Assignment #2:
Assigned: January 23rd
Due: January 29th by midnight

Homework branch name: **Homework2**
5% of final grade

Objective:

To practice using a combination of waypoints and velocity vectors to fly a route around some of the trees at White Field. We will NOT be running this test on Physical drones.

Setup:

Check out the resources that have been added to the repository. Particularly useful elements might be the code for: (1) the method: **point_on_circle:** finding latitude and longitude coordinates given the latitude and longitude of the center of the circle, the radius of the circle, and the angle of the circle, (2) ned_utilities.py especially set_ned (which computes a velocity vector given origin and target GPS coordinates. You absolutely do not need to reuse this code; although the NED methods are probably helpful for a starting point.

Submission:

Submit all parts of your assignment by committing it to github under the Homework2 branch that you will create in your own assigned repository. Place your homework in a project called Homework2. It should include all python code, flight logs of your three flights, and a pdf containing your report and including the flight images (see instructions below).

Requirements:

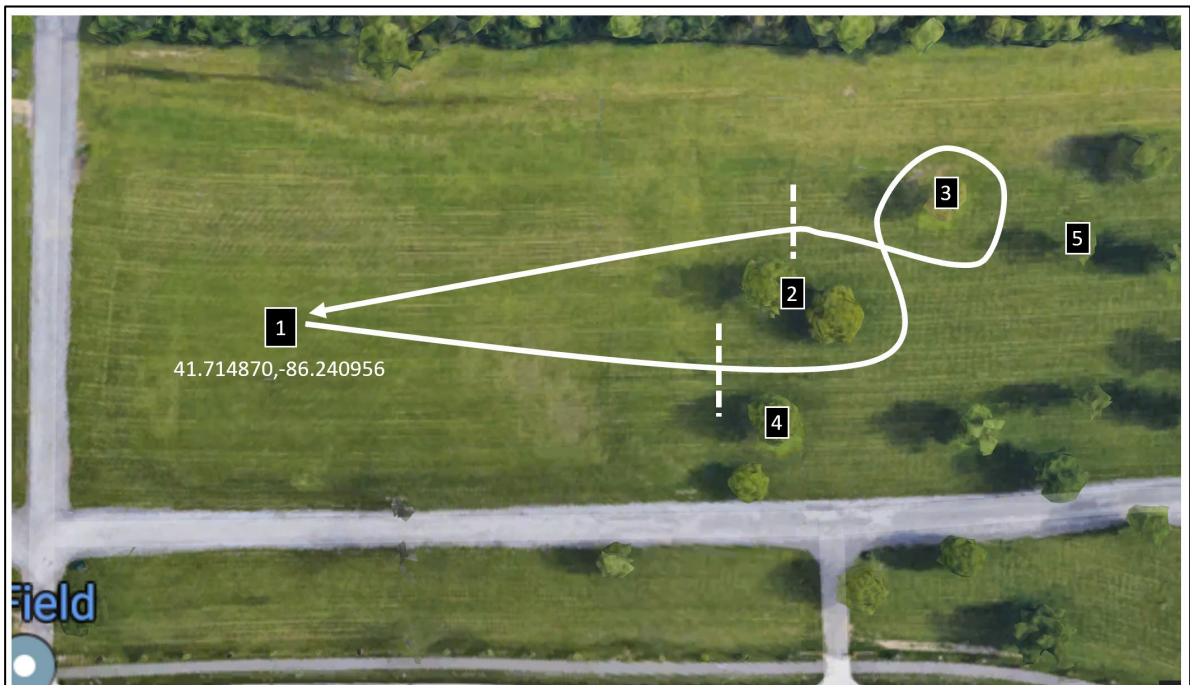
Scenario: You are on an army reconnaissance mission and you need to send a drone to scout a (pretend) trail, as shown in the Image of White Field on the next page. You need to fly at an altitude of 10 meters which will place you around the height of the tree foliage. You must use both velocity vectors and waypoints in the course of your homework assignment.

1. Use Google Maps to identify the coordinates of the trees – as you will need this information for the remainder of the homework assignment.

2. Write python code to direct your SITL drone to take off at position 1, and fly the route shown in the satellite view of White Field. Set the home coordinates to 41.714870,-86.240956 ie. Position #1. Fly south of the trees (#2) then go around tree (#3) passing up to its west and back down to the east. Head home, by traveling North of trees (#2) and ending back at the starting position. Take the passageway between Trees (#4) and (#5). During your flight – log your route to a file labeled by the name of your Flight (e.g., Flight-1, Flight-2). Do not crash drones into trees.

3. Plot each flight onto a using a Python graphing library (e.g., matplotlib.py). Plot the route itself, the starting position, and Trees labeled 2-5 (note Tree #2 is actually two trees so please plot both). These should be plotted as green circles on your graph unless you find a better representation.

4. Design an experiment to explore changes in the configuration of your program. You need to create:
   a. **Your best flight**. This would complete the flight in the fastest possible time while



simultaneously providing the smoothest flight possible (without abrupt changes in the

flight path). Note: There is a clear trade-off here as it may be possible to produce an almost perfect flight pattern if you fly very slowly, or you may prefer to complete the mission a little faster while still maintaining a high-quality flight path. You'll have to determine the sweet spot which carefully balances both qualities.

   b. **Two alternate flights**: Alternate flights could vary the magnitude of the velocity, scaling factors, duration, and/or one alternate flight could be entirely using velocity vectors or using waypoints.

5. Write up a report of your experiment. The report will likely be from 1.5 to 3 pages (including the images). You do not need to specify a hypothesis, but do need to include a clear explanation of the variants in each flight that you report. Your report should also include the plotted route for each flight. Discuss differences in your three flights and your findings for which option you found to be most effective. Name your report **Homework2-Report.pdf**

6. **Reading Assignment**
   Read the paper on the experimental use of the UTM. The link is provided via the homework page on

In two to three paragraphs summarize the purpose of the UTM and current challenges as described in the report. Add your summary to the end of the Homework2-Report.pdf

Everyone should work individually on this assignment.

Points will be assigned as follows:

1. Python code runs correctly and SITL UAVs are able to complete the route. Evidence of significant use of both Velocity Vectors and Waypoints. The "best" route is reasonably smooth and fast.	**5 points**
2. Report describes the experiments that were conducted clearly with a discussion of results.	**3 points**
3. Evidence that the UTM paper has been read, digested, and discusses the purpose of UTM and its current challenges.	**2 points**
4. Meet submission requirements	Negative points if homework is not submitted on time, does not have a separate branch for Homework2 and/or does not comply with the file name requirements.

Points add up to 10, but will be scaled to 5% of the final grade.