Secure Digital Assessment of Data Analysis Courses Using R

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ACKNOWLEDGEMENTS

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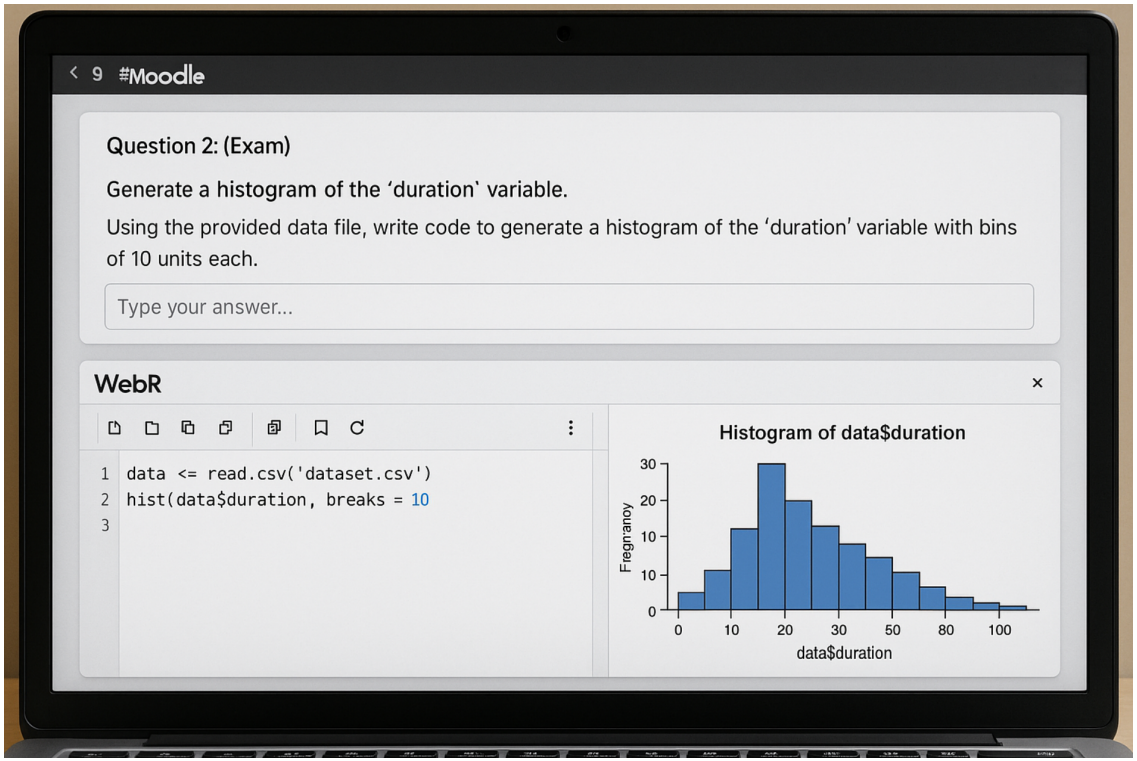
Background and Motivation

- 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.



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!

Objective

Need for secure digital assessment in programming-heavy courses.

We propose a secure framework, based on:

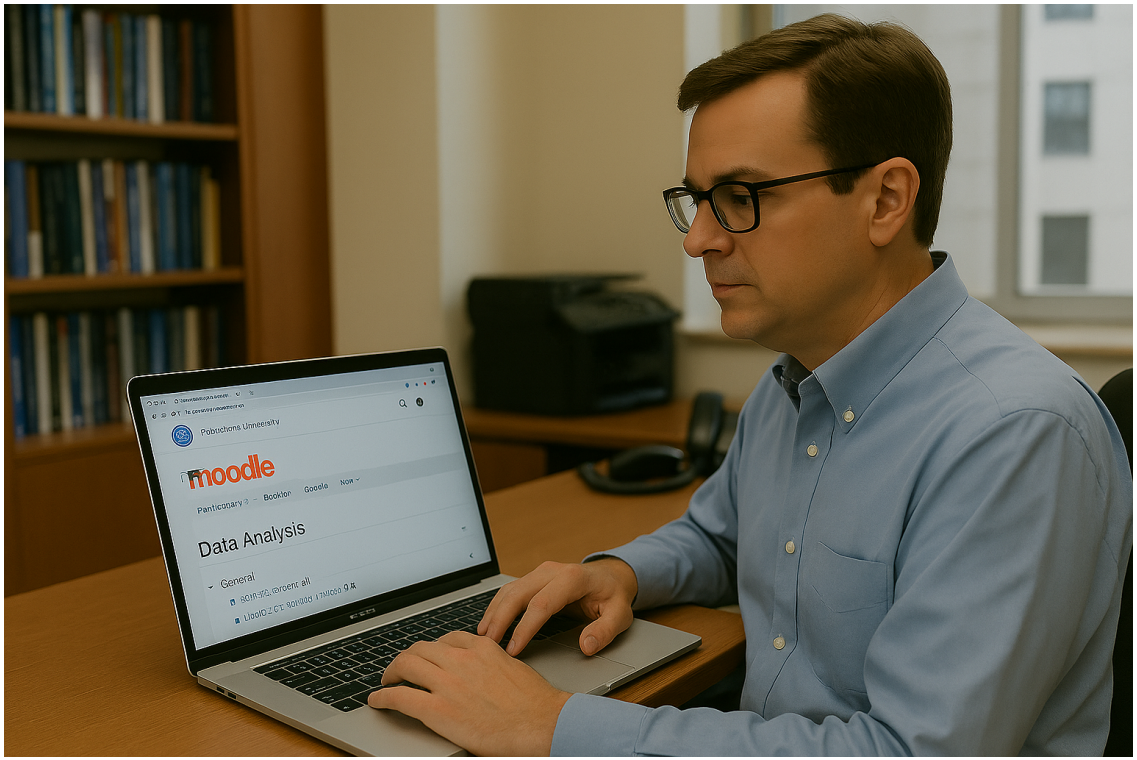
- Moodle
- Safe Exam Browser (SEB)
- WebR.

Proposed Secure Assessment Setup

Proposed Secure Assessment Setup

Moodle:

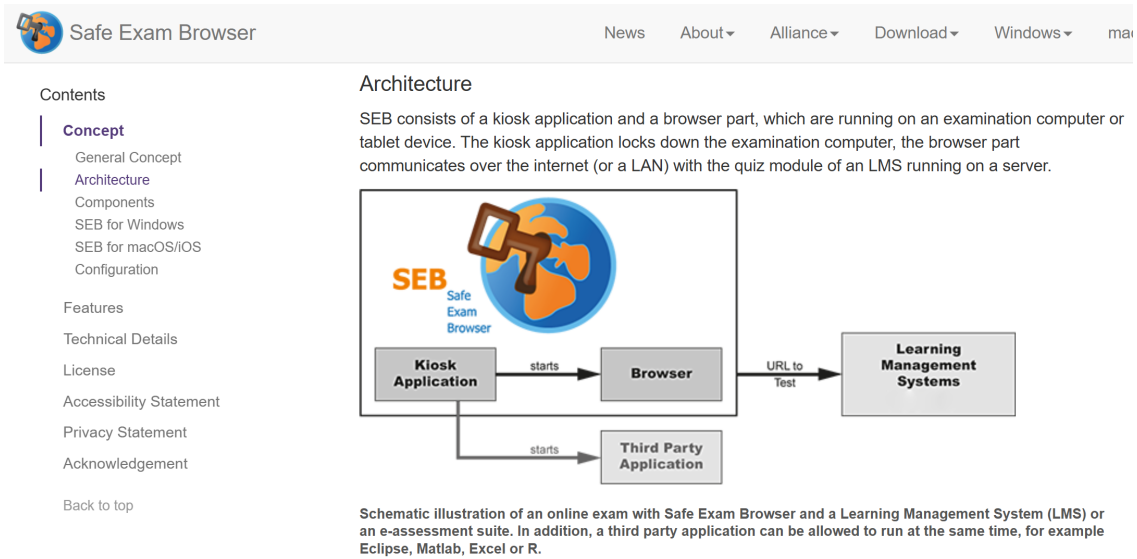
- Moodle is fully integrated with UPM's digital infrastructure.
- Moodle is used to evaluate simultaneously hundred of students.
- Students are used to using Moodle.



Proposed Secure Assessment Setup

Safe Exam Browser

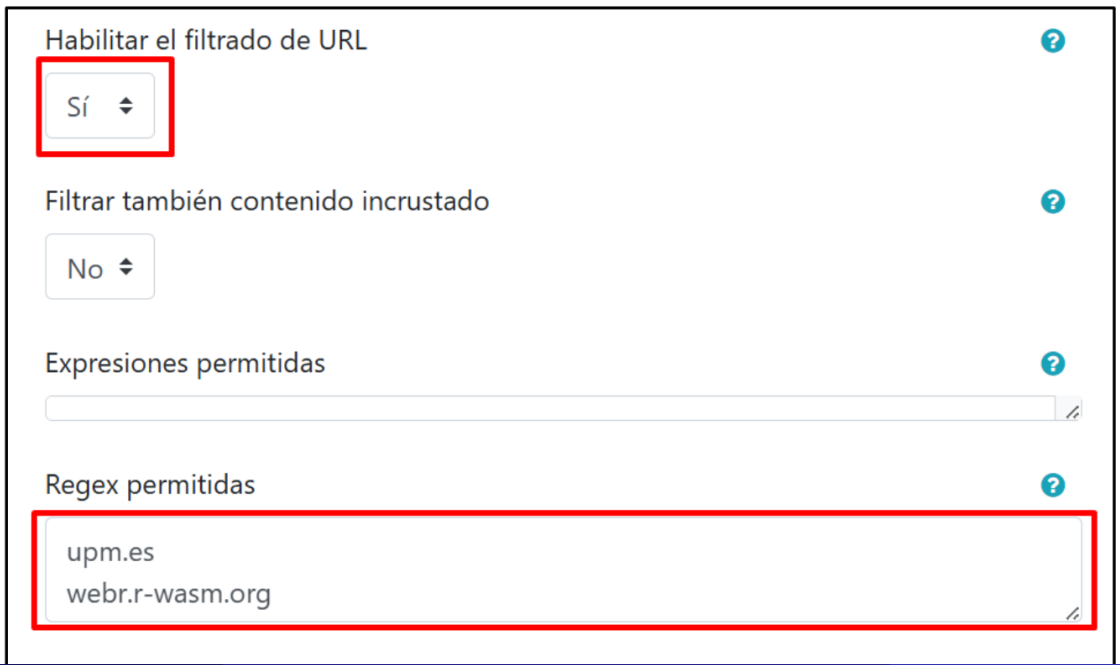
- Developed by ETH Zurich, IT Services.
- SEB locks down the exam environment, restricting web/app access.
- SEB is integrated in Moodle.



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.

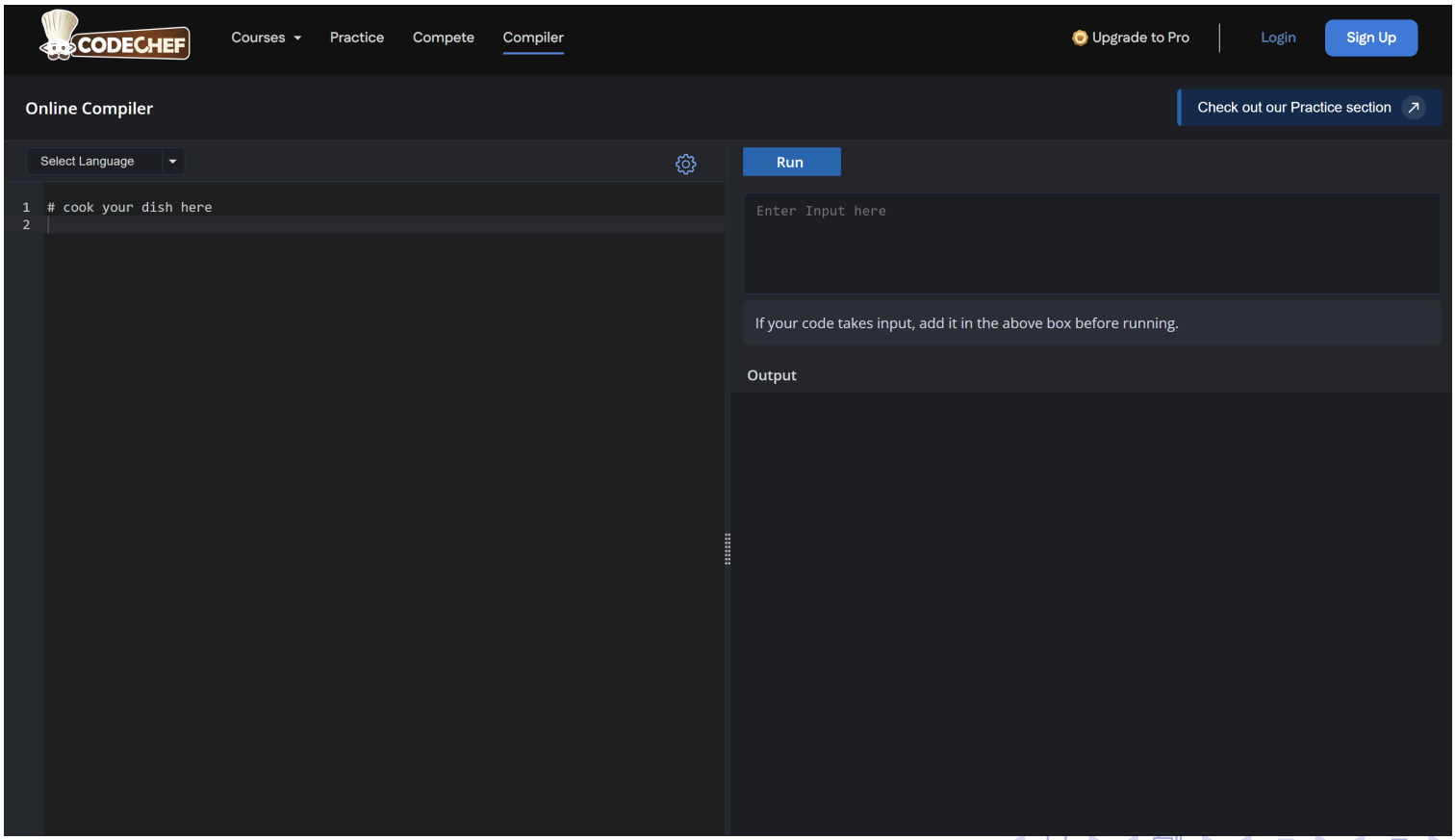


R Web Platforms

CodeChef

Web: `https://www.codechef.com/ide`

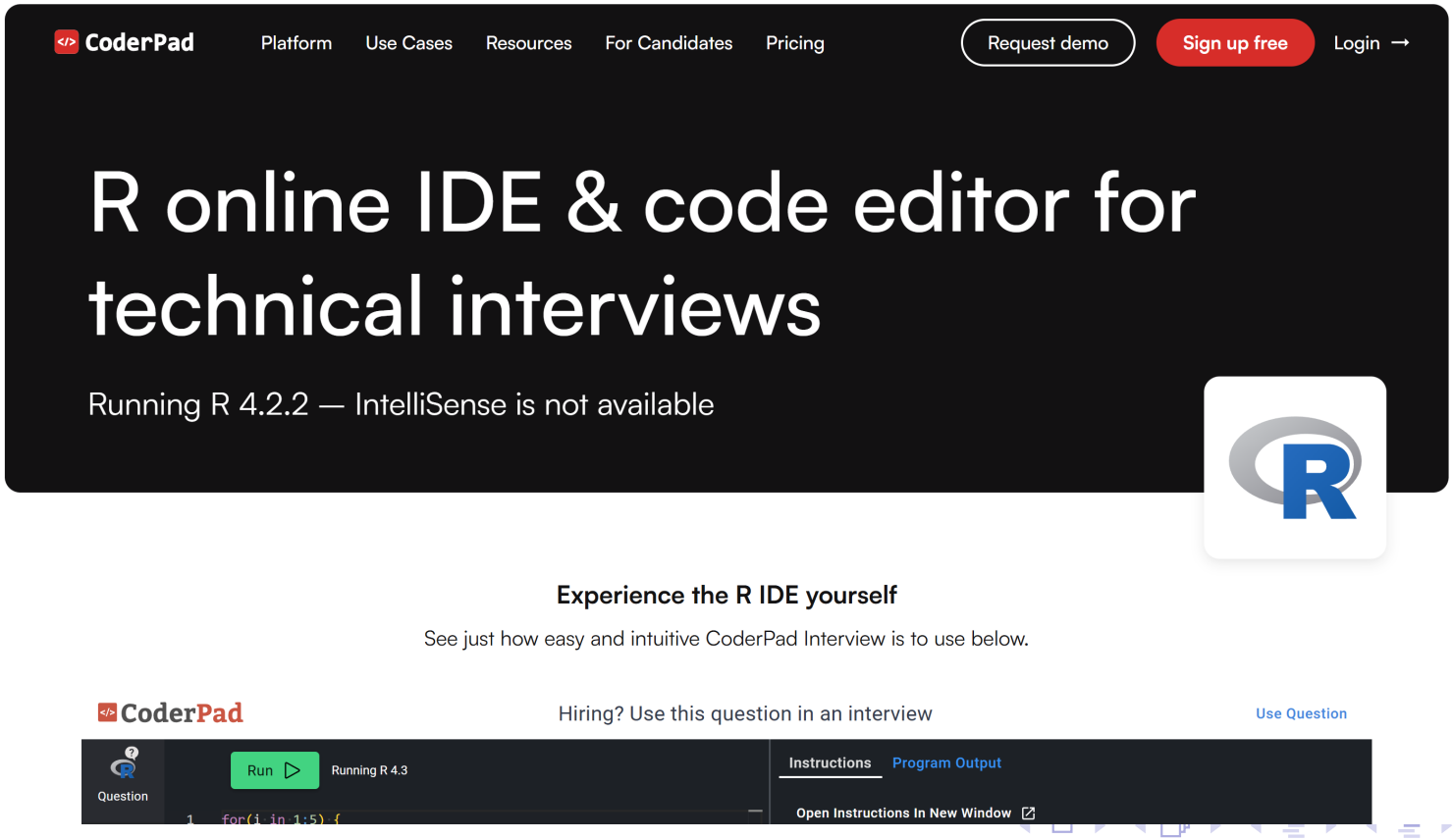
CodeChef is a competitive programming platform run by the Indian company Unacademy.



Coderpad

Web: `https://coderpad.io/languages/r/`

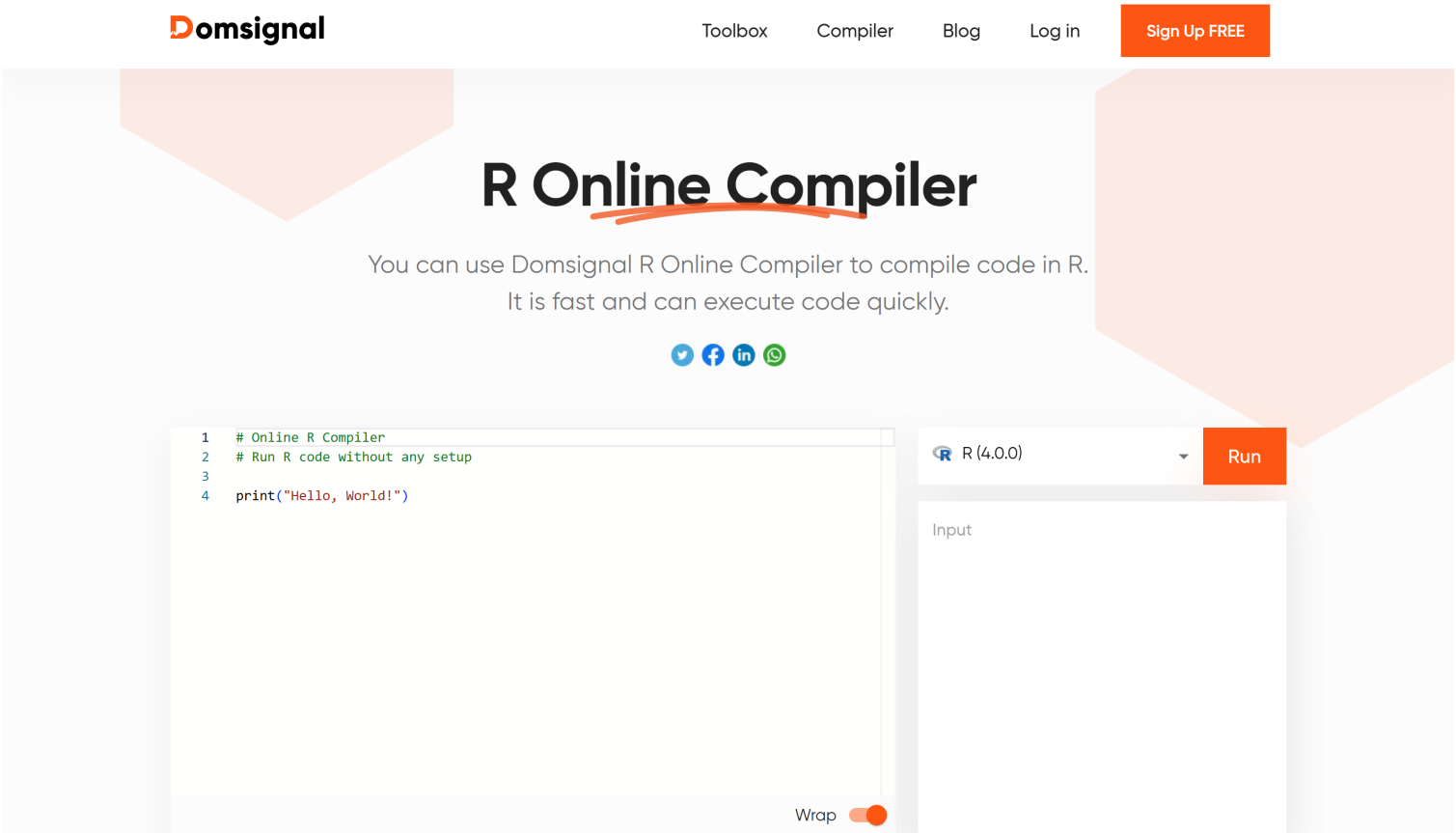
Coderpad is developed by CoderPad, Inc., a US-based company that provides real-time collaborative coding environments.



DomSignal

Web: `https://domsignal.com/r-online-compiler`

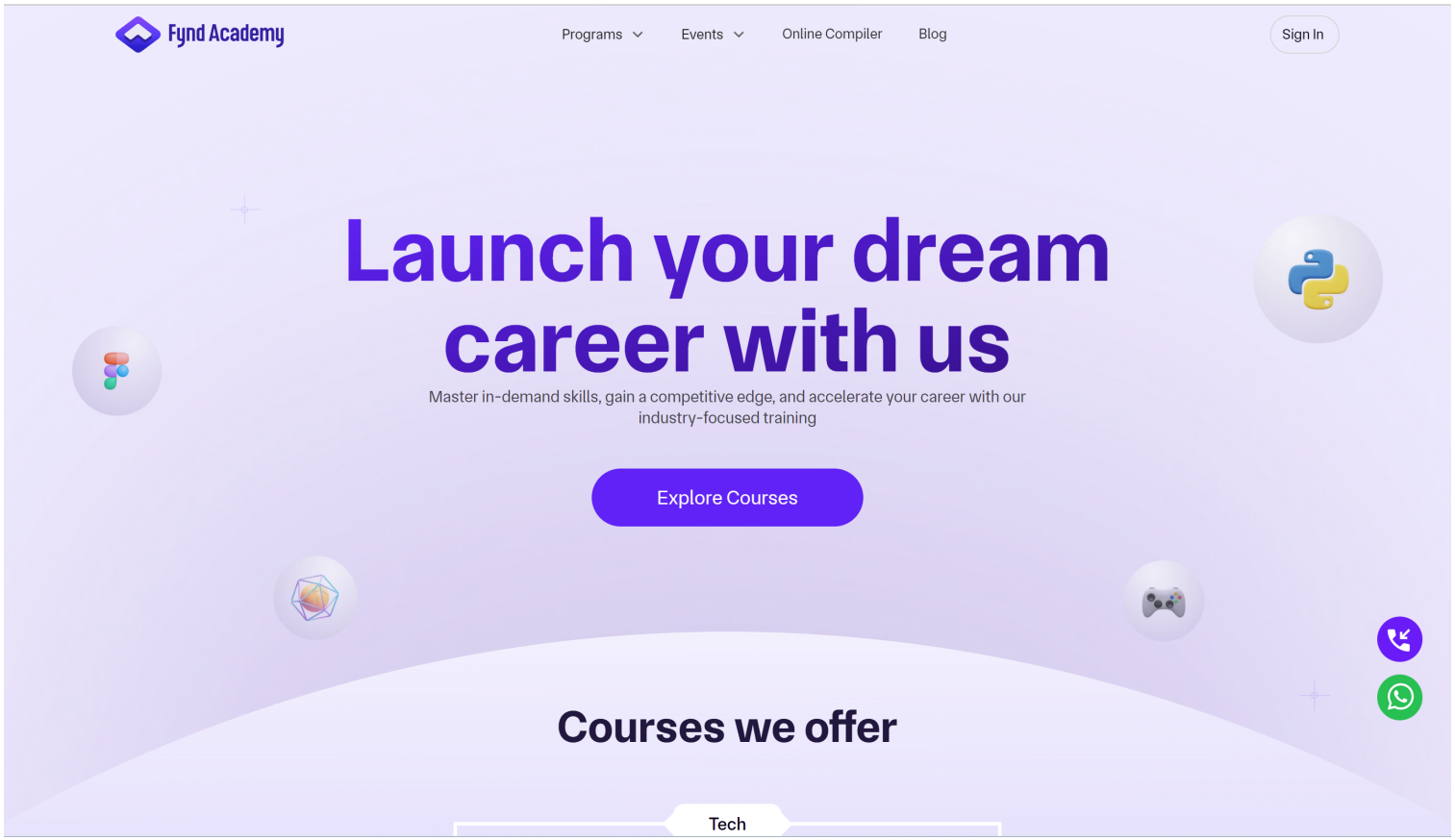
DomSignal is a lightweight code execution service hosted at domsignal.com.



Fynd Academy

Web: `https://www.fynd.academy/`

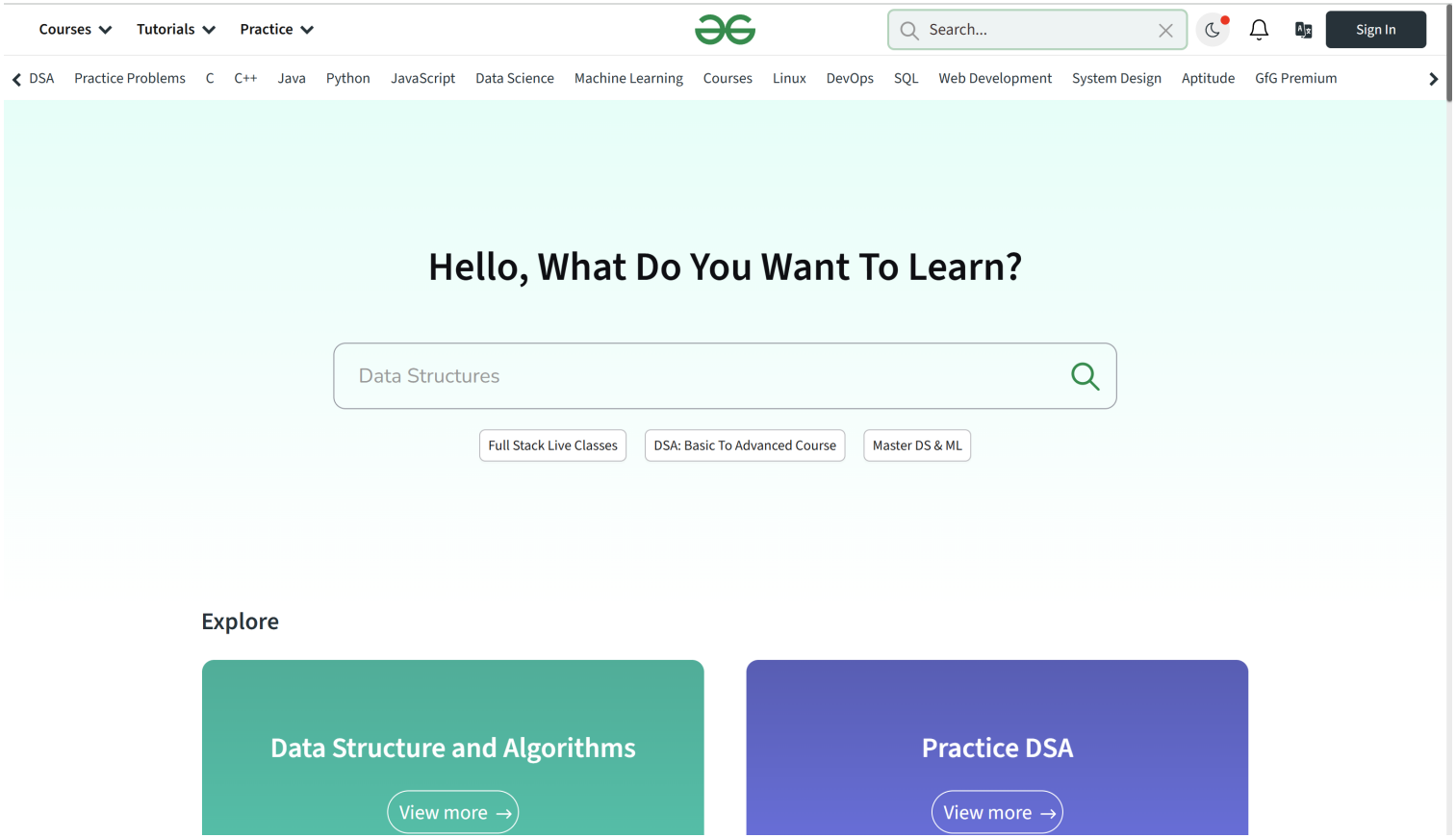
Fynd Academy is an Indian learning platform affiliated with Fynd.



GeeksForGeeks

Web: `https://ide.geeksforgeeks.org/`

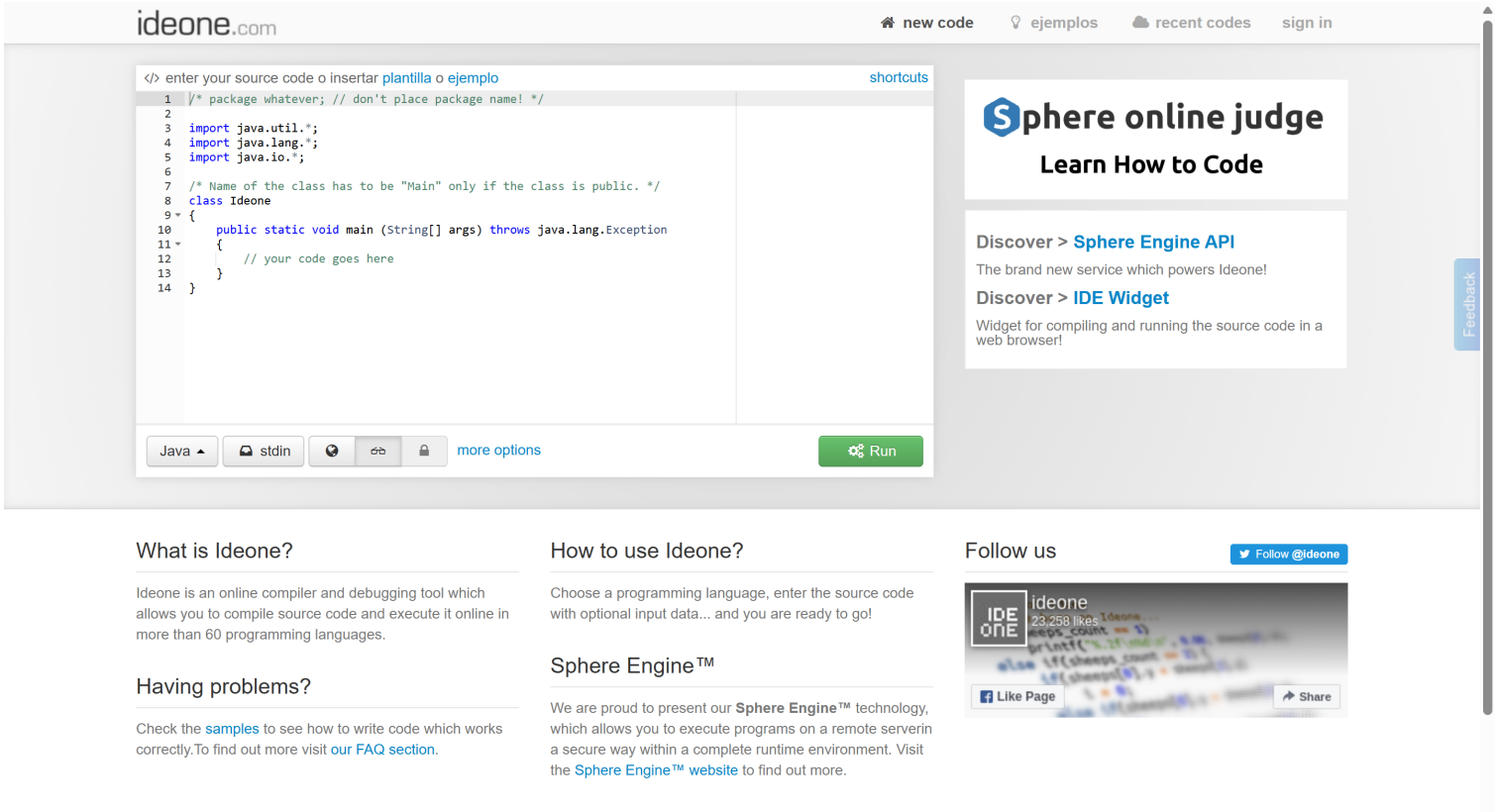
GeeksForGeeks IDE is part of a popular educational platform.



Ideone

Web: `https://ideone.com/`

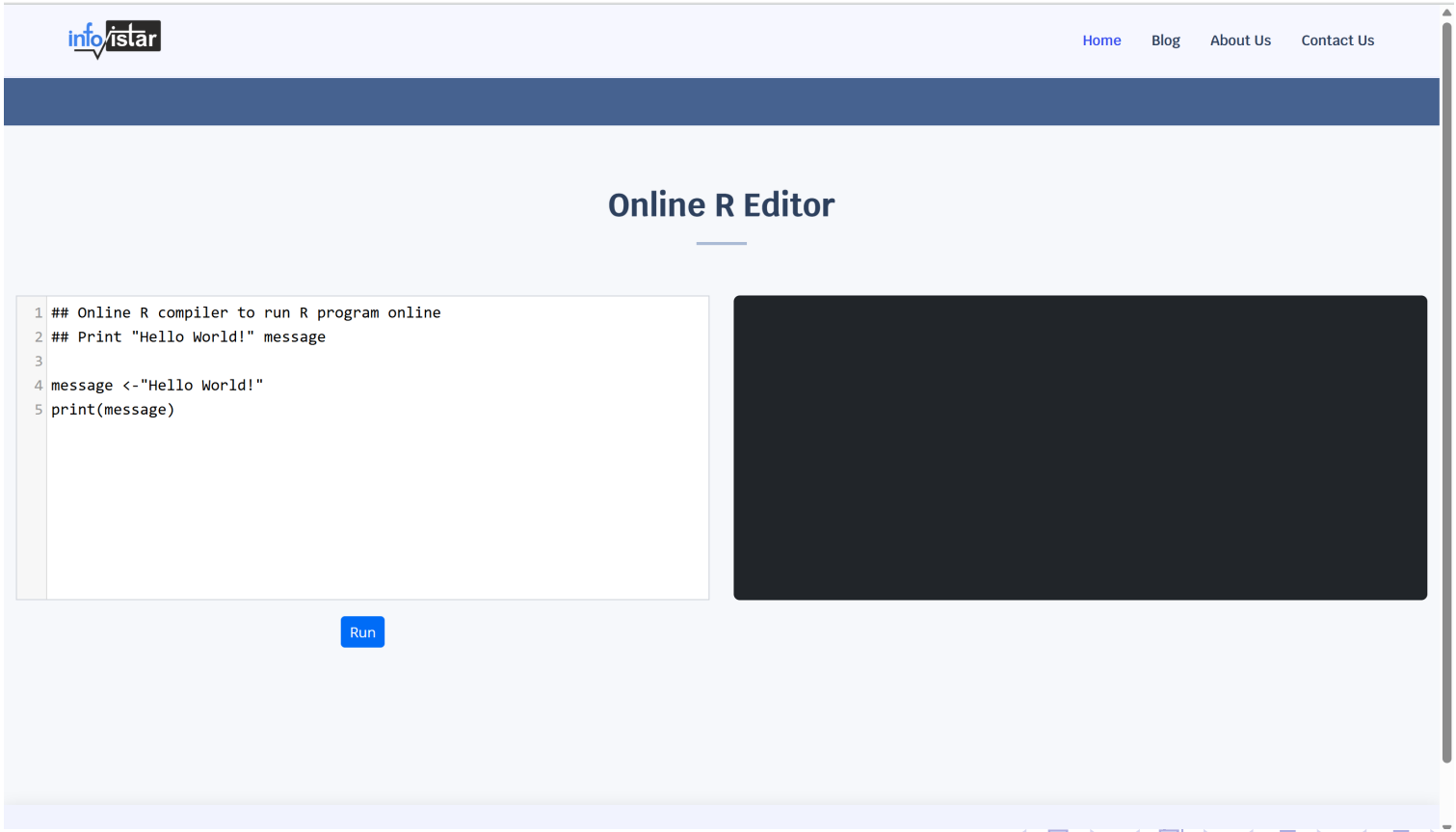
Ideone is operated by Sphere Research Labs and functions as both a code-sharing tool and an online judge system.



Infovistar

Web: `https://infovistar.in/tools/compiler/r`

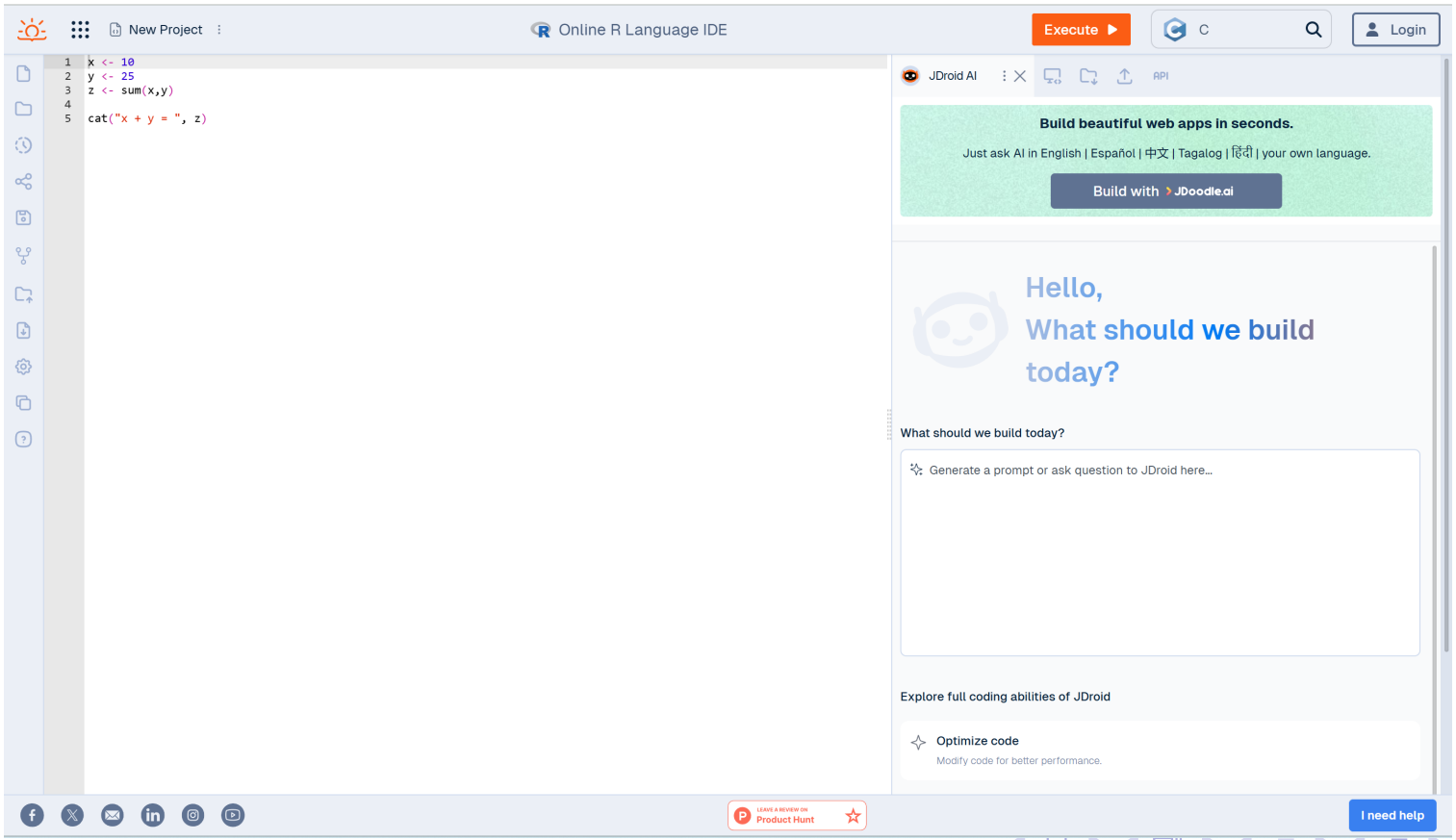
Infovistar is an Indian-based website that provides online compilers and IT training resources.



JDoodle

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

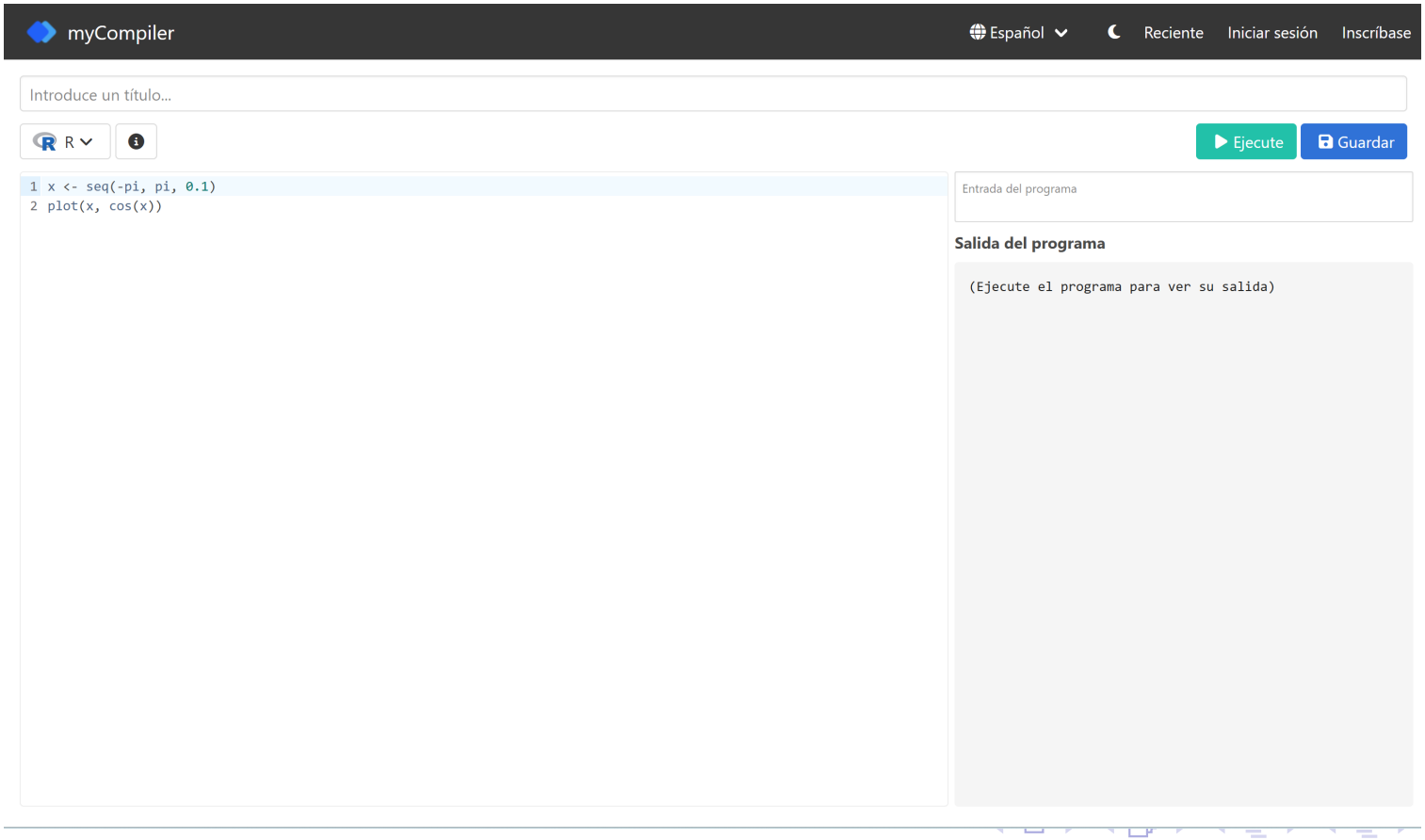
JDoodle is a lightweight online IDE that supports many languages, including R.



MyCompiler

Web: `https://mycompiler.io/new/r`

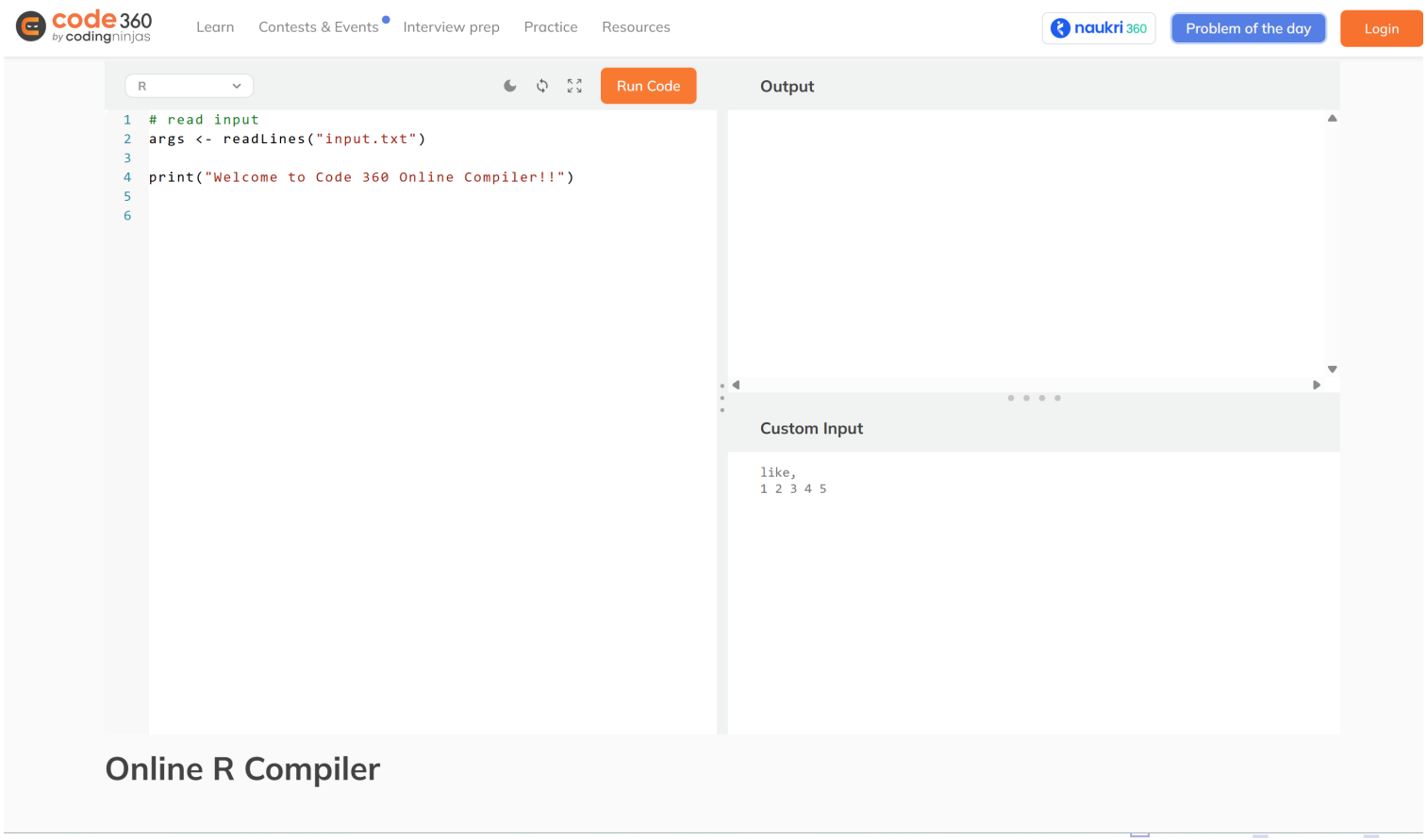
MyCompiler is a lightweight browser-based IDE supporting multiple programming languages.



Naukri

Web: `https://www.naukri.com/code360/ide`

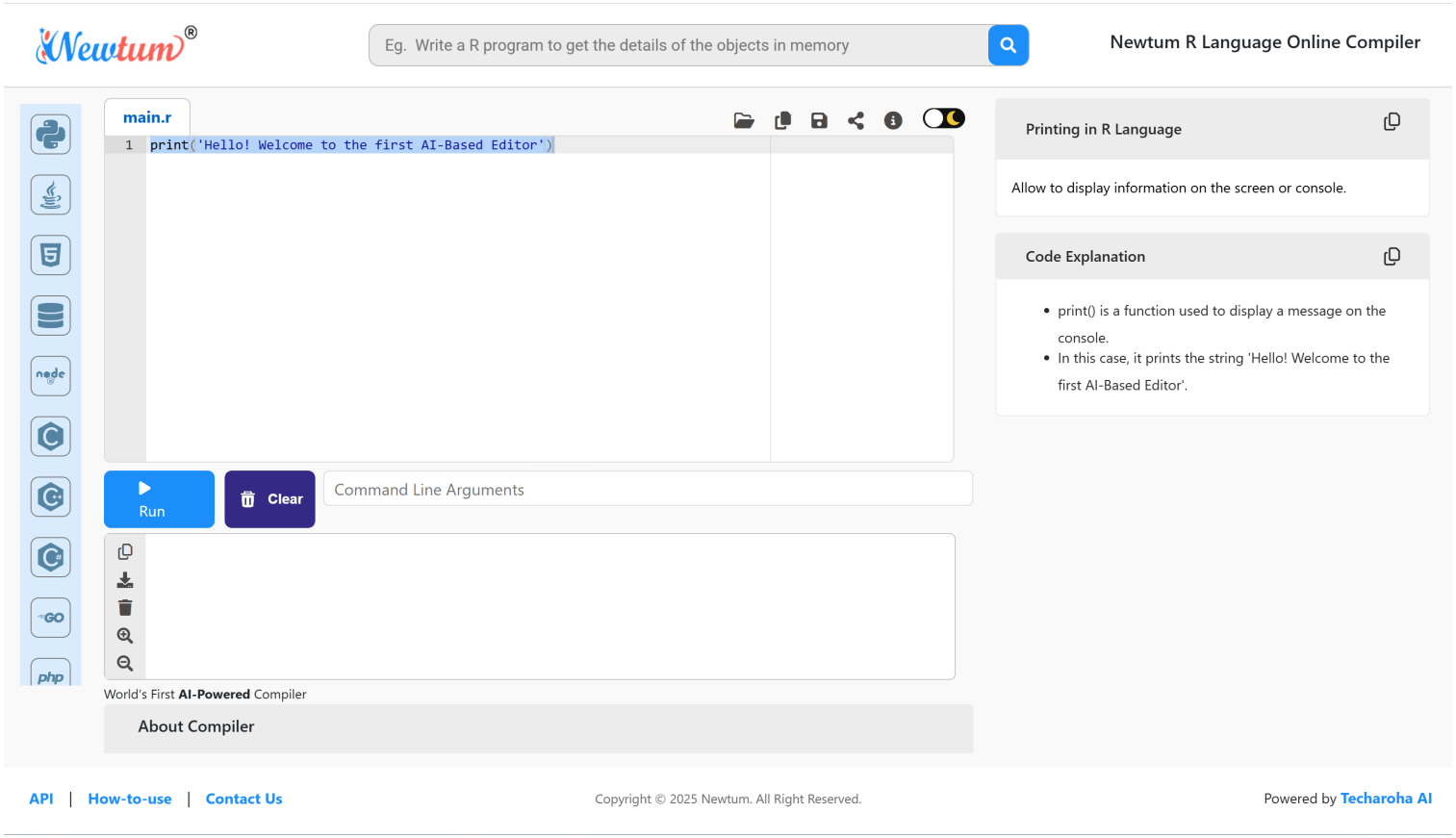
Naukri's IDE is part of the Code360 portal, an educational extension of India's largest job platform.



Newtum

Web: `https://www.newtum.com/`

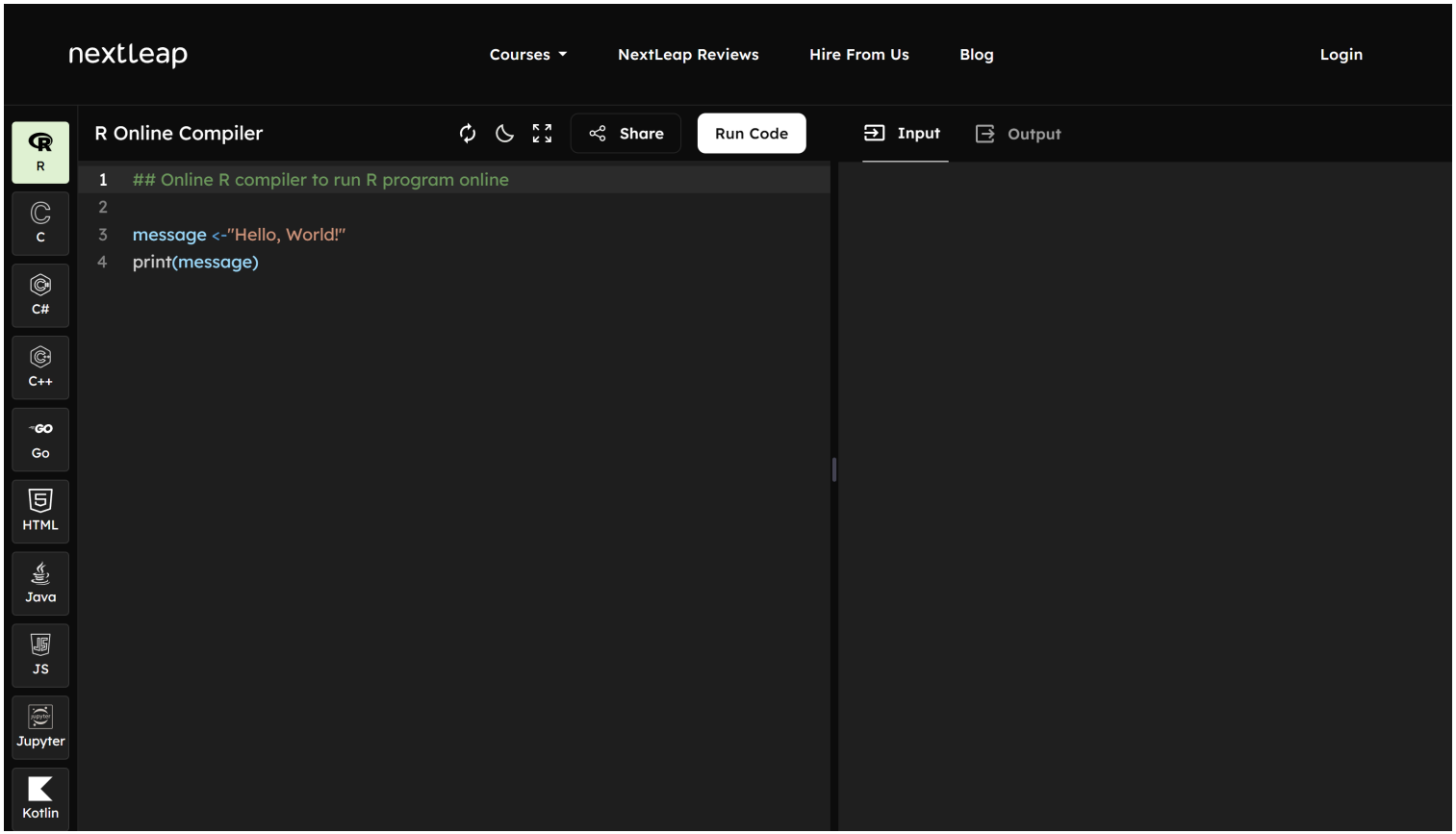
Newtum is an online learning portal for children and beginners.



NextLeap

Web: `https://www.nextleap.app/`

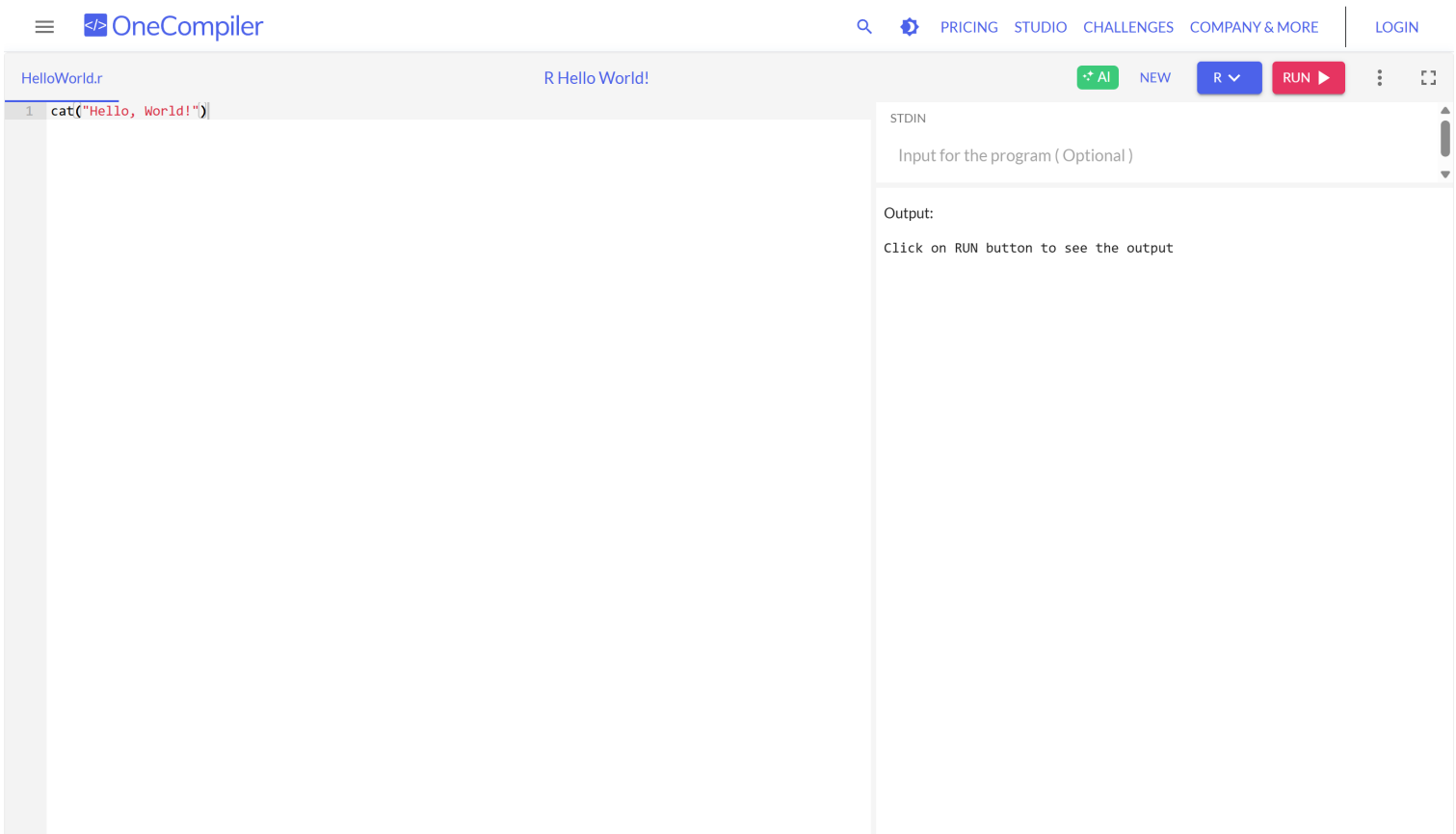
NextLeap is a career acceleration platform in India.



OneCompiler

Web: `https://onecompiler.com/r`

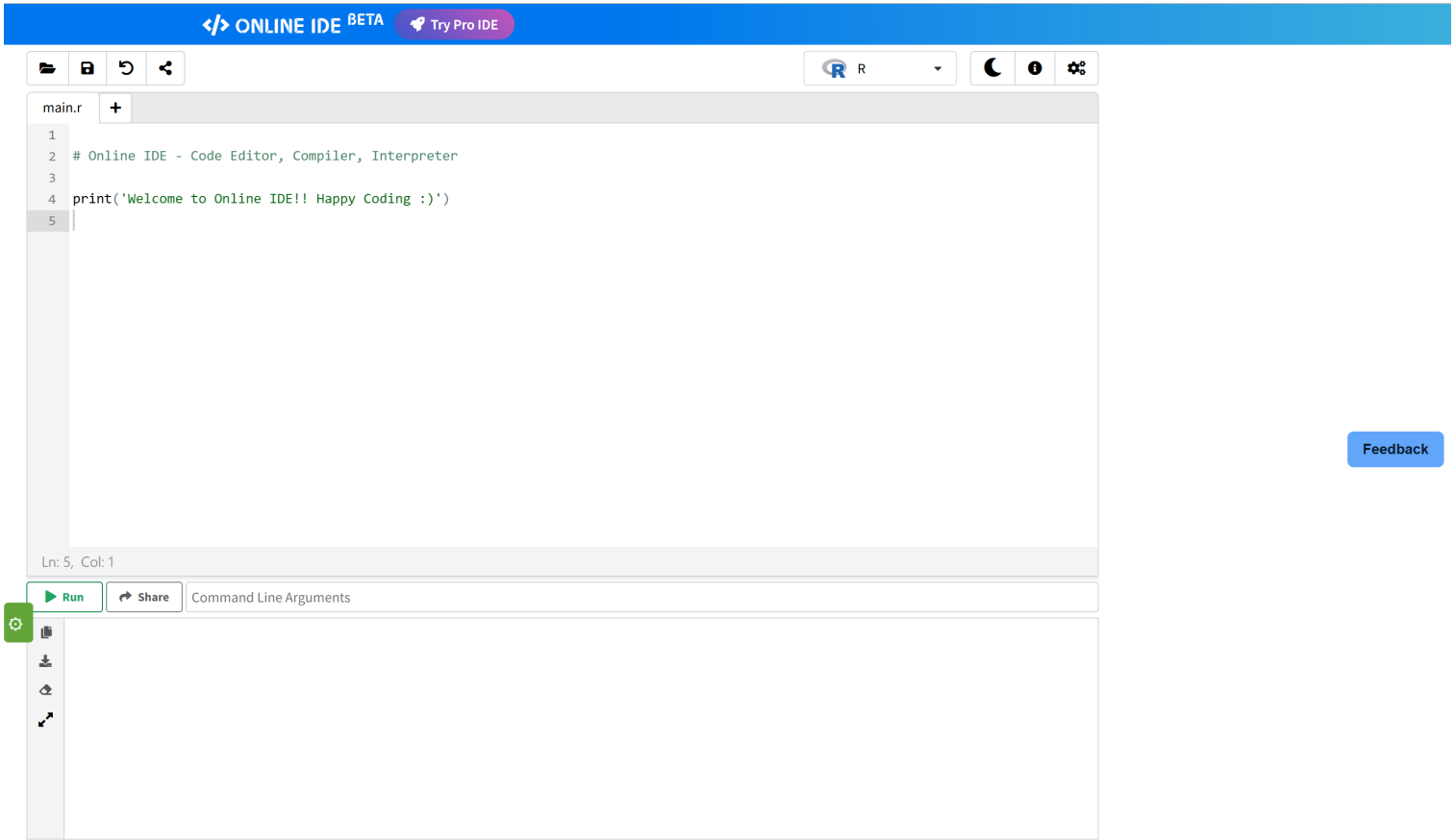
OneCompiler is a general-purpose online IDE that supports dozens of languages.



OnlineIDE

Web: `https://www.online-ide.com/`

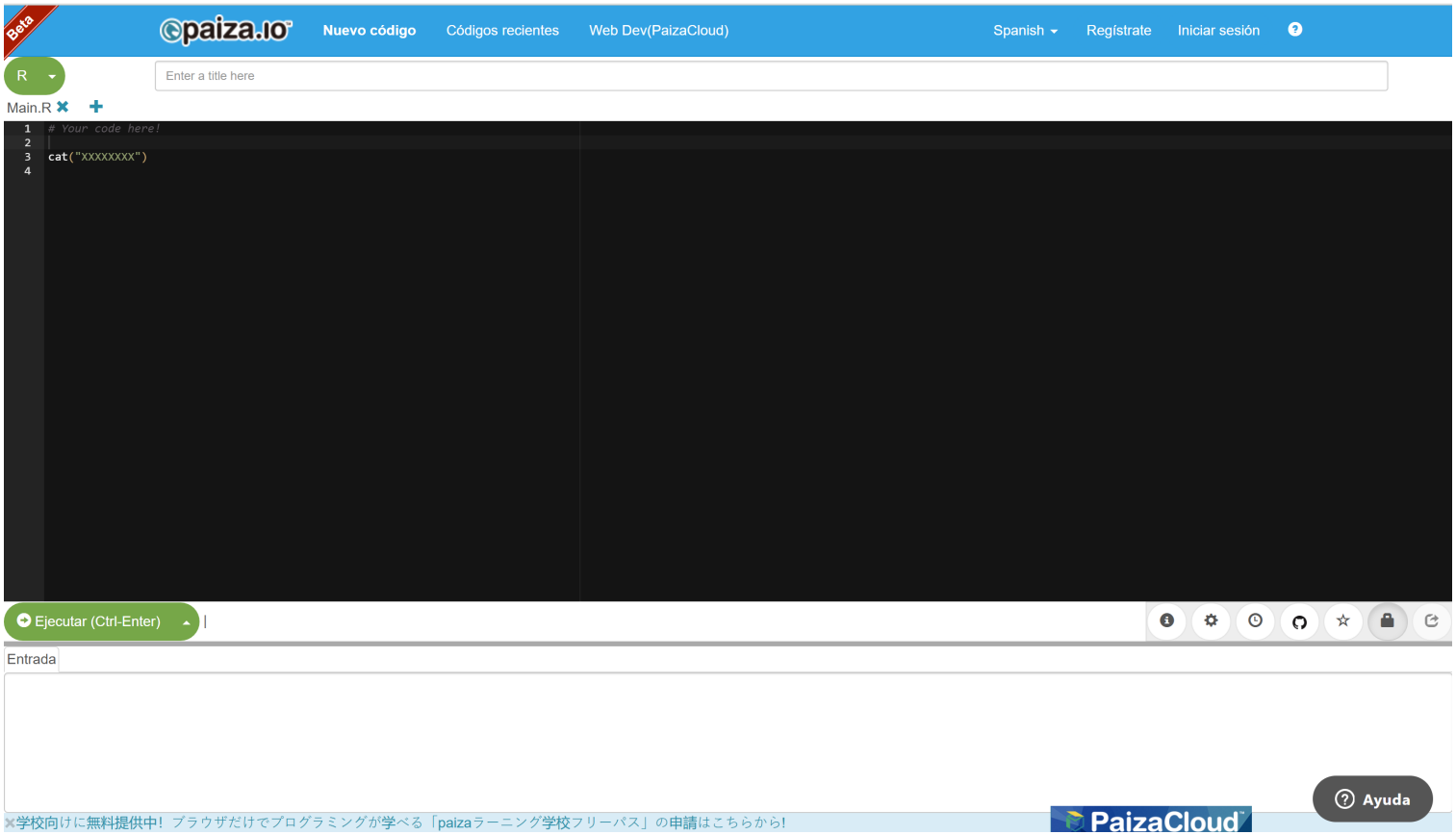
Online IDE is a basic execution tool accessible via online-ide.com.



PaizaIO

Web: `https://paiza.io`

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

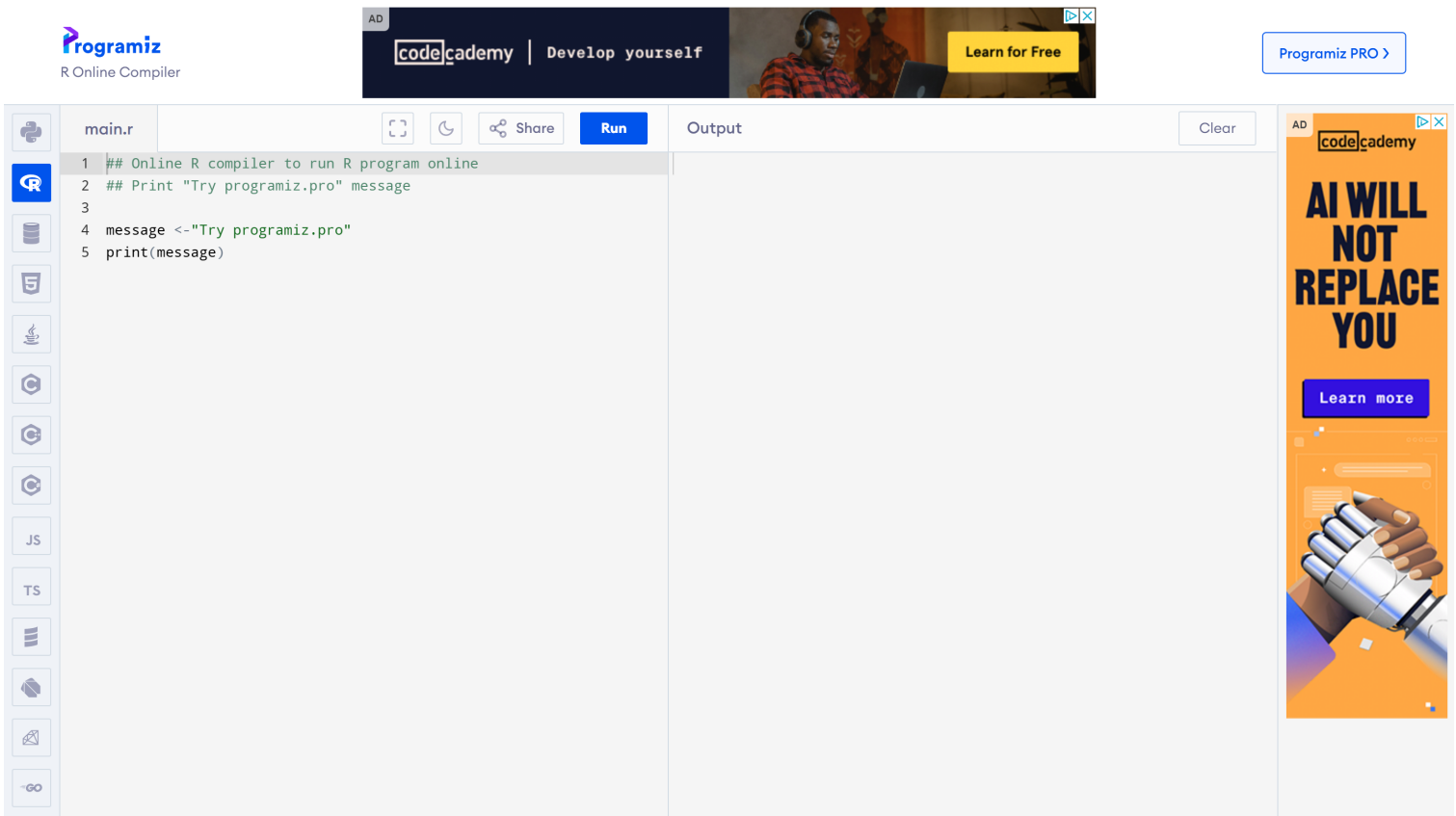


Programiz

Web:

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

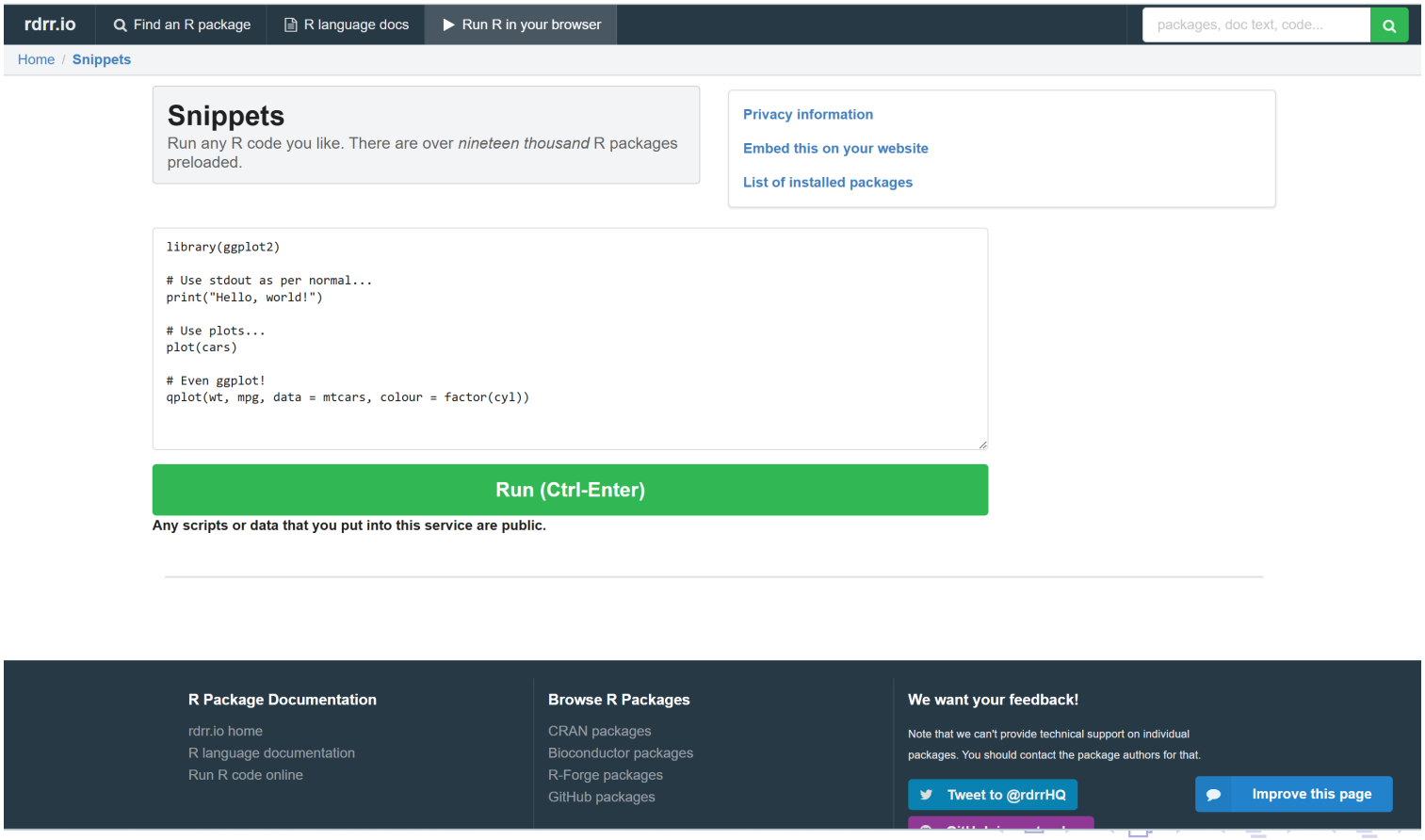
Programiz is a Nepal-based educational platform offering programming tutorials.



Rdrrio

Web: `https://rdrr.io/snippets/`

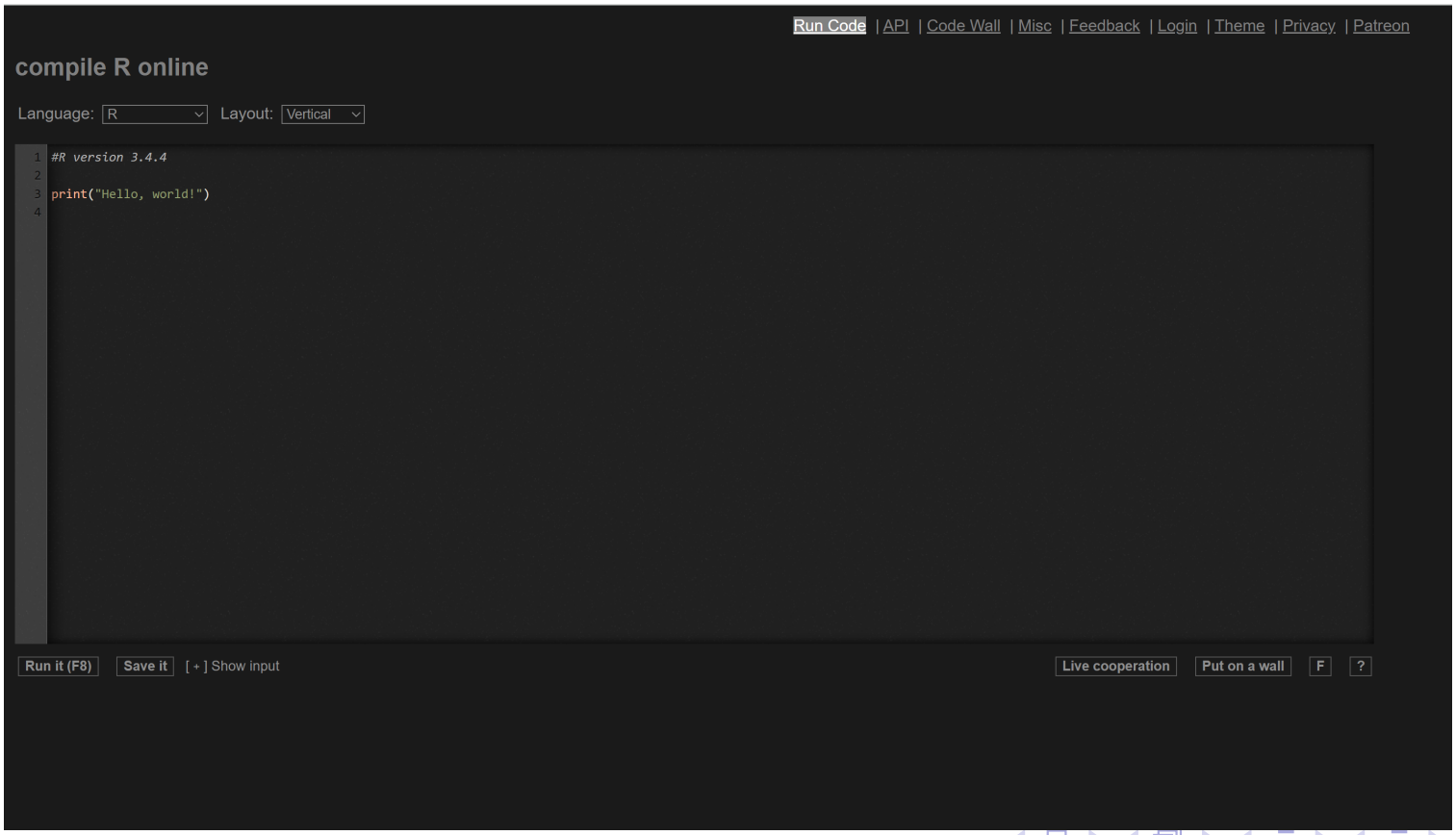
Rdrr.io is a platform designed to help users browse R documentation and execute code snippets.



Rextester

Web: `https://rextester.com`

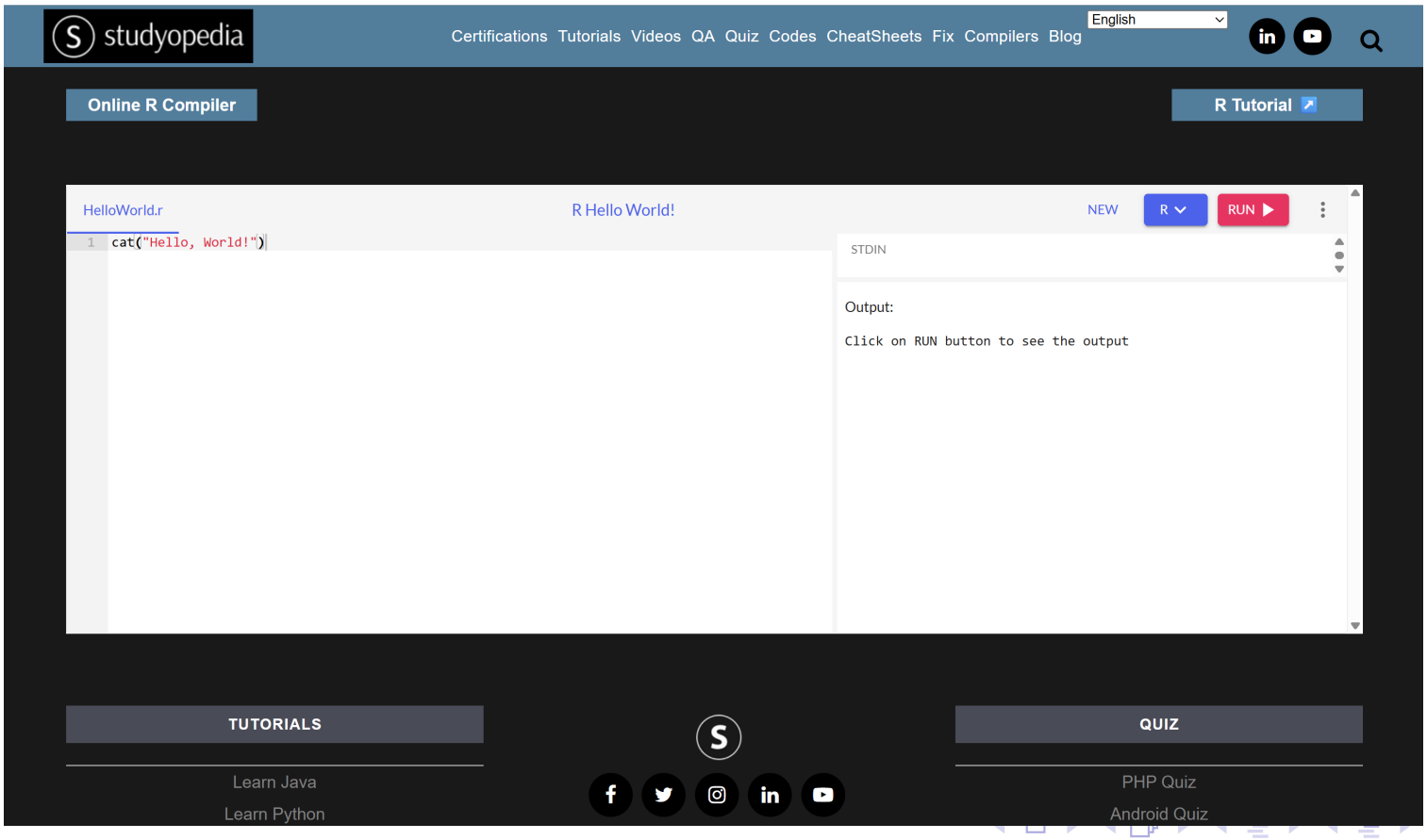
Rextester is an online compiler that supports multiple programming languages.



Studyopedia

Web: `https://www.studyopedia.com/`

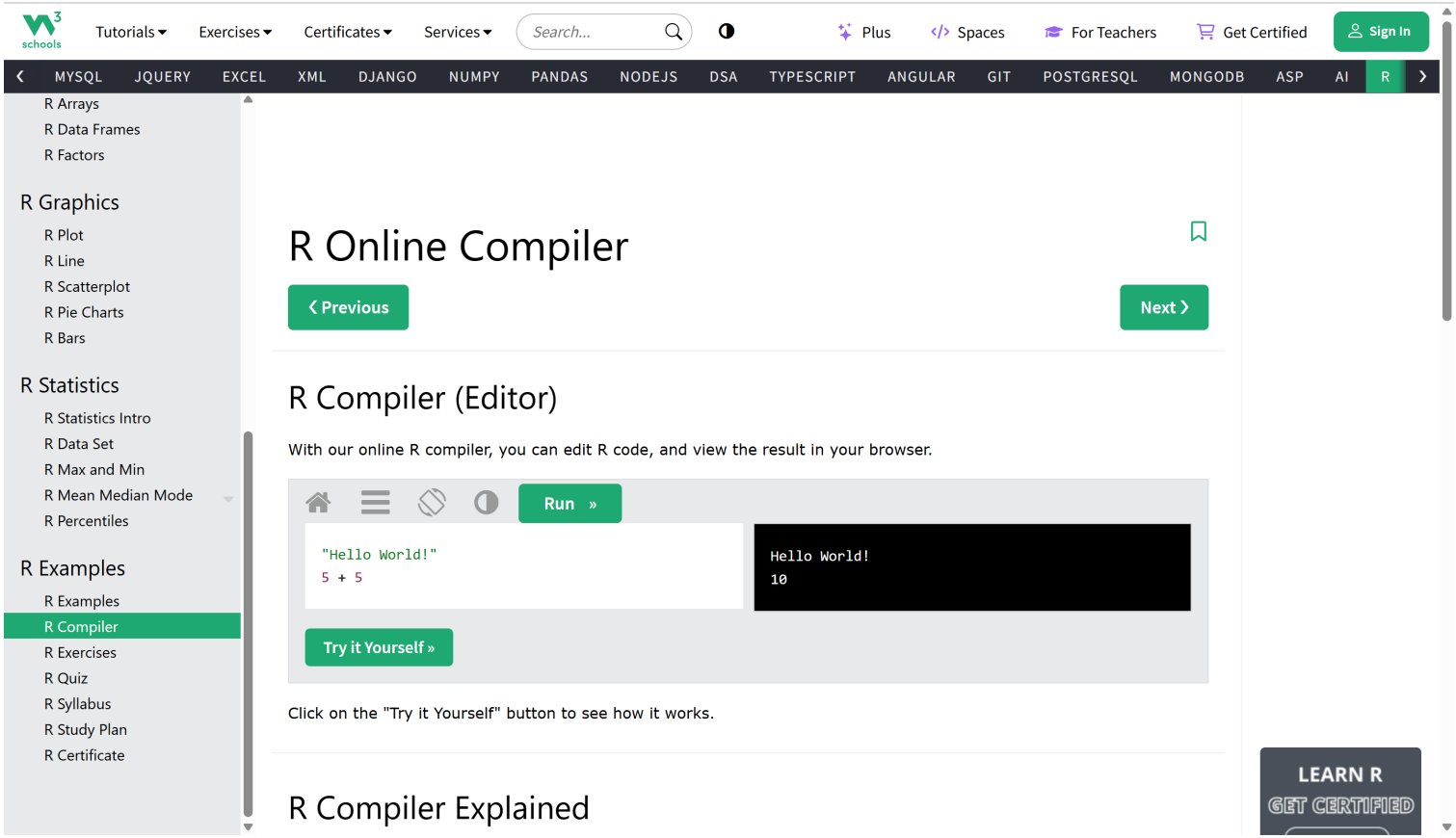
Studyopedia is an educational website offering tutorials in programming and web technologies.



W3Schools

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

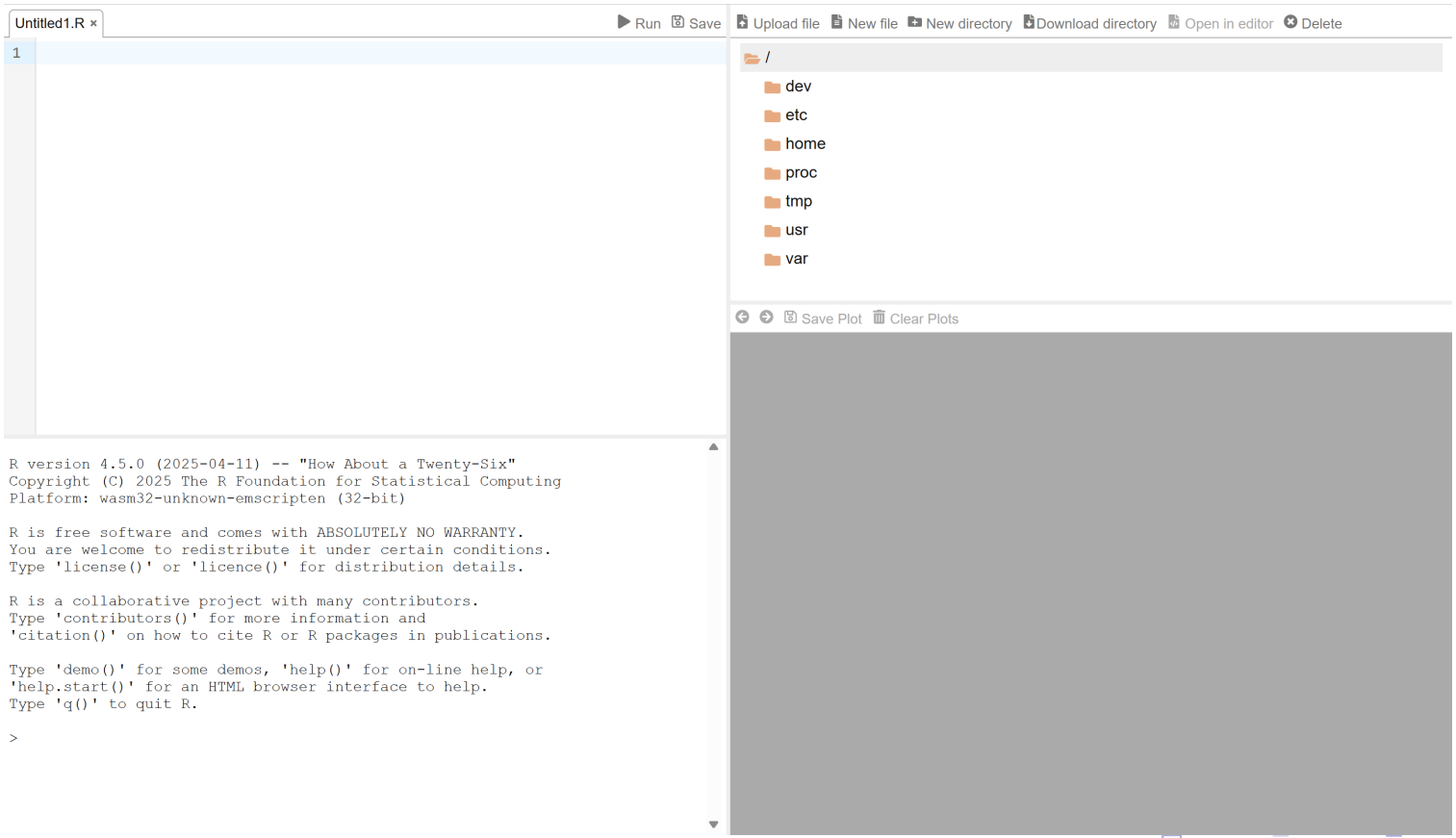
W3Schools is a global web development tutorial platform.



WebR

Web: `https://webr.r-wasm.org/latest/`

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

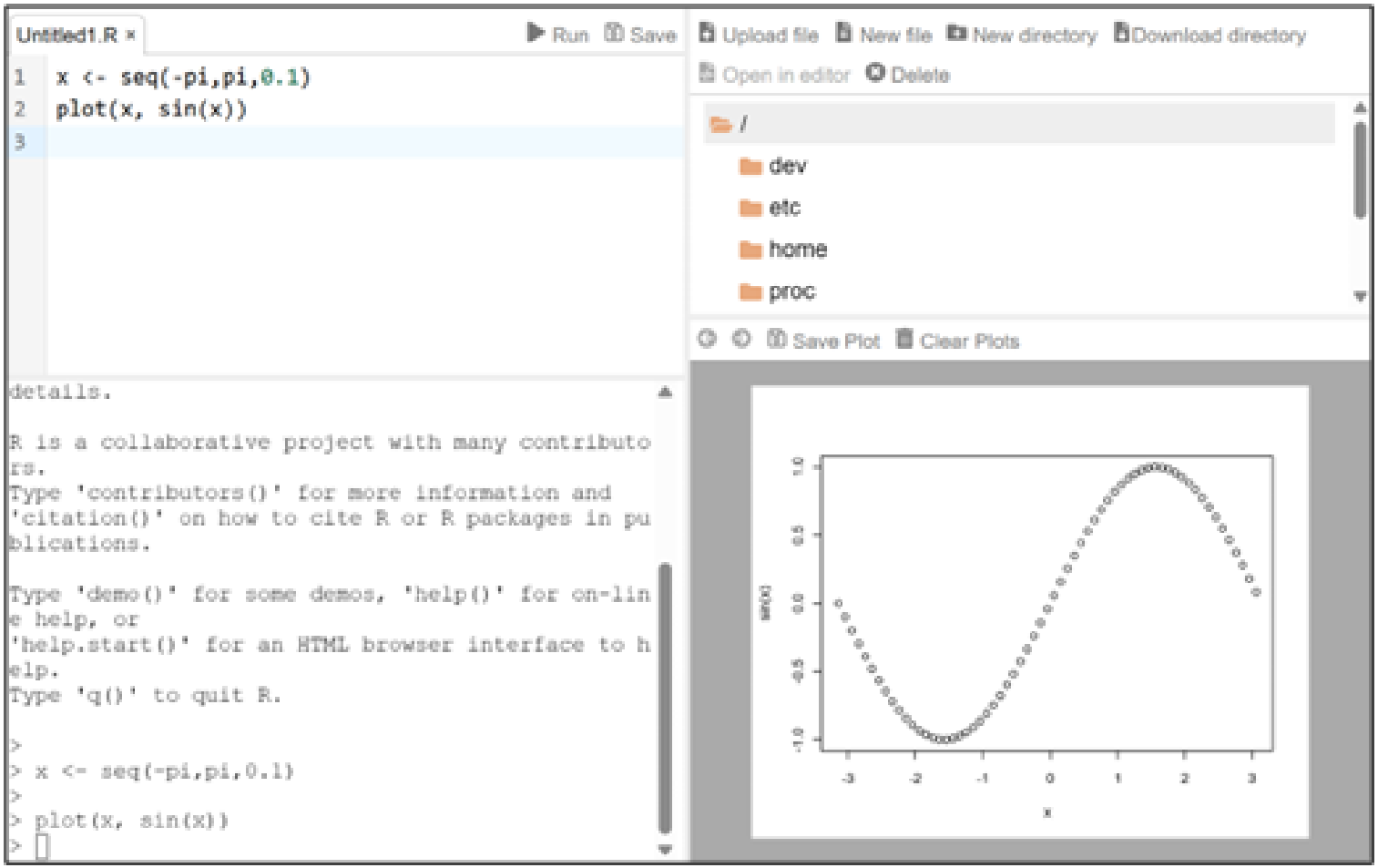


Conclusions and future work

Results

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)

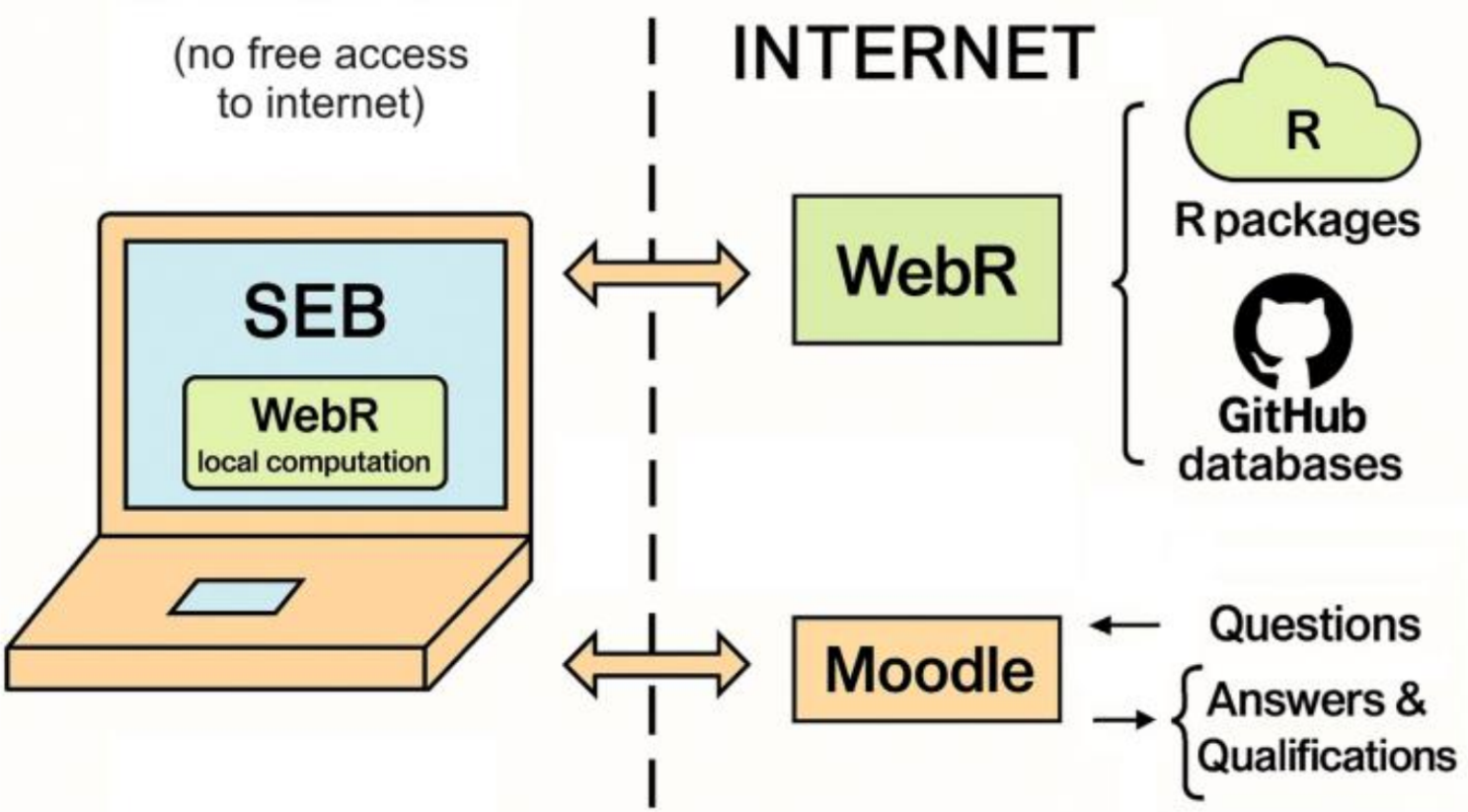
- **NOT Code Sharing (CS):** Whether users can NOT share their code or access code executed by others.
- **NO Artificial Intelligence (AI):** NO integration with AI-based tools or services, including image or text processing.
- **NO Search Tool (ST):** NO inclusion of built-in search functions to find 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.