

# HIGH PERFORMANCE RESEARCH COMPUTING

## ACES: Fundamentals of R Programming

HPRC Training

26 September 2023



High Performance  
Research Computing  
DIVISION OF RESEARCH



# Acknowledgements

This short course is sponsored in part by the CCSN Community Engagement Program Travel Award. We gratefully acknowledge their support in providing this community resource.



CSSN Community Engagement Program  
**CCEP**

Please submit by October 1 for SC23

**CCEP Travel Rewards Program**

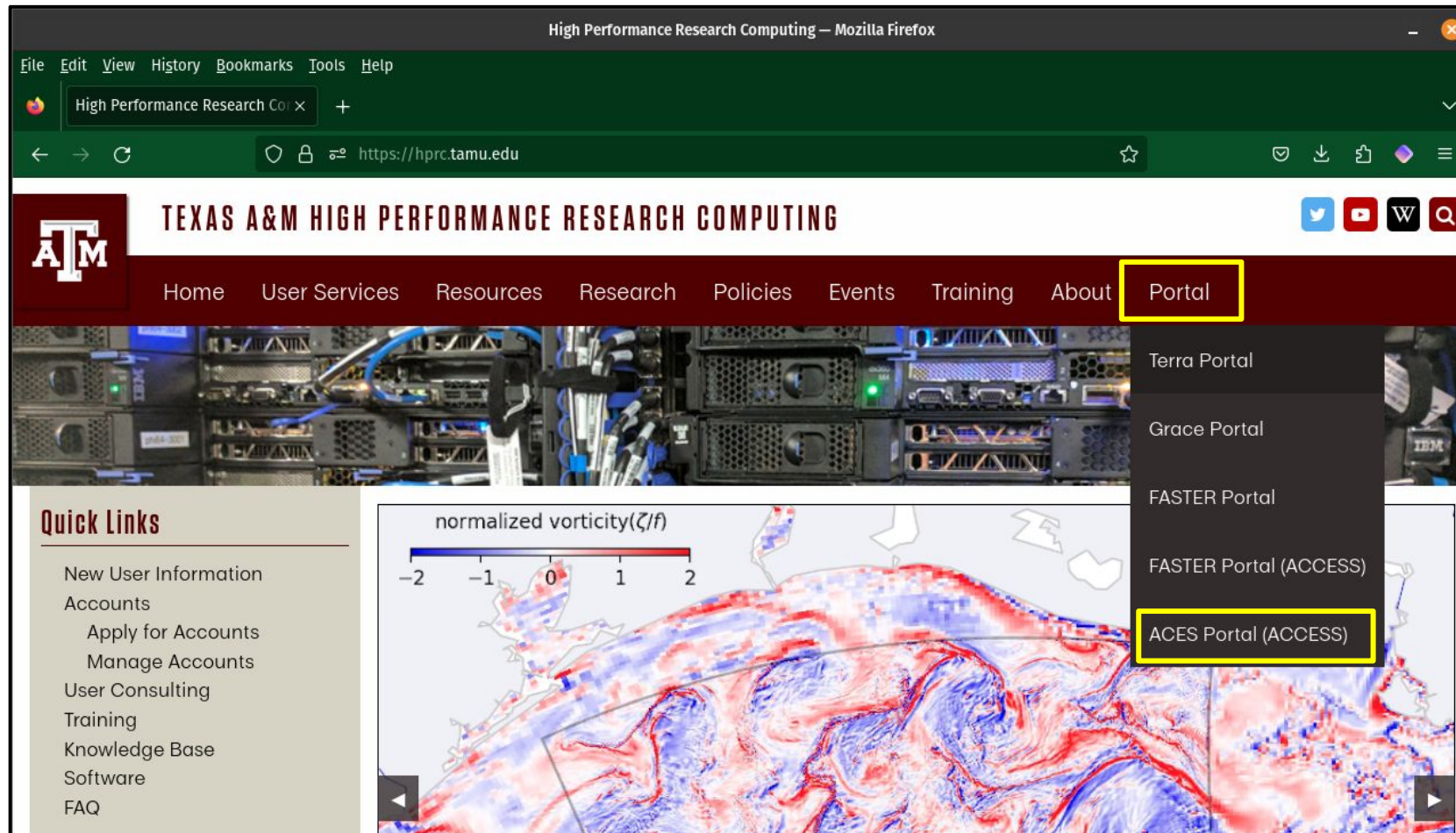
CCEP (CSSN Community Engagement Program) gives travel rewards to ANYONE for community engagement, feedback forums, documentation and much more!

Submissions are reviewed once a month. Please submit by October 1 for SC23 or two months prior to the conference that you desire to attend.

# Course Outline

1. Accessing ACES
2. Launching RStudio
3. R as a calculator
4. Data types
5. Variables
6. Matrices
7. Data Frames
8. Importing/Exporting Data
9. Data Visualization

# Accessing the HPRC ACES Portal



HPRC webpage: [hprc.tamu.edu](https://hprc.tamu.edu)

# Accessing ACES via the Portal (ACCESS)

Log-in using your ACCESS credentials.

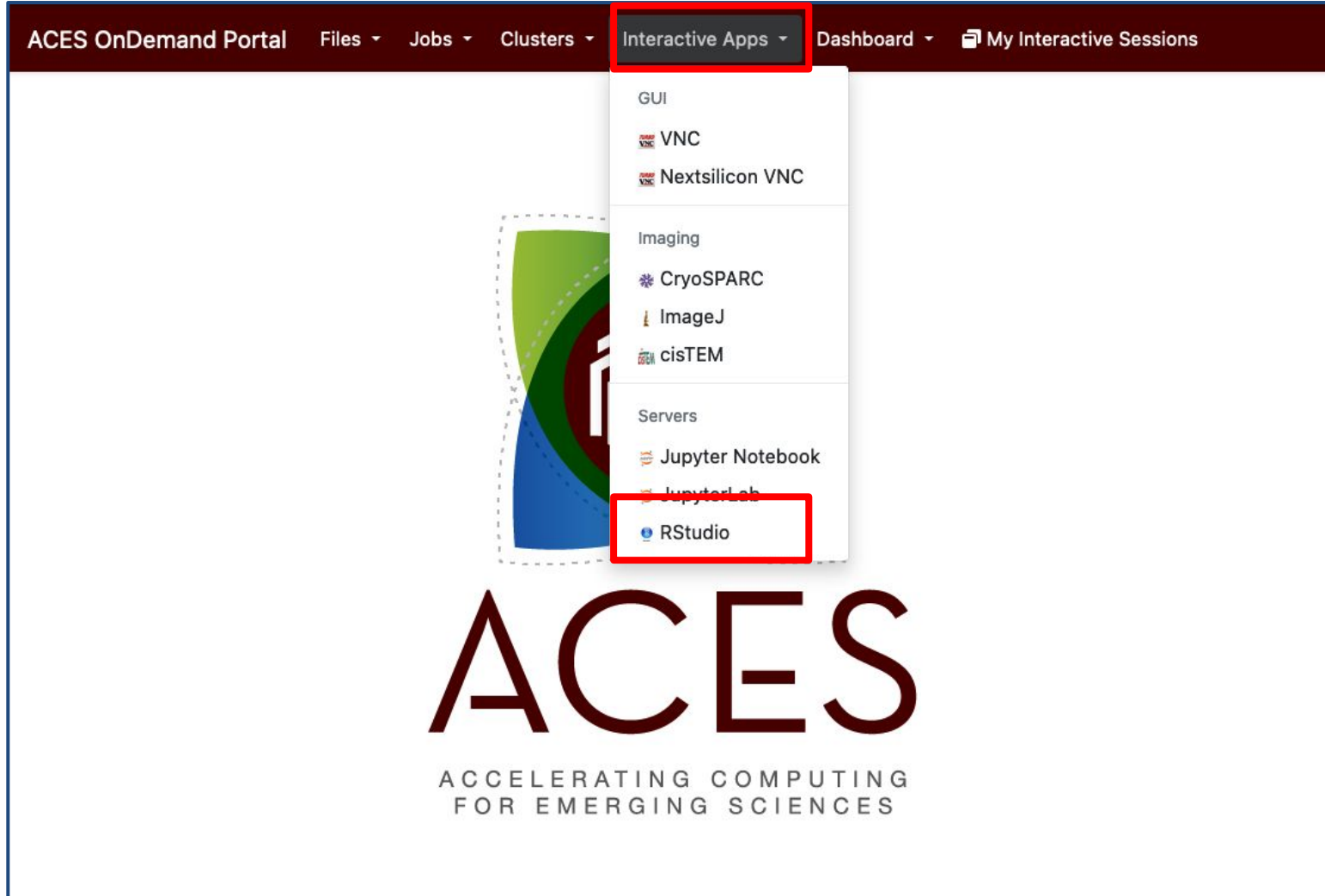
The screenshot shows the ACCESS portal interface. At the top left is the ACCESS logo, and at the top right is the 'Powered By CILogon' logo. Below the logo is a teal bar with the text 'Consent to Attribute Release'. Underneath is a white box containing the text: 'TAMU FASTER ACCESS OOD requests access to the following information. If you do not approve this request, do not proceed.' followed by a bulleted list: 'Your CILogon user identifier', 'Your name', 'Your email address', and 'Your username and affiliation from your identity provider'. Below this is a teal bar with the text 'Select an Identity Provider'. Underneath is a dropdown menu showing 'ACCESS CI (XSEDE)' with a question mark icon. Below the dropdown is a checkbox labeled 'Remember this selection' and a teal 'Log On' button. At the bottom of the white box is the text: 'By selecting "Log On", you agree to the [privacy policy](#).' At the very bottom of the page is a footer with small text: 'For questions about this site, please see the [FAQs](#) or send email to [help@cilogon.org](mailto:help@cilogon.org). Know your responsibilities using the CILogon Service. See acknowledgment of support for this site.'

The screenshot shows the ACCESS portal login page. At the top left is the ACCESS logo, and at the top right is the CILogon logo. Below the logo is the text 'Login to CILogon'. Underneath are two input fields: 'ACCESS Username' and 'ACCESS Password'. Below the password field is a checkbox labeled 'Don't Remember Login' and a teal 'Login' button. To the right of the login form is the CILogon logo and the text 'CILogon facilitates secure access to CyberInfrastructure (CI)'. Below this are three links: 'If you had an XSEDE account, please enter your XSEDE username and password for ACCESS login', 'Register for an ACCESS Account', 'Forgot your password?', and 'Need Help?'. At the bottom of the page is a footer with the text 'Click Here for Assistance'.

This is a close-up of the 'Select an Identity Provider' dropdown menu. The dropdown is open, showing the selected option 'ACCESS CI (XSEDE)' with a question mark icon to its right.

Select the Identity Provider appropriate for your account.

# Launching RStudio on ACES



The screenshot displays the ACES OnDemand Portal interface. The top navigation bar includes links for 'Files', 'Jobs', 'Clusters', 'Interactive Apps', 'Dashboard', and 'My Interactive Sessions'. The 'Interactive Apps' menu is open, showing a list of applications: GUI, VNC, Nextsilicon VNC, Imaging, CryoSPARC, ImageJ, cisTEM, Servers, Jupyter Notebook, JupyterLab, and RStudio. The 'RStudio' option is highlighted with a red box. The ACES logo, featuring a stylized 'A' with green, blue, and red segments, is visible in the background. Below the logo, the text 'ACES' is written in large, bold, dark red letters, followed by the tagline 'ACCELERATING COMPUTING FOR EMERGING SCIENCES' in smaller, dark red letters.



**Interactive Apps**

GUI

VNC

Nextsilicon VNC

Imaging

CryoSPARC

ImageJ

cisTEM

Servers

Jupyter Notebook

JupyterLab

**RStudio**

**Interactive Apps [Sandbox]**

Imaging

CryoSPARC 4

### RStudio version: 2023.06.1-524

This app will launch RStudio using the R\_tamu software module on an ACES compute node.

You can install your own R packages directly within RStudio.

R version

4.2.2

Number of hours (max 168)

7

Number of cores (max 96)

1

Total GB memory (max 480)

12

Email

Email address must be provided if the checkbox for email notification is checked (see below).

I would like to receive an email when the session starts

Slurm account (optional)

This field is needed only if you want to use a different account other than your default account. Leave it blank if you don't know what to provide.

**Launch**

\* The RStudio session data for this session can be accessed under the [data root directory](#).

Set number of hours to 7

Set number of cores to 1

Click "Launch" once the correct parameters have been selected

ACES OnDemand Portal Files Jobs Clusters Interactive Apps Dashboard My Interactive Sessions Develop Help

Session was successfully deleted.

Home / My Interactive Sessions

**Interactive Apps**

- GUI
- VNC
- Nextsilicon VNC
- Imaging
- CryoSPARC
- ImageJ
- cisTEM
- Servers
- Jupyter Notebook
- JupyterLab
- RStudio

**Interactive Apps [Sandbox]**

- Imaging
- CryoSPARC 4

**RStudio (5427)** 1 node | 1 core | Running

Host: ac073 Delete

Created at: 2023-09-19 13:41:50 CDT

Time Remaining: 6 hours and 57 minutes

Session ID: 3afecef4-42f0-4596-9114-0a82c23caea1

Connect to RStudio Server

Click this button when it says "Connect to RStudio Server" (this will take a minute)



# RStudio Interface

**Console:** Allows users to input R commands directly

**Terminal:** Allows shell access to the node

**Files:** File Browser: Allows users to interact with file system

**Plots:** Displays user-generated graphs/figures

**Packages:** Load and install packages

**Help:** Access help pages for functions and packages

# Accessing the Course Materials

- Use the terminal tab in the RStudio GUI and run the following commands:

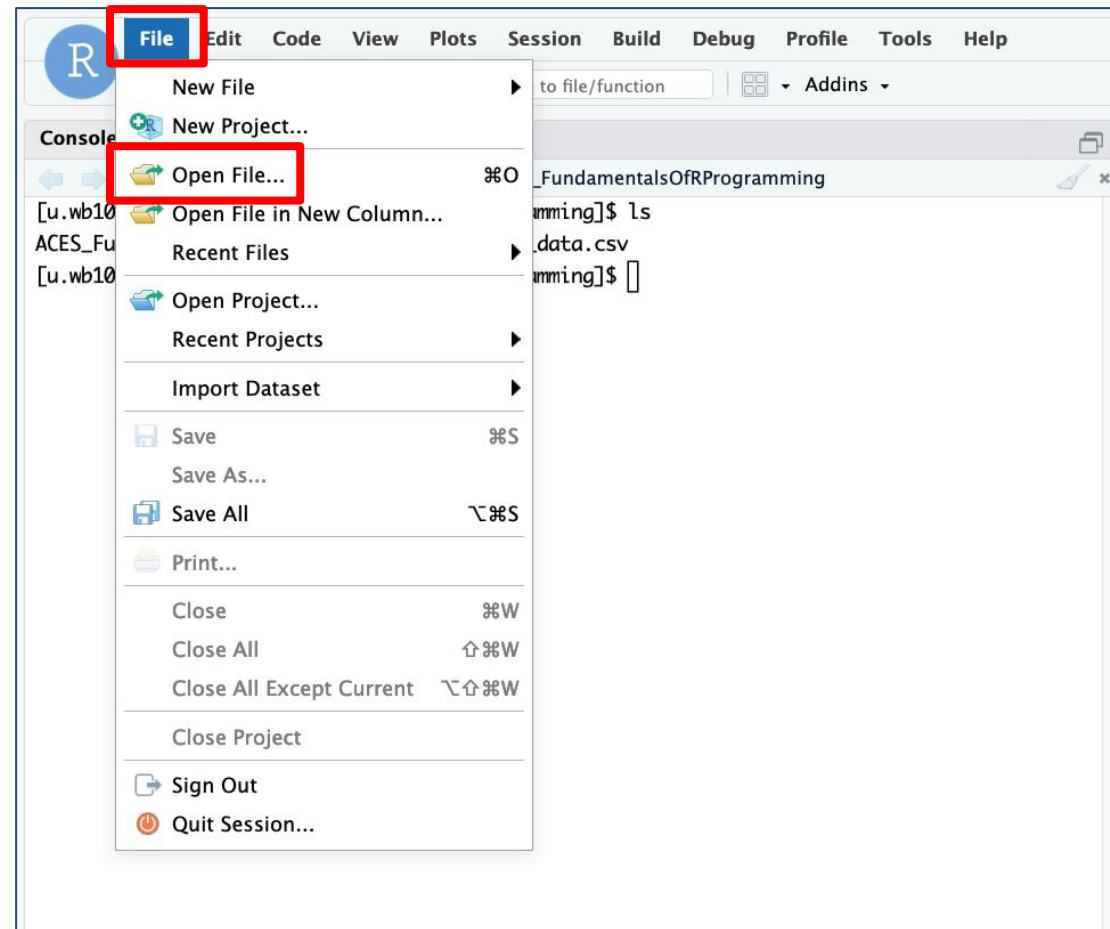
```
[user@ac000 ~]$ cp -r /scratch/training/ACES_FundamentalsOfRProgramming/ .  
[user@ac000 ~]$ cd ACES_FundamentalsOfRProgramming  
[user@ac000 ~]$ ls
```

The output should read:

```
ACES_FundamentalsOfR.Rmd  king_county_house_data.csv
```

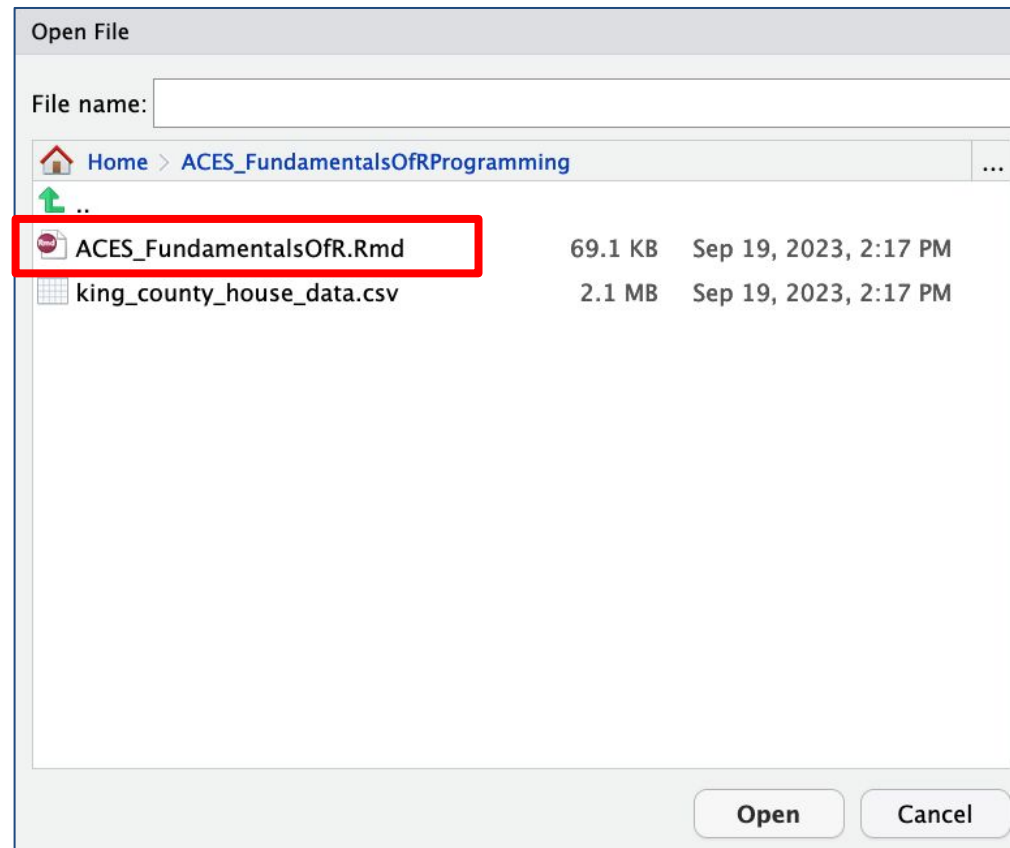
# Accessing the Course Materials

- Next, in the upper left corner, select File > Open File



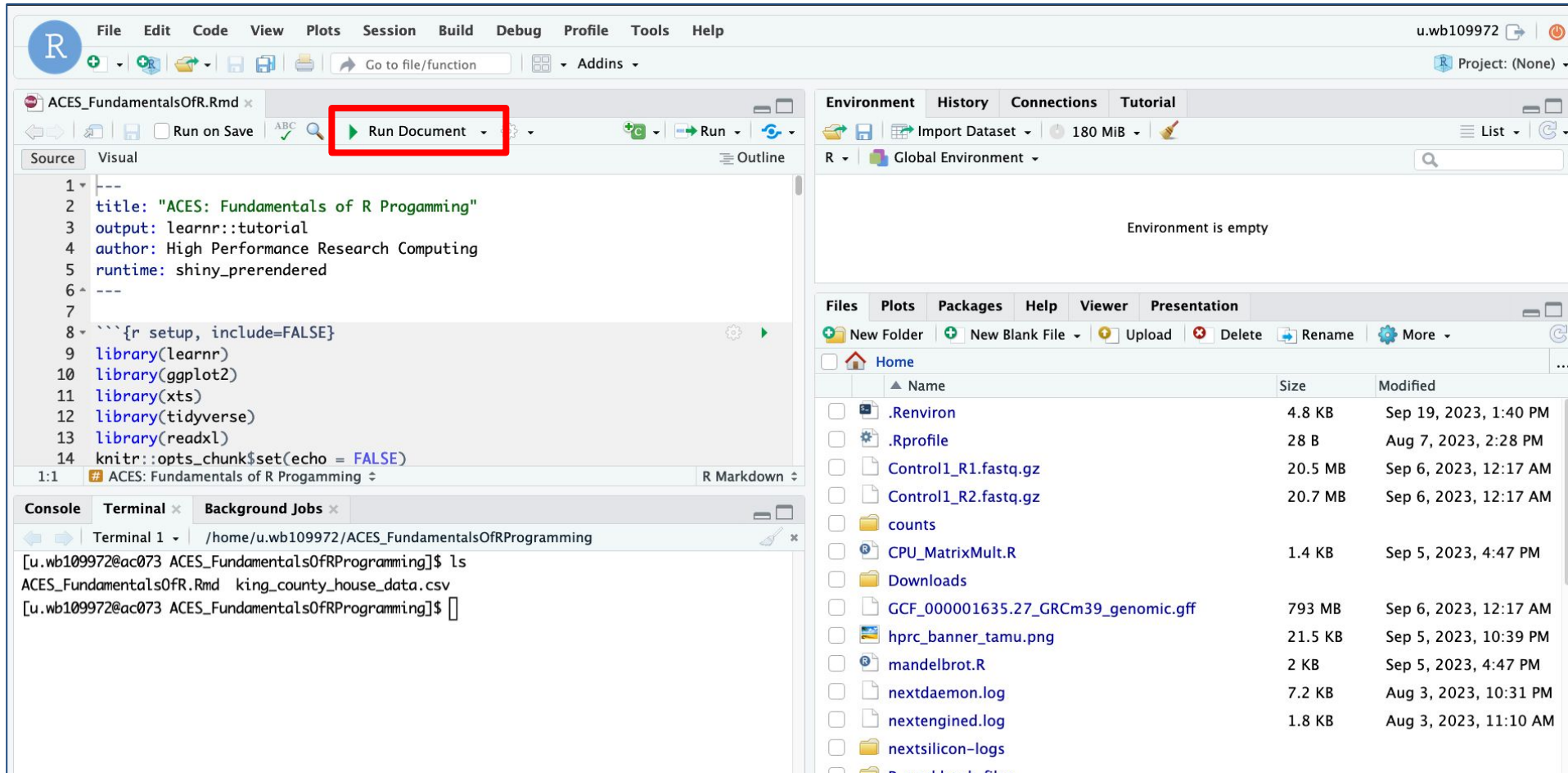
# Accessing the Course Materials

- Navigate to the ACES\_FundamentalsOfRProgramming directory and select “ACES\_FundamentalsOfR.Rmd”



# Accessing the Course Materials

- Select “Run Document” from the toolbar to launch the workbook



The screenshot displays the RStudio environment. The top menu bar includes File, Edit, Code, View, Plots, Session, Build, Debug, Profile, Tools, and Help. The toolbar below the menu contains various icons, with the 'Run Document' button (a green play icon) highlighted by a red rectangle. The main editor window shows a document titled 'ACES\_FundamentalsOfR.Rmd' with the following content:

```
1 ---  
2 title: "ACES: Fundamentals of R Programming"  
3 output: learnr::tutorial  
4 author: High Performance Research Computing  
5 runtime: shiny_prerendered  
6 ---  
7  
8 ```{r setup, include=FALSE}  
9 library(learnr)  
10 library(ggplot2)  
11 library(xts)  
12 library(tidyverse)  
13 library(readxl)  
14 knitr::opts_chunk$set(echo = FALSE)
```

The bottom-left pane shows the Terminal window with the following output:

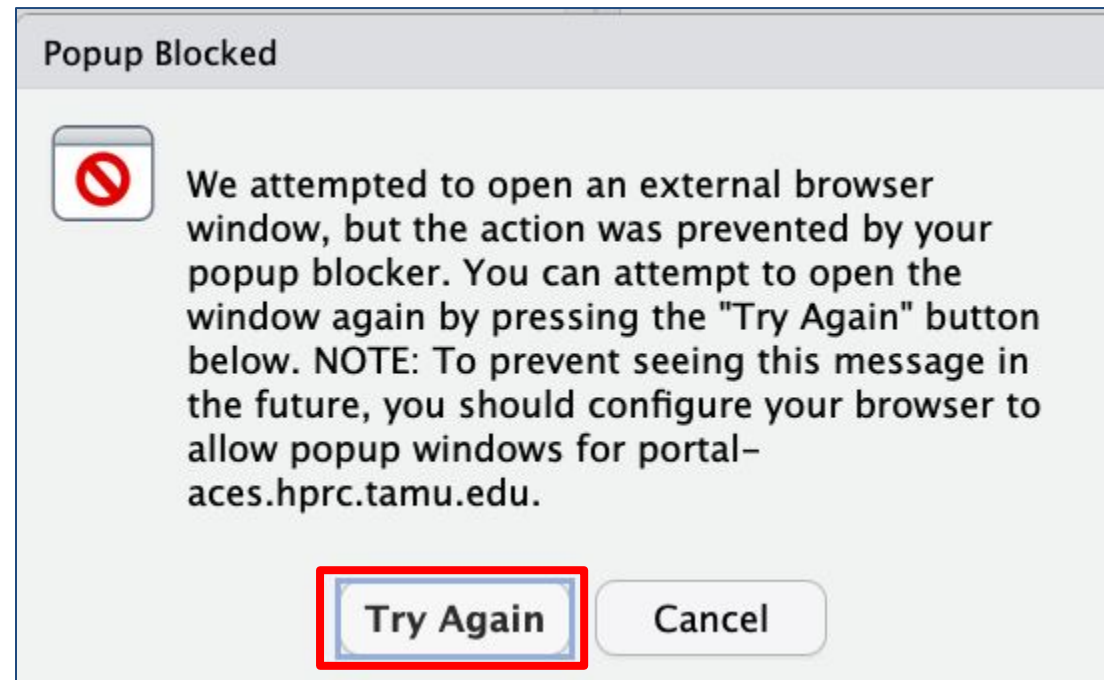
```
Terminal 1 - /home/u.wb109972/ACES_FundamentalsOfRProgramming  
[u.wb109972@ac073 ACES_FundamentalsOfRProgramming]$ ls  
ACES_FundamentalsOfR.Rmd  king_county_house_data.csv  
[u.wb109972@ac073 ACES_FundamentalsOfRProgramming]$
```

The bottom-right pane shows the Files view with a table of files and folders:

Name	Size	Modified
.Renvirom	4.8 KB	Sep 19, 2023, 1:40 PM
.Rprofile	28 B	Aug 7, 2023, 2:28 PM
Control1_R1.fastq.gz	20.5 MB	Sep 6, 2023, 12:17 AM
Control1_R2.fastq.gz	20.7 MB	Sep 6, 2023, 12:17 AM
counts		
CPU_MatrixMult.R	1.4 KB	Sep 5, 2023, 4:47 PM
Downloads		
GCF_000001635.27_GRCh39_genomic.gff	793 MB	Sep 6, 2023, 12:17 AM
hprc_banner_tamu.png	21.5 KB	Sep 5, 2023, 10:39 PM
mandelbrot.R	2 KB	Sep 5, 2023, 4:47 PM
nextdaemon.log	7.2 KB	Aug 3, 2023, 10:31 PM
nextengined.log	1.8 KB	Aug 3, 2023, 11:10 AM
nextsilicon-logs		
R-workbook_files		

# Accessing the Course Materials

- If you see a dialog box that says “Popup Blocked” click “Try Again” and the workbook should open in a new tab





# Transition to Workbook

The screenshot shows a web-based learning interface for R programming. On the left is a navigation sidebar with a list of topics: 'R as a calculator' (selected), 'Data types', 'Variables', 'Built-in functions', 'Vectors', 'Matrices', 'Data Frames', 'Importing and Exporting Data', 'Base Plotting Functions in R', 'Introduction to ggplot2', 'Bonus Material: Flow control', and 'Bonus Material: User-created Functions'. The main content area is titled 'R as a calculator' and contains an introductory paragraph, a section on 'Arithmetic Operators' with a bulleted list of symbols (+, -, \*, /, ^, %%), and three interactive code blocks. Each code block has a 'Start Over' button and a 'Run Code' button. The first code block contains the comment '# Add 12 and 3' followed by three blank lines. The second code block contains the comment '# Subtract 7 from 11' followed by three blank lines. The third code block is empty.

Open in Browser Publish

## ACES: Fundamentals of R Programming

- R as a calculator**
- Data types
- Variables
- Built-in functions
- Vectors
- Matrices
- Data Frames
- Importing and Exporting Data
- Base Plotting Functions in R
- Introduction to ggplot2
- Bonus Material: Flow control
- Bonus Material: User-created Functions

### R as a calculator

In it's simplest form, R can be used as a calculator (although it can do so much more!). Let's get started in R by doing some basic arithmetic!

#### Arithmetic Operators

- Addition: +
- Subtraction: -
- Multiplication: \*
- Division: /
- Exponentiation: ^
- Modulo: %%

Use the correct operators to complete the equations in the code chunks below.

R Code Start Over Run Code

```
1 # Add 12 and 3
2
3
```

R Code Start Over Run Code

```
1 # Subtract 7 from 11
2
3
```

R Code Start Over Run Code

# Need Help? Contact the HPRC Helpdesk

Website: [hprc.tamu.edu](http://hprc.tamu.edu)

Email: [help@hprc.tamu.edu](mailto:help@hprc.tamu.edu)

Phone: (979) 845-0219

## Help us help you -- we need more info

- Which Cluster (ACES, FASTER, Terra, Grace)
- NetID (NOT your UIN)
- Job id(s) if any
- Location of your jobfile, input/output files
- Application used, if any
- Module(s) loaded, if any
- Error messages
- Steps you have taken, so we can reproduce the problem