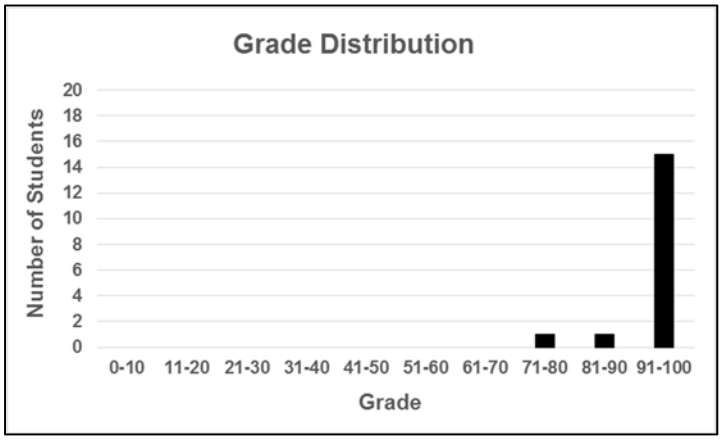
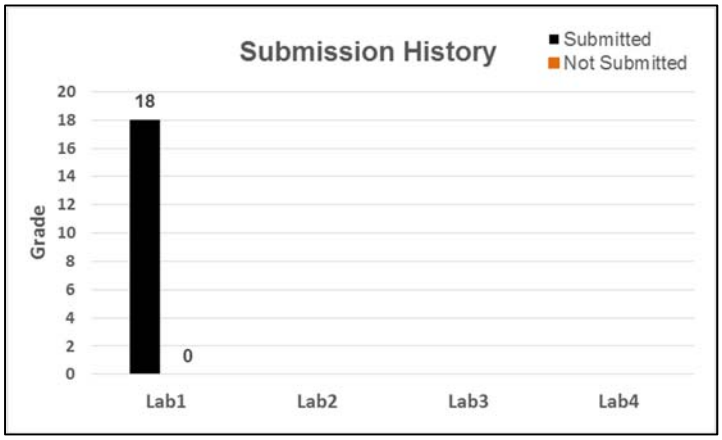
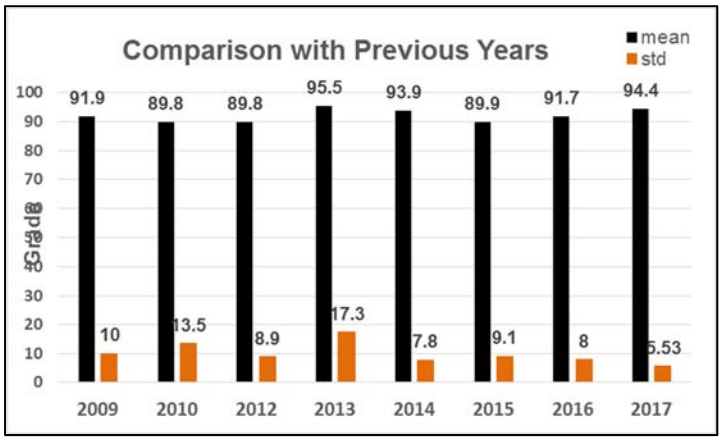
CFD LAB #1 REPORT

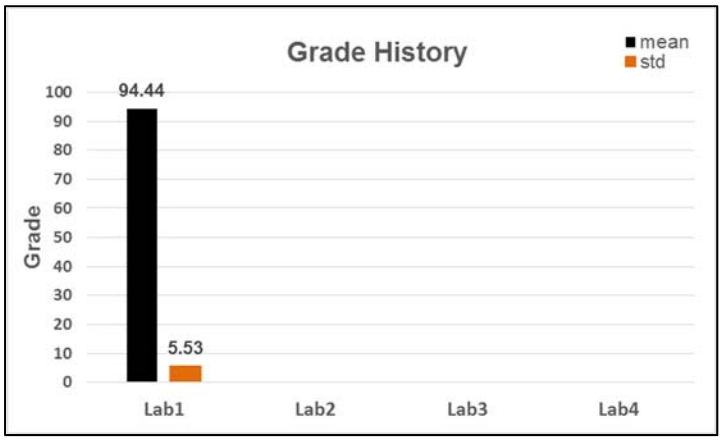
General

Number of students	18
Number of submitted reports	18
Number of not-submitted reports	0
Grade average	89.51
Grade standard deviation	7.78









Common Mistakes

Exercise 9.1
- Some students couldn’t get correct friction factor. Students might have picked the shear stress value from the developing region while it should always be the developed region or near the end of the pipe that the value should be taken.

Exercise 9.2
- Some students didn’t understand the meaning of Pg and P
- Many students used error of friction factor directly from 9.1. The error at 9.1 is shown in percentage, so that value needs to be divided by 100 to be compared with the Ug in V&V sheet.

Exercise 9.3
- Many students used Rg or P to check the sensitivity of grid refinement ratio. However, checking Ug change is more accurate since Ug is the final outcome from the verification study.

Exercise 9.4
- Many students couldn’t tell the difference of verification and validation. In CFD grid study, verification is to see if the solution converges as the grid becomes finer.To see if the verification is successful, you need to check if the convergence path is “Monotonic Convergence” since it is most desired state and Ug can be estimated. The verification could be ended up as “Oscillatory Convergence”, “Monotonic Divergence” or “Oscillatory Divergence" but those are not that desirable. “Oscillatory Convergence” can still provide the Ug but “Monotonic Convergence” is way more satisfactory. Once the verification is successful, the convergence rate can be quantified as an uncertainty (Ug for CFD grid study) mathematically and it will be used during the validation. Validation is getting the difference of current result against the real value (AFD with reasonable assumption or EFD) and see if that difference is within the uncertainty range. One should note that when the error is compared against the uncertainty, those values should be normalized with the same denominator so that those two values become comparable (mistake in exercise 9.2).

Exercise 9.5
- Many students couldn’t estimate the developing length by looking up the appropriate figure. Figure of centerline velocity distribution is most desirable to check since one can easily tell where the speed evens out.

Exercise 9.6
- Same as 9.5

Exercise 9.7
- None

Positive Feedback
- Got familiar with the software
- Understood more about CFD process

Negative Feedback
- Exercise part is confusing
- Refinement ratio was inconsistent
- Aspect ratio of the grid was large
- Small number of points in radial direction

→ Grids are set to have small grid points to have less computing time since it is for academic use.
→ Grid quality seems okay since the result covered in the exercise looks reasonable and V&V was okay.

Suggestions
- Using non-uniform mesh for both laminar and turbulent condition
- More explanation on V&V part
- More practical problem
- 3D pipe flow or 2D channel flow
- AFD for the entrance length should be validated
- Using unstructured mesh for pipe flow
- Add curve to pipe or change the diameter
- How the variables inside the ANSYS work

→ More complex flows will be simulated in the future labs.
→ Parametric studies will be done in Lab#2 (domain size study)
→ V&V is covered a bit in the common mistake section
→ Current labs are aimed to run the simulation and to do the data reduction. A lot of time and effort are expected to explain many variables inside the ANSYS. During the labs, by following the manual, students are expected to get used to the complicate commercial program.