BLENDER 5.1 MASTERY GUIDE

Learn Step-by-Step 3D Creation by Building Real Projects, Mastering Interface, Lighting, Materials, Animation, and a Perpetual Motion Loop

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INTRODUCTION

Blender is a powerful, free, and open-source 3D creation software used for modeling, animation, rendering, visual effects, simulation, and more. It offers a complete, all-in-one environment that allows users to design, create, and produce professional-quality 3D content without the need for multiple applications.

In this recent version (Blender 5.1), Blender introduces notable improvements in performance, stability, and workflow efficiency. Enhancements in rendering, animation playback, and geometry nodes make it faster and more responsive, while new and refined tools simplify complex tasks. These updates make Blender 5.1 more accessible to beginners while still providing the depth and flexibility required by advanced users and professionals.

Blender supports a wide range of creative tasks, including 3D modeling, sculpting, texturing, lighting, rigging, animation, video editing, and compositing. Its flexibility makes it suitable for various industries such as film production, game development, architecture, and product design.

Whether you are just starting your journey into 3D design or looking to enhance your existing skills, Blender 5.1 provides the tools, performance, and creative freedom needed to bring your ideas to life.

CHAPTER ONE

DOWNLOADING AND INSTALLING BLENDER

To download and install Blender, the official and safest method is through Blender.org. Blender is free, open-source software compatible with Windows, macOS, and Linux.

Quick Setup Guide

1. **Download**: Visit the Blender Download Page. The site usually detects your OS automatically.
2. **Run Installer**: Open the downloaded file (e.g., .msi for Windows, .dmg for Mac) and follow the setup wizard.
3. **Initial Config**: On first launch, you can select your preferred theme, language, and "Select" mouse button (Left or Right).

Platform-Specific Steps

- **Windows**:
  - **Installer**: Run the .msi file and follow the prompts. You may need administrator rights.
  - **Microsoft Store**: Search for "Blender" in the Microsoft Store for automatic updates and no admin requirement.
  - **Portable**: Download the .zip version to run Blender without installation (ideal for USB sticks).
- **macOS**:
  - Open the .dmg file and drag the Blender icon into your **Applications** folder.
- **Linux**:
  - Download the .tar.xz file, extract it, and run the executable. Alternatively, use Snapcraft or Steam for easier management. **System Requirements**

Before installing, ensure your hardware meets these standards.

BLENDER 3D HARDWARE REQUIREMENTS GUIDE

Choosing the right computer for Blender depends on what you want to create—from simple models to complex animations. This guide outlines **minimum**, **recommended**, and **advanced** hardware setups, along with alternative solutions like cloud rendering.

Minimum Hardware Requirements

Blender is highly accessible and runs on **Windows, macOS, and Linux**—even from a USB drive. However, for a smooth basic experience, your system should meet the following:

Minimum Specs

- **Operating System**: Windows 8.1 (64-bit), macOS 11.2, or Linux (glibc 2.28+)
- **CPU**: 4-core processor (with SSE4.2 support)
- **RAM**: 8 GB
- **GPU**: Graphics card with at least 2 GB VRAM (OpenGL 4.3+)
- **Storage**: SSD recommended (HDD still works)
- **Input Devices**: Mouse, trackpad, or pen tablet

These specs are suitable for learning Blender and handling simple projects, but performance may drop with complex scenes.

Why These Components Matter

- **CPU**: Handles simulations, calculations, and general performance
- **GPU**: Crucial for rendering (especially in Eevee and Cycles)
- **RAM**: More RAM allows smoother multitasking and larger scenes
- **Storage**: SSDs improve loading speeds and overall responsiveness

If you experience lag or freezing, consider upgrading—but remember, creativity matters more than hardware.

Recommended Hardware (High Performance)

For more advanced work such as detailed modeling, animation, and rendering, stronger hardware is recommended:

Recommended Specs

- **CPU**: AMD Ryzen 9 or Intel i9 (16+ cores)
- **RAM**: 64 GB or more
- **GPU**: High-end GPU (16 GB+ VRAM, e.g., RTX or Radeon series)
- **Storage**: NVMe SSD (1 TB or more)
- **Cooling**: Efficient cooling system (liquid cooling preferred)

This setup allows you to work smoothly with complex scenes and high-quality renders.

Important Note

Even high-end systems can struggle with extremely large or detailed projects. Hardware upgrades can improve performance, but they are not always the only solution.

Cloud Rendering & Alternatives

For heavy rendering tasks, such as large animations or complex scenes, you can use external solutions:

When to Use It

- When your system cannot handle large renders
- When you need faster results
- When rendering overnight is not enough

Available Options

Online Render Farms

- **Rentaflop** – Affordable GPU rendering
- **Blender Grid** – Optimized for Cycles rendering
- **RebusFarm** – High-performance cloud rendering
- **RenderStreet** – Subscription-based service

Cloud rendering saves time and reduces strain on your computer.

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Additional Solutions

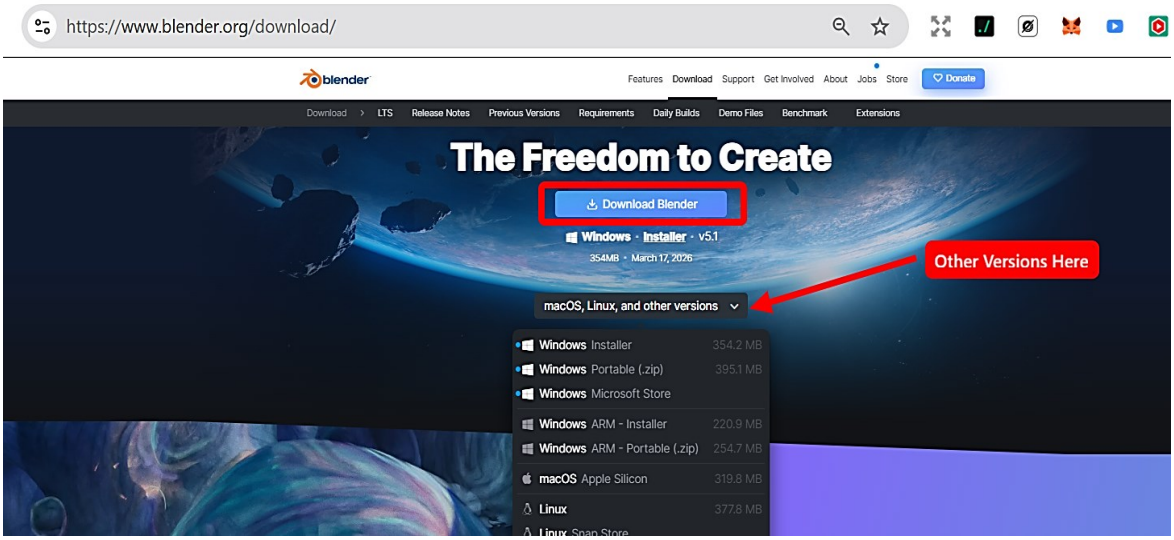
- ❖ **Blender Add-ons** (e.g., Barista) for batch rendering
- ❖ **Remote computing services** (e.g., Vagon) to access powerful machines online

HOW TO INSTALL BLENDER 5.1 (STEP-BY-STEP GUIDE)

Follow these simple steps to download, install, and launch Blender 5.1 on your Windows computer:

Step 1: Download Blender

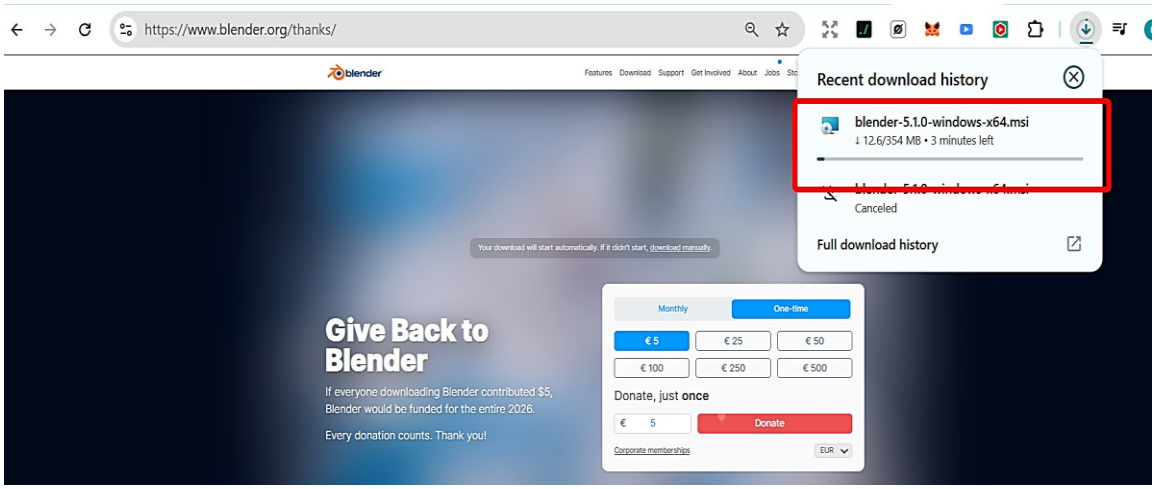
1. Open your preferred web browser.
2. In the search bar, type **"Blender download"** and press Enter.
3. Click on the official Blender website from the search results.
4. On the homepage, locate the latest version (**Blender 5.1**) and click **Download Blender**.



Tip: Blender is also available for macOS and Linux, but here you should select the **Windows version**.

Step 2: Start the Download

- ❖ After clicking download, you may be redirected to a donation page.
- ❖ The download should begin automatically.



- ❖ You can choose to donate to support Blender development, but it is optional.

Step 3: Run the Installer

1. Once the file is downloaded, open your **Downloads** folder.
2. Locate the Blender installer file.
3. Double-click the file to launch the **Blender Setup Wizard**.

Step 4: Install Blender

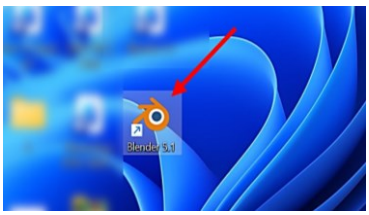
1. Click **Next** on the setup window.
2. Choose the installation location (you can leave it as default).
3. Click **Next**, then click **Install**.
4. If prompted, click **Yes** to allow administrative permissions.
   - ❖ The installation process will begin and complete within a few moments.

Step 5: Finish Installation

- ❖ Once installation is complete, click **Finish**.
- ❖ A Blender shortcut will appear on your desktop.

Step 6: Launch Blender

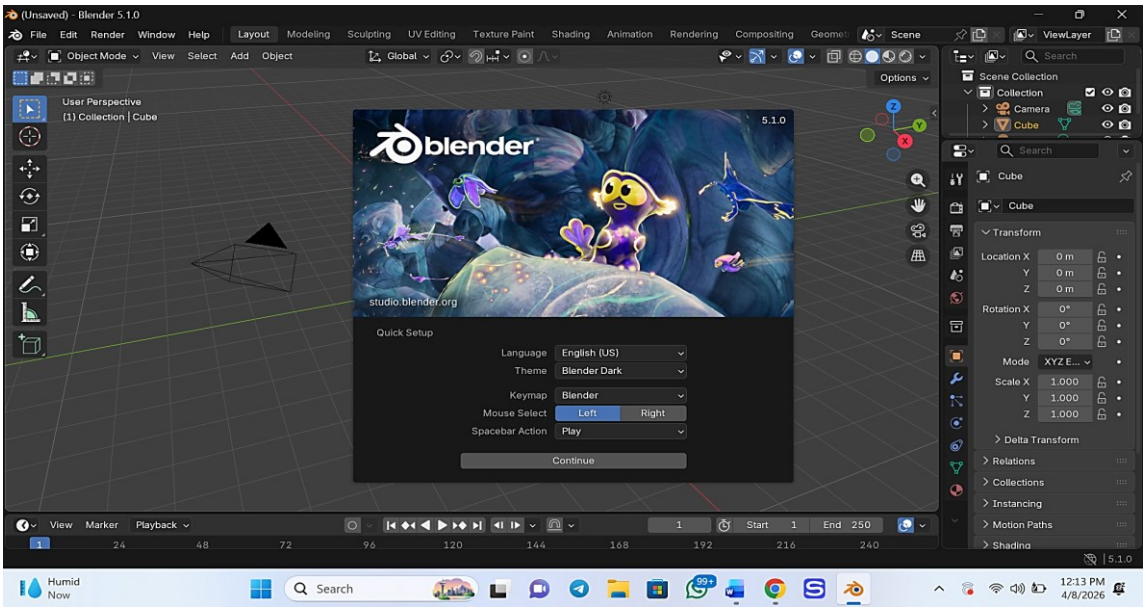
1. Double-click the **Blender desktop shortcut**.



2. Blender will open and display the initial setup screen.

Step 7: Configure Initial Settings

When Blender launches for the first time, you can customize:



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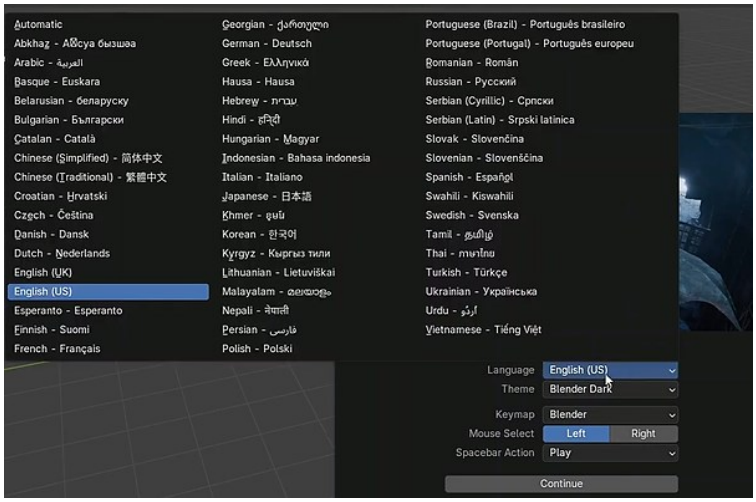
- **Language**: Default is English (you can change it if needed)

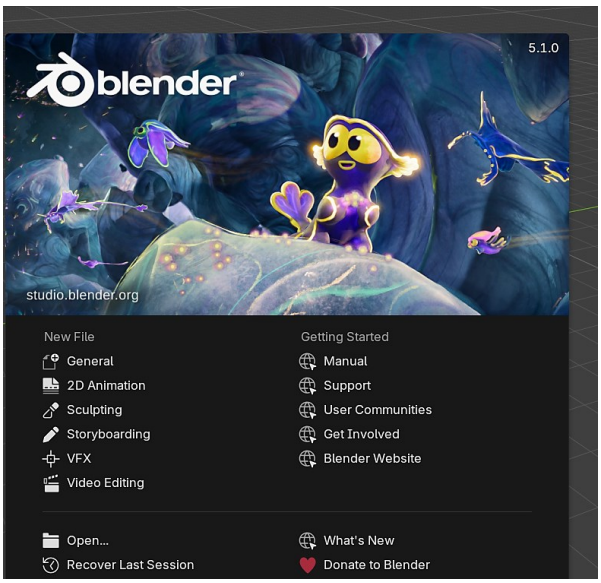


- **Theme**: Choose between **Dark** or **Light** mode
- **Keymap**: Default Blender controls (can be changed)
- **Mouse Select**: Left-click (recommended) or right-click
- **Other Preferences**: Adjust playback or tool settings if desired

After selecting your preferences, click **Continue**.

Step 8: Start Using Blender

- Choose a workspace such as:
  - General (recommended for beginners)
  - 2D Animation
  - Sculpting
  - VFX
  - Video Editing



- Blender will open its main interface, and you're ready to start creating.

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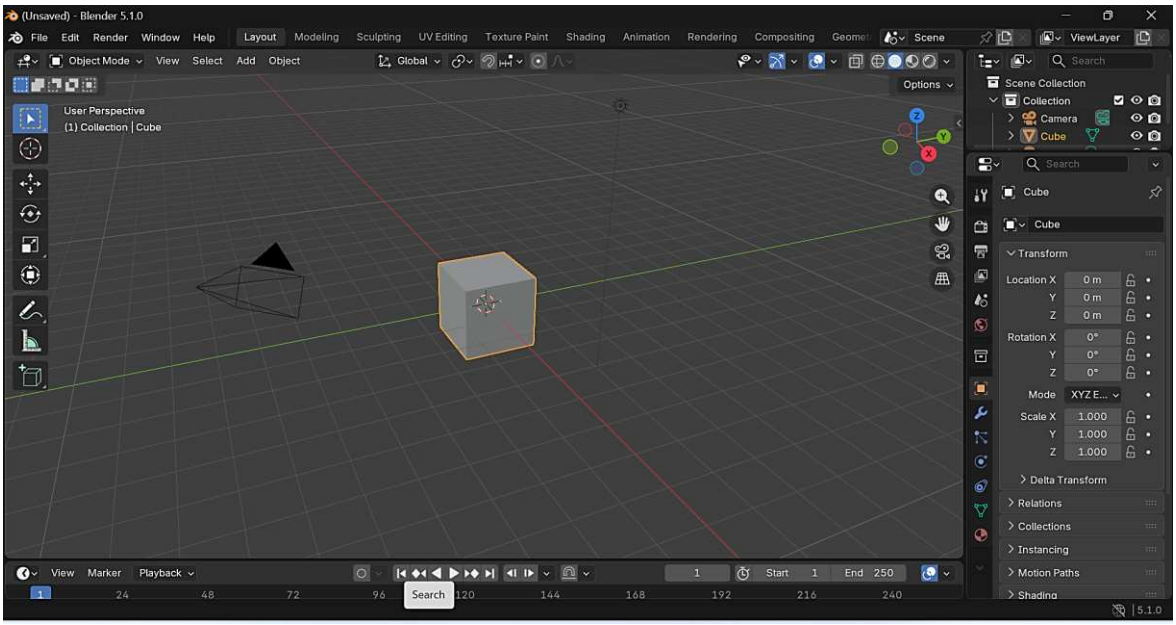
CHAPTER TWO

USER INTERFACE AND 3D NAVIGATION IN BLENDER 5.1

In Blender 5.1, the user interface (UI) continues its design philosophy of a "non-overlapping" workspace where everything is accessible within a single window through a system of flexible panels. Navigation is centered around the **3D Viewport**, utilizing a combination of mouse shortcuts and on-screen gizmos for movement.

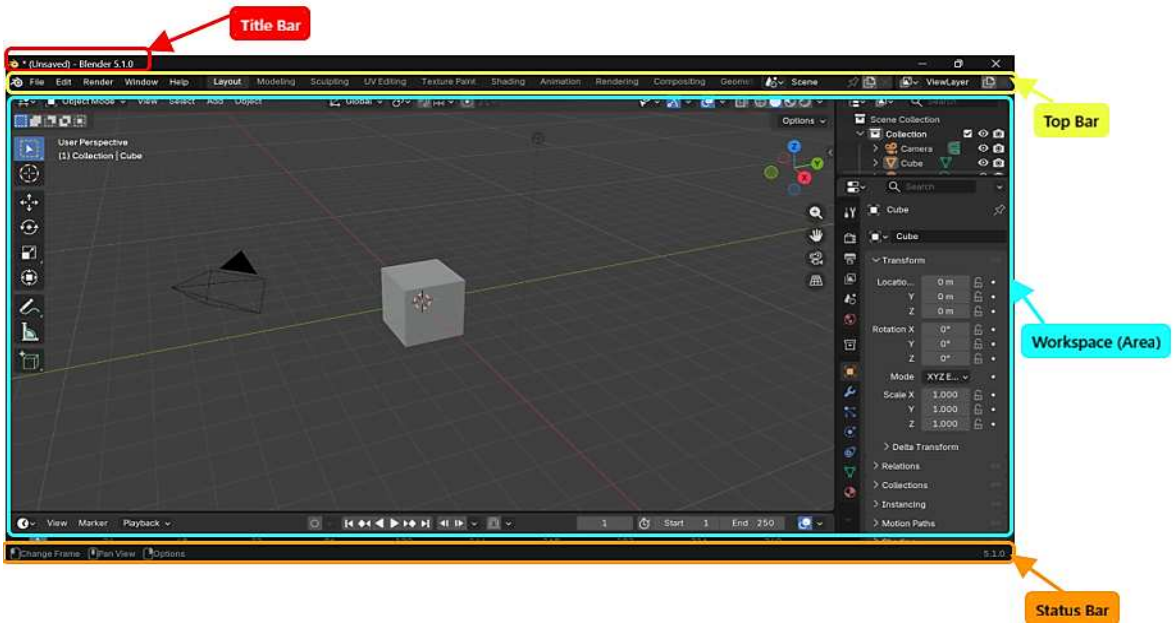
BLENDER USER INTERFACE



When you launch Blender and close the splash screen, the main interface appears. This workspace is designed to give you access to all the tools and features needed for 3D creation.

Main Parts of the Blender Interface

Blender's window is divided into three primary sections:



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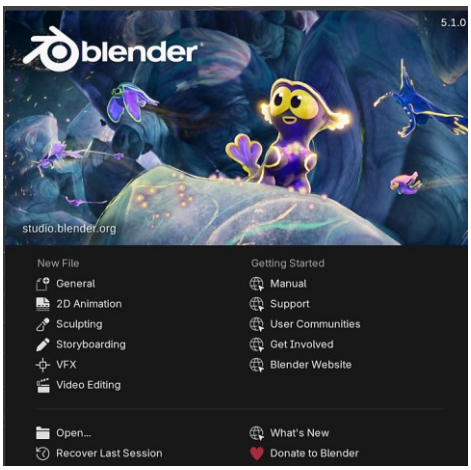
- **Title Bar:** At the top of the interface is the **Title Bar**, which displays: The Blender version, The current project name (or "Untitled" if not yet saved)
- **Topbar**: Located at the top of the screen, it contains the main menu. From here, you can save and open files, import and export projects, adjust settings, and render your work.
- **Workspace (Areas)**: This is the central part of the screen where most of your work takes place. It includes panels such as the 3D Viewport, Outliner, and Properties.
- **Status Bar**: Found at the bottom, it displays helpful information such as shortcut hints and system statistics.

Customization Options

Blender provides several ways to personalize your workspace and improve your workflow:

- **Keyboard Shortcuts**: Blender relies heavily on shortcuts for speed and efficiency. You can customize these in the *Keymap Editor* within Preferences.
- **Theme Colors**: The interface colors can be changed to suit your preference. If your screen looks different from tutorials or manuals, your theme may have been modified. You can adjust or select themes in *Preferences → Themes*.
- **Accessibility Settings**: Blender supports visibility adjustments such as resolution scaling and custom fonts. These options are available in the *Interface Preferences*.

The Splash Screen



When Blender starts, a splash screen appears in the center of the window. This screen provides quick access to essential options.

How to Close and Reopen

- To close it: Click anywhere outside the splash screen or press **Esc**.
- To reopen it: Click the Blender icon in the Topbar and select **Splash Screen**.

Note: When opening Blender for the first time or after an update, the splash screen may include a quick setup guide.

Splash Screen Features

The splash screen is divided into two main sections:

1. Splash Image

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Located at the top, it displays the Blender artwork and version number.

2. Interactive Region

The lower section contains useful options:

- **New File**: Start a new project using a template
- **Recent Files**: Quickly access recently opened projects
- **Open**: Browse and open an existing Blender file
- **Recover Last Session**: Restore your previous session from temporary data
- **What's New**: View the latest updates and release notes
- **Donate to Blender**: Support Blender's development

WORKSPACES IN BLENDER

Workspaces in Blender are predefined screen layouts designed for specific tasks such as modeling, animation, sculpting, or rendering. Each workspace contains a set of panels (called *Editors*) arranged to suit a particular workflow. As you work on a project, you will often switch between different workspaces depending on what you are doing.

Accessing and Using Workspaces

Workspaces are located at the **Topbar** of the Blender interface and appear as tabs.

Basic Controls

- **Switch Workspaces**: Click on a tab to activate it.
- **Rename Workspace**: Double-click a tab to rename it.
- **Add Workspace**: Click the **+ (Add Workspace)** button to create a new workspace from a template (e.g., Modeling, Sculpting, Compositing).

Workspace Management (Right-Click Menu)

Right-click on any workspace tab to access additional options:

- **Duplicate**: Creates a copy of the current workspace, including its layout.
- **Delete**: Removes the selected workspace (cannot delete the last one).
- **Reorder to Front/Back**: Moves the workspace to the beginning or end of the tab list.
- **Previous Workspace (Ctrl + PageUp)**: Switch to the workspace on the left.
- **Next Workspace (Ctrl + PageDown)**: Switch to the workspace on the right.
- **Delete Other Workspaces**: Keeps only the selected workspace and removes the rest.

Default Workspace: Layout

By default, Blender opens with the **Layout** workspace, which is a general-purpose setup. It includes:

- **3D Viewport (top left)** – Main area for viewing and editing objects
- **Outliner (top right)** – Displays all objects in the scene
- **Properties (bottom right)** – Contains settings and options

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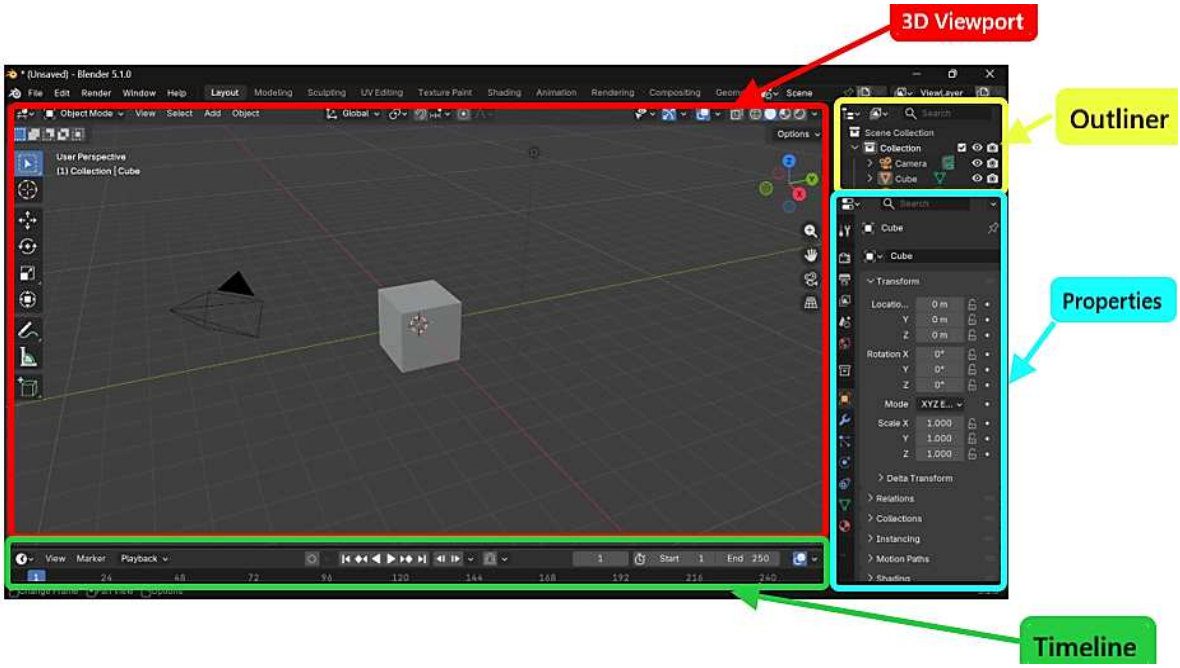
❖ **Timeline (bottom left)** – Controls animation playback



Blender's four-editor "Layout" workspace.

HOW TO RESET BLENDER UI TO DEFAULT

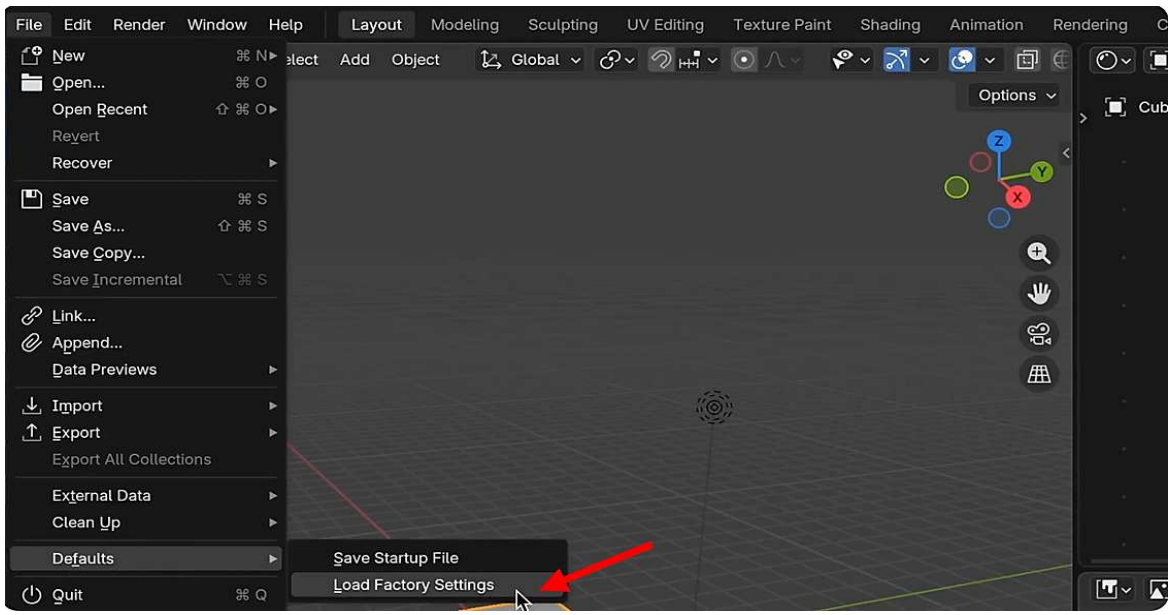
If your Blender interface looks unusual—missing panels, rearranged windows, or not matching tutorials—don't worry. You haven't broken anything. You can easily restore it to its original layout.

Method 1: Reset the Entire Interface (Recommended)

This is the safest and most effective way to fix major UI issues.

Step 1: Open Factory Settings

1. Go to the **File** menu (top-left corner).
2. Select **Defaults → Load Factory Settings**.



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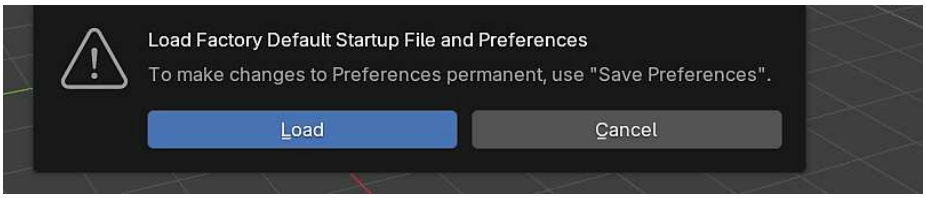


- This will instantly reset:
  - All panels
  - Workspaces
  - Interface layout

Step 2: Check the Interface

- Blender will reload with its default appearance.
- If everything looks normal again, the reset was successful.

Step 3: Save as Default (Optional but Important)

If you want Blender to always open with this clean layout:

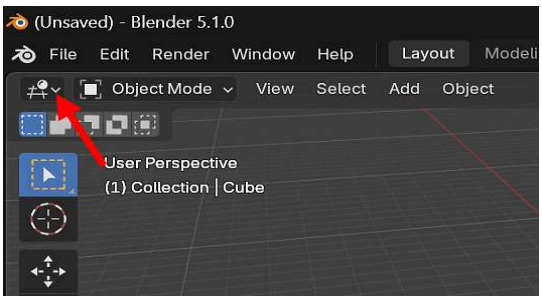
1. Go to **File → Defaults → Save Startup File**
2. Click **OK** to confirm

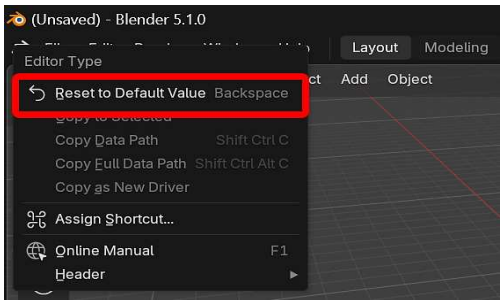
This ensures Blender launches with the default interface every time.

Method 2: Fix a Single Workspace

If only one workspace is affected, you don't need a full reset:

1. Right-click on the **workspace tab** (top of the interface)





2. Switch back to the **Layout** workspace (default workspace)
   - This restores just that workspace without affecting others.

HOW TO ENABLE ADD-ONS & USE THE EXTENSIONS PLATFORM IN BLENDER

Blender add-ons are powerful tools written in Python that extend Blender's functionality. They allow you to perform additional tasks, improve workflows, and customize your experience.

This section will walk you through how to **enable add-ons** and use Blender's **Extensions Platform**.

Step 1: Open Preferences

1. Press **F4** to open the File menu

   *(or go to **File → Preferences**)*

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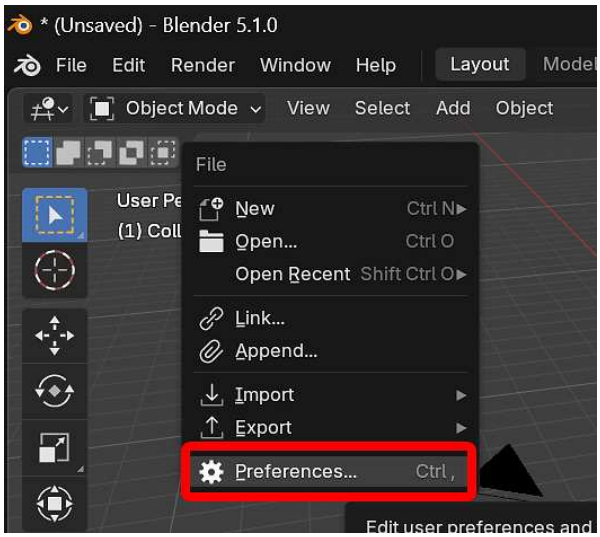


2. Click **Preferences**

Inside the Preferences window, focus on two important tabs:

- **Extensions (or Get Extensions)**
- **Add-ons**

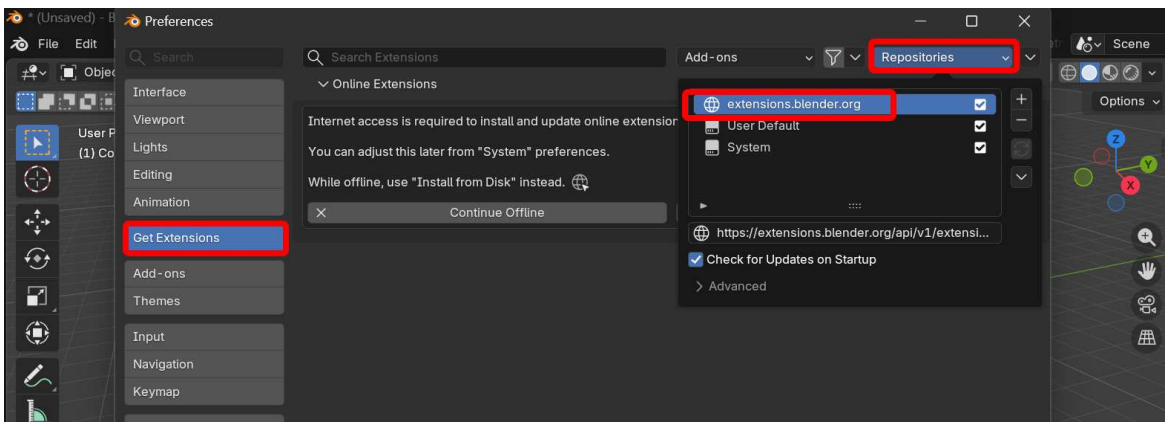
Step 2: Understand the Extensions Platform

The **Extensions tab** connects Blender to an online library of free add-ons and themes.

Note: This feature was introduced in Blender 4.2. Older versions will only have the Add-ons tab.

Access the Extensions Website

1. In the **Extensions tab**, open the **Repositories dropdown**



2. Copy the provided link (extensions.blender.org)
3. Paste it into your web browser

This opens the **Blender Extensions Platform**, where you can:

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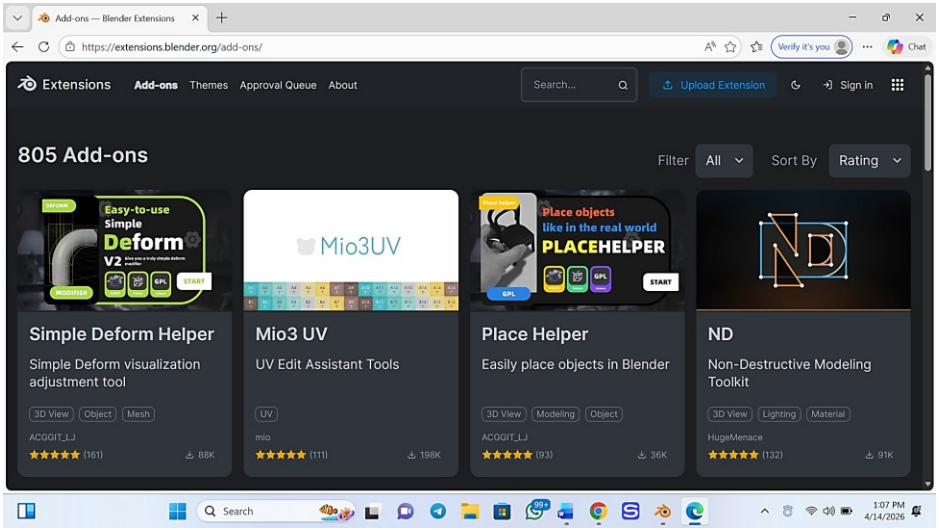
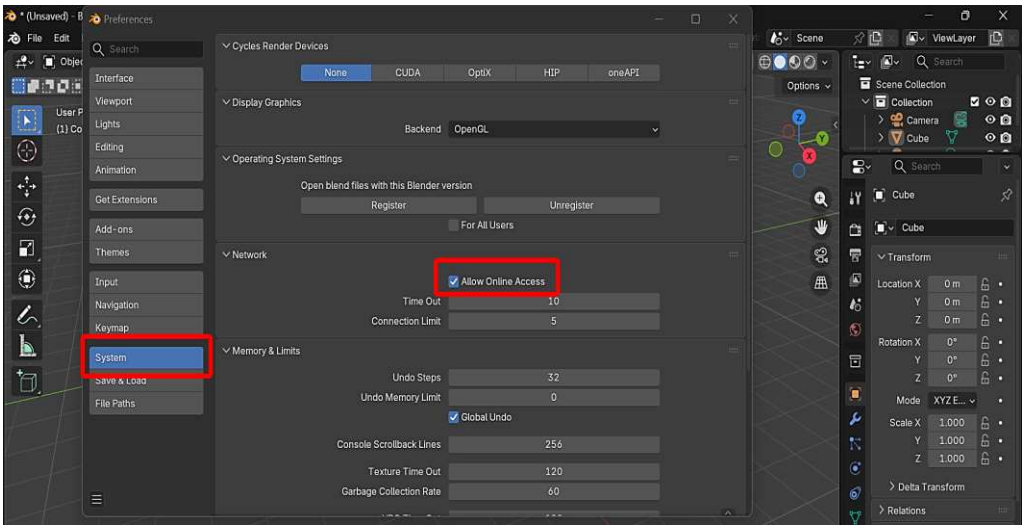


- ❖ Browse add-ons
- ❖ Search for tools and themes
- ❖ Discover community-created resources

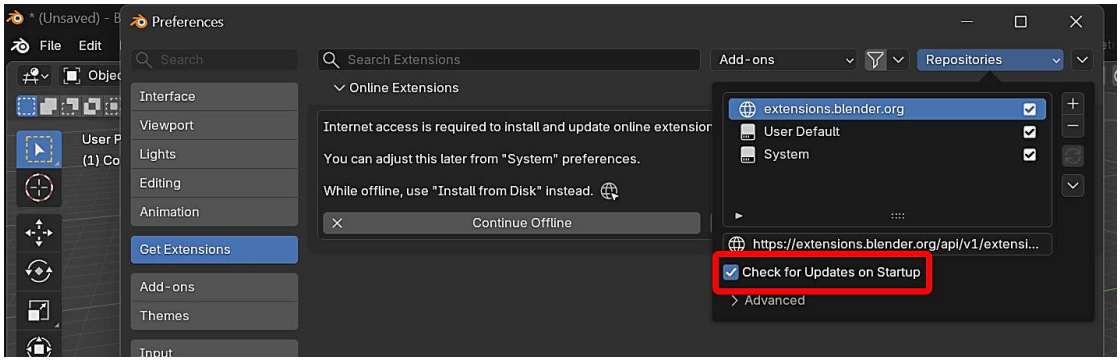
Step 3: Enable Online Access

To keep extensions updated:

1. Go to the **System tab** in Preferences
2. Under **Network**, enable **Online Access**



3. Enable **Check for updates on startup**



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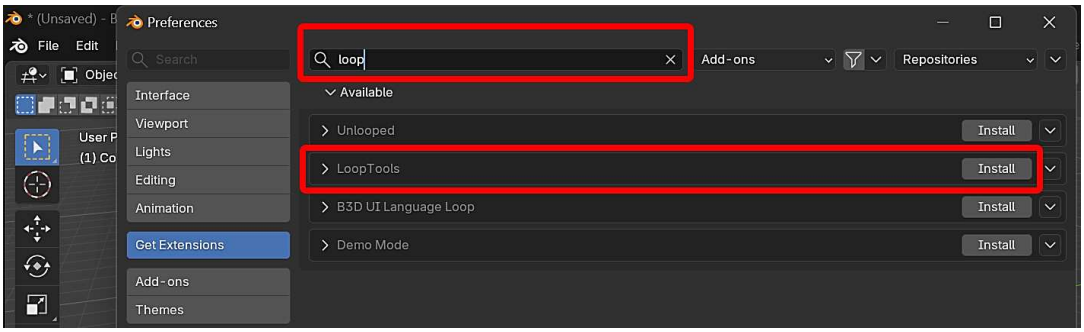
Note: Blender respects your settings, but third-party add-ons may behave differently.

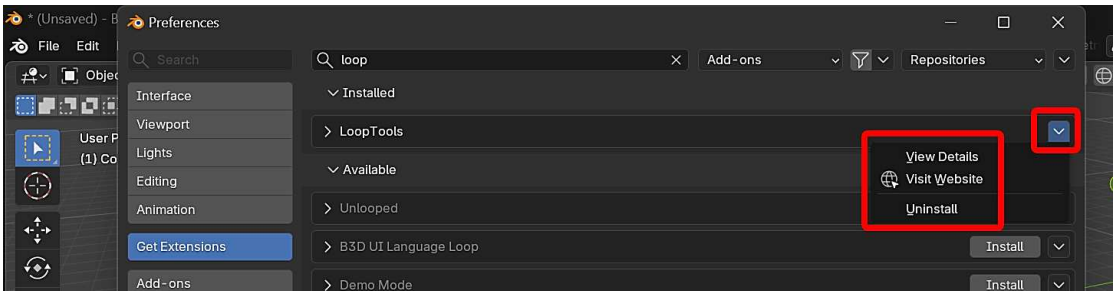
Step 4: Install an Add-on from Extensions

Let's install an example add-on (**Loop Tools**):

1. Return to the **Extensions tab**
2. In the search bar, type **"Loop Tools"**
3. Click **Install**



- ❖ Once installed, the add-on is **automatically enabled**
- ❖ You can also:

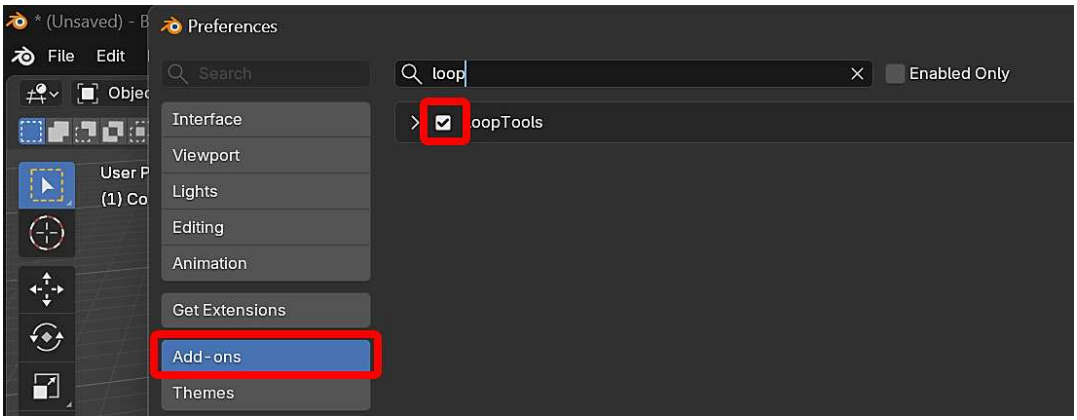


- ❖ Uninstall it
- ❖ View details
- ❖ Visit its website

Step 5: Manage Add-ons

1. Go to the **Add-ons tab**
2. Search for the add-on (e.g., *Loop Tools*)

Enable or Disable:



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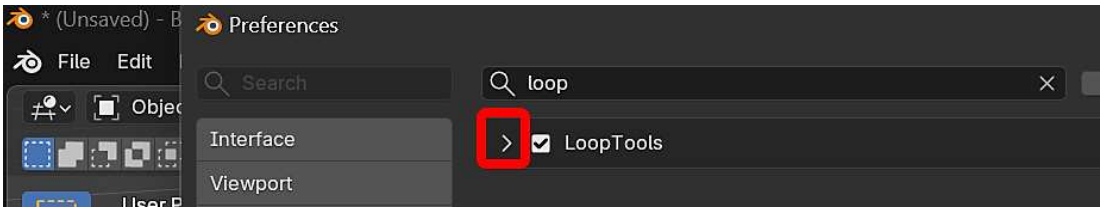
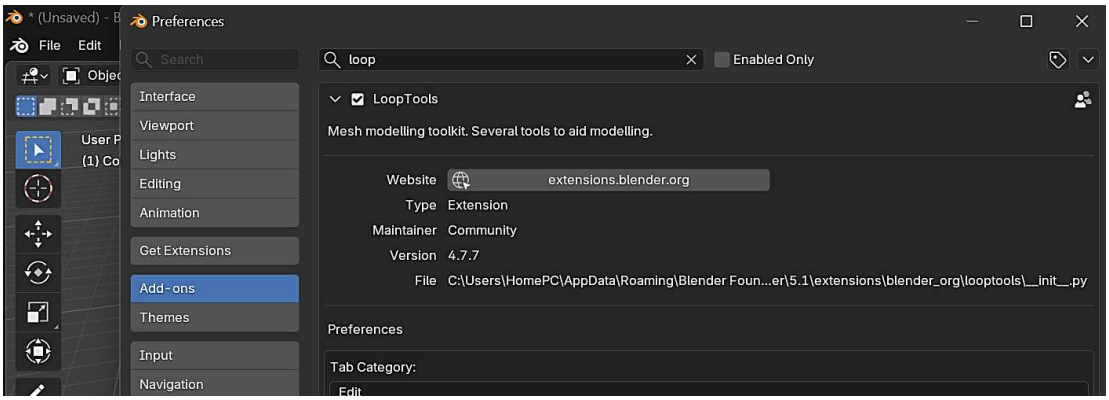
- ☑ Checked box = Enabled
- ☐ Unchecked box = Disabled

You can expand the add-on to view more information or documentation.

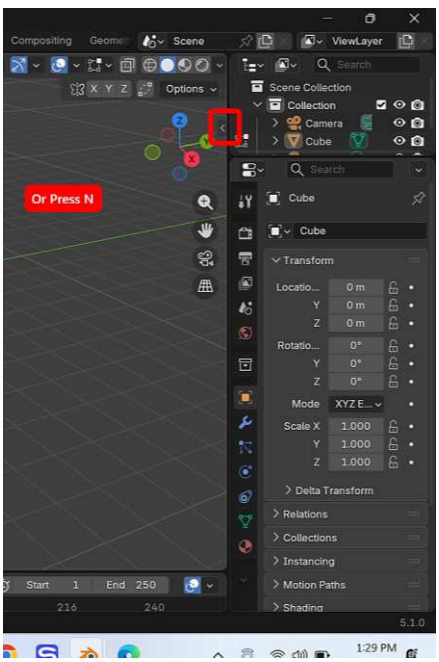


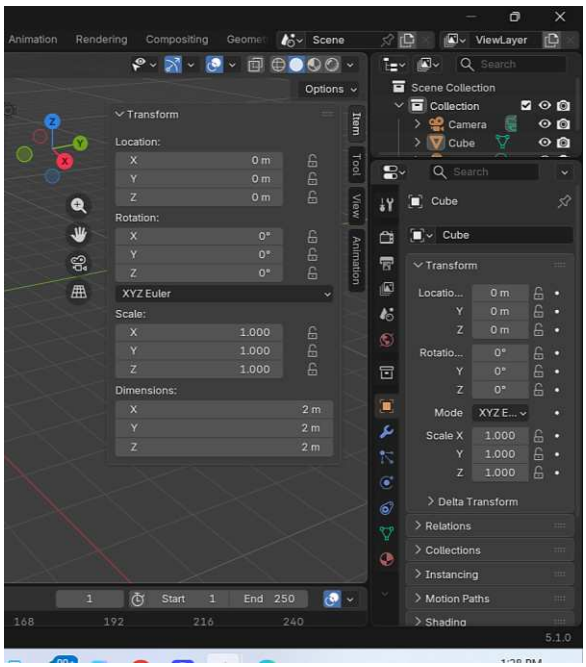


Step 6: Use the Add-on in Blender

For example, **Loop Tools** enhances mesh editing:

1. Select a mesh object (e.g., a cube)
2. Switch to **Edit Mode**
3. Open the **Sidebar** using **N**





4. Locate the add-on panel (e.g., “Edit” tab)

Note: Some tools only appear in specific modes (e.g., Edit Mode).

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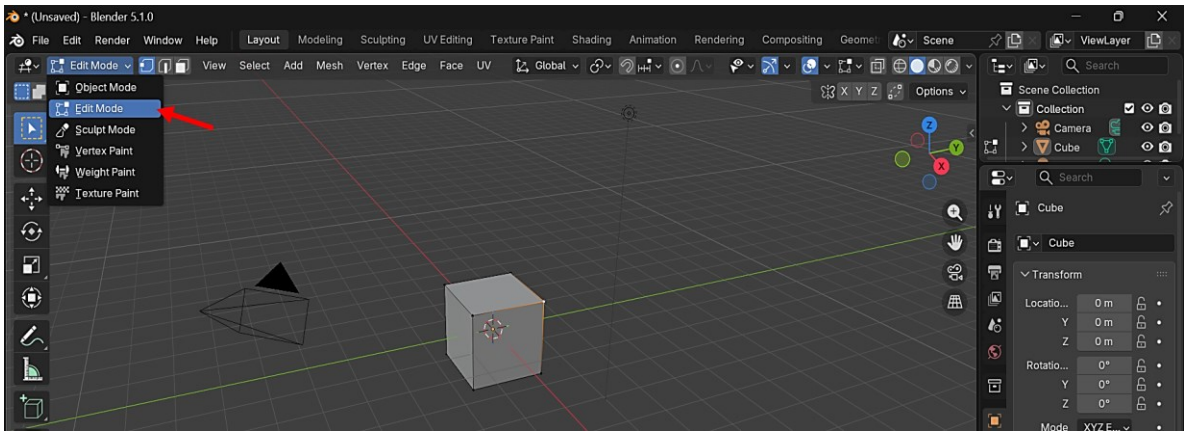
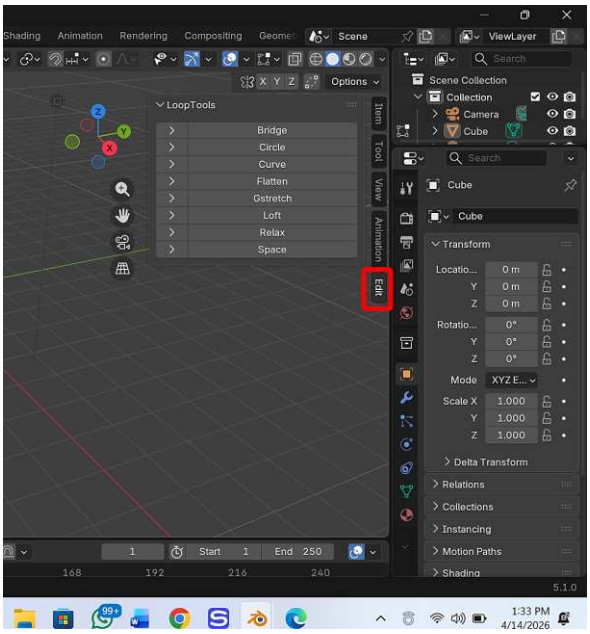


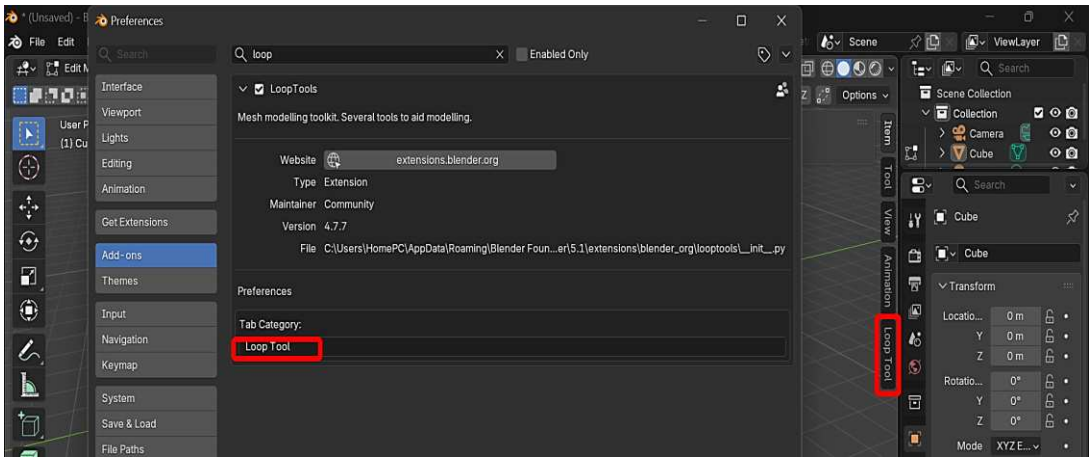


You can also access it by **right-clicking** in Edit Mode.

Step 7: Customize the Add-on Panel (Optional)

You can create a custom tab for better organization:

1. Go back to **Preferences → Add-ons**
2. Find the add-on
3. In the **Name field**, enter a custom name (e.g., “Loop Tools”)



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- ❖ The sidebar will instantly update with the new tab name

OTHER DEFAULT WORKSPACES

Blender includes several built-in workspaces for different tasks:

- ❖ **Modeling** – Create and edit 3D geometry
- ❖ **Sculpting** – Shape models using sculpting tools
- ❖ **UV Editing** – Map 2D textures onto 3D models
- ❖ **Texture Paint** – Paint textures directly on models
- ❖ **Shading** – Create and edit materials
- ❖ **Animation** – Animate objects over time
- ❖ **Rendering** – View and analyze rendered images
- ❖ **Compositing** – Combine and enhance rendered outputs
- ❖ **Geometry Nodes** – Procedural modeling using node systems
- ❖ **Scripting** – Write and run Python scripts

Additional Workspaces

You can also add specialized workspaces such as:

2D Animation

- ❖ **2D Animation** – Work with Grease Pencil for drawing and animation
- ❖ **2D Full Canvas** – Similar, but with a larger drawing area

VFX (Visual Effects)

- ❖ **Masking** – Create masks for compositing or editing
- ❖ **Motion Tracking** – Track camera movement and stabilize footage

Video Editing

- ❖ **Video Editing** – Combine and edit video clips

Saving and Loading Workspaces

- ❖ Workspaces are saved within your **.blend file**.
- ❖ When opening a file, enabling **Load UI** ensures Blender uses the file's saved layout instead of your current one.
- ❖ You can also save your preferred workspace setup as part of Blender's default settings.

Workspace Settings

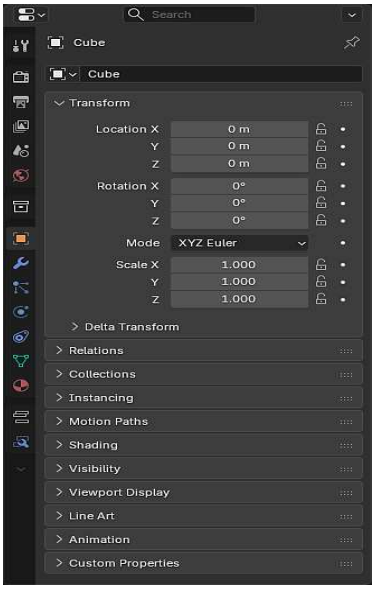
Reference

Editor: Properties Editor

Panel: Tool tab ▸ Workspace

Properties Editor

The **Properties Editor** is one of the most important panels in Blender. It provides access to a wide range of settings related to the active scene, selected objects, materials, and other data types.



This editor is **context-sensitive**, meaning the options it displays will change depending on what you have selected or are currently working on. For example, selecting an object will show object-related settings, while selecting a light or camera will display their specific properties.

Key options include:

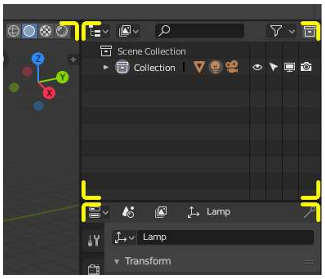
- **Pin Scene**: Keeps a specific scene linked to the workspace
- **Mode**: Automatically switches to a specific mode when the workspace is activated
- **Sequencer Scene**: Selects the scene used in video editing
- **Sync Scene Time**: Synchronizes timing with the video sequence editor
- **Filter Add-ons**: Controls which add-ons are active in the workspace

AREAS IN BLENDER

In Blender, the interface is divided into rectangular sections called **Areas**. Each area contains an **Editor**—such as the 3D Viewport, Outliner, or Properties Editor—designed for a specific task. These areas are grouped into **Workspaces**, helping you stay organized while working on different parts of a project.

Area boundaries are easy to identify by their **rounded corners**.

Understanding Areas



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- Each **Area** displays a specific editor with its own functionality.
- Multiple areas together form a **Workspace** (e.g., Modeling, Animation).
- Some keyboard shortcuts are **context-sensitive**, meaning they only work when your mouse cursor is over the correct area.

Example: Pressing **Ctrl + J** (Join Objects) will only work in the **3D Viewport**, not in the Outliner.

Resizing Areas

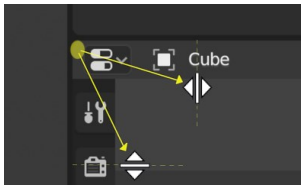
You can adjust the size of areas to suit your workflow:

1. Move your cursor over the border between two areas.
2. When the cursor changes to a **double-headed arrow**, click and drag to resize.
3. Hold **Ctrl** while dragging to snap to convenient sizes.

Splitting and Joining Areas

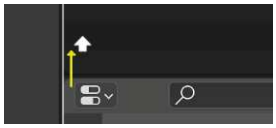
Blender allows you to create or merge areas easily:

Splitting an Area



- Move your cursor to a corner until it becomes a **cross (+)**.
- Click and drag:
  - **Left/Right** to split vertically
  - **Up/Down** to split horizontally

Joining Areas



- Drag from one area corner into another area.
- The highlighted region shows which areas will be merged.

Docking and Replacing Areas

- You can **split and join areas simultaneously** by dragging between them.
- Dragging one area into the center of another will **replace** it.

Area Options (Right-Click Menu)

Right-click on an area border to access options:

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- **Vertical/Horizontal Split** – Choose how to divide an area
- **Join Up/Down/Left/Right** – Merge areas in a chosen direction
- **Swap Areas** – Exchange positions of two areas

Swapping Contents

To swap the contents of two areas:

1. Press **Ctrl + LMB** on a corner of one area.
2. Drag to another area and release.

The areas do not need to be adjacent, but must be in the same window.

Maximizing and Restoring Areas

Maximize Area

- **Shortcut**: Ctrl + Spacebar
- Expands the selected area to fill the window while keeping the Topbar and Status Bar visible.
- Useful for focusing on a single editor.

Restore Area

- Press **Ctrl + Spacebar** again to return to the previous layout.

Focus Mode

- **Shortcut**: Ctrl + Alt + Spacebar
- Expands the area to full screen and hides:
  - Topbar
  - Status Bar
  - Toolbars and side panels

This provides maximum workspace for detailed tasks.

Duplicate Area into New Window

- Creates a new floating window with the same editor.
- Ideal for **multi-monitor setups**.

Tip: Hold **Shift + LMB** on an area corner and drag outward to quickly open a new window.

REGIONS IN BLENDER

In Blender, every **Editor** is divided into smaller sections called **Regions**. These regions organize tools, settings, and controls, making the interface easier to use and more efficient.

Each region may contain elements such as **tabs, panels, buttons, and widgets**, all designed to support specific tasks within the editor.

Main Types of Regions

1. Main Region

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The **Main Region** is the largest and most important part of any editor.

- ❖ It is always visible.
- ❖ It displays the primary content you are working on.
- ❖ Its function depends on the editor type (e.g., 3D Viewport shows your scene, Shader Editor shows nodes).

2. Header

The **Header** is a horizontal strip located at the **top or bottom** of an editor.

- ❖ Contains menus and commonly used tools
- ❖ Changes depending on the active editor, object, and mode

Header Options (Right-Click Menu):

- ❖ Show/Hide Header
- ❖ Show Tool Settings
- ❖ Show/Hide Menus
- ❖ Flip to Top or Bottom
- ❖ Split or close the area
- ❖ Access maximize and focus modes

3. Toolbar

The **Toolbar** is located on the **left side** of the editor.

- ❖ Contains interactive tools (e.g., move, rotate, scale)
- ❖ Press **T** to show or hide it

4. Tool Settings

This is a horizontal panel (similar to the header) that displays settings for the **currently selected tool**.

- ❖ Can be positioned at the top or bottom
- ❖ Can be shown or hidden via the header menu

5. Adjust Last Operation Panel

This region appears after performing an action.

- ❖ Allows you to **modify or fine-tune the last operation**
- ❖ Example: After adding a cube, you can adjust its size and properties

6. Sidebar

The **Sidebar** is located on the **right side** of the editor.

- ❖ Contains panels with detailed settings for objects and tools
- ❖ Press **N** to toggle visibility

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7. Footer

Some editors include a **Footer**, usually at the top or bottom.

- Displays information about active tools or operations
- In animation editors, it includes:
  - Playback controls
  - Keyframe settings
  - Timeline navigation tools

These controls allow you to:

- Preview animations smoothly
- Insert and manage keyframes
- Control playback and timing
- Adjust frame ranges for specific scenes

ARRANGING REGIONS IN BLENDER

Blender allows you to organize and adjust regions within an editor to suit your workflow. This includes scrolling, resizing, scaling, and managing special panels like the Asset Shelf.

Scrolling Regions

You can navigate within a region using the following methods:

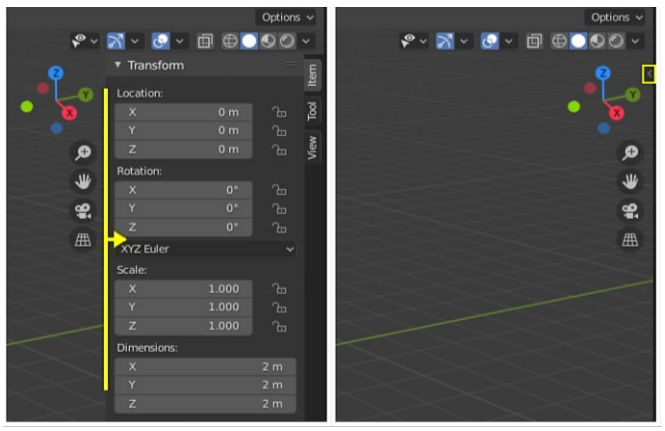
- **Middle Mouse Button (MMB)**: Click and drag to scroll vertically or horizontally.
- **Mouse Wheel**: Scroll up or down when hovering over a region (if zoom is not active).

Some regions, such as animation timelines, include **scrollbars with zoom controls**:

- Drag the small handles (dots) at the ends to **zoom in or out** of the content.
- Press **Ctrl + MMB** and drag to quickly adjust both horizontal and vertical ranges.

Resizing and Hiding Regions

- To resize a region, drag its border just like you would with areas.
- To **hide a region**, shrink it completely until it disappears.
- A small **arrow icon** will remain—click it to restore the hidden region.



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Scaling Regions

Certain regions (like the Toolbar) can be scaled:

- Press **Ctrl + MMB** and drag inside the region
- Or use **Numpad + / -** while hovering over the region
- Press **Home** to reset the scale to default

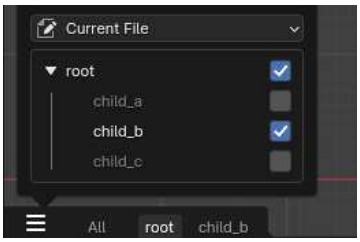
Asset Shelf

The **Asset Shelf** is a panel (commonly in the 3D Viewport) used to manage and access assets such as materials, brushes, and poses.

Searching Assets

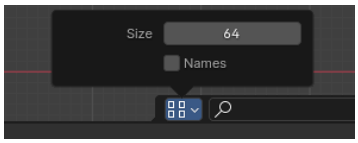
- Hover over the Asset Shelf
- Press **Ctrl + F**
- Type a keyword to filter and find specific assets quickly

Using Tabs (Catalogs)



- Assets can be organized into **catalogs**, displayed as tabs
- Each tab shows its own content and any related subcategories
- This helps you quickly narrow down and find specific assets

Display Options



You can customize how assets appear:

- Adjust the **size** of asset thumbnails
- Enable **Names** to display asset labels
- Hover over an item to view its name (if names are hidden)
- Drag the top edge of the shelf to display **multiple rows** of assets

Filtering Assets

- **By Active Tool**: Shows only assets relevant to the currently selected tool (e.g., brushes for sculpting)

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