<table>
<thead>
<tr>
<th>Topic</th>
<th>Flow chart</th>
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<tr>
<td><strong>Sub Topic</strong></td>
<td>Algorithms and Flowcharts</td>
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<tr>
<td><strong>Summary</strong></td>
<td>Discussing flow chart symbols, and describing flowcharts using a few examples</td>
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<tr>
<td><strong>Authors</strong></td>
<td>Autar Kaw, Shenique Johnson</td>
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<td><strong>Last Revised</strong></td>
<td>February 12, 2010</td>
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<td><strong>Web Site</strong></td>
<td><a href="http://www.eng.usf.edu/~kaw/class/programming">http://www.eng.usf.edu/~kaw/class/programming</a></td>
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**Flowcharts**

A **flowchart** is the combination of geometric symbols connected with arrows that represent steps in a process.

### Flowchart Symbols

- **Flowline**
  - Used to connect symbols and indicate the flow of logic.

- **Terminal**
  - Used to represent the beginning or end of a task.

- **Decision**
  - Used for logic of comparison operations.

- **Offpage Connector**
  - Used to indicate that the flowchart continues to a second page.

- **Processing**
  - Used for arithmetic and data manipulation operations.

- **Connector**
  - Used to join different flowlines.

- **Predefined Process**
  - Used to represent a group of statements that perform one processing task.

- **Annotation**
  - Used to provide additional information about another flowchart symbol.

- **Input/Output**
  - Used for input and output operations.

- **Loop**
  - Used for loops

Note: All symbols are not necessary to have a complete flowchart.
Example 1
Hero’s formula for calculating the area of a triangle with the length of the three sides as $a$, $b$, $c$ is given by $A = \sqrt{s(s-a)(s-b)(s-c)}$, where $s$ is the semi-perimeter of the triangle, $s = \frac{a+b+c}{2}$. The perimeter of the triangle is given by $P = a+b+c$. Construct a flow chart for calculating the perimeter and area of any triangle.

Solution

Figure 1: Flow chart for calculating the area and perimeter for any triangle.
Example 2
So you want my phone number and need to know my BMI? How shallow can you get? In 1998, the federal government developed the body mass index (BMI) to determine ideal weights. Body mass index is calculated as 703 times the weight in pounds divided by the square of the height in inches, the obtained number is then \textbf{rounded off} to the nearest whole number (Hint: 23.5 will be rounded to 24; 23.1 will be rounded to 23; 23.52 will be rounded to 24). Criteria for a healthy weight is given as follows.

<table>
<thead>
<tr>
<th>Range of BMI</th>
<th>Meaning of Range</th>
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<tbody>
<tr>
<td>BMI&lt;19</td>
<td>Unhealthy weight</td>
</tr>
<tr>
<td>19≤BMI≤25</td>
<td>Healthy weight</td>
</tr>
<tr>
<td>BMI&gt;25</td>
<td>Unhealthy weight</td>
</tr>
</tbody>
</table>

Construct a flow chart for the above example that will, based on persons weight and height, determine whether a person is healthy or unhealthy weight.

\textbf{Solution}
A person’s BMI I calculated by the formula

\[ BMI = \frac{\text{weight}(lbs)}{[height(in)]^2} \times 703 \]

The steps in the algorithm are
1. Enter the person’s weight in lbs and height in inches.
2. Calculate BMI using \( BMI = \frac{\text{weight}(lbs)}{[height(in)]^2} \times 703 \)
3. If BMI not in the range of 19 and 25, then the person has an unhealthy weight, else the weight is healthy.
Figure 2: Flow chart for calculating a person’s BMI.
Example 3

The function $e^x$ can be calculated by using the following infinite Maclaurin series

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots$$

Figure 3: Flowchart for calculating exp(x) using Maclaurin Series.
**Figure 4:** Alternate Flow Chart to Figure 3 for Calculating the Maclaurin Series.
Figure 5: Flowchart for calculating $e^x$ with pre-specified tolerance.

The function $e^x$ can be calculated by using the following infinite Maclaurin series

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots$$

Since you can use only a finite number of terms in the series, the absolute relative error $|\varepsilon_a|$ is defined as,

$$|\varepsilon_a| = \frac{\text{Present Approximation} - \text{Previous Approximation}}{\text{Present Approximation}} \times 100$$
If $|\varepsilon_a|$ is less than the pre-specified relative error tolerance, then the pre-specified relative error tolerance is met.