Managing Program Flow

INTRODUCTION

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“Begin at the beginning,” the King said, very gravely, “and go on till you come to the end: then stop.”

Lewis Carroll, *Alice in Wonderland*

Statements Execute in Order

```
statement one
statement two

statement three might be long and be split across
   multiple lines to make it
   easier to read

statement four
statement five
```

Statements Execute in Order

```
statement one
statement two

statement three might be long and be split across
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statement four
statement five
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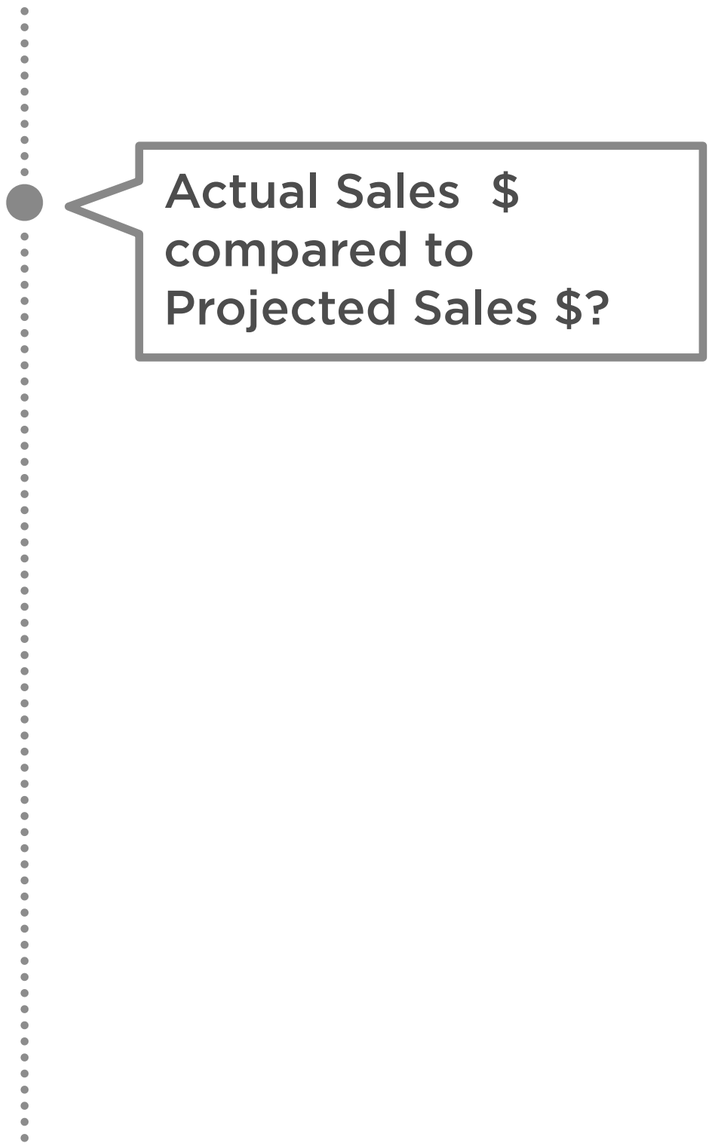
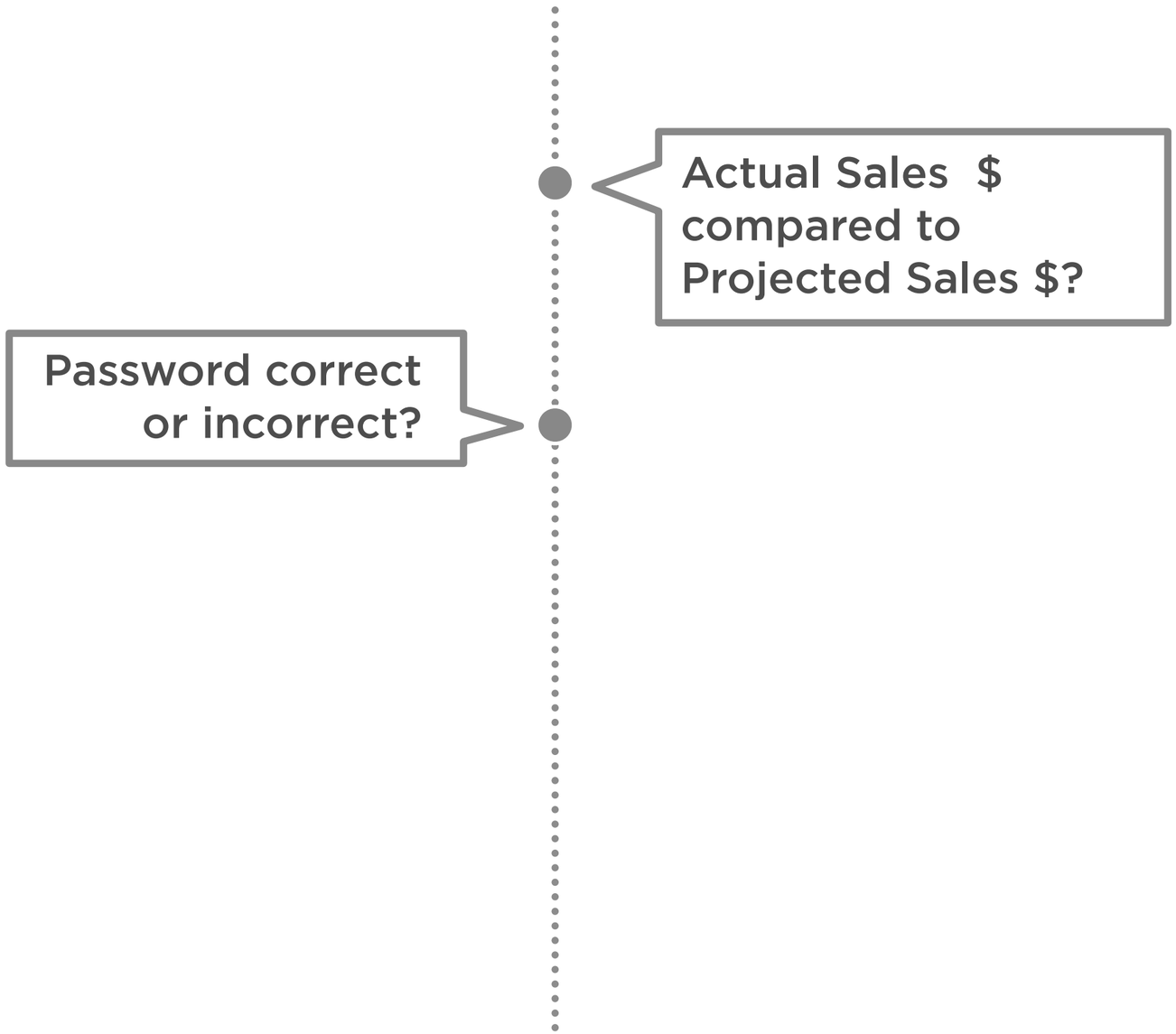
Controlling the Flow of Your Program

Controlling the Flow of Your Program

Controlling the Flow of Your Program



Controlling the Flow of Your Program



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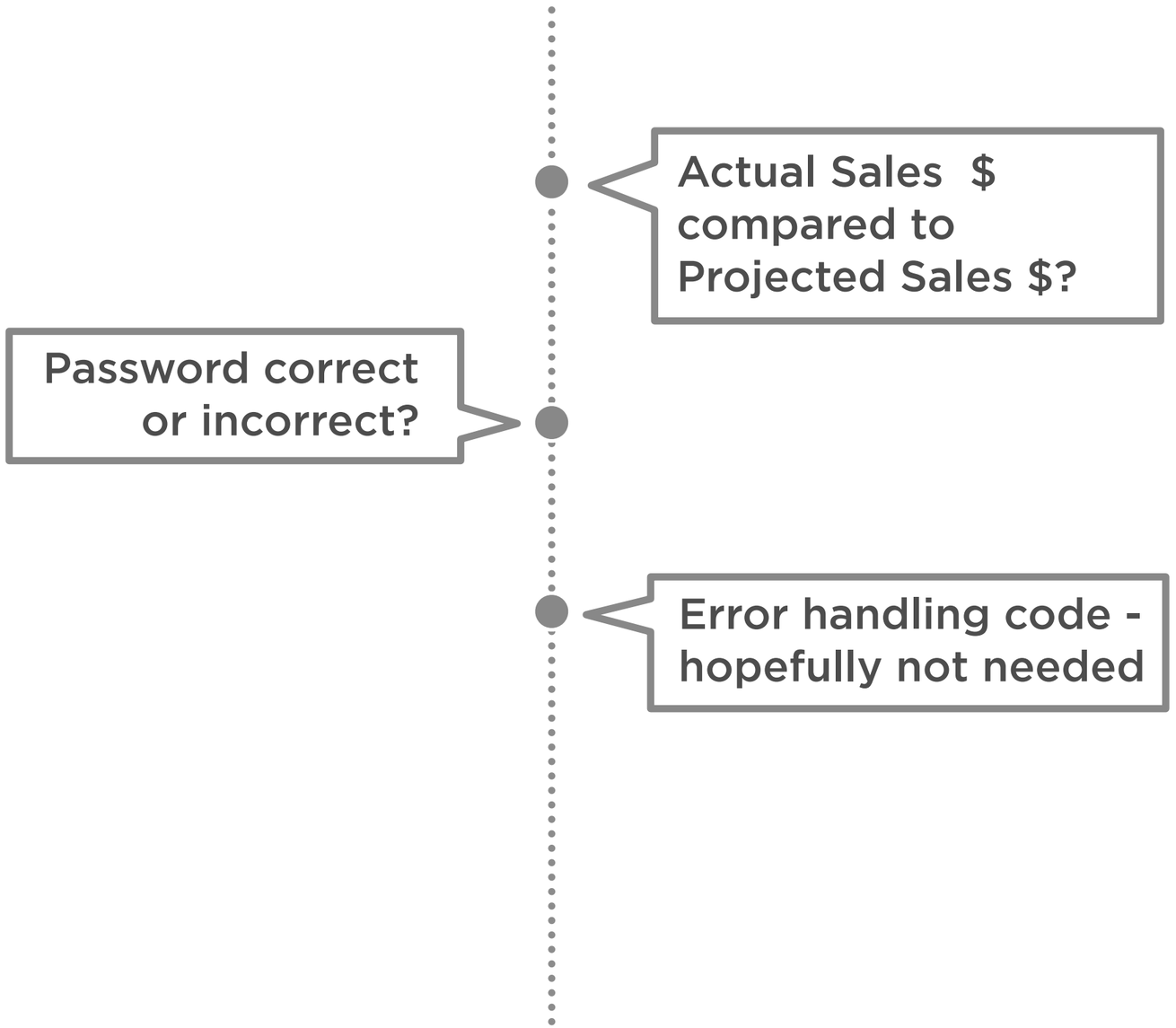
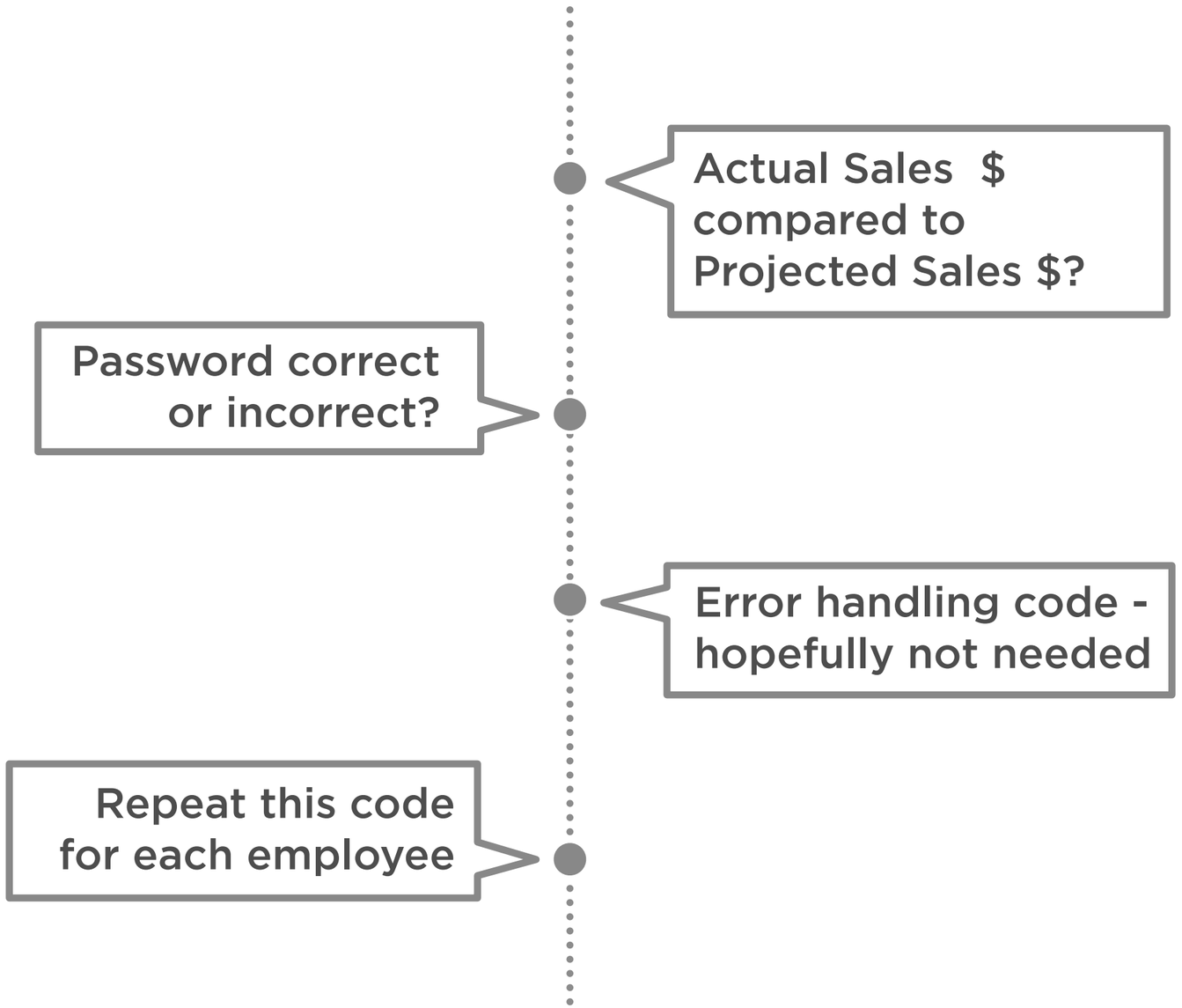


Controlling the Flow of Your Program



Program Flow: Conditions

if

Example: **if**

```
if balance > 1000  {
   print("You earn interest on this account.")
   // any additional statements
}
```

Example: **if**

```
if balance > 1000  {
    print("You earn interest on this account.")
    // any additional statements
}
```

Example: **if**

condition

```
if balance > 1000 {
    print("You earn interest on this account.")
    // any additional statements
}
```

Example: **if**

condition - any result must be either true or false

```
if balance > 1000 {
    print("You earn interest on this account.")
    // any additional statements
}
```

Conditions

```
if balance > 1000        {...}

if balance < 0           {...}

if temperature <= 55     {...}

if creditsRemaining >= 0 {...}
```

Checking Equality in a Condition

Checking Equality in a Condition

```
if balance = 0

if petName = "Jock"
```

Checking Equality in a Condition

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Incorrect:
Single = is for assignment (to set a value)

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```
if balance == 0

if petName == "Jock"
```

Checking Equality in a Condition

```
if balance = 0
if petName = "Jock"
```

Incorrect:
Single = is for assignment
(to set a value)

```
if balance == 0
if petName == "Jock"
```

Correct:
Double == is for equality
(to check a value)

Checking Equality in a Condition

```
if balance = 0

if petName = "Jock"
```

Incorrect:
Single = is for assignment
(to set a value)

```
if balance == 0

if petName == "Jock"
```

Correct:
Double == is for equality
(to check a value)

```
if petName != "Fido"  // check for inequality
```

Code Blocks

```
if balance > 1000  {
   print("You earn interest on this account.")
   // additional statements
}
```

Code Blocks

```
if balance > 1000 {
    print("You earn interest on this account.")
    // additional statements
}
```

start of the code block

Code Blocks

```
if balance > 1000 {
    print("You earn interest on this account.")
    // additional statements
}
```

start of the code block

end of the code block

Symbol Check

Symbol Check

Curly Braces

{ }

Symbol Check

Curly Braces

{ }

Square Brackets

[ ]

Symbol Check

Curly Braces	Square Brackets	Parentheses
{ }	[ ]	( )

```
struct file_handler {
 const char *type;
 int (*handler)(const char *line);
};

static void push_string(const char *name)
{
 unsigned int name_len = strlen(name) + 1;

 fputs(name, stdout);
 putchar(0);
 offset += name_len;
}

static void push_pad (void)
{
 while (offset & 3) {
  putchar(0);
  offset++;
 }
}
```

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  putchar(0);
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  const char *type;
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  fputs(name, stdout);
  putchar(0);
  offset += name_len;
}

static void push_pad (void)
{
  while (offset & 3) {
    putchar(0);
    offset++;
  }
}
```

Code Blocks

```
// more code above

if balance > 1000 {
    print("You earn interest on this account.")
    // additional statements
}

// more code below
```

start of code block

end of code block

Code Blocks

```
// more code above

if balance > 1000  {
   print("You earn interest on this account.")
   // additional statements
}


// more code below
```

Code Blocks

```
// more code above

if balance > 1000  {
   print("You earn interest on this account.")
   // additional statements
}


// more code below
```

Code Blocks

```
// more code above

if balance > 1000  {
   print("You earn interest on this account.")
   // additional statements
}


// more code below
```

Code Blocks

```
// more code above

if balance > 1000  {
   print("You earn interest on this account.")
   // additional statements
}


// more code below
```

Code Blocks

```
// more code above

if balance > 1000  {
   print("You earn interest on this account.")
   // additional statements
}


// more code below
```

Code Blocks

```
// more code above

if balance > 1000  {
   print("You earn interest on this account.")
   // additional statements
}

// more code below
```

Code Blocks

```
// more code above

if balance > 1000  {
   print("You earn interest on this account.")
   // additional statements
}


// more code below
```

Code Blocks: Brace Style

Code Blocks: Brace Style

Opening brace on same line

```
if someVariable > 0  {
   // Any additional statements
}
```

Code Blocks: Brace Style

Opening brace on same line

```
if someVariable > 0  {
   // Any additional statements
}
```

Opening brace on next line

```
if someVariable > 0
{
   // Any additional statements
}
```

Code Blocks: Brace Style

Opening brace on same line

```
if someVariable > 0  {
    // Any additional statements
}
```

Opening brace on next line

```
if someVariable > 0
{
    // Any additional statements
}
```

Code Blocks: Alternative

Code Blocks: Alternative

BASIC Style

```
If Balance > 1000 Then
   Print("You earn interest on this account.")
   ' Any additional statements
End If
```

Code Blocks: Alternative

BASIC Style

```
If Balance > 1000 Then
   Print("You earn interest on this account.")
   ' Any additional statements
End If
```

C Style

```
if balance > 1000  {
   print("You earn interest on this account.")
   // Any additional statements
}
```

Code Blocks: Alternative Styles

Code Blocks: Alternative Styles

Python Style

```
if balance > 1000:
     print('You earn interest on this account.')
     #any additional statements



print('Now outside the code block.')
```

Code Blocks: Alternative Styles

Python Style

```
if balance > 1000:
    print('You earn interest on this account.')
    #any additional statements

print('Now outside the code block.')
```

Code Blocks

```
if balance > 1000  {
   print("You earn interest on this account.")
   // additional statements
}


// more code below
```

If / Else

```
if balance > 1000  {
   // this block only if condition is true
   print("You earn interest on this account.")
}
```

If / Else

```
if balance > 1000  {
   // this block only if condition is true
   print("You earn interest on this account.")
} else  {
   // this block only if condition is false.
   print("You do NOT earn interest on this account.")
}
```

If / Else

```
if balance > 1000 {
    // this block only if condition is true
    print("You earn interest on this account.")
} else  {
    // this block only if condition is false.
    print("You do NOT earn interest on this account.")
}
```

If / Else

```
if balance > 1000 {
    // this block only if condition is true
    print("You earn interest on this account.")
} else {
    // this block only if condition is false.
    print("You do NOT earn interest on this account.")
}
```

If / Else

```
if balance > 1000 {
    // this block only if condition is true
    print("You earn interest on this account.")
} else {
    // this block only if condition is false.
    print("You do NOT earn interest on this account.")
}

// now outside the if/else
print("This statement is ALWAYS reached.")
```

Program Flow: Creating Complex Conditions

Complex Conditions

Complex Conditions

```
if
{
    // code to calculate interest
    // any additional statements
}
```

Complex Conditions

```
if  balance > 1000
{
    // code to calculate interest
    // any additional statements
}
```

Complex Conditions

```
if  balance > 1000  AND
{
    // code to calculate interest
    // any additional statements
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}


if
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

```
if cartTotal > 100
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}


if cartTotal > 100 OR
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

```
if cartTotal > 100 OR memberType == "Premium"
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

```
if cartTotal > 100 OR memberType == "Premium"
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

```
if cartTotal > 100 OR memberType == "Premium"
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

```
if cartTotal > 100 OR memberType == "Premium"
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

```
if cartTotal > 100 OR memberType == "Premium"
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

```
if cartTotal > 100 OR memberType == "Premium"
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

```
if cartTotal > 100 OR memberType == "Premium"
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions

```
if balance > 1000 AND accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

```
if cartTotal > 100 OR memberType == "Premium"
{
    print("You qualify for free shipping!")
    shippingCost = 0
}
```

Complex Conditions: Common Syntax

```
if    balance > 1000   AND  accountType == "Savings"
{
    // code to calculate interest
    // any additional statements
}
```

&& (and) **|| (or)**

Complex Conditions: Common Syntax

```
if  ( balance > 1000 ) AND (accountType == "Savings")
{
    // code to calculate interest
    // any additional statements
}
```

&& (and) **|| (or)**

Complex Conditions: Common Syntax

```
if ((balance > 1000 ) AND (accountType == "Savings"))
{
    // code to calculate interest
    // any additional statements
}
```

&& (and) **||** (or)

Complex Conditions: Common Syntax

```
if ((balance > 1000 ) && (accountType == "Savings"))
{
    // code to calculate interest
    // any additional statements
}
```

&& (and) **||** (or)

Complex Conditions: Common Syntax

```
if ((balance > 1000 ) && (accountType == "Savings"))
{
    // code to calculate interest
    // any additional statements
}
```

&& (and) **|| (or)**

```
if (condition1 && condition2 && condition3) {
...
}
```

Multiple Branches

Multiple Branches

```
If supermarket has full-fat milk
   buy full fat milk
Else
   buy skimmed milk
End
```

Multiple Branches

```
If supermarket has full-fat milk
   buy full fat milk
Else
   buy skimmed milk




End
```

Multiple Branches

```
If supermarket has full-fat milk
   buy full fat milk
Else
   If supermarket has 2% milk
      buy 2% milk
   Else
      buy skimmed milk
   End
End
```

Multiple Branches

```
If supermarket has full-fat milk
    If it's on sale AND expiration date > 2 weeks ahead
        buy two full fat milk
    Else
        buy one full fat milk
    End
Else
    If they have 2% milk
        buy 2% milk
    Else
        buy skimmed milk
    End
End
```

Multiple Branches

```
If supermarket has full-fat milk
    If it's on sale AND expiration date > 2 weeks ahead
        buy two full fat milk
    Else
        buy one full fat milk
    End
Else
    If they have 2% milk
        buy 2% milk
    Else
        buy skimmed milk
    End
End
```

Multiple Branches

```
If supermarket has full-fat milk
    If it's on sale AND expiration date > 2 weeks ahead
        buy two full fat milk
    Else
        buy one full fat milk
    End
Else
    If they have 2% milk
        buy 2% milk
    Else
        buy skimmed milk
    End
End
```

Multiple Branches

```
If supermarket has full-fat milk
    If it's on sale AND expiration date > 2 weeks ahead
        buy two full fat milk
    Else
        buy one full fat milk
    End
Else
    If they have 2% milk
        buy 2% milk
    Else
        buy skimmed milk
    End
End
```

Multiple Branches

```
If supermarket has full-fat milk
    If it's on sale AND expiration date > 2 weeks ahead
        buy two full fat milk
    Else
        buy one full fat milk
    End
Else
    If they have 2% milk
        buy 2% milk
    Else
        buy skimmed milk
    End
End
```

nested if

nested if

Dealing With Ranges

```
if bathTemperature < 90 {
    print("Brrr!")
} else {
    if bathTemperature < 95 {
        print("That's lukewarm.")
    } else {
        if bathTemperature < 105 {
            print("Perfect!")
        } else {
            if bathTemperature < 110 {
                print("This isn't a hot tub")
            } else {
                print("Are you trying to boil a lobster?)
            }
        }
    }
}
```

Dealing With Ranges

```
if bathTemperature < 90 {
    print("Brrr!")
}
if bathTemperature > 90 && bathTemperature < 95 {
    print("That's lukewarm.")
}
if bathTemperature >= 95 && bathTemperature <= 105 {
    print("Perfect!")
}
if bathTemperature >= 105 && bathTemperature <= 110 {
    print("This isn't a hot tub")
}
if bathTemperature >= 110 {
     print("Are you trying to boil a lobster?)
}
```

Switch Statement

```
switch bathTemperature {
    case < 90:
       print("Brrr!")
    case 90...95:
       print("That's lukewarm.")
    case 96...105:
       print("Perfect!")
    case 106...110 {
       print("This isn't a hot tub"
    default:   // any other value
       print("Are you trying to boil a lobster?)
}
```

Switch Statement

```
switch bathTemperature {
    case < 90:
       print("Brrr!")
    case 90,91,92,93,94,95:
       print("That's lukewarm.")
    case 96,97,98,99,100,101,102,103,104,105:
       print("Perfect!")
    case 106,107,108,109,110 {
       print("This isn't a hot tub"
    default:   // any other value
       print("Are you trying to boil a lobster?)
}
```

Program Flow: Creating Loops

Loops / Iteration

Loops / Iteration

```
statement one
statement two
statement three
// etc.
```

Loops / Iteration

```
{
  statement one
  statement two
  statement three
  // etc.
}
```

Loops / Iteration

"repeat this code"

```
{
  statement one
  statement two
  statement three
  // etc.
}
```

Loops / Iteration

"repeat this 10 times"

```
{
  statement one
  statement two
  statement three
  // etc.
}
```

Loops / Iteration

"repeat this 100000 times"

```
{
  statement one
  statement two
  statement three
  // etc.
}
```

Loops / Iteration

"repeat this for each employee in the company"

```
{
  statement one
  statement two
  statement three
  // etc.
}
```

Loops / Iteration

"repeat this for each document in the folder"

```
{
  statement one
  statement two
  statement three
  // etc.
}
```

Loops / Iteration

"repeat this for each track in the album"

```
{
  statement one
  statement two
  statement three
  // etc.
}
```

Loops / Iteration

"repeat this forever"

```
{
  statement one
  statement two
  statement three
  // etc.
}
```

While Loop

While Loop

```
statement one
statement two
statement three
// etc.
```

While Loop

```
while  some condition is true  {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (some condition is true) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

true / false

```
while (some condition is true) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (some condition is true) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

true

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

true

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

true

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

false

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

```
while (   myVariable < 1000   ) {
    statement one
    statement two
    statement three
    // etc.
}
```

While Loop

While Loop

```
int counter = 0
```

While Loop

```
int counter = 0

while ( counter < 10 )  {
    print("The counter is: " + counter)
    counter = counter + 1
}

print("Now outside the loop.")
```

While Loop

```
int counter = 0

while ( counter < 10 )  {
    print("The counter is: " + counter)
    counter = counter + 1
}

print("Now outside the loop.")
```

counter output

```
The counter is: 0
The counter is: 1
The counter is: 2
The counter is: 3
The counter is: 4
The counter is: 5
The counter is: 6
The counter is: 7
The counter is: 8
The counter is: 9
Now outside the loop.
```

While Loop

```
int counter = 0

while ( counter < 10 )  {
    print("The counter is: " + counter)
    counter = counter + 1
}

print("Now outside the loop.")
```

While Loop

```
int counter = 0

while ( counter < 10 )  {
    print("The counter is: " + counter)
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}

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while ( counter < 10 )  {
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While Loop

```
int counter = 0

while ( counter < 10 )  {
    print("The counter is: " + counter)
    counter = counter + 1
}

print("Now outside the loop.")
```

For Loop

For Loop

```
for (          )  {

}
```

For Loop

```
// C-style for loop
for (                                                    ) {

}
```

For Loop

```
// C-style for loop
for ( initializer    ;   condition  ; at-the-end   )  {

}
```

For Loop

```
// C-style for loop
for ( int counter = 0 ; counter < 10 ; counter++  )  {

}
```

For Loop

```
// C-style for loop
for ( int counter = 0 ; counter < 10 ; counter++  )  {
    print("The counter is: " + counter)
}

print("Now outside the loop.")
```

For Loop

```
// C-style for loop
for ( int counter = 0 ; counter < 10 ; counter++  )  {
    print("The counter is: " + counter)
}

print("Now outside the loop.")
```

For Loop

```
// C-style for loop
for ( int counter = 0 ; counter < 10 ; counter++  )  {
    print("The counter is: " + counter)
}

print("Now outside the loop.")
```

For Loop

```
// C-style for loop
for ( int counter = 0 ; counter < 10 ; counter++ )  {
    print("The counter is: " + counter)
}

print("Now outside the loop.")
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For Loop

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// C-style for loop
for ( int counter = 0 ; counter < 10 ; counter++ ) {
    print("The counter is: " + counter)
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print("Now outside the loop.")
```

counter output

```
The counter is: 0
The counter is: 1
The counter is: 2
The counter is: 3
The counter is: 4
The counter is: 5
The counter is: 6
The counter is: 7
The counter is: 8
The counter is: 9
Now outside the loop.
```

For Loop

```
// C-style for loop
for ( int counter = 0 ; counter < 10 ; counter++ )  {
    print("The counter is: " + counter)
}

print("Now outside the loop.")
```

For-In / For-Each Loop

For-In / For-Each Loop

```
for each item in collection  {
    // statements to execute
    // ...
}
```

For-In / For-Each Loop

```
for each person in contactList  {
    // statements to execute
    // ...
}
```

For-In / For-Each Loop

```
for each file in documentsFolder  {
    // statements to execute
    // ...
}
```

For-In / For-Each Loop

```
for each track in album  {
    // statements to execute
    // ...
}
```