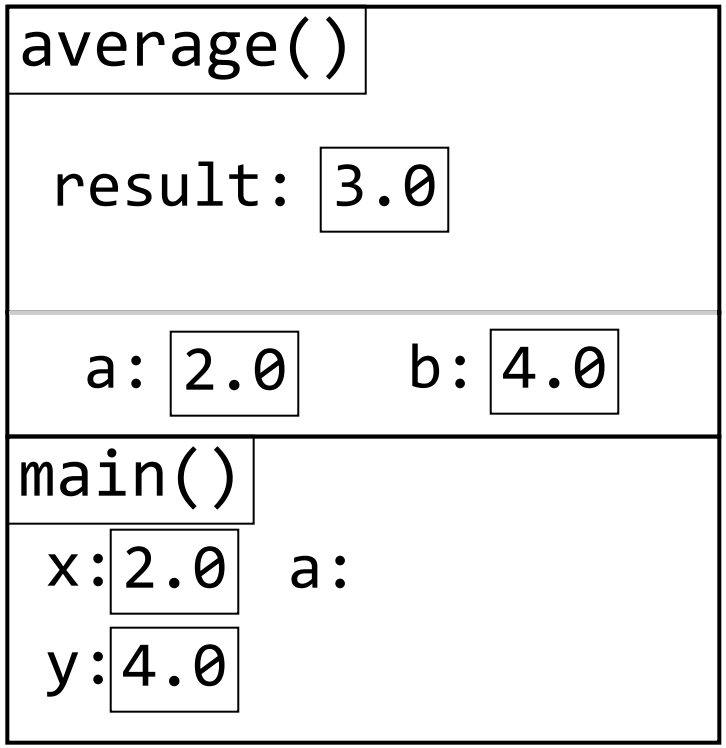
{
  double result = (a + b) / 2.0;
  return result;
}
```

```
int main(void)
{
  double x = 2.0;
  double y = 4.0;
  double a = average(x, y);
  printSquare(x);

  return 0;
}
```



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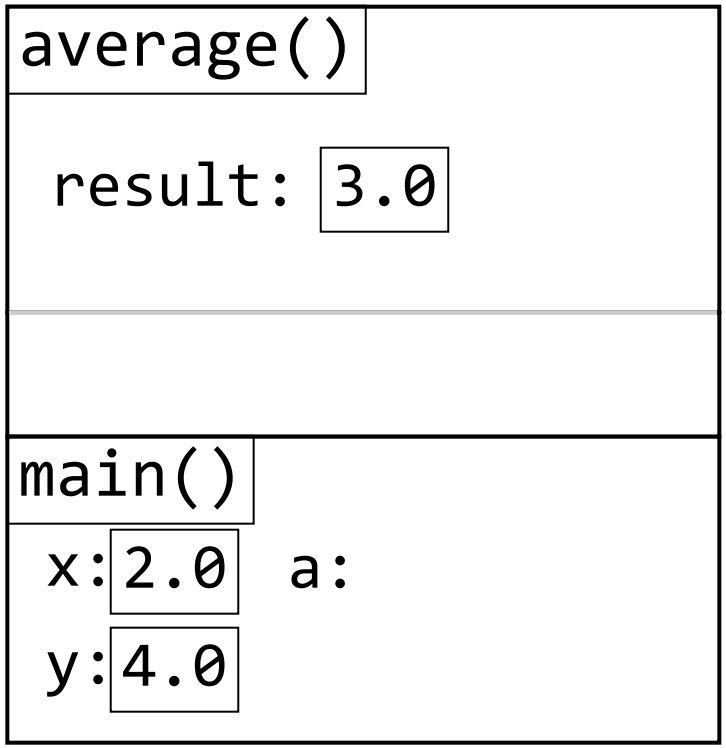
{
  double result = (a + b) / 2.0;
  return result;
}
```

```
int main(void)
{
  double x = 2.0;
  double y = 4.0;
  double a = average(x, y);
  printSquare(x);

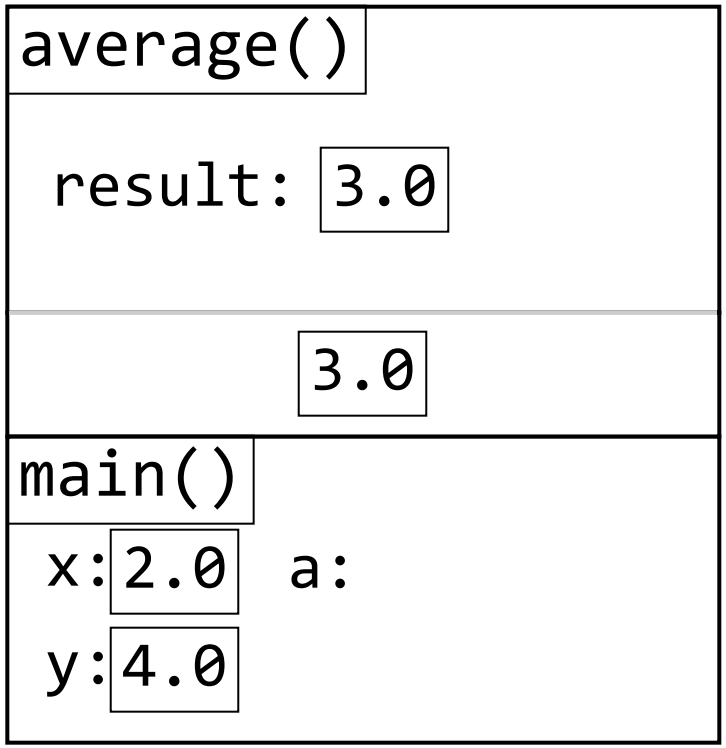
  return 0;
}
```



```
double average(double a, double b)
{
  double result = (a + b) / 2.0;
  return result;
}
```

```
int main(void)
{
  double x = 2.0;
  double y = 4.0;
  double a = average(x, y);
  printSquare(x);

  return 0;
}
```



```
double average(double a, double b)
{
  double result = (a + b) / 2.0;
  return result;
}
```

```
int main(void)
{
  double x = 2.0;
  double y = 4.0;
  double a = average(x, y);
  printSquare(x);

  return 0;
}
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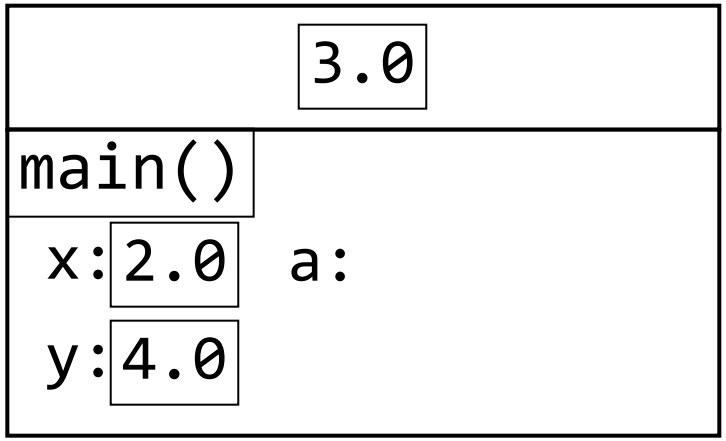

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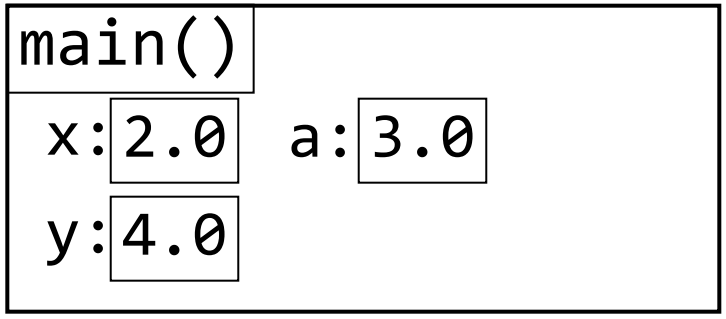

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  printf("The square of %g is %g", a, square(a));
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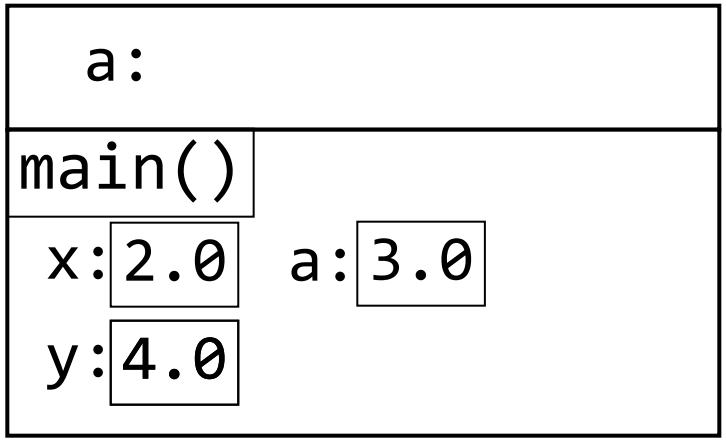

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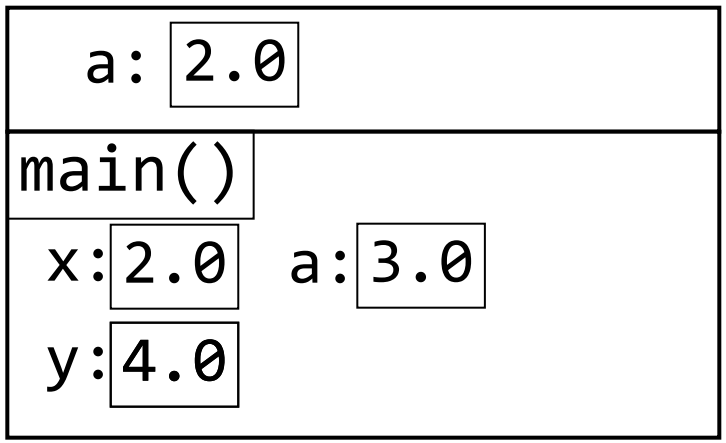

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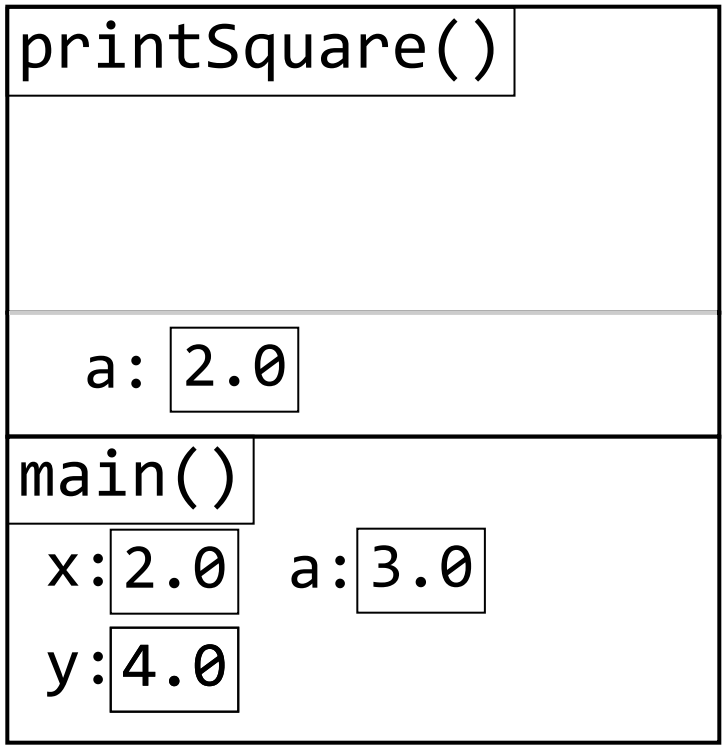

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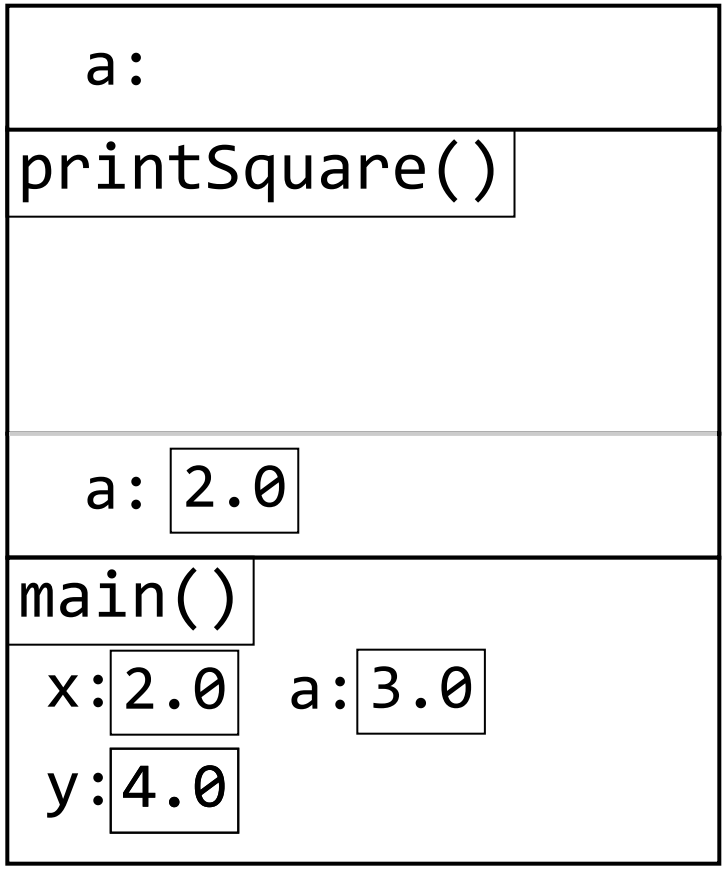

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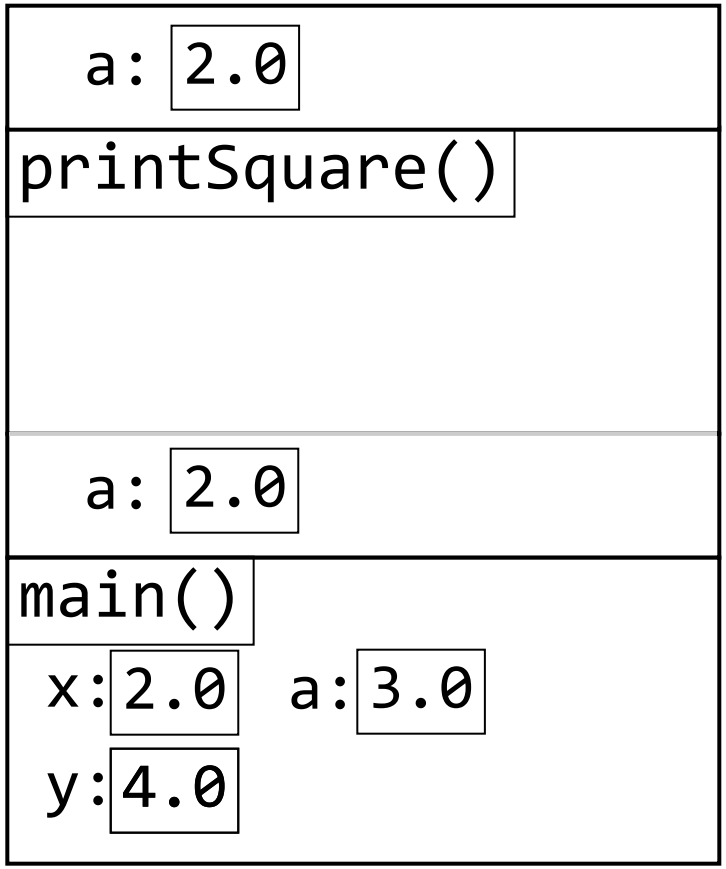

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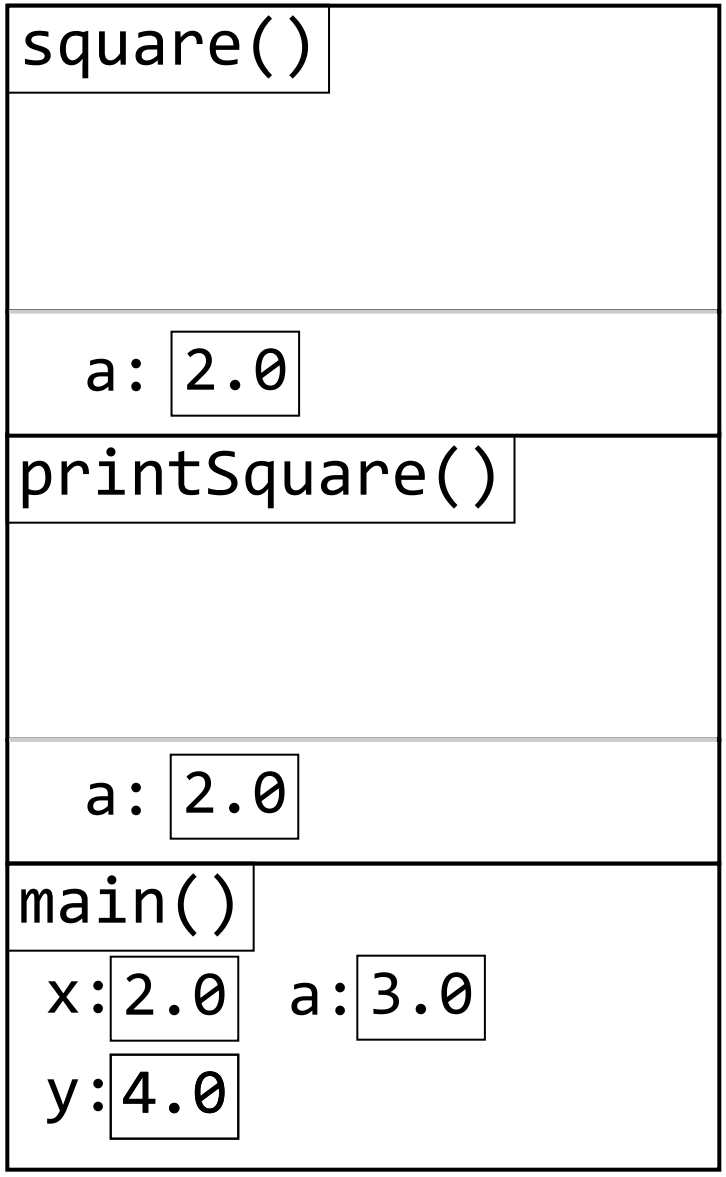

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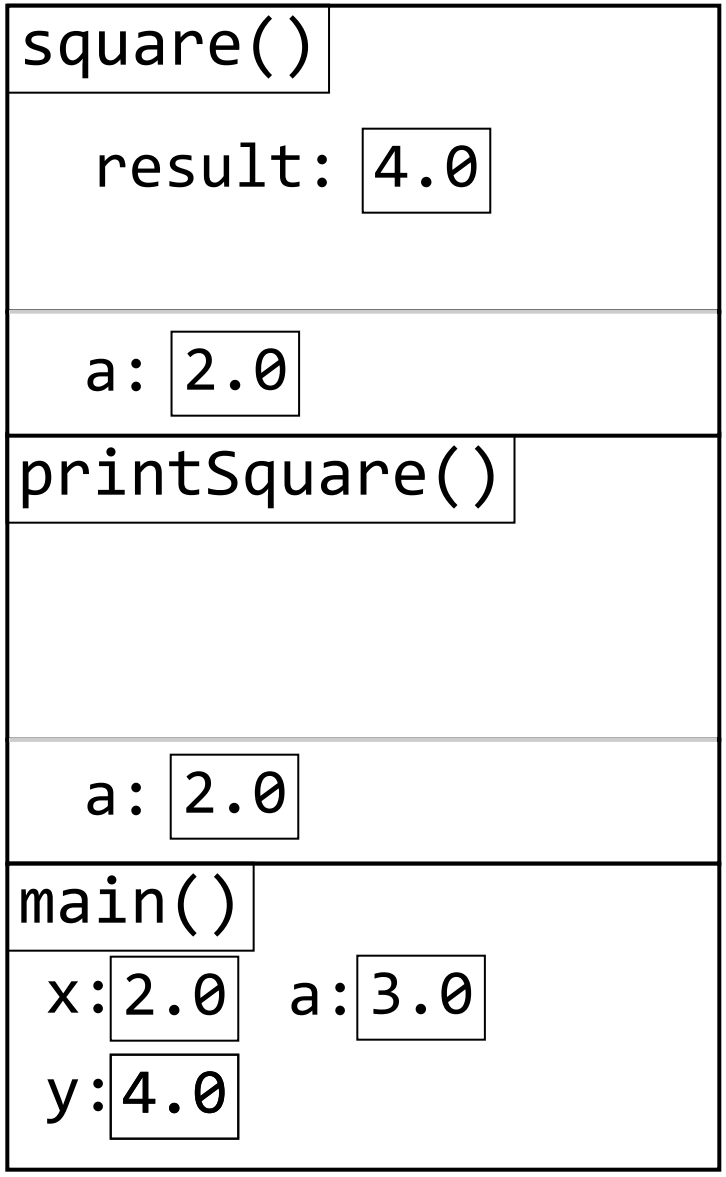

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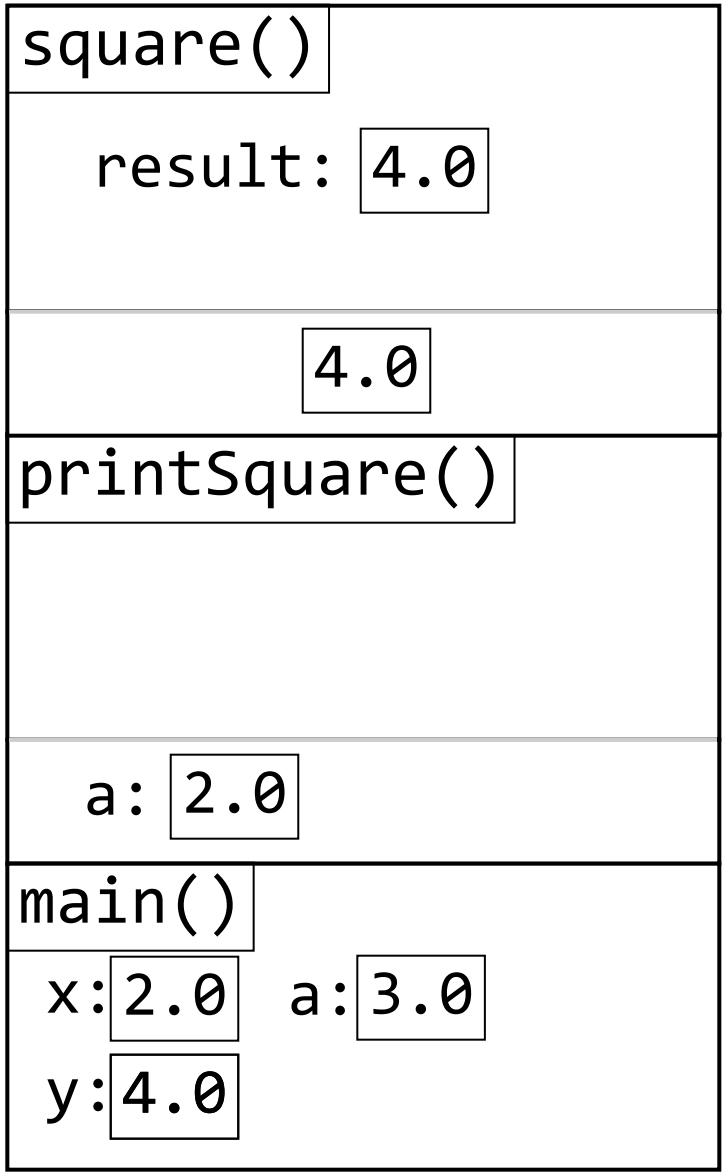

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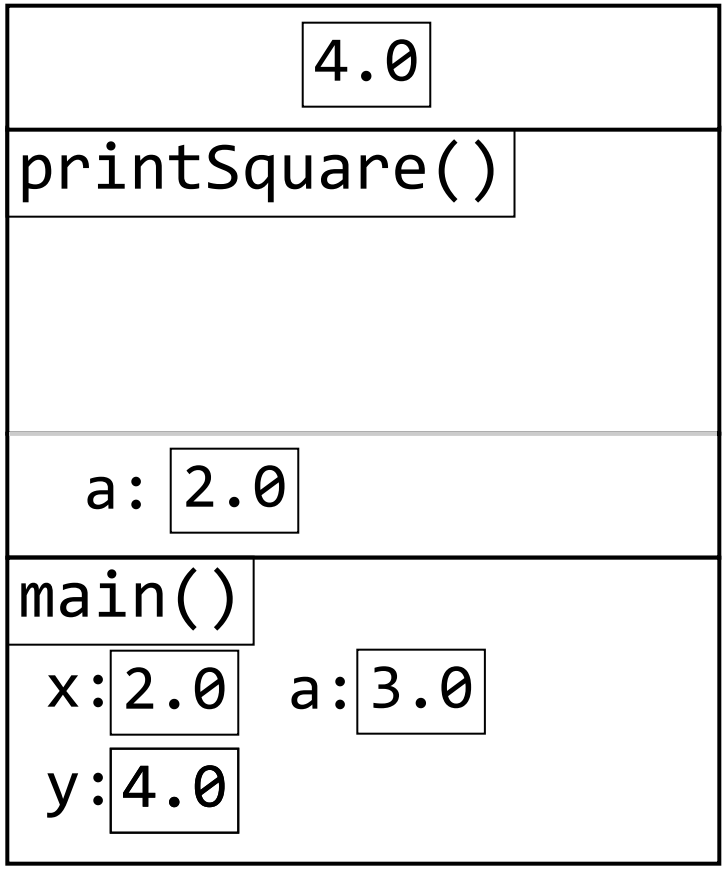

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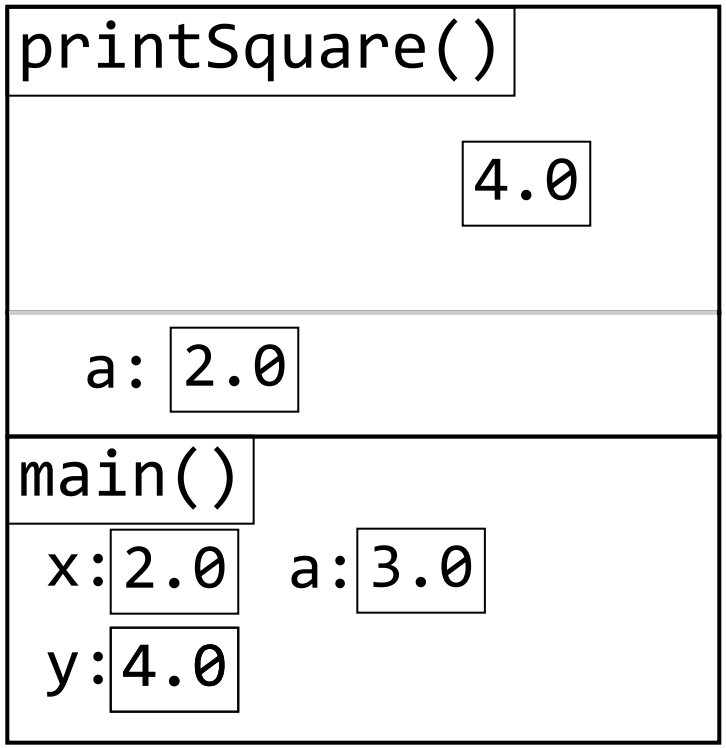

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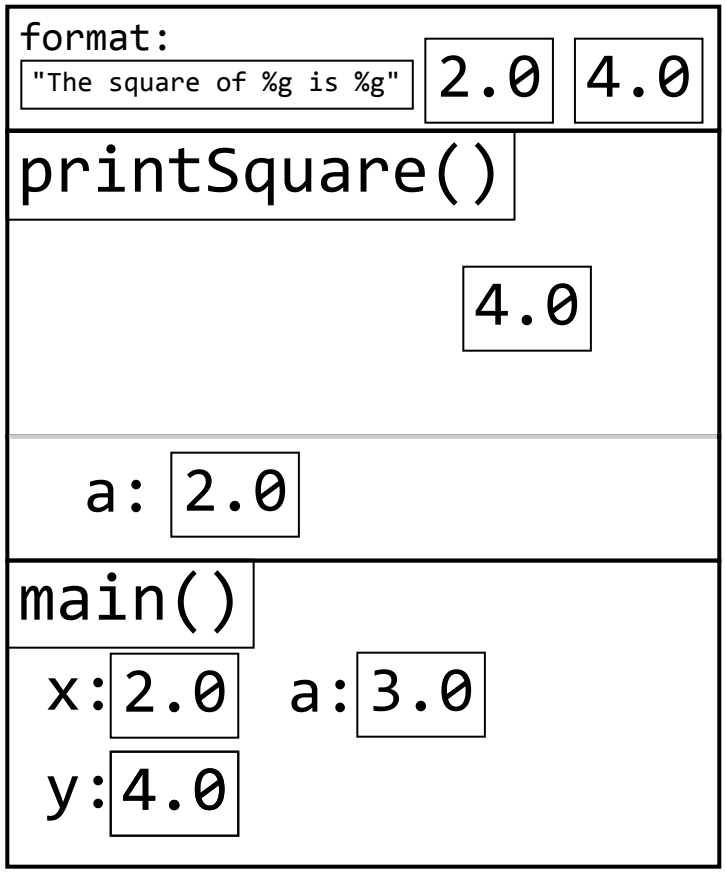

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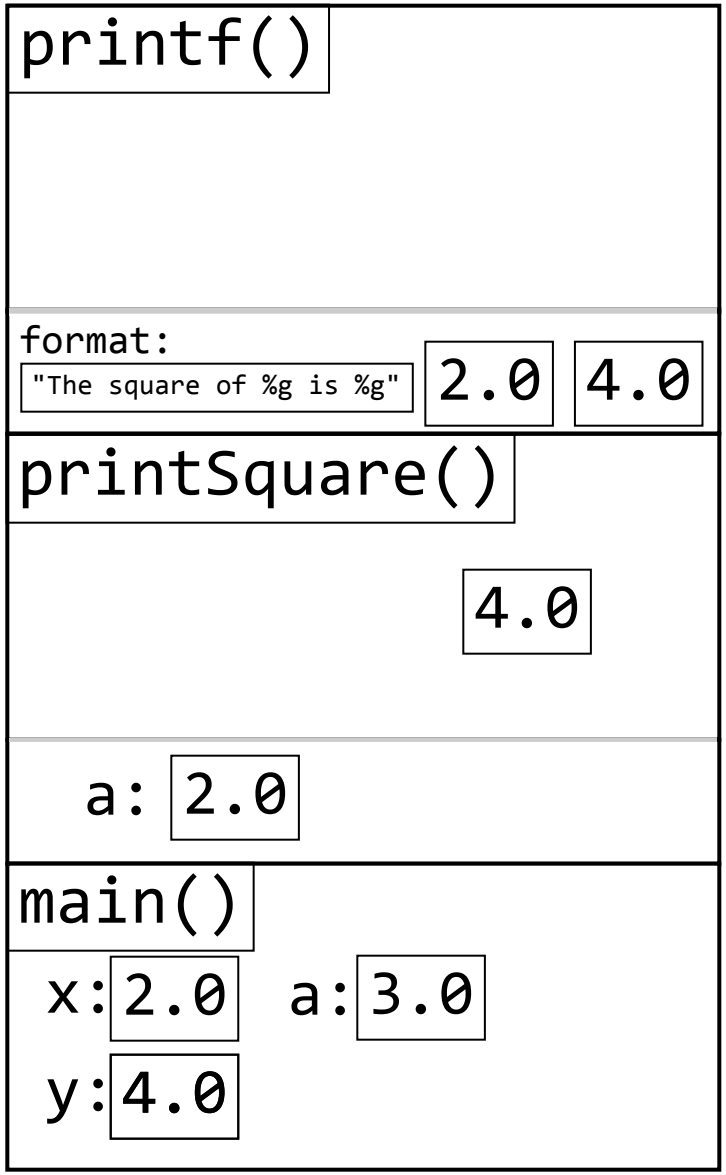

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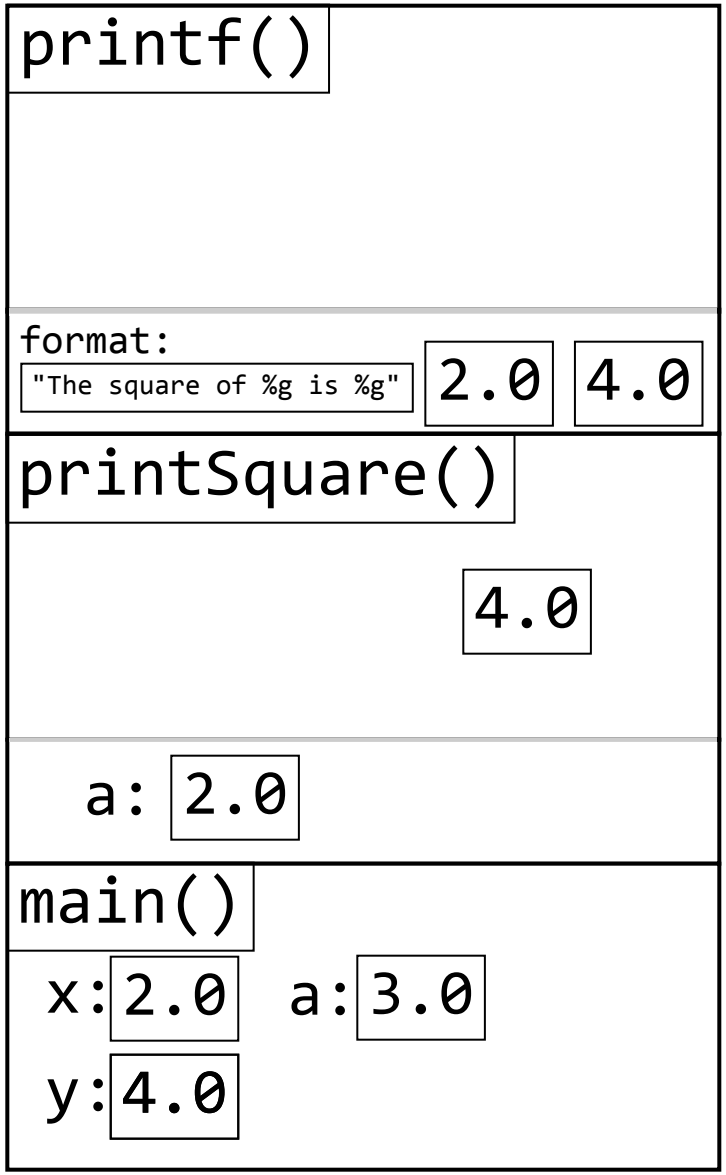
  double a = average(x, y);
  printSquare(x);

  return 0;
}
```

```
The square of 2 is 4
```



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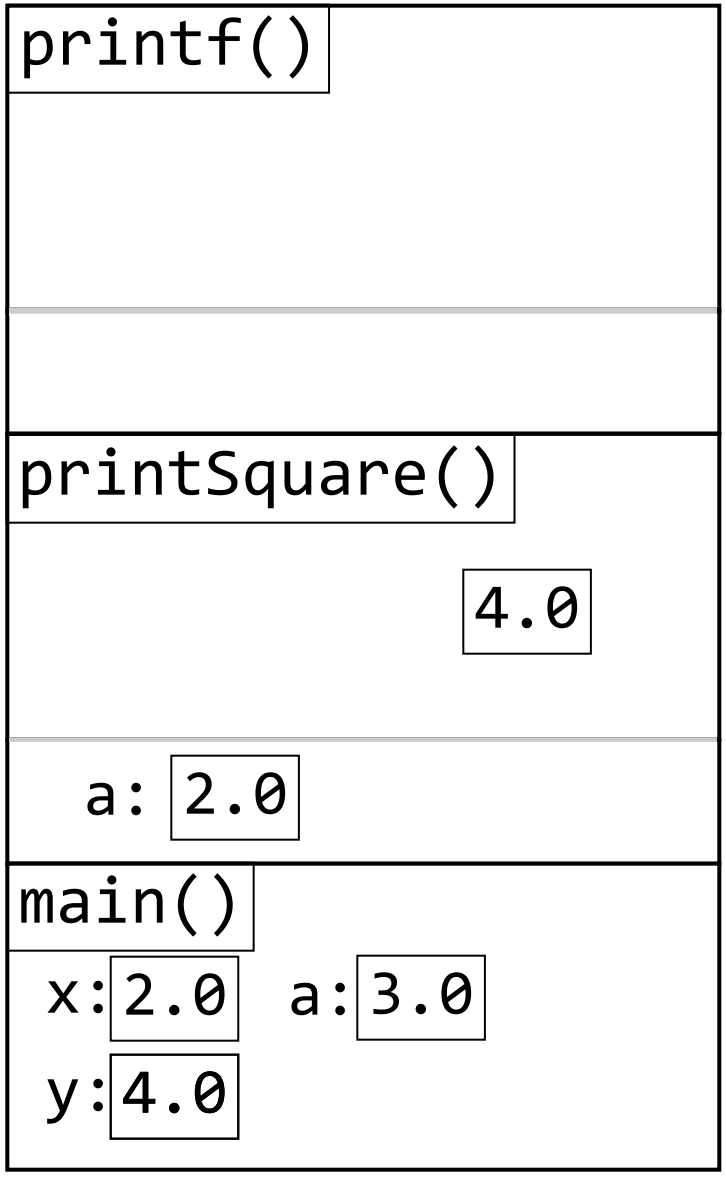

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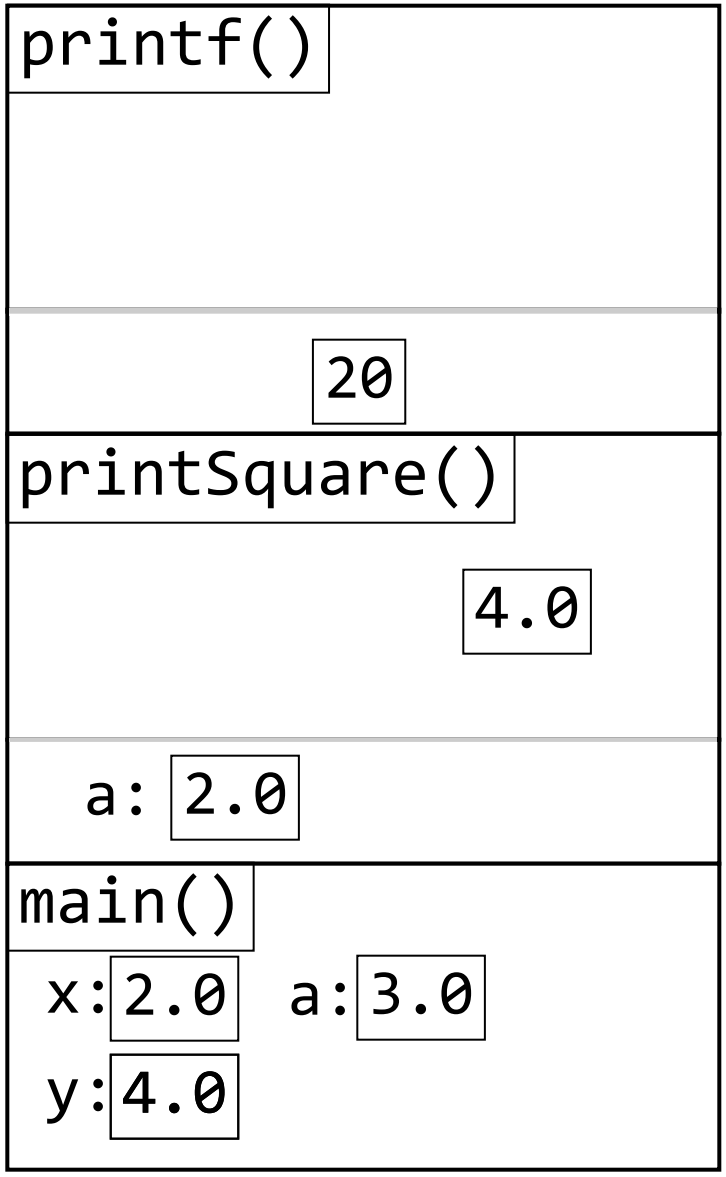

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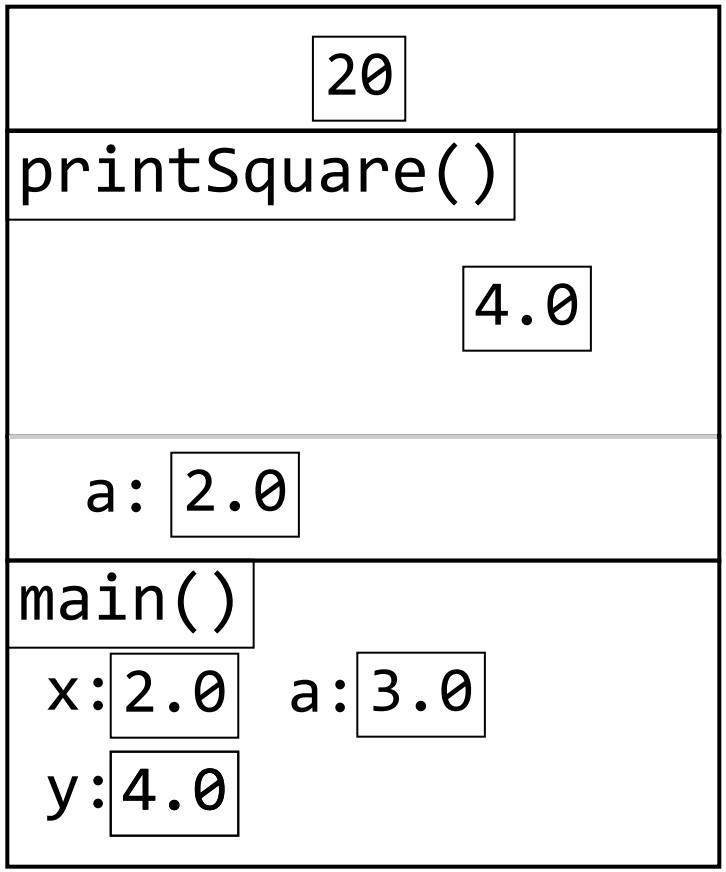

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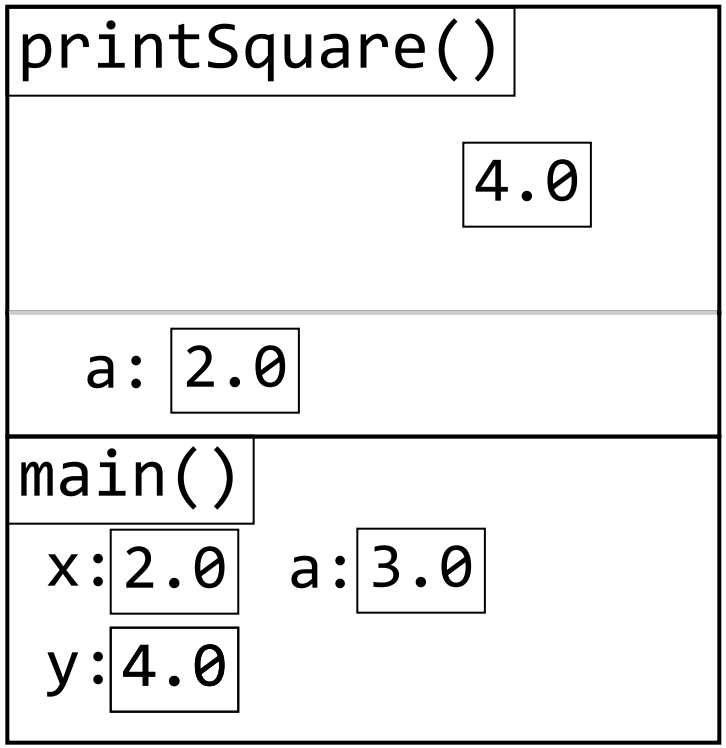

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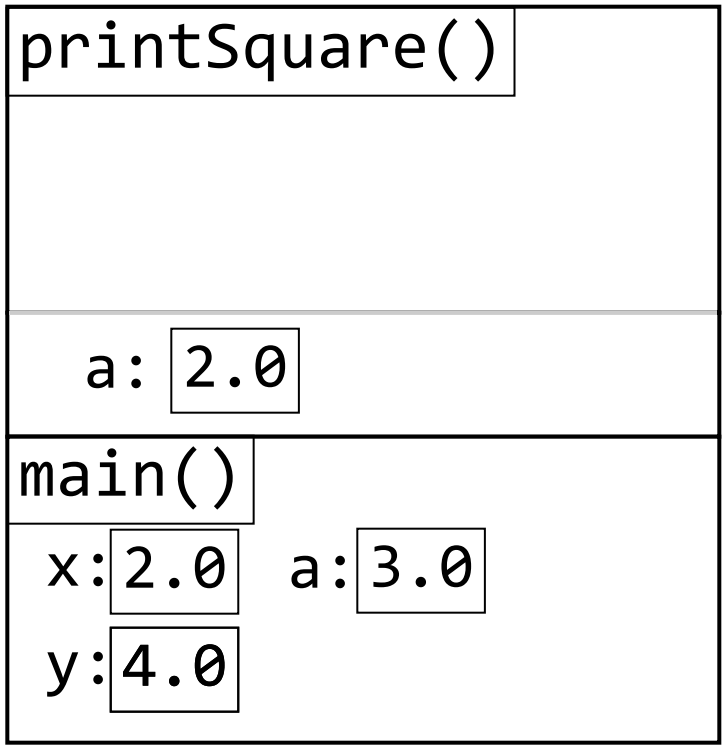

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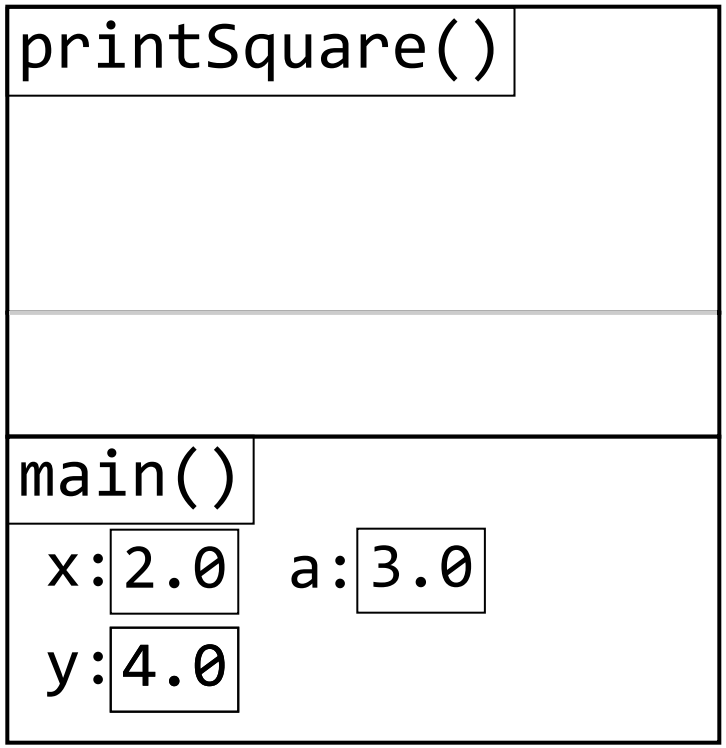

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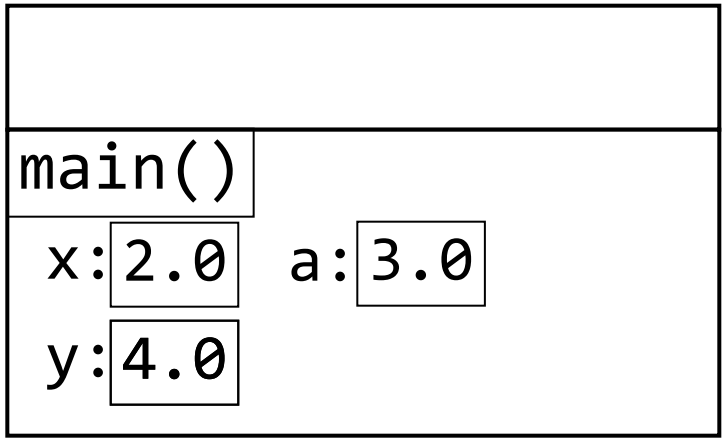

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