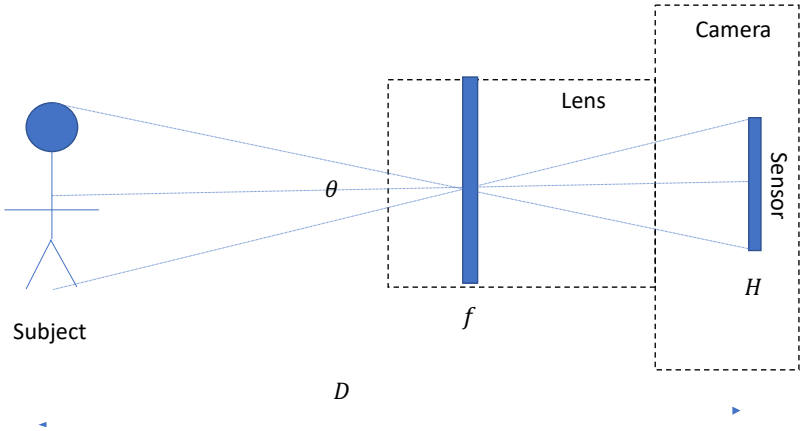
EGR-101 Intro Computing Engineers

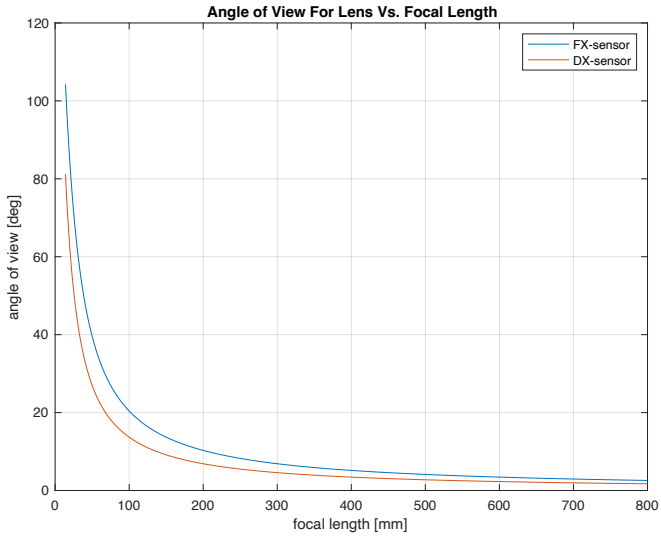
Due: 1 November 2021 at the start of class

Question 1 (50 Points)

Please help me decide what lens to purchase for wildlife photography. A critical attribute of a lens is its focal length f. An important attribute of the camera is the sensor height H. The camera system has a field of view θ as shown below. The subject is located a distance D from the focal plane. A relation between the respective parameters is $\theta = 2\tan^{-1}(\frac{H}{2f})$. Further, the height of a subject that can be captured by the camera system is $D\theta$.

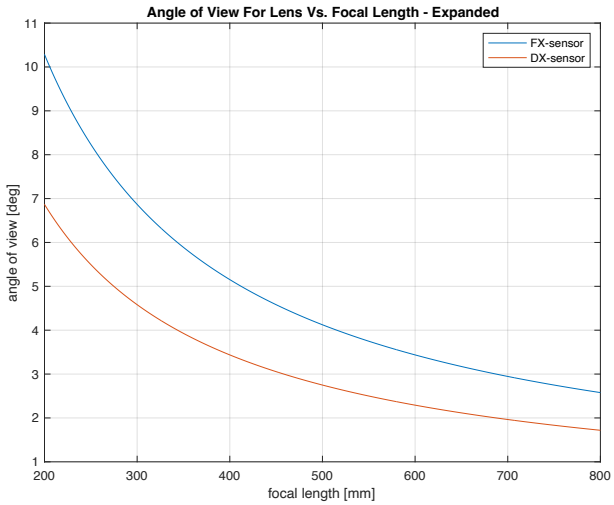


In a well-documented MATLAB script, $hwmk7Q1.m$ submit a program to relate the Angle of View vs. Focal-Length using traditional programming – do not use vectorization in your solution. Have your program generate a plot similar to that depicted below for two sensor sizes H = 36mm (FX) and 24mm (DX), respectively. Submit your plot in a file $hwmk7Q1a.fig$, where the program will save the figure using the save command.



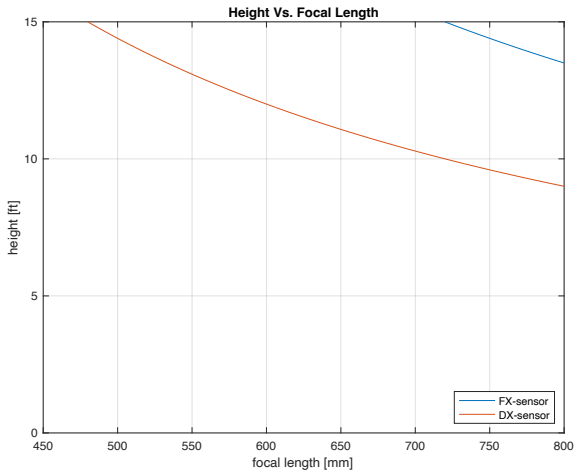
$hwmk7Q1a.fig$

Also submit a plot in a file $hwmk7Q1b.fig$, where the program will save the figure using the save command, using the command $xlim()$to limit the plot.



$hwmk7Q1b.fig$

If the National Park limits the distance R to wildlife to 300 ft, how large of a lens should I buy to ensure that the 5ft wild-life extends to 1/3 for the image? By recognizing the height associated with the field of view is $R\theta$, have your program generate the plot below, using non-vectorization, and save $hwmk7Q1c.fig$.



$hwmk7Q1c.fig$

Grading: 4 pts for $hwmk7Q1.m.$ 2 pts each for $hwmk7Q1a.fig$, $hwmk7Q1b.fig$ and $hwmk7Q1c.fig$, respectively.

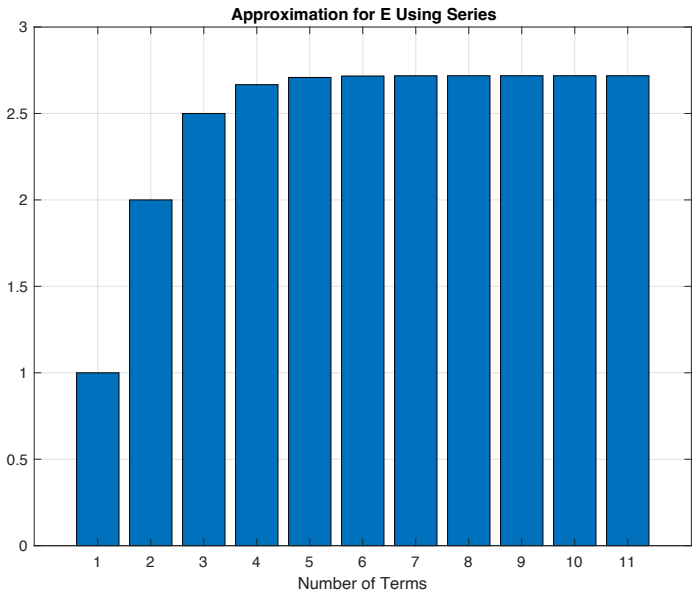
Question 2 (50 Points)

Repeat Question 1 using vectorization.

Grading: 4 pts for $hwmk7Q2.m.$ 2 pts each for $hwmk7Q2a.fig$, $hwmk7Q2b.fig$ and $hwmk7Q2c.fig$, respectively.

Question 3 (50 Points)

In a well-documented script, $hwmk7Q3.m$, calculate e, Euler's number using a for-loop. Recall that $e = \sum_{n=0}^{\infty} \frac{1}{n!}$. You may use the MATLAB function to compute the factorial. Record your answer for N-terms, in a comment embedded in your script, when N =10, which has 11 terms. In a comment, compare your estimate for e to MATLAB's using $\exp(1)$. Also, write an equivalent the one-line command, using vectorization, in your script. Finally, using the MATLAB command $bar(\ \ )$, prepare $hwmk7Q3.fig$, which depicts how the estimate of e evolves with increasing number of terms in the series.

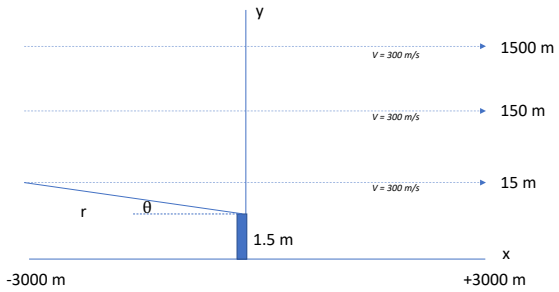


$hwmk7Q3.fig$

Grading: 4 pts for $hwmk7Q3.m.$ 2 pts comparing your estimate of e to MATLAB's. 2 pts. for the one-line command that performs the same calculation. 2 pts for $hwmk7Q3.fig$.

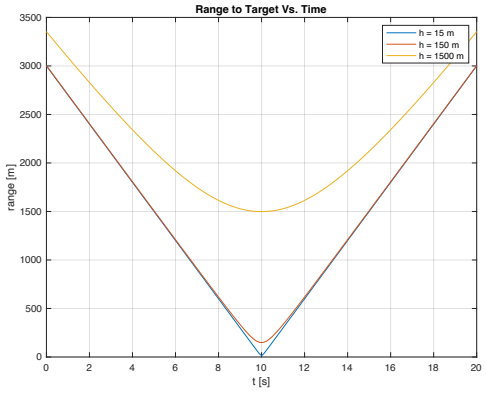
Question 4 (50 Points)

In a well-documented script, $hwmk7Q4.m$, simulate three air vehicles traveling at 300m/s, over an epoch of 20 seconds. They are observed by a sensor located on an antenna of height 1.5m.

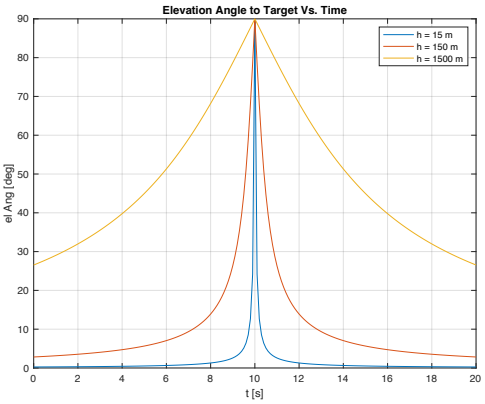


Air Vehicle Simulation

The equations of motion are $x(t) = -3000 + 300t$ and $y(t) = 15, 150, and\ 1500$ for the three targets. The range to the target is $r(t) = \sqrt{x(t)^2 + (y - 1.5)^2}$. The elevation angle $\theta(t) = \cos^{-1}\frac{x(t)}{r(t)}$. Form vectors for $t, x, y, r\ and\ \theta$. Make sure that they are all the same length and construct two figures shown below.



$hwmk7Q4a.fig$



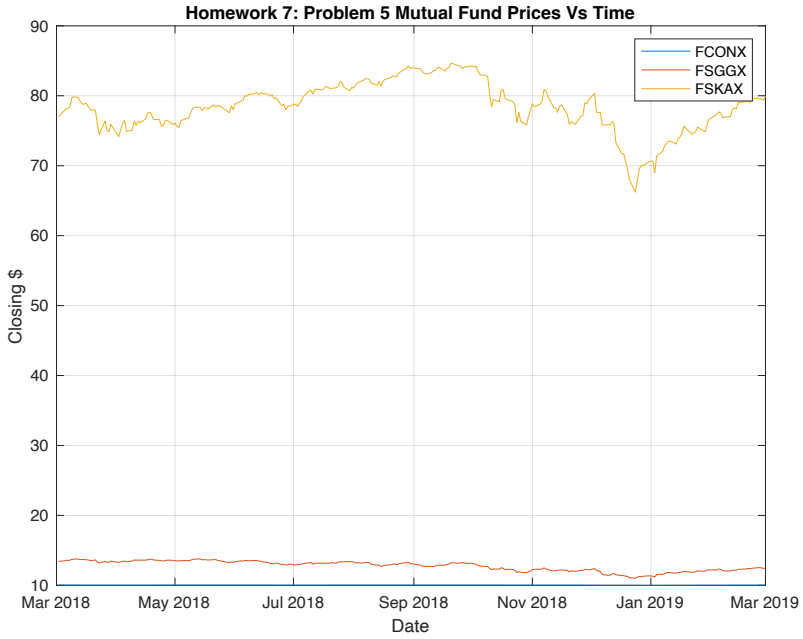
$hwmk7Q4b.fig$

Grading: 4 pts for $hwmk7Q4.m.$ 3 pts $hwmk7Q4a.fig$. 3 pts $hwmk7Q4b.fig$.

Question 5 (10 Points)

In a well-documented MATLAB script, $hmwk7Q5.m$, analyze the mutual fund data contained in the file hmwk7StockData.mat. The data represents the closing share price for each trading-day, over a year period. The mutual fund FSKAX is a mutual fund composed of US stocks. The fund FSGGX is composed of foreign stocks, while FCONX is a bond mutual fund. Have your code derive the maximum value of each security and determine the date of the highest price. Similarly, have your program calculate the minimum value of each security and determine the date of the minimum price.

Submit a figure similar to the one below in a file $hmwk7Q5.fig$.



$hmwk7Q5.fig$

Grading: 2 Points for *hmwk7Q5.m*, 4 Points for *hmwk7Q5.fig*, 2 Points for values and the date for three funds, 2 Points for minimum values and the date for three funds.