

```

# Ketan Dilip Attarde
# Registration number: 24-27-06
# echelon form
def echelon_form(matrix):
    rows = len(matrix)
    cols = len(matrix[0])

    # Iterate through each column
    for i in range(min(rows, cols)):
        # Find the pivot element (non-zero) in the current column
        if matrix[i][i] == 0:
            for j in range(i+1, rows):
                if matrix[j][i] != 0:
                    # Swap rows to get a non-zero pivot
                    matrix[i], matrix[j] = matrix[j], matrix[i]
                    break

        # If the pivot is still zero, skip this column
        if matrix[i][i] == 0:
            continue

        # Normalize the pivot row
        pivot = matrix[i][i]
        for j in range(i, cols):
            matrix[i][j] /= pivot

        # Eliminate the other rows
        for j in range(i+1, rows):
            factor = matrix[j][i]
            for k in range(i, cols):
                matrix[j][k] -= factor * matrix[i][k]

    return matrix

# Example usage
matrix = [
    [2, 1, -1, 1],
    [1, 2, 1, 1],
    [1, 1, 1, 1],
    [1, 1, 1, 1]
]

```

Release notes ✕

...

Please follow our [blog](#) to see more information about new features, tips and tricks, and featured notebooks such as [Analyzing a Bank Failure with Colab](#).

2024-08-20

- TPU memory usage and utilization can now be checked with `!tpu-info`
- Gemini Chat responses are now grounded in relevant sources
- Added a new "Create Gemini API key" link in the user secrets panel
- Added a new "Gemini: Creating a prompt" snippet and touched up the existing "Gemini: Connecting to Gemini" snippet
- Added the ability to specify custom placeholder text for various interactive form params (see [examples](#))
- Keyboard navigation a11y improvements to comments UI
- Various minor rendering improvements to interactive forms UI
- A11y improvements for the run button and header
- Updated tooltip styling
- A11y improvements for the file browser's disk usage bar
- On mobile, tooltips now trigger on long press
- On mobile, release notes updates will no longer display automatically
- Python package upgrades
 - astropy 5.3.4 -> 6.1.2
 - bigframes 1.11.1 -> 1.14.0
 - bokeh 3.3.4 -> 3.4.3
 - dask 2023.8.1 -> 2024.7.1
 - earthengine-api 0.1.412 -> 0.1.416

```

    [-2, 1, 2, 3]
]

print("Matrix Before Converting:")
print(matrix)
print()
echelon_matrix = echelon_form(matrix)
print("After Converting to Row Echelon Form:")
for row in echelon_matrix:
    print(row)

```

⇒ Matrix Before Converting:
 [[2, 1, -1, -1], [-3, -1, 2, 2], [-2, 1, 2, 3]]

After Converting to Row Echelon Form:
 [1.0, 0.5, -0.5, -0.5]
 [0.0, 1.0, 1.0, 1.0]
 [0.0, 0.0, 1.0, -0.0]

```

# solving a system of linear equation
def print_system(a, b):
    n = len(b)
    for i in range(n):
        row = ["{:+5.2f}".format(a[i][j]) for j in range(len(a[i]))]
        print(" ".join(row), " | {:+5.2f}".format(b[i]))
    print()

def rref(a, b):
    n = len(a)
    m = len(a[0])

    row = 0
    for col in range(m):
        if row >= n:

```

- geopandas 0.13.2 -> 0.14.4
- kagglehub 0.2.8 -> 0.2.9
- keras 2.15.0 -> 3.4.1
- lightgbm 4.1.0 -> 4.4.0
- malloy 2023.1067 -> 2024.1067
- numba 0.58.1 -> 0.60.0
- numpy 1.25.2 -> 1.26.4
- opencv-python 4.8.0.76 -> 4.10.0.84
- pandas 2.0.3 -> 2.1.4
- pandas-gbq 0.19.2 -> 0.23.1
- panel 1.3.8 -> 1.4.5
- requests 2.31.0 -> 2.32.3
- scikit-learn 1.2.2 -> 1.3.2
- scipy 1.11.4 -> 1.13.1
- tensorboard 2.15.2 -> 2.17.0
- tensorflow 2.15.0 -> 2.17.0
- tf-keras 2.15.1 -> 2.17.0
- xarray 2023.7.0 -> 2024.6.0
- xgboost 2.0.3 -> 2.1.1

- Python package inclusions
 - einops 0.8.0

2024-07-22

- You can now embed Google sheets directly into Colab to streamline interactions with data with InteractiveSheet.

Example:

```

from google.colab import sheets
sh = sheets.InteractiveSheet()
df = sh.as_df()

```

- Fixed multiple rendering bugs in cell editors with wide text content (i.e. text is no longer hidden or clipped)
- Fixed multiple accessibility issues in Colab's comments feature (e.g. proper keyboard focus management, added accessibility landmarks, etc)
- Fixed bug where AI code generation would fail for extremely long broken code snippets

```

        break

    max_row = row
    for r in range(row + 1, n):
        if abs(a[r][col]) > abs(a[max_row][col]):
            max_row = r

    if abs(a[max_row][col]) < 1e-12:
        continue
    a[row], a[max_row] = a[max_row], a[row]
    b[row], b[max_row] = b[max_row], b[row]

    pivot = a[row][col]
    for j in range(col, m):
        a[row][j] /= pivot
        b[row] /= pivot

    for r in range(n):
        if r != row:
            factor = a[r][col]
            for j in range(col, m):
                a[r][j] -= factor * a[row][j]
                b[r] -= factor * b[row]

    row += 1

return a, b

def solve_from_rref(a, b):

    n = len(b)
    m = len(a[0])
    for i in range(n):
        if all(abs(a[i][j]) < 1e-12 for j in range(m)) and abs(b[i]) > 1e-12:

```

- Fixed multiple scrollbar bugs in the user secrets panel
- Added the ability for workspace admin to purchase Colab Pro and Pro+ Subscriptions for users
- Fixed bug where user secrets couldn't be moved to a tab
- Fixed several focus management accessibility issues in tabs, the table of contents, the left toolbar, and the run button
- Fixed bug where overflowing cells may be omitted when pasting from Google Sheets
- Fixed bug where the generate code button did not activate on touch
- Python package upgrades
 - bigframes 1.9.0 -> 1.11.1
 - cvxpy 1.3.4 -> 1.5.2
 - earthengine-api 0.1.408 -> 0.1.412
 - google-api-core 2.11.1 -> 2.19.1
 - google-api-python-client 2.84.0 -> 2.137.0
 - google-cloud-aiplatform 1.56.0 -> 1.59.0
 - google-cloud-bigquery 3.21.0 -> 3.25.0
 - google-cloud-core 2.3.3 -> 2.4.1
 - google-cloud-datastore 2.15.2 -> 2.19.0
 - google-cloud-firestore 2.11.1 -> 2.16.1
 - google-cloud-functions 1.13.3 -> 1.16.4
 - google-generativeai 0.5.4 -> 0.7.2
 - kagglehub 0.2.5 -> 0.2.8
 - pip 23.1.2 -> 24.1.2
 - setuptools 67.7.2 -> 71.0.4
 - sympy 1.12.1 -> 1.13.1
 - torch 2.3.0 -> 2.3.1
 - transformers 4.41.2 -> 4.42.4
- Python package inclusions
 - accelerate 0.32.1

2024-06-18

```

        return "No solution"
    if all(abs(a[i][j]) < 1e-12 for j in range(m)) and abs(b[i]) < 1e-12:
        return "Infinite solutions"

    return b

# Example systems to solve
a1 = [[2, 3, 1],
      [4, 1, -3],
      [-6, 2, 2]]
b1 = [1, 2, -3]

a2 = [[1, -2, 1],
      [2, -4, 2],
      [-1, 2, -1]]
b2 = [0, 0, 0]

a3 = [[1, -2, 1],
      [2, -4, 2],
      [-1, 2, 1]]
b3 = [0, 1, 0]

# Solving system 1
print("\nOriginal System 1:")
print_system(a1, b1)
a_rref, b_rref = rref(a1, b1)
print("\nRREF of System 1:")
print_system(a_rref, b_rref)
solution = solve_from_rref(a_rref, b_rref)
print("\nSolution to System 1:", solution)

# Solving system 2
print("\nOriginal System 2:")
print_system(a2, b2)
a_rref, b_rref = rref(a2, b2)
print("\nRREF of System 2:")
print_system(a_rref, b_rref)
solution = solve_from_rref(a_rref, b_rref)

```

- Inline AI completions are now available to users on the free-of-charge tier
- Reduced latency for LSP and terminal connections
- Improved quality of inline completions
- Visual improvements to switch controls across Colab
- Various bug fixes, performance and a11y improvements to the user secrets panel
- Improved tooltip UX behavior
- Improved behavior when copying data from Google Sheets and pasting in Colab
- Scroll to cell fixes for single tabbed view and jump to cell command
- Improved tab header behavior
- A11y improvements for notebook-focused cells
- Python package upgrades
 - torch 2.2.1 -> 2.3.0
 - torchaudio 2.2.1 -> 2.3.0
 - torchvision 0.17.1 -> 0.18.0
 - torchtext 0.17.1 -> 0.18.0
 - google-cloud-aiplatform 1.51.0 -> 1.56.0
 - bigframes 1.5.0 -> 1.8.0
 - regex 2023.12.25 -> 2024.5.15

2024-05-13

- Code actions are now supported to automatically improve and refactor code. Code actions can be triggered by the keyboard shortcut "Ctrl/⌘ + ."
- Python package upgrades
 - bigframes 1.0.0 -> 1.5.0
 - google-cloud-aiplatform 1.47.0 -> 1.51.0
 - jax[tpu] 0.4.23 -> 0.4.26
- Python package inclusions
 - cudf 24.4.1

```
print("\nSolution to System 2:", solution)

# Solving system 3
print("\nOriginal System 3:")
print_system(a3, b3)
a_rref, b_rref = rref(a3, b3)
print("\nRREF of System 3:")
print_system(a_rref, b_rref)
solution = solve_from_rref(a_rref, b_rref)
print("\nSolution to System 3:", solution)
```



Original System 1:

| | | | | |
|-------|-------|-------|--|-------|
| +2.00 | +3.00 | +1.00 | | +1.00 |
| +4.00 | +1.00 | -3.00 | | +2.00 |
| -6.00 | +2.00 | +2.00 | | -3.00 |

RREF of System 1:

| | | | | |
|-------|-------|-------|--|-------|
| +1.00 | +0.00 | +0.00 | | +0.50 |
| +0.00 | +1.00 | +0.00 | | +0.00 |
| +0.00 | +0.00 | +1.00 | | -0.00 |

Solution to System 1: [0.5, 0.0, -0.0]

Original System 2:

| | | | | |
|-------|-------|-------|--|-------|
| +1.00 | -2.00 | +1.00 | | +0.00 |
| +2.00 | -4.00 | +2.00 | | +0.00 |
| -1.00 | +2.00 | -1.00 | | +0.00 |

RREF of System 2:

| | | | | |
|-------|-------|-------|--|-------|
| +1.00 | -2.00 | +1.00 | | +0.00 |
| +0.00 | +0.00 | +0.00 | | +0.00 |
| +0.00 | +0.00 | +0.00 | | +0.00 |

Solution to System 2: Infinite solutions

2024-04-15

- TPU v2 runtime is now available
- L4 runtime is now available for paid users
- New distributed fine-tuning Gemma tutorial on TPUs ([GitHub](#))
- Symbol rename is now supported with keyboard shortcut F2
- Fixed bug causing inability to re-upload deleted files
- Fixed breaking bug in colabtools %upload_files_async
- Added syntax highlighting to %%writefile cells
- Cuda dependencies that come with Torch are cached for faster downloads for packages that require Torch and its dependencies ([GitHub issue](#))
- Python package upgrades
 - bigframes 0.24.0 -> 1.0.0
 - duckdb 0.9.2 -> 0.10.1
 - google-cloud-aiplatform 1.43.0 -> 1.47.0
 - jax 0.4.23 -> 0.4.26

2024-03-13

- Fixed bug that sometimes caused UserSecrets to move / disappear
- Improved messaging for mounting drive in an unsupported environment ([GitHub issue](#))
- Python package upgrades
 - torch 2.1.0 -> 2.2.1
 - torchaudio 2.1.0 -> 2.2.1
 - torchvision 0.16.0 -> 0.17.1
 - torchtext 0.16.0 -> 0.17.1
 - PyMC 5.7.2 -> 5.10.4
 - BigFrames 0.21.0 -> 0.24.0
 - google-cloud-aiplatform 1.42.1 -> 1.43.0
 - tornado 6.3.2 -> 6.3.3

2024-02-21

Original System 3:

| | | | | |
|-------|-------|-------|--|-------|
| +1.00 | -2.00 | +1.00 | | +0.00 |
| +2.00 | -4.00 | +2.00 | | +1.00 |
| -1.00 | +2.00 | +1.00 | | +0.00 |

RREF of System 3:

| | | | | |
|-------|-------|-------|--|-------|
| +1.00 | -2.00 | +0.00 | | +0.25 |
| +0.00 | +0.00 | +1.00 | | +0.25 |
| +0.00 | +0.00 | +0.00 | | -0.50 |

Solution to System 3: No solution

Start coding or [generate](#) with AI.

- Try out Gemma on [Colab](#)!
- Allow unicode in form text inputs
- Display documentation and link to source when displaying functions
- Display image-like ndarrays as images
- Improved UX around quick charts and execution error suggestions
- Released Marketplace image for the month of February ([GitHub issue](#))
- Python package upgrades
 - bigframes 0.19.2 -> 0.21.0
 - regex 2023.6.3 -> 2023.12.25
 - spacy 3.6.1 -> 3.7.4
 - beautifulsoup4 4.11.2 -> 4.12.3
 - tensorflow-probability 0.22.0 -> 0.23.0
 - google-cloud-language 2.9.1 -> 2.13.1
 - google-cloud-aiplatform 1.39.0 -> 1.42.1
 - transformers 4.35.2 -> 4.37.2
 - pyarrow 10.0.1 -> 14.0.2

2024-01-29

- New [Kaggle Notebooks <> Colab updates](#)! Now you can:
 - Import directly from Colab without having to download/re-upload
 - Upload via link, by pasting Google Drive or Colab URLs
 - Export & run Kaggle Notebooks on Colab with 1 click
- Try these notebooks that talk to Gemini:
 - [Gemini and Stable Diffusion](#)
 - [Learning with Gemini and ChatGPT](#)
 - [Talk to Gemini with Google's Speech to Text API](#)
 - [Sell lemonade with Gemini and Sheets](#)
 - [Generate images with Gemini and Vertex](#)
- Python package upgrades

- google-cloud-aiplatform 1.38.1 -> 1.39.0
- bigframes 0.18.0 -> 0.19.2
- polars 0.17.3 -> 0.20.2
- gdown 4.6.6 -> 4.7.3 ([GitHub issue](#))
- tensorflow-hub 0.15.0 -> 0.16.0
- flax 0.7.5 -> 0.8.0
- Python package inclusions
 - sentencepiece 0.1.99

2024-01-08

- Avoid nested scrollbars for large outputs by using `google.colab.output.no_vertical_scroll()`
[Example notebook](#)
- Fix [bug](#) where downloading models from Hugging Face could freeze
- Python package upgrades
 - huggingface-hub 0.19.4 -> 0.20.2
 - bigframes 0.17.0 -> 0.18.0

2023-12-18

- Expanded access to AI coding has arrived in Colab across 175 locales for all tiers of Colab users
- Improvements to display of ML-based inline completions (for eligible Pro/Pro+ users)
- Started a series of [notebooks](#) highlighting Gemini API capabilities
- Enable ⌘/Ctrl+L to select the full line in an editor
- Fixed [bug](#) where we weren't correctly formatting output from multiple execution results
- Python package upgrades
 - CUDA 11.8 to CUDA 12.2
 - tensorflow 2.14.0 -> 2.15.0
 - tensorboard 2.14.0 -> 2.15.0
 - keras 2.14.0 -> 2.15.0
 - Nvidia drivers 525.105.17 -> 535.104.05
 - tensorflow-gcs-config 2.14.0 -> 2.15.0

- bigframes 0.13.0 -> 0.17.0
- geemap 0.28.2 -> 0.29.6
- pyarrow 9.0.0 -> 10.0.1
- google-generativeai 0.2.2 -> 0.3.1
- jax 0.4.20 -> 0.4.23
- jaxlib 0.4.20 -> 0.4.23
- Python package inclusions
 - kagglehub 0.1.4
 - google-cloud-aiplatform 1.38.1

2023-11-27

- Removed warning when calling await to make it render as code
- Added "Run selection" to the cell context menu
- Added highlighting for the %%python cell magic
- Launched AI coding features for Pro/Pro+ users in more locales
- Python package upgrades
 - bigframes 0.12.0 -> 0.13.0
- Python package inclusions
 - transformers 4.35.2
 - google-generativeai 0.2.2

2023-11-08

- Launched Secrets, for safe storage of private keys on Colab ([tweet](#))
- Fixed issue where TensorBoard would not load ([#3990](#))
- Python package upgrades
 - lightgbm 4.0.0 -> 4.1.0
 - bigframes 0.10.0 -> 0.12.0
 - bokeh 3.2.2 -> 3.3.0
 - duckdb 0.8.1 -> 0.9.1
 - numba 0.56.4 -> 0.58.1
 - tweepy 4.13.0 -> 4.14.0
 - jax 0.4.16 -> 0.4.20

- jaxlib 0.4.16 -> 0.4.20

2023-10-23

- Updated the **Open notebook** dialog for better usability and support for smaller screen sizes
- Added smart paste support for data from Google Sheets for R notebooks
- Enabled showing release notes in a tab
- Launched AI coding features for Pro/Pro+ users in Australia AU Canada CA India IN and Japan JP ([tweet](#))
- Python package upgrades
 - earthengine-api 0.1.357 -> 0.1.375
 - flax 0.7.2 -> 0.7.4
 - geemap 0.27.4 -> 0.28.2
 - jax 0.4.14 -> 0.4.16
 - jaxlib 0.4.14 -> 0.4.16
 - keras 2.13.1 -> 2.14.0
 - tensorboard 2.13.0 -> 2.14.1
 - tensorflow 2.13.0 -> 2.14.0
 - tensorflow-gcs-config 2.13.0 -> 2.14.0
 - tensorflow-hub 0.14.0 -> 0.15.0
 - tensorflow-probability 0.20.1 -> 0.22.0
 - torch 2.0.1 -> 2.1.0
 - torchaudio 2.0.2 -> 2.1.0
 - torchtext 0.15.2 -> 0.16.0
 - torchvision 0.15.2 -> 0.16.0
 - xgboost 1.7.6 -> 2.0.0
- Python package inclusions
 - bigframes 0.10.0
 - malloy 2023.1056

2023-09-22

- Added the ability to scope an AI generated suggestion to a specific Pandas dataframe ([tweet](#))
- Added Colab link previews to Docs ([tweet](#))
- Added smart paste support for data from Google Sheets

- Increased font size of dropdowns in interactive forms
- Improved rendering of the notebook when printing
- Python package upgrades
 - tensorflow 2.12.0 -> 2.13.0
 - tensorboard 2.12.3 -> 2.13.0
 - keras 2.12.0 -> 2.13.1
 - tensorflow-gcs-config 2.12.0 -> 2.13.
 - scipy 1.10.1 -> 1.11.2
 - cython 0.29.6 -> 3.0.2
- Python package inclusions
 - geemap 0.26.0

2023-08-18

- Added "Change runtime type" to the menu in the connection button
- Improved auto-reconnection to an already running notebook ([#3764](#))
- Increased the specs of our highmem machines for Pro users
- Fixed add-apt-repository command on Ubuntu 22.04 runtime ([#3867](#))
- Python package upgrades
 - bokeh 2.4.3 -> 3.2.2
 - cmake 3.25.2 -> 3.27.2
 - cryptography 3.4.8 -> 41.0.3
 - dask 2022.12.1 -> 2023.8.0
 - distributed 2022.12.1 -> 2023.8.0
 - earthengine-api 0.1.358 -> 0.1.364
 - flax 0.7.0 -> 0.7.2
 - ipython-sql 0.4.0 -> 0.5.0
 - jax 0.4.13 -> 0.4.14
 - jaxlib 0.4.13 -> 0.4.14
 - lightgbm 3.3.5 -> 4.0.0
 - mkl 2019.0 -> 2023.2.0
 - notebook 6.4.8 -> 6.5.5
 - numpy 1.22.4 -> 1.23.5
 - opencv-python 4.7.0.72 -> 4.8.0.76
 - pillow 8.4.0 -> 9.4.0

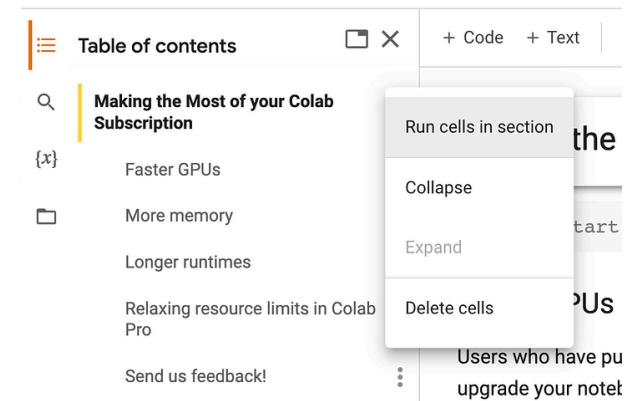
- plotly 5.13.1 -> 5.15.0
- prettytable 0.7.2 -> 3.8.0
- pytensor 2.10.1 -> 2.14.2
- spacy 3.5.4 -> 3.6.1
- statsmodels 0.13.5 -> 0.14.0
- xarray 2022.12.0 -> 2023.7.0
- Python package inclusions
 - PyDrive2 1.6.3

2023-07-21

- Launched auto-plotting for dataframes, available using the chart button that shows up alongside datatables ([post](#))



- Added a menu to the table of contents to support running a section or collapsing/expanding sections ([post](#))



- Added an option to automatically run the first cell or section, available under Edit -> Notebook settings ([post](#))

Notebook settings

Runtime type

Python 3 ▾

Hardware accelerator

None ▾ ?

- ☒ Automatically run the first cell or section
- ☐ Omit code cell output when saving this notebook

Cancel Save

- Launched Pro/Pro+ to Algeria, Argentina, Chile, Ecuador, Egypt, Ghana, Kenya, Malaysia, Nepal, Nigeria, Peru, Rwanda, Saudi Arabia, South Africa, Sri Lanka, Tunisia, and Ukraine ([tweet](#))
- Added a command, "Toggle tab moves focus" for toggling tab trapping in the editor (Tools -> Command palette, "Toggle tab moves focus")
- Fixed issue where `files.upload()` was sometimes returning an incorrect filename ([#1550](#))
- Fixed f-string syntax highlighting bug ([#3802](#))
- Disabled ambiguous characters highlighting for commonly used LaTeX characters ([#3648](#))
- Upgraded Ubuntu from 20.04 LTS to [22.04 LTS](#)
- Updated the Colab Marketplace VM image
- Python package upgrades:
 - autograd 1.6.1 -> 1.6.2
 - drivefs 76.0 -> 77.0
 - flax 0.6.11 -> 0.7.0
 - earthengine-api 0.1.357 -> 0.1.358
 - GDAL 3.3.2->3.4.3
 - google-cloud-bigquery-storage 2.20.0 -> 2.22.2
 - gspread-dataframe 3.0.8 -> 3.3.1
 - holidays 0.27.1 -> 0.29
 - jax 0.4.10 -> jax 0.4.13
 - jaxlib 0.4.10 -> jax 0.4.13
 - jupyterlab-widgets 3.0.7 -> 3.0.8
 - nbformat 5.9.0 -> 5.9.1
 - opencv-python-headless 4.7.0.72 -> 4.8.0.74
 - pygame 2.4.0 -> 2.5.0

- spacy 3.5.3 -> 3.5.4
- SQLAlchemy 2.0.16 -> 2.0.19
- tabulate 0.8.10 -> 0.9.0
- tensorflow-hub 0.13.0 -> 0.14.0

2023-06-23

- Launched AI coding features to subscribed users starting with Pro+ users in the US ([tweet](#), [post](#))
- Added the Kernel Selector in the Notebook Settings ([tweet](#))
- Fixed double space trimming issue in markdown [#3766](#)
- Fixed run button indicator not always centered [#3609](#)
- Fixed inconsistencies for automatic indentation on multi-line [#3697](#)
- Upgraded Python from 3.10.11 to 3.10.12
- Python package updates:
 - duckdb 0.7.1 -> 0.8.1
 - earthengine-api 0.1.350 -> 0.1.357
 - flax 0.6.9 -> 0.6.11
 - google-cloud-bigquery 3.9.0 -> 3.10.0
 - google-cloud-bigquery-storage 2.19.1 -> 2.20.0
 - grpcio 1.54.0 -> 1.56.0
 - holidays 0.25 -> 0.27.1
 - nbformat 5.8.0 -> 5.9.0
 - prophet 1.1.3 -> 1.1.4
 - pydata-google-auth 1.7.0 -> 1.8.0
 - spacy 3.5.2 -> 3.5.3
 - tensorboard 2.12.2 -> 2.12.3
 - xgboost 1.7.5 -> 1.7.6
- Python package inclusions:
 - gcsfs 2023.6.0
 - geopandas 0.13.2
 - google-cloud-bigquery-connection 1.12.0
 - google-cloud-functions 1.13.0
 - grpc-google-iam-v1 0.12.6
 - multidict 6.0.4

- tensorboard-data-server 0.7.1

2023-06-02

- Released the new site colab.google
- Published Colab's Docker runtime image to us-docker.pkg.dev/colab-images/public/runtime ([tweet](#) [instructions](#))
- Launched support for Google children accounts ([tweet](#))
- Launched DagsHub integration ([tweet](#), [post](#))
- Upgraded to Monaco Editor Version 0.37.1
- Fixed various Vim keybinding bugs
- Fixed issue where the N and P letters sometimes couldn't be typed ([#3664](#))
- Fixed rendering support for compositional inputs ([#3660](#), [#3679](#))
- Fixed lag in notebooks with lots of cells ([#3676](#))
- Improved support for R by adding a Runtime type notebook setting (Edit -> Notebook settings)
- Improved documentation for connecting to a local runtime (Connect -> Connect to a local runtime)
- Python package updates:
 - holidays 0.23 -> 0.25
 - jax 0.4.8 -> 0.4.10
 - jaxlib 0.4.8 -> 0.4.10
 - pip 23.0.1 -> 23.1.2
 - tensorflow-probability 0.19.0 -> 0.20.1
 - torch 2.0.0 -> 2.0.1
 - torchaudio 2.0.1 -> 2.0.2
 - torchdata 0.6.0 -> 0.6.1
 - torchtext 0.15.1 -> 0.15.2
 - torchvision 0.15.1 -> 0.15.2
 - tornado 6.2 -> 6.3.1

2023-05-05

- Released GPU type selection for paid users, allowing them to choose a preferred NVidia GPU
- Upgraded R from 4.2.3 to 4.3.0
- Upgraded Python from 3.9.16 to 3.10.11
- Python package updates:

- attrs 22.2.0 -> attrs 23.1.0
- earthengine-api 0.1.349 -> earthengine-api 0.1.350
- flax 0.6.8 -> 0.6.9
- grpcio 1.53.0 -> 1.54.0
- nbclient 0.7.3 -> 0.7.4
- tensorflow-datasets 4.8.3 -> 4.9.2
- termcolor 2.2.0 -> 2.3.0
- zict 2.2.0 -> 3.0.0

2023-04-14

- Python package updates:
 - google-api-python-client 2.70.0 -> 2.84.0
 - google-auth-oauthlib 0.4.6 -> 1.0.0
 - google-cloud-bigquery 3.4.2 -> 3.9.0
 - google-cloud-datastore 2.11.1 -> 2.15.1
 - google-cloud-firestore 2.7.3 -> 2.11.0
 - google-cloud-language 2.6.1 -> 2.9.1
 - google-cloud-storage 2.7.0 -> 2.8.0
 - google-cloud-translate 3.8.4 -> 3.11.1
 - networkx 3.0 -> 3.1
 - notebook 6.3.0 -> 6.4.8
 - jax 0.4.7 -> 0.4.8
 - pandas 1.4.4 -> 1.5.3
 - spacy 3.5.1 -> 3.5.2
 - SQLAlchemy 1.4.47 -> 2.0.9
 - xgboost 1.7.4 -> 1.7.5

2023-03-31

- Improve bash ! syntax highlighting ([GitHub issue](#))
- Fix bug where VIM keybindings weren't working in the file editor
- Upgraded R from 4.2.2 to 4.2.3
- Python package updates:
 - arviz 0.12.1 -> 0.15.1
 - astropy 4.3.1 -> 5.2.2
 - dopamine-rl 1.0.5 -> 4.0.6
 - gensim 3.6.0 -> 4.3.1
 - ipykernel 5.3.4 -> 5.5.6

- ipython 7.9.0 -> 7.34.0
- jax 0.4.4 -> 0.4.7
- jaxlib 0.4.4 -> 0.4.7
- jupyter_core 5.2.0 -> 5.3.0
- keras 2.11.0 -> 2.12.0
- lightgbm 2.2.3 -> 3.3.5
- matplotlib 3.5.3 -> 3.7.1
- nltk 3.7 -> 3.8.1
- opencv-python 4.6.0.66 -> 4.7.0.72
- plotly 5.5.0 -> 5.13.1
- pymc 4.1.4 -> 5.1.2
- seaborn 0.11.2 -> 0.12.2
- spacy 3.4.4 -> 3.5.1
- sympy 1.7.1 -> 1.11.1
- tensorboard 2.11.2 -> 2.12.0
- tensorflow 2.11.0 -> 2.12.0
- tensorflow-estimator 2.11.0 -> 2.12.0
- tensorflow-hub 0.12.0 -> 0.13.0
- torch 1.13.1 -> 2.0.0
- torchaudio 0.13.1 -> 2.0.1
- torchtext 0.14.1 -> 0.15.1
- torchvision 0.14.1 -> 0.15.1

2023-03-10

- Added the [Colab editor shortcuts](#) example notebook
- Fixed triggering of @-mention and email autocomplete for large comments ([GitHub issue](#))
- Added View Resources to the Runtime menu
- Made file viewer images fit the view by default, resizing to original size on click
- When in VIM mode, enable copy as well as allowing propagation to monaco-vim to escape visual mode ([GitHub issue](#))
- Upgraded CUDA 11.6.2 -> 11.8.0 and cuDNN 8.4.0.27 -> 8.7.0.84
- Upgraded Nvidia drivers 525.78.01 -> 530.30.02
- Upgraded Python 3.8.10 -> 3.9.16
- Python package updates:
 - beautifulsoup4 4.6.3 -> 4.9.3
 - bokeh 2.3.3 -> 2.4.3

- debugpy 1.0.0 -> 1.6.6
- Flask 1.1.4 -> 2.2.3
- jax 0.3.25 -> 0.4.4
- jaxlib 0.3.25 -> 0.4.4
- Jinja2 2.11.3 -> 3.1.2
- matplotlib 3.2.2 -> 3.5.3
- nbconvert 5.6.1 -> 6.5.4
- pandas 1.3.5 -> 1.4.4
- pandas-datareader 0.9.0 -> 0.10.0
- pandas-profiling 1.4.1 -> 3.2.0
- Pillow 7.1.2 -> 8.4.0
- plotnine 0.8.0 -> 0.10.1
- scikit-image 0.18.3 -> 0.19.3
- scikit-learn 1.0.2 -> 1.2.2
- scipy 1.7.3 -> 1.10.1
- setuptools 57.4.0 -> 63.4.3
- sklearn-pandas 1.8.0 -> 2.2.0
- statsmodels 0.12.2 -> 0.13.5
- urllib3 1.24.3 -> 1.26.14
- Werkzeug 1.0.1 -> 2.2.3
- wrapt 1.14.1 -> 1.15.0
- xgboost 0.90 -> 1.7.4
- xlrd 1.2.0 -> 2.0.1

2023-02-17

- Show graphs of RAM and disk usage in notebook toolbar
- Copy cell links directly to the clipboard instead of showing a dialog when clicking on the link icon in the cell toolbar
- Updated the [Colab Marketplace VM image](#)
- Upgraded CUDA to 11.6.2 and cuDNN to 8.4.0.27
- Python package updates:
 - tensorflow 2.9.2 -> 2.11.0
 - tensorboard 2.9.1 -> 2.11.2
 - keras 2.9.0 -> 2.11.0
 - tensorflow-estimator 2.9.0 -> 2.11.0
 - tensorflow-probability 0.17.0 -> 0.19.0
 - tensorflow-gcs-config 2.9.0 -> 2.11.0
 - earthengine-api 0.1.339 -> 0.1.341

- flatbuffers 1.12 -> 23.1.21
- platformdirs 2.6.2 -> 3.0.0
- pydata-google-auth 1.6.0 -> 1.7.0
- python-utils 3.4.5 -> 3.5.2
- tenacity 8.1.0 -> 8.2.1
- tiff file 2023.1.23.1 -> 2023.2.3
- notebook 5.7.16 -> 6.3.0
- tornado 6.0.4 -> 6.2
- aiohttp 3.8.3 -> 3.8.4
- charset-normalizer 2.1.1 -> 3.0.1
- fastai 2.7.0 -> 2.7.1
- soundfile 0.11.0 -> 0.12.1
- typing-extensions 4.4.0 -> 4.5.0
- widgetsnbextension 3.6.1 -> 3.6.2
- pydantic 1.10.4 -> 1.10.5
- zipp 3.12.0 -> 3.13.0
- numpy 1.21.6 -> 1.22.4
- drivefs 66.0 -> 69.0
- gdal 3.0.4 -> 3.3.2 [GitHub issue](#)
- Added libudunits2-dev for smoother R package installs [GitHub issue](#)

2023-02-03

- Improved tooltips for pandas series to show common statistics about the series object
- Made the forms dropdown behave like an autocomplete box when it allows input
- Updated the nvidia driver from 460.32.03 to 510.47.03
- Python package updates:
 - absl-py 1.3.0 -> 1.4.0
 - bleach 5.0.1 -> 6.0.0
 - cachetools 5.2.1 -> 5.3.0
 - cmdstanpy 1.0.8 -> 1.1.0
 - dnspython 2.2.1 -> 2.3.0
 - fsspec 2022.11.0 -> 2023.1.0
 - google-cloud-bigquery-storage 2.17.0 -> 2.18.1
 - holidays 0.18 -> 0.19
 - jupyter-core 5.1.3 -> 5.2.0

- packaging 21.3 -> 23.0
- prometheus-client 0.15.0 -> 0.16.0
- pyct 0.4.8 -> 0.5.0
- pydata-google-auth 1.5.0 -> 1.6.0
- python-slugify 7.0.0 -> 8.0.0
- sqlalchemy 1.4.46 -> 2.0.0
- tensorflow-io-gcs-filesystem 0.29.0 -> 0.30.0
- tiffio 2022.10.10 -> 2023.1.23.1
- zipp 3.11.0 -> 3.12.0
- Pinned sqlalchemy to version 1.4.46

2023-01-12

- Added support for @-mention and email autocomplete in comments
- Improved errors when GitHub notebooks can't be loaded
- Increased color contrast for colors used for syntax highlighting in the code editor
- Added terminal access for custom GCE VM runtimes
- Upgraded Ubuntu from 18.04 LTS to 20.04 LTS ([GitHub issue](#))
- Python package updates:
 - GDAL 2.2.2 -> 2.2.3.
 - NumPy from 1.21.5 to 1.21.6.
 - attrs 22.1.0 -> 22.2.0
 - chardet 3.0.4 -> 4.0.0
 - cloudpickle 1.6.0 -> 2.2.0
 - filelock 3.8.2 -> 3.9.0
 - google-api-core 2.8.2 -> 2.11.0
 - google-api-python-client 1.12.11 -> 2.70.0
 - google-auth-http2 0.0.3 -> 0.1.0
 - google-cloud-bigquery 3.3.5 -> 3.4.1
 - google-cloud-datastore 2.9.0 -> 2.11.0
 - google-cloud-firestore 2.7.2 -> 2.7.3
 - google-cloud-storage 2.5.0 -> 2.7.0
 - holidays 0.17.2 -> holidays 0.18
 - importlib-metadata 5.2.0 -> 6.0.0
 - networkx 2.8.8 -> 3.0
 - opencv-python-headless 4.6.0.66 -> 4.7.0.68

- pip 21.1.3 -> 22.04
- pip-tools 6.2.0 -> 6.6.2
- prettytable 3.5.0 -> 3.6.0
- requests 2.23.0 -> 2.25.1
- termcolor 2.1.1 -> 2.2.0
- torch 1.13.0 -> 1.13.1
- torchaudio 0.13.0 -> 0.13.1
- torchtext 0.14.0 -> 0.14.1
- torchvision 0.14.0 -> 0.14.1

2022-12-06

- Made fallback runtime version available until mid-December ([GitHub issue](#))
- Upgraded to Python 3.8 ([GitHub issue](#))
- Python package updates:
 - jax from 0.3.23 to 0.3.25, jaxlib from 0.3.22 to 0.3.25
 - pyarrow from 6.0.1 to 9.0.0
 - torch from 1.12.1 to 1.13.0
 - torchaudio from 0.12.1 to 0.13.0
 - torchvision from 0.13.1 to 0.14.0
 - torchtext from 0.13.1 to 0.14.0
 - xlrd from 1.1.0 to 1.2.0
 - DriveFS from 62.0.1 to 66.0.3
- Made styling of markdown tables in outputs match markdown tables in text cells
- Improved formatting for empty interactive table rows
- Fixed syntax highlighting for variables with names that contain Python keywords ([GitHub issue](#))

2022-11-11

- Added more dark editor themes for Monaco (when in dark mode, "Editor colorization" appears as an option in the Editor tab of the Tools → Settings dialog)
- Fixed bug where collapsed forms were deleted on mobile [GitHub issue](#)
- Python package updates:

- rpy2 from 3.4.0 to 3.5.5 ([GitHub issue](#))
- notebook from 5.5.0 to 5.7.16
- tornado from 5.1.1 to 6.0.4
- tensorflow_probability from 0.16.0 to 0.17.0
- pandas-gbq from 0.13.3 to 0.17.9
- protobuf from 3.17.3 to 3.19.6
- google-api-core[grpc] from 1.31.5 to 2.8.2
- google-cloud-bigquery from 1.21.0 to 3.3.5
- google-cloud-core from 1.0.1 to 2.3.2
- google-cloud-datastore from 1.8.0 to 2.9.0
- google-cloud-firestore from 1.7.0 to 2.7.2
- google-cloud-language from 1.2.0 to 2.6.1
- google-cloud-storage from 1.18.0 to 2.5.0
- google-cloud-translate from 1.5.0 to 3.8.4

2022-10-21

- Launched a single-click way to get from BigQuery to Colab to further explore query results ([announcement](#))
- Launched [Pro, Pro+, and Pay As You Go](#) to 19 additional countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, Greece, Hungary, Latvia, Lithuania, Norway, Portugal, Romania, Slovakia, Slovenia, and Sweden ([tweet](#))
- Updated jax from 0.3.17 to 0.3.23, jaxlib from 0.3.15 to 0.3.22, TensorFlow from 2.8.2 to 2.9.2, CUDA from 11.1 to 11.2, and cuDNN from 8.0 to 8.1 ([backend-info](#))
- Added a readonly option to [drive.mount](#)
- Fixed bug where Xarray was not working ([GitHub issue](#))
- Modified Markdown parsing to ignore block quote symbol within MathJax ([GitHub issue](#))

2022-09-30

- Launched [Pay As You Go](#), allowing premium GPU access without requiring a subscription
- Added vim and tcclib to our runtime image
- Fixed bug where open files were closed on kernel disconnect ([GitHub issue](#))

- Fixed bug where the play button/execution indicator was not clickable when scrolled into the cell output ([GitHub issue](#))
- Updated the styling for form titles so that they avoid obscuring the code editor
- Created a GitHub repo, [backend-info](#), with the latest apt-list.txt and pip-freeze.txt files for the Colab runtime ([GitHub issue](#))
- Added `files.upload_file(filename)` to upload a file from the browser to the runtime with a specified filename

2022-09-16

- Upgraded pymc from 3.11.0 to 4.1.4, jax from 0.3.14 to 0.3.17, jaxlib from 0.3.14 to 0.3.15, fsspec from 2022.8.1 to 2022.8.2
- Modified our save flow to avoid persisting Drive filenames as titles in notebook JSON
- Updated our [Terms of Service](#)
- Modified the `Jump to Cell` command to locate the cursor at the end of the command palette input (`Jump to cell` in Tools → Command palette in a notebook with section headings)
- Updated the styling of the Drive notebook comment UI
- Added support for terminating your runtime from code: `python from google.colab import runtime runtime.unassign()`
- Added regex filter support to the Recent notebooks dialog
- Inline `google.colab.files.upload JS` to fix `files.upload()` not working ([GitHub issue](#))

2022-08-26

- Upgraded PyYAML from 3.13 to 6.0 ([GitHub issue](#)), drivefs from 61.0.3 to 62.0.1
- Upgraded TensorFlow from 2.8.2 to 2.9.1 and ipywidgets from 7.7.1 to 8.0.1 but rolled both back due to a number of user reports ([GitHub issue](#), [GitHub issue](#))

- Stop persisting inferred titles in notebook JSON ([GitHub issue](#))
- Fix bug in background execution which affected some Pro+ users ([GitHub issue](#))
- Fix bug where Download as .py incorrectly handled text cells ending in a double quote
- Fix bug for Pro and Pro+ users where we weren't honoring the preference (Tools → Settings) to use a temporary scratch notebook as the default landing page
- Provide undo/redo for scratch cells
- When writing ipynb files, serialize empty multiline strings as [] for better consistency with JupyterLab

2022-08-11

- Upgraded ipython from 5.5.0 to 7.9.0, fbprophet 0.7 to prophet 1.1, tensorflow-datasets from 4.0.1 to 4.6.0, drivefs from 60.0.2 to 61.0.3, pytorch from 1.12.0 to 1.12.1, numba from 0.51 to 0.56, and lxml from 4.2.0 to 4.9.1
- Loosened our requests version requirement ([GitHub issue](#))
- Removed support for TensorFlow 1
- Added Help → Report Drive abuse for Drive notebooks
- Fixed indentation for Python lines ending in [
- Modified styling of tables in Markdown to left-align them rather than centering them
- Fixed special character replacement when copying interactive tables as Markdown
- Fixed ansi 8-bit color parsing ([GitHub issue](#))
- Configured logging to preempt transitive imports and other loading from implicitly configuring the root logger
- Modified forms to use a value of None instead of causing a parse error when clearing raw and numeric-typed form fields

2022-07-22

- Update scipy from 1.4.1 to 1.7.3, drivefs from 59.0.3 to 60.0.2, pytorch from 1.11 to 1.12, jax & jaxlib from 0.3.8 to 0.3.14, opencv-python from 4.1.2.30 to 4.6.0.66, spaCy from 3.3.1 to 3.4.0, and dlib from 19.18.0 to 19.24.0
- Fix Open in tab doc link which was rendering incorrectly ([GitHub issue](#))
- Add a preference for the default tab orientation to the Site section of the settings menu under Tools → Settings
- Show a warning for USE_AUTH_EPHEM usage when running authenticate_user on a TPU runtime ([code](#))

2022-07-01

- Add a preference for code font to the settings menu under Tools → Settings
- Update drivefs from 58.0.3 to 59.0.3 and spacy from 2.2.4 to 3.3.1
- Allow [display_data](#) and [execute_result](#) text outputs to wrap, matching behavior of JupyterLab (does not affect stream outputs/print statements).
- Improve LSP handling of some magics, esp. %%writefile ([GitHub issue](#)).
- Add a [FAQ entry](#) about the mount Drive button behavior and include link buttons for each FAQ entry
- Fix bug where the notebook was sometimes hidden behind other tabs on load when in single pane view.
- Fix issue with inconsistent scrolling when an editor is in multi-select mode.
- Fix bug where clicking on a link in a form would navigate away from the notebook
- Show a confirmation dialog before performing Replace all from the Find and replace pane.

2022-06-10

- Update drivefs from 57.0.5 to 58.0.3 and tensorflow from 2.8.0 to 2.8.2
- Support more than 100 repos in the GitHub repo selector shown in the open dialog and the clone to GitHub dialog

- Show full notebook names on hover in the open dialog
- Improve the color contrast for links, buttons, and the ipywidgets.Accordion widget in dark mode

2022-05-20

- Support URL params for linking to some common pref settings: [force_theme=dark](#), [force_corgi_mode=1](#), [force_font_size=14](#). Params forced by URL are not persisted unless saved using Tools → Settings.
- Add a class markdown-google-sans to allow Markdown to render in Google Sans
- Update monaco-vim from 0.1.19 to 0.3.4
- Update drivefs from 55.0.3 to 57.0.5, jax from 0.3.4 to 0.3.8, and jaxlib from 0.3.2 to 0.3.7

2022-04-29

- Added 🦀 mode (under Miscellaneous in Tools → Settings)
- Added "Disconnect and delete runtime" option to the menu next to the Connect button
- Improved rendering of filter options in an interactive table
- Added git-lfs to the base image
- Updated torch from 1.10.0 to 1.11.0, jupyter-core from 4.9.2 to 4.10.0, and cmake from 3.12.0 to 3.22.3
- Added more details to our [FAQ](#) about unsupported uses (using proxies, downloading torrents, etc.)
- Fixed [issue](#) with apt-get dependencies

2022-04-15

- Add an option in the file browser to show hidden files.
- Upgrade gdown from 4.2.0 to 4.4.0, google-api-core[grpc] from 1.26.0 to 1.31.5, and pytz from 2018.4 to 2022.1

2022-03-25

- Launched [Pro/Pro+](#) to 12 additional countries: Australia, Bangladesh, Colombia, Hong Kong, Indonesia, Mexico, New Zealand, Pakistan, Philippines, Singapore, Taiwan, and Vietnam
- Added [google.colab.auth.authenticate_service_account](#) to support using [Service Account keys](#)
- Update jax from 0.3.1 to 0.3.4 & jaxlib from 0.3.0 to 0.3.2
- Fixed an issue with Twitter previews of notebooks shared as GitHub Gists

2022-03-10

- Launched [Pro/Pro+](#) to 10 new countries: Ireland, Israel, Italy, Morocco, the Netherlands, Poland, Spain, Switzerland, Turkey, and the United Arab Emirates
- Launched support for [scheduling notebooks for Pro+ users](#)
- Fixed bug in interactive datatables where filtering by number did not work
- Finished removing the python2 kernelspec

2022-02-25

- Made various accessibility improvements to the header
- Fix bug with [forms run:auto](#) where a form field change would trigger multiple runs
- Minor updates to the [bigquery example notebook](#) and snippet
- Include background execution setting in the sessions dialog for Pro+ users
- Update tensorflow-probability from 0.15 to 0.16
- Update jax from 0.2.25 to 0.3.1 & jaxlib from 0.1.71 to 0.3.0

2022-02-11

- Improve keyboard navigation for the open dialog

- Fix issue where nvidia-smi stopped reporting resource utilization for some users who were modifying the version of nvidia used
- Update tensorflow from 2.7 to 2.8, keras from 2.7 to 2.8, numpy from 1.19.5 to 1.21.5, tables from 3.4.4 to 3.7.0

2022-02-04

- Improve UX for opening content alongside your notebook, such as files opened from the file browser. This includes a multi-pane view and drag-drop support
- Better Twitter previews when sharing example Colab notebooks and notebooks opened from GitHub Gists
- Update pandas from 1.1.5 to 1.3.5
- Update openpyxl from 2.5.9 to 3.0.0 and pyarrow from 3.0.0 to 6.0.0
- Link to the release notes from the Help menu

2022-01-28

- Add a copy button to [data tables](#)
- Python LSP support for better completions and code