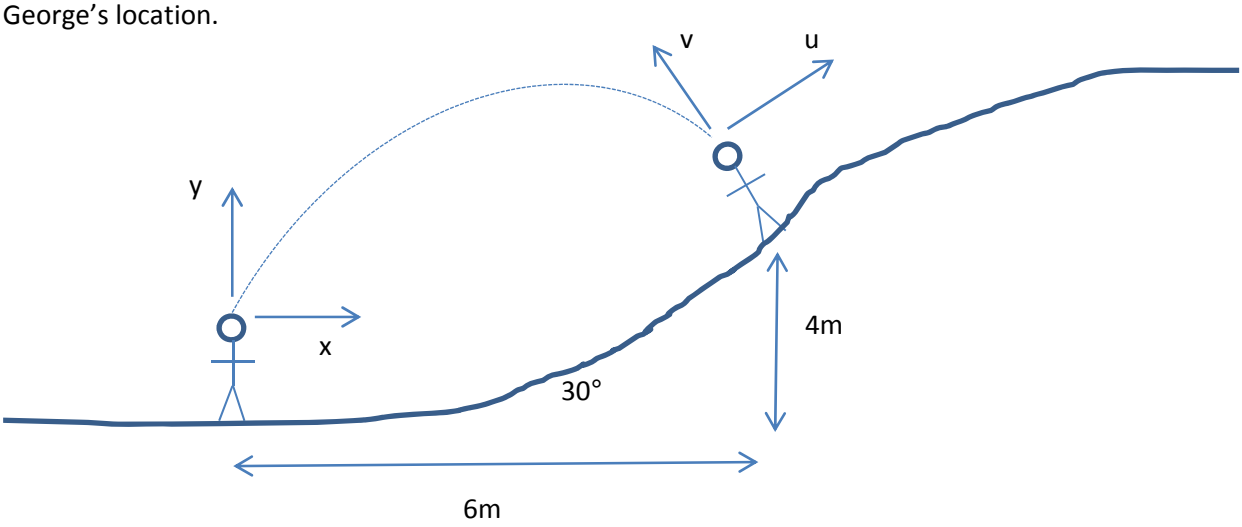
Week 9 Application Activity
ME219 Computer Programming for Engineers

This week we will revisit our problem from Week 1, except this time we'll use MATLAB to solve it. Fred throws a high pass to his friend George standing on a nearby hill as shown, with initial horizontal and vertical velocities of 4 and 10 m/s, respectively. We're interested in figuring out some of aspects of the ball's trajectory relative to George's position (i.e. components of the trajectory that are tangential and normal to the plane of the hill). You will follow 2 general steps when solving this problem: (1) Calculate horizontal and vertical positions of the ball relative to Fred's location; and (2) Perform a coordinate transformation to determine the tangential and normal components of the ball's position relative to George's location.



1. Start MATLAB, navigate to the directory where you want to save your work, and start a new m-file called "balltrajectory.m". Your program should do the following:
2. **PART 1**: create a time row vector running from zero to 2 seconds in steps o 0.1 seconds.
3. **PART 2**: create variables representing the following given conditions:
    a. Initial position of the ball in (x,y) coordinates (neglect Fred's height)
    b. Initial velocity of the ball
    c. Acceleration due to gravity
    d. Orientation of (u,v) coordinate system with respect to (x,y) coordinate system
    e. Position of (u,v) coordinate system in (x,y) coordinates
    f. 2x2 rotation matrix

4. **PART 3**: using the equations of projectile motion, create row vectors representing x and y positions as functions of your time vector:

$$x(t) = v_{0x}t + x_o$$

$$y(t) = v_{oy}t - \frac{1}{2}gt^2 + y_o$$

5. **PART 4**: using your rotation matrix, (x,y) coordinates, and (dx,dy) coordinates, calculate the transformed (u,v) coordinates using the following equation. This should give you a single variable with 2 rows (1 for the u coordinate, 1 for the v coordinate).

$$[R]\begin{bmatrix} x - dx \\ y - dy \end{bmatrix}$$

6. **PART 5**: using array addressing, extract the first and second rows of the matrix from PART 4 and store as separate u and v variables, respectively.
7. **PART 6**: although we haven't officially learned about plotting in MATLAB, it's helpful to visualize this problem. Type the following commands to produce plots of your work:

```
figure(1)
plot(x,y)
xlabel('X')
ylabel('Y')
title('Ball trajectory from Fred''s reference frame')
axis equal
grid

figure(2)
plot(u,v)
xlabel('u')
ylabel('v')
title('Ball trajectory from George''s reference frame')
axis equal
grid
```

8. **PART 7**: use comments in your code to describe what each section is doing.

When finished, upload your completed m-file to Blackboard using the link provided.