Carnegie Mellon University
Master of Computational Data Science

Carnegie Mellon University
Language Technologies Institute

Predicting Learning Outcomes

Nov 13 Standup

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11-632 (Fall 2023)
MCDS Capstone Course

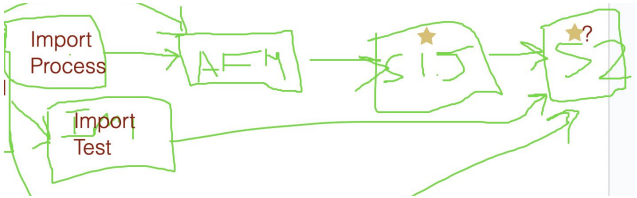
Sub Group 1-Mengjie, Xinyu

Last week:

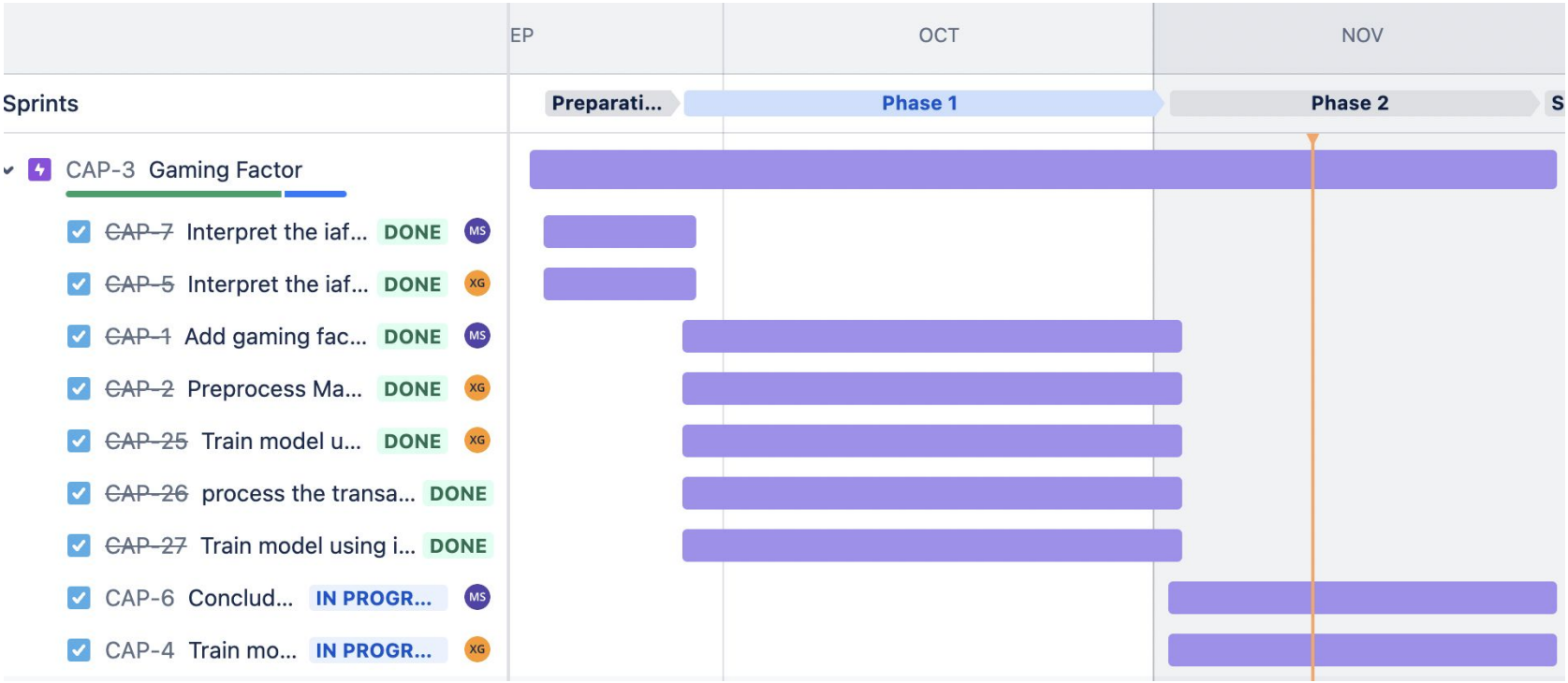
- Met with advisor to get familiar with LearnSphere Workflow
- Developed scripts for retrieving pre-test and post-test scores for workflow component

This week:

- Convert existing scripts to Workflow Components on LearnSphere
- Write draft report



Sub Group 1-Mengjie, Xinyu



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- Using parameter derived from modeling the **learning process data** to predict students' **post-test score**

```
# Model 1: pretest only
test_scores %>%
  lm(Posttest ~ Pretest, data = .) %>%
  summ()

# Model 2: pretest + PredAvgiAFM
test_scores %>%
  lm(Posttest ~ PredAvgiAFM + Pretest, data = .) %>%
  summ()

# Model 3: pretest + int_iAFM
test_scores %>%
  lm(Posttest ~ int_iAFM + Pretest, data = .) %>%
  summ()

# Model 4: pretest + int_iAFM_reverse
test_scores %>%
  lm(Posttest ~ int_iAFM_reverse + Pretest, data = .) %>%
  summ()

# Model 5: pretest + int_iAFM + int_iAFM_reverse
test_scores %>%
  lm(Posttest ~ int_iAFM + int_iAFM_reverse + Pretest, data = .) %>%
  summ()
```

Model	# students	F-statistic	R-squared	Adjusted R-squared	p
pretest	129	71.18	0.36	0.35	0.00
pretest + PredAvgiAFM	129	49.19	0.44	0.43	0.00
pretest + int_iAFM	129	84.03	0.57	0.56	0.00
pretest + int_iAFM_reverse	129	75.66	0.55	0.54	0.00
pretest + int_iAFM + int_iAFM_reverse	129	55.73	0.57	0.56	0.00

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- Pairwise ANOVA to analyze the effect of student estimates
- Model 1 vs. Model X (other models)

  High F-statistic: variable “*pretest”* is significantly related to “posttest”

  Low R-squared: “*pretest”* does not explain a significant proportion of the variance in the dependent variable, we should incorporate more variables
- Model 3 vs. Model 4

  “Intercepts” is a better-fitting variable compared to “predAvgIafm” and is more effective in explaining the variation in the posttest scores.

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- Model 3 vs. Model 5

  Same R-squared: **int_iAFM_reverse** doesn't seem to significantly enhance the model's ability to explain the variation in Posttest scores

  Possible reasons:

  1. **int_iAFM_reverse** has limited contribution to the posttest score

  2. **int_iAFM** and **int_iAFM_reverse** might be highly correlated or redundant, which could lead to multicollinearity issues in Model 5

  3. New variable increase the model complexities

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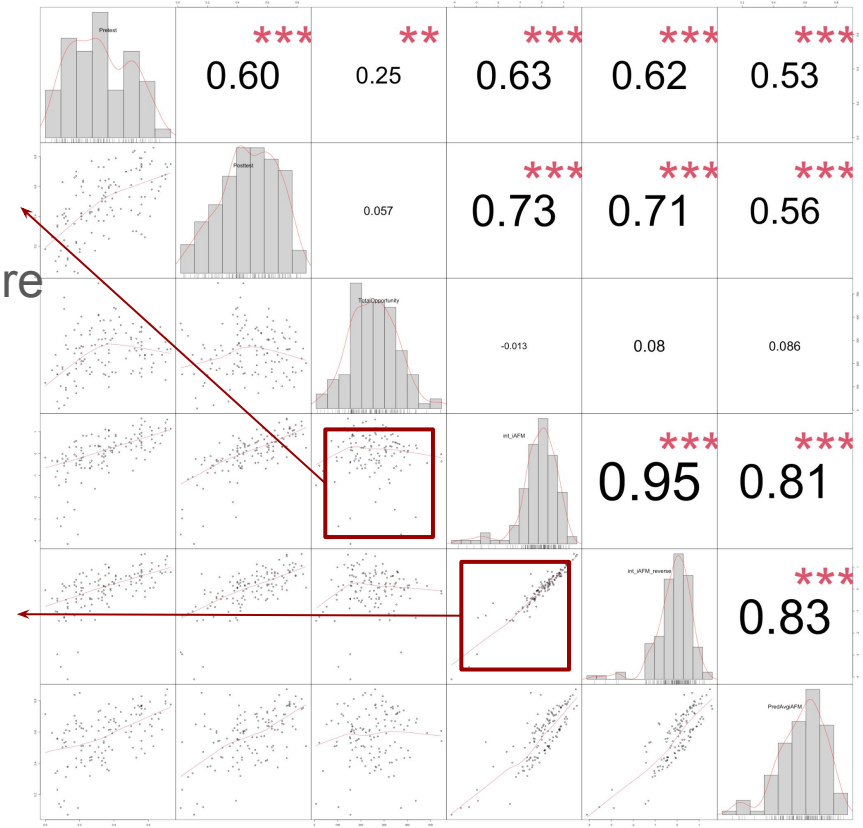
- Correlation study

Observation 1: corr(total_opportunity, intercept_reverse) = -0.013
Interpretation: The tutor system gives more practice to students who need it.

Observation 2: corr(intercept, intercept_reverse) = 0.95
Interpretation: students with good initial scores have better final scores



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Step 2 Alternative - 1 parameter fit

Create a table with both pre and post in separate rows for each student

Student	Test-Time	Test-Score	Process-Model-Prediction1	Process-Model-Prediction2
S1	Pre	.4	prob(-1.1) [intercept_iAFM]	prob(-1.1) [intercept_iAFM]
S1	Post	.6	prob(.4) [intercept_iAFM_reverse]	prob(.34) [max-Opp-iAFM-pred]

S2 …

Run analyses

Two parameter version:

Model1: Test-Score ~ Process-Model-Prediction1 [+ Intercept]

Model2: Test-Score ~ Process-Model-Prediction2 [+ Intercept]

One parameter version:

Model3: Test-Score ~ 1* Process-Model-Prediction1 [+ Intercept]

Model4: Test-Score ~ 1* Process-Model-Prediction2 [+ Intercept]

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Next week:

- Besides F-statistics, report more statistics (e.g., AIC, BIC) for the 5 models in Step 2
- Correlation matrix with pretest, posttest, total_opp, intercept_iAFM, intercept_iAFM_reverse, PredAvgiAFM
- Further analyze the differences between 5 models
- Make scatter plots based on results from step 4