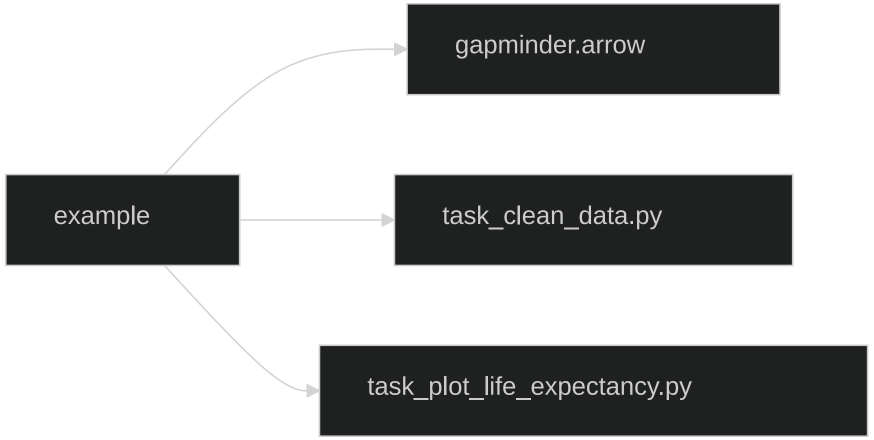
Effective Programming Practices for Economists

Reproducible Research

What does pytask do?

Janoś Gabler and Hans-Martin von Gaudecker

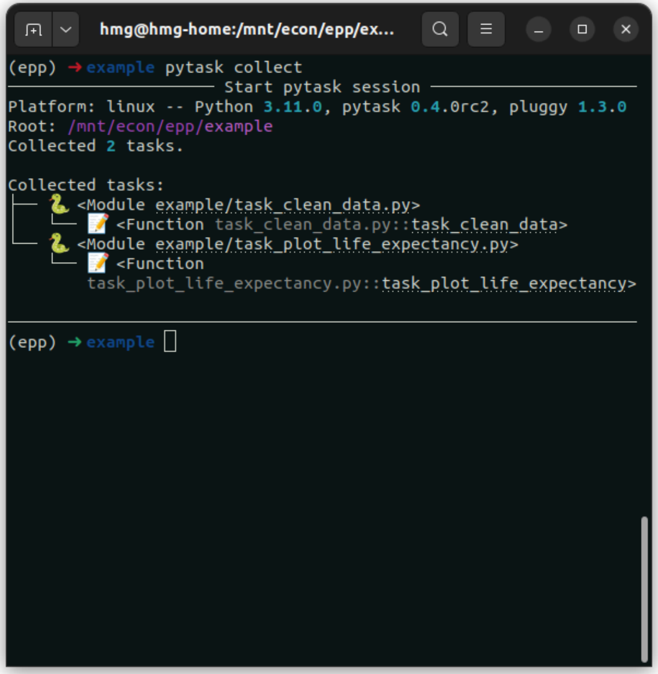
A tiny example project



- `example/task_clean_data.py`
  - Contains the function `task_clean_data`
  - If called, the function reads in `example/gapminder.arrow` and produces `example/bld/data.pkl`
- `example/task_plot_life_expectancy.py`
  - Contains the function `task_plot_life_expectancy`
  - If called, the function reads in `example/bld/data.pkl` and produces `example/bld/life_expectancy.svg`

Step 1: collection

- Go through all folders in working directory
- Collect all files with name `task_XXX.py`
- Go through those files and collect all functions that start with `task_`
- Task functions and their (default) inputs will be used to construct the workflow



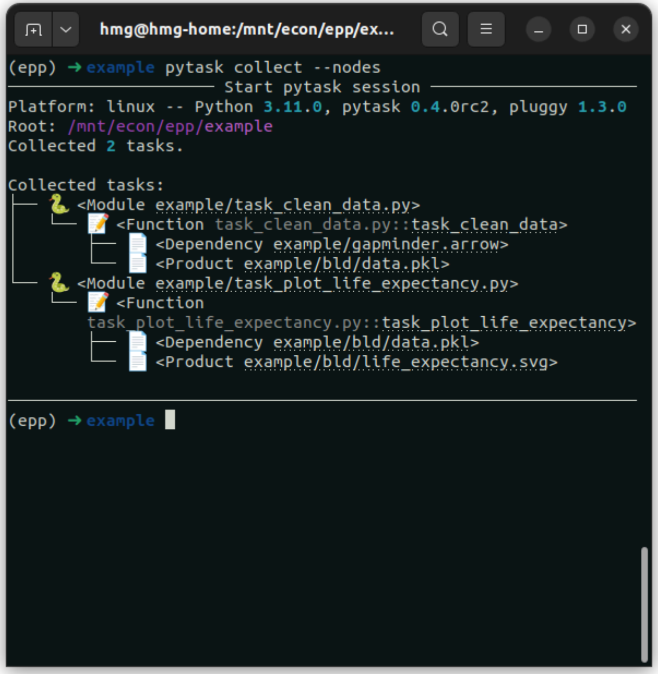
```
(epp) ➜ example pytask collect
──────────────────────── Start pytask session ────────────────────────
Platform: linux -- Python 3.11.0, pytask 0.4.0rc2, pluggy 1.3.0
Root: /mnt/econ/epp/example
Collected 2 tasks.

Collected tasks:
├── 🐍 <Module example/task_clean_data.py>
│   └── 📝 <Function task_clean_data.py::task_clean_data>
└── 🐍 <Module example/task_plot_life_expectancy.py>
    └── 📝 <Function
        task_plot_life_expectancy.py::task_plot_life_expectancy>

──────────────────────────────────────────────────────────────────────
(epp) ➜ example 
```

Step 2: Dependency graph (DAG)

- Inspect function signatures to build a dependency graph
- `produces` describes function output
- Other arguments are function dependencies
- DAG structure enables to determine an order of execution that respects dependency structure (topological sort)



hmg@hmg-home:/mnt/econ/epp/ex...

```
(epp) → example pytask collect --nodes
────────────────────────── Start pytask session ──────────────────────────
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│   └── 📝 <Function task_clean_data.py::task_clean_data>
│       ├── 📄 <Dependency example/gapminder.arrow>
│       └── 📄 <Product example/bld/data.pkl>
└── 🐍 <Module example/task_plot_life_expectancy.py>
    └── 📝 <Function
        task_plot_life_expectancy.py::task_plot_life_expectancy>
        ├── 📄 <Dependency example/bld/data.pkl>
        └── 📄 <Product example/bld/life_expectancy.svg>

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(epp) → example █
```
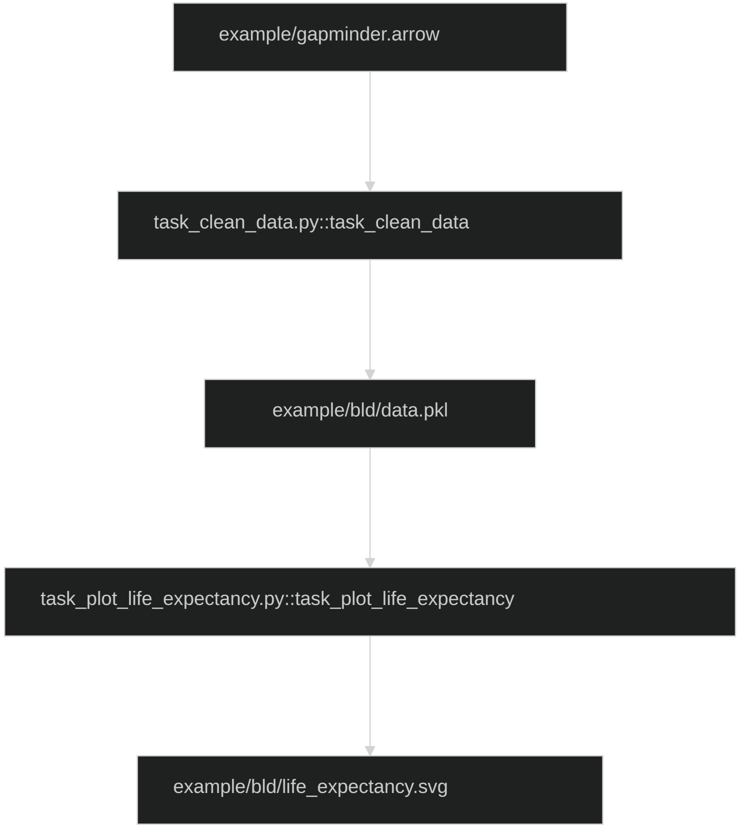
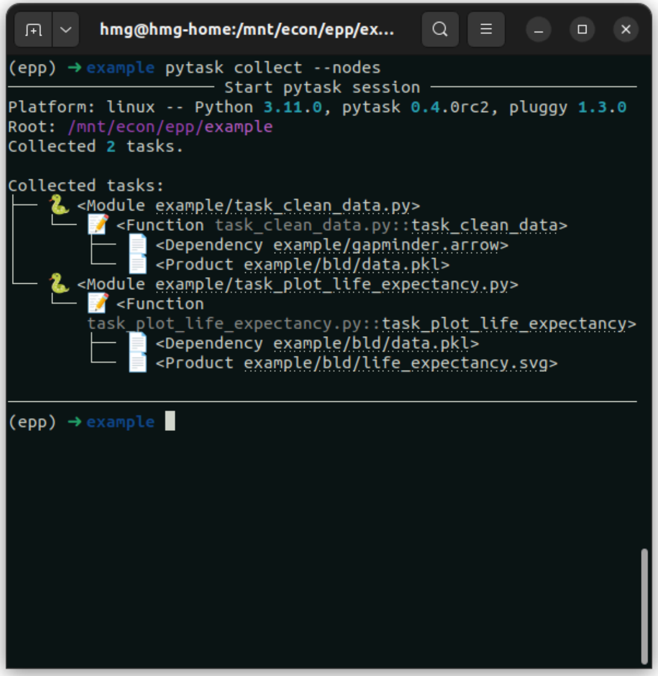

Can you see the DAG?


example/gapminder.arrow
task_clean_data.py::task_clean_data
example/bld/data.pkl
task_plot_life_expectancy.py::task_plot_life_expectancy
example/bld/life_expectancy.svg



```
(epp) → example pytask collect --nodes
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        └── 📄 <Product example/bld/life_expectancy.svg>

──────────────────────────────────────────────────────────────
(epp) → example
```
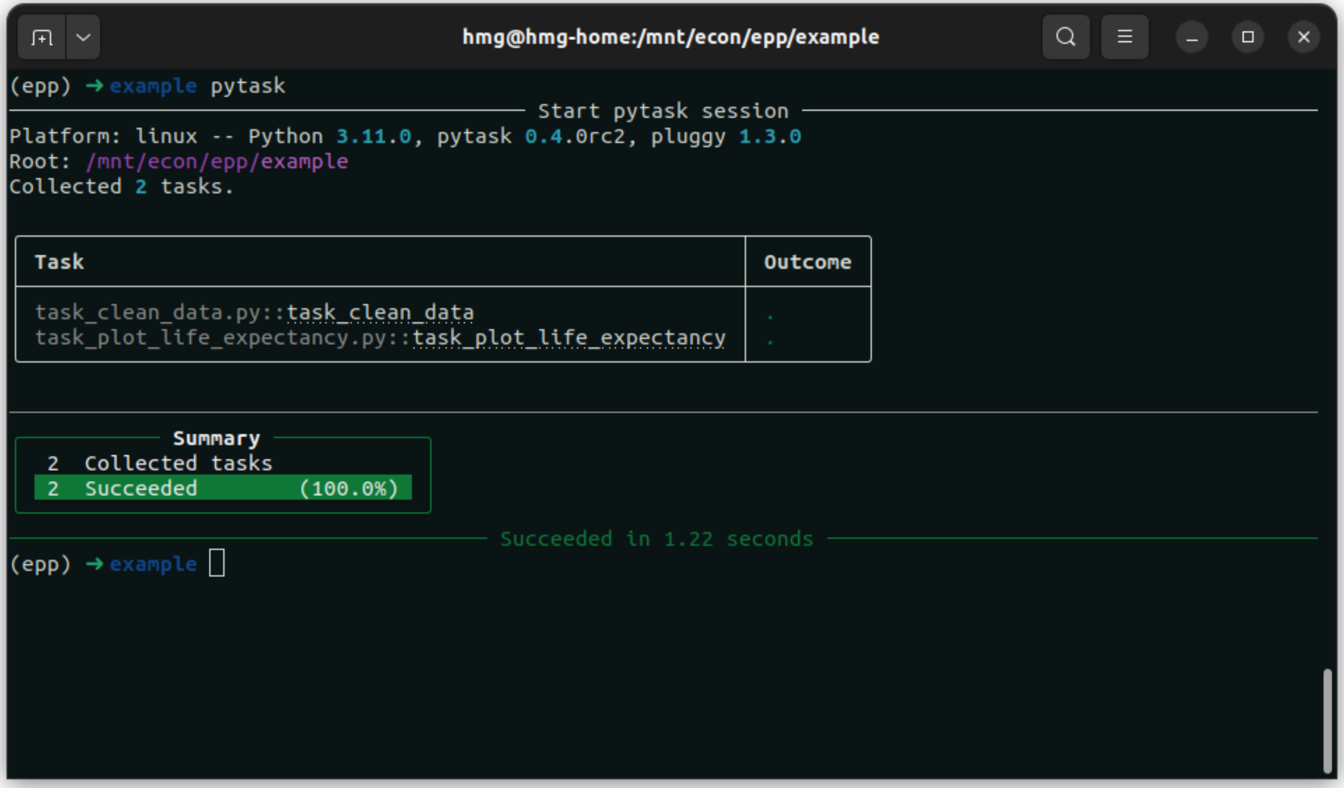

Step 3: Track changes and execute

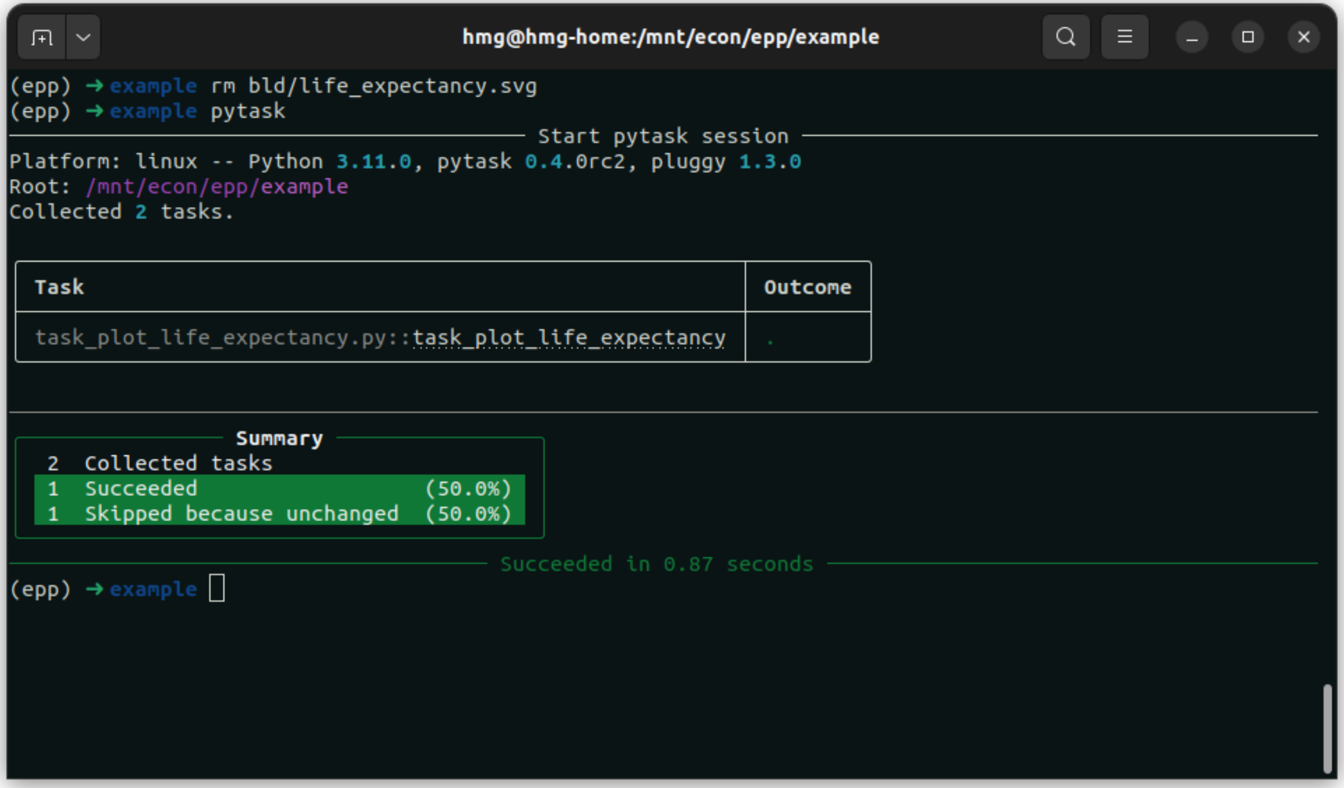
- Pytask knows which files should need to be generated
- Also keeps track on when code or products have changed
- Functions are only run if:
  - They have changed
  - A dependency has changed
- Huge time savings in large empirical projects!

Run for the first time



```
hmg@hmg-home:/mnt/econ/epp/example

(epp) → example pytask
──────────────────────────────── Start pytask session ────────────────────────────────
Platform: linux -- Python 3.11.0, pytask 0.4.0rc2, pluggy 1.3.0
Root: /mnt/econ/epp/example
Collected 2 tasks.

┏━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━┓
┃ Task                                                          ┃ Outcome ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━┩
│ task_clean_data.py::task_clean_data                           │ .       │
│ task_plot_life_expectancy.py::task_plot_life_expectancy       │ .       │
└───────────────────────────────────────────────────────────────┴─────────┘

──────────────────────────────────────────────────────────────────────────────────────

╭─────────── Summary ───────────╮
│  2  Collected tasks           │
│  2  Succeeded        (100.0%) │
╰───────────────────────────────╯
─────────────────────────── Succeeded in 1.22 seconds ───────────────────────────────
(epp) → example
```

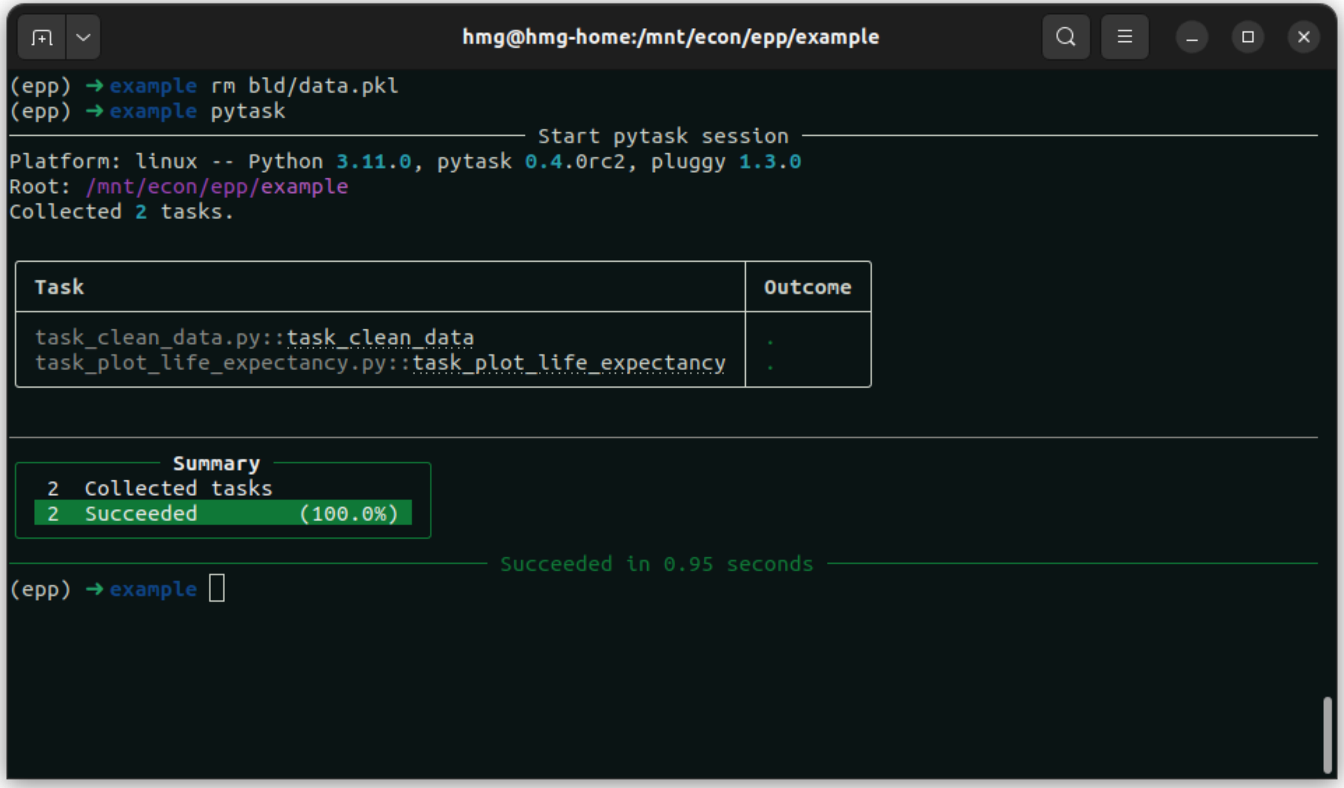
Delete plot and run again



hmg@hmg-home:/mnt/econ/epp/example

```
(epp) → example rm bld/life_expectancy.svg
(epp) → example pytask
──────────────────────────── Start pytask session ────────────────────────────
Platform: linux -- Python 3.11.0, pytask 0.4.0rc2, pluggy 1.3.0
Root: /mnt/econ/epp/example
Collected 2 tasks.

┌───────────────────────────────────────────────────────┬─────────┐
│ Task                                                  │ Outcome │
├───────────────────────────────────────────────────────┼─────────┤
│ task_plot_life_expectancy.py::task_plot_life_expectancy │ .       │
└───────────────────────────────────────────────────────┴─────────┘

──────────────────────────────────────────────────────────────────────────────
┌──────────────── Summary ────────────────┐
│ 2  Collected tasks                      │
│ 1  Succeeded                   (50.0%)  │
│ 1  Skipped because unchanged   (50.0%)  │
└─────────────────────────────────────────┘
────────────────────── Succeeded in 0.87 seconds ──────────────────────
(epp) → example
```

Delete cleaned data and run again



```
(epp) → example rm bld/data.pkl
(epp) → example pytask
──────────────────────────── Start pytask session ────────────────────────────
Platform: linux -- Python 3.11.0, pytask 0.4.0rc2, pluggy 1.3.0
Root: /mnt/econ/epp/example
Collected 2 tasks.

┌──────────────────────────────────────────────────────────┬─────────┐
│ Task                                                     │ Outcome │
├──────────────────────────────────────────────────────────┼─────────┤
│ task_clean_data.py::task_clean_data                      │ .       │
│ task_plot_life_expectancy.py::task_plot_life_expectancy  │ .       │
└──────────────────────────────────────────────────────────┴─────────┘

──────────────────────────────────────────────────────────────────────────────

┌────────────── Summary ───────────────┐
│  2  Collected tasks                  │
│  2  Succeeded              (100.0%)  │
└──────────────────────────────────────┘
───────────────────────── Succeeded in 0.95 seconds ─────────────────────────
(epp) → example
```