EECS1022
MOBILE COMPUTING

CONTROL STRUCTURES
SELECTION
(SLIDES ADAPTED FROM PROF.H. ROUMANI)

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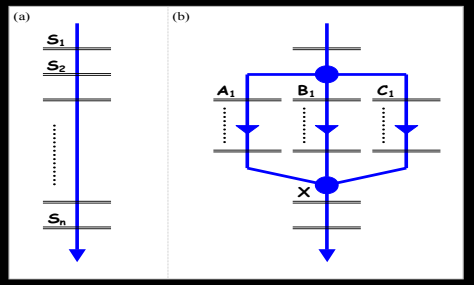
FLOW OF CONTROL

- What is control; how does it flow?
- Sequence versus Selection Flow



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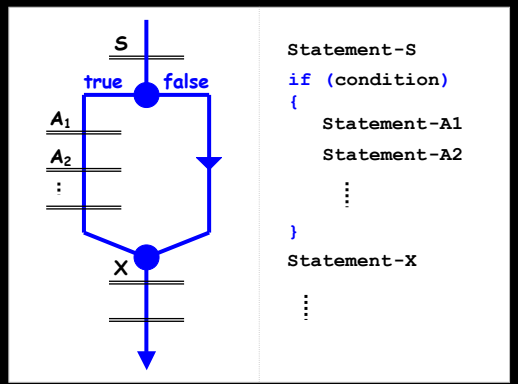
SELECTION: IF




```
Statement-S
if (condition)
{
   Statement-A1
   Statement-A2
      ⋮
}
Statement-X
   ⋮
```

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EXAMPLE

Write a method that reads an int and out-puts its *abs* value without using `Math.abs`.

```
public int myAbs(int n)
{
   int result = n;
   if (n < 0)
   {
      result = -n;
   }
   return result;
}
```

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PITFALL

What is wrong with this?

```
public int myAbs(int n)
{
   int result = n;
   if (n < 0);
   {
      result = -n;
   }
   return result;
}
```

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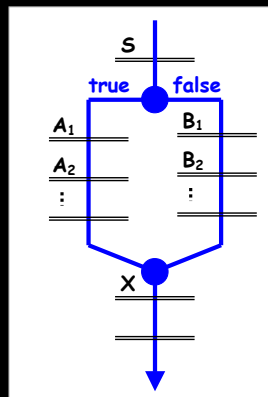
SELECTION: IF-ELSE




```
Statement-S
if (condition)
{
   Statement-A1
   Statement-A2
   ...
} else
{
   Statement-B1
   Statement-B2
   ...
}
Statement-X
```

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EXAMPLE

Rewrite the **myAbs** body using if-else

```
int result;
if (n < 0)
{
   result = -n;
}
else
{
   result = n;
}
return result;
```

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PITFALL

What is wrong with this?

```
if (n < 0)
{
   int result = -n;
}
else
{
   int result = n;
}
return result;
```

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Building the Condition

- **Relational Expression**

```
if (k < 0)
```

- **Boolean Variable**

```
boolean b = k < 0
if (b)
```

- **Boolean Expression**

```
if (k < 0 || b && m > h)
```

Uses boolean operators: &&, ||, and !

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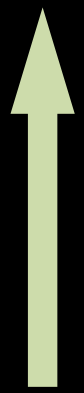
Operator Precedence



```
. ++ -- !
cast
* / %
+ -
<  <=  >  >=
== !=
&&
||
= op=
```

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Example

- Express the condition x ∈ [a, b)

```
if (x >= a && x < b)
```

- Express the condition x ∉ [a, b)

```
if (!(x >= a && x < b))
```

Can use deMorgan's Law to convert negated conjunctions to disjunctions.

```
if (x < a || x >= b)
```

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Example

Given two object references x and y, write a condition to determine if the objects they reference are equal.

Which one is correct and why:

- `if (x == y)`
- `if (x.equals(y))`
- `if (x.equals(y) && x != null)`
- `if (x != null && x.equals(y))`

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EXERCISES

Implement these methods:

- public boolean isOdd(int n)
  Returns true if n is odd else returns false.
- public char getFullGrade(int mark)
  Returns the full letter grade (A,B,C,D,E,F) given the mark (out of 100) in a course.
- public boolean isLeap(int year)
  Returns true if the year is a leap else returns false.
  A leap year is divisible by 4 and if it is divisible by 100 then it must also be divisible by 400; e.g. 2016 is, 2000 is, but 2100 is not.

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ITERATION
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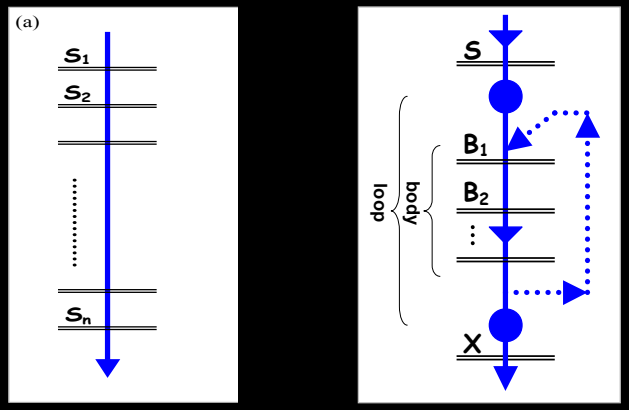
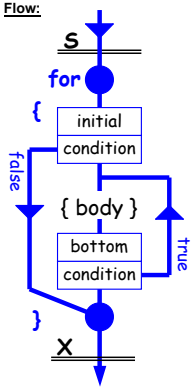
ITERATION FLOW OF CONTROL



2

ITERATION: FOR

Flow:



Syntax:

```
Statement-S
for (initial; condition; bottom)
{
   body;
}
Statement-X
```

Algorithm:

1. Start the `for` scope
2. Execute `initial`
3. If `condition` is `false` go to `9`
4. Start the body scope `{`
5. Execute the body
6. End the body scope `}`
7. Execute `bottom`
8. If `condition` is `true` go to `4`
9. End the `for` scope

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EXAMPLE

Output a table of square roots in [0,9].

```
for (int i = 0; i < 10; i = i + 1)
{
   double root = Math.pow(i, 0.5);
   System.out.print(i);
   System.out.print("\t");
   System.out.println(root);
}
```

4

for (initial; condition; bottom)

```
for (int i = 0; i < MAX; i = i + 1)
{
   ...
}
```

```
int i = 0;
for (; i < MAX; i = i + 1)
{
   ...
}
```

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for (initial; condition; bottom)

- Can it be omitted?
- Can it be set to the literal `true`?
- What if it were false at the beginning?
- Is it monitored throughout the body?

6

for (initial; condition; bottom)

- Can be any statement.
- Can be omitted.
- Will the loop become infinite if it is omitted?

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EXAMPLE

Write a fragment to output the exponents of all powers of 2 that are smaller than a million.

Correct output:

```
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
```

```
final int MILLION = 1000000;
for (int expo = 0; Math.pow(2, expo) < MILLION; expo++)
{
   System.out.print(expo);
   System.out.print(" ");
}
System.out.println();
```

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EXAMPLE

Rewrite the fragment so it only outputs the exponent of the greatest power of 2 that is smaller than a million.

```
int expo = 0;
for (; Math.pow(2, expo) < MILLION; expo++)
{
}
System.out.println(expo - 1);
```

```
int expo = 0;
for (; Math.pow(2, expo) < MILLION; expo++);
System.out.println(expo - 1);
```

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NESTED LOOPS

- Must be fully nested
- Nested structures imply nested scopes

```
for (int i = 0; i < 10; i++)
{
   for (int j = 0; j < 10; j++)
   {
      System.out.println(i + "  " + j);
   }
}
```

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EXERCISES

Implement these methods:

- public boolean isPrime(int n)
  Returns true if n is prime, else returns false.
- public int log2 (int n)
  Returns the number of repeated division of n by 2 until the result of the division is 1
- public double factorial(int n)
  Returns n!
- public double oddRecipSum (int n)
  Returns the sum of the reciprocals of odd integers with alternating signs between 1 and 10^6 (should around $\pi/4$)

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