

Solutions

Overview

This script makes some plots from Q10, which is about what solutions participants would find most useful.

Import packages and utilities

```
project_root <- here::here() # requires that you be somewhere in the
# project directory (not above it)
# packages
suppressMessages(source(file.path(project_root, "scripts/packages.R")))
# functions and objects used across scripts
suppressMessages(source(file.path(project_root, "scripts/utils.R")))
```

Load data

```
solutions_raw <- load_qualtrics_data("clean_data/solutions_Q10.tsv")
other_quant <- load_qualtrics_data("clean_data/other_quant.tsv")
```

Wrangle data

First, remove empty rows, i.e. rows from respondents who didn't receive this question. As with many questions in this survey, we can cut some corners in the code because the question was mandatory. For example, no need to worry about incomplete answers.

```
nrow(solutions_raw)
```

```
[1] 332
```

```
solutions <- exclude_empty_rows(solutions_raw) # from scripts/utils.R  
nrow(solutions)
```

```
[1] 233
```

Let's reshape the data from wide to long format for easier plotting later.

```
long_data <- solutions %>%  
  pivot_longer(  
    cols = everything(),  
    names_to = "solution",  
    values_to = "utility"  
  )  
  
long_data <- long_data %>%  
  mutate(  
    utility_score = recode(  
      utility,  
      "Non-applicable" = 0L,  
      "Not very useful" = 0L,  
      "Useful" = 1L,  
      "Very useful" = 2L  
    )  
  )  
# Using interger literals 0L, 1L, etc., ensures that  
# the new column will be integers, not doubles.  
  
long_data
```

```
# A tibble: 2,796 x 3
```

	solution <chr>	utility <chr>	utility_score <int>
1	Computing environments	Very useful	2
2	Publicity	Very useful	2
3	Containerization	Very useful	2
4	Documentation help	Very useful	2

5	A learning community	Very useful	2
6	Event planning	Very useful	2
7	Mentoring programs	Very useful	2
8	Education	Very useful	2
9	Legal support	Very useful	2
10	Industry partnerships	Very useful	2

i 2,786 more rows

Descriptive statistics

Next, let's calculate some simple descriptive statistics. I will choose:

- The total “score”, that is, the total number of “points” a solution received (see scoring scheme in previous code chunk)
- The mean (which might be misleading if 0s drag it down, and also, who's to say what a 1.5 really means? Are the distances between the Likert points equal? We don't know.)
- The median
- The mode
- The standard deviation

```
# Helper to compute the (numeric) mode
get_mode <- function(x) {
  ux <- unique(x)
  ux[which.max(tabulate(match(x, ux)))]
}

summary_df <- long_data %>%
  group_by(solution) %>%
  summarise(
    total = sum(utility_score),
    mean = mean(utility_score, na.rm = TRUE),
    median = median(utility_score),
    mode = get_mode(utility_score),
    st_dev = sd(utility_score, na.rm = TRUE)
  ) %>%
  ungroup()

# Order by highest total "score"
summary_df <- summary_df %>%
  arrange(desc(total))

summary_df
```

```
# A tibble: 12 x 6
```

	solution <chr>	total <int>	mean <dbl>	median <int>	mode <int>	st_dev <dbl>
1	Sustainability grants	353	1.52	2	2	0.732
2	Help finding funding	316	1.36	2	2	0.764
3	Computing environments	301	1.29	1	2	0.783
4	A learning community	251	1.08	1	1	0.733
5	Documentation help	248	1.06	1	1	0.788
6	Legal support	242	1.04	1	1	0.762
7	Education	236	1.01	1	1	0.801
8	Industry partnerships	232	0.996	1	0	0.838
9	Publicity	232	0.996	1	1	0.817
10	Mentoring programs	216	0.927	1	1	0.776
11	Containerization	203	0.871	1	0	0.820
12	Event planning	190	0.815	1	0	0.807

Cool. It looks like sustainability grants are by far the most popular, with assistance identifying funding sources and free computing environments in second and third place. These were the only three solutions that had a mode of 2.

Save for supplement.

```
write_df_to_file(summary_df, "supplementary_tables/solutions_overview.tsv")
```

Out of curiosity, how does it look when we order by variability?

```
summary_df %>%
  arrange(desc(st_dev))
```

```
# A tibble: 12 x 6
```

	solution <chr>	total <int>	mean <dbl>	median <int>	mode <int>	st_dev <dbl>
1	Industry partnerships	232	0.996	1	0	0.838
2	Containerization	203	0.871	1	0	0.820
3	Publicity	232	0.996	1	1	0.817
4	Event planning	190	0.815	1	0	0.807
5	Education	236	1.01	1	1	0.801
6	Documentation help	248	1.06	1	1	0.788
7	Computing environments	301	1.29	1	2	0.783

8 Mentoring programs	216	0.927	1	1	0.776
9 Help finding funding	316	1.36	2	2	0.764
10 Legal support	242	1.04	1	1	0.762
11 A learning community	251	1.08	1	1	0.733
12 Sustainability grants	353	1.52	2	2	0.732

This analysis doesn't seem as interesting as it was for the challenges. Industry partnerships, Containerization, and Publicity all show high variance/stddev. These were also somewhat less popular. Come to think of it, the std devs don't vary much.

```
max(summary_df$st_dev)
```

```
[1] 0.8381931
```

```
min(summary_df$st_dev)
```

```
[1] 0.731665
```

```
max(summary_df$st_dev)-min(summary_df$st_dev)
```

```
[1] 0.1065281
```

Yeah, the std devs only range from 0.73 to 0.84 (~0.11)—substantially less than the differences in std devs between challenges (~0.66). We could probably demonstrate this with a significance test later if it feels interesting.

Out of curiosity, how many people said they would all be very useful?

```
nrow(
  solutions %>%
    filter(if_all(.cols = everything(), ~ . == "Very useful"))
)
```

```
[1] 14
```

Ah, ok. Not that many.

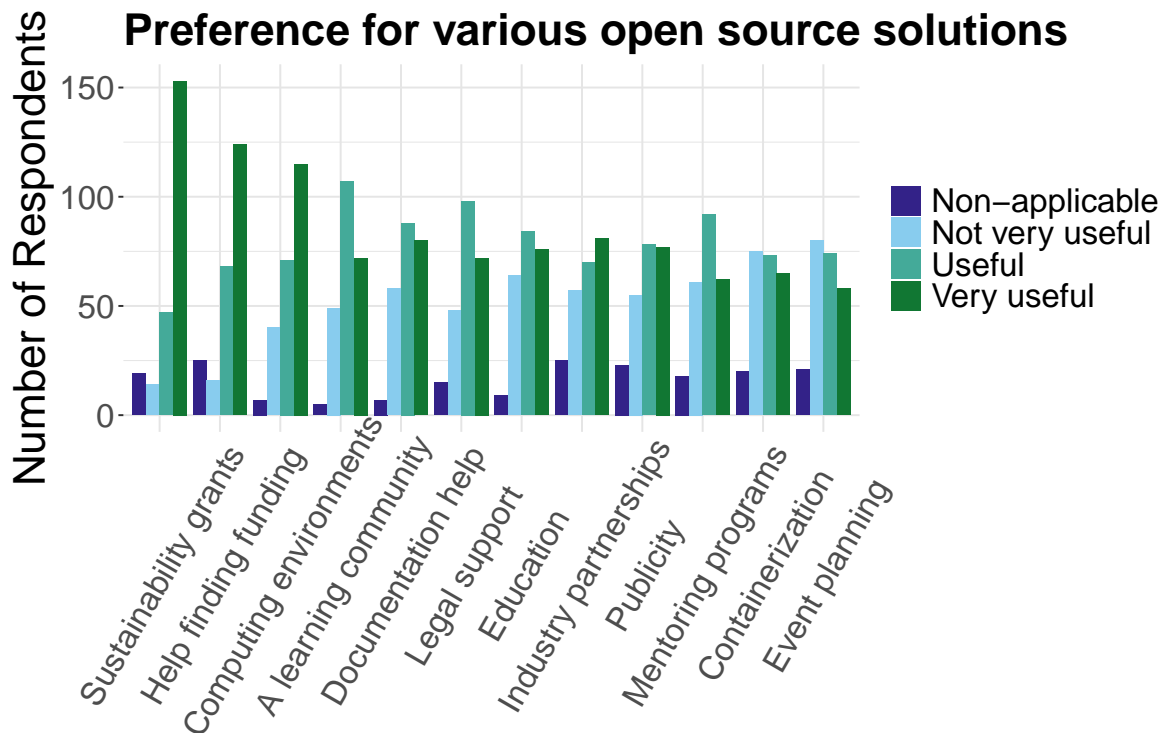
Plot the distributions

Prepare data for plotting.

```
ordered_levels <- (summary_df %>%  
  arrange(desc(total)))$solution  
  
long_data$solution <- factor(long_data$solution, levels = ordered_levels)
```

Grouped bar chart showing the distributions of answers.

```
grouped_plot <- grouped_bar_chart(  
  df = long_data,  
  x_var = "solution",  
  fill_var = "utility",  
  title = "Preference for various open source solutions"  
)  
  
grouped_plot
```



Save the plot if you wish.

```
save_plot("fave_solutions.tiff", 10, 6, p=grouped_plot)
```

Simple bar plot

Now let's make a simpler bar plot from the next question, which asked participants to choose their favorite solution.

```
favorites <- data.frame(other_quant$favorite_solution)
favorites <- exclude_empty_rows(favorites) # from scripts/utils.R

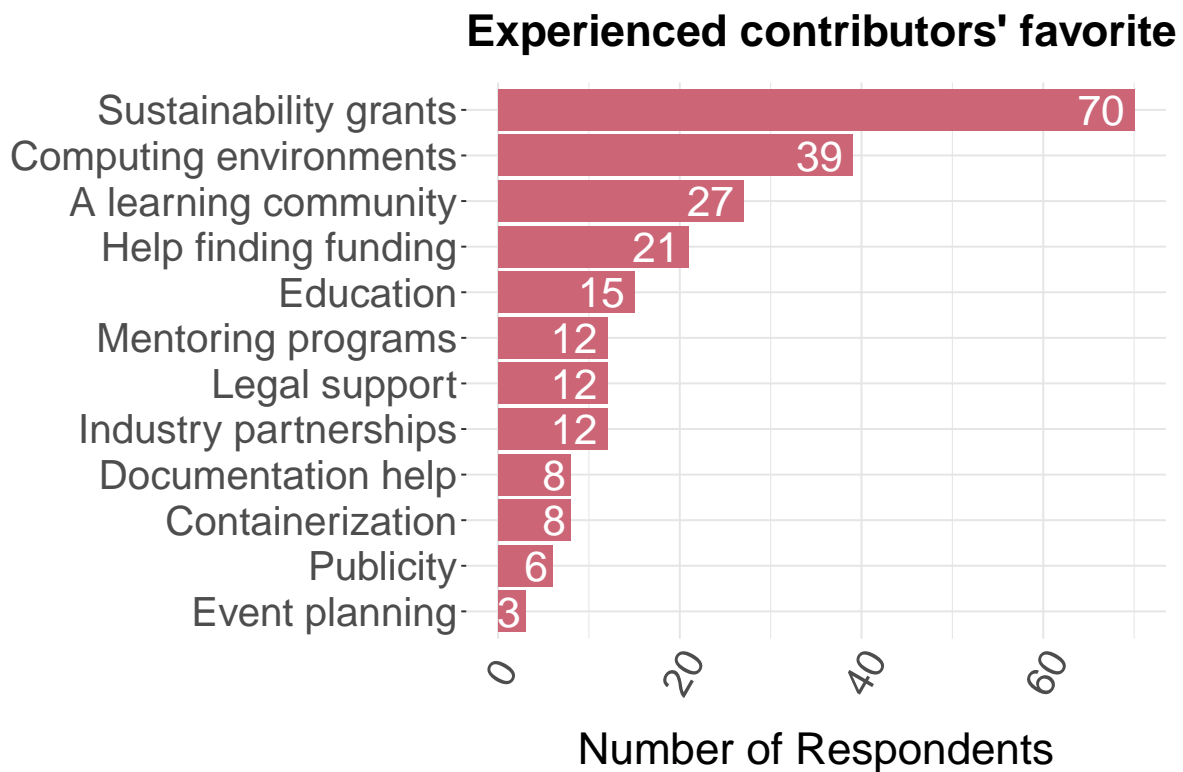
fav_to_plot <- data.frame(table(favorites[, 1]))
# from scripts/utils.R
fav_to_plot <- reorder_factor_by_column(
  df = fav_to_plot,
  factor_col = Var1,
  value_col = Freq,
  descending = FALSE
)
head(fav_to_plot)
```

	Var1	Freq
1	A learning community	27
2	Computing environments	39
3	Containerization	8
4	Documentation help	8
5	Education	15
6	Event planning	3

```
faves_plot <- basic_bar_chart(
  df = fav_to_plot,
  x_var = "Var1",
  y_var = "Freq",
  title = "Experienced contributors' favorite solutions",
  show_axis_title_x = TRUE,
  show_axis_title_y = FALSE,
  ylabel = "Number of Respondents",
  show_bar_labels = TRUE,
  color_index = 7,
```

```
horizontal = TRUE
)

faves_plot
```



The top solutions are not exactly the same in this question compared to tallying up the totals from the previous one, though they are close.

Save the plot if you wish.

```
save_plot("fave_solutions_simple.tiff", 12, 6, p=faves_plot)
```

```
# SVG is higher quality
```

```
svglite::svglite(file.path(FIGURE_PATH, "fave_solutions_simple.svg"), width = 13, height = 6
```

```
pdf
2
```

Save the data to file for tweaking the final figure.


```
write_df_to_file(fav_to_plot, "data_for_plots/exp_fave_solns.tsv")
```

Incorporating demographics

Plots

Who are these people who want access to computing environments? Don't all the UCs already offer this?

Let's focus on job category.

```
campus_job_fave <- other_quant %>%
  select(campus, job_category, favorite_solution)
campus_job_fave <- exclude_empty_rows(campus_job_fave, strict = TRUE)

# For visual clarity, let's combine postdocs and other staff researchers.
campus_job_fave <- campus_job_fave %>%
  mutate(
    job_category = recode(
      job_category,
      "Post-Doc" = "Postdocs and\nStaff Researchers",
      "Other research staff" = "Postdocs and\nStaff Researchers"
    )
  )

head(campus_job_fave)
```

	campus	job_category	favorite_solution
1	UC Santa Barbara	Faculty	Sustainability grants
2	UC Santa Barbara	Postdocs and\nStaff Researchers	Containerization
3	UC Santa Barbara	Postdocs and\nStaff Researchers	Computing environments
4	UC Santa Barbara	Faculty	Sustainability grants
5	UC Santa Barbara	Faculty	Documentation help
7	UC Santa Barbara	Faculty	Legal support

Of the people who selected “Computing environments”, what is the distribution of job categories?

```

compute <- campus_job_fave %>%
  filter(favorite_solution == "Computing environments")
compute_counts <- data.frame(table(compute$job_category))

compute_counts <- compute_counts %>% rename(job_category = Var1, compute = Freq)

compute_counts <- reorder_factor_by_column(
  df = compute_counts,
  factor_col = job_category,
  value_col = compute
)

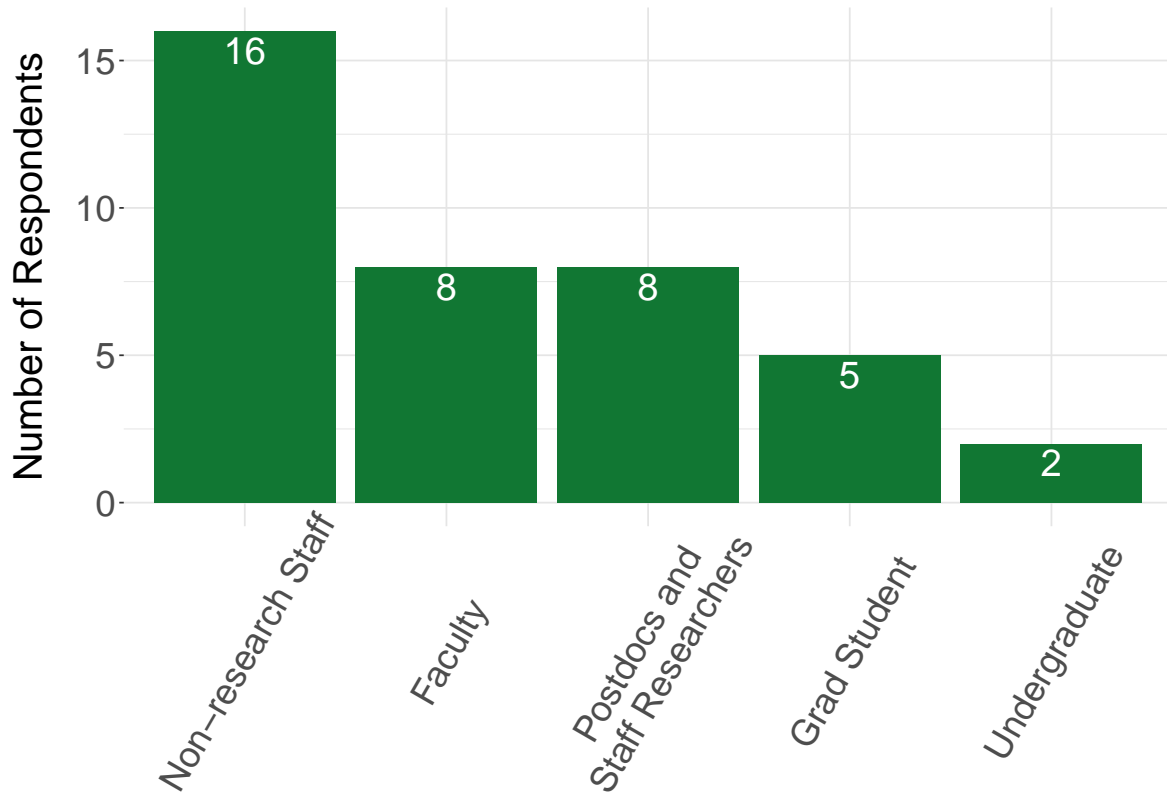
```

```

compute_bar <- basic_bar_chart(
  df = compute_counts,
  x_var = "job_category",
  y_var = "compute",
  title = "Respondents whose top choice was\n'Access to free, feature-rich computing environ",
  color_index = 4,
  show_bar_labels = TRUE
)
compute_bar

```

Respondents whose top choice was 'Access to free, feature-rich computing environments'



Save the plot if you wish.

```
save_plot("compute_job.tiff", 10, 10, p=compute_bar)
```

So those are the absolute numbers, but they don't normalize for the sample sizes of the different job categories. The number of non-research staff who voted for computing environments might be high because there are simply a lot of non-research staff in our survey.

```
total_counts <- data.frame(table(campus_job_fave$job_category))

total_counts <- total_counts %>% rename(job_category = Var1, total = Freq)

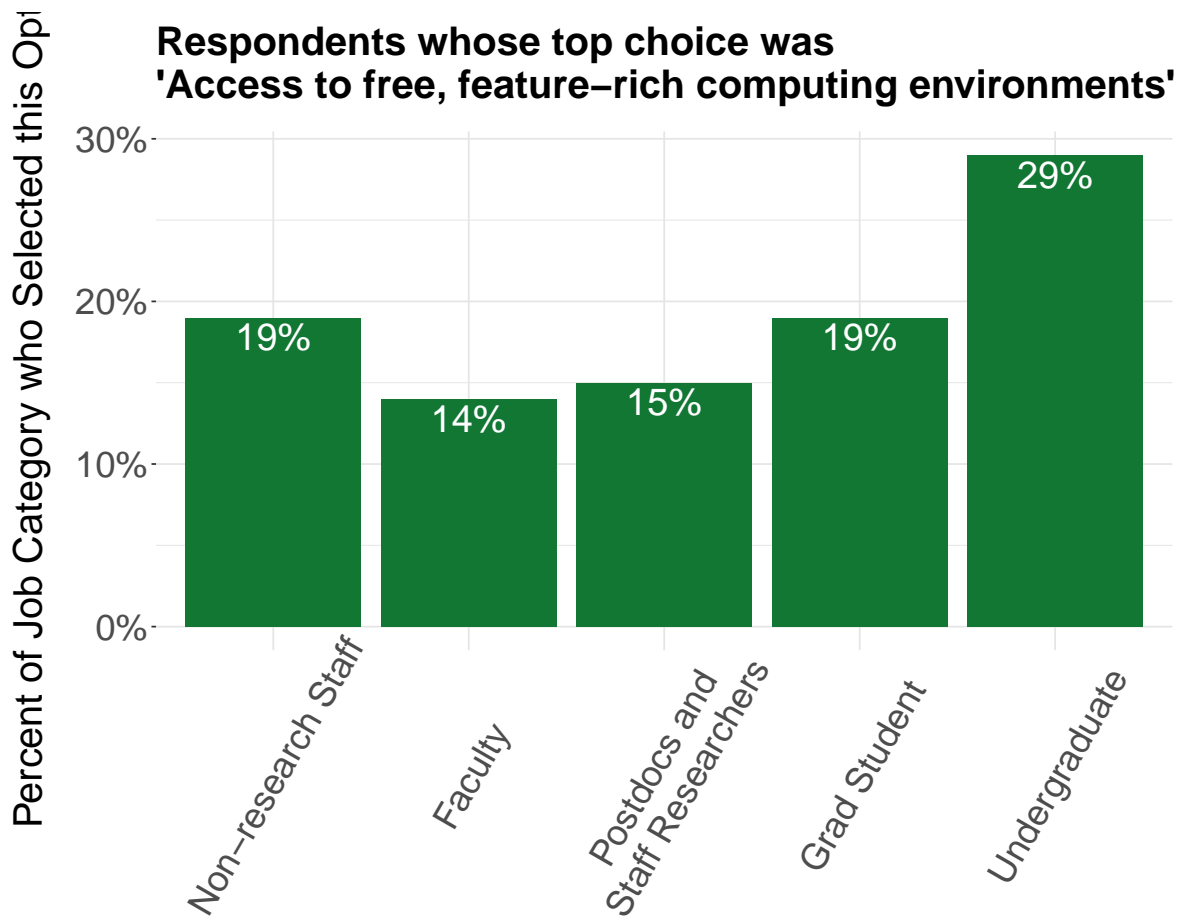
proportion_df <- compute_counts %>%
  left_join(total_counts, by = "job_category") %>%
  mutate(proportion = round(compute / total, 2))
```

```
proportion_df
```

	job_category	compute	total	proportion
1	Faculty	8	59	0.14
2	Grad Student	5	26	0.19
3	Non-research Staff	16	86	0.19
4	Postdocs and\nStaff Researchers	8	55	0.15
5	Undergraduate	2	7	0.29

The previous plot suggested the demand was mostly coming from non-research staff, but that was deceiving, because we do indeed have a lot of non-research staff in our sample. Let's make a plot that is, I think, more informative. This plot shows the percent of people in that job category who selected computing environments as their favorite solution.

```
compute_bar_prop <- basic_bar_chart(  
  df = proportion_df,  
  x_var = "job_category",  
  y_var = "proportion",  
  ylabel = "Percent of Job Category who Selected this Option",  
  title = "Respondents whose top choice was\n'Access to free, feature-rich computing environ",  
  color_index = 4,  
  show_bar_labels = TRUE,  
  percent = TRUE  
)  
compute_bar_prop
```



Save the plot if you wish.

```
save_plot("compute_job_prop.tiff", 10, 10, p=compute_bar_prop)
```

Let's make the same plot, but this time with campus info.

```
compute_counts2 <- compute %>%
  select(-favorite_solution) %>%
  count(
    campus,
    job_category,
    name = "count"
  )

compute_counts2$job_category <- factor(
```

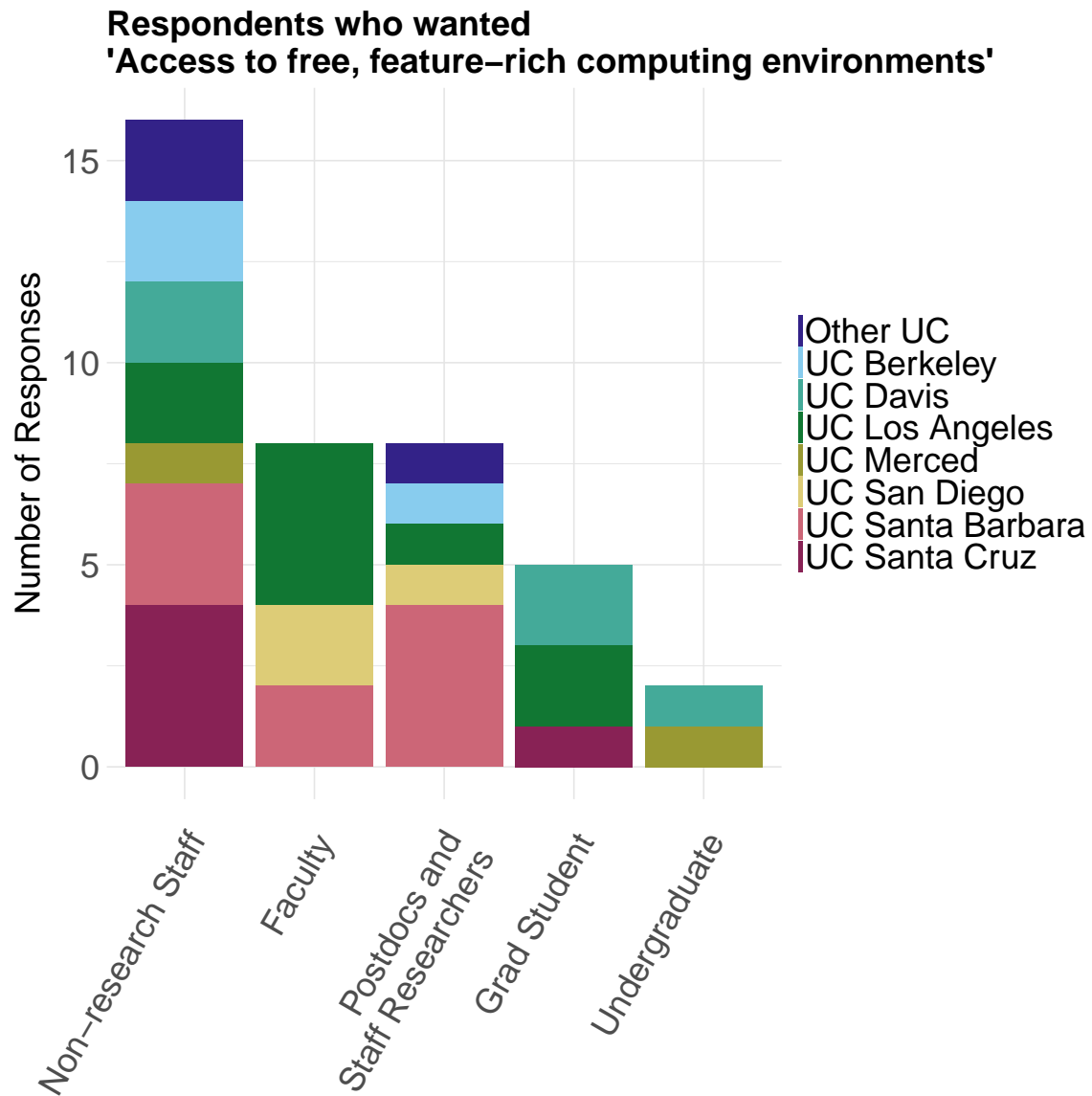
```

compute_counts2$job_category,
levels = levels(compute_counts$job_category)
)

compute_campus_bar <- stacked_bar_chart(
  df = compute_counts2,
  x_var = "job_category",
  y_var = "count",
  fill = "campus",
  title = "Respondents who wanted\n'Access to free, feature-rich computing environments'",
  ylabel = NULL,
  proportional = FALSE
)

compute_campus_bar

```



This one is a bit harder to interpret, because it's a busy plot and the sample sizes are small. Anyway, save the plot if you wish.

```
save_plot("compute_job_campus.tiff", 14, 14, p=compute_campus_bar)
```

Response rates by campus, for “Compute environments”

I’m wondering if there’s one or two campuses in particular where compute environments are lacking.

```
compute_counts_campus <- campus_job_fave %>%  
  filter(favorite_solution == "Computing environments") %>%  
  count(campus, name = "compute_n")  
  
# a scalar  
total_compute_votes <- nrow(campus_job_fave %>%  
  filter(favorite_solution == "Computing environments"))  
  
campus_totals <- campus_job_fave %>%  
  count(campus, name = "campus_total")  
  
campus_totals <- left_join(campus_totals, compute_counts_campus, by="campus")  
campus_totals <- exclude_empty_rows(campus_totals, strict=TRUE)  
  
campus_totals %>% mutate( compute_perc = 100*compute_n / campus_total)
```

	campus	campus_total	compute_n	compute_perc
1	Other UC	19	3	15.78947
2	UC Berkeley	26	3	11.53846
3	UC Davis	29	5	17.24138
5	UC Los Angeles	40	9	22.50000
6	UC Merced	8	2	25.00000
7	UC San Diego	9	3	33.33333
9	UC Santa Barbara	61	9	14.75410
10	UC Santa Cruz	32	5	15.62500

So, anywhere from 12% to 33% of respondents selected this as their favorite solution, when we break it down by campus. The numbers from UCSD (33%) and UC Merced (25%) should probably be taken with a grain of salt, since those campuses had really low participation rates.

For each job category, what are the top 5 favorite solutions?

From the “choose one” question

First, calculate the result based on Q11, the “choose one” question, where participants had to choose their favorite solution.


```

job_fave <- campus_job_fave %>% select(-campus)

# Combine students into one group for visual clarity
job_fave <- job_fave %>%
  mutate(
    job_category = recode(
      job_category,
      "Grad Student" = "Students",
      "Undergraduate" = "Students"
    )
  )

#Reorder factor levels for plotting
job_fave$job_category <- factor(job_fave$job_category, levels = c(
  "Faculty",
  "Postdocs and\nStaff Researchers",
  "Students",
  "Non-research Staff"
))

job_fave_counts <- job_fave %>%
  count(
    job_category,
    favorite_solution,
    name = "count"
  )

# 2) For each job_category, keep only the top 5 solutions by count
top_solutions <- job_fave_counts %>%
  group_by(job_category) %>%
  # slice_max() picks the rows with the highest `count`
  slice_max(order_by = count, n = 5, with_ties = TRUE) %>%
  ungroup()

top_solutions

```

A tibble: 29 x 3

job_category <fct>	favorite_solution <chr>	count <int>
1 "Faculty"	Sustainability grants	24
2 "Faculty"	Computing environments	8
3 "Faculty"	Help finding funding	6

```

4 "Faculty"           Industry partnerships      5
5 "Faculty"           Containerization          3
6 "Faculty"           Documentation help        3
7 "Faculty"           Education                 3
8 "Postdocs and\nStaff Researchers" Sustainability grants 16
9 "Postdocs and\nStaff Researchers" Help finding funding 9
10 "Postdocs and\nStaff Researchers" Computing environments 8
# i 19 more rows

```

This looks like it's worth plotting. Let's go back to the big data frame, since my `grouped_bar_chart` function doesn't want counts (it will count rows itself); drop all job/solution combinations except those that appear in the `top_solutions` data frame.

```

job_fave_top <- job_fave %>%
  semi_join(
    top_solutions,
    by = c("job_category", "favorite_solution")
  )

head(job_fave_top)

```

```

      job_category      favorite_solution
1      Faculty Sustainability grants
2 Postdocs and\nStaff Researchers Computing environments
3      Faculty Sustainability grants
4      Faculty Documentation help
5 Postdocs and\nStaff Researchers Computing environments
6      Faculty Computing environments

```

```

# Reorder factor levels so legend items are in order of appearance
job_fave_top <- job_fave_top %>%
  mutate(favorite_solution = fct_inorder(favorite_solution))

```

```

# I'm just including the names here for my own reference,
# but they're not actually used in the code.
solutions_palette <- list(
  # modified from https://sronpersonalpages.nl/~pault/
  "Sustainability grants" = "#332288",
  "Computing environments" = "#77aadd",
  "Documentation help" = "#44bb99",
  "A learning community" = "#bbcc33",

```

```

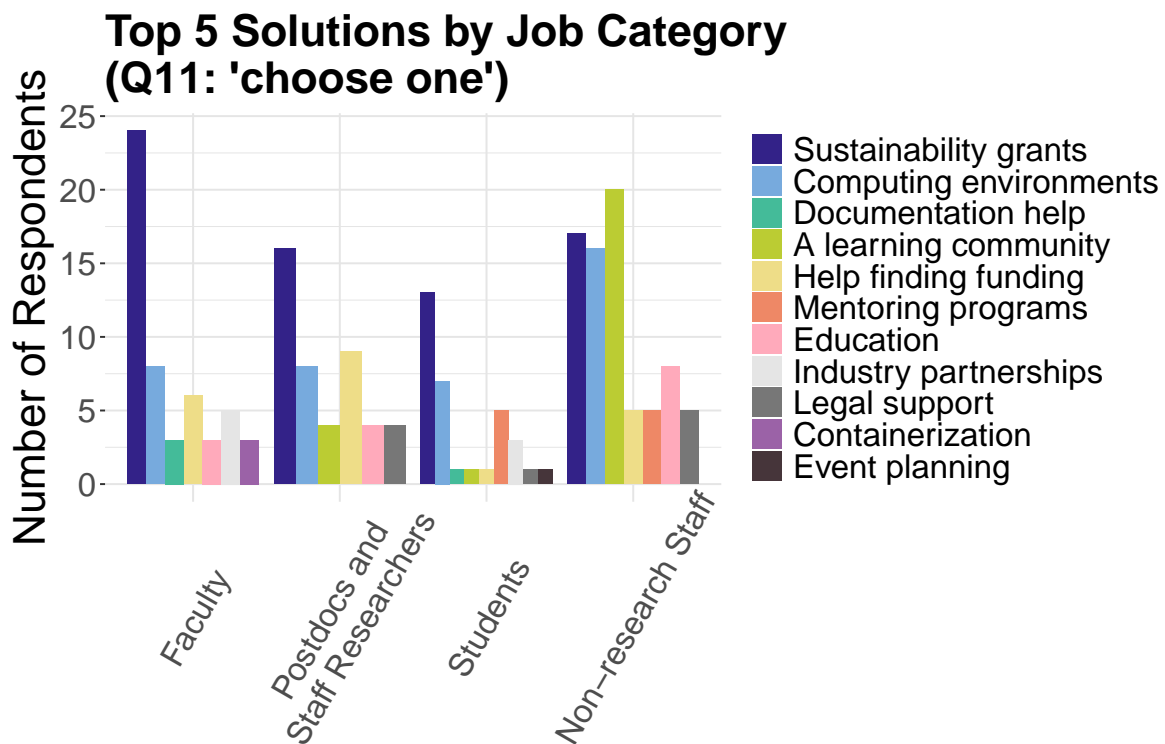
"Help finding funding" = "#eedd88",
"Mentoring programs" = "#ee8866",
"Education" = "#ffaabb",
"Industry partnerships" = "#e5e5e5",
"Legal support" = "#777777",
"Containerization" = "#9B62A7",
"Event planning" = "#46353A"
)

```

```

q11_plot <- grouped_bar_chart(
  df = job_fave_top,
  x_var = "job_category",
  fill_var = "favorite_solution",
  title = "Top 5 Solutions by Job Category\n(Q11: 'choose one')",
  color_palette = solutions_palette
)
q11_plot

```



```
save_plot("top_solutions_by_job.tiff", 12, 10, p=q11_plot)
```

Likert points

Now we ask the same question (top 5 per job category), but we get the result by tallying up the Likert scale “points” from Q10.

```
solutions_job_raw <- cbind(solutions_raw, other_quant$job_category)
# Rename last column
names(solutions_job_raw)[ncol(solutions_job_raw)] <- "job_category"
```

Remove rows that contain any empty entries.

```
nrow(solutions_job_raw)
```

```
[1] 332
```

```
solutions_job <- exclude_empty_rows(solutions_job_raw, strict = TRUE) # from scripts/utils.R
nrow(solutions_job)
```

```
[1] 233
```

For visual clarity in our plots, let’s combine postdocs and other staff researchers, as well as undergrads and grad students.

```
solutions_job <- solutions_job %>%
  mutate(
    job_category = recode(
      job_category,
      "Post-Doc" = "Postdocs and Staff Researchers",
      "Other research staff" = "Postdocs and Staff Researchers"
    )
  )

solutions_job <- solutions_job %>%
  mutate(
    job_category = recode(
      job_category,
      "Grad Student" = "Students",
```

```

    "Undergraduate" = "Students"
  )
)

solutions_job$participantID <- row.names(solutions_job)

head(solutions_job)

```

	Computing environments	Publicity	Containerization	Documentation help
1	Very useful	Very useful	Very useful	Very useful
2	Useful	Very useful	Very useful	Not very useful
3	Very useful	Very useful	Very useful	Very useful
4	Not very useful	Useful	Useful	Very useful
5	Useful	Not very useful	Useful	Very useful
7	Not very useful	Not very useful	Very useful	Not very useful
	A learning community	Event planning	Mentoring programs	Education
1	Very useful	Very useful	Very useful	Very useful
2	Useful	Non-applicable	Very useful	Very useful
3	Useful	Useful	Useful	Not very useful
4	Not very useful	Useful	Not very useful	Not very useful
5	Not very useful	Not very useful	Useful	Very useful
7	Not very useful	Not very useful	Not very useful	Not very useful
	Legal support	Industry partnerships	Sustainability grants	
1	Very useful	Very useful	Very useful	
2	Very useful	Useful	Very useful	
3	Very useful	Very useful	Very useful	
4	Useful	Not very useful	Very useful	
5	Useful	Useful	Very useful	
7	Very useful	Not very useful	Very useful	
	Help finding funding		job_category	participantID
1	Very useful		Faculty	1
2	Useful	Postdocs and Staff Researchers		2
3	Very useful	Postdocs and Staff Researchers		3
4	Very useful		Faculty	4
5	Useful		Faculty	5
7	Very useful		Faculty	7

Let's reshape the data from wide to long format for easier counting and plotting.

```

long_data_job <- solutions_job %>%
  pivot_longer(

```

```

    cols = -c(participantID, job_category),
    names_to = "solution",
    values_to = "utility"
  )

long_data_job <- long_data_job %>%
  mutate(
    utility_score = recode(
      utility,
      "Non-applicable" = 0L,
      "Not very useful" = 0L,
      "Useful" = 1L,
      "Very useful" = 2L
    )
  )

long_data_job

```

```

# A tibble: 2,796 x 5
  job_category participantID solution      utility      utility_score
  <chr>         <chr>      <chr>      <chr>          <int>
1 Faculty      1      Computing environments Very useful      2
2 Faculty      1      Publicity          Very useful      2
3 Faculty      1      Containerization   Very useful      2
4 Faculty      1      Documentation help Very useful      2
5 Faculty      1      A learning community Very useful      2
6 Faculty      1      Event planning     Very useful      2
7 Faculty      1      Mentoring programs Very useful      2
8 Faculty      1      Education          Very useful      2
9 Faculty      1      Legal support       Very useful      2
10 Faculty     1      Industry partnerships Very useful      2
# i 2,786 more rows

```

Modifying some code I copied from challenges_plus_job.qmd.

```

get_summary_df <- function(job_str, df) {
  res <- df %>%
    filter(job_category == job_str) %>%
    group_by(solution) %>%
    summarise(
      total = sum(utility_score),

```

```

    mean = mean(utility_score, na.rm = TRUE)
  ) %>%
  ungroup() %>%
  arrange(desc(total))
return(res)
}

```

```

jobs_ordered <- c(
  "Faculty",
  "Postdocs and Staff Researchers",
  "Students",
  "Non-research Staff"
)

summary_tables <- lapply(jobs_ordered, function(j) get_summary_df(j, long_data_job))
names(summary_tables) <- jobs_ordered
summary_tables

```

\$Faculty

A tibble: 12 x 3

	solution <chr>	total <int>	mean <dbl>
1	Sustainability grants	98	1.66
2	Help finding funding	85	1.44
3	Computing environments	75	1.27
4	Industry partnerships	61	1.03
5	Publicity	60	1.02
6	Containerization	53	0.898
7	Documentation help	52	0.881
8	Legal support	52	0.881
9	A learning community	46	0.780
10	Education	45	0.763
11	Event planning	41	0.695
12	Mentoring programs	39	0.661

\$`Postdocs and Staff Researchers`

A tibble: 12 x 3

	solution <chr>	total <int>	mean <dbl>
1	Sustainability grants	90	1.64
2	Help finding funding	81	1.47
3	Computing environments	68	1.24

4	Publicity	67	1.22
5	Documentation help	62	1.13
6	A learning community	58	1.05
7	Education	57	1.04
8	Industry partnerships	57	1.04
9	Legal support	56	1.02
10	Event planning	51	0.927
11	Mentoring programs	50	0.909
12	Containerization	49	0.891

\$Students

A tibble: 12 x 3

	solution <chr>	total <int>	mean <dbl>
1	Sustainability grants	62	1.88
2	Computing environments	56	1.70
3	Help finding funding	55	1.67
4	Industry partnerships	49	1.48
5	Mentoring programs	44	1.33
6	Documentation help	43	1.30
7	Education	43	1.30
8	A learning community	42	1.27
9	Publicity	42	1.27
10	Legal support	41	1.24
11	Containerization	37	1.12
12	Event planning	36	1.09

\$`Non-research Staff`

A tibble: 12 x 3

	solution <chr>	total <int>	mean <dbl>
1	A learning community	105	1.22
2	Sustainability grants	103	1.20
3	Computing environments	102	1.19
4	Help finding funding	95	1.10
5	Legal support	93	1.08
6	Documentation help	91	1.06
7	Education	91	1.06
8	Mentoring programs	83	0.965
9	Industry partnerships	65	0.756
10	Containerization	64	0.744
11	Publicity	63	0.733
12	Event planning	62	0.721

Let's plot the top 5. First, a little data wrangling.

```
all_tbl <- bind_rows(summary_tables, .id = "job_category")

top_by_job_points <- all_tbl %>%
  group_by(job_category) %>%
  slice_max(mean, n = 5, with_ties = FALSE) %>%
  ungroup() %>%
  select(job_category, solution, mean) %>%
  mutate(job_category = factor(job_category, levels = jobs_ordered))

# Reorder factor levels for visual clarity

ordered_solns_top_by_points <- c(
  "Sustainability grants",
  "Help finding funding",
  "Computing environments",
  "Industry partnerships",
  "Publicity",
  "Documentation help",
  "Legal support",
  "A learning community",
  "Mentoring programs"
)

top_by_job_points$solution <- factor(
  top_by_job_points$solution,
  levels = ordered_solns_top_by_points
)
```

Let's add a whitespace in this long job category name

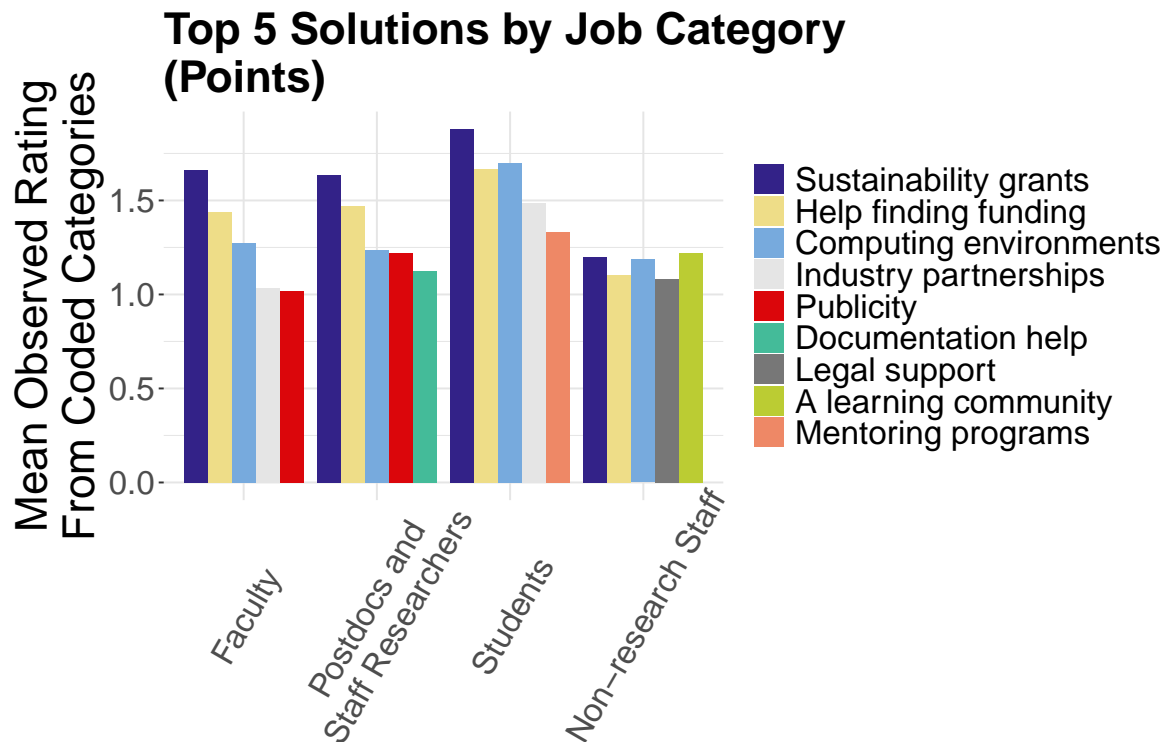
```
top_by_job_points <- top_by_job_points %>%
  mutate(
    job_category = recode(
      job_category,
      "Postdocs and Staff Researchers" = "Postdocs and\nStaff Researchers",
    )
  )
```

```
# For the sake of time, I am just hard-coding the colors
# in the proper order to match the other plots
```

```
solutions_palette2 <- list(
  # modified from https://sronpersonalpages.nl/~pault/
  "Sustainability grants" = "#332288",
  "Help finding funding" = "#eedd88",
  "Computing environments" = "#77aadd",
  "Industry partnerships" = "#e5e5e5",
  "Publicity" = "#db060b",
  "Documentation help" = "#44bb99",
  "Legal support" = "#777777",
  "A learning community" = "#bbcc33",
  "Mentoring programs" = "#ee8866"
)
```

```
top_points_plot <- ggplot(
  top_by_job_points,
  aes(
    x = job_category,
    y = mean,
    fill = solution
  )
) +
  geom_col(position = position_dodge()) +
  scale_fill_manual(values = solutions_palette2) +
  labs(
    x = "Job Category",
    y = "Mean Observed Rating\nFrom Coded Categories",
    fill = "Solution",
    title = "Top 5 Solutions by Job Category\n(Points)"
  ) +
  theme(
    axis.title.x = element_blank(),
    axis.title.y = element_text(size = 24),
    axis.text.x = element_text(angle = 60, vjust = 0.6, size = 18),
    axis.text.y = element_text(size = 18),
    axis.ticks.x = element_blank(),
    legend.title = element_blank(),
    legend.text = element_text(size = 18),
    panel.background = element_blank(),
    panel.grid = element_line(linetype = "solid", color = "gray90"),
    plot.title = element_text(hjust = 0, size = 24, face = "bold"),
    plot.margin = unit(c(0.3, 0.3, 0.3, 0.3), "cm")
  )
```

```
top_points_plot
```



```
save_plot("top5_solutions_by_job_points.tiff", 12, 10, p=top_points_plot)
```

Proportion useful or very useful

As another way of confirming/exploring these trends, let's look at the proportion of each group who said "useful" or "very useful".

```
# Calculate proportion of TRUEs by taking the mean of a logical vector,  
# created by %in%.  
proportions <- long_data_job %>%  
  group_by(job_category, solution) %>%  
  summarize(proportion = mean(utility %in% c("Useful", "Very useful"))) %>%  
  ungroup()
```

``summarise()`` has grouped output by 'job_category'. You can override using the ``groups`` argument.

proportions

```
# A tibble: 48 x 3
  job_category solution      proportion
  <chr>         <chr>         <dbl>
1 Faculty      A learning community 0.610
2 Faculty      Computing environments 0.780
3 Faculty      Containerization      0.593
4 Faculty      Documentation help    0.593
5 Faculty      Education              0.559
6 Faculty      Event planning         0.508
7 Faculty      Help finding funding   0.831
8 Faculty      Industry partnerships  0.644
9 Faculty      Legal support          0.678
10 Faculty     Mentoring programs     0.525
# i 38 more rows
```

```
top_by_prop <- proportions %>%
  group_by(job_category) %>%
  slice_max(order_by = proportion, n = 5)
```

```
# Filter to include only challenges present in the top n dataframe
filtered_props <- proportions %>%
  semi_join(top_by_prop, by = c("job_category", "solution"))
```

```
# Reorder factor levels
filtered_props$solution <- factor(
  filtered_props$solution,
  levels = ordered_solns_top_by_points
)

filtered_props$job_category <- factor(
  filtered_props$job_category,
  levels = jobs_ordered
)
```

Let's add a whitespace in this long job category name

```
filtered_props <- filtered_props %>%
  mutate(
```

```

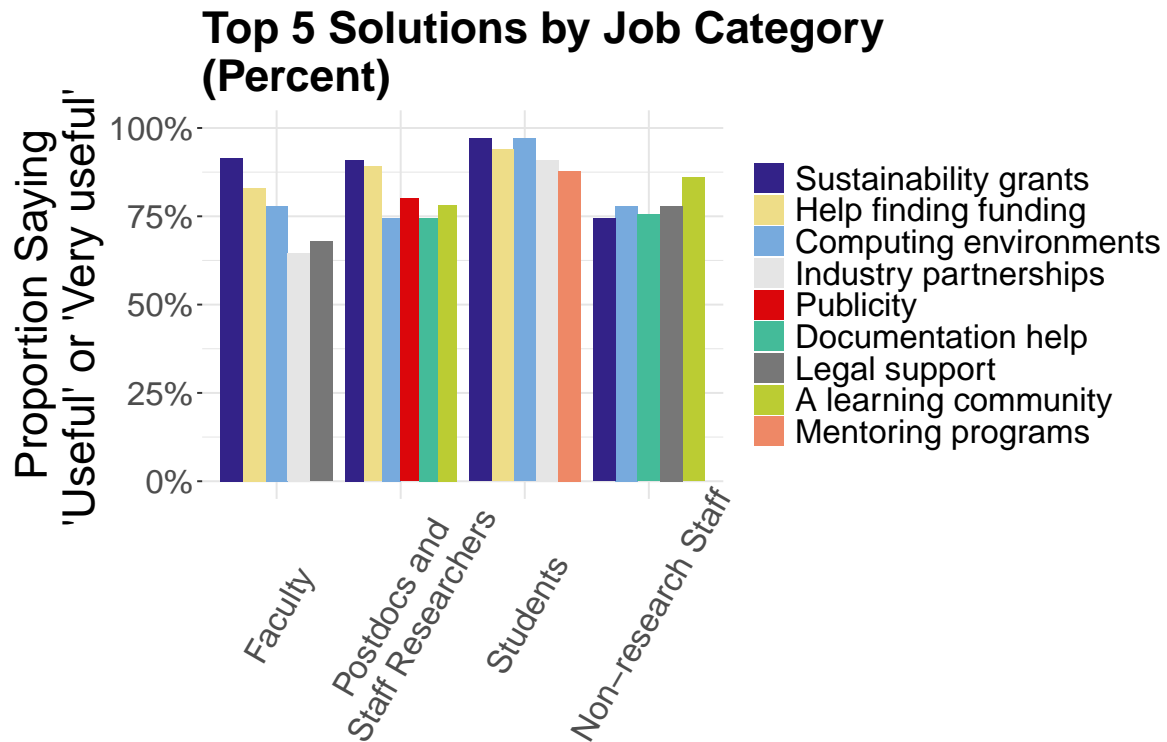
    job_category = recode(
      job_category,
      "Postdocs and Staff Researchers" = "Postdocs and\nStaff Researchers",
    )
  )
)

```

```

top_perc_plot <- ggplot(
  filtered_props,
  aes(
    x = job_category,
    y = proportion,
    fill = solution
  )
) +
  geom_col(position = position_dodge()) +
  scale_y_continuous(labels = scales::percent, limits = c(0, 1)) +
  scale_fill_manual(values = solutions_palette2) +
  labs(
    x = "Job Category",
    y = "Proportion Saying\n'Useful' or 'Very useful'",
    fill = "Challenge",
    title = "Top 5 Solutions by Job Category\n(Percent)"
  ) +
  theme(
    axis.title.x = element_blank(),
    axis.title.y = element_text(size = 24),
    axis.text.x = element_text(angle = 60, vjust = 0.6, size = 18),
    axis.text.y = element_text(size = 18),
    axis.ticks.x = element_blank(),
    legend.title = element_blank(),
    legend.text = element_text(size = 18),
    panel.background = element_blank(),
    panel.grid = element_line(linetype = "solid", color = "gray90"),
    plot.title = element_text(hjust = 0, size = 24, face = "bold"),
    plot.margin = unit(c(0.3, 0.3, 0.3, 0.3), "cm")
  )
top_perc_plot

```



```
save_plot("top5_solns_by_job_percent.tiff", 12, 10, p=top_perc_plot)
```

Combined plot

```
p_combined <- patchwork::wrap_plots(
  top_points_plot,
  top_perc_plot,
  q11_plot
) + plot_layout(ncol = 2)

p_combined <- p_combined +
  plot_annotation(tag_levels = "A") &
  theme(plot.tag = element_text(size = 26))
```

```
svglite::svglite(file.path(FIGURE_PATH, "figureS6.svg"), width = 20, height = 14); print(p_c
```

A Learning Community

Let's make a plot similar to the one before, where we plotted the percent of folks in each job category who selected "computing environments" as their favorite solution. This time, though, we'll look at "A learning community".

```
learn <- campus_job_fave %>%  
  filter(favorite_solution == "A learning community")  
learn_counts <- data.frame(table(learn$job_category))  
  
learn_counts <- learn_counts %>% rename(job_category = Var1, learning = Freq)  
  
learn_counts <- reorder_factor_by_column(  
  df = learn_counts,  
  factor_col = job_category,  
  value_col = learning  
)
```

```
total_counts <- data.frame(table(campus_job_fave$job_category))  
  
total_counts <- total_counts %>% rename(job_category = Var1, total = Freq)  
  
proportion_df2 <- learn_counts %>%  
  left_join(total_counts, by = "job_category") %>%  
  mutate(proportion = round(learning / total, 2))  
  
proportion_df2
```

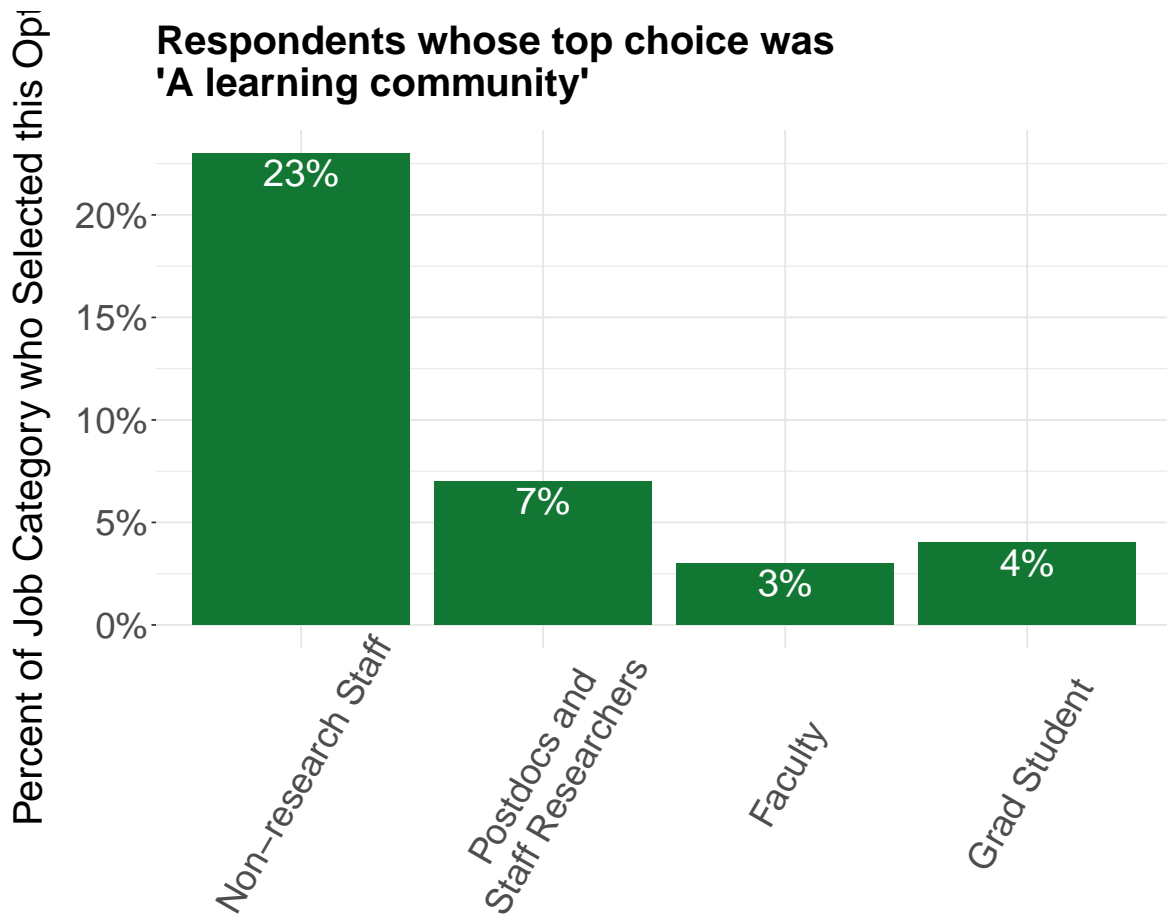
	job_category	learning	total	proportion
1	Faculty	2	59	0.03
2	Grad Student	1	26	0.04
3	Non-research Staff	20	86	0.23
4	Postdocs and\nStaff Researchers	4	55	0.07

```
learn_bar_prop <- basic_bar_chart(  
  df = proportion_df2,  
  x_var = "job_category",
```

```

y_var = "proportion",
ylabel = "Percent of Job Category who Selected this Option",
title = "Respondents whose top choice was\n'A learning community'",
color_index = 4,
show_bar_labels = TRUE,
percent = TRUE
)
learn_bar_prop

```




```
save_plot("learn_job_prop.tiff", 12, 10, p=learn_bar_prop)
```

Sustainability grants

Same thing, but now with sustainability grants.

```
grants <- campus_job_fave %>%
  filter(favorite_solution == "Sustainability grants")
grants_counts <- data.frame(table(grants$job_category))

grants_counts <- grants_counts %>% rename(job_category = Var1, grants = Freq)

grants_counts <- reorder_factor_by_column(
  df = grants_counts,
  factor_col = job_category,
  value_col = grants
)
```

```
total_counts <- data.frame(table(campus_job_fave$job_category))

total_counts <- total_counts %>% rename(job_category = Var1, total = Freq)

proportion_df3 <- grants_counts %>%
  left_join(total_counts, by = "job_category") %>%
  mutate(proportion = round(grants / total, 2))

proportion_df3
```

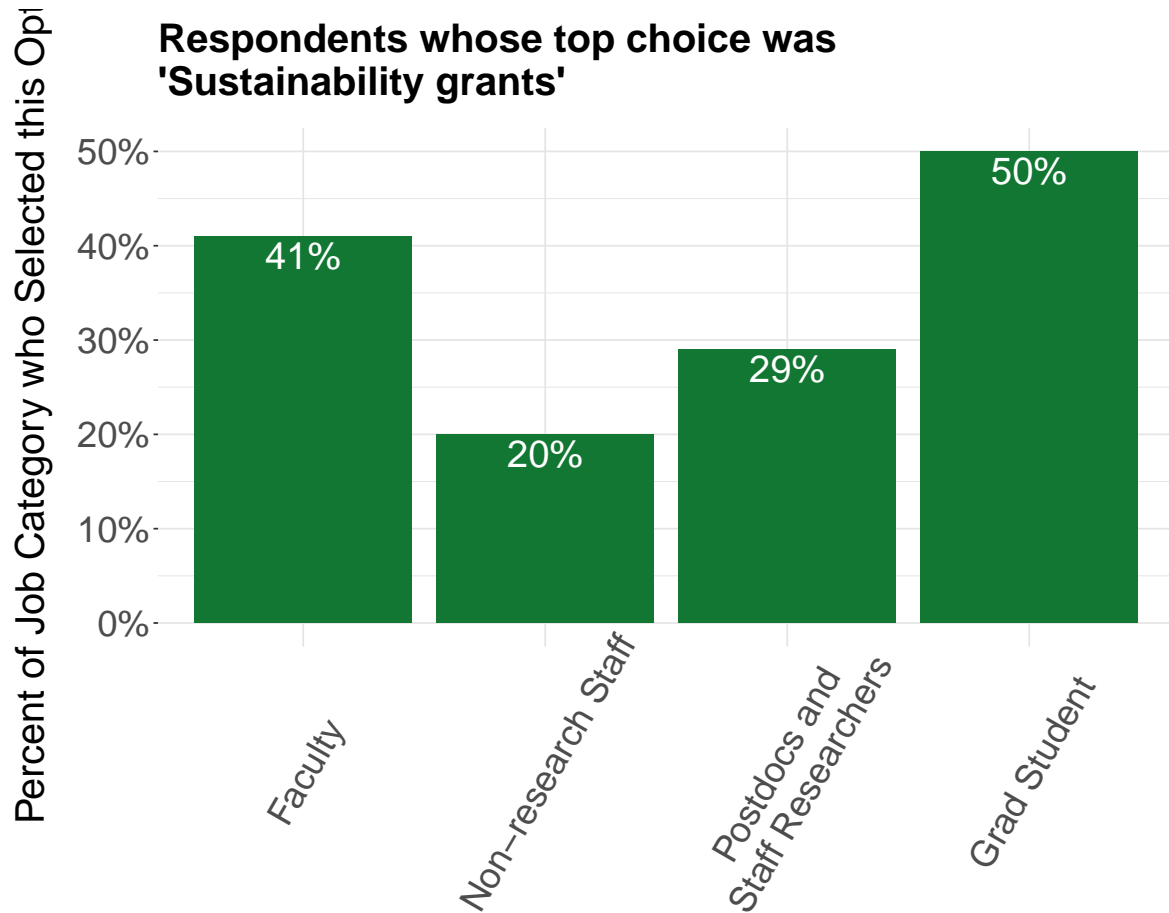
	job_category	grants	total	proportion
1	Faculty	24	59	0.41
2	Grad Student	13	26	0.50
3	Non-research Staff	17	86	0.20
4	Postdocs and\nStaff Researchers	16	55	0.29

```
grants_bar_prop <- basic_bar_chart(
  df = proportion_df3,
  x_var = "job_category",
  y_var = "proportion",
  ylabel = "Percent of Job Category who Selected this Option",
```

```

title = "Respondents whose top choice was\n'Sustainability grants'",
color_index = 4,
show_bar_labels = TRUE,
percent = TRUE
)
grants_bar_prop

```



```

save_plot("grants_job_prop.tiff", 12, 10, p=grants_bar_prop)

```

Session Info

```
sessionInfo()
```

```
R version 4.4.2 (2024-10-31)
Platform: aarch64-apple-darwin20
Running under: macOS 26.1
```

```
Matrix products: default
```

```
BLAS:   /Library/Frameworks/R.framework/Versions/4.4-arm64/Resources/lib/libRblas.0.dylib
LAPACK: /Library/Frameworks/R.framework/Versions/4.4-arm64/Resources/lib/libRlapack.dylib;
```

```
locale:
```

```
[1] C.UTF-8/C.UTF-8/C.UTF-8/C/C.UTF-8/C.UTF-8
```

```
time zone: America/Los_Angeles
```

```
tzcode source: internal
```

```
attached base packages:
```

```
[1] tools      grid      stats      graphics  grDevices datasets  utils
[8] methods    base
```

```
other attached packages:
```

```
[1] treemapify_2.5.6      tidyr_1.3.1           svglite_2.2.1
[4] stringr_1.5.1         scales_1.4.0          readr_2.1.5
[7] pwr_1.3-0             patchwork_1.3.2       ordinal_2023.12-4.1
[10] lme4_1.1-37           Matrix_1.7-1          languageserver_0.3.16
[13] here_1.0.1            gtools_3.9.5          ggforce_0.5.0
[16] FSA_0.10.0            fpc_2.2-13            forcats_1.0.0
[19] factoextra_1.0.7      ggplot2_3.5.2          emmeans_1.11.2
[22] dplyr_1.1.4           corrplot_0.95         ComplexHeatmap_2.22.0
[25] cluster_2.1.8.1       BiocManager_1.30.26
```

```
loaded via a namespace (and not attached):
```

```
[1] Rdpack_2.6.4          rlang_1.1.6           magrittr_2.0.3
[4] clue_0.3-66           GetoptLong_1.0.5      matrixStats_1.5.0
[7] compiler_4.4.2        flexmix_2.3-20        systemfonts_1.2.3
[10] png_0.1-8             callr_3.7.6           vctrs_0.6.5
[13] pkgconfig_2.0.3       shape_1.4.6.1         crayon_1.5.3
[16] fastmap_1.2.0         labeling_0.4.3        utf8_1.2.6
[19] rmarkdown_2.29        ggfittext_0.10.2      tzdb_0.5.0
[22] ps_1.9.1              nloptr_2.2.1          purrr_1.1.0
[25] xfun_0.53             modeltools_0.2-24     jsonlite_2.0.0
```

[28]	tweenr_2.0.3	parallel_4.4.2	prabclus_2.3-4
[31]	R6_2.6.1	stringi_1.8.7	RColorBrewer_1.1-3
[34]	boot_1.3-31	diptest_0.77-2	numDeriv_2016.8-1.1
[37]	estimability_1.5.1	Rcpp_1.1.0	iterators_1.0.14
[40]	knitr_1.50	IRanges_2.40.1	splines_4.4.2
[43]	nnet_7.3-19	tidyselect_1.2.1	yaml_2.3.10
[46]	doParallel_1.0.17	codetools_0.2-20	processx_3.8.6
[49]	lattice_0.22-6	tibble_3.3.0	withr_3.0.2
[52]	evaluate_1.0.4	polyclip_1.10-7	xml2_1.4.0
[55]	circlize_0.4.16	mclust_6.1.1	kernlab_0.9-33
[58]	pillar_1.11.0	renv_1.1.5	foreach_1.5.2
[61]	stats4_4.4.2	reformulas_0.4.1	generics_0.1.4
[64]	rprojroot_2.1.1	S4Vectors_0.44.0	hms_1.1.3
[67]	minqa_1.2.8	xtable_1.8-4	class_7.3-22
[70]	glue_1.8.0	robustbase_0.99-4-1	mvtnorm_1.3-3
[73]	rbibutils_2.3	colorspace_2.1-1	nlme_3.1-166
[76]	cli_3.6.5	textshaping_1.0.1	gtable_0.3.6
[79]	DEoptimR_1.1-4	digest_0.6.37	BiocGenerics_0.52.0
[82]	ucminf_1.2.2	ggrepel_0.9.6	rjson_0.2.23
[85]	farver_2.1.2	htmltools_0.5.8.1	lifecycle_1.0.4
[88]	GlobalOptions_0.1.2	MASS_7.3-61	