

ME 8813 Machine Learning Fundamental for ME
Homework Assignment 3
(Due 3/17/2024, Sunday, 11:55pm)
(This is an individual assignment)

Electronic Submission Guideline: *your submission to Canvas* should be one python source file **ME8813ML_Homework3_YourLastName_FirstName.py**, or **ME8813ML_Homework3_YourLastName_FirstName.ipynb**, as well as a report file **ME8813ML_Homework3_YourLastName_FirstName_Report.pdf**.

Use the package pgmpy to build a Bayesian network model. The documentation is available at: <https://pgmpy.org/>

Jason, the robot juggler, drops balls quite often when its battery is low and the road is uneven. In previous trials, it has been determined that when its battery is low and juggling on an uneven road it will drop the ball 9 times out of 10. On the other hand, when its battery is not low and it is on an even road, the chance that it drops a ball is much lower, about 1 in 100. When its battery is low and juggling on an even road, the chance to drop the ball is 5 times out of 10. When its battery is not low and juggling on an uneven road, the chance to drop is 3 times out of 10. The battery was recharged recently, so there is only a 5% chance that the battery is low. The probability of juggling on an uneven road during the show is 0.4. Another robot, Olga the observer, reports on whether or not Jason has dropped the ball. Unfortunately, Olga's vision system is somewhat unreliable. There is a chance of 1 in 10 that Olga gives a false report (i.e., report a dropped ball when the ball is not dropped, or does not report when there is a ball drop).

Based on information from Olga, the task is to represent and draw inferences about whether the battery is low depending on how well Jason is juggling.

- (1) Construct a Bayesian network to represent the problem.
- (2) List all independencies in this model using function `get_independencies()`.
- (3) Suppose that Olga reports that Jason has dropped the ball. What effect does this have on your belief that the battery is low? Use the Variable Elimination to perform an exact inference.
- (4) Perform an approximate inference for the above question again.

List all the results above in your report.