Mar 2nd, 8:00 AM - 9:30 AM

Backwards Chaining – Accelerating Solo Flight Training

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Backwards Chaining – Accelerating Solo Flight Training

Oklahoma State University Aviation

Stillwater, OK

Mar 2nd, 2020

National Training Aircraft Symposium

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Outline

- ***What is Backward (v. Forward) Chaining?***
- Research Objective
- Standard FAA Airport Traffic Pattern
- Flight/Cockpit Orientation
- “Results” to date
- Summary

What is Backward Chaining?

- Backward chaining is a learning strategy which takes a sequential series of learning steps and teaches them in reverse to convention (backwards).
- For solo flight:
  - Instead of traditional “Forward Chain”, Take-Off first……
  - Student is taught to Land the aircraft (“Backward Chain”), first
    - The position from the desired landing spot is methodically and progressively increased all the way backwards through a standard FAA General Aviation traffic pattern to the point of Take-Off.
    - Then, the student is allowed to forward chain the entire experience from Take-Off, first in simulation, to be followed in an actual aircraft.

Research Objective

- Explore the potential impacts and benefits of ab-initio pilot training, starting with whether or not the initial solo experience (as the sole occupant and manipulator of the controls of an aircraft) in an actual aircraft could be accelerated?

Research Question (RQ1)

If a student, with no prior flight training experience, is taught to land the aircraft in a simulator first, via a backward chaining approach, will this accelerate their flight training to solo in actual aircraft?

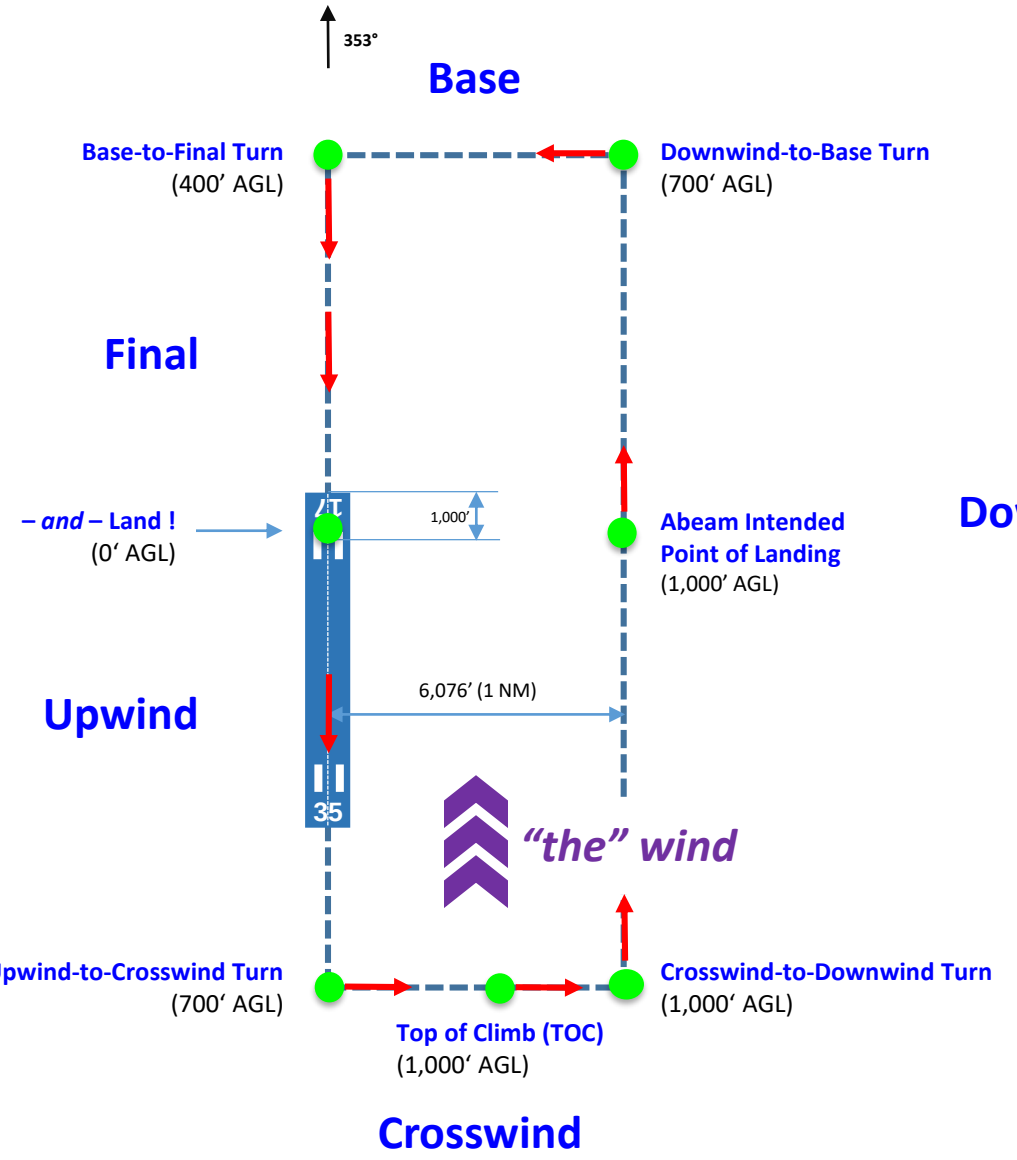
FAA General Aviation Traffic Pattern - Plan View

Legend:

North UP
360° in direction
- North = 0°
- East = 90°
- South = 180°
- West = 270°
- North also = 360°

Runway Numbering
- Degrees Magnetic
- Rounded to nearest 10°
- Truncated to first two digits

NM – Nautical Mile
AGL – Above Ground Level

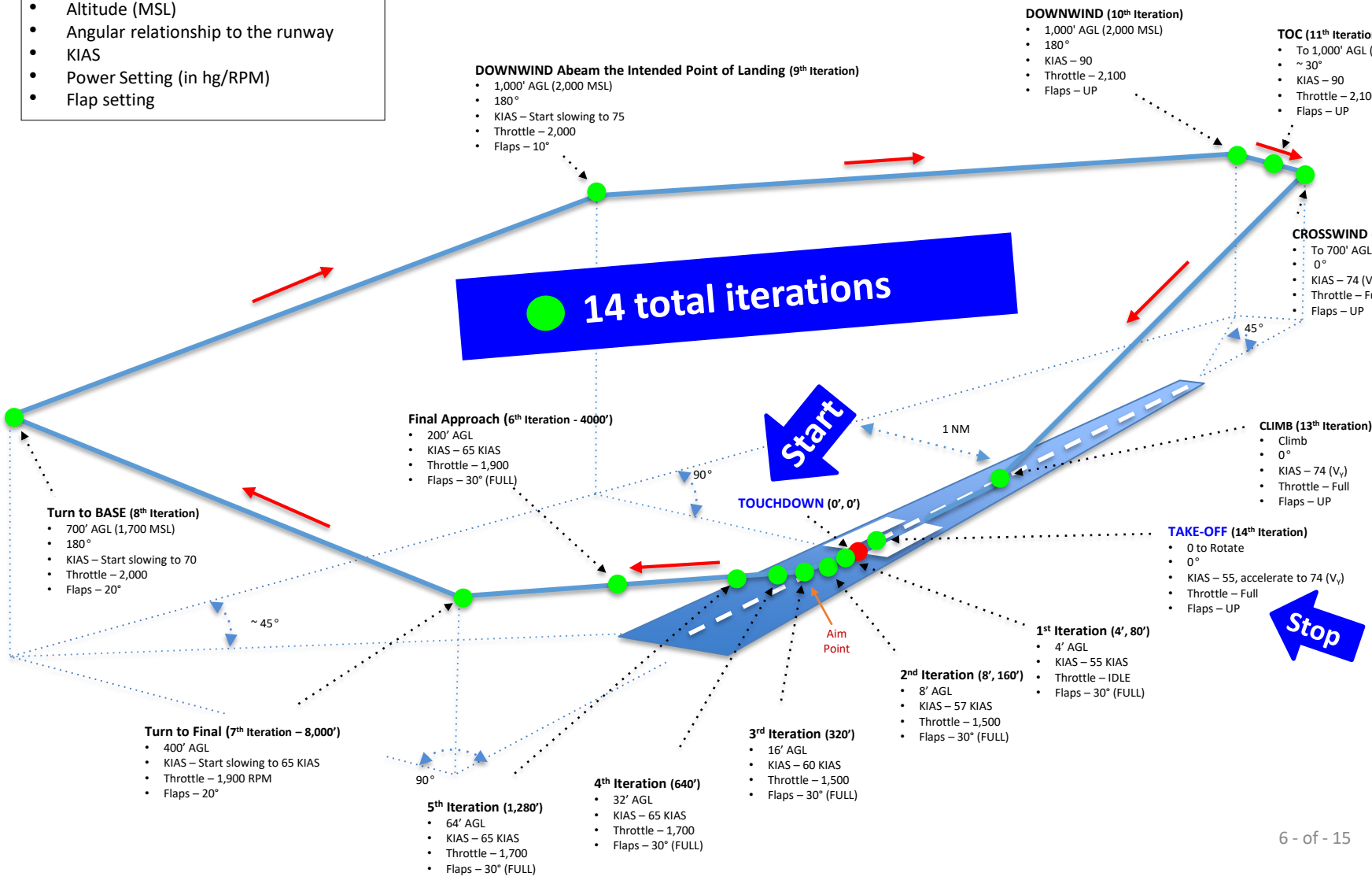


Backwards Chaining Traffic Pattern - Isometric

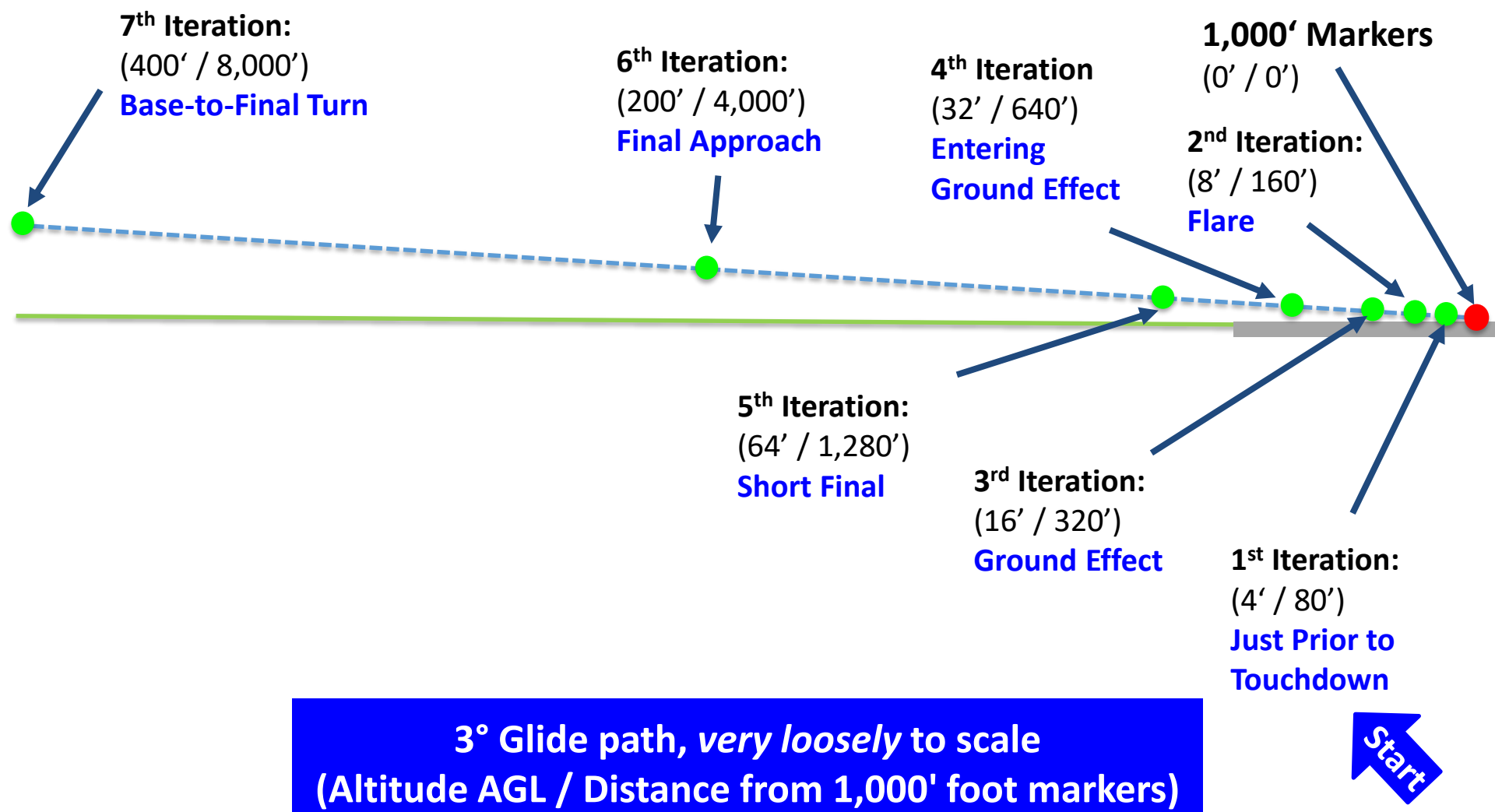
Segment KEY:

Name of the leg

- Altitude (MSL)
- Angular relationship to the runway
- KIAS
- Power Setting (in hg/RPM)
- Flap setting



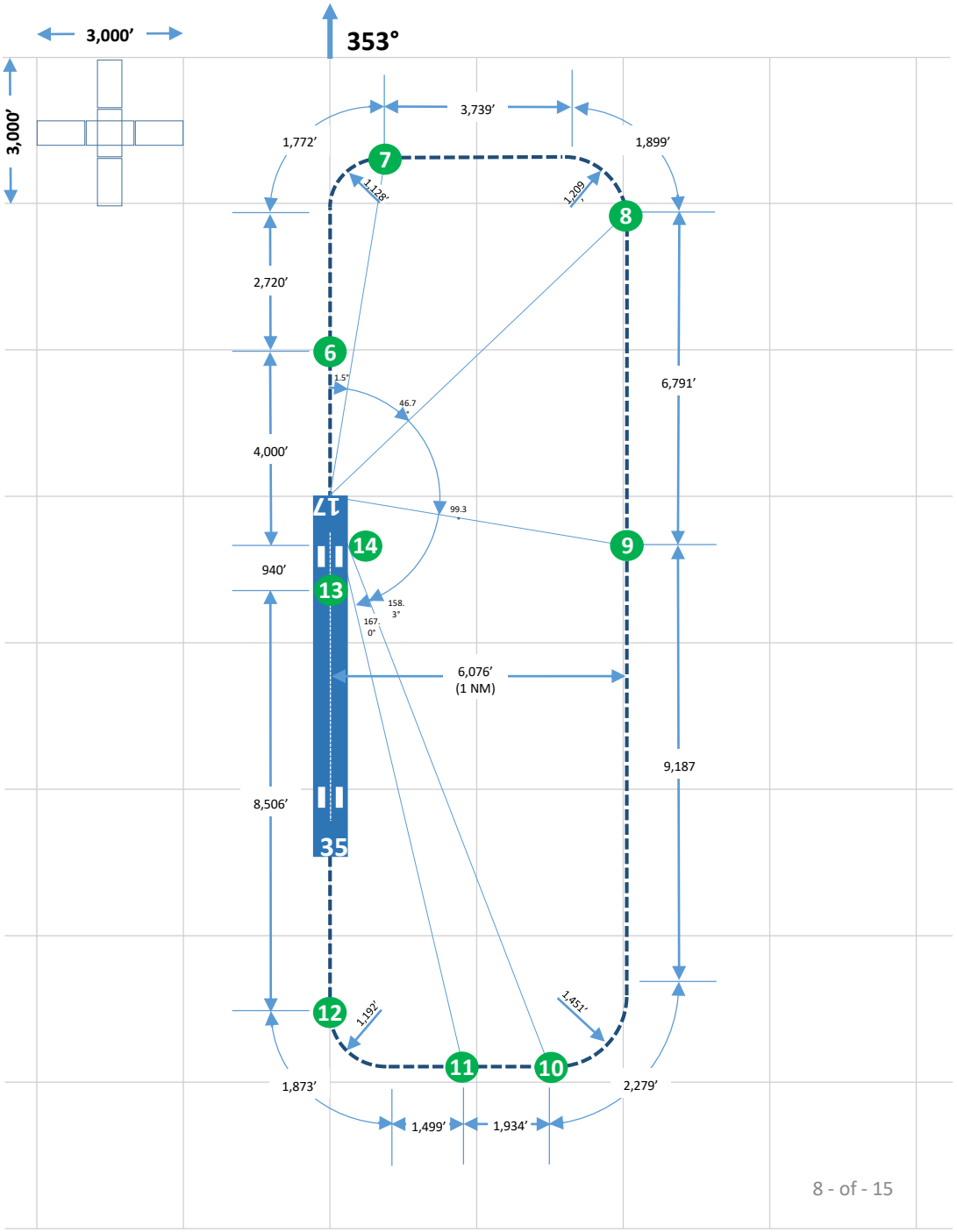
Final Approach Examination



3° Glide path, *very loosely* to scale
(Altitude AGL / Distance from 1,000' foot markers)

Overhead Traffic Pattern to Scale

Time and distance allocations for your turns have been made



Expectations…….of you

- **Two simulator sessions**
  - ~ 60-90 min each
  - No more than 1 week apart
  - Scheduled as close as possible to your actual flight training start date
- **Follow instructions** given at each step (iteration)
- **Be:**
  - Eager
  - Willing to make mistakes
  - Willing to learn
- **Ask questions**
- ***Try to enjoy experience and have fun!***

Flight/Cockpit Orientation

Why is the train leaning?

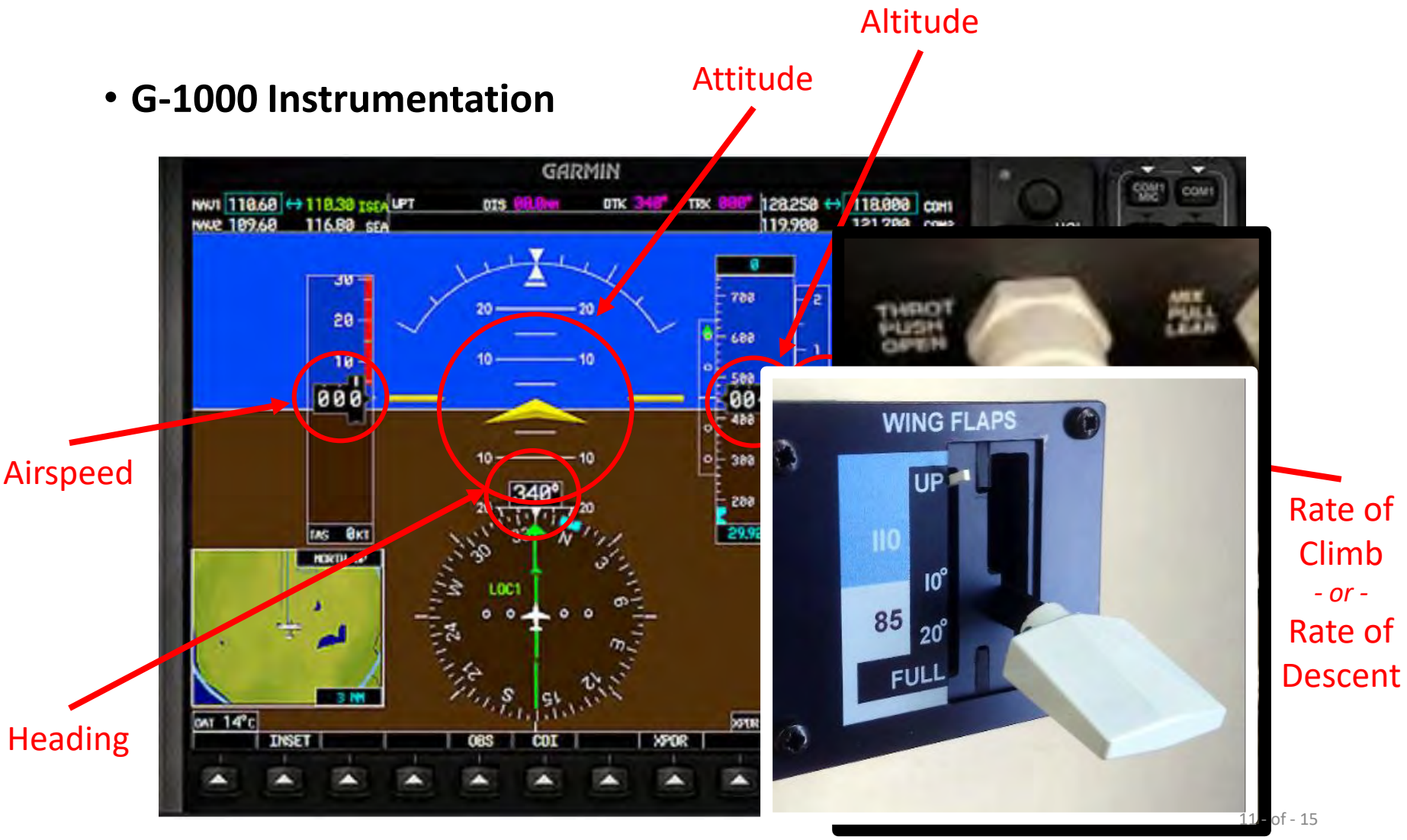
- **Difference from Driving**
  - ***Cars:***
    - Steer (change direction) [in aviation called – Yaw]
    - Speed
    - The road pitches and sometimes, if built correctly, rolls for you
  - ***Airplanes:***
    - Pitch (altitude, also = ***airspeed!***)
    - Roll (primary direction change)
    - Yaw (coordination)

    - Flaps – help you slow down and steepen approach for landing

Cars: Yaw
Airplanes: Pitch – Roll, and –Yaw
but never forget - Airspeed is sacrosanct (your life)!

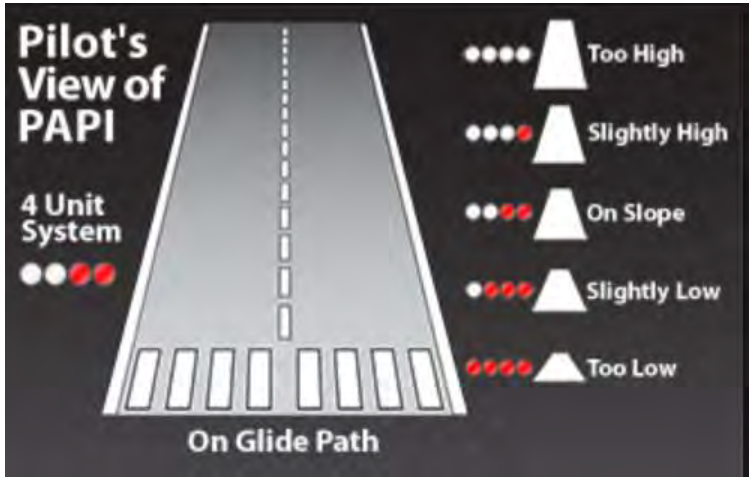
Flight/Cockpit Orientation

- **G-1000 Instrumentation**



Flight/Cockpit Orientation

- Guidance to manage your Flight Path
  - **Pitch 1st (Attitude)**
  - **Power 2nd (Throttle – *Airspeed!!*)**
  - **Flaps 3rd (Glide angle)**
  - **Recheck with PAPI – look outside !**
    (Precision Approach Path Indicator)



- **Fly visually as much as possible**
- **Desired flight path is a continuous balance between:**
  - **Airspeed – Throttle – Glide angle**

Backward Chaining Iteration Maturation

	Pilot	Start	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Stop		
Iteration			Just Prior to Touchdown	Flare	Ground Effect	Entering Ground Effect	Short Final	Final Approach	Turn-to-Final	Turn-to-Base	Abeam Intendend Point of Landing	Turn-to-Downwind	Top of Climb (TOC)	Turn-to-Crosswind	Upwind Climb	Take-Off			
Alt (AGL)			4	8	16	32	64	200	400	700	↓ 700	1,000	1,000	↑ 700	↑	0			
Time to Touchdown (sec)			1	2	3	6	12	37	76	121	169	245	269	284	353	363			
3-May-19	1	0802	2	1	2	1	3	1	1	1							0903	1 hr 01 min	
6-May-19	1	1306							1	1	2	1	1	1		3	1420	1 hr 14 min	2 hr 46 min
8-May-19	1	1235														3	1307	0 hr 32 min	
12-Dec-19	2	1314	2	3	1	3	6	4	4	2							1427	1 hr 13 min	
13-Dec-19	2	1217								1	3	1		2		3	1331	1 hr 14 min	2 hr 27 min
13-Dec-19	3	1032	2	1	3	2	3	6	5	4							1158	1 hr 26 min	
16-Dec-19	3	1133								2	4	2		1*		3*	1251	1 hr 18 min	2 hr 44 min
14-Jan-20	4	0732	2	2	2	3	4	3	5	1							0849	1 hr 17 min	
16-Jan-20	4	726								4	1	2		1		4	0841	1 hr 15 min	2 hr 32 min
TBD																			

- 09 May – N9196W – C172R – 1.0 – L/V – CFI observed
- 13 Dec – N9198W – C172R – 0.7 – L/V – Not observed
- 17 Dec – N250SU – C172S – 0.7 – L quartering 5-6 KTS – CFI observed
- 21 Jan – N5520U – C172S – 0.9 – R quartering 8-10 KTS – Not observed

“Results” to date….

“You’re welcome! It was a good experience watching what good can come from two sim sessions!”

December 17, 2019

Jared Freihoefer, OSU CFI

“Throughout the Backwards Chaining research that I participated in with Dr. Vance I learned how to fly a flight pattern “backwards”. Instead of immediately jumping into a cockpit without knowing how anything works, the study created a way for me to grow accustomed to a cockpit and even helped me land a Cessna 172 the very first time I flew. In my opinion, I think that the research put me one step ahead of other students and allowed me to feel much more comfortable in the cockpit on my first few training flights.”

May 8, 2019

Luke Basham, OSU ProPilot student

- 4 flights (two …
- …ving us…
- …by stu… save for 1 demo pattern (by me)
- …ern cir…
- …e in fla…

“Flew with Dalton this evening. He landed twice without me touching the controls at all! Very impressive.“

December 19, 2019

Jared Freihoefer, OSU CFI

“In my experience with the "Backward Chaining" research project, I can confidently say through each flight sequence in the simulator, I felt more and more comfortable controlling the aircraft. We started slow, which was necessary for easing into learning how to maneuver the plane, and as we continued, each iteration became easier and easier, until I was able to fly in the pattern from takeoff to landing. Once I took what I had learned from the simulation and transferred it to an actual aircraft, I felt very comfortable and confident in my ability. Going into this project, I did not expect to be able to do what I did, and looking back on my experience, I am amazed with the progress I made.”

January 22, 2020

Jake Ingle, OSU ProPilot student

“The backwards chaining research was a very motivating method of training as I got to see rapid improvement of my skills from the beginning of it to the initial flight. It made me want to keep going to see more and more progress.”

December 13, 2019

Dalton Selby, OSU ProPilot student

Summary

- **This (is) will all be new**
- **Take it one step (iteration) at a time**
- **Ask questions**
- **Learn**

Most importantly….

Have fun – and Enjoy !

There appears to be flight training acceleration merit in this approach