

Secure Digital Assessment of Data Analysis Courses Using R

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ACKNOWLEDGEMENTS

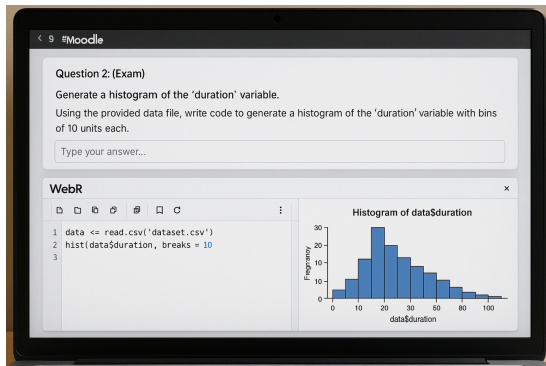
This work was supported by the Universidad Politécnica de Madrid under the 2024–25 Educational Innovation Project (PIE-IE25.0502), titled 'Secure Assessment in Computational Subjects: Implementation and Statistical Analysis of Results'.

Background and Motivation

- Higher Technical School of Industrial Engineers of the Polytechnic University of Madrid (ETSII-UPM)
- Teaching: Statistics, Design of Experiments and Regression Models, Advanced Statistical Techniques and Data Analysis.
- Degrees: Industrial Technologies, Chemical, and Organization Engineering.
- Number of students: 1,200 annually, 400-550 simultaneously.

Background and Motivation

- To properly assess students' skills in statistics and data analysis courses, it is essential that they are able to manipulate and analyze large datasets during the exam.



The screenshot shows a Moodle exam interface. The question asks the student to generate a histogram of the 'duration' variable using provided data. Below the question is a WebR console window. The console displays R code that reads a CSV file and generates a histogram with 10 bins. To the right of the code is a histogram titled 'Histogram of data\$duration'. The histogram shows a right-skewed distribution of data values, with the highest frequency occurring in the 15-20 bin range.

Question 2: (Exam)

Generate a histogram of the 'duration' variable.

Using the provided data file, write code to generate a histogram of the 'duration' variable with bins of 10 units each.

Type your answer...

WebR

```
1 data <- read.csv('dataset.csv')
2 hist(data$duration, breaks = 10)
3
```

Histogram of data\$duration

Bin Range	Frequency
0-10	5
10-20	15
20-30	30
30-40	20
40-50	15
50-60	12
60-70	8
70-80	5
80-90	3
90-100	2

Background and Motivation

- Over the past few years, at ETSII-UPM we have assessed more than 500 students simultaneously, each using their own computer and accessing the RStudio program installed on their devices.



Background and Motivation

- However, new challenges have emerged.
- The rise of AI tools and online platforms makes it difficult to ensure academic integrity.



Threats and Challenges

- Generative AI can answer exam questions from screenshots or text.
- Traditional RStudio or posit.cloud are not secure.
- Secure exam environment is essential.

gptr: An R Interface with the ChatGPT API

Author: [Wanjun Gu](#)

gptr is an R package that provides a convenient interface with the OpenAI ChatGPT API. It allows you to interact with ChatGPT, a powerful language model, for various natural language processing tasks.



The **gptr** R package makes talking to ChatGPT in R super easy. It helps researchers and data folks by simplifying the complicated stuff, like asking questions and getting answers. With **gptr**, you can use ChatGPT in R without any hassle, making it simpler for everyone to do cool things with language!

Need for secure digital assessment in programming-heavy courses.

We propose a secure framework, based on:

- Moodle
- Safe Exam Browser (SEB)
- WebR.

Proposed Secure Assessment Setup

Proposed Secure Assessment Setup

Moodle:

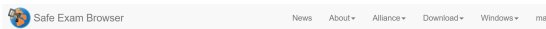
- Moodle is fully integrated with UPM's digital infrastructure.
- Moodle is used to evaluate simultaneously hundred of students.
- Students are used to using Moodle.



Proposed Secure Assessment Setup

Safe Exam Browser

- Developed by ETH Zurich, IT Services.
- SEB locks down the exam environment, restricting web/app access.
- SEB is integrated in Moodle.



Contents

Concept

- General Concept
- Architecture
- Components
- SEB for Windows
- SEB for macOS/iOS
- Configuration

Features

- Technical Details

- License

- Accessibility Statement

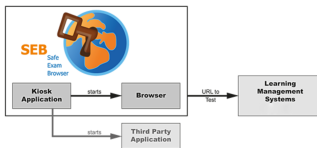
- Privacy Statement

- Acknowledgement

- Back to top

Architecture

SEB consists of a kiosk application and a browser part, which are running on an examination computer or tablet device. The kiosk application locks down the examination computer, the browser part communicates over the internet (or a LAN) with the quiz module of an LMS running on a server.

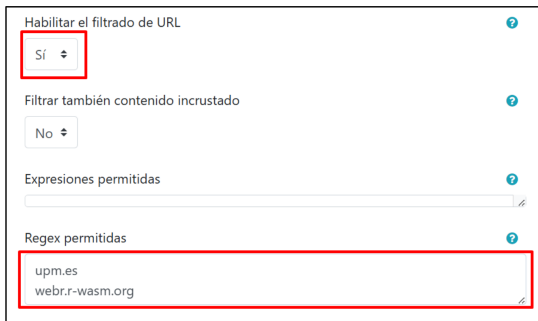


Schematic illustration of an online exam with Safe Exam Browser and a Learning Management System (LMS) or an e-assessment suite. In addition, a third party application can be allowed to run at the same time, for example Eclipse, Matlab, Excel or R.

Proposed Secure Assessment Setup

Moodle configuration:

- SEB (Safe Exam Browser) enforces a secure exam environment by restricting access to unauthorized resources.
- Moodle can be configured to allow access only to specific web platforms, such as the institutional Moodle site and approved R environments like WebR.
- This ensures students can only use trusted tools during the exam, preventing the use of AI or code-sharing services.



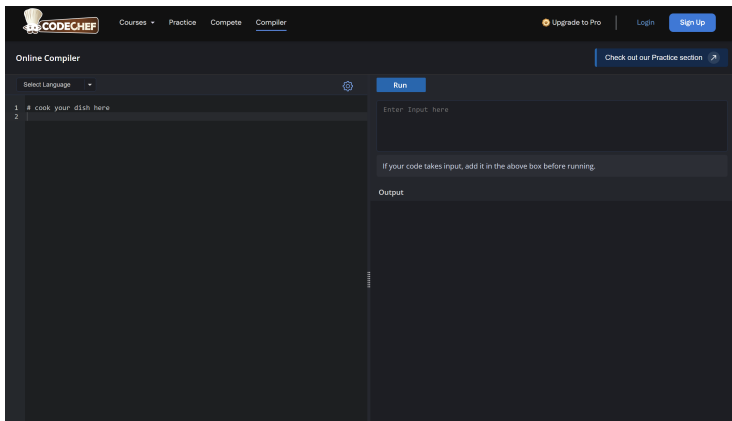
The screenshot shows the Moodle configuration page for URL filtering. The settings are as follows:

- Habilitar el filtrado de URL:** Set to **Sí** (Yes).
- Filtrar también contenido incrustado:** Set to **No** (No).
- Expresiones permitidas:** An empty text input field.
- Regex permitidas:** A text input field containing the following domains:
 - upm.es
 - webr.r-wasm.org

R Web Platforms

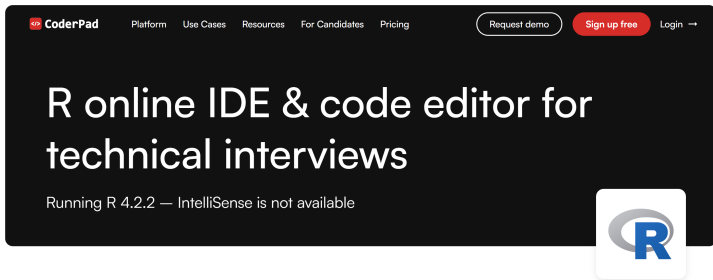
Web: <https://www.codechef.com/ide>

CodeChef is a competitive programming platform run by the Indian company Unacademy.



Web: <https://coderpad.io/languages/r/>

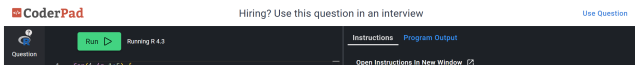
Coderpad is developed by CoderPad, Inc., a US-based company that provides real-time collaborative coding environments.



The screenshot shows the CoderPad website interface. At the top, there is a navigation bar with the CoderPad logo, links for Platform, Use Cases, Resources, For Candidates, and Pricing, and buttons for Request demo, Sign up free, and Login. The main heading reads "R online IDE & code editor for technical interviews". Below the heading, it says "Running R 4.2.2 — IntelliSense is not available". A large blue 'R' logo is positioned on the right side of the main content area.

Experience the R IDE yourself

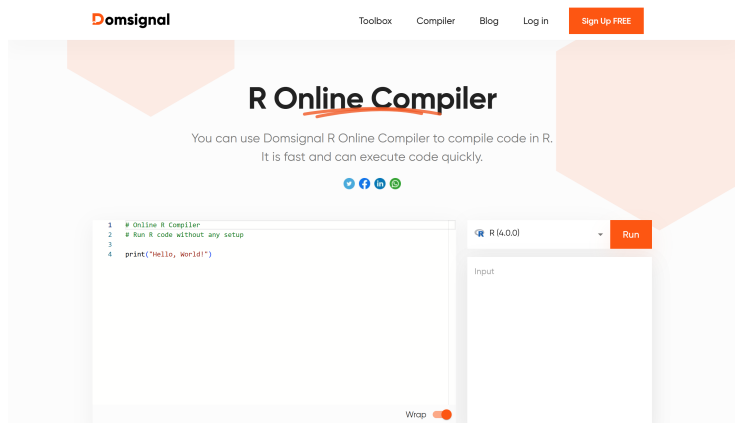
See just how easy and intuitive CoderPad Interview is to use below.



This screenshot shows a CoderPad interface for an interview question. It features a "Question" tab, a "Run" button, and a "Running R 4.3" status. Below the code editor, there are tabs for "Instructions" and "Program Output", and a link to "Open Instructions in New Window".

Web: <https://domsignal.com/r-online-compiler>

DomSignal is a lightweight code execution service hosted at domsignal.com.



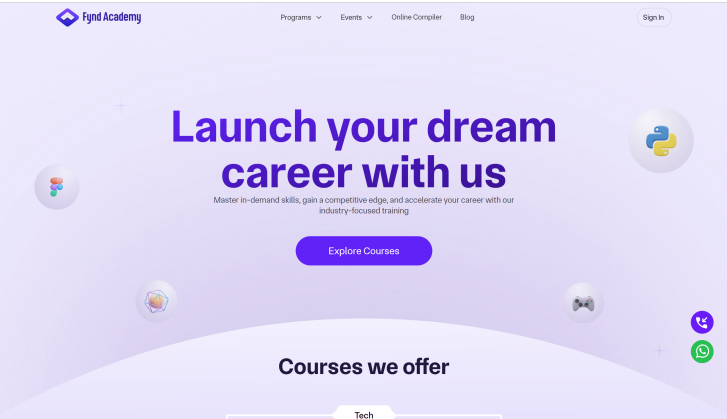
The screenshot shows the DomSignal R Online Compiler interface. At the top left is the DomSignal logo. To the right are navigation links for 'Toolbox', 'Compiler', 'Blog', and 'Log In', along with a 'Sign Up FREE' button. The main heading is 'R Online Compiler', with 'Online' underlined in orange. Below the heading is the text: 'You can use Domsignal R Online Compiler to compile code in R. It is fast and can execute code quickly.' There are social media icons for Twitter, Facebook, LinkedIn, and GitHub. The interface features a code editor on the left with the following code:

```
1 # Online R Compiler
2 # Run R code without any setup
3
4 print("Hello, world!")
```

At the bottom of the code editor is a 'Wrap' toggle switch. To the right of the code editor is a dropdown menu showing 'R (4.0.0)' and an orange 'Run' button. Below the dropdown is an 'Input' field. At the bottom right of the interface are navigation icons for back, forward, and search.

Web: <https://www.fynd.academy/>

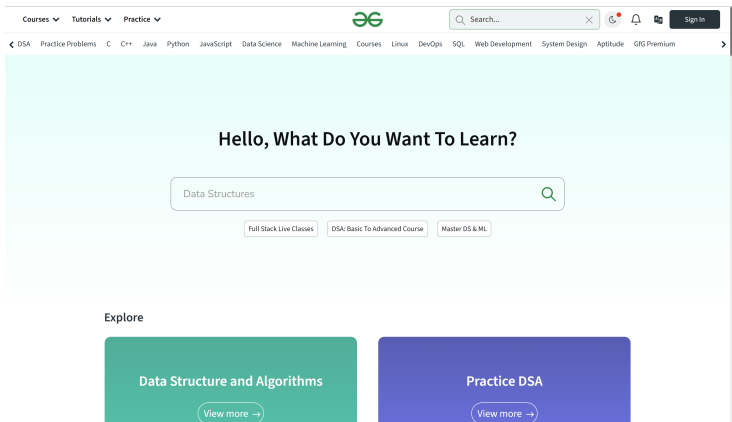
Fynd Academy is an Indian learning platform affiliated with Fynd.



The screenshot shows the homepage of Fynd Academy. At the top left is the Fynd Academy logo. The navigation menu includes "Programs", "Events", "Online Compiler", and "Blog". A "Sign In" button is located in the top right corner. The main heading reads "Launch your dream career with us". Below this, a sub-heading states: "Master in-demand skills, gain a competitive edge, and accelerate your career with our industry-focused training". A prominent blue button labeled "Explore Courses" is centered below the text. The page features several circular icons representing different fields: a colorful flower-like icon, a Python logo, a globe with a gear, a game controller, and a WhatsApp icon. At the bottom, a section titled "Courses we offer" is visible, with a "Tech" category highlighted.

Web: <https://ide.geeksforgeeks.org/>

GeeksForGeeks IDE is part of a popular educational platform.



Web: <https://ideone.com/>

Ideone is operated by Sphere Research Labs and functions as both a code-sharing tool and an online judge system.

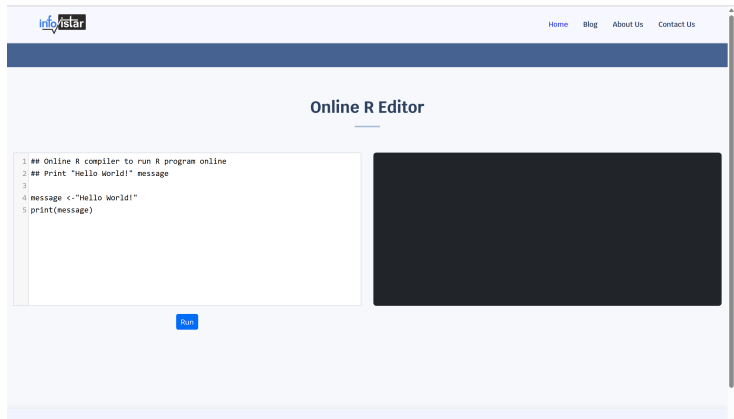
The screenshot displays the Ideone website interface. At the top, the URL 'ideone.com' is visible. The main area features a code editor with the following Java code:

```
1 /* package whatever; // don't place package name! */
2
3 import java.util.*;
4 import java.lang.*;
5 import java.io.*;
6
7 /* Name of the class has to be "Main" only if the class is public. */
8 class Ideone
9 {
10     public static void main (String[] args) throws java.lang.Exception
11     {
12         // your code goes here
13     }
14 }
```

Below the code editor are buttons for 'Java', 'stdin', 'stdout', 'more options', and a green 'Run' button. To the right, a sidebar contains a 'Sphere online judge' section with the text 'Learn How to Code' and 'Discover > Sphere Engine API'. Below this, it says 'Discover > IDE Widget' and 'Widget for compiling and running the source code in a web browser!'. The footer contains three sections: 'What is Ideone?' (describing it as an online compiler and debugging tool), 'How to use Ideone?' (instructions on entering code and input data), and 'Follow us' (with a 'Follow @ideone' button). A 'Sphere Engine™' section is also present, highlighting the technology used for remote execution.

Web: <https://infovistar.in/tools/compiler/r>

Infovistar is an Indian-based website that provides online compilers and IT training resources.



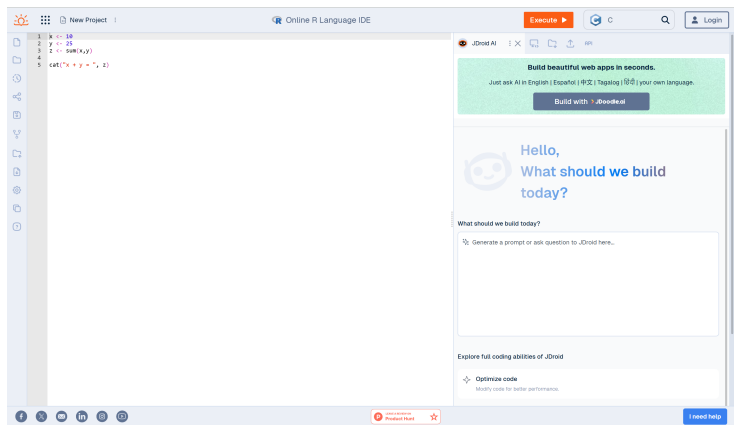
The screenshot displays the 'Online R Editor' interface on the Infovistar website. At the top left is the 'Infovistar' logo, and at the top right are navigation links for 'Home', 'Blog', 'About Us', and 'Contact Us'. The main heading 'Online R Editor' is centered. Below it, a code editor contains the following R code:

```
1 ## Online R compiler to run R program online
2 ## Print "Hello World!" message
3
4 message <-"Hello World!"
5 print(message)
```

Below the code editor is a blue 'Run' button. To the right of the code editor is a large black rectangular area, likely intended for the output of the R program. At the bottom of the browser window, standard navigation icons are visible.

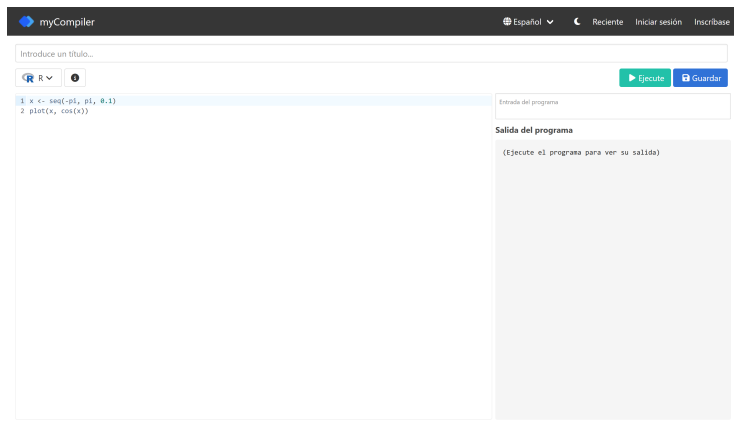
Web: <https://www.jdoodle.com/execute-r-online/>

JDoodle is a lightweight online IDE that supports many languages, including R.



Web: <https://mycompiler.io/new/r>

MyCompiler is a lightweight browser-based IDE supporting multiple programming languages.



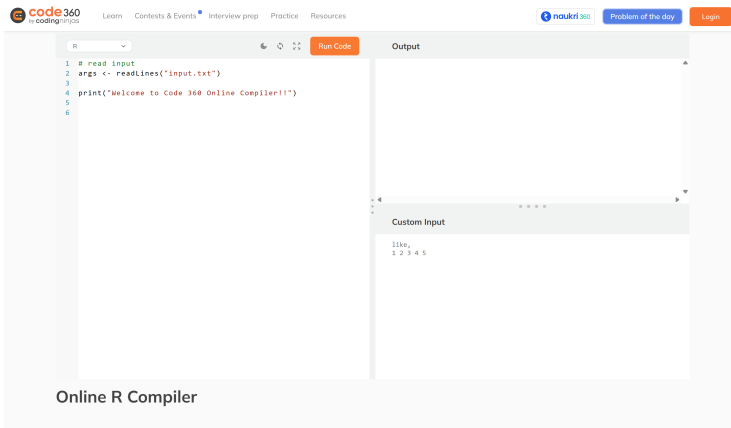
The screenshot displays the MyCompiler web IDE interface. At the top, there is a dark header with the 'myCompiler' logo on the left and navigation links for 'Español', 'Reciente', 'Iniciar sesión', and 'Inscribase' on the right. Below the header is a text input field labeled 'Introduce un título...'. Underneath this is a toolbar with a language selector set to 'R', a refresh icon, and two buttons: 'Ejecute' (with a play icon) and 'Guardar' (with a save icon). The main workspace is divided into two panes. The left pane contains R code:

```
1 x <- seq(-pi, pi, 0.1)
2 plot(x, cos(x))
```

The right pane is titled 'Salida del programa' and contains the instruction '(Ejecute el programa para ver su salida)'. At the bottom of the interface, there are several small navigation icons.

Web: <https://www.naukri.com/code360/ide>

Naukri's IDE is part of the Code360 portal, an educational extension of India's largest job platform.



The screenshot displays the Code360 Online R Compiler interface. At the top, the Code360 logo is on the left, and navigation links for 'Learn', 'Contests & Events', 'Interview prep', 'Practice', and 'Resources' are in the center. On the right, there are buttons for 'naukri 360', 'Problem of the day', and 'Login'. The main workspace is split into two panels: a code editor on the left and an output panel on the right. The code editor contains the following R code:

```
1 # read input
2 args <- readLines("input.txt")
3
4 print("Welcome to Code 360 Online Compiler!!")
5
6
```

The output panel shows the result of the code execution, which is a 'Custom Input' box containing the text:

```
like,
1 2 3 4 5
```

Below the workspace, the text 'Online R Compiler' is displayed.

Web: <https://www.newtum.com/>

Newtum is an online learning portal for children and beginners.

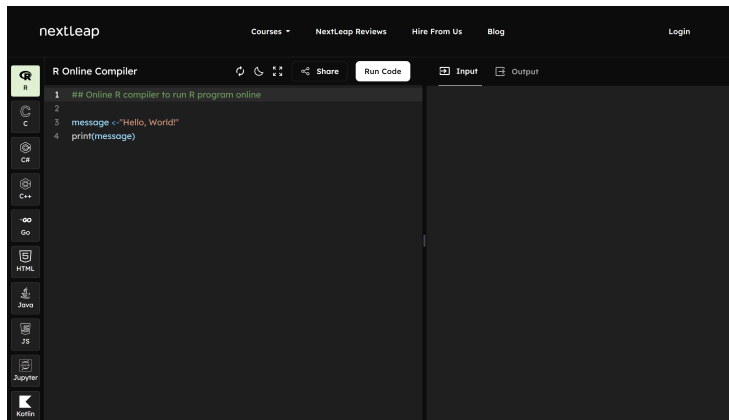
The screenshot displays the Newtum R Language Online Compiler interface. At the top left is the Newtum logo. A search bar contains the text "Eg. Write a R program to get the details of the objects in memory". The main editor area, titled "main.r", shows a single line of R code: `1 print('Hello! Welcome to the first AI-Based Editor')`. Below the editor are "Run" and "Clear" buttons, and a "Command Line Arguments" input field. A vertical sidebar on the left contains icons for various programming languages: Python, JavaScript, Java, C++, C, PHP, and others. On the right side, there are two panels: "Printing in R Language" with the text "Allow to display information on the screen or console.", and "Code Explanation" which provides a bulleted list:

- print() is a function used to display a message on the console.
- In this case, it prints the string 'Hello! Welcome to the first AI-Based Editor'.

At the bottom of the interface, there are links for "API", "How-to-use", and "Contact Us", a copyright notice "Copyright © 2025 Newtum. All Right Reserved.", and a power by "Techaroha AI".

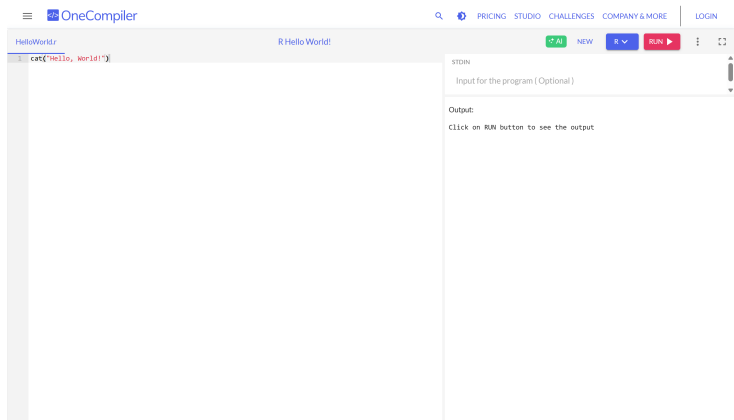
Web: <https://www.nextleap.app/>

NextLeap is a career acceleration platform in India.



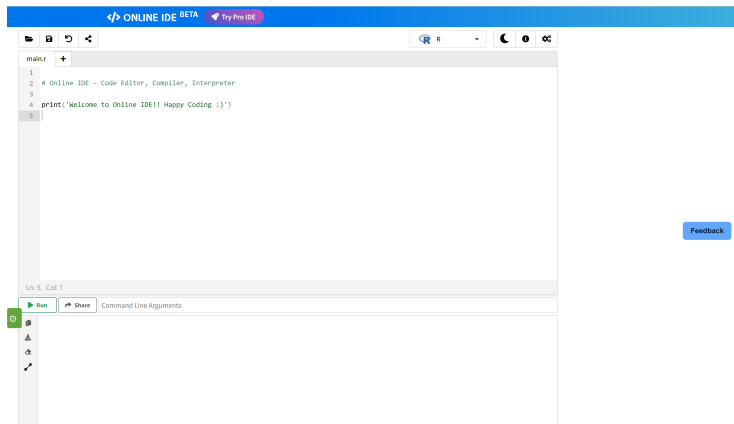
Web: <https://onecompiler.com/r>

OneCompiler is a general-purpose online IDE that supports dozens of languages.



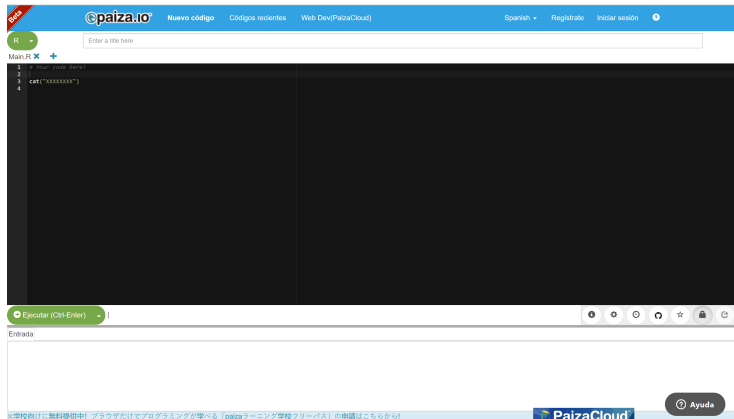
Web: <https://www.online-ide.com/>

Online IDE is a basic execution tool accessible via [online-ide.com](https://www.online-ide.com/).



Web: <https://paiza.io>

Paiza.IO is a cloud-based compiler platform developed in Japan.

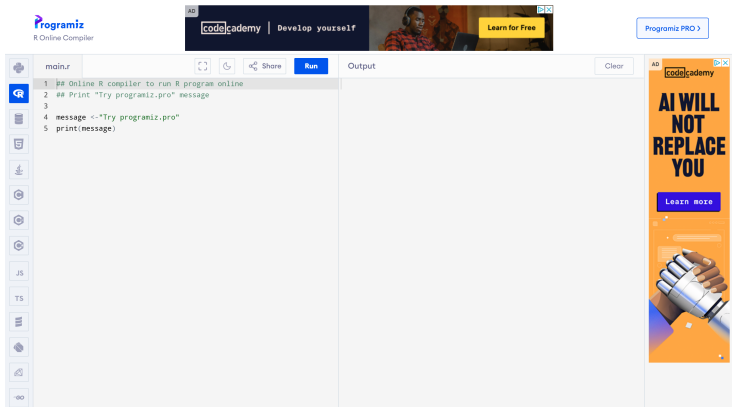


The screenshot displays the PaizaIO web interface. At the top, there is a blue navigation bar with the PaizaIO logo, a 'Nuevo código' button, and links for 'Códigos recientes' and 'Web Dev(PaizaCloud)'. On the right side of the bar are options for 'Spanish', 'Registrarse', and 'Iniciar sesión'. Below the navigation bar, there is a green 'R' language selector and a text input field labeled 'Enter a title here'. The main area is a dark-themed code editor with a file tab labeled 'Main.R'. The code in the editor consists of four lines: a comment '# #lang= r', a blank line, a function definition 'cat("XXXXXXXXXX")', and another blank line. Below the code editor is a green 'Ejecutar (Ctrl-Enter)' button. Underneath the button is an 'Entrada' (Input) field. At the bottom of the interface, there is a light blue footer with a promotional message in Spanish, the PaizaCloud logo, and an 'Ayuda' (Help) button.

Web:

<https://www.programiz.com/r-programming/online-compiler>

Programiz is a Nepal-based educational platform offering programming tutorials.



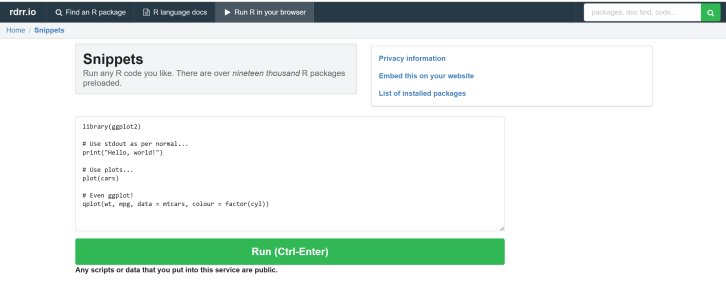
The screenshot displays the Programiz R Online Compiler interface. At the top left, the Programiz logo and 'R Online Compiler' text are visible. A navigation bar includes the Codecademy logo with the tagline 'Develop yourself', a 'Learn for Free' button, and a 'Programiz PRO' button. The main workspace is divided into a code editor on the left and an 'Output' pane on the right. The code editor contains the following R code:

```
1 # Online R compiler to run R program online
2 ## Print "Try programiz.pro" message
3
4 message <- "Try programiz.pro"
5 print(message)
```

Below the code editor is a vertical toolbar with icons for file operations and language selection (JS, TS). The 'Output' pane is currently empty. On the right side of the interface, there is a vertical advertisement for Codecademy with the text 'AI WILL NOT REPLACE YOU' and a 'Learn more' button. The bottom of the interface features a dark blue footer with navigation icons.

Web: <https://rdrr.io/snippets/>

Rdrr.io is a platform designed to help users browse R documentation and execute code snippets.



The screenshot shows the Rdrr.io interface. At the top, there is a navigation bar with the Rdrr.io logo, a search bar containing "packages, doc text, code...", and links for "Find an R package", "R language docs", and "Run R in your browser". Below the navigation bar, the page title is "Snippets". A sub-header "Snippets" is followed by the text "Run any R code you like. There are over *nineteen thousand* R packages preloaded." To the right, there are links for "Privacy information", "Embed this on your website", and "List of installed packages". The main content area contains a code editor with the following R code:

```
library(ggplot2)
# Use stdout as per normal...
print("Hello, world!")

# Use plots...
plot(cars)

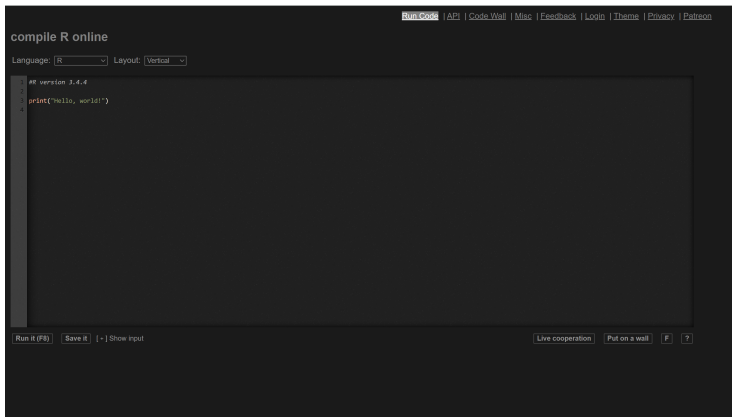
# Even ggplot!
ggplot(wt, mpg, data = mtcars, colour = factor(cyl))
```

Below the code editor is a large green button labeled "Run (Ctrl-Enter)". Underneath the button, a warning states: "Any scripts or data that you put into this service are public." At the bottom of the page, there is a dark footer with three columns of information:

- R Package Documentation**
 - [rdrr.io home](#)
 - [R language documentation](#)
 - [Run R code online](#)
- Browse R Packages**
 - [CRAN packages](#)
 - [Bioconductor packages](#)
 - [R-Forge packages](#)
 - [GitHub packages](#)
- We want your feedback!**
 - Note that we can't provide technical support on individual packages. You should contact the package authors for that.
 - [Tweet to @rdrrHQ](#)
 - [Improve this page](#)

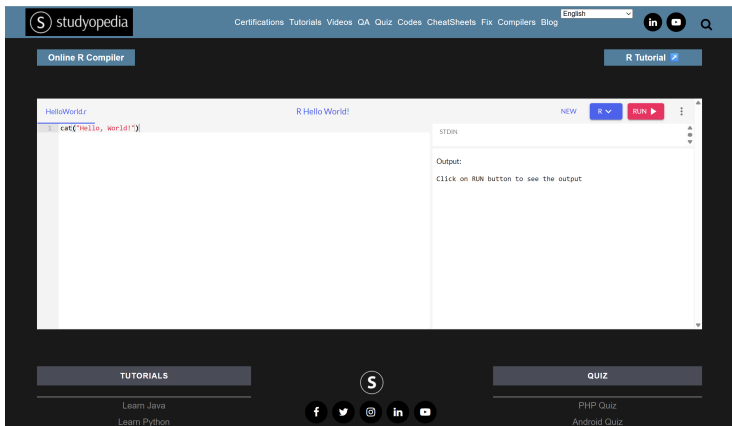
Web: <https://rextester.com>

Rextester is an online compiler that supports multiple programming languages.



Web: <https://www.studyopedia.com/>

Studyopedia is an educational website offering tutorials in programming and web technologies.



Web: https://www.w3schools.com/r/r_tryit.asp

W3Schools is a global web development tutorial platform.

The screenshot shows the W3Schools website interface. At the top, there is a navigation bar with the W3Schools logo, a search bar, and various utility links like 'Plus', 'Spaces', 'For Teachers', 'Get Certified', and 'Sign in'. Below the navigation bar is a horizontal menu with categories such as MySQL, JQUERY, EXCEL, XML, DJANGO, NUMPY, PANDAS, NODEJS, DSA, TYPESCRIPT, ANGULAR, GIT, POSTGRESQL, MONGODB, ASP, AI, and R. The 'R' category is currently selected and highlighted in green.

The main content area is titled 'R Online Compiler' and features a 'Previous' button on the left and a 'Next' button on the right. Below this, the section is titled 'R Compiler (Editor)'. A descriptive text states: 'With our online R compiler, you can edit R code, and view the result in your browser.' Below the text is a code editor interface with a 'Run' button. The code editor shows the following code:

```
"Hello World!"  
5 + 5
```

The output area on the right displays the result:

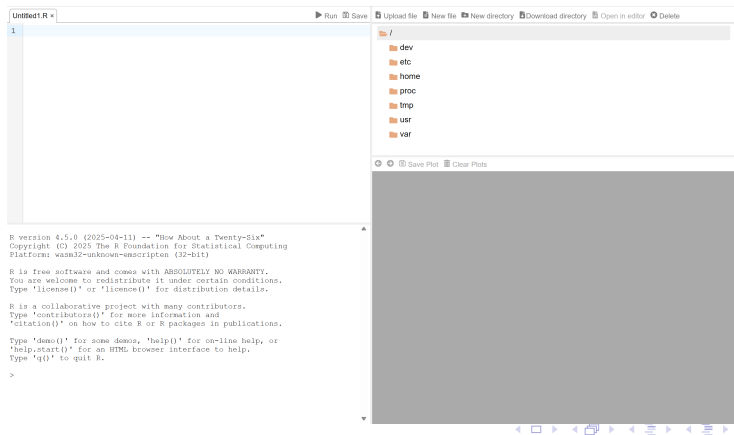
```
Hello World!  
10
```

Below the code editor is a 'Try it Yourself >' button. A note below the button says: 'Click on the "Try it Yourself" button to see how it works.'

At the bottom of the page, there is a section titled 'R Compiler Explained' and a 'LEARN R GET CERTIFIED' button.

Web: <https://webr.r-wasm.org/latest/>

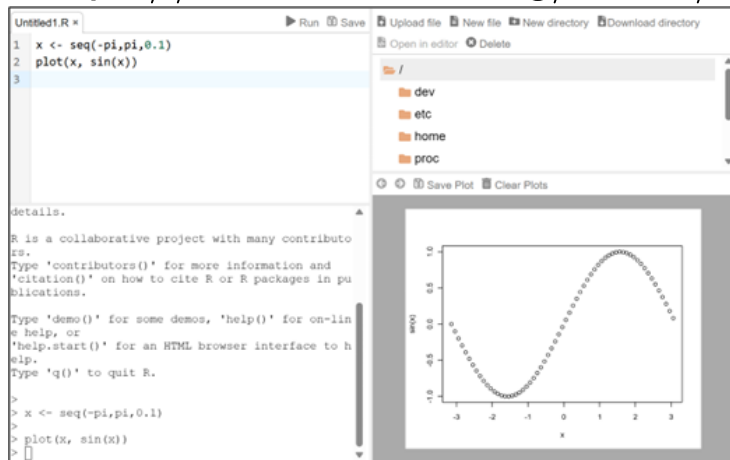
WebR is a project built on WebAssembly by the R community and R Foundation.



Conclusions and future work

Chosen environment:

<https://webr.r-wasm.org/latest/>



Benefits of webr.r-wasm.org (1/2)

- **Basic Code Execution (BCE):** Whether the platform allows running basic R code successfully.
- **Offline Execution (OE):** Whether the environment can load entirely in the browser and support simple calculations without an active internet connection.
- **Browser File Upload (BFU):** Ability to upload files directly from the local device via the browser for use within the R environment.
- **External File Upload (EFU):** Ability to access and use external files, such as datasets or R scripts hosted on platforms like GitHub.
- **Access to Default Datasets (ADD):** Availability of built-in R datasets for immediate use.
- **Graph Generation (GG):** Capability to generate and display graphical outputs from R code.

Benefits of webr.r-wasm.org (2/2)

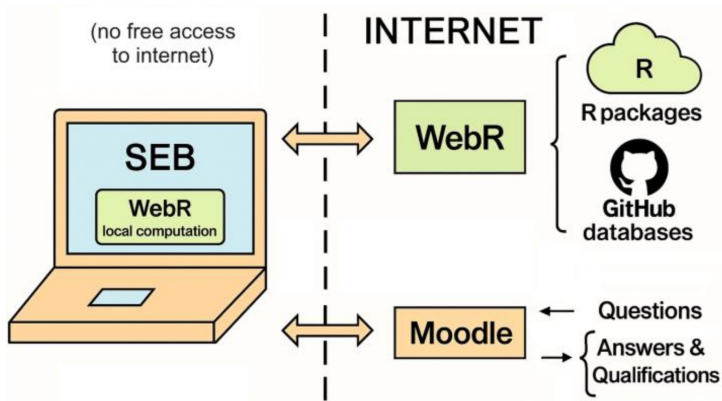
- **NOT Code Sharing (CS):** Whether users can NOT share their code or access code executed by others.
- **NO Artificial Intelligence (AI):** NO integration with AI-based tools or services, including image or text processing.
- **NO Search Tool (ST):** NO inclusion of built-in search functions to find code examples or documentation.
- **NO Account Requirement (AR):** Access to the platform does NOT require user registration or subscription.

Performance Comparison: Real Exam Conditions

- **January 2025 – ETSII-UPM:** An alternative R platform was tested with **500 students** during final exams.
 - Result: **Severe web saturation issues**, including lag, crashes, and incomplete submissions.
- **June 2025 – ETSII-UPM: 535 students** took the exam simultaneously using **WebR (webr.r-wasm.org)**.
 - Result: **No incidents reported**. The platform remained stable and responsive throughout the session.

Conclusions and future work

- WebR selected for its robust and secure features.
- Minimal server interaction: ideal for high-volume exams.
- Positive feedback from students and instructors.



Conclusions

- A secure digital assessment system is feasible and effective.
- Moodle + SEB + WebR is scalable to hundreds of students.
- Future work: compatibility with Android/Chromebook, UX improvements.