Designing Programs for Tables

CMPU 101 – Problem Solving and Abstraction

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Semester Recap:

1. We can represent complex data as tables…
   - encoded directly in a program or loaded from an external source.
   - Real data may need (automatic/manual) clean-up.
2.
   -
   -
     -
     -
     -
3.
   -
4.
5.

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   - Real data may need (automatic/manual) clean-up.
2. We can use *sanitizers* for automatic data clean-up to…
   - Ensure all data in a column is of the desired type, with default values for null data.
   - But “real data” sets can be much harder to work with than contrived examples:
     - Missing values
     - Inconsistent entry of data
     - Differing levels of precision (dates like: 1987 vs 7 July 1987)
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   - This *begs the question*: Should we modify table data by hand?
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   - This *begs the question*: Should we modify table data by hand?
4. We can *modify* table data later using **transform-column**
5. We can *remove* (apparent) bad data using **filter-with.**

Last Friday's Lab

- We saw this clean-up process in our lab by looking at the student data from the form (***none*** of) you filled out.
  - That's because I never sent out the email to have you fill out the form.
- Let's continue to use this data set though…

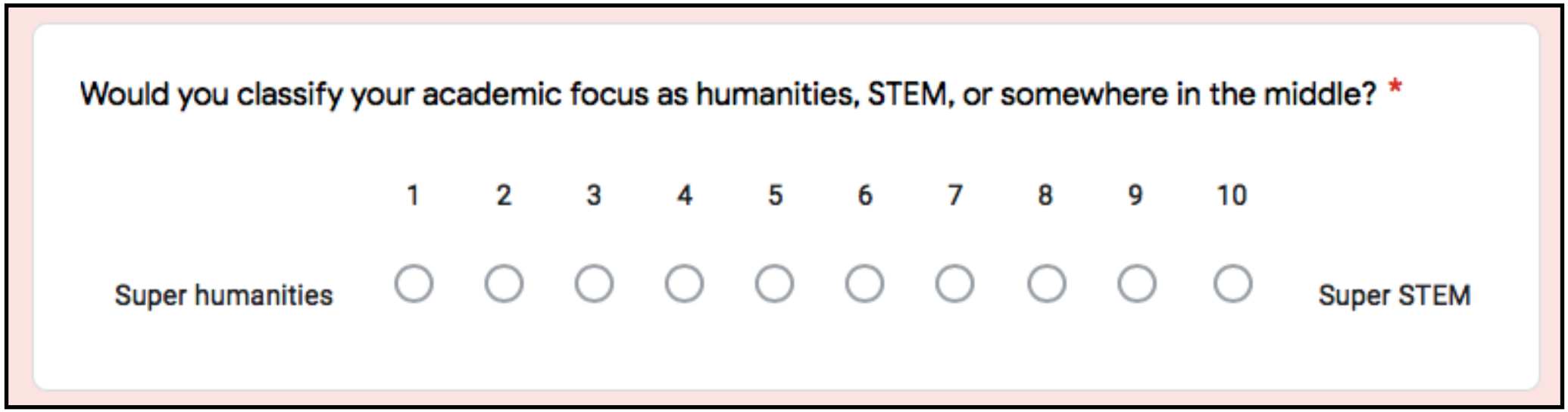
Task plans

- If you aren't sure how to approach a problem, utilize a set of *procedures* to design a solution & identify code you need to write:

1. Develop a concrete example of desired output
   - Typically, a table with 4–6 rows
2. Identify functions useful to transform data
   - Functions you already know or look up in the documentation
3. Develop a sequence of steps to transform data
   - Draw as pictures, use textual descriptions, or a combination of the two
   - Use functions from previous step
4. Repeat Step 3 to further break down steps until it is easy to write expressions/functions for each step

Example: “Bin”ning

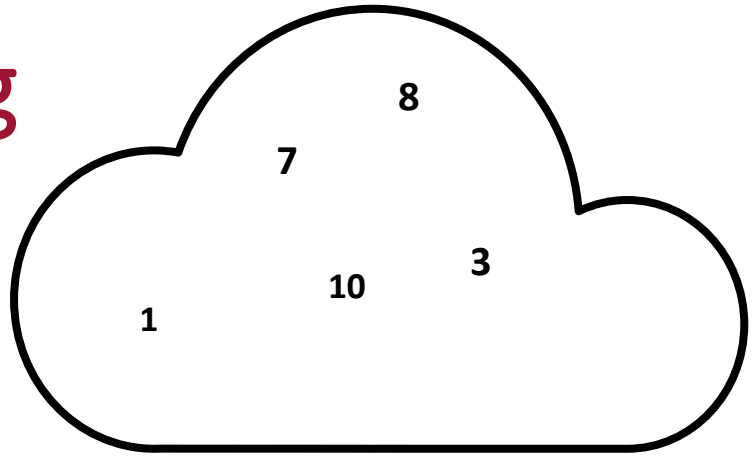
- How should we consider the distribution of responses to this question…



Example: “Bin”ning

- We don’t particularly care about how many students rated their STEM-iness as 2 or 8 or any particular number.
- Instead, we might want to *bin* the responses into a few categories.

Example: “Bin”ning



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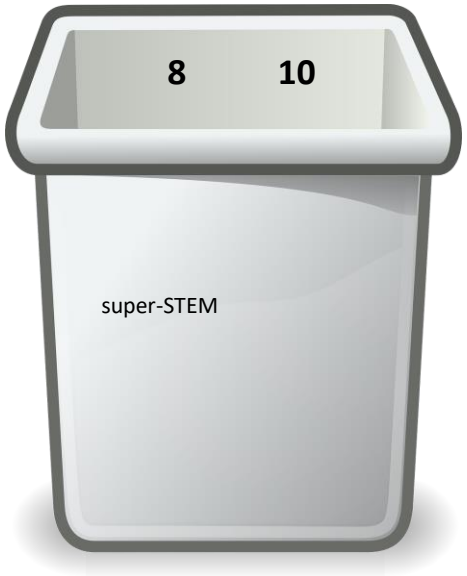

task plan

- To count the number of students in these three categories

- SNAPSHOT: TBD (Let’s develop one together)

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task plan

- More formally,

1. Write **stem-category.**
2. Add stem category to table using **build-column.**
3. Summarize results using **count.**
4. Visualize the results using **pie-chart.**

Let's develop code + tests (1st requires a table)

```
test-table =
  table: stem-level
    row: 1
    row: 3
    row: 4
    row: 7
    row: 8
    row: 10
  end
```

The test table can omit the columns we're not using!

(2nd: create stem-category column using helper $\mathcal{F}$)

```
test-table =
  table: stem-level
    row: 1
    row: 3
    row: 4
    row: 7
    row: 8
    row: 10
  end

fun stem-category(r :: Row) -> String:
  doc: "Return a stem category (non-stem, stem, or super-stem) for a given stem-level"
  #tbd...
where:
  stem-category(test-table.row-n(0)) is "non-stem"
  stem-category(test-table.row-n(1)) is "non-stem"
  stem-category(test-table.row-n(2)) is "stem"
  stem-category(test-table.row-n(3)) is "stem"
  stem-category(test-table.row-n(4)) is "super-stem"
  stem-category(test-table.row-n(5)) is "super-stem"
end
```

The test table can omit the columns we're not using!

If the survey data changes, our tests will
still pass!

(2nd helper function details)

```
fun stem-category(r :: Row) -> String:
  doc: "Return a stem category (non-stem, stem, super-stem) for a given stem-level"
  s = r["stem-level"]
  if s < 4:
    "non-stem"
  else if s < 8:
    "stem"
  else:
    "super-stem"
  end
where:
  #tests on previous slide...
end
```

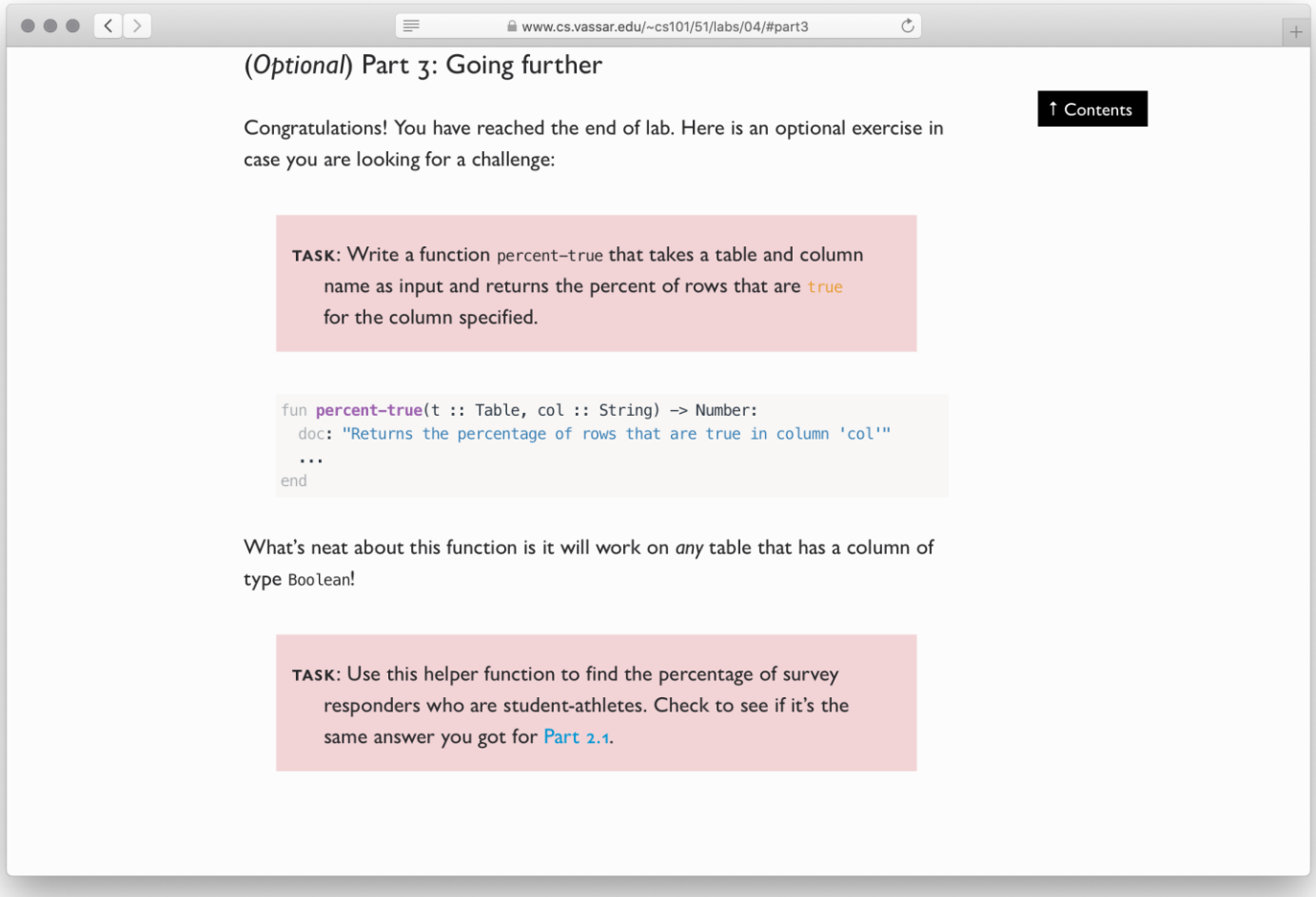
(3rd build column called stem-category++)

```
data-stem-category =
  build-column(student-data-cleaned,
    "stem-category", stem-category)


# the ++ part
# count the population in each category
counts =
  count(data-stem-category, "stem-category")

#then provide visual representation
pie-chart(counts, "value", "count")
```

Nested Functions



One approach to student-athletes question

```
fun percent-true(t :: Table, col :: String) -> Number:
  doc: "Return the percentage of rows that are true in column 'col'"
  ...
end
```

Developing precent-true

```
fun percent-true(t :: Table, col :: String) -> Number:
  doc: "Return the percentage of rows that are true in column 'col'"
  filter-with(t, ???).length() / t.length()
end
```

#??? --> need a helper function here to get us the columns with true

A(n incorrect) helper function for precent-true

(A few students ran into this exact problem on Friday!)

```
fun true-filter(r :: Row) -> Boolean:
  doc: "Return true if 'col' is true in this row"
  r[col] #more like return value of column!
end

fun percent-true(t :: Table, col :: String) -> Number:
  doc: "Return the percentage of rows that are true in column 'col'"
  filter-with(t, true-filter).length() / t.length()
end
```

What is wrong with this approach

- **col** is undefined in **true-filter**
- Pyret only knows the value for **col** when you're "inside" **percent-true**
- This means we need to define **true-filter** "*inside*" **percent-true**
  - i.e. nest the helper function

A (correct) helper function for precent-true

```
fun percent-true(t :: Table, col :: String) -> Number:
  doc: "Return the percentage of rows that are true in column 'col'"
   #nest true filter within percent-true & before actual code
  fun true-filter(r :: Row) -> Boolean:
    r[col]
  end

  filter-with(t, true-filter).length() / t.length()
end
```

Add a test table to complete the solution

- As usual, let's test our function using a simple test table:

```
test-table-student-athlete =
  table:
    student-athlete
    row: true
    row: false
  end

fun percent-true(t :: Table, col :: String) -> Number:
  # ...
where:
  percent-true(test-table-student-athlete, "student-athlete") is 0.5
end
```

Q: When do you need to nest a helper function?

A: if that function needs data that **can't** be passed in directly to the function.

Access to the code from this lecture

Includes virtually all suggested lab solutions!

https://code.pyret.org/editor#share=1WXx7yJvtOKJtXjza0CdCi8gdtozF8ZnR&v=31c9aaf

Acknowledgements

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