ENGG1811 Computing for Engineers

Week 12b: Programming exercises
Programming

- Basic programming constructions
  - Declaring variables
  - If/then/else
  - Loops: for, while

- Functions / subs
  - To perform similar work

- Sometime you may also find similar work within a function
An OOB exercise

The cosine of an angle $\alpha$ in radians can be derived from the series

$$\cos \alpha = \sum_{k=0}^{\infty} (-1)^k \frac{\alpha^{2k}}{(2k)!} = 1 - \frac{\alpha^2}{2!} + \frac{\alpha^4}{4!} - \frac{\alpha^6}{6!} + \ldots$$

Write a OO Basic function that calculates an approximation to cosine using the first $(n+1)$ terms of the series, stopping after including the term where $k$ is equal to $n$ ($\alpha$ and $n$ are parameters to the function).

*Note:* An inefficient method is to use two loops or to compute each term from scratch. A better method is to use one loop and you need think about what you have to multiply each term in the series by to get the next term.
\[
\cos \alpha = \sum_{k=0}^{\infty} (-1)^k \frac{\alpha^{2k}}{(2k)!} = 1 - \frac{\alpha^2}{2!} + \frac{\alpha^4}{4!} - \frac{\alpha^6}{6!} + \ldots
\]

<table>
<thead>
<tr>
<th>k</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-th term</td>
<td>1</td>
<td>$-\frac{\alpha^2}{2!}$</td>
<td>$\frac{\alpha^4}{4!}$</td>
<td>$-\frac{\alpha^6}{6!}$</td>
</tr>
</tbody>
</table>

Multiply by

Write these expressions in terms of k

k = 1  
k = 2  
k = 3
Reshaping a matrix by taking its elements column-by-column

\[
v = \begin{bmatrix}
1 & 2 & 3 & 4 \\
5 & 6 & 7 & 8 \\
\end{bmatrix}
\]

\[
>> \text{reshape}(v, [4,2])
\]

\[
\text{ans} = \\
\begin{bmatrix}
1 & 3 \\
5 & 7 \\
2 & 4 \\
6 & 8 \\
\end{bmatrix}
\]
Matlab exercise (1)

- Given a vector v with 12 elements
- You want to compute a vector w with 4 elements such that
  - \( w(1) = v(1) + v(2) + v(3) \)
  - \( w(2) = v(4) + v(5) + v(6) \)
  - \( w(3) = v(7) + v(8) + v(9) \)
  - \( w(4) = v(10) + v(11) + v(12) \)
- Do this using two different methods:
  - With loops
  - Without loops (Hint: Use reshape)
Matlab exercise (2)

• Given a vector \( v \) with 12 elements
• You want to compute a vector \( w \) with 4 elements such that
  – \( w(1) = v(1) + v(5) + v(9) \)
  – \( w(2) = v(2) + v(6) + v(10) \)
  – \( w(3) = v(3) + v(7) + v(11) \)
  – \( w(4) = v(4) + v(8) + v(12) \)
• Do this without loops (Hint: Use reshape)