Decisions, Decisions...

Conditional statements and expressions

Straight-line code

```plaintext
timeSamples = 0:5:200;

tempLaw = 24.5+69*exp(-0.0426*timeSamples);

hold on

plot(timeSamples, tempLaw, 'g--o')

hold off
```
What lies beneath...

When mapping the ocean floor with sonar, large marine animals or equipment faults may produce erroneous data*

if data appears valid then
   incorporate it into the seafloor map
otherwise
   disregard the data
'nuff said

* We follow the politician's rule: If the data is suspicious, disregard it

Branching code

data appears valid?

No
- disregard the data

Yes
- incorporate into map

on to the next step
**MATLAB if statement**

General format of the MATLAB if statement:

```matlab
if conditional expression
    actions to perform if conditional expression is true
else
    actions to perform if conditional expression is false
end
```

```matlab
age = input('Enter your age:');
if (age < 18)
    disp('Like to help you son, but you''re too young to vote')
else
    disp('Glad to meet ya!')
end
```

**Multiple actions**

```matlab
if conditional expression
    actions to perform if conditional expression is true
else
    actions to perform if conditional expression is false
end
```

```matlab
if (a == 0)
    result1 = 0;
    result2 = 1;
else
    result1 = 10/a;
    result2 = a^2 + 1;
end
```
Conditional expressions

- **Relational operators** compare two numbers:
  
  \[
  \begin{align*}
  &=& \sim &=& < &=& > &=& \leq &=& \geq
  \end{align*}
  \]

- **Conditional expressions** have the general form:
  
  \[
  \text{expression} \quad \text{operator} \quad \text{expression}
  \]

- For example*:
  
  \[
  \begin{align*}
  \text{age} &=& 21 \\
  \text{age} &\sim& 21 \\
  \text{age} &<& (2 \times \text{num} + 4) \\
  (2 \times \text{num}) &>& (\text{age} + 10)
  \end{align*}
  \]

* If age is 15 and num is 10, are these expressions true or false?

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Boolean values

The value of a conditional expression is 1 (true) or 0 (false)

oldie and toddler are type logical, but their value can sometimes be treated as a number
Between a rock and a hard place...

Question: Are you between 18 and 21 years of age?*

```matlab
if (18 <= age <= 21)
    disp('You have a Junior Operator''s license!')
end
```

Well, yes, that's a valid MATLAB statement, but the result may not be what you expect...

Let's evaluate this expression for the following values:

<table>
<thead>
<tr>
<th>Age</th>
<th>20</th>
<th>15</th>
<th>25</th>
</tr>
</thead>
</table>

* Which means in Massachusetts you get a funny looking driver's license

The whole truth...

Question: Are you between 18 and 21 years of age?

This question combines two simpler questions:

- Is your age greater than or equal to 18?
- Is your age less than or equal to 21?

MATLAB:

```
(age >= 18) & (age <= 21)
```
Another question

Question: Are you under 18 or over 65 years of age?*

This question combines
- Is your age less than 18?
- or
- Is your age greater than 65?

MATLAB:
\[(\text{age} < 18) \text{ or } (\text{age} > 65)\]

* Which means reduced admission fee at the MFA...

Final question: To be, or not to be,...

Question: Is your age not equal to 65?
\[\text{age } \sim 65\]

This can be rephrased as:
- Is it not true that your age equals 65?
\[\sim(\text{age } = 65)\]

Logical value of expression is "flipped" with \(\sim\) ("not")
More questions*

Suppose \( a \) is 5 and \( b \) is 2

\[
\begin{align*}
(a &== 5) & (b &== 5) \\
(a &== 5) & (b &= 5) \\
(a &== 5) & \sim(b &= 5) \\
(a &= 1) & | b \ \\
(a &= 5) & (b < 5) \\
(a &= 5) & (b < 5) & (b > 2) \\
\sim((a &== 5) & (b &== 5))
\end{align*}
\]

* I lie like a rug

---

Analyzing health data

What is the average cholesterol level for women in their twenties who exercise at least 30 minutes a day?

<table>
<thead>
<tr>
<th>cholesterol</th>
<th>189</th>
<th>239</th>
<th>178</th>
<th>185</th>
<th>251</th>
<th>165</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>25</td>
<td>35</td>
<td>28</td>
<td>40</td>
<td>28</td>
<td>22</td>
<td>...</td>
</tr>
<tr>
<td>sex</td>
<td>'m'</td>
<td>'m'</td>
<td>'f'</td>
<td>'m'</td>
<td>'m'</td>
<td>'f'</td>
<td>...</td>
</tr>
<tr>
<td>exercise</td>
<td>30</td>
<td>15</td>
<td>40</td>
<td>25</td>
<td>15</td>
<td>60</td>
<td>...</td>
</tr>
</tbody>
</table>
Vector to scalar comparisons

A conditional expression can be applied *element-by-element* to a vector of values:

ages = [55 52 20 10 63];
oldies = (ages >= 50);
twenties = (ages == 20);

* Write a statement that assigns `numOldies` to the number of values in the `ages` vector over 50.

Vector to vector comparisons

A conditional expression can be applied to two vectors:

ages = [55 52 20 10 63];
newAges = [55 27 20 15 63];
sameAge = (ages == newAges);
older = (ages > newAges);
Vector to vector comparisons

A conditional expression can be applied to two vectors:

ages = [55 52 20 10 63];
newAges = [55 27 20 15 63];
sameAge = (ages == newAges);
older = (ages > newAges);

<table>
<thead>
<tr>
<th>ages</th>
<th>55</th>
<th>52</th>
<th>20</th>
<th>10</th>
<th>63</th>
</tr>
</thead>
<tbody>
<tr>
<td>newAges</td>
<td>55</td>
<td>27</td>
<td>20</td>
<td>15</td>
<td>63</td>
</tr>
<tr>
<td>sameAge</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>older</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Luxuries*

- **any** returns true if *any* of the logical values in a vector are true
- **all** returns true if *all* of the logical values in a vector are true

**Examples:**

ages = [10 62 18 27]
anyKids = any(ages < 18)
anySeniors = any(ages >= 65)
allAdults = all(ages >= 18)
noSeniors = all(ages <= 65)

* Why luxuries?