Introduction to Computer for Engineers

Lecture 7
Numerical Integration

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Review Matlab

While loop

- Syntax
  while (**conditional statement**)
  instructions (when the statement is true)
  end

- Note : you can combine **if** and **break** to exit the loop

- **Example** sum of 10 natural number using while loop

Review Matlab

Algorithm for calculating the sum

- Declare a variable used for storing the sum, eg. **sum_var** = 0
- Iterate **until we reach the biggest number k**, that we want to compute the sum
  sum_var = sum_var + k
  End of iterate
- Show the value of the sum, eg. **sum_var**

Implement using **for loop** and **while loop**

Review Matlab

Implementation code

```
sum_var = 0;
k = 0;
while ( k <= 10 ) // biggest number is 10
    sum_var = sum_var  + k;
    k = k + 1;
end

 sum_var
```

Review Matlab

Implementation code 2

```
sum_var = 0;
k = 0;
while ( 1 ) // while loop will run forever
    sum_var = sum_var  + k;
    k = k + 1;
    if (k == 11)  break; // exit the loop
end

sum_var
```

Review Math

Area computation

- Area of a triangle with the bottom a and the height h

$$S_{triangle} = \frac{ha}{2}$$

- Area of a rectangle with length a and b :

S_rec = a x b

- Area of a trapezoid with top, bottom and the height are respectively a,b and h

$$\text{S\_trap} = \frac{h}{2}(a + b)$$

Numerical Integration

Based on
- **The computation of sum**
- **The area**

Numerical Integration = Sum of Area

Demonstration: compute the value of

$$I = \int_0^5 (2x - 4)dx$$

$$I = \int_0^5 (x^2 - 2x + 3)dx$$

Numerical Integration

Demonstration: compute the value of

$$I = \int_0^5 (2x - 4)dx = [x^2 - 4x]_0^5 = 25 - 20 = 5$$

$$I = \int_0^5 (x^2 - 2x + 3)dx = \left[\frac{x^3}{3} - x^2 + 3x\right]_0^5 = \frac{95}{3} = 31.6$$

Numerical Integration

Implementation

Declare a variable for storing the value of the integral

Plot the function inside the integral on the interval 0-5

Numerical calculation using
- **Sum of rectangles**
- **Sum of trapezoids**

Identifying the source of error, Compare with exact solution

Increase the quality of solution by splitting more equidistance

End of Lecture 7