Debug Large Data Apps: shiny + reactlog + sparklyr

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slides: http://bit.ly/adv-r-2019

Overview

- Recap: `shiny`
- Debugging `shiny`: `shiny + reactlog`
- Large Data : `sparklyr`
- Large Data w/ `shiny`: `shiny + sparklyr`
- Combine: `shiny + sparklyr + reactlog`
- `shiny` Optimization

Shiny

Shiny

- Website:
  - https://shiny.rstudio.com/
  - https://shiny.rstudio.com/reference/shiny/latest/

- “Shiny is an R package that makes it easy to build interactive web apps straight from R. You can host standalone apps on a webpage or embed them in R Markdown documents or build dashboards. You can also extend your Shiny apps with CSS themes, htmlwidgets, and JavaScript actions.”

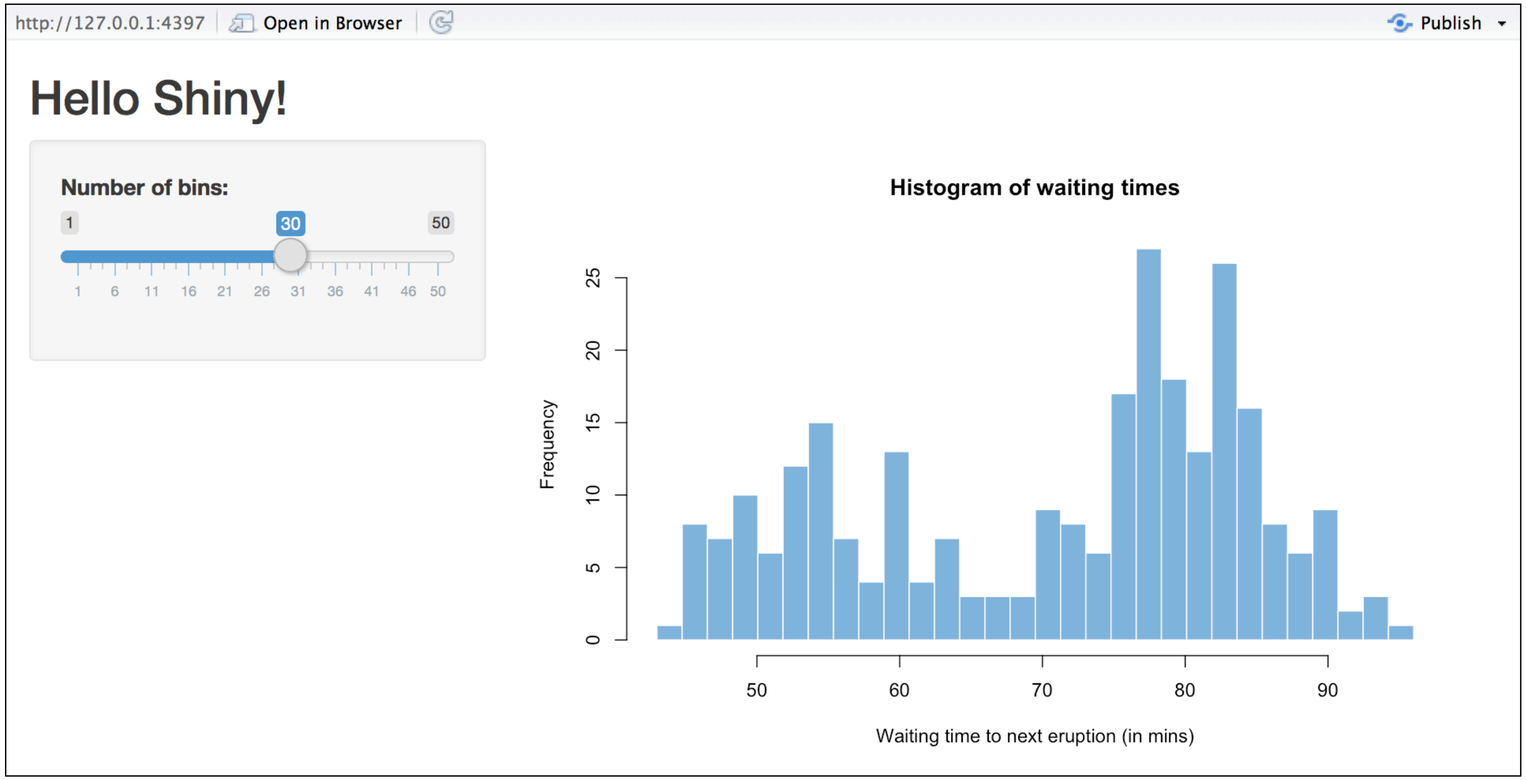
  - tldr; Make full stack developers within R

- ```
  shiny::runExample("01_hello")
  ```

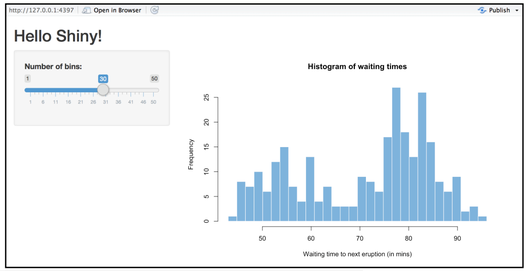

  ```

Shiny: App Parts

1. `ui`
    - **U**ser **I**nterface
    - How it looks
2. `server`
    - How it works
3. `shinyApp(ui, server)`
4. In a `app.R` file



shiny::runExample("01_hello")




```r
# Define UI for app that draws a histogram ----
ui <- fluidPage(

  # App title ----
  titlePanel("Hello Shiny!"),

  # Sidebar layout with input and output definitions ----
  sidebarLayout(

    # Sidebar panel for inputs ----
    sidebarPanel(

      # Input: Slider for the number of bins ----
      sliderInput(inputId = "bins",
                  label = "Number of bins:",
                  min = 1,
                  max = 50,
                  value = 30)

    ),

    # Main panel for displaying outputs ----
    mainPanel(

      # Output: Histogram ----
      plotOutput(outputId = "distPlot")

    )
  )
)
```

```r
# Define server logic required to draw a histogram ----
server <- function(input, output) {

  # Histogram of the Old Faithful Geyser Data ----
  # with requested number of bins
  # This expression that generates a histogram is wrapped in a
  # call to renderPlot to indicate that:
  #
  # 1. It is "reactive" and therefore should be automatically
  #    re-executed when inputs (input$bins) change
  # 2. Its output type is a plot
  output$distPlot <- renderPlot({

    x    <- faithful$waiting
    bins <- seq(min(x), max(x), length.out = input$bins + 1)

    hist(x, breaks = bins, col = "#75AADB", border = "white",
         xlab = "Waiting time to next eruption (in mins)",
         main = "Histogram of waiting times")

    })

}
```

Demo:

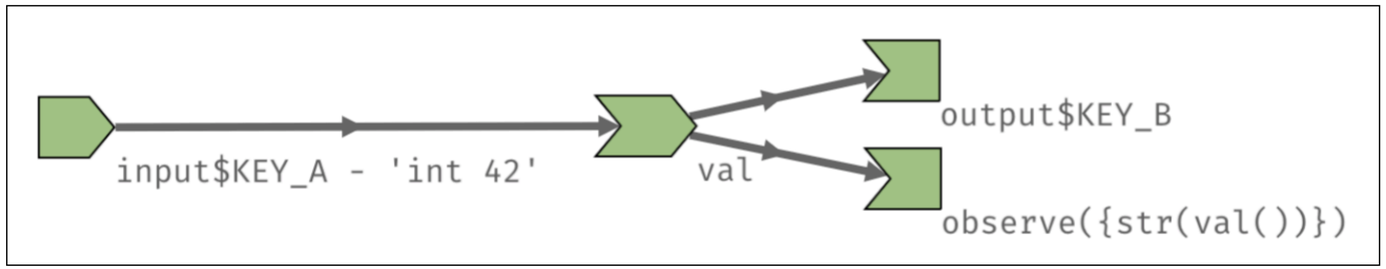
```
shiny::runExample("01_hello")
```

Reactive Programming

- Reactive Programming -

  Paradigm concerned about the propagation of change

- Three types of reactive elements




```
# Sources
input$KEY_A

# Conductors
val <- reactive({
  input$KEY_A + 1
})

# Endpoints
output$KEY_B <- renderPrint({
  val()
})

observe({
  str(val())
})
```

Demo:

```
shiny::runGitHub(
  "rstudio/cranwhales",
  ref = "sync"
)
```

`reactlog`: Debugging the State of Shiny

Situation

- Built a Shiny application - 😄😄
- Add a new reactive feature to your application - 😄😄
- Reactive output does not update - 😞😐
- No errors in console - 😳😱⁉️

Debugging Reactive Code

- Debugging reactive code within a *working* Shiny application is **not a trivial task**
- Must know the reactive state:
  - Value
  - Dependencies / Invalidations
  - … over time!

Solution:

`reactlog` !!

What is `reactlog`?

- Website: https://rstudio.github.io/reactlog/
- “A snapshot of the history ("log") of all reactivity interactions within a shiny application”
- Traverse the reactive log forwards or backwards in time
- Search for defined reactive objects
- Filter to a reactive object’s family tree (dependency tree)
- Built on cytoscape.js

Setup

- Install
  - ```
    install.packages(
      "shiny", dependencies = TRUE
    )
    ```
  - Dependency of shiny v1.3.2

- Usage
  - ```
    # enable reactlog
    # before running your app!!
    options(shiny.reactlog = TRUE)

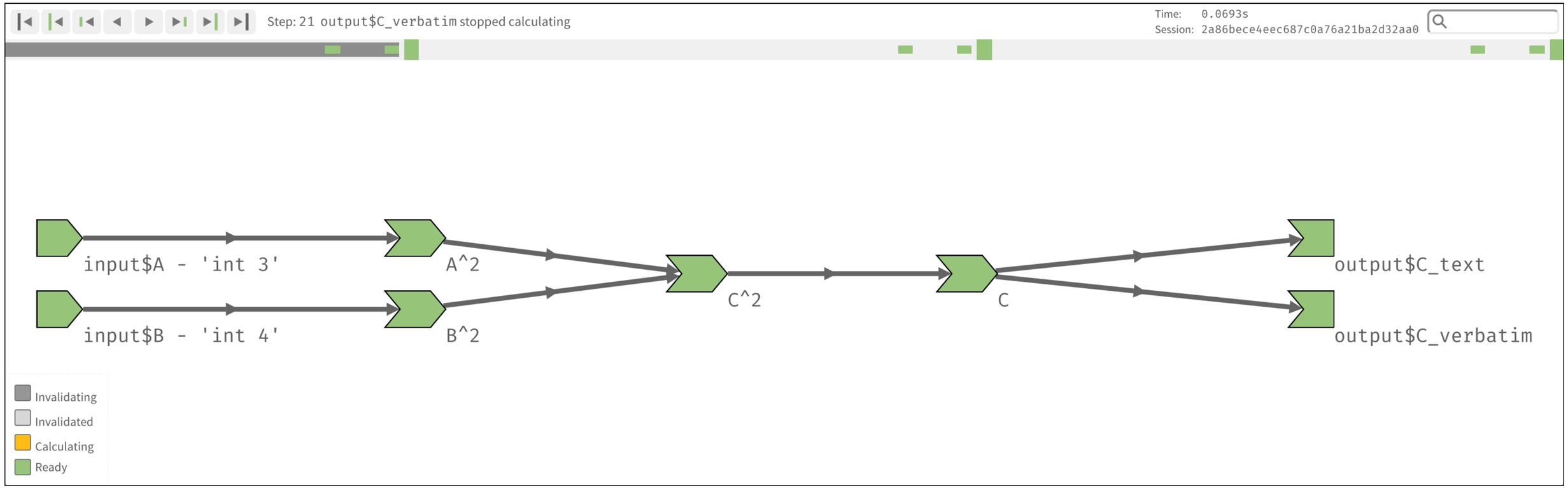
    # run your shiny app
    shiny::runApp()

    # in your app...
    #   Mac: `cmd + F3`
    #   Windows: `ctrl + F3`
    # or...
    shiny::reactlogShow()
    ```

Debugging Shiny Apps with `reactlog`

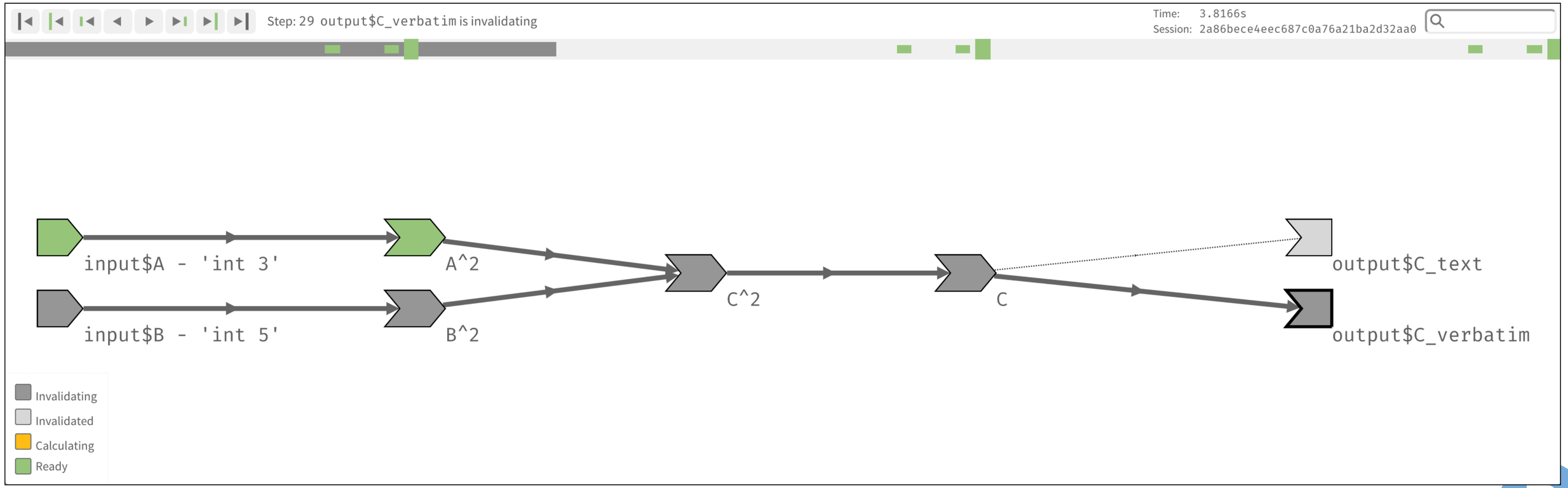
(Working) Pythagoras

- **Demo:** http://bit.ly/adv-r-2019-cloud



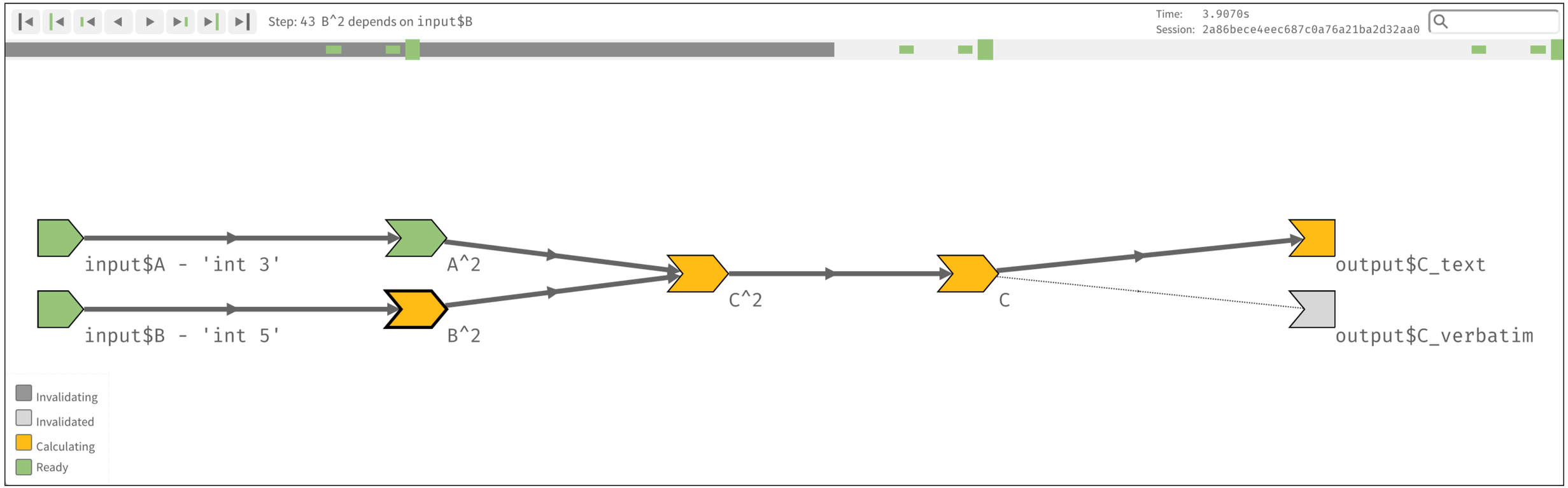
(Working) Pythagoras

- Changed Value of `input$B` to `5`
- All downstream dependencies are invalidated



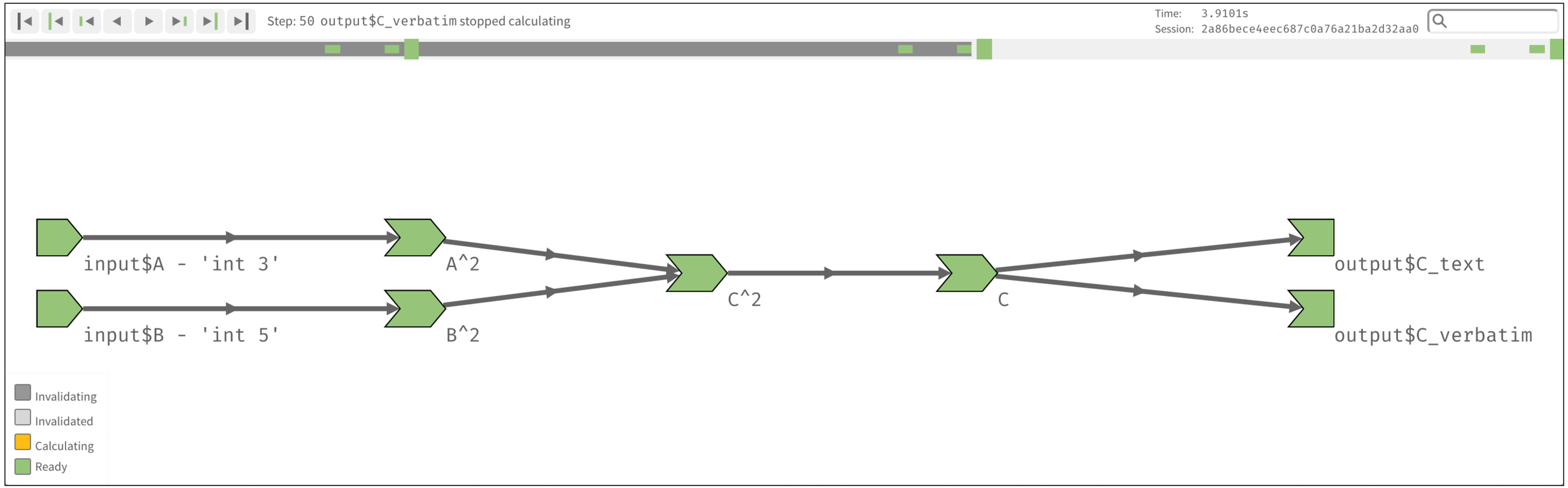
(Working) Pythagoras

- All visible output values are re-calculated



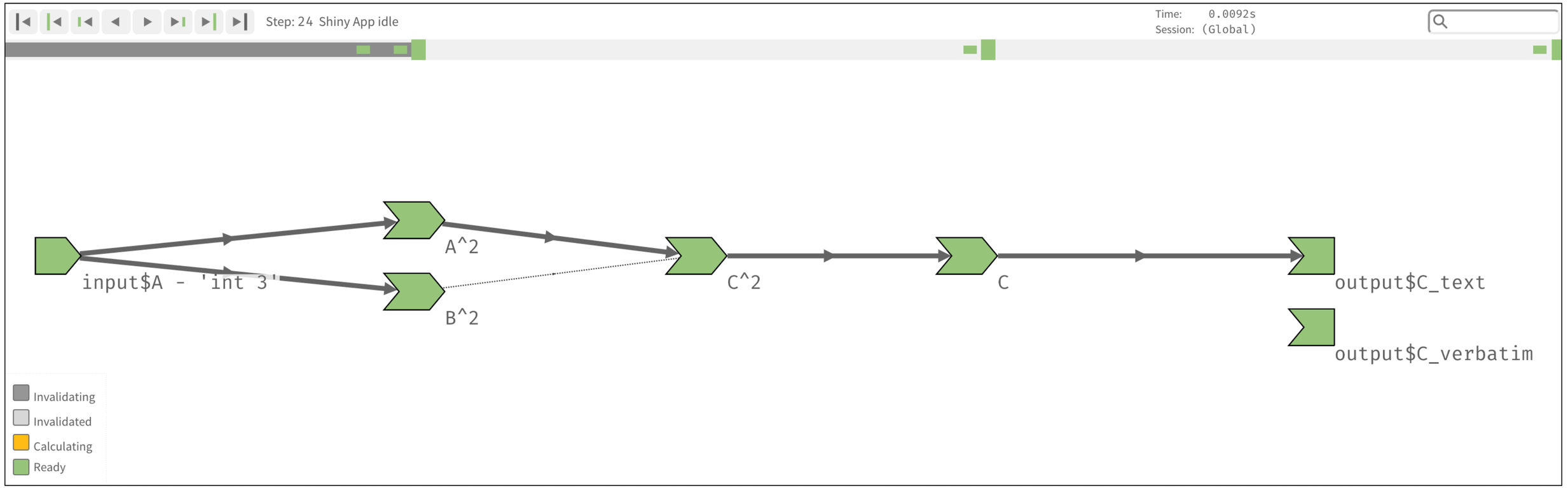
(Working) Pythagoras

- Back to steady state (Shiny is idle)



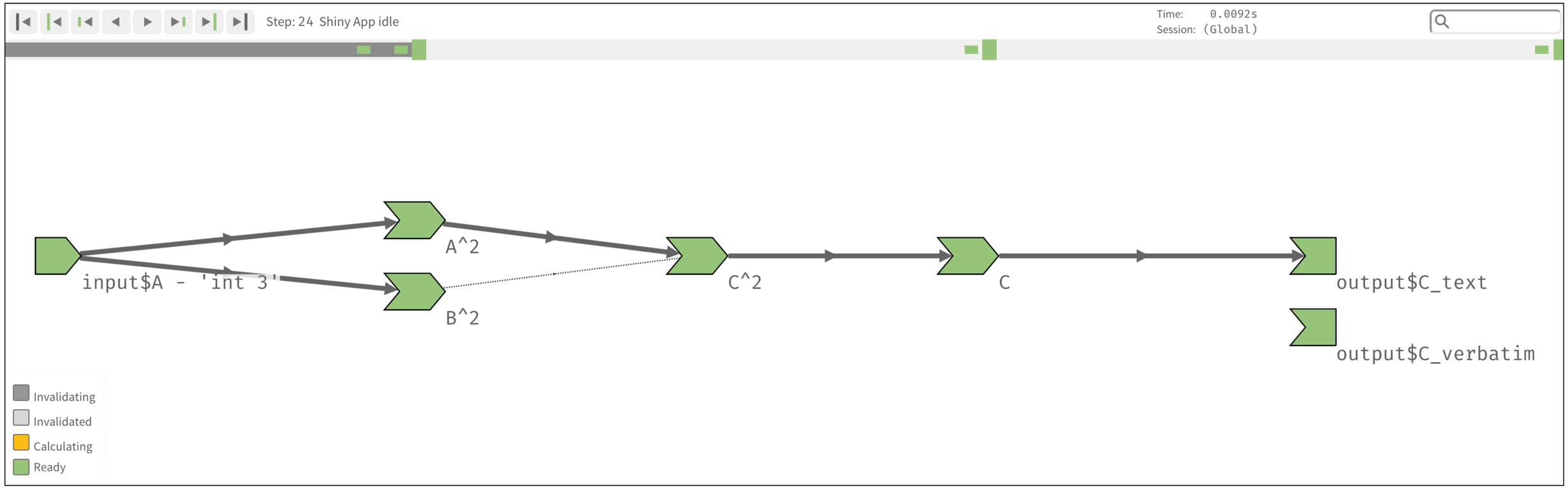
Broken Pythagoras

- **Demo:** http://bit.ly/adv-r-2019-cloud



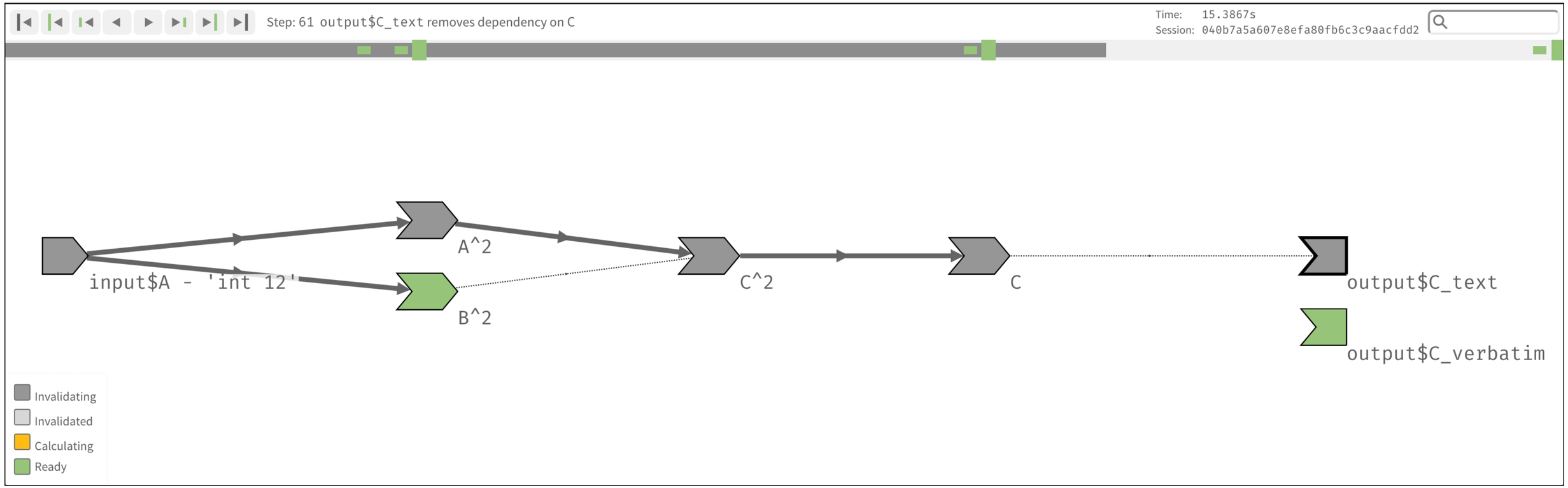
Broken Pythagoras

- **Problem:** `input$A` **is used to calculate** `B^2`



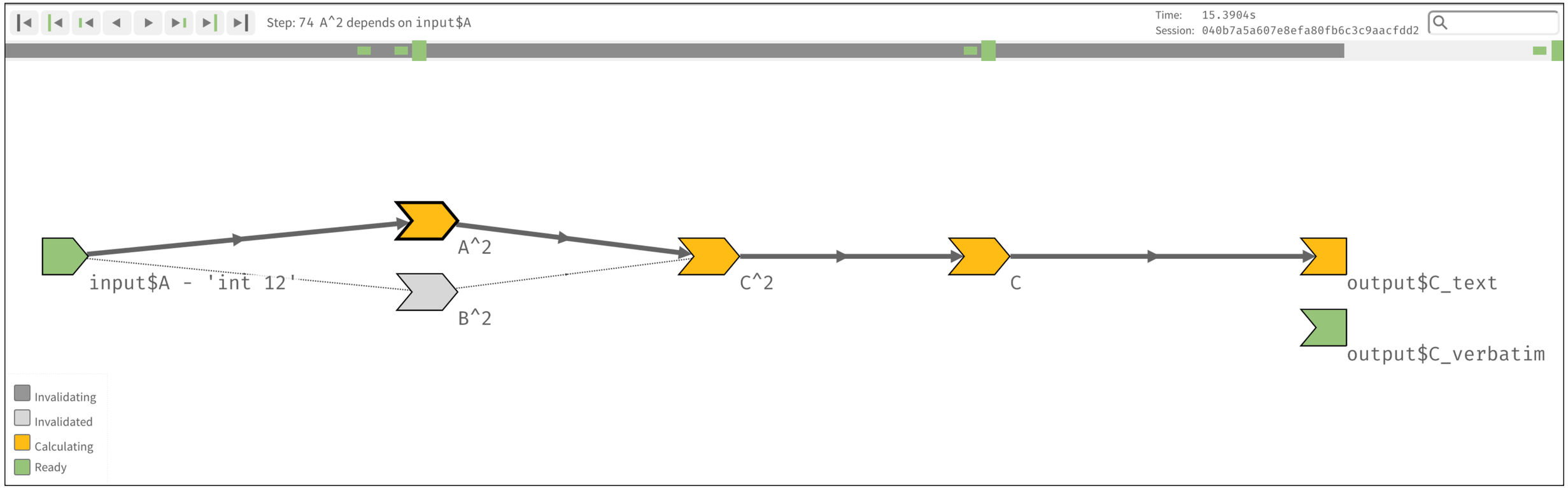
Broken Pythagoras

- Problem: `C_verbatim` is **never** invalidated



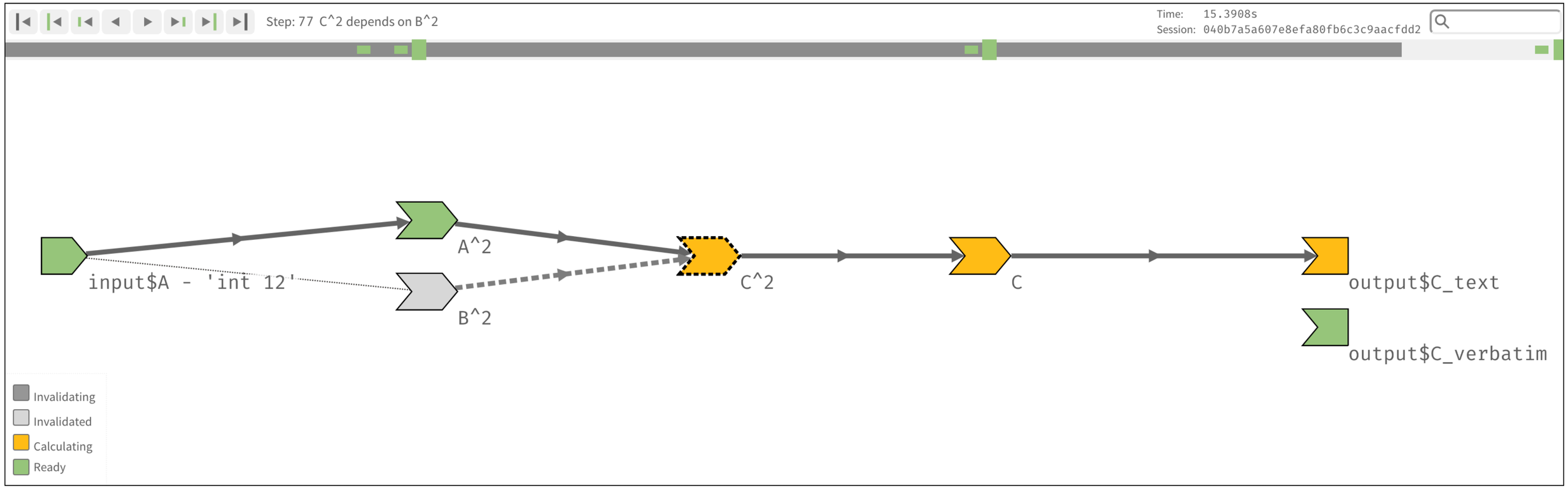
Broken Pythagoras

- Calculation looks correct… so far



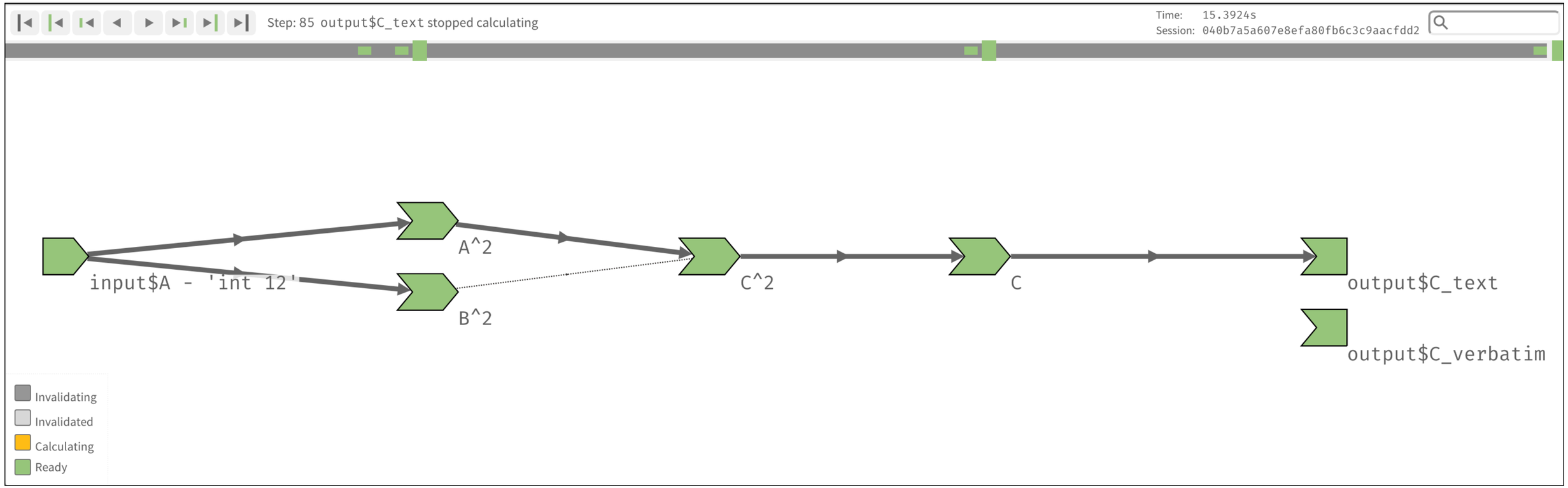
Broken Pythagoras

- Problem: Unwanted `isolate()` call in `C^2` to `B^2`



Broken Pythagoras

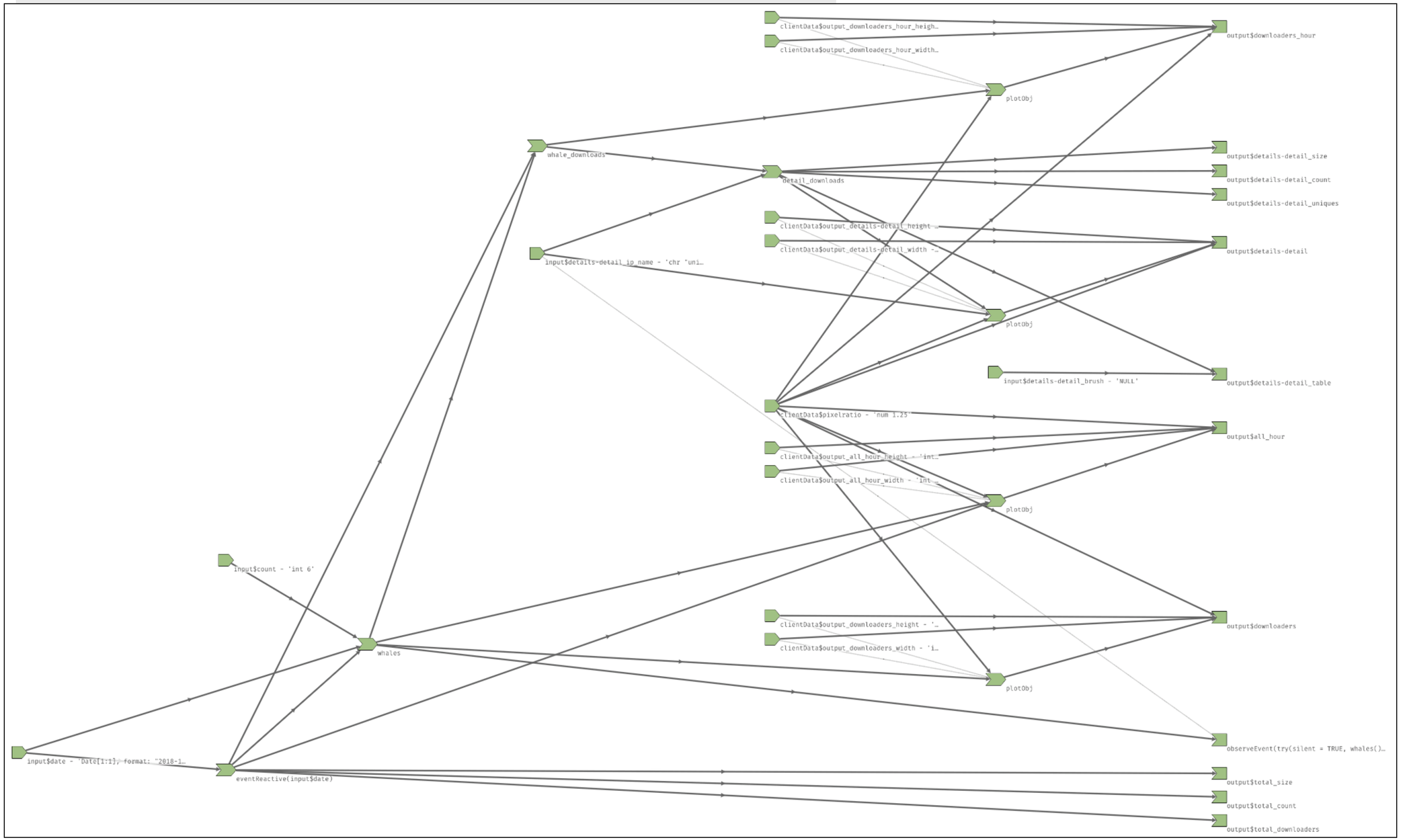
- Back to steady state (Shiny is idle)



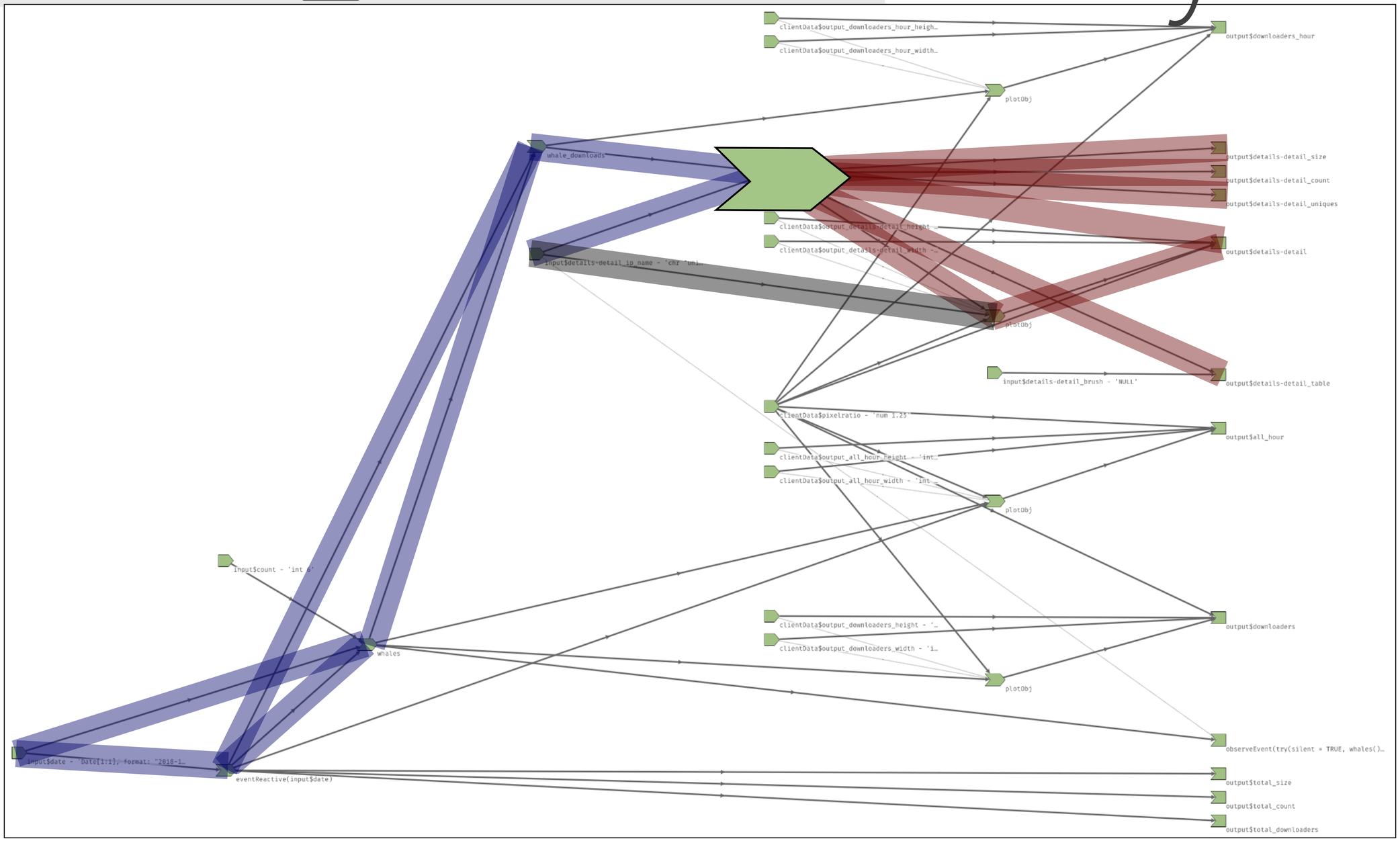
Searching within `reactlog`

- `cranwhales`: github.com/rstudio/cranwhales
- Run app:
  - ```
    options(shiny.reactlog = TRUE)
    shiny::runGitHub("rstudio/cranwhales", ref = "sync")
    ```
- Very dense application!
- Using the search bar in the top right,
  search for `"detail_downloads"` to filter the graph
    ```

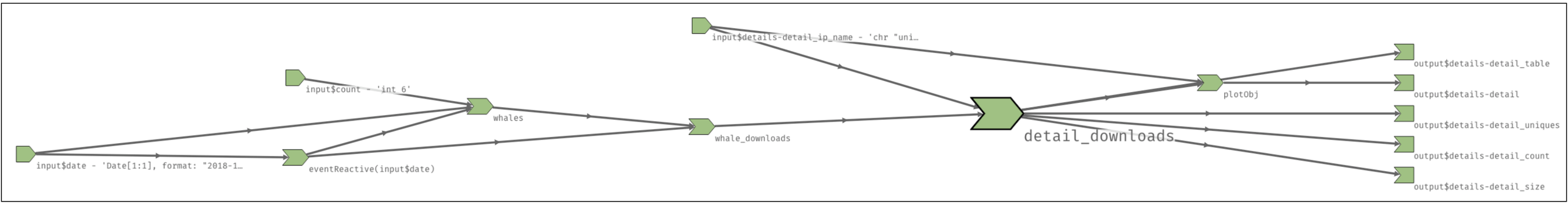
cranwhales is **dense!**



detail_downloads family tree



`detail_downloads` family tree



Things to Remember

- Shiny outputs that are not visible are not calculated. …This is on purpose!
  (Effective Reactive Programming - Joe Cheng @ Shiny DevCon 2016 “Part 1”@46:34)

- If new reactive objects are being created for every user interaction,
  you may have coded an “anti-solution”
  (Shiny DevCon 2016 “Part 1”@17:00)
  - Will cause reactlog graph to become **very** large
  - Maybe use a reactive() vs an observe()?

- `reactlog` is **NOT** a *performance* debugger. `reactlog` is a *reactivity* debugger
  - Use profvis for *performance analysis*

- Do not keep `options(show.reactlog = TRUE)` when deploying to production

`reactlog`: Future Ideas

- Visually differentiate separate user sessions
- Display the value of an endpoint (`output`) or conductor (`reactive()`)
- Add expandable / collapsable groups for a set of reactive objects
  - Ex: `renderPlot` is made of 5+ reactive objects...
    really only one reactive component for a user
- Remove reactive objects from the `reactlog` graph that have been garbage collected
- Combine `reactlog` and `profvis` to analyze a Shiny application's performance and reactive state simultaneously

reactlog

Questions?

sparklyr

Data Sizes

- Website: https://db.rstudio.com/
- "Small" data
  - In-memory only (typical R)
  - Fast!
- "Medium" data
  - On-disk data sets (MySQL)
  - Disk read time is slower
- "Large" data
  - Distributed (spark)
  - Communication is very slow
  - Parallel computation power is high

sparklyr

- `sparklyr`: R interface for Apache Spark
  - GitHub: https://github.com/rstudio/sparklyr
  - Website: https://spark.rstudio.com/
- Why use `sparklyr`?
  - (personally) Provides a complete `dplyr` backend
  - Many natively implementations of Machine Learning methods for spark

Demo:

`sparklyr` - plot flight delay by distance

~ 5min

Demo:

`sparklyr` - linear model of flight `delay` by `dist`

~ 5 min

sparklyr

Questions?

shiny + sparklyr

Demo:

- Accomplished
  - Make plot of delay
  - Make model of delay

- Goals
  - Display plot
  - Display model / model outputs
  - Choose a `dist` threshold
  - Choose train / test percentages

~15 mins

`sparklyr` + `shiny`

Questions?

Demo:

`sparklyr` + `shiny` + `reactlog`

~5 mins

Shiny Optimization

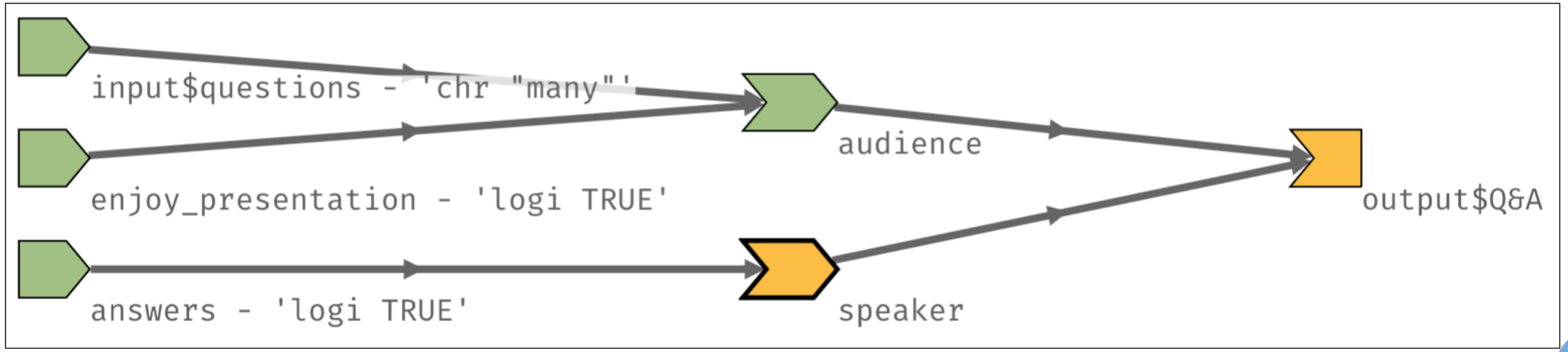
Shiny Optimization

1. Move work outside of Shiny (very often)
    - Preprocess data outside of the server function
2. Make code faster (very often)
    - Use `profvis::profvis` to find bottle necks
3. Use caching (sometimes)
    - See #1.
    - Use `shiny::renderCachedPlot`
4. Use async (rare)
    - Only after all options have been exhausted

https://resources.rstudio.com/rstudio-conf-2019/shiny-in-production-principles-practices-and-tools-joe-cheng

Questions?

- **`shiny`:** https://shiny.rstudio.com
- **`reactlog`:** https://rstudio.github.io/reactlog
- **`sparklyr`:** https://spark.rstudio.com
- **Community:** https://community.rstudio.com/
- **Slides:** http://bit.ly/adv-r-2019



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